VOLUME 2

# CLIMATE RESPONSE AND RESILIENCE

## TECHNICAL RECOMMENDATIONS AND SOURCES

**CLIMATE EMERGENCY MOBILIZATION WORK GROUP**

FREDERICK COUNTY AND THE CITY OF FREDERICK, MARYLAND

AUGUST 2021

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# INTRODUCTION TO VOLUME 2

This section of the report includes details that expand on the shorter summary recommendations in the main body of the report. These longer recommendations are the 'Why' and 'How To' for pursuing each recommended action. Specific information is provided in the following subsections to inform discussion, adoption, impacts on at-risk portions of our community, financing, and implementation. Tracking progress in moving the recommendation forward (Progress Metrics) and outcomes from implementing the strategy (Results Metrics) are also included, to provide the community transparency on actions to reduce GHG emissions or increase resiliency in the community. The subsections and what they provide are:

**Recommendation:** A brief description of the recommendation.

**Expected GHG Reduction or Climate Adaptation:** This may include tracking possibilities for Results Metrics.

**Timeline for Action:** This includes tracking options for discussion, adoption, financing, etc., i.e. Progress Metrics.

**Rationale:** This provides a description of the climate impact that the recommendation will address, based on peer-reviewed literature, government documents, science-supported web-based materials, lessons or examples from other jurisdictions (we are not recreating the wheel), and justification from County or City documents.

**Co-Benefits:** Benefits to other parts of the community that will be derived from implementation of the recommendation.

**Equity Considerations:** Benefits to the underserved, low income, disabled, or senior members of our community.

**Cost and Cost-Benefit Analyses:** Estimated costs reported for similar actions in other communities or agencies and if available, up-front costs and recovered costs through time.

**Finance:** Funding options from local-to-national agencies, organizations, and foundations to indicate that substantial funds are available beyond local public resources (incurred costs need not be solely from County and City reserves or revenues).

**Recommended Actions:** How the recommendation can be enacted through legislative, administrative, state/federal cooperation, and community roles.

**References:** Sources for the material included in the recommendation.

## 1 Provide the organizational structure necessary to respond to the climate emergency

- Establish a joint County-City Office on Climate Response and Resilience to provide technical expertise, engage the public, publicly report progress on goals, develop innovative financing support, and provide accountability.
- Place equity and the needs of people as the drivers in climate planning and action.
- Make all significant decisions through the lens of climate change.

A combined Climate Response and Resilience Office (CRRO) is proposed to serve both County and City governments with three shared staff members, as a complement to the existing sustainability offices and other participating jurisdictions to:

1) regularly provide coordination, oversight, and accountability of climate program implementation;

2) provide technical assistance to County, school district, and City government departments, as well as other municipalities in Frederick County that choose to participate, in identifying the best technical solutions and expand thinking toward more sustainable practices and purchases;

3) launch and implement a robust public education and engagement campaign;

4) publicly report progress on achieving climate-related actions and metrics semi-annually;

5) review all public policies, regulations, and services to ensure that appropriate officials, staffs, and contractors have addressed impacts on emissions or resiliency;

6) seek funds from a variety of traditional and innovative funding sources to achieve goals;

7) administer the Benchmarking Program as described in Recommendation 3; and

8) coordinate with Frederick County Public Schools to create an interactive educational website for all residents, complementary to the K-12 climate education curriculum in Recommendation 37.

In a study of local leaders, researchers found that climate planning, action and resilience was hampered by the lack of dedicated staff and budget (Kelly et al., 2017). This was echoed in a recent focus group of local mayors, who expressed frustrations regarding stormwater management and flooding, noting "Every time it rains, we grit our teeth. We are too busy fixing problems caused by the last storm to prepare for the next." To stay attuned to the risks and prepared to alleviate the impacts of these extremes, the proposed County and City CRRO can undertake analysis of local, historical, and forecasted conditions, implement a constant and frequent public awareness effort, and maintain a progress database. This office can work with relevant departments to seek funds from a variety of public and private sources and recommend innovative funding models used by other jurisdictions so climate solutions are not stalled by funding barriers.

A County and City CRRO should be jointly funded and staffed with three qualified professionals within the first year, and reporting metrics should be finalized as a dashboard on a public website with educational and programming content included.

There are multiple examples across the U.S. for these types of climate-specific offices focusing on public communication and engagement, planning, implementation oversight and public reporting. Dane County, Wisconsin, with a population of 500,000, implements its climate response through the Dane County Office of Energy and Climate Change (2021). Boston (https://www.boston.gov/departments/environment/boston-climate-action; https://www.boston.gov/take-action-climate-change) and its Climate Resilience Program Coordinator maintain webpages and active communication with annual reports on its progress to meet its 2007 plan. Boulder County's Office of Sustainability, Climate and Resilience is an expansion of its original Sustainability Office: https://www.bouldercounty.org/environment/sustainability/. Locally, Montgomery County has a climate home

page, https://www.montgomerycountymd.gov/green/climate/index.html, that provides updates on county implementation, resources, newsletters, press releases, and child-dedicated web information. Washington, D.C. has established the District of Columbia Commission on Climate Change and Resiliency which maintains a website, https://dccccr.org/, convenes quarterly meetings, and annually provides (1) a comprehensive inventory of at-risk infrastructure and (2) recommendations for government departments for additional action. It is administered by a Designated Staff Executive, a salaried employee, with an established budget.

An important responsibility of the CRRO will be **continuous ongoing assessments of climate recommendation implementation** that provides accountability to local residents and business owners with assurances that the local government and elected officials are taking actions that protect their health, properties, and livelihoods.

A second responsibility for the CRRO will be **to provide technical assistance to County, school district, and City government departments in identifying the best technical solutions and expand thinking toward more sustainable practices and purchases.**

**The climate change public education and engagement campaign**, the third responsibility of the CRRO, is critical for achieving climate goals.

"Climate solutions are the most successful when city leaders partner with community groups to set priorities and shape those solutions" (Kelly, 2017).

Although nearly all Americans have now heard of global warming, the greenhouse effect, and climate change, many have yet to understand the full implications of the problem and the opportunities that lie in the solutions. In 2009, 69% of Americans said that they would like more information on climate change (Informing an Effective Response to Climate Change, 2021). The Yale Center on Climate Communication reports that Americans are worried about harm from extreme events in their local area including extreme heat (64%), droughts (60%), flooding (58%), and/or water shortages (54%) (Leiserowitz, 2019).

The success of City and County climate mitigation and adaptation efforts will be highly dependent on how effectively the residents, businesses and schools are being actively engaged and encouraged to participate. In order to educate every sector of the public, the CRRO should strive to create and maintain partnerships with key stakeholders, provide increased opportunities for educating the community about climate change, and empower the community to take action, easing concerns and the risks and stress associated with climate-related impacts. The County Public Health Officer has stated that it is much less expensive to educate people to prevent climate-related health impacts (and it is likely so for property damage as well) than it is to ameliorate the impacts after the fact.

The City and County should initiate a public education and engagement campaign within the first year, led by a full time communications and/or education professional. Recommended activities include:

- Target the traditionally underrepresented communities with messages and events tailored to reach them. People most vulnerable to the impacts of climate change need information and access to the tools and programs necessary to build climate resilience. For example, people can learn to participate in existing energy efficiency retrofit programs that reduce utility bills; identify mold in their homes and how to prevent and correct mold issues; and learn about the roll-out of new programs, such as food hubs, community gardens and transportation services. Members of these communities can identify climate-related problems enabling the City and the County technical staff to most effectively address climate resilience needs, such as heat island effect reduction; solutions to address food security and shortage issues; and home air quality improvements. As with COVID–19 vaccination and other public health campaigns, working with and through Trusted Messengers can reap good results (Trusted Messengers, n.d.).
- Develop a social marketing, conservation behavior-change plan to more specifically identify audiences, the barriers they face, and benefits they would reap by adopting climate-responsible behavior. Create specific tools (targeted messaging, incentives, fostering social norms, increasing

convenience, reducing costs, etc.) to promote adoption of very specific behaviors achievable for each group. Since senior citizens are the largest part of the City's and County's populations, a special effort should be made to reach out to and include this group of people, such as outreach through senior centers, the AARP, and other networks.

- Support the many Green Teams within Frederick County municipalities, faith communities, etc., to promote and spread awareness of County and City programs. In a recent focus group with county green team leaders, the number one request was a chance for more help connecting and communicating with each other through regular meetings.

- Develop a volunteer network of Ambassadors. Green Team members, and those of other established groups active on climate action issues, could become the first to join a network of Ambassadors. These volunteers could be recruited to provide educational workshops, and other events, and promote the multiple programs to continue to engage residents in implementing climate action strategies, much like the Sustainability Stewards, coordinated by Broward County (Broward County Energy and Sustainability Program, 2021) as part of their climate action strategy.

- Broadly promote the County's excellent Green Homes Challenge, which guides, rewards, and recognizes households for saving energy, adopting green lifestyle practices, and using renewable energy. 3,000 households are involved in the challenge, saving 2,272 Metric Tons of greenhouse gas emission equivalents (GHGe's) per year (Frederick County, n.d.-a). According to the Empowerment Institute's Sustainable Lifestyles Campaign (2021), "Between 50 and 90% of a community's natural resources are used at the household level with up to 75% of these resources wasted through inefficiency and lack of awareness." In most communities, the financial burden of this inefficiency and environmental pollution falls on municipalities as the primary accountable party responsible for providing services such as water, water treatment, landfills, roads and environmental quality. One of the major opportunities for cost containment is helping citizens better steward the community's natural resources.

- Promote Maryland Green Registry for businesses. Only twenty of the 6,236 businesses in Frederick County are registered in the Maryland Green Registry for business. Business owners in Frederick County can take advantage of substantial savings through smart, sustainable environmental practices. Statewide, Maryland Green Registry members are saving over $76 million annually (Maryland Green Registry, n.d.).

- Promote and collaborate with the Multifaith Alliance of Climate Stewards of Frederick County, Interfaith Partners for the Chesapeake (IPC) and Interfaith Power and Light (IPL). These interfaith groups work together from a faith-based commitment of stewardship of natural resources to protect the watershed, advance clean energy access for congregations and households, and together, reach roughly 200 of the 19,000 congregations in the region. Supporting these interfaith groups could increase outreach and impact.

- Collaborate with FCPS to include school Green Teams and connect curriculum to climate-related programs and events throughout the county (Rec #37) The collaboration can include simple climate-specific modules for elementary, middle, and high school students that change quarterly. As well as preparing knowledgeable future residents, climate education and awareness for students increases the likelihood parents will be more familiar with climate risks and solution options through children's discussions within the family, much like two decades ago in the Mothers Against Drunk Driving (MADD) education effort.

- Host regular educational events, townhall meetings, roundtable discussions and focus groups to advance the mission of the Climate Emergency Resolution and the resulting recommendations as they are being implemented. Involve government departments/divisions and include business groups, community organizations, ministerial associations, and members of the community to increase capacity around targeted needs on issues related to water quality, green infrastructure, agriculture, sustainability, education, environmental health and protection, and climate resilience. Facilitate public/private partnerships specifically focused on climate outreach and education.

**Publicly reporting progress on achieving climate-related actions and metrics semi-annually** is the fourth responsibility of the CRRO, and will improve buy-in by the general public and encourage adoption of recommended practices. Most approaches to climate change program planning use metrics to assess achievement toward specific project milestones and overall goals.

Frederick County and City established the following targets in the Climate Emergency Resolutions adopted in 2020: equitably reduce GHG emissions from 2010 levels 50% by 2030 and 100% by 2050 and employ efforts to safely drawdown carbon from the atmosphere.

The CRRO should establish metrics to be tracked within the first six months of office operations, using recommendations in this report as a guide. The CRRO website should be the venue for publicly reporting selected metrics through a dashboard format, easily understandable and accessible for citizen engagement. The City of Boston's website provided above (https://www.boston.gov/departments/environment/boston-climate-action) includes a dashboard that is engaging, easy to understand and thorough. The City of Menlo Park partners with nonprofits, businesses and other members of the private sector to share their reporting: https://menlospark.org/what-we-do/. Another example of reporting is Philadelphia's Building Performance Standards programs: http://visualization.phillybuildingbenchmarking.com/#!/. These reporting efforts build public confidence in climate efforts.

Metrics are measurable values that show progress toward goals in a planned time frame. Like any strategy — which climate program planning is — metrics focus decision-making on priority actions that lead to desired outcomes. As the old axiom states — you can't manage what you don't measure — and this is especially true for climate programming which can take years before seeing the cumulative effect of program actions. It can also assist in identifying the most cost-effective policies for the desired outcome.

Baseline measurement is the process of establishing the starting point of any process and/or metric, from which the impact of any change is measured. It is used to gauge how effective a program is in terms of meeting its intended goals. A baseline is not a single value because one can easily mistake routine variations for measured change. A baseline is a series of the average level of performance over a past timeframe. The Metropolitan Washington Council of Governments (MWCOG) has provided useful baseline data for some sectors of this report — but not all. County and City data can be used for some areas of work.

Climate goals are usually expressed in terms of percent reduction in energy consumption or GHGs in a given year. It is also important to choose a subset of metrics linked to cost. After all, the goals should reflect realistic investment over time. It is important to remember that climate neutral means a 100% reduction in current baseline carbon impact OR that the jurisdiction emits the same amount of GHGs as is offset by other means.

While metrics measure performance and the effectiveness of policies to reach goals, they also allow stakeholders to understand desired policy outcomes and modify behavior over time. Similarly, metrics can identify policies that are achieving desired outcomes and those that need to be modified or replaced altogether.

It is recommended the CRRO devise, in collaboration with responsible departments, a suite of metrics that can include, but are not limited to, the following categories of indicators:

- Measures of climate impact to establish a baseline as well as targets for energy savings or GHGs reduced against the baseline. Supply-side measures can also be applied such as the increase in charging stations over a period of time, or the miles of bike/multi-use paths added.

- Return on investment or simple payback for significant projects allows a relative ranking among projects based on investment

- Cost/benefit or the cost per unit of energy saved or GHGs reduced to determine greatest impact per dollar invested.

- Portfolio analysis allows policies to be grouped by sector or other relevant features. By comparing mixes of policies and their metrics, the CRRO can arrive at an appropriate project mix for the City and County that combines large climate impact projects with high investment along with smaller measures having a lower investment profile, but perhaps create greater access and equity.

- Goals, priorities, projects and even metrics can be adjusted over time for compelling reasons. As data are accumulated, lessons learned will give rise to consideration of adjustment.

The fifth main responsibility of the CRRO is to **ensure City and County policies, regulations and services are all aligned with goals of the Climate Resolutions through review and revisions process to ensure a "whole government" response**. This office will be responsible for providing the analysis necessary to evaluate pending decisions through the lens of climate change and equity considerations as described below.

The sixth CRRO responsibility, **seeking funds from a variety of traditional and innovative funding sources to achieve goals**, provides a way for the City and County to address a common barrier to climate action — funding. The Livable Frederick Master Plan (Frederick County, 2019) includes finding new funding opportunities (pp. 66, 69, 165) and the need for 'additional funding sources' is noted in the City Comprehensive Plan (City of Frederick, 2020), opportune for addressing the new climate and its opportunities. For some time, governments, businesses, and individuals have put off investing in a clean energy future because of concerns related to expense and finance even though data and experience show that a broad transition from a fossil-fueled economy to one that is clean, healthy, environmentally responsible and sustainable has positive economic outcomes. In fact, the Global Commission on the Economy and Climate, which has conducted the most authoritative research to date, has estimated that humanity could save $26 trillion through a global shift to sustainable development by 2030 (Global Commission on the Economy and Climate, 2018).

Frederick City and County have both found ways to make substantial investments and respond to emergencies as demonstrated by the COVID–19 crisis. Mini-grants were provided to several sectors of the business community, and human resources were redeployed to meet unique emergency needs. Related to the climate emergency, both City and County governments have been successful securing grants over the years, most recently for projects such as expanding broadband access to rural residents and financing energy retrofits for low income residents. However, the scale and speed of the need for transitioning to a clean energy economy demands that a centralized CRRO tap a variety of tools that other governments have used to fund larger scale government and/or non-profit partner projects, many which have the potential to pay for themselves through savings. These funds need not always come from local public revenues.

Although rebates and subsidies have incentivized a market shift to clean energy, they have not done enough to move clean energy technologies and other climate-related strategies into the marketplace at a rate that can match the need for GHG reductions. As a result, alternative financing approaches both backed by government agencies and those funded strictly by private capital providers are becoming more prevalent. These financing approaches can be categorized as follows:

- On-bill financing
- 3rd-party financing
- Commercial Property Assessed Clean Energy (PACE)
- Revolving Loan Funds (RLFs)
- Energy Service Agreements (ESAs)

**On-bill financing** structures a monthly payment for the installed measure/s to be slightly less than the energy savings for that month, allowing the customer to pay less each month on their total utility bill while including the loan payment. These programs provide loans for a maximum term of 24 to 60 months and are usually made available to commercial and public sector customers. However, Hawaii's GEM$ program applies on-bill financing to invest in renter and low-income households, including even those with high turnover. All customers of Hawaii's electric companies or 95% of the state's population are

eligible to apply for the program. The program has three primary design features for success with these households: 1) approval is not based on creditworthiness, but instead on bill payment history; 2) the repayment obligation is transferable to the next tenant; and 3) the high upfront cost of renewables and energy efficiency are surmounted by a longer repayment period of up to 20 years.

**3rd-party financing** is more common in the residential and small business sectors where loan recipients receive anywhere from below-market financing to the market rate, depending on the credit enhancements available through state agencies, Green Banks and/or other capital providers or third-party lenders. The advantage of third-party financing is that the functions typically performed by a lending institution — credit evaluation, exposure to non-payment — do not have to be adopted by the program administrator. The third-party lender and its capital partners assume the risk through loan loss reserves or loan guarantees and can provide other qualifying credit enhancements. The Connecticut Green Bank created a second loan loss (lender takes initial loss, but a smaller percentage is covered by the Green Bank) reserve for its Smart-E loan product to provide local lenders the ability to offer better terms such as lower interest rates, longer terms and more flexible qualifying criteria to residential customers looking to do an energy efficiency retrofit (Connecticut Green Bank, 2015).

**PACE** involves issuing a loan through a special tax assessment on an owner's property, thus tying the loan to the property rather than to the borrower and allowing for the loan to be repaid over a longer loan term. If the owner decides to sell the property before the loan is repaid, the loan conveys and the new owner will continue to make payments as part of the property tax bill. Frederick has had several PACE projects, including BAR-T, a summer camp, the first to receive PACE financing for an advanced energy management system as well as solar power for the camp operations. The Frederick Indoor Sports Center has used PACE financing for the installation of rooftop solar (Frederick County, n.d.-b).

**RLFs** use the principal, interest, and fees from prior loans to fund ongoing efficiency investments. They are usually administered by a state or non-profit entity. Administrators focus on keeping operational costs low and terms at a reasonable length so that the fund is not stressed by insufficient payments. The advantage of these funds is that, if well designed, they provide a sustainable funding source for future loans, while providing technical assistance and reducing transaction costs. RLFs are initially capitalized through state treasury investments, ratepayer funds, state bond proceeds or other unique financial resources. Of late, RLFs have been a successful tool for institutions, including many higher education institutions. Harvard maintains a $12 million RLF that provides capital for high-performance campus design, operations, maintenance, and occupant behavior projects. Harvard first launched the fund in 2002. Basic project eligibility guidelines state that projects must reduce the University's environmental impacts and have a payback period of ten years or less. Since its inception, the RLF has supported nearly 200 projects that have yielded over $4 million in energy savings annually. Iowa State, Tufts and the University of Maine Foundation also have RLFs (McCaffree, 2010).

**ESAs** were used in the past to provide companies with a way to purchase power and save energy by providing a renewable solution at rates less than or equal to existing utility bills, a scenario that is gaining momentum with institutions such as hospitals and universities. Today, it is being downsized for use in the residential sector to take the sting out of the high upfront costs of clean energy upgrades. All the assessment, planning and construction oversight is done by the administrator and the customer pays for the project through energy savings over a longer than conventional time frame (Nadel, 2019). The Home Advance program offered by Sealed (https://sealed.com/) uses a co-branding approach with utilities and Green Banks to offer homeowners an energy retrofit. The company finances the installation with a 20-year agreement, pays the utility bills and takes monthly service fees based on actual energy savings. The homeowner pays slightly less than they did before. Sealed has worked successfully in New York and is expanding to other states.

An increasingly interesting delivery mechanism that often packages one or more of these alternative financing solutions in one institution is the Green Bank. Green Banks seek to expand market

opportunities through focused private investment. There are several barriers to clean energy investment that Green Banks address:

- Climate projects in some sectors are too small to attract conventional lending
- Customer base appears to be credit risky for the high, upfront cost of the technologies
- Small, geographically dispersed projects cannot, on their own, be cost-effective for lending.

Green Banks offer credit enhancements such as loan loss reserves or loan guarantees to reduce risk for private investors. Green Banks also pool loans together to diversify risk and achieve scalability for private investors that might not otherwise consider the loans on an individual basis. Green Banks work with a variety of capital providers to offer an array of financing options depending on the market gaps they are attempting to solve. Their understanding of the channels to reach project prospects help to catalyze a volume of activity that can be an investable level for capital providers (Weiss et al., 2020).

**Placing equity and the needs of people as the driver in climate planning and action:** Making equity, racial justice, and a just economy core goals of City and County resilience and climate action plans is a recommended best practice (Kelly et al., 2017). With this mandate, communities are finding ways to innovate, such as creating community land trusts to protect land from speculation and ensure affordable housing in perpetuity; by providing solar energy for low-income households; or by budgeting carve-outs for equitable access to clean energy options in car purchases or energy retrofits. Inclusionary zoning is another example of a policy choice that creates equity in housing AND provides opportunities for climate-responsible land use planning.

All residents of Frederick County will experience impacts to their health and economic wellbeing due to climate change, but those already under-resourced will find it more difficult to adapt and recover quickly from a potential extreme weather event. Existing health threats will be amplified for everyone, but for those already disproportionately impacted by adverse health outcomes, the effects will be multiplied. Likewise, those on insecure economic footing are likely to experience still greater precarity.

If we do not recognize the inequality that exists in our society, we run the risk of exacerbating it through the actions of our government and institutions. Inequality results from vast differences in access to money, information and resources. Since inequality has largely resulted from actions of the decision-makers of the past, the future decisions by our City and County leaders must seek to alleviate the inequality that exists, and at the very least, not make matters worse.

Commitments to equity are spread throughout County and City policies and activities of the Livable Frederick Master Plan and the 2020 City Comprehensive Plan. Responding to climate is no different. Frederick City and County must meet their overall climate goals while distributing the benefits fairly and in a way that meets our commitment to equity. This means our actions should put the needs of the most vulnerable first, including prioritizing climate actions that may make their lives more financially tolerable, such as cheaper energy, cleaner transportation, and healthier environments.

This protection of the most disadvantaged portions of our community is best exemplified by the Frederick County Health Department's primary commitment to illness, PREVENTION for all county residents. In dialogue with the Health Department, Director Dr. Barbara Brookmyer suggested that PREVENTION of the medical condition before it was manifest should be considered as a primary intervention, instead of just focusing on providing medical care after a condition has led to a need for treatment. PREVENTION, i.e., providing sufficient resources to the community so that all residents have equitable opportunities in order to eliminate illnesses associated with the environment that the individuals live in. Intervention in homes (rented or owned) and neighborhoods, to ensure good air quality, potable water, adequate sewage disposal, summer air conditioning, winter heating, guaranteed transportation to jobs, affordable and

accessible nutritious food, and funding options to prevent basement flooding and exposure to pathogens or mold are important steps to preventing illness. Many of the recommendations of this report are designed to directly protect these individuals and/or guard against further negative impact of fiscally constrained groups. The Health Department's guiding principle of *preventing* disease and illness, promoting wellness and safety, and protecting the community's public health is also the foundation of the proposed recommendations.

An *equitable* society is one where each individual has what they need to care for their family's health and general wellbeing. This differs from a society that proposes to meet every person's needs with the exact same solution.

Colleagues in Philadelphia (Heckert & Rosan, 2018) have developed a vulnerability (equity) index for areas of the city most in need of public and private placement of sustainable green infrastructure practices that if implemented, could substantially reduce persistent, disproportionate spatial disparities in public health and infrastructure resilience established over past decades. This green infrastructure disparity has just been reviewed for the U.S. (Leahy & Serkez, 2021) and its shocking results indicate that high income urban areas have 50% more trees than low income areas. Huge differences were evident in Maryland's largest city, Baltimore, where city areas with median incomes of $31,000 have 3% tree canopy while canopy totals 74% in areas with median incomes of $154,000. Exploring canopy extents in Frederick could be a useful assessment for targeting future tree planting and maintenance. Using compiled Frederick statistics on demography, income, receipt of public assistance, access to transportation, air quality, food access, education, amount of green infrastructure, etc. (Table 1, below) and relationships established in the Philadelphia analyses, maps have been generated indicating likely County and City areas for targeted implementation of sustainable practices that will reduce climate impacts (Fig. 1). On the left (Fig. 1a), all portions of the population and the environmental factors were given minimal weight and generally, vulnerability was highest along the Monocacy River corridor. In contrast, in Figure 1b (right), individuals receiving Medicaid, Social Security Income, those under 4 or over 64 years old, and those with disabilities were given maximum weight (most vulnerable) and dramatically different spatial patterns were identified that were much more heterogeneous across the County. These dramatic spatial differences in vulnerability suggest there is a distinct need for targeted implementation of practices to reduce environmental threats like those from extreme heat, major storms and flooding, and drought. Maps like these, with parameter weighting chosen to reflect identified variations in vulnerability or threat, could inform public and private decisions for modifying local land use, construction, public health access, and other important social services to best protect residents and their properties.

**Table 1. Frederick population and environmental parameters used to develop the distribution of need for deployment of practices to ameliorate the new climate impacts in the area.**

| | | | | | |
|---|---|---|---|---|---|
| Minority | Low Income | Did Not Complete High School | Under 4 | Over 64 | Linguistic Isolation |
| Proximity to Traffic | Ozone Levels | Particulate Matter 2.5 | Medicaid | SSI | SNAP |
| Disability | Vacancy | No Vehicle Access | Tree Canopy | Impervious Surfaces | ALICE |
| Poverty | Food Desert | Park Access | Land Surface Temperature | | |

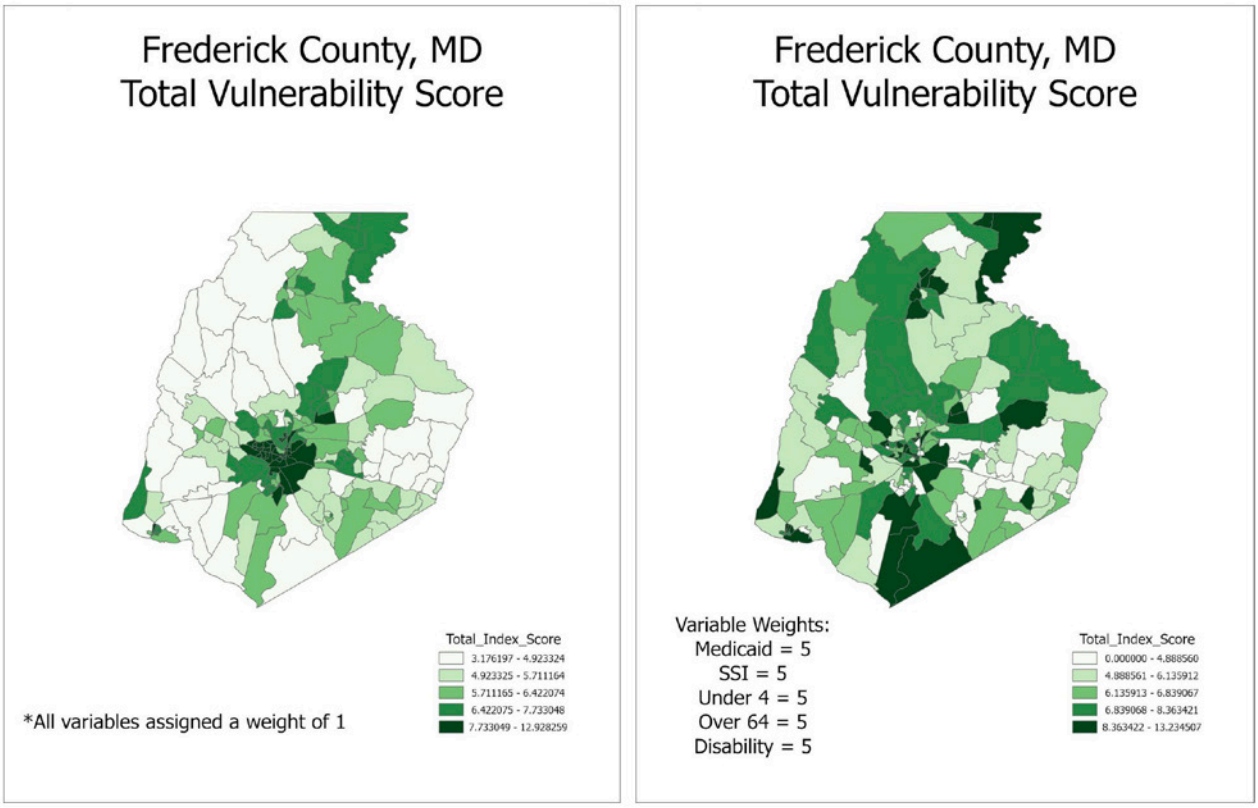


**Figure 1. Most vulnerable population areas in Frederick based on the Philadelphia Equity Index. Vulnerable population areas with all population and environmental factors weighted at a) 1 (minimal) and b) with Medicaid, Social Security recipients, children under 4 and persons older than 64, and disabled weighted at 5.**

**Make all significant decisions through the lens of Climate Change, while centering the needs of people.** This can be accomplished by requiring that climate change is included in the review, adoption, and implementation of all future public policies, ordinances, regulations and purchases. Identified in the 2020 draft City Climate Action Plan as a universal policy for City decisions, adoption and routine application of climate in future decisions should be easily/readily incorporated in the future.

City and County officials and staff have enormous responsibilities to protect quality of life for area residents and businesses and have done so effectively over the past decades, stimulating local growth. However, the rising income inequality in this area, coupled with disparate impacts of increased extreme heat, flooding, drought and extreme weather events, calls for a decision-making process that takes these impacts into account with more analysis and intentional review. Within the first six months of receipt of the CEMWG final report, internal review procedures should be established and required for formally tracking and evaluating possible new City and County legislation, executive decisions, and departmental/division projects (such as permitting, construction, development, public health, education, etc.) through considerations of the area's changing climate. Tracking sheets for pending public policies, ordinances, regulations, or purchasing of services (maintenance, public works, etc.) should include credible climate-specific review and sign-off by staff and officials. It is recommended that review boards for each jurisdiction be established, with technically skilled residents to assist in evaluation of services, codes, regulations, ordinances, or policies. Oversight of this review could be ensured through the proposed staff of the CRRO or the County Sustainability Commission and City Sustainability Committee through a change in bylaws and recruitment strategies.

Changing the way decisions are made by elected officials and their staffs to address changing climate

patterns is not new. Several jurisdictions have adopted new procedures into governance of their communities for this reason. A prime example is seen in the Rockefeller Foundation 100 Resilient Cities program (now the Resilient Cities Network, https://resilientcitiesnetwork.org/) where Chief Resilience Officers work with officials to identify specific code changes, policies, and procedures to increase GHG emission reductions and local adaptations to minimize climate-induced damage or threats. In another example to reduce GHG emissions and better adapt to new atmospheric conditions, California established its Energy Commission (https://www.energy.ca.gov/news/2018-05/energy-commission-adopts-standards-requiring-solar-systems-new-homes-first) in 1975, which now focuses on climate. On the legal front, "…courts are drifting towards an affirmative requirement for [GHG emission] analysis…" in environmental impact reports in California (Maclean, 2008). In Rockville, the city's sustainability office works across multiple community sectors and stakeholders to encourage the consideration and adoption of practices to minimize climate threats (Klareich, F., personal communication, 2021). Several jurisdictions have included citizens and other stakeholders (Los Angeles and Oakland, CA; Portland, OR) in their decision processes, suggesting similar strong participation in our governments and the community response to extreme events.

Mr. Dana French, lead editor of the Livable Frederick Master Plan) and a recognized experienced planner, emphasized a need for 'collaboration of core functions and sectors' and avoidance of the natural tendency for siloed decision-making; communication and dialog lead to better commitments vs. siloed decisions (D. French comments, S. Frederick Corridor Charrette 1, April 5, 2021.) Collaborative decisions and assessments must become standard operating procedure within both governments as climate change affects many institutions and public places simultaneously.

Evaluating each decision for its potential impact on climate resilience and human need is expected to reap savings and increased benefits. For example, replacing or building new infrastructure (such as culverts) should take into account future flooding potential. Maintaining parks and other community green space should include policy changes to increase soil organic matter, which increases the capacity for soil to hold water. Similarly, replacing fossil-fueled fleets and machines with electrified equipment (automobiles, buses, mowers and other landscaping equipment, etc.) during regularly scheduled fleet replacements will result in improved air quality and fewer GHGs as well as a reduced fuel and maintenance costs. Therefore, assessment of government-sponsored legislation, policies, purchases, or infrastructure commitments through the 'lens of climate change' not only saves substantial public funds through time but offers multiple protections beyond the expected direct benefit of the decision.

The City and County have created a very high quality of life that attracts new businesses and their employees, tourism and a strong economy, and ensures community well-being. Implementing policies and practices that respond to the realities of the changing climate must become standard operating procedure so that future generations can continue to thrive in the society, culture, and natural beauty we value.

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## 2 Lead by Example

Frederick County and the City of Frederick have made great progress in the past decade to reduce GHGs and pollutants in government operations. Local sustainability plans and Climate Action Plans have led to progress on LED lighting conversion, electrification of vehicle fleets, solar array installations, and more. The Metropolitan Washington Council of Governments has estimated that Frederick County reduced GHGs by 37% from 2005 to 2018 (2021). It should be noted that this reduction is, in part, attributable to the closure of the last heavy industrial manufacturing plant in the County during the same period. However, the efforts of both the County and City have been noteworthy.

This leadership matters. On average, local governments own 20% of the community's building floorspace (Miller, 2019) and provide 15.6% of the purchasing power (Darnall, 2021). In addition, local governments own and/or lease sizable vehicle fleets, and Frederick City and County own substantial parcels of public parkland. By changing practices in these four main areas — buildings, transportation, land management and consumption, governments can provide a model of energy efficiency and clean energy use, and have the power to change markets to cleaner, more sustainable practices. Leading by example can change the trajectory of the entire community to a healthier and thriving future — visions promoted in several local government plans.

Purchasing products and services has great potential impact, 2–3 times more than other areas of operations (Darnall, 2021). Both governments can use the power of the purse to favor the selection of sustainable, low-carbon, products and services (Sustainable Purchasing Leadership Council, 2021) and to move to a more restorative economy. Products used by the City and County should be "remade" — through recycling, repurposing and restoring. County contractors should also use remade products to the greatest extent possible to move Frederick toward a more restorative economy.

The City of Frederick (2021) calls for the adoption of an Environmentally Preferable Purchasing Policy in their Draft Climate Action Plan for Government Operations. This is good news. However, there are data that show that of the 60% of local governments in the United States with sustainable purchasing plans, only 12.5% are successful (Darnall, 2021). In a comparison with Japanese municipalities with similar plans and a 58% success rate, researchers found that the following practices made a difference: alignment between purchasing and other citywide policies; access to information by purchasing department heads; leadership support; a culture of innovation; and vendor collaboration.

The National Association of State Procurement Officials (2021) lists these environmental factors for consideration in green purchasing policies: pollutant releases; toxicity; waste generation and waste minimization; end of life considerations such as reusability, recyclability, compostability; greenhouse gas emissions and energy use in manufacturing or shipping; water consumption; depletion of natural resources; impacts on biodiversity; environmental factors in manufacturing; packaging; and social justice/social responsibility of maker. The Sustainable Purchasing Leadership Council also includes guidance on which sustainable supplier rating tools to use for purchasing decisions (2021).

Public parks have long been tools for demonstrations of ecological practices and are free and open to all members of the public. Many such practices providing important ecosystem protections and services are more easily appreciated through direct experience. Waterford Park in the City of Frederick is an example of a park developed by the City, with the help of passionate and visionary volunteers to be an ecological teaching laboratory, much like Highline Park in NYC (2021).

There is also a case to be made that public parks, universally popular and widely visited assets in every

community, are the best tool we have for educating the public about climate change. The National Park Service (2021) provides numerous examples of using beautiful, treasured natural spaces to demonstrate how climate change is impacting nature and in turn, how those changes threaten human health and well being.

Practices described in this report which would be further enhanced by demonstrations and educational experiences on public park land are:

- Conservation landscaping (healthy soils/ regenerative practices, integrated pest management, organic practices, use of natives, etc.) (Recommendation 20)
- Forestry Best Management Practices (BMPs) (Recommendation 25)
- Riparian buffers (Recommendation 25, 26)
- Rain Gardens (Recommendation 21)
- Urban food forests (Recommendation 17)
- Monarch way-stations (Recommendation 26)
- Wetlands protection (Recommendation 18, 26)
- Regenerative agriculture (Recommendation 19)
- Composting (Recommendation 24)
- Passive house design (for buildings under renovation at parks) (Recommendation 4)
- Silviculture (Recommendation 25)
- Organic fruit and vegetable gardening (Recommendation 19)
- Green roofs (Recommendation 4)

Through well-crafted signage and ongoing education partnerships and educational events with FCPS (Recommendation 37) and local groups with environmental stewardship missions, public parks can become a powerful demonstration of environmentally responsible living and climate resiliency. These learning partnerships can also tie into career development with secondary and higher education partners in areas such as environmental science, regenerative agriculture, conservation landscaping, forestry, natural resources management, and more.

To move these forward, County and City Actions are:

- Adopt Sustainable Purchasing Policies, and implement the administrative practices shown to make such policies successful.
- Integrate educational demonstrations of ecologically sound practices on parklands as part of parks master plans. These demonstrations are compatible with the mission of parks and the array of other activities provided (see recommendations list above).
- Continue to conserve energy through building retrofits to improve public building energy performance as per Recommendation 3 and use 100% clean, renewable energy by 2030 for all buildings.
- Electrify fleets as per Recommendations 12 and 13.

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## 3 Institute a Building Performance Standard

**Expected GHG Reduction or Climate Adaptation:** Implementing Building Performance Standards (BPS) across the County and City will improve performance, conserve energy, and reduce operating costs in buildings and mitigate the release of GHGs that drive climate extremes. Tracking can be done through summarizing energy, water and waste data each year for each building type (Years 1–5), thereby documenting reductions in energy and water use and waste generation through the period of interim standards (Years 5–15) and thereafter in Years 15–30, once the final BPS standards have been put in place.

**Timeline for Action:** Successful implementation of BPS is a slow integration of steps which will lead to effective adoption and enforcement of required building operations for the use of energy and water and waste generation.

There are a number of specific steps in this 30 year plan. The first step requires compiling energy consumption data by building type across the County and City, while protecting the building owners' confidentiality (Institute for Market Transformation [IMT], 2019); a year's worth of utility data is required, if not multiple years; from the compiled data, benchmarking of building type (broadly by square footage) and its associated energy, water or waste use can be derived. Through discussions with consultants, experts, and business leaders of companies with substantial energy and water use and wastes, Step 2 is to develop a set of recommendations over the next year to inform BPS ordinance content, i.e. performance standards for each building type to determine what is technically feasible via a known pathway to each target. Step 3 sets interim building standards for energy, water and waste, perhaps over a 3–5 year period using the trajectory approach established by the Institute for Market Transformation (Institute for Market Transformation, n.d.), which applies metrics for each property type and a minimum level of performance that each property within that type must meet. The idea is that each building will have its own trajectory for reaching the final standard based on its performance in the baseline year. Step 4, over 15–30 years, is to evaluate steps to decarbonize and electrify providing grid flexibility and reliability.

**Rationale:** To meet long-term climate goals for GHG emission reduction and increasing infrastructure resilience that protects public health and property, the City and County should adopt BPS that focus on, in the short-term energy, and in the longer term energy, water and waste. The ENERGY STAR Portfolio Manager Platform (U.S. Environmental Protection Agency, n.d.) can be used in ordinances to improve performance, conserve energy, and reduce operating costs in buildings for the equitable benefit of the residents of Frederick County and City and to mitigate climate change. The basis of a BPS ordinance is adapted from the IMT BPS Model Lease Ordinance guidelines (Institute for Market Transformation, 2021) that include benchmarking of building energy, water and waste in a building type coupled with education and technical assistance.

The BPS is an ordinance with four principals:

**1. Equity must be central in designing a BPS ordinance.** This means equitable representation and input have been provided to ensure disinvested communities are represented. The community should be aware of the risk that passing this policy will impact costs for building owners and tenants in low income housing. It should provide tenant protections and prioritize funding for affordable housing and small business owners who lack the resources to achieve compliance.

**2. Function as a platform.** This platform provides Frederick County and City the option to develop multiple standards. These standards include but are not limited to performance metrics for water and energy consumption, peak electricity demand, and GHG emissions produced on site or from district energy systems.

**3. Include short- and long-term requirements to encourage owners to early action** while providing them with certainty that allows planning for long-term comprehensive capital improvements. This strategy also provides the County and City time to adjust requirements, resource needs and funding options.

**4. Compliance pathways should be flexible.** This will allow building owners with unusual circumstances to propose alternative compliance plans with performance levels and timing which may differ from the ordinance requirement.

The success of BPS will fall largely on Frederick County Top 20 ("Top 20") employers as they 1) have existing sustainability efforts underway; 2) employ 10% of the Frederick County population; and 3) have resources (people) who can assist in future implementation of CEMWG recommendations that reduce GHGs and protect public health, businesses and property. In that group are three important educational institutions: Frederick County Public Schools, Frederick Community College and Hood College. Working closely with the Top 20 will lead to successful adoption, implementation and integration. Simply, the Top 20 must be a part of the solution.

Details in adoption, implementation and enforcement of County and City BPS follow.

**Step 1** is data collection of a building type's performance on energy and water use and waste generation. BPS should be adopted by all property types, which requires detailed analysis of building performance data. This may be possible by working with a utility to determine aggregate building energy use data for at least one year, more if possible. Those data provide a benchmark/starting point for comparisons on future building performance. For the short-term, initial energy focus, the electric utility FirstEnergy will be a major partner by providing access to electric utility smart meter interval data that yield information necessary to better understand how and when a building uses electricity. These data can inform energy professionals to propose cost-effective no/low-cost energy conservation measures that most likely qualify for Federal and State grant opportunities and electric utility incentives via EmPOWER-MD (Maryland Energy Administration, n.d.). BPS also must link to alternative funding, i.e. grants, incentives, Green Bank, Green leasing. This will provide the County the ability to evaluate and estimate the capacity and cost to improve energy use for each property type. BPS acceptance by the building community MUST map out a clear compliance path AFTER benchmarking and provide local resources to assist with BPS, yielding local green jobs.

**Step 2** is the development of a set of recommendations. Either during rulemaking of the ordinance or post-passage of the ordinance, setting up teams of consultants, experts and utility representatives to recommend performance standards for each building type should be considered, ideally to determine what is technically feasible via possible pathways to each target. Other team members might include Frederick County-based businesses who supply product and implement (i.e. building envelope, lighting, building controls, HVAC and solar) practices for short and long term. This process can take one year and define the type of action each building type must take. The outcome should be a suite of retrofits that can be implemented at a building by a future date when the target performance is required. The 15–30 year compliance paths are presented below.

**Step 3** is setting interim standards (Fig. 1) and can be done using the trajectory approach established by the IMT which applies metrics for each property type and a minimum level of performance that each property within that type must meet specified by the performance standard. The idea is that each building will have its own trajectory for reaching the final standard based on its performance in the baseline year. Frederick City and County should set the interim standards to drive a building's progress toward sustained energy savings.

Examples for meeting long term BPS over a 15 or 30 year timeline include lighting upgrades and building tune-ups, envelope (physical separator between conditioned and unconditioned environment of a building, including resistance to air, water, heat, and noise) and mechanical upgrades (e.g. HVAC, roof-top units, boiler replacements).

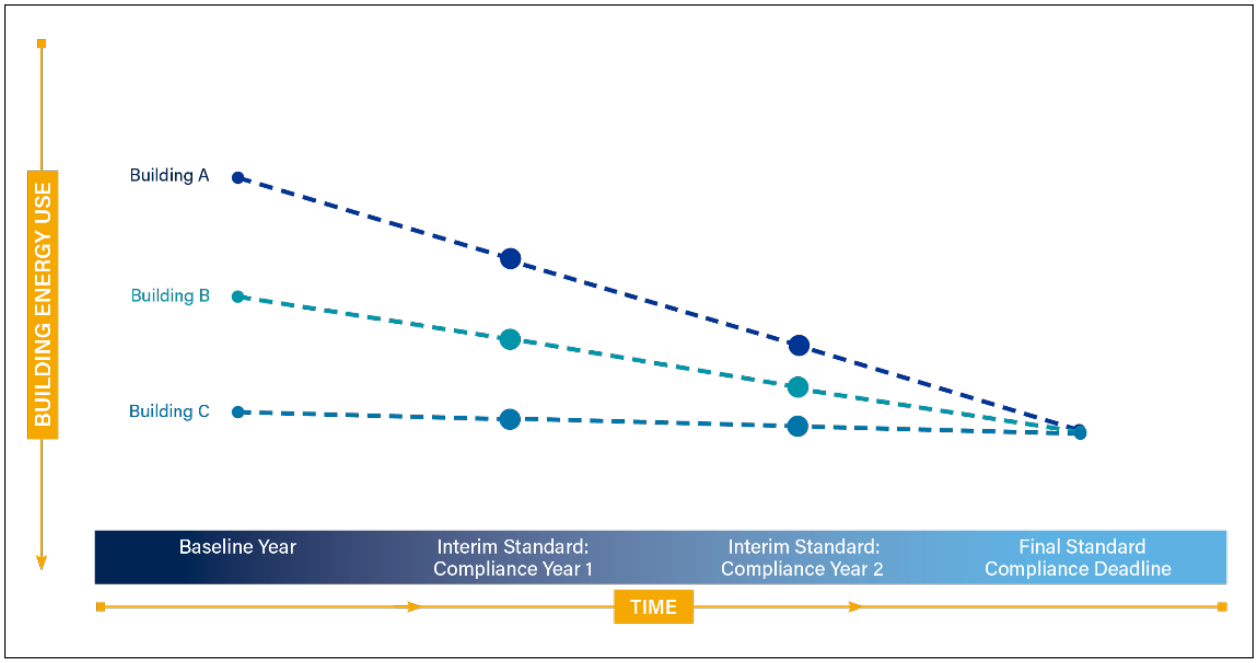


**Figure 1: Interim Standards for 3 Office Buildings (IMT, 2021)**

The final step, **Step 4**, is to evaluate ways to decarbonize and electrify providing grid flexibility and reliability. These would include electrification of all buildings, complete transition to clean energy, and installing and adopting technologies to reduce energy demand.

Montgomery County has set up a program to guide some steps. It will be implementing the Building Energy Performance Standard model developed by the IMT in 2021. Their approach is as follows:
1. June 2015 - adopted Building Energy Benchmarking law that requires owners of certain buildings to report energy use to the County each year. The first deadline for owners to comply was June 2016. The benchmarking policy initially targeted buildings greater than 50,000 square feet. The proposed amendment expands the size requirements over time to include other building types and eventually cover 85% of commercial and multifamily buildings in the county.
Note: a growing number of jurisdictions (Building Rating, n.d.). have now implemented "beyond benchmarking" policies that compel building owners to take action to improve their buildings' energy performance in addition to reporting data.

Over time, all buildings covered by the Building Energy Benchmarking Law would then need to meet the regulations for water and waste through a phased approach.

**Based on stakeholder input and IMT published recommendations, the proposed BEPS policy includes the following elements for all governments:**

- Long-term performance standards that balance the climate emergency need for immediate action with building owners' need for flexibility in how they manage their buildings, including maintaining confidentiality for the owner(s) if requested. Long-term standards will also give the County time to educate and engage the impacted community;

- Performance standards based on site energy use intensity by building type that measure improvements that are under building owners' and occupants' direct control;

- Full credit for onsite solar generation as a deduction from site energy use in calculating progress towards BEPS;

- Phasing in newly covered buildings to first familiarize owners with energy benchmarking and reporting, then building energy performance standards;

- A performance baseline that averages two years with the highest energy use consumption to recognize and credit variability in operations and hold owners harmless for exceptional circumstances stemming from the pandemic or other events outside the owners' control;

- A process to cover building owners who cannot reasonably meet one or more of the applicable interim or final performance standards due to economic infeasibility or other circumstances beyond the owner's control can submit building performance improvement plans (BPIPs);

- A building performance improvement board made up of members of the covered community, energy professionals, and advocates who will advise government officials on BPS implementation, technical review, and complementary programs and policies.

While the proposed legislation outlines the parameters of BPS and creates a framework, some facets will be set via regulation to be established at a later date. These include:

- Building type groupings with shared characteristics that facilitate the implementation and enforcement of BPS;

- Numerical performance standards for each building type;

- Required format for BPIPs;

- Parameters for economic feasibility or other factors that will dictate circumstances under which BPIPs will be allowed; and

- Adjustments or assistance specific to under-resourced building sectors, such as affordable housing, small businesses, houses of worship, and nonprofits.

For every government/jurisdiction, building types subject to the ordinance and government policies for non-compliance will be established. For example, all municipal, institutional, commercial and multifamily buildings equal to or greater than 50,000 sq ft would be required to develop and implement BPS. This includes multiple buildings (e.g. a complex) that share a single Parcel Identification Number (Tax ID or property parcel) that have a combined gross footage of 50,000 sq ft or greater. Poor performance and non-compliance will be considered a violation and fines imposed. The dedicated funds will support a technical assistance hub and provide assistance to under-served buildings with BEPS compliance challenges.

County and City documents and recent actions indicate that implementing BPS would be consistent with future efforts to reduce climate impacts. The County and City have committed to reducing both GHGs and climate change-induced threats to its citizens, properties and businesses through adoption of the Climate Emergency Resolutions. Building Codes and Policies in the The Built Environment section of the Livable Frederick Master Plan (Frederick County, 2019) highlights 'energy efficient criteria for capital projects,' 'incentives for sustainable construction,' and 'revise code for climate,' all relevant to BPS and energy reductions in new and retrofit construction (p. 186). The City's Climate Action Plan (City of Frederick, 2021) outlines energy efficiencies and consumption reductions for some of the major public services of the City, again consistent with the goals of BPS, i.e. to reduce energy demand and our climate-determining local emissions.

### Co-benefits

This policy provides a platform to address health, equity and resilience within the County and City. It should yield affordable utility bills via energy efficiency improvements to help building owners and tenants. It should also lower demand on the grid, reducing the risk of power outages and offering the utility provider the opportunity to implement cleaner, more reliable options to the grid. Importantly, BPS will reduce greenhouse gas emissions thereby contributing to healthier conditions for individuals in vulnerable portions of our community.

### Equity Considerations

The structure of the BPS provides flexibility to address inequality through policies that build up a community. The policy can integrate requirements that touch on issues such as public health (through GHG reductions and associated improved air quality, less frequent extreme heat, and storm-induced flooding) and affordability (reducing energy and water costs for owners and tenants), resiliency, and economic development and serve as a starting point for a more comprehensive policy agenda to reduce ongoing economic disparities, e.g. the policy can address affordable housing and prevent displacement as a social imperative (City Energy Project, 2021). And as outlined in the recommendation of Workforce Training (Recommendation 36), provide programs in communities which will benefit from workforce development to create a pool of experienced trained workforce to serve the buildings in Frederick County and City to meet the goals set in the BPS.

### Cost-Benefit Analysis

There are currently no data on cost savings for BPS implementation as the NYC (New York City, n.d.), Washington, D.C. (District of Columbia, 2021) and St. Louis (City of St. Louis, 2017) programs have just been implemented; performance results will not be available until 2025-2026.

Future analyses can focus on a number of sectors to generate comprehensive costs and savings. For example, small business owners typically are resource constrained but would benefit from taking energy efficiency action. In order to understand options to reduce utility bills, owners would need to participate in an energy audit at some small cost, making them aware of energy savings investments that could reduce their utility bills, freeing up money to be used in other business expenses. For public health, some actions taken to improve building energy performance have been shown to improve occupant health and well-being particularly among vulnerable groups. For example, according to a study written on fuel poverty and human health (Liddell & Morris, 2010), insulation retrofits and weatherization can improve indoor air quality, reduce the buildup of mold and address other indoor air quality issues. Many of these simple actions have been shown to drastically improve indoor air quality and reduce respiratory and cardiovascular diseases and allergies (Recommendations 26, 27).

Staffing expenses to support a benchmarking policy can be paid for by the revenue collected from annual reporting filing fees by building owners.

### Finance

After an initial outlay of public funds to set up the BPS steps above, recovered costs from lower energy demand (and eventually water use and waste generation) can be recovered in increased business profits and tax revenues those generate. Lower utility costs may also facilitate more community-wide payment of utility bills through the savings generated and through those recovered funds, increased collection of fees from utilities. Funding options beyond these local sources include federal and state programs. Federal tax credits are available for builders of energy efficient homes (Environmental Protection Agency, 2021) and deductions for energy efficient commercial buildings (Environmental Protection Agency, 2021). The Maryland Energy Administration has a number of programs that can support energy efficient upgrades or construction, including BeSMART Energy Efficiency Loan for Homeowners, Low-to-Moderate Income Energy Efficiency Grant, and Maryland Home Energy Loan Program. BPS for County and City buildings should include these funding sources for BPS inclusion as part of public requirements.

### Recommended Actions — Legislative

- In order to move us toward energy efficient conditions for the public Frederick County should consider all pathways to achieving significant greenhouse gas reduction goals. The core elements to achieving this goal are a combination of buildings measuring and reporting energy consumption data; utilities providing access to whole-building energy data; and state and local governments publishing the data. Begin by passing legislation that provides the County with the ability to collect building energy data (benchmarking), evaluate performance over time and add policy that will serve to equitably improve building performance, occupant health and reach GHG goals.
    - Benchmarking provides the foundation for improved building energy performance. Begin by passing a benchmarking ordinance that

serves as data collection for energy and carbon metrics.

- Adopt regulation to provide necessary detail to implement a Building Performance Standard (Nadel & Hinge, 2020). A building performance standard is a comprehensive policy that encompasses provisions that include these additional actions beyond benchmarking:
  - Building types and size that should be covered
  - Defined metrics
  - How and when the metrics should be applied
  - Lead time for when policy will be enforced
  - Exceptions — buildings or building types exempt from policy
  - Identify funding sources for energy improvements
  - Determine if renewable energy credits (RECs) should be offered as an alternative compliance path
  - Include a technical assistance program to support adoption of energy efficiency standards by building owners, consultants and workforce
  - Develop special provisions for affordable housing
- Consider consulting with IMT (IMT, n.d.) for guidance in drafting the Building Performance Standard.

### Recommended Actions — Administrative

Identify the staging steps before and after ordinance adoption to set technically achievable final performance standards for each metric adopted for each property type. Setting these standards requires detailed analysis, including building performance data related to each metric. The analysis also must evaluate how the building performance data relate to each metric proposed and the ability to verify and quantify the ability and cost to improve for each property type.

Metrics include but are not limited to:

- Greenhouse Gas Emissions: Setting the City's and County's climate goals
- Energy Consumption: Reducing consumption is moving building stock toward the City's and County's GHG emissions goals
- Energy Demand: Minimizing peak demands and adding demand flexibility
- Administration/Enforceability: Reducing the strain and burden on building owners and City and County administrators

Follow the recommended steps produced by Steven Winters Association, Inc. (Steven Winters, 2020) Carbon Neutral Cities Alliance:

- If the County does not have access to local building performance data for a given metric, it will need to adopt requirements to collect such data alongside the BPS ordinance. Conduct a Building Performance Study to determine the reduction targets for each building type and compliance reporting milestones
- Establish a Building Energy Improvement Board to evaluate and inform rulemaking decisions and compliance pathways, set and update performance standards, advise and oversee implementation of the policy. The Board should be composed of representatives from the building industry, utilities and building owners.
- Energy data collected from the utility are considered a reference performance level. Starting with baseline building performance will be critical to analyze at least one year of data of all covered properties to inform the process of setting final standards. These data may be available through the local utility provider.
- Develop appropriate performance metrics. This should be done by compiling relevant data sources and creating analysis methodology.
  - Develop energy use, fuel splits and carbon intensities, by building type and/or space use, necessary to meet building sector GHG reduction goals by 2050.
  - Identify the potential energy and emission standards and metrics relevant to achieving the identified targets, with variations by building type as needed, pros and cons.
  - Identify preliminary energy use intensity ranges, and fuel split targets for total building sector, and by building type/or space type.
  - Conduct preliminary engineering assessment, with energy modeling of established building prototypes, to determine anticipated achievable performance by building type.

- Calculate rough order of magnitude (per sq. ft. or energy unit) cost estimates of upgrades required to reach anticipated achievable performance, by building type as relevant. Provide a range with associated criteria for low to high estimates.
- Define the path, which includes a package of retrofits that are implemented at a building between now and a future date, and targets which are each building's resulting performance after the potential paths are followed.

■ Determine direct energy costs and staff requirements. Models vary by jurisdiction and government structure.

■ Identify funding mechanisms to pay for efficiency investments. Consider revenue collected from fees associated from filing building energy data annually to comply with a benchmarking policy and fines from noncompliance.

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## 4 Adopt building codes that emphasize energy efficiency and climate adaptation

**Expected GHG Reduction or Climate Adaptation:** Increasing energy efficient building, whether new or retrofits, will reduce energy consumption and GHG emissions, helping to meet the Climate Resolution goals for 2030 and 2050. Importantly, the changes in City and County building codes will also increase climate resiliency in local infrastructure, thereby reducing public health threats from poor indoor air or thermal conditions. Tracking can be instituted by an annual tally of 1) numbers of retrofits receiving energy efficient technology and new residential units and commercial buildings with Leadership in Energy and Environmental Design (LEED) or passive housing designs, perhaps through permits granted; 2) climate-related illnesses (heat stress, heat- or flood-induced medical treatment) reported to the County Health Department to allow quantification of illness specific to climate-resilient vs. non-climate resilient buildings; and 3) any reported flood damage tabulated for historical vs. new flood-resistant buildings equipped with the new technologies to reduce water damage and repairs.

**Timeline for Action:** Adoption of new codes should be the highest priority for both governments. Those codes and associated amendments should be finalized within two years. For maximum benefit to builders, and to ease compliance, City and County code updates should be as similar as possible. Tracking of administrative and legislative progress could begin in year 1 for City and County adoption and editing of new building codes, with revisions accommodated in Year 2. Creation of a web-based database would follow to record the results of LEED or passive housing permits issued and heat and flood-related illnesses associated with these newer technology buildings for comparison with the same data from buildings without the more current improvements. The pre- and post-new technology data would quantify benefits of the new construction practices for protection of public health and property.

**Rationale:** Most existing buildings are 'leaky,' thereby transmitting heat in the summer or cold in the winter throughout the building while new construction requirements only loosely require protections for new owners or renters from temperature extremes or flooding damage, the latter attributable to inadequate public conveyance systems built to address precipitation and runoff prior to 1980. Technologies developed in the last three decades can minimize heat, cold, and air quality threats in existing buildings and certainly in new construction as well as repeated inundation and accompanying flooding from stormwater or sewage backups and seepage through sub-ground level portions of a building. In order to minimize these threats to health and properties, particularly for financially stressed individuals and families, it is imperative to require repair and construction practices to prevent these impacts going forward.

There are a number of construction options that can reduce resident, owner, or employee exposures to within-building elevated summer or winter cold temperatures, thereby protecting human health (illness, medication, hospitalizations), limiting energy use, and reducing local GHG emissions. Passive housing construction is a rapidly expanding industry that reduces energy demand AND improves indoor air quality and heating/cooling to protect residents ( Zavos, 2021; van Dam & van Huet, 2015). New construction should also plan or orient buildings in such a way that renewable energy sources (e.g. solar power) are encouraged.

For retrofits, the following system and building upgrades should be considered: cool roofs, double- and triple-paned windows, elimination of unplanned building air leaks, energy-efficient HVAC systems (e.g. ductless electric heating and cooling systems with infrared bulbs in air handlers to enhance filtration), installing and maintaining energy recovery ventilation

(ERV) air exchange units, larger stormwater and sewage conveyance systems, expanded wastewater and stormwater storage capacities, sealed below ground stories to water seepage, and installation and maintenance of backflow valves for stormwater and sewage backups.

In low lying areas or areas where there is a history of flooding, elevating buildings and adopting appropriate foundation designs should be considered. Although building in floodplains is prohibited in the County and City, any proposed renovations of existing structures in floodplains should require two or more feet of freeboard; freeboard is an elevation above a designated high-water level. For example, the bottom of the lowest horizontal structural member should be elevated a minimum of two feet above the base flood elevation. The Federal Emergency Management Agency (FEMA) suggests one foot and Albany/ Dougherty Counties in GA suggest three feet but with increasing extreme events and flooding as in the May, 2018 flood, the more elevated an existing building is, the better chance to eliminate property damage. This is especially pertinent since base flood elevations will be higher in the future, particularly those associated with much more frequent 100 year storms. Beyond local requirements, Maryland requires State Waterway Construction Permits for floodplains that can experience 100 year floods and details are available from the Maryland Department of the Environment (MDE, n.d.). For inland floodplains, Marion County, OR has specific regulations for properties in urban and rural areas (Marion County, n.d.). Similarly, Albany and Dougherty County, GA have specific building requirements for floodplain construction/retrofits (Albany, 2020).

Certain types of foundations are more effective in flood situations than others. Deep pile or column foundations are desired if significant erosion is possible where the following conditions exist: erodibility of the soil; potential for high velocity flow; potential for flood-borne debris; and required resistance to wind forces. Through the National Flood Insurance Program (NFIP), FEMA has identified high-risk flood areas (susceptible to 100 year storms), V- and A-zones, that require flood insurance if the owners have federally backed loans. For existing floodplain structures, private property owners should consult FEMA flood maps to identify possible retrofits to minimize flood damage (FEMA, 2021).

Basement and lower story sealants are now required in most jurisdictions. Rubberized membranes are now used, connected to a drain tile at the base of the foundation that runs or is pumped to daylight. Retrofitting older homes is also possible with interior drain tiles. In areas with inadequate public stormwater or sewage conveyance systems or insufficient storm storage capacities at public facilities, City or County funds should be appropriated to install greater conveyance and storage capacities for stormwater systems and sewerage utilities. If this option is impractical or not cost-effective for the number of homes and buildings impacted, the City and County should 1) provide flood damage insurance (property, repairs, and goods), 2) provide backwater valves for residences in older areas constructed prior to stormwater management requirements or areas with inadequate sewer storage capacities, and 3) reimburse property owners for flooding damage from up-gradient ponding due to these shortfalls in public service. (Note: In these recurring flooding areas, homeowners have bought homes in ‘good faith’ that public services will protect their properties and are caught short when, through no fault of their own, storm-induced flooding occurs through insufficient public protections for their property). Further, as the City continues to annex areas to increase the City boundary and the County has identified primary and secondary growth areas in *Livable Frederick Master Plan* (2019) for population growth and construction, long-term plans for larger capacity stormwater and sewerage conveyance and storage should be a priority (see Recommendation 31).

Although not an obvious part of energy efficiency in rehabilitation of old buildings or new construction, water usage should be as efficient as possible as water treatment, delivery, and heating and cooling in a home or business consume energy and therefore generate GHGs. Besides these benefits to GHG reductions, the massive heat wave and drought in the western U.S. in 2021 (Mack, 2021) indicates why water use should be as efficient as possible. The U.S. Environmental Protection Agency (EPA) has a

program, WaterSense (EPA, n.d.), that promotes water efficiency in buildings. WaterSense promotes best practices, fixtures, and technologies that save water. WaterSense-labeled homes and products allow EPA to promote water efficiency and communicate the value and benefits in a quantifiable manner to homeowners and utilities. To qualify for WaterSense labeling a home must be verified to demand at least 30% less water than homes newly constructed (EPA, 2021). The labeling is important for homes seeking LEED certification, but the principles are beneficial to any home. As society moves to address the challenges associated with climate change, water efficiency will grow in importance and is the second portion of the three-component Building Performance Standard (BPS) policy in Recommendation 3.

Other jurisdictions have adopted requirements to protect their residents in rental and privately owned new and old homes and businesses. For heat, Los Angeles, CA (Los Angeles Municipal Code, 2014), Washington, D.C. (District of Columbia, 2014), and Philadelphia (City of Philadelphia, 2010) have established ordinances for cool roofs in buildings under repair or new construction; these include solar reflectance and thermal emittance criteria. Multiple states have enacted regulations to protect residents from poor indoor air quality (Environmental Law Institute, 2020) but enforcement details are lacking. Eliminating air leaks (tightening) is an increasingly important retrofit strategy, including Frederick's Power Saver Retrofit Program but it needs to be directed to the lowest income residents. It would be ideal to establish that the new technology common to passive housing to ensure indoor air quality that includes cool air in the summer is embedded in all future single-family and multi-family residential construction in the area. Installing and maintaining appropriate ventilation systems (EPA, 2011) can also dramatically improve indoor air quality, thereby meeting the illness prevention goal of the County Health Department (Frederick County, n.d.).

The evolution of building codes over the past decades have reduced energy consumption by 30% and the Department of Energy (DOE, 2014) forecasts that further evolution of the energy codes will correspond to 841 million tons of reduced CO2 emissions nationally. To accomplish much of the protections above, the 2021 International Green Construction Code (IgCC) should be adopted as soon as possible by both the City and County. DOE (n.d.) estimates that buildings meeting the 2021 IECC, as compared with buildings meeting the 2018 IECC, would result in national site energy savings of 9.38%, source energy savings of 8.79%, and energy cost savings of approximately 8.66% of residential building energy consumption.Various other codes, standards, and certifications will offer increased energy efficient buildings and should be considered as amendments. For example, 'stretch codes,' a locally mandated code or alternative compliance path, is more aggressive than the base code (IEA, 2017; NBI, n.d.). Frederick City and County should also incorporate Passive House design principles into the building codes and policies to achieve deep energy and carbon savings. By doing so the City and County will be at the forefront of energy conservation. There are multiple examples of passive housing design for residential and commercial buildings in urban areas. In April, 2012, there were 30,000 passive houses in Europe (Janderson, n.d.). Korea, Japan, and China have substantial commitments as well (Jacos, 2017). New York City has 65 buildings (condominiums) using passive housing designs (CityRealty, 2021). Portland, OR, San Francisco, CA, and Victoria, B.C., Canada are all exploring passive house construction (Roux-Delagarde, n.d.).

City and County documents identify protecting public health from hazards and other threats, such as those derived from poor housing construction. In the *Livable Frederick Master Plan*, the chapter 'A Vision for Our Health' summarizes County commitments to ensuring that all people, including those in poverty, have equal access to services to foster wellness. The Housing Diversity section of the Plan states, "…build a varied housing stock in order to *support fairness, equity, and resilience* for our community and that serves the needs of present and future residents." Elaborating, specific commitments include, "Provide technical support to homeowners seeking to renovate existing older housing. Assist with weatherization programs/energy efficiency improvements to reduce utility bills in older, poorly insulated homes. And continue to provide funding or consider tax credits for installing or upgrading accessibility for seniors and disabled citizens in older

housing" (Frederick County, 2019, p. 106). The Plan also suggests, "Support the mitigation and subsidy of housing costs in the county for the development of new housing stock, the *rehabilitation of existing housing stock*,..." (p. 111). Specific to energy efficiency, the Plan's Built Environment (p. 186) has five supporting initiatives under its commitment to Building Codes and Policies, all relevant to the proposed adoption of the codes and building designs noted above. The *2020 City Comprehensive Plan* (City of Frederick, 2021) includes the following, "For construction of new City buildings, require that energy efficiency certification be attained where feasible" (p. 13-278). The City's Climate Action Plan (City of Frederick, 2020, pp. 15, 25) will "Develop LEED or above code green building policy" as well as consider the IgCC, consistent with the recommendation above. Since CEMWG is suggesting that the City and County 'lead by example' (see Recommendation 2), adopting similar building requirements for non-public buildings ought to be considered.

**Co-Benefits:** Steps to ensure home heat/cold, indoor air quality, and flooding protections are not only excellent strategies for limiting economic hardships from excessive utility bills, public health threats (particularly for asset limited, income constrained, employed [ALICE], senior, and disabled populations) from respiratory distress, heat stress and dehydration, and moisture- and heat-induced illnesses from mold and other fungi, but reduce demands on medical services and insurance or out-of-pocket liabilities. Environmental impacts are reduced due to less air pollution and construction waste and economic benefits are increased due to lower energy costs, new business opportunities, job creation, and reduction in rate subsidies (Zhang, 2006). Contractors will benefit by upgrading skills needed for new technology installation, assisted by proposed training through the County Office of Economic Development or Frederick Community College's Construction Management program (see Recommendation 36).

**Equity Considerations:** Low income families are more likely to experience higher utility costs per square foot because of less efficient older homes and poor maintenance of affordable rental properties. These families have to juggle paying for essentials such as food, transportation, rent, and medicine and are more likely to have power shut off and not turned back on due to the financial barrier to reinstate power. For prospective homeowners, due to the shortage of housing in Frederick County and rising cost of real-estate, it is difficult for families 200% below the federal poverty line to maintain (see Department of Housing and Urban Development [HUD], 2010), let alone purchase, a home and even if a home is secured, there is a constant struggle to keep up with the high energy cost from inefficient homes. There is one program available through HUD (2010) targeting families with this level of income; unfortunately, the program is only able to help 20% of the applicants who apply. The Empower Maryland Limited Income Energy Efficiency Program (https://dhcd.maryland.gov/Residents/Pages/lieep/default.aspx) is another option helping limited income households with installation of materials and equipment at no charge.

To properly provide support for our community, additional and/or expanded grant programs for weatherization of homes should be created using ALICE income guidelines and staggered with the fiscal year. The improved income guidelines would provide more opportunity for families in Frederick to take part in this program. The staggered effect would come from offering the program twice a year so funding would not run out, or for a better result, provide it to non-profit partner agency(s) in tandem with the County or City government. One example is Prosperity Accounts through the United Way of Frederick County. Prosperity Accounts use the Housing Assistance Program (HAP) funding to help individuals purchase a home. Traditionally, HAP funding is completely distributed within 6 months of the fiscal year. With United Way of Frederick County receiving a portion of the funds, available support is extended through the rest of the fiscal year while providing additional benefits to aid families in purchasing a home. A viable option for expanding available funds could be developed through a no-interest bearing revolving loan fund. This strategy has been used successfully in Wisconsin to help low-income seniors remain in their homes, funding needed safety and weatherization retrofits using qualified vendors, collecting on the loan when the home is sold.

Consistent with the *Livable Frederick Master Plan* statement, "Support the enforcement of the Frederick County minimum livability code to protect the health, safety, and welfare of residents" (Frederick County, 2019, p. 108), many of these building requirements could be initiated by limiting fiscal impacts on low-income community members through adopting incentives, public-private partnerships, and creative financing like Green Banks to transition existing properties or build new construction. Rental owners should be engaged and required to transition existing buildings to the new designs, perhaps benefiting from private-public partnering possible in Green Banks or public incentive programs. Frederick's Power Saver Retrofit Program should be advertised and cued to households with limited income (ALICE, disabled, or senior residents), the lower middle class, and below. New York City has set up Cool Neighborhoods NYC with $100M for tree plantings, cool roof installations, and energy assistance for low-income residents (https://www.epa.gov/heatislands/local-heat-equity-examples#new-york). Additionally, NGOs similar to BlocPower (BlocPower.io) could provide low-cost options for facilitating installation of energy-saving infrastructure for low-income homeowners.

As indicated by the New Buildings Institute (2018), "Some states have taken notice of the impact energy efficient housing plays in low-income communities and they encourage high-performance building by placing funding conditions on funding sources like grants and tax credits." An excellent example is the Pennsylvania Housing Finance Agency (PHFA). It established requirements for the use of their housing tax credits by prioritizing projects for developers seeking Passive House certification. Since updating the policy in 2015, the state has provided tax credits to support the development of over 900 Passive House units. Pennsylvania is on its way to hosting the largest concentration of Passive House/Net-Zero Energy-Capable dwelling units in the U.S within just a few years of the policy change.

**Cost and Cost-Benefit Analyses:** A common misconception is that energy efficient buildings may not be financially justified. Green buildings typically have had a higher upfront cost, (5–10% more for a single family home but for multi-unit buildings, 0–3% higher costs (Passive House Alliance, n.d.) compared to conventional construction, but they provide benefits that those built to current code projects lack. Obvious benefits include reduced energy and water use, less waste production, and lower operations and maintenance costs. Often overlooked are the enhanced occupant health and productivity returns. According to World Bank analysis, the overall net benefit of investing in resilient infrastructure is $4 for every $1 invested (World Bank, 2019). The financial benefits of green design over 20 years is estimated at $5.79/sq ft (Khawam, 2006). On the basis of energy savings alone, investing in green buildings is cost effective (Chicago, 2017).

Cool roofs cost slightly more than conventional roofs but EPA reports that in California, a cool roof's average annual net savings approximated $0.50/sq. ft. (EPA, 2021). Air sealing homes and installing and maintaining air ventilation systems (e.g. energy recovery ventilation units) range from $1-2/sq ft but costs can be recovered within one year (J. Rensberger, personal communication, 2021). Rubber-membrane sealing for basements/foundations is estimated at $2-2.50/sq ft but can eliminate flooding damages that range from $1500 to greater than $10,000 while addressing sewage back-ups and cleaning and subsequent repairs, which can easily exceed $10,000 if contaminated water soaks porous drywall, insulation, and furnaces (ServiceMASTER, 2018).

**Finance:** Evidence is showing that green buildings are a higher-value, lower-risk asset than those built to current building code standards. There are options available for financing passive housing; an overview for our area is available at DSIRE, NC Clean Energy Technology Center. Incentives are now available in at least 12 states (perhaps a future option for Maryland) with other programs providing funds for low-income owners (Passive House Institute – United States. There are also federal tax credits available for builders of energy efficient homes (Homebuilder Tax Credits, and deductions for energy efficient commercial buildings (Tax Deductions for Commercial Buildings). The Maryland Energy Administration has a number of programs that can support energy efficient upgrades or construction, including BeSMART Energy Efficiency Loan for Homeowners, Low-to-Moderate Income Energy Efficiency Grant, and Maryland Home Energy Loan

Program. Another option for financing is through a Green Bank that underwrites loans from lending institutions that might be perceived as higher risk or lower return than normal; a Frederick Green Bank is currently being explored. These may allow building upgrades; initial costs might be recouped on future sale of the property.

The Federal government's Weatherization Assistance Program offers fiscal relief for some energy-related activities. Maryland maintains funding for seniors and assessing the Qualified Allocation rule to incentivize development of targeted low-income senior housing should be initiated. The state also includes several programs to increase energy efficiency (EmPOWER Maryland Limited Income Energy Efficiency Program). While additional grant programs are developed, the Weatherization Assistance Program and the EmPower Maryland Limited Income Energy Efficiency Program should be promoted in line with local services targeting the intended audience, i.e. ALICE families and those who are 200% below the federal poverty line. Local services that best reach the intended audience include the Housing Authority Homeownership Program, United Way of Frederick County Prosperity Accounts, Habitat for Humanity Land Trust and Home Repair Programs, Community Action Agency Homebuyer Workshop, and Interfaith Housing Alliance Homeownership Program. For flood protection, the National Flood Insurance Program may also offer insurance options but eligibility is limited and repairs to walls, insulation, and personal goods are not always covered.

### Recommended Actions — Legislative

- Current City of Frederick code is the 2015 International Building Code including residential, mechanical and energy conservation. Current county codes include 2018 International Code Council both residential and commercial with amendments, 2017 National Electrical Code, 2018 ICC Plumbing and Mechanical Code, and 2018 International Energy Conservation Code. The City and County should adopt the 2021 International Green Construction Code as the base code and the 2021 International Energy Conservation Code as a compliance path. Various stretch codes, standards, and certifications will offer increased energy efficient buildings and can be added as amendments. These stretch codes should be considered: ASHRAE 189.1, LEED, Living Building Challenge, Passive House Institute US Certification, Zero Energy Ready Home, and Zero Energy Advanced Energy Design Guide (AEDG) for K–12 school buildings. U.S. EPA's WaterSense products should be considered in future codes as well.

- Add a "Solar Ready" option to building codes and provide incentives for such an option. This would encourage builders to construct buildings in such a way as to make later solar installations easier and less expensive. This would include options such as roof orientation, roof pitch, and locating all rooftop protrusions together instead of scattered over the roof. A group of county solar installers should be engaged to detail what is most beneficial to them. Builders who meet a subset of the options could be designated as "Solar Ready Silver" and those who meet all the options "Solar Ready Gold" and use these designations in their marketing efforts.

- Add an "EV Ready" option to building codes and provide incentives for such an option, encouraging builders to pre-wire for EV charging and offering them an EV Ready designation that could be used in their marketing efforts. Criteria for this would differ between single family homes and commercial buildings.

### Recommended Actions — Legislative

- By executive order require the City and County to take all necessary steps to integrate the U.S. Green Building Council's LEED Silver standards as a minimum for construction of all new County and City facilities and all major renovations to existing County and City facilities, with a particular focus on integrating technologies and design, material, and construction elements that generate lower long-term operating expenses and reduced energy and subsequently carbon emissions. Passive Housing is preferable, however, as it is a performance-based option and offers quantifiable assessments of energy efficiency vs. assigned efficiencies for LEED buildings.

- The County and City should also consider any development projects that are receiving financial

assistance or special approvals to include sustainable elements. Developers can select the elements from a sustainable strategies menu (Kats, 2003).

- Expand home inspections that accompany construction permits for repairs, retrofits, and new buildings to ensure replaced or new materials are consistent with maximum use of cool roofs, building ventilation, below ground flood protection, and efficient water use products. Train inspectors on these new technologies.

### Administrative and Legislative — City and County

- Change outreach for the Power Saver Retrofit Program so it is applied primarily to residences for the lowest-income portions of our community and aggressively seek traditional and creative funding since this population is most at risk from climate impacts.

- Establish an active collaboration of the Office of Economic Development, Frederick Community College, and the Frederick County Business Industry Association to identify and then set up ongoing training modules for new technology installation and maintenance in new construction and retrofits.

- Revise building requirements to ensure maintenance of high indoor air quality and water use for residence and commercial building retrofits, repairs, and new construction.

- Establish and expand existing public incentive and energy assistance programs (e.g. Low Income Home Energy Assistance Program) for low-income, ALICE, disabled, or senior populations.

- Build expanded stormwater and sewage conveyance and storage systems for flood-prone areas or establish public funding mechanisms to reimburse or insure homeowners for flooding and sewage damage.

- Develop long-term infrastructure plans for stormwater and sewage conveyance and storage systems for the City and primary and secondary growth areas identified in the *Livable Frederick Master Plan* (Frederick County, 2019).

- Strongly encourage real estate appraisers to receive training in these new technologies and features, assuring property owners that value is accurately assessed.

### State and Federal Actions

- Seek establishment of a Maryland passive house incentives program, as described for 12 states in the U.S. (https://www.phius.org/software-resources/incentives/incentives).

- Delegations should seek permanent State/Federal funding for routine installation of climate resilient technologies.

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## 5 Incentivize the transition to environmentally sustainable ("green") homes

**Expected GHG Reduction or Climate Adaptation:** The Home Energy Score (HES), developed by the Department of Energy (DOE), provides a means to quantify estimated reductions of energy use per home and a calculated $CO_2$ equivalent metric tons ($CO_2$emt) per year, critical to showing energy demand declines, associated lower GHG release, and cost savings for homeowners. Metrics might include development of a self-reporting HES database to document home energy consumption declines following conservation measures, such as the installation of energy-saving appliances, residential retrofits, etc.

**Timeline for Action:**

YEARS 1–5

A recommended first step is to establish a relationship with a national or regional mentoring organization, such as the Green Building Institute, Earth Advantage, ID Energy, or CLEAResult. The Green Building Institute and Earth Advantage support jurisdictions in Portland, Oregon and Michigan.

A next step is to work with the real estate industry to recognize the value associated with green home improvements and how to use the HES to market homes for sale. Then, it is important to pass local legislation that requires a Home Energy Score (HES) as part of all major home improvement permitting requests.

Lenders, appraisers, assessors, inspectors, and energy technology professionals should be notified to support the implementation of the HES, including how to properly document green energy improvements using measures such as energy cost savings, reduction in carbon footprint, improved home value, home durability, and indoor air quality.

The City and County should consider establishing a pilot program similar to Denver's (Lotus Engineering, 2019) to perform a preliminary assessment of the system and familiarize homeowners and realtors of the benefits of participating in the program. A documentation system should be set up to record progress.

YEAR 6+

Assuming the success of the pilot program, adopt the process throughout Frederick City and County and work with the state of Maryland to implement the program statewide.

**Rationale:** Creative and practical uses of green energy technologies in existing housing provide opportunities for reducing the carbon footprints of communities. There are challenges associated with the best ways to incentivize homeowners to invest in green technologies in order to improve the energy efficiency of their homes. Adopting a HES system:

- Incentivizes homeowners to become aware of various technical options to improve the energy efficiency of their homes.
- Encourages homeowners to become aware of financial incentives available to offset capital investments for installing green technologies.
- Persuades homeowners to invest in improving home energy efficiency.

Adopting a home energy scoring system that rates the energy efficiency of a home and allows for comparison with other homes of similar characteristics is built on several models and relies on experience. There are a number of sophisticated scoring systems (Leadership in Energy and Environmental Design [LEED], Passive House, Environmental Protection Agency [EPA] Green Star Homes, and DOE's Home Energy Rating System) but all of these systems require testing, verification, and documentation that could be both costly and time consuming. What is needed is a system that is quick and straightforward, easily understandable, reasonably inexpensive, and has a high level of confidence with industry stakeholders. The system must be easily understood by homeowners who may

not have a technical background. DOE's HES system was designed with all of these objectives in mind. It is a proven system that has been in operation for more than eight years and has been adopted by a number of states and organizations, including Oregon (Oregon Department of Energy, n.d.), California (California Energy Commission, 2021), Missouri (Missouri, n.d.), and others.

It is recommended that Frederick City and County adopt the DOE HES system to document a home's energy efficiency (DOE, n.d.) as documentation of energy reductions through home upgrades reducing energy consumption, lowering emissions, and saving homeowners money. Based on the results of HES for 128,000 homes, DOE determined that the average initial HES score was 4.6/10 compared to 7.1/10 after improvements. This resulted in an average reduction in $CO_2$eq of 1.9 metric tons/year/home, an average reduction of $575/year/home in energy bills, and a 22% drop in energy demand/year/home [email from Glenn Dickey (BGS contractor to DOE/HES Program) to Robert Robey, 7/8/2021].

By requiring all homes for sale, resale, or major rehabilitation to obtain a nationally recognized HES, there will be a standardized basis by which individuals can:

- Better determine the value of the home to the seller and buyer.
- Document the status of a home's energy efficiency.
- Accurately compare a home's energy-related operating cost to other homes.

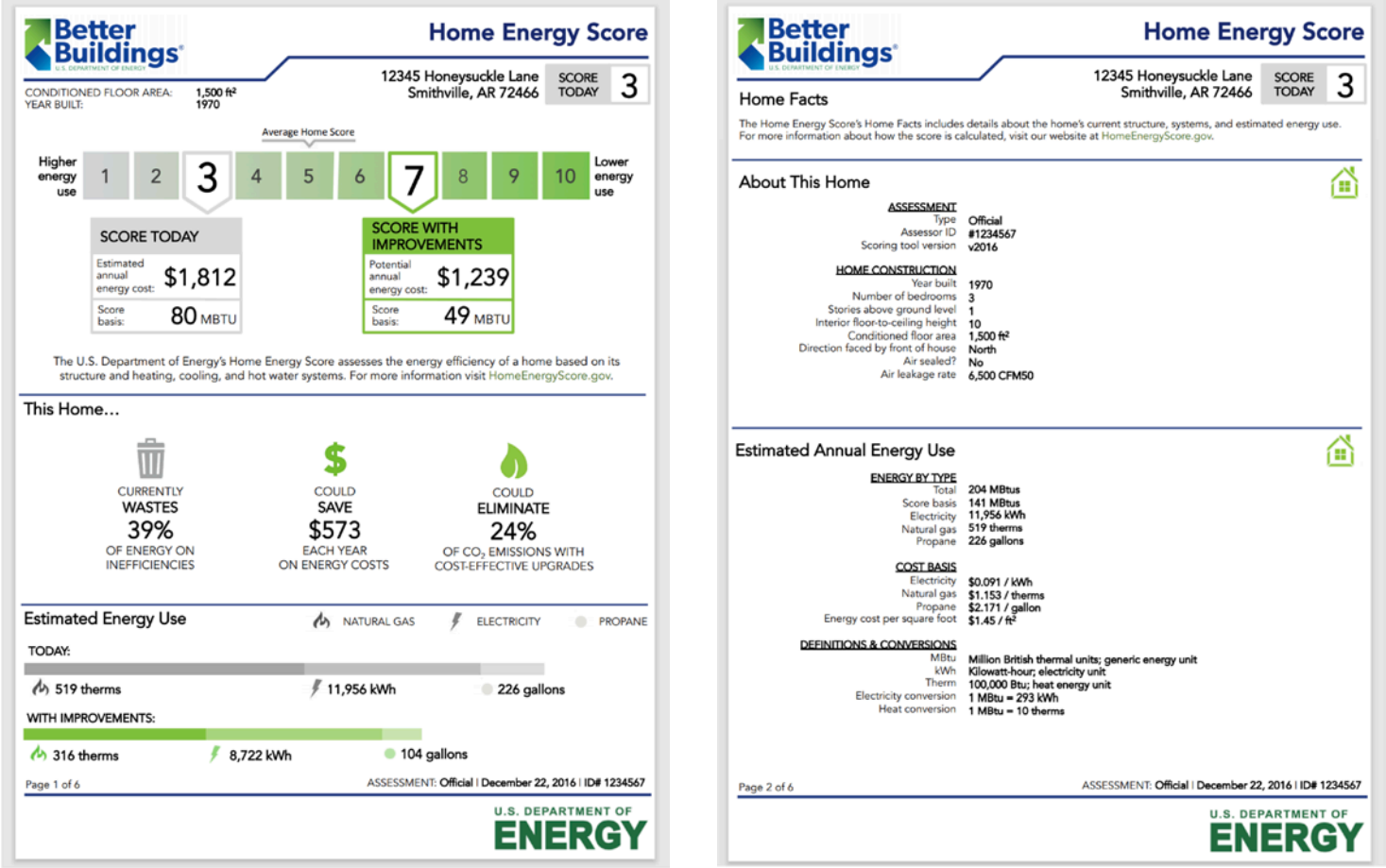
It is logical that most home buyers will want a home with the highest HES they can afford because higher scores mean lower utility costs and longer asset life. Buyers may want to take the opportunity to work with lenders to obtain funds for making energy efficiency upgrades as part of their mortgage. Home sellers will want their home to have the highest HES they can afford to improve their competitive position in the marketplace because buyers will look at comparable homes and through compiled HES, weigh the score as a factor in decision-making.

Individuals who want to make major alterations or renovations to a home may be encouraged to raise the standard of the upgrades to reflect current green building codes. Examples include exchanging fossil-fueled HVAC systems, hot water heaters, gas stoves, and fireplaces with electric alternatives; replace older and inefficient electric HVAC systems and appliances with energy efficient alternatives; and improve the air tightness of a home's envelope including insulation ratings and ventilation.

Recommendation 4 calls for updating the building codes, which should include requirements in new construction for high HES standards.

As stated earlier, there are a number of highly sophisticated rating systems available, such as LEED, Passive House, EPA's Green Star Homes, and DOE's Home Energy Rating System. In order to achieve certification in most of these systems, a costly and protracted testing and documentation process is required. The HES system, however, is designed to be quick: the average time to assess a house is only one hour. The assessment results are simple to understand for professionals and laymen alike. The system has been in operation since 2013. It is a proven system that has been made easy to implement through technical support available from DOE, state jurisdictions, and contractors.

In sum, HES would allow homeowners to better control their energy costs. As shown in Figure 1, potential upgrades and efficiency are identified. The key information resulting from a home's assessment is the quantification of potential reductions in operating costs, reductions in energy waste, and reductions in the carbon footprint. The areas of the home covered by the HES are identified in Figure 2.



Better Buildings
U.S. DEPARTMENT OF ENERGY

Home Energy Score

CONDITIONED FLOOR AREA: 1,500 ft²
YEAR BUILT: 1970

12345 Honeysuckle Lane
Smithville, AR 72466

SCORE TODAY 3

Average Home Score

Higher energy use | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Lower energy use

SCORE TODAY
Estimated annual energy cost: $1,812
Score basis: 80 MBTU

SCORE WITH IMPROVEMENTS
Potential annual energy cost: $1,239
Score basis: 49 MBTU

The U.S. Department of Energy's Home Energy Score assesses the energy efficiency of a home based on its structure and heating, cooling, and hot water systems. For more information visit HomeEnergyScore.gov.

This Home...

CURRENTLY WASTES 39% OF ENERGY ON INEFFICIENCIES

COULD SAVE $573 EACH YEAR ON ENERGY COSTS

COULD ELIMINATE 24% OF $CO_2$ EMISSIONS WITH COST-EFFECTIVE UPGRADES

Estimated Energy Use — NATURAL GAS | ELECTRICITY | PROPANE

TODAY:
519 therms | 11,956 kWh | 226 gallons

WITH IMPROVEMENTS:
316 therms | 8,722 kWh | 104 gallons

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ASSESSMENT: Official | December 22, 2016 | ID# 1234567

U.S. DEPARTMENT OF ENERGY

Better Buildings
U.S. DEPARTMENT OF ENERGY

Home Energy Score

12345 Honeysuckle Lane
Smithville, AR 72466

SCORE TODAY 3

Home Facts

The Home Energy Score's Home Facts includes details about the home's current structure, systems, and estimated energy use. For more information about how the score is calculated, visit our website at HomeEnergyScore.gov.

About This Home

ASSESSMENT
Type: Official
Assessor ID: #1234567
Scoring tool version: v2016

HOME CONSTRUCTION
Year built: 1970
Number of bedrooms: 3
Stories above ground level: 1
Interior floor-to-ceiling height: 10
Conditioned floor area: 1,500 ft²
Direction faced by front of house: North
Air sealed?: No
Air leakage rate: 6,500 CFM50

Estimated Annual Energy Use

ENERGY BY TYPE
Total: 204 MBtus
Score basis: 141 MBtus
Electricity: 11,956 kWh
Natural gas: 519 therms
Propane: 226 gallons

COST BASIS
Electricity: $0.091 / kWh
Natural gas: $1.153 / therms
Propane: $2.171 / gallon
Energy cost per square foot: $1.45 / ft²

DEFINITIONS & CONVERSIONS
MBtu: Million British thermal units; generic energy unit
kWh: Kilowatt-hour; electricity unit
Therm: 100,000 Btu; heat energy unit
Electricity conversion: 1 MBtu = 293 kWh
Heat conversion: 1 MBtu = 10 therms

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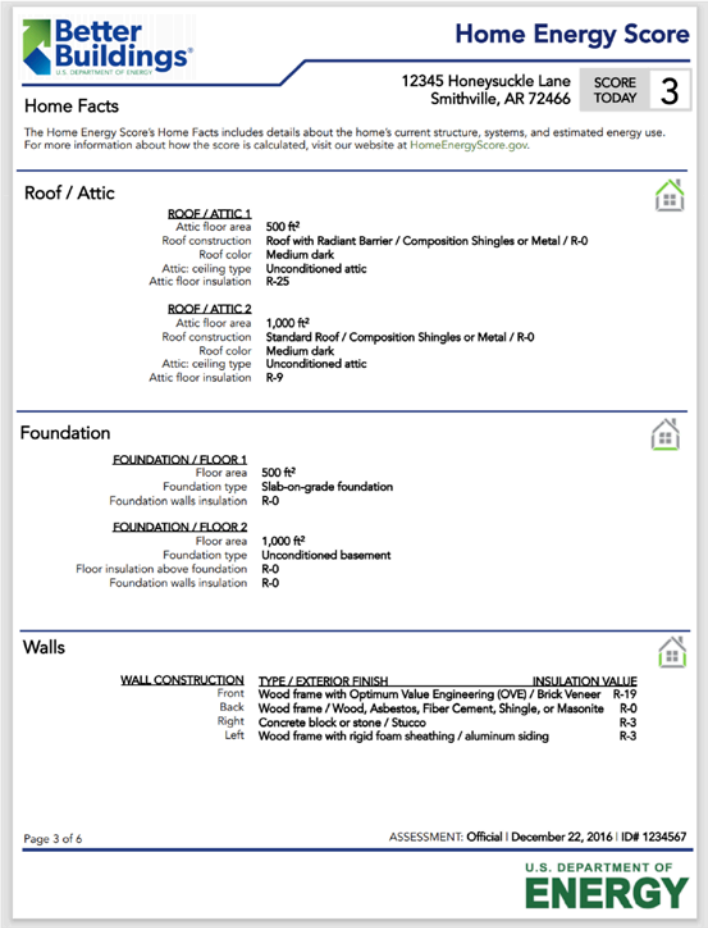
U.S. DEPARTMENT OF ENERGY

**Figure 1. Sample Home Energy Score Report, HES (DOE, n.d.)**



Better Buildings
U.S. DEPARTMENT OF ENERGY

Home Energy Score

12345 Honeysuckle Lane
Smithville, AR 72466

SCORE TODAY 3

Home Facts

The Home Energy Score's Home Facts includes details about the home's current structure, systems, and estimated energy use. For more information about how the score is calculated, visit our website at HomeEnergyScore.gov.

Roof / Attic

| | ROOF / ATTIC 1 | ROOF / ATTIC 2 |
|---|---|---|
| Attic floor area | 500 ft² | 1,000 ft² |
| Roof construction | Roof with Radiant Barrier / Composition Shingles or Metal / R-0 | Standard Roof / Composition Shingles or Metal / R-0 |
| Roof color | Medium dark | Medium dark |
| Attic: ceiling type | Unconditioned attic | Unconditioned attic |
| Attic floor insulation | R-25 | R-9 |

Foundation

| | FOUNDATION / FLOOR 1 | FOUNDATION / FLOOR 2 |
|---|---|---|
| Floor area | 500 ft² | 1,000 ft² |
| Foundation type | Slab-on-grade foundation | Unconditioned basement |
| Floor insulation above foundation | | R-0 |
| Foundation walls insulation | R-0 | R-0 |

Walls

| WALL CONSTRUCTION | TYPE / EXTERIOR FINISH | INSULATION VALUE |
|---|---|---|
| Front | Wood frame with Optimum Value Engineering (OVE) / Brick Veneer | R-19 |
| Back | Wood frame / Wood, Asbestos, Fiber Cement, Shingle, or Masonite | R-0 |
| Right | Concrete block or stone / Stucco | R-3 |
| Left | Wood frame with rigid foam sheathing / aluminum siding | R-3 |

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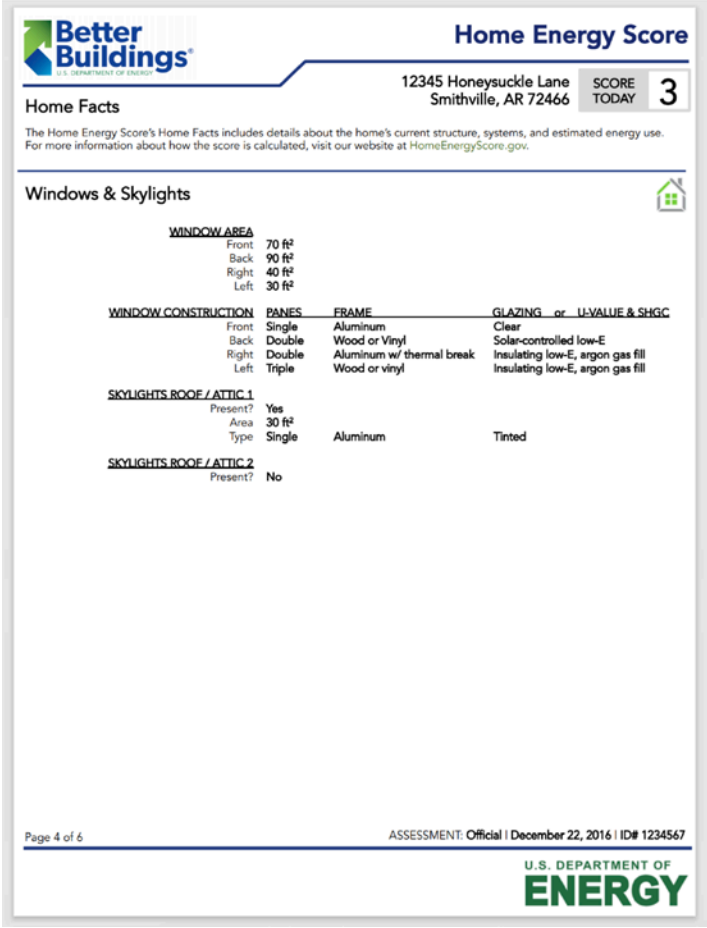
U.S. DEPARTMENT OF ENERGY



Better Buildings
U.S. DEPARTMENT OF ENERGY

Home Energy Score

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Smithville, AR 72466

SCORE TODAY 3

Home Facts

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Windows & Skylights

| WINDOW AREA | |
|---|---|
| Front | 70 ft² |
| Back | 90 ft² |
| Right | 40 ft² |
| Left | 30 ft² |

| WINDOW CONSTRUCTION | PANES | FRAME | GLAZING or U-VALUE & SHGC |
|---|---|---|---|
| Front | Single | Aluminum | Clear |
| Back | Double | Wood or Vinyl | Solar-controlled low-E |
| Right | Double | Aluminum w/ thermal break | Insulating low-E, argon gas fill |
| Left | Triple | Wood or vinyl | Insulating low-E, argon gas fill |

| | SKYLIGHTS ROOF / ATTIC 1 | | | SKYLIGHTS ROOF / ATTIC 2 |
|---|---|---|---|---|
| Present? | Yes | | | No |
| Area | 30 ft² | | | |
| Type | Single | Aluminum | Tinted | |

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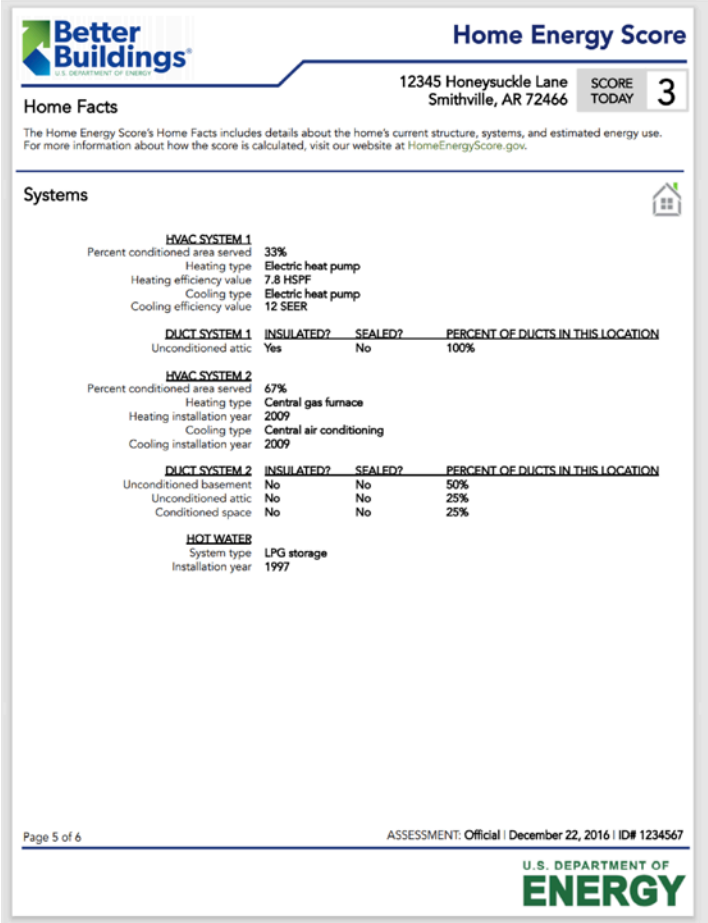
U.S. DEPARTMENT OF ENERGY

**Figure 1. Sample Home Energy Score Report, HES (DOE, n.d.) CONTINUED**



Better Buildings
U.S. DEPARTMENT OF ENERGY

Home Energy Score

12345 Honeysuckle Lane
Smithville, AR 72466

SCORE TODAY 3

Home Facts

The Home Energy Score's Home Facts includes details about the home's current structure, systems, and estimated energy use. For more information about how the score is calculated, visit our website at HomeEnergyScore.gov.

Systems

HVAC SYSTEM 1
Percent conditioned area served: 33%
Heating type: Electric heat pump
Heating efficiency value: 7.8 HSPF
Cooling type: Electric heat pump
Cooling efficiency value: 12 SEER

| DUCT SYSTEM 1 | INSULATED? | SEALED? | PERCENT OF DUCTS IN THIS LOCATION |
|---|---|---|---|
| Unconditioned attic | Yes | No | 100% |

HVAC SYSTEM 2
Percent conditioned area served: 67%
Heating type: Central gas furnace
Heating installation year: 2009
Cooling type: Central air conditioning
Cooling installation year: 2009

| DUCT SYSTEM 2 | INSULATED? | SEALED? | PERCENT OF DUCTS IN THIS LOCATION |
|---|---|---|---|
| Unconditioned basement | No | No | 50% |
| Unconditioned attic | No | No | 25% |
| Conditioned space | No | No | 25% |

HOT WATER
System type: LPG storage
Installation year: 1997

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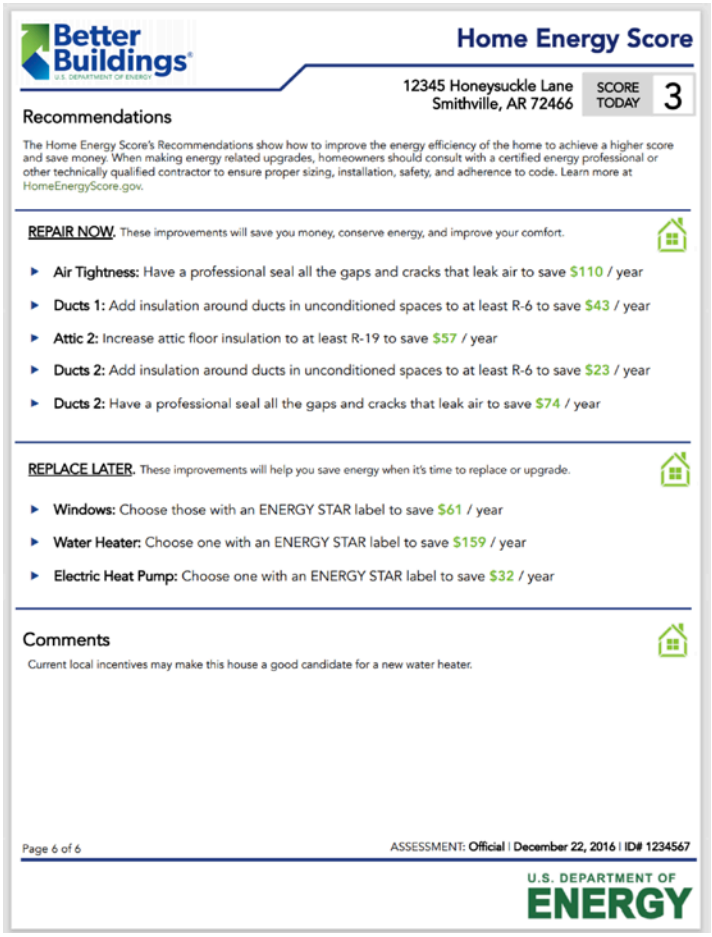

Better Buildings
U.S. DEPARTMENT OF ENERGY

Home Energy Score

12345 Honeysuckle Lane
Smithville, AR 72466

SCORE TODAY 3

Recommendations

The Home Energy Score's Recommendations show how to improve the energy efficiency of the home to achieve a higher score and save money. When making energy related upgrades, homeowners should consult with a certified energy professional or other technically qualified contractor to ensure proper sizing, installation, safety, and adherence to code. Learn more at HomeEnergyScore.gov.

REPAIR NOW. These improvements will save you money, conserve energy, and improve your comfort.

- **Air Tightness:** Have a professional seal all the gaps and cracks that leak air to save $110 / year
- **Ducts 1:** Add insulation around ducts in unconditioned spaces to at least R-6 to save $43 / year
- **Attic 2:** Increase attic floor insulation to at least R-19 to save $57 / year
- **Ducts 2:** Add insulation around ducts in unconditioned spaces to at least R-6 to save $23 / year
- **Ducts 2:** Have a professional seal all the gaps and cracks that leak air to save $74 / year

REPLACE LATER. These improvements will help you save energy when it's time to replace or upgrade.

- **Windows:** Choose those with an ENERGY STAR label to save $61 / year
- **Water Heater:** Choose one with an ENERGY STAR label to save $159 / year
- **Electric Heat Pump:** Choose one with an ENERGY STAR label to save $32 / year

Comments

Current local incentives may make this house a good candidate for a new water heater.

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U.S. DEPARTMENT OF ENERGY

**Figure 1. Sample Home Energy Score Report, HES (DOE, n.d.) CONTINUED**

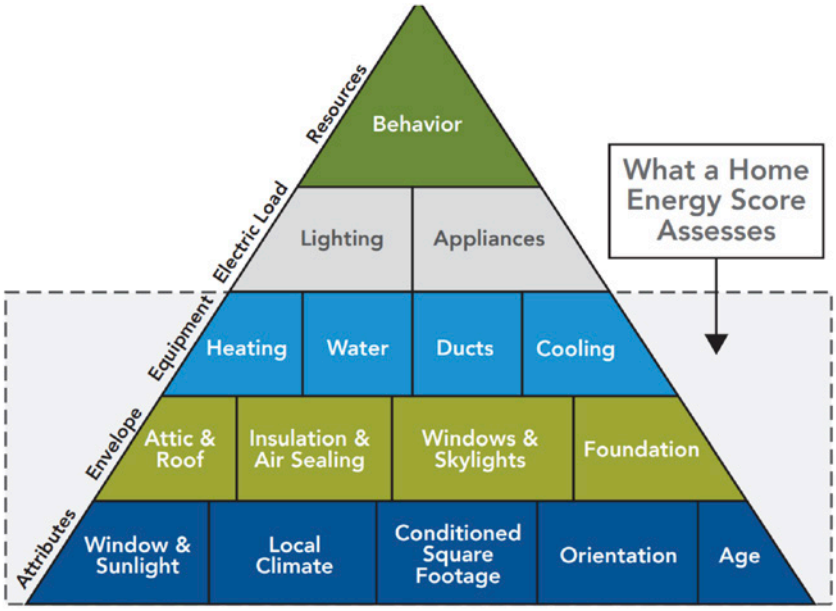


**Figure 2. Areas of the home covered by the HES (Source: Lotus Engineering, 2019)**

As noted above, several states have established HES options or requirements. Oregon passed an ordinance for use of HES as a voluntary tool for homeowners (Oregon Secretary of State, n.d.) and states use the HES scores for various rebates (NJ), incentives (CO), and possible incentives (MI) (Glickman, 2014). Some mortgage reductions are also tied to HES results (e.g. FHA Energy Efficient Homes Policy, Fannie Mae's HomeStyle® Energy Mortgage Loan) and Connecticut's Green Bank requires HES results to fulfill its energy audit requirement for incentives for residential solar installation.

Frederick City and County documents repeatedly address increasing energy efficiency. In the City's draft Climate Action Plan (City of Frederick, 2020), although only addressing government buildings, it uses the American Society of Heating, Refrigerating and Air-Conditioning Engineers Level II energy audits to identify energy demand in its major utilities, indicating a City commitment to identifying buildings that may be rehabbed for lower energy requirements and GHG emissions. There should be similar interest for energy efficiency of homes and buildings because access to safe and affordable housing is a goal of the strategic plan (see CommUNITY 2030 2019 Appendix; City of Frederick, n.d.). Energy Audits are identified as key aspects of County assessments as well as per the Livable Frederick Master Plan (Frederick County, 2019). Specifically, the Energy Audit and Retrofit initiative states, "Establish large-scale energy audit and retrofit programs to reduce energy consumption and increase economic efficiencies" followed by supporting Initiatives to "1) encourage the Public Service Commission (PSC) … to expand the funding of energy audit activities in their programs by offering financial incentives for professional energy audits" and "2) encourage the Maryland Energy Administration (MEA) to offer incentives to qualified engineers to provide energy audits to customers of utilities who are not served by a utility under PSC jurisdiction" (p. 188). HES provides an inexpensive option to fulfil these initiatives.

**Co-benefits:** Improving a home's energy efficiency not only saves energy, mitigates waste, and improves the indoor living environment, it also reduces the carbon footprint of the home, i.e. lower GHG emissions and improved local climate-driven conditions. Motivating homeowners to embrace the "greening" of existing housing stock coupled with the adoption of new green building codes for new construction and major renovations (Recommendation 4) will result in significant carbon footprint reduction.

Adopting a countywide HES system will help incentivize individuals to improve the energy efficiency of existing homes and will provide a high standard to be applied to existing commercial and industrial buildings as well as new construction. The system could also be applied to rental properties, with a number of jurisdictions nationwide (e.g. Denver and Ft. Collins) considering that possibility. Additionally, HES adoption for new and retrofit construction provides local jobs and identifies Frederick as an ideal community for new residents where there is a proactive focus on reducing energy consumption, a boon for the local economy.

**Equity Considerations:** Adopting HES as a routine assessment capacity for low income renters and homeowners in the City and County would identify areas in the homes for energy efficient retrofits. In addition to lowering operating costs, the improvements, in turn, act to prevent health threats to residents from inadequate ventilation, heating and cooling, etc., a major goal of the County Health Department (see Recommendation 1). Further, better living conditions prevent lost days of work from illness and reduce the number of repeated small repairs in a residence, saving residents from unexpected bills.

**Cost and Cost-Benefit Analyses:** Improving a home's energy efficiency and transitioning from fossil-fueled to electric-powered technologies should:

- Reduce operating costs and lower utility bills
- Improve home value during resale and reduce time on the market
- Improve the durability of the home and
- Improve air quality in the home to improve human health

In addition, implementation of HES will contribute to the reduction of the region's carbon footprint, thereby reducing the cost impact of climate change.

**Finance:** The City and County should consider alternatives for funding the HES during a pilot program. Participants in the program should view it as an investment in establishing a program that will result in benefits to the residents as well as reducing the carbon footprint. There are a number of improvements that can be made to a home that will result in a higher HES. These improvements include: sealing air ducts, whole home air sealing, replacing inefficient appliances with Energy Star appliances, and changing out end-of-life fossil fuel heating systems and hot water heaters with electric alternatives. It is recommended that Frederick City and County staff and elected officials work with the state of Maryland and financial institutions to improve incentives available to homeowners choosing to invest in improving the energy efficiency of their homes.

Data on financing green improvements for a home can be found in the financing module of the Home Energy Score System. Some existing and potential opportunities are listed below:

- Federal Housing Administration (FHA) Energy Efficiency Homes Policy
- Fannie Mae HomeStyle Energy Mortgage
- Connecticut Green Bank's Residential Solar Incentive Program
- Future — Freddie Mac Green Choice
- Future — Home Insurance Companies
- Future — Property Assessed Clean Energy (PACE) financing

Financing could be stimulated if the City, County, and the State work collaboratively in optimizing an incentive program of tax credits and rebates as appropriate to offset the initial capital costs for investing in improving a home's energy efficiency. The State or County should also consider the establishment of a specific fund or a 'Green Bank' to facilitate home improvements focused on improving energy efficiency.

**Recommended Actions:**

**Legislative City & County**

- Develop an HES Assessor training program with a national or industrial partner.
- Create a resource pool for use by seniors and economically disadvantaged individuals to improve access to funding for energy efficiency upgrades to homes.
- Initiate a Pilot Program (for example, 1000 homes) to implement HES. Seek grant funds (investor, state, federal, etc.) to run the program and potential subsidies to demonstrate the validity of the program's benefits.
- Establish a tax credit for full/partial funding for securing residential HES.
- Require HES to be included on the Multiple Listing Service (MLS) for all homes being sold.
- Create legislation similar to the Mathieu Cast Act in Michigan which does not allow municipalities to tax energy efficiency improvements and solar assessments — increasing property taxes for improvement to a home's energy efficiency is a disincentive.

**Administrative City & County**

- Establish a mentor relationship with an established HES provider about implementing HES.
- Implement a data storage system to document progress. The program will aid in identifying energy and capital savings and establish data-driven processes to ensure scalable savings that persist.
- Create a registry for HES data populated with location, building type, size, age, appliances, insulation, window types/layers, and other energy efficiency attributes.
- Create a help center to usher residents and businesses through the process of obtaining an HES score and documenting execution of green upgrades to qualify for financial incentives.

- Create a resource center that provides:
  - Technical solutions and estimated costs
  - Contractors to install and maintain technologies
  - Federal, State, and Local incentive programs to mitigate costs
  - A list of certified Assessors to create a HES
- Develop a mentoring relationship with a jurisdiction already using HES to become familiar with Best Practices for smooth transition in implementing HES and avoiding pitfalls
- Begin outreach program with Realtors, Lenders, Appraisers, and Assessors to work with clients to support the implementation of HES. If training is required to increase HES awareness, benefits, and adoption, work with the Frederick County Association of Realtors, Frederick County Business Industry Association, and the City and County Offices of Economic Development to establish on-line training modules.
- Establish an HES pilot program
  - Finance initial assessments to initiate the program
  - Work with a network of realtors, assessors, and financial institutions to coordinate implementation strategies
  - Track and resolve issues that need to be addressed
  - Test viability of incentive programs offered
  - Prepare a report on HES performance for use in evaluating the benefit of the program and to market wider adoption of the program

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## 6 Accelerate solar deployment

**Expected GHG Reduction or Climate Adaptation:** Increasing on-site generation of electricity from carbon-free solar energy systems installed at government and privately owned commercial and residential buildings in Frederick City and County will reduce GHG emissions, and in doing so will help to improve both public health and public safety.

**Timeline for Action:** Expansion of current actions to install solar photovoltaic (PV) systems at City and County facilities should begin immediately. As is explained below, this can be done without significant impacts on City and County budgets, leaving funds available for other purposes. To facilitate a more rapid increase in the number of solar generation facilities installed at privately owned commercial and residential buildings, the City and County should expeditiously proceed to initiate changes to City and County codes and regulations to allow/define conditions for solar panel installations. In addition, the City and County should identify local areas receiving solar PV systems and project likely installation areas for priority and secondary growth locales of the Livable Frederick Master Plan (Frederick County, 2019). Progress will be tracked through documenting code changes through time as well as identified locales for installation.

**Rationale:** The cost of installing solar PV systems has been steadily dropping and multiple vendors are competing aggressively for installation contracts for large arrays. Many cities, counties, and non-government entities (including homeowners and renters in Maryland and across the nation) are opting for electricity bill savings by arranging with a tax-paying third party to own a solar array and simply paying for the electricity taken from the system. In this way, all capital and maintenance cost (including panel and inverter repair) outlays are avoided or minimized until the third-party owner recovers the contracted sum fixed at the start of the project. This approach is especially advantageous for entities that do not pay income taxes, such as city and state governments, since the tax savings are currently 30%, and when combined with the other financial income opportunities that the third-party owners are experienced in maximizing, the amount that a city or county government can save without incurring large capital costs can be substantial. Tax-paying utility customers who are willing to invest in oversized solar systems may opt to use that approach because the annual utility costs can be reduced to zero and they may potentially receive a check from the utility at the end of the year if the energy from the installed solar PV system exceeds their needs (see below for additional information concerning the various financial benefits that are available to solar PV system owners).

Solar PV systems can be installed on unshaded or seldom-shaded portions of building roofs. Best results occur if the roofs are flat or sloped in a roughly southerly direction although slopes to the east or west may be economical. They can also be installed almost anywhere on an unshaded part of a customer's property. However, there are County restrictions: installations are not permitted on large portions of prime agricultural land nor can trees be removed to accommodate installation of a solar PV system.

**Three specific sites for solar PV systems** – **schools**, **row homes** (aka attached townhomes), and **community solar projects** — are described below to illustrate the range of solar siting possibilities.

**Schools:** Sixty-four schools are listed on the Frederick County Public Schools (FCPS) website. Schools are an ideal site for solar PV systems because:

1) In addition to or as an alternative to installing arrays on roofs, schools typically have a large number of unshaded parking spaces on level ground where carports could be installed to support a large number of solar panels. Alternatively, fewer solar panels could be installed on posts positioned between rows of cars. Although carports are an added cost, they provide additional value — they prevent vehicles

parked under them from overheating on bright sunny days and they keep vehicles largely free of snow and ice during the winter. With these attributes, use fees could potentially be charged to cover a portion of the panel installation cost.

2) School buildings use little electricity during the summer months, allowing the transfer of higher percentages of their generated power to the electric grid in the time when peak demand across other buildings is highest, adding a measure of resilience to the grid.

3) On-site solar generation provides an excellent educational opportunity for current and future students.

The **Technical Addendum** following the References provides additional information on solar carports installed at FCPS parking lots.

**Row homes:** Downtown Frederick contains a large number of streets with old historic homes (many are in the Historic District Overlay zone) with common walls between neighboring homes. As a result, roofs may be contiguous. Roofs are typically flat and black from a waterproofing tar coating; many are unobstructed. When first built many decades ago, these homes typically had little or no thermal insulation in the space between their top-floor ceilings and roofs. During the past 60 to 70 years, however, most homeowners have installed insulation in this space to reduce heating bills and minimize summertime overheating.

The City of Frederick should consider implementing a pilot program to install solar collectors on the roofs of a sample set of these homes to determine the costs and benefits of a larger-scale implementation. Economies-of-scale, where solar PV systems are installed at the same time on all the roofs of row homes, should produce considerable cost savings. The Maryland Energy Agency has a grants program that might provide funding for such a pilot program, which should include: 1) investigation of whether the roofs need retarring or other roof treatment to prevent water leaks, 2) whether the solar collectors can be supported approximately a foot above the roofs to avoid the possibility of causing leaks, and 3) market research to learn the net cost that homeowners should expect to pay after state and federal financial/tax incentives are applied. To address City Historic Preservation Guidelines (2019), solar panels would be installed at a low slope and would not be visible from streets, sidewalks, or the windows of other homes.

**Community solar projects:** Aware that some residents a) live in apartments or in homes where the property is shaded by trees or other buildings and therefore are unable to install solar systems, or b) would simply prefer not to install them, Maryland and many other states have authorized the Public Service Commission (PSC) to allow third parties to create large solar arrays in unshaded locations, and then "sublet" portions of the overall array to various ratepayers located in the same electric utility service territory where the large array is located. The PSC instructed the utilities that they must deal with those who temporarily "acquire" a portion of the large array exactly the same as they would if the same solar panels were actually installed on the acquirer's premises. Therefore, the acquirer gets all the benefits with none of the inconveniences of owning an on-site solar system.

Other jurisdictions have adopted solar energy as common renewable energy supplies for local needs. Solar PV utility (55%) and distributed (rooftops, 32%) energy in California contributes approximately 9000 MW of energy. California Assembly Bill 178 has been adopted and requires that as of Jan 1, 2020, all new single- and multi-family buildings up to three stories high need to be solar powered (Cal Solar Inc., 2020). Small-scale solar PV-generated energy is also high in Arizona, New York, Massachusetts, and New Jersey (U.S. Energy Information Administration, 2021). More locally, by June, 2020, there were 9,816 homes in Montgomery County with solar, in response to Maryland's 2019 Clean Energy Jobs Act that requires half of Maryland's energy to come from renewable sources by 2030 and 14.5% derived from in-state solar energy systems. The state's Residential Clean Energy Grant Program also provides upfront rebates of $1,000 for eligible homeowners who buy solar systems with no regular sales tax on their purchase of solar panels and related equipment (Honeydew Energy Advisors, 2020).

There are many examples of the advantages and programs for solar PV installations elsewhere. In

September 2020, Generation 180, a Virginia-based public-interest organization that advocates for solar schools, released the third edition of Brighter Future: A Study on Solar in U.S. Schools that was prepared through funding from two organizations, The Solar Foundation and the Solar Energy Industries Association. This report states that 7,332 solar schools exist in the U.S., with the count doubling since the previous 2014 report. Nine states (AZ, CA, CT, IN, MA, NJ, NV, NY, and VA) have each installed more than 20,000 kW of solar generation. Maryland is 12th, with 16,964 kW. Among Maryland counties, Montgomery County has the largest solar school-based generation. While most schools have used roof-top installation of solar panels, there is no evidence that this is less costly than installations above carports over their expected 40-year lifetime (Generation180, 2021). Anne Arundel Community College was an early adopter of the solar carport concept, implementing a large installation in 2011 (Space Daily, 2011).

Frederick County has documented interest in future expansion of solar-generated energy in the Livable Frederick Master Plan (2019). Future housing for the County is envisioned as a "...balance of mixed use and single family units with a focus on green, solar, and sustainable alternative energy features" (p. 75). A specific Alternative Power initiative is, "Support the provision of clean energy systems, such as wind and solar, in the county to replace or supplement conventional power supply" (p. 193) and consistent with the points above, recommends considering solar in County buildings and parking lots (p. 195). The City's draft Climate Action Plan (City of Frederick, 2021) suggests installing renewable energy at City facilities, is exploring ground-mount solar installations throughout the City, and is considering power purchase agreements as the financial instrument for the installations (p. 16).

**Equity Considerations:** Solar-powered public schools reduce GHG emissions as a result of their lower demand for fossil-fuel-based energy, thereby improving local air quality and associated heat extremes and medical conditions more common to lower income individuals and families. Increasing solar PV installation also provides employment opportunities for many individuals, often stimulated through affordable public and public-private training opportunities (Recommendation 35). With appropriate outreach and education regarding the solar panels powering their schools, students will be better informed about solutions that help the entire community.

**Finance:** As noted above, the installation of solar PV systems can be accomplished with relatively small capital expenditures by the City and County, making funds available for other worthy projects, by working with third parties. The third party owns and maintains the solar PV system for several years, during which most of the solar generation (all of the portion that falls under the Net Metering regulations) is sold to the host facility at a price that is roughly 5% to 10% less than the price of electricity from the utility company. This arrangement reduces the capital cost of the project because it enables the entity that finances and installs the solar PV system to take advantage of the federal investment tax incentives that the not-for-profit utility customers (such as the City and County) cannot claim. The utility customer will see a small saving on the electric bills each month until the cost of the installations is covered, but then the customer has full ownership of the solar system and the full monthly electric bill savings it produces, plus other income as described below.

Maryland – like many other states — has passed three laws related to solar PV systems that provide special financial benefits to their owners or "renters" who are also customers of their local electric utility:

- The **Renewable Energy Portfolio Standard** law requires all electric utilities to purchase sufficient Renewable Energy Credits (RECs, 1.0 MWh of generated or transmitted electricity in the PJM regional transmission grid) such that the aggregate MWh purchased corresponds to a certain percentage of the total MWh sold to customers in a given year. The law defines two tiers of eligible renewable energy sources, with separate minimum requirements, and also specifies a set-aside amount for RECs produced from solar PV systems only. If any utility fails to meet the requirements, they must make an Alternative Compliance Payment that is deposited into the Maryland Strategic Energy Investment Fund that is used to issue loans and grants that spur the creation of new Tier 1 renewable energy resources in the state.

- Maryland also has a **Net-Metering law** that requires electric utilities to buy any excess electricity generated by a residential or nonresidential customer's actual or virtual on-site solar PV system (where "excess" means more kW generation at any time than the customer's instantaneous kW load), and to keep a record of the cumulative kWh excess. Then, during times when there is no excess, the account is debited instead of charging the customer for the kWh used. At the end of each year, the utility either sends the customer a check for the net surplus kWh in the account, or a bill if the account shows that the total kWh used was more than the total kWh generated. The Net Metering law allows customers to oversize their solar PV installations to generate up to twice the kWh they are expected to use in a year.

- Maryland also has a pilot **Community Solar Program** (Maryland Public Services Commission, n.d.) underway. In this program, an entity builds a large solar PV array and "sells" or leases portions of it to utility customers who cannot install an array at their residence or facility because it is rented instead of owned, or the home or facility is too shaded, or is otherwise unsuitable for an on-site solar PV system; or the customer simply chooses not to install the system at the customer's premises. The utility treats the customer no differently than those customers who have the solar system installed at their premises. If the customer acquired 5% of the Community Solar System, then the utility simply credits the customer's account with 5% of the generation of the System. The program also is designed such that residential customers whose annual income is below a certain level can receive a state grant to cover a significant portion of the participation costs for the program.

### Recommended actions:

- The County should develop a plan with FCPS officials to install solar and solar carports within the next 5 years to save money and reduce GHG emissions.

- An ad hoc City-County technical group should be formed with representatives from the two governments, builders, developers, solar companies, and utilities to lay out future solar array/panel building options for new construction and retrofits of existing structures.

- An outreach/education program should be established and maintained, distributing funding opportunities, incentives, tax breaks, and siting options to residents and businesses

- The City should specifically identify location possibilities for solar panel arrays for buildings in the Historic District Overlay and seek funds for a pilot demonstration.

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## Technical Addendum to Recommendation 6: Illustrative Details Concerning School Solar Carports

The installation of **Solar Carports** can be accomplished with relatively small capital expenditures by the County, saving public funds for other worthy projects. This can be done by allowing private industry to own and maintain the carports and solar panel arrays for several years, during which most of the solar generation (all of the portion that falls under the Net Metering regulations, Maryland Public Service Commission, 2019) is sold to the County at a price that is 5% to 10% less than the price of electricity from Potomac Edison. This arrangement reduces the capital cost of the project, benefitting the County, because it enables the entity that finances and installs the Solar Carports to take advantage of the federal Investment Tax Incentives that the County cannot claim as it does not pay income taxes. The County will see a small saving on electric bills each month until the cost of the installations is covered, and then the County collects the full monthly savings plus other income (e.g. sale of excess solar generation and Renewable Energy Credit [https://www.epa.gov/greenpower/renewable-energy-certificates-recs]) over the remaining life of the solar collectors, which may be a total of 40 years or longer. An important point is that when any "technical glitch" (i.e. equipment failure) occurs while the financing entity owns the Solar Carports, the entity's revenue drops because it is being "paid for performance" (i.e. selling electricity to the County). The entity therefore has a large incentive to have repairs done quickly. At the end of the contract term, ownership of the carports, solar panels, structural supports, inverters, wires, cables, etc., all transfer to the County, together with rights to 100% of the savings (but also responsibility for equipment maintenance.)

The list of FCPS schools was obtained from the website https://www.fcps.org/schools-directory and the number of parking spaces has been estimated based on counts obtained from one elementary, middle, or high school. Data for a typical Solar Carport (https://www.solarelectricsupply.com/commercial-solar-systems/solar-carport) indicated that each carport would support solar panels with an approximately 3-kW(dc) rating. The final number needed for the analysis is the typical annual kWh(ac) generation produced by each kW(dc) installed. This rounded value (1,345) was obtained using the PVWatts Calculator software tool (NREL, https://PVwatts.nrel.gov/) for a group of solar panels at a school in Middletown. The variation in kWh(ac) per parking space was less than 1% for schools from Thurmont to Urbana, with the Middletown site being close to the average of the PVWatts value for those two locations.

A solar system installation contractor confirmed that a utility customer can install more solar collectors than the limit dictated by Net Metering regulations (Maryland Public Services Commission, 2019), but the overall solar installation must be electrically divided (via wiring connections) into two sections, and a separate grid interconnection agreement obtained for each section with the local electric utility. One section connects with the school's electrical circuitry and its connection to the utility grid, and the kW rating is governed by Maryland's Net Metering regulations. The other section, with the balance of the total solar arrays' kW rating, connects directly to the utility grid. For the first interconnection, the utility pays the annual average price of electricity for the net excess that flows to the grid over the year, but the utility pays a lower price for the electricity flowing to the grid via the second interconnection.

The table below shows the approximate value for the annual electricity generation by Solar Carports located at 64 Frederick County public schools.

### Solar Carports at Frederick County Public Schools

| School Type | Number | Parking Spots per School | Total Solar MW(dc) Capacity | Total Solar MWh(ac)/yr Generated |
|---|---|---|---|---|
| Elem. | 39 | 165 | 19.3 | 26,000 |
| Middle | 13 | 200 | 7.8 | 10,500 |
| High | 12 | 600 | 21.6 | 29,000 |
| Total | 64 | | 48.7 | 65,500 |

## 7 Facilitate the transformation of utility customers to clean electricity

**Expected GHG Reduction or Climate Adaptation:** Frederick City and County can meet or exceed a migration goal of 50% of electricity customers to zero-carbon energy by 2030 using a combination of clean energy generation strategies while advocating for, supporting, and utilizing 100% renewable retail energy suppliers and aggregators.

Driving demand for existing renewable suppliers while also implementing new on-premises sources will increase the proportion of clean energy in use on the Maryland grid. Combined with increased efficiency and energy conservation efforts, this will also reduce the Frederick carbon footprint. By working with local utilities, tracking of residential and business shifts to clean energy can be tabulated each year to assess successful transitioning by 2030.

**Timeline for Action:** The City and County should begin exploring purchasing, policy, and advocacy options and planning in FY 2021 and 2022, while continuing and enhancing support for existing programs (for example, Sustainable Frederick County, 2021) now and through the rest of this decade.

Secondly, the City and County should closely monitor the Community Choice pilot in Montgomery County and begin planning in FY 2022 for local implementation as soon as the state authorizes it for other jurisdictions and request that the Maryland legislature support this option. The City and County FY 2022 budgets should include funds for outreach and incentives to promote the roll-out of Community Choice. Tracking can be done through documenting discussions of and changes in City and County policies and purchase agreements for clean energy as well as establishing and detailing ongoing dialog with Montgomery County staff on the Community Choice pilot project and expansion across the state through delegation outreach to the state legislature.

**Rationale:** Significant change in power sourcing will be needed to achieve 50% clean energy adoption. By 2018, the proportion of renewable energy currently offered on the grid in Maryland approximated 11% of electricity generation, and about 8% of peak capacity as of 2019 (Maryland Public Service Commission [MD PSC], 2020b). Promotion of clean energy supply and aggregation will help increase renewable energy utilization in our region, thus furthering progress toward the 2030 goal of a 50% reduction in GHG emissions.

Citizens for whom on-premises renewable infrastructure is not feasible or appropriate can still make a significant difference by selecting a renewable energy retail supplier like ClearView Energy (ClearView, n.d.), Energy Harbor (Energy Harbor, 2021), Clean Choice Energy (Clean Choice, 2021), or Common Energy (Common Energy, 2021). The MD PSC supports consumer choice and online shopping of electricity suppliers (MD PSC, 2021b).

Community Choice Aggregation provides a means for counties and municipalities to save money on energy bills by leveraging citizen, business, and government combined purchasing power, while moving all participants to 100% renewable energy (Environmental Protection Agency, 2021). During the 2021 Session, Montgomery County's delegation introduced a bill that was adopted that authorizes the County to offer a **Community Choice Energy Pilot Program (CCE)** to residents and other utility customers who obtain electricity each month from the electric grid. The basic idea is that the County will sign an agreement with one or more parties who are Public Service Commission-authorized suppliers of electricity in Maryland to provide 100% carbon-free electricity for a stated time period to all current and future customers. These customers would have the right to opt out. In selecting suppliers, the County will carefully screen applicants for demonstrated

reliability, service quality, and contract structure. See more details about CCE in the technical addendum below.

Sponsorship of existing programs like the Green Homes Challenge (Frederick County, n.d.) can accelerate progress toward 50% renewable energy utilization. Every additional household, business, or government location that chooses clean energy drives up utilization and demand for renewable energy while helping to decrease dependence on fossil fuels. These efforts can work alongside other initiatives sponsored by the state of Maryland, including net metering (Maryland Public Service Commission, 2020a), tax incentives, and the community solar pilot program (Maryland Public Service Commission, 2021a).

Other localities also are actively encouraging citizens to switch to clean power (Montgomery County Department of Environmental Protection, 2021). Locally, Prince George's County offers property tax incentives for residential solar photovoltaic (PV) installations (Prince George's County, n.d.) and Baltimore Shines (Adaptation Clearinghouse, 2011) has established three pilot studies for installing solar PV in low income community areas. Many U.S. cities have adopted solar PV ordinances, rebates, and incentives including Madison, WI; Anchorage, AK; Long Beach, San Francisco, Los Angeles, Fremont, Santa Monica, San Rafael, Woodland, Dublin, West Hollywood, and Torrance, CA; NYC, Syracuse, and Rochester, NY; Kansas City and Columbia, MO; Portland, OR; Nashville, TN; Washington, D.C.; South Bend, Bloomington, and Gary, IN; Boulder and Ft. Collins, CO; Columbia, SC; Salt Lake City, UT; Aurora, IL; East Hartford and Fairfield, CT; Orlando, Margate, and Miami Beach, FL; and Nashua, NH (United States Conference of Mayors, n.d.). The same source identifies a list of U.S. cities offering clean energy choices for residences including Washington, D.C., San Leandro, Carson, Alameda, Oakland, Encinitas, Fremont, Culver City, San Rafael, Woodland, Los Angeles, San Jose, Napa, and San Francisco, CA, Portland, OR, Denver and Ft. Collins, CO, Austin, TX, Evanston, IL, Gary, IN, and Avondale, AZ. Resident selection of renewable energy is now offered in many parts of the U.S., some through setting up Community Choice Aggregations [Environmental Protection Agency (EPA), 2021]. These include California, Illinois, Ohio, Massachusetts, New Jersey, New York, and Rhode Island. Facilitating clean energy choice selection, whether residential-generated through solar installations or choosing renewable energy options from utilities, is common and should be expanded to meet our climate resolution goals.

The County and City recognize the importance of low energy costs for residents. In the Livable Frederick Master Plan (Frederick County, 2019), A Vision for Our Community states, "COMMUNITIES ARE aesthetically pleasing, with quality housing options including a balance of mixed use and single family units **with a focus on green, solar, and sustainable alternative energy features**" (Frederick County, 2019, p. 75). Another equally important statement is, "deployments of distributed energy resources **powered by renewable energy resources** (Frederick County, 2019, p. 177). Following on, the text reads, "Initiative: Alternative Power Support the provision of clean energy systems, such as wind and solar, in the county to replace or supplement conventional power supply" (Frederick County, 2019, p. 193). The City's Comprehensive Plan (City of Frederick, 2020) has similar text. Under Land Use Policy 6, the following is found: "New development and redevelopment applications will provide for the construction of sustainable and **energy-efficient** public facilities and infrastructure" (City of Frederick, 2020 pp. 13-263). Specific to residential construction, ES Policy 4 states, "**Achieve energy savings** and improved air quality by requiring energy-efficient site design and building construction" (City of Frederick, 2020, pp. 13-278); this policy includes eight implementation actions specific to energy efficient construction, thereby reducing costs and health threats to residents as well as reducing GHG emissions. Under maintaining a SUSTAINABLE City (City of Frederick, 2020, pp. 1-40), the text reads, "Encouraging the **use of efficient and renewable energy**,...". A commitment to ensuring the use of renewables and less expensive energy appear as foundational commitments for the two governments.

**Co-Benefits:** In addition to helping increase the proportion of customers using renewable energy and lowering GHG emissions, the proposed actions can also help reduce energy costs. This means a reduction in the Frederick carbon footprint is achieved, while City and County governments also save substantial public funds. Use of renewable energy improves local air quality and reduces extreme heat and storm events, thereby protecting public health as well as property.

**Equity Considerations:** Selection of a renewable energy supplier like Common Energy or Clean Choice Energy requires no investment and because renewable energy is so efficient, it can often reduce monthly energy bills as well as GHG emissions. Thus, energy becomes more affordable and all populations can benefit, freeing up family resources for other basic needs.

**Cost and Cost-Benefit Analyses:** Solar electric generation is now the least expensive electricity in history (Evans, 2020). Adopting renewable energy can therefore benefit an organization's bottom line, as well as help support a sustainable future for Frederick. Renewable energy retail suppliers and aggregators are already in operation and require no direct financial support.

Spreading the news about these options through effective low-cost outreach programs should increase, thereby expanding public awareness and future adoption of these alternative renewable energy supplies. Active public or public/private support for renewable energy may be accelerated through tax credits and other incentives. Over time, the transition to clean energy will reduce the most egregious impacts of climate change, more than offsetting costs for any outreach or missed tax revenue.

**Finance:** One option to incentivize adoption of clean energy is leveraging County taxes and associated policy to encourage utility customers to switch to clean energy. Any lost revenue can be offset with savings from net-metered, locally generated renewable energy and Community Choice aggregation savings (EPA, 2021). Staff should explore federal and state grants, awards, and loans such as those provided by multiple programs through the Department of Energy (n.d.). The Maryland Energy Administration (MEA) has the Clean Energy Rebate Program (n.d.-a.). Some solar developer financing options can be found at the MEA's Business Incentives page. (n.d.-b). LetsGoSolar provides a long list of Federal, State, and other funding sources (grants, loans, mortgages) for solar panel installation (LetsGoSolar, 2021).

**Recommended Actions:**

- Set the example by pioneering new, local, renewable energy generation on City and County properties (e.g. solar schools). Where on-premises generation does not make sense, purchase 100% renewable energy-sourced electricity for City and County properties from clean energy providers and aggregators.

- Partner with power companies to promote and incentivize the switch to clean energy through existing providers.

- Monitor the Community Choice Energy Aggregation Pilot in Montgomery County for potential future implementation in Frederick County, and promote adoption statewide.

- Aggressively promote existing programs such as the Green Homes Challenge and commercial Property Assessed Clean Energy (PACE). Pursue and publicize federal and state tax incentives to homeowners for energy conservation and clean energy sourcing for new construction and retrofits.

- Offer property tax incentives for residential solar PV or other renewable energy installations.

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## Technical Addendum to Recommendation 7: Community Choice Energy (CCE) Program

A Community Choice Energy Program enables an "aggregator" (which can be any form of local government, e.g., a county, city, or town) to procure electricity on behalf of their residents, businesses, and municipal accounts from 3rd-party suppliers. The role of the local electric utility (which in Frederick County is either Potomac Edison or the town of Thurmont) continues to perform its traditional tasks of electricity delivery and submitting a monthly bill that also includes the cost of electricity supply, as it has been doing for the past several years. Unless a utility customer has already signed a contract to receive electricity from a different supplier, the supplier of the electricity their local electric utility delivers was generated in hundreds of different power plants in the 13 states served by the PJM transmission grid, plus a small percentage generated locally in renewable energy systems located at homes, businesses, etc.

The electricity supplied to the homes and businesses of participants in a future Frederick County CCE Program will all have been conceptually (but not literally) generated from 100% carbon-free energy sources. The reason this is conceptually true is that, per contract terms, the same amount of kWh consumed each month by each CCE Program participant was (or soon will be) injected into the grid, and this electricity is guaranteed to be from a carbon-free energy source. Therefore, the "grid is greener" than it would have been if the program didn't exist because a smaller fraction of the total came from sources that release GHG to the atmosphere.

Although it would be desirable for the source(s) of electricity to be in Frederick County, the amount of clear open space that is needed is unlikely to be available, in part because the County limits the amount of prime agricultural land that can be used for non-agricultural purposes. Therefore, it is likely that there will be multiple sources of electricity for Frederick County's CCE Program located in Western Maryland and in Pennsylvania and Virginia, as well as possibly in other states.

The most difficult aspect of the initiative is the attempt to ensure that in future years the price charged for the electricity each participant consumes is as low as possible, and preferably is less than the average price the utility would have charged if the program didn't exist. Each supplier of carbon-free electricity knows the amount of revenue it requires in order to meet its financial objectives and stay in business, so it specifies in its contract that the price it charges will increase by some amount (currently, the annual escalation rate is about 1.5%, but the rate may be higher by the time the contemplated CCE Program can begin). It is possible that the average price that the utility will charge will increase at the same rate, but there is no way for anyone to know in advance what the utility's future charges will be (significant changes only occur after a utility requests the Public Service Commission to grant a rate increase, which requires public hearings).

Another challenging aspect is to what extent to allow new Program participants to enroll after the date when carbon-free electricity is first delivered to Program participants. Inevitably, new homes and buildings will continue to be built in the County and vacancies occupied. Also, some Frederick County citizens who initially opted out may change their mind and want to opt in. Another complicating factor is that some of the residents and businesses that the County will notify that their electricity supplier will be changed unless they opt out, will already be receiving electricity supply under a contract from a 3rd-party supplier. The contract will typically state that if the customer wants to terminate the contract, they must give an advanced notice prior to termination or a financial penalty will be imposed. The terms of the bill that authorized Montgomery County to offer a Pilot CCE Program stipulates that the County will be responsible for paying any such "Exit Charges" imposed by existing 3rd-party suppliers or solar-system providers under pre-existing contracts with Program participants.

## 8 Reinvest savings from energy efficiency projects toward more energy reduction

**Expected GHG Reduction or Climate Adaptation:** The cleanest, lowest climate impact energy is the energy that doesn't need to be used. Often referred to as a Negawatt (Lovins, 1990), a negawatt is a negative megawatt: a megawatt of power saved by increasing efficiency or reducing consumption. According to the American Council for an Energy-Efficient Economy (2019), energy efficiency can get us half-way to our 2050 climate and greenhouse gas emission goals. These savings can be recorded by public division heads and reported to the Climate Response and Resilience Office and to elected officials as requested.

**Timeline for Action:** Reinvesting savings should be an ongoing, continuous process that is always exploring opportunities, new technologies, and new methods for reducing energy usage. Progress could be tracked by reporting when these milestones are accomplished: 1) establishing official re-investment policies, 2) developing the tracking database (building types, current technologies in each, energy consumption, initial funds, funds remaining), and 3) finalizing a plan to assess/record installation of new technologies and energy consumption and educating the public about findings.

**Rationale:** Frederick City and County have been very active in improving the energy efficiency of government infrastructure and buildings. Building energy audits, lighting retrofits, and other activities have been effective in reducing energy use in public infrastructure. These efforts should be organized as an on-going project that continuously considers new opportunities.

Transparently documenting City and County transfers of savings and/or unused funds from completed energy efficiency projects to other climate-specific projects is ideal for encouraging similar behaviors by staff, citizens, and business owners for expanding community participation in building a more resilient City and County. It is leading by example (Recommendation 2), showing residents and business owners that wise and repeated use of available funds for ongoing protection of their properties, health, and immediate environment will prove most effective in ensuring local quality of life.

Building resilience and reducing GHGs are integral to achieving goals outlined in City and County planning documents and demonstrate good fiscal accountability. The draft City Climate Action Plan (City of Frederick, 2020) outlines considerable investment in City services and infrastructure to minimize climate impacts and hence, re-investment of savings and unspent energy efficiency funds for other City projects is consistent with shortening the time to ensure future resiliency. The Livable Frederick Master Plan (Frederick County, 2019) statements regarding the importance of preparations for 2040 also implicitly address climate-focused attention as the predicted impacts will worsen in the next two decades. Using any and all public funds saved through increased energy efficiency for additional projects to reduce climate impacts is a sensible approach to minimize and prevent reactive repairs and interventions in the future.

**Co-Benefits:** Repeated use of savings as well as excess funds from finished energy efficiency projects for other climate-specific needs expands climate adaptation locally. Those efforts not only save money (future inflation-driven cost increases are avoided), reduce GHG emissions, and better protect public health, while community resilience increases across City and County public and private infrastructure.

**Equity Considerations:** The use and re-use of every dollar focused on reducing climate impacts maximizes likely improvements and response capacities for underserved groups in the community. These savings can expand and provide transportation to and from cooling centers, subsidize utility payments, aid routine residential weatherization efforts, and guarantee public

transportation important for jobs and emergency services during local, major weather events. Continuous building of local climate resilience is essential and redirecting saved and unused funds to these efforts ensures that effort is maintained.

**Cost and Cost-Benefit Analyses:** There should be little fiscal impact on public funds. Reinvesting savings from energy efficiency projects into additional energy efficiency efforts will positively impact City and County budgets through reduced energy and maintenance costs as older, less efficient infrastructure is replaced. Continuously improving the City and County's infrastructure to be more efficient will also ensure greater resiliency in the face of climate disruptions and extreme weather events.

**Finance:** Securing external funds for several locally funded public services could allow greater use of local public revenues for climate-specific projects and, importantly, flexibility in use and reinvestment of savings or unused funds from a project to other climate needs that may not be allowed in many state and federal grants and awards.

**Recommended Actions:**

- Adopt a policy that cost savings from energy efficiency projects which exceed the cost of the project will be reinvested in other energy saving projects. These additional funds can be used to jump start projects with higher upfront costs and those where the savings are not sufficient to offset the implementation cost.

- Create an inventory of the types of energy consuming products used in municipal operations. This includes buildings, appliances, streetlights, mowers, etc. Determine the status of the energy efficiency of each product type as they are used (i.e. from manufacturer specifications, user experience, etc.), and as part of a routine replacement schedule, increase efficiencies as improved solutions become available.

- Frederick County should collaborate with all municipalities in the county to learn from each other on these efforts and negotiate group purchasing arrangements when possible. Public education about these efforts will also help businesses, institutions, and organizations learn about new technologies and replacements, and provide a model for ensuring future energy efficiency in all operations.

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## 9 Reduce greenhouse gas emissions associated with the electricity grid

**Expected GHG Reduction or Climate Adaptation:** Other recommendations address the GHG emissions reductions that can be achieved by installing energy efficiency measures and solar photovoltaic (PV) systems at homes and other buildings (Recommendation 6, etc.) from the point of view of the facility owners. This recommendation describes: 1) the additional GHG reduction benefit that these same actions achieve by reducing emissions associated with the electric grid, and 2) actions the City and County can take by joining with other counties and municipalities to advocate for state and federal government actions that will accelerate the further reduction in GHG emissions associated with the electricity grid. Tracking can be accomplished through listing GHG reductions that utilities have derived from these changes as well as specific state or federal actions that have become part of the region's energy network.

**Timeline for Action:** Outreach to leaders in other counties and municipalities to develop joint advocacy activities should begin immediately. Progress in these actions can be documented through listing meeting dates and outcomes from the external conversations, particularly any policies adopted by utilities to reduce GHG emissions.

**Rationale:** The rationale behind this recommendation is that two electric grids, **transmission** and **distribution**, are involved in getting electricity from power plants to customers in the City of Frederick and Frederick County. Operating at very high voltages, the **transmission grid** gathers electricity from more than 1,300 large- and medium-size power plants (many of them with multiple generating units) located in more than a dozen states (including Maryland and the District of Columbia) that extend from New Jersey to northern Illinois, and from southwest Michigan to northeast North Carolina. The **transmission grid** then delivers the electricity to more than 100 **distribution grids** and a small number of very large customers (e.g., major manufacturing plants, military bases, large federal government facilities) located in 13 states and the District of Columbia. This transmission grid is operated by PJM Interconnection LLC (PJM, 2021) and selects which power plants and other resources are eligible to supply power to the grid and provide ancillary services, such as helping to maintain the grid's alternating current (AC) frequency constant at 60 Hz as loads vary, and determining how much the power plants and other service providers will be paid. That process includes an auction every three years. Utilities that offer "negawatts" (i.e. power reductions) from the energy efficiency programs they sponsor may also be included as bidders. Once reliable criteria are satisfied, price is the only criterion for selection. Now, however, with GHG emissions a major concern, there are proposals to modify the selection criteria.

In addition to maintaining the transmission grid's frequency constant, PJM's major operational task is to ensure the grid is not overloaded by continuously controlling the amount of power each selected entity will supply to the grid to meet the constantly varying power demand at more than a thousand locations where distribution utilities and large customers are withdrawing power, metering all power flows.

Because of the interstate nature of operations, the Federal Energy Regulatory Commission (FERC) oversees PJM's operations and must approve all the rules and procedures it proposes before they take effect (FERC, 2021).

The **distribution grids** operate at multiple voltages and are owned and operated by distribution utilities, whose operations in any state or district are governed exclusively by an agency of that state or district government. The distribution grids then deliver power to individual customers, some of whom own or lease buildings in multiple locations (e.g. retail stores, fast-food and restaurant chains).

The distribution grid in almost all of Frederick County and in all or portions of other counties in the northwestern portion of Maryland is owned and operated by Potomac Edison, an electric utility that is a wholly owned subsidiary of FirstEnergy Corporation (FirstEnergy, 2021). An example of a local arrangement is Thurmont. The town owns the small electric utility that serves municipal facilities and the town's residents and businesses. Potomac Edison supplies the power under a wholesale contract. The operating rules that Potomac Edison and other large utilities in Maryland follow, and the rate structures that define the way monthly electric bills of customers are calculated, must be approved by the Maryland Public Service Commission (n.d.). Potomac Edison and the other Maryland distribution utilities are not permitted to generate any of the electricity they sell to customers, but federal and state governments have passed various laws that require the utilities to buy electricity generated from certain eligible renewable energy sources that are offered to them. These laws serve two purposes: 1) reduce GHG emissions associated with the electric grids, and 2) help to make on-site electricity generation from solar and wind energy more affordable. **In Maryland, there are three such laws:**

- **PURPA (Public Utility Regulatory Policies Act of 1978)** requires electric utilities to purchase all the electricity generated in a privately owned small power production facility (up to 80 MW and use an energy source or sources that in combination includes at least biomass, waste, or renewable energy). The price to be paid shall be the utility's "avoided cost," the value of which shall be determined by the state agency that usually performs this function.

- **Net Metering** (as defined in Maryland) requires electric utilities to give customers who self-generate power using solar PV systems a credit for any generation that exceeds the load imposed by equipment fed from the electric meter, and to deduct from the cumulative "banked" credit whenever the customer's electric demand exceeds on-site generation. At the end of each year, the utility must mail a check to the customer for any remaining banked credits. Because the law allows customers to oversize up to twice the amount of their average historic annual energy (kWh) usage, those customers who install oversized systems are likely to receive a check, as do those customers who install energy efficiency measures and thereby reduce their annual electricity usage.

- Maryland — like many other states — has a **Renewable Energy Portfolio Standard** law that requires all electric utilities to purchase sufficient Renewable Energy Credits (RECs) such that the aggregate MWh purchased corresponds to a certain percentage of the total MWh sold to customers in a given year (US Energy Information Administration, n.d.). Each REC is a certified statement that the seller is the owner of an eligible renewable energy system that has generated 1.0 MWh of electricity somewhere in the territory served by PJM's transmission grid, or has been transferred to that grid (Environmental Protection Agency, n.d.). The law defines two tiers of eligible renewable energy sources, with separate minimum requirements, and also specifies a set-aside amount for RECs produced solely from solar PV systems. If any utility fails to meet the requirements, they must make an Alternative Compliance Payment (ACP) that is deposited into the Maryland Strategic Energy Investment Fund (SEIF), used to issue loans and grants that spur the creation of new Tier 1 renewable energy resources in the state.

The smaller portion of electricity flowing to Frederick County customers is derived from the total amount of renewable energy that Potomac Edison purchased from customers and others, which is fairly "clean" (little or no emissions). It is not 100% clean because the portion generated by the combustion of waste or biomass fuels generates GHG emissions. The larger portion is derived from electricity supplied via the PJM transmission grid, which is not as "clean" but has been getting "cleaner" every year as the fraction produced from power plants fueled by coal and oil has declined.

The more self-generation using solar PV systems occurs, the larger the first 'clean' portion becomes

while the less clean part of the distributed energy declines. The second portion also becomes cleaner as a result of:

- decreases in the amount of electricity purchased each month by buildings and homes as a result of installing energy efficiency measures, thereby requiring less generation by power plants and their accompanying GHG emissions,

- increases in the power (MWh) generated by eligible renewable energy installations producing RECs that are sold to Potomac Energy and other distribution utilities to help them satisfy their Renewable Energy Portfolio Standard (a regulatory mandate to increase production of energy from renewable sources) obligations, and

- advocacy by the City and County in the form of testimony submitted to state and federal agencies in support of proposed changes to laws and rules that will result in reduced GHG emissions associated with the transmission grid.

That this effort for increasing 'cleaner' energy into the grid is working is evident through a recent summary by the Renewables Accelerator of the American Cities Climate Challenge (n.d.): "Despite the challenges posed by the COVID-19 pandemic and economic downturn in 2020, US local governments bought more renewable energy in 2020 than any year before, … . Nearly 100 cities and counties across 33 states completed 143 deals, adding 3,683 megawatts (MW) of renewable energy capacity." Multiple examples from cities across the U.S. can be examined on this website.

This recommendation is consistent with the objectives of City and County visionary plans because its purpose is to reduce GHG emissions, which will mitigate climate change impacts, protect human health, limit damage to public and private infrastructure, and expand the high quality of life that characterizes the area for many residents. *The Livable Frederick Master Plan* (Frederick County, 2019) states that strong commitment in the Vision for Our Environment: "We have been resolute and innovative in our efforts to reduce our contribution to greenhouse gas emissions, to sequester carbon, and to be adaptive and resilient in the face of the changes and challenges associated with our changing climate" (p. 177). Similarly, the City's 2020 Comprehensive Plan (City of Frederick, 2021) states in an implementation initiative, "Work in partnership with the County, State, and adjacent municipalities to reduce emissions and other pollutants from man-made sources" (p. 13-278). These goals are strong indicators of the intent of both governments to explore all power sources and ways to reduce their impacts on GHGs and associated climate impacts.

**Co-Benefits:** Reducing the GHGs associated with the energy grid decreases energy costs for all customers since clean, renewable energy is less expensive and is expected to decline in price as technology improves. The reduced emissions, in turn and through time, improve air quality, reduce extreme heat and storm events, and shorten droughts, thereby improving local conditions that protect rather than jeopardize public health and crop productivity, as well as minimizing likely flood damages in more modest storms.

**Equity Considerations:** All members of the public, particularly individuals and families with limited income, benefit from any decrease in GHG emissions through acting on this recommendation.

**Recommended Actions:** Frederick City and County officials should proceed as quickly as possible to join with other counties and municipalities to advocate for state and federal government actions that will accelerate the reduction in GHG emissions associated with both the transmission and distribution electricity grids, including proposals to 1) eliminate or significantly limit the eligibility of renewable energy sources that create GHG emissions to be sources of RECs, and 2) raise limits on the amount of solar generated through net-metering and community solar projects permitted in the state.

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## 10 Expand the installation and use of microgrids

**Expected GHG Reduction or Climate Adaptation:** Adding to existing grid resiliency or creating new ones is expected to pay significant future dividends (in both financial terms and reduced stress levels), as well as reducing GHG emissions. Assessing results can be done by tracking microgrids built and output generated.

**Timeline for Action:** Expansion of current actions to enhance resiliency at City and County facilities and in public and private institutions by the deployment of microgrids within the City and County should begin immediately, and should include workshops, hearings, and development of a plan for locating and funding the microgrids.

**Rationale:** The rationale behind this recommendation is based on the three key benefits of microgrids: 1) they improve the resiliency of the facility(ies) they serve, 2) they reduce monthly energy bills, and 3) they reduce GHG emissions and improve public health.

It is the unfortunate expectation that severe storms in all seasons — including tornadoes and hurricanes during hot weather — are more likely occurrences as a result of climate change. These weather events mean that the likelihood of localized electric grid outages are also more likely and, if an outage is widespread, may last from a few days to more than a week. The nearly statewide power outage in Texas in February, 2021 (Wood, 2021), should be a "wake-up call" for the nation.

For many, power outages are merely an inconvenience and for businesses a loss of income. However, they can be life-threatening for people at home and for those in nursing homes or hospitals where lives depend on a continuous supply of electricity to keep vital medical equipment functioning.

Microgrids can do this, as well as keep the lights on and keep all equipment functioning when power from the grid is lost, while simultaneously producing energy bill savings every day that power from the grid is available. Many homes, businesses, and other entities already have back-up generators powered by gasoline, fuel oil, natural gas, or propane that operate to provide electricity during power outages. Such generators are required for hospitals and some states require or encourage them for nursing homes, prisons, emergency shelters, convenience stores, and for gas stations along evacuation routes. They make economic sense for hotels, apartment buildings, and any facility that stores large quantities of frozen food.

However, back-up generators have two disadvantages: 1) they provide no economic value except when events occur that require them to operate, and 2) they may fail to run at some point before power from the grid has been restored. Microgrids are important because they have neither of these disadvantages - they are ultra-reliable and operate every day of the year, reducing GHG emissions and saving money for the facility owner. They typically consist of a solar photovoltaic (PV) system, a battery, one or more back-up generators (including all existing units), and a control system that continuously determines the extent to which each microgrid component and, when it is functioning, the power that the electric grid contributes to satisfying the host facility(ies) energy needs. They often also include a combined heat and power (CHP) system for the host facility. As with stand-alone solar PV and CHP systems, third parties are willing to invest in and own the microgrid system, take responsibility for its maintenance, and sell its electricity and heat outputs to the host facility for cost savings.

It is important to note that the economics of microgrids are highly site-specific. Microgrids that are economical elsewhere in Maryland may not be as viable in Frederick County, City, and other areas and other areas of Northwest Maryland because Potomac Edison's electricity price is much lower than that in most other areas of the state. It may be difficult for a third party owner to be able to make an offer to a facility owner that shows sufficient cost-savings to be attractive.

On the other hand, two additional factors should be kept in mind:

- A microgrid project for an emergency shelter may be eligible to receive substantial funding from state, county, and federal (e.g. Federal Emergency Management Agency) agencies if the shelter is located in an area of urgent need (e.g., near a major highway that is regularly impassable with heavy snows).

- The costs of solar PV systems and batteries are falling, and if a microgrid is not economically viable in 2021 or 2022, the economics may be much improved in a few years.

Microgrid energy supply is increasing in many cities and counties to support portions of these areas/communities. For example, microgrids service major educational institutions, such as the University of California, San Diego, New York University, Fairfield University, and Princeton University. Multiple defense installations have established microgrids (Wood, 2020) and a microgrid powers the Santa Rita Jail in Dublin, CA and an 81-acre high-density development in San Jose, CA (Wood, 2021). Hartford, CT installed a microgrid to provide cooling to jeopardized portions of their community (Gies, 2017). For the intense heat and flooding increasingly prevalent in this area, guaranteeing power to residents and services that protect them is critical.

**Co-Benefits:** Entities that install on-site energy efficiency measures and/or renewable energy-generating systems typically find that they are a cost-effective investment. Those who simply purchase electricity from renewable-energy systems installed by an entity that retains ownership for a period of years are generally also pleased to realize cost savings without incurring any capital outlay. And as noted above, protecting the health of local residents is ensured through these failsafe measures.

**Equity Considerations:** All members of the public will benefit from the decrease in GHG emissions that result from acting on this recommendation, but these benefits are of particular importance to lower income families, seniors, or disabled persons who frequently occupy substandard housing and may experience excessive utility bills, poor indoor air quality, and illness, all issues that reduced GHGs will help ameliorate. During major power outages, guaranteed power to the residents of low-income or affordable housing units should be mandated.

**Experience of Other Communities:** As is documented in the **Technical Addendum**, several other Maryland counties already have microgrids operating.

**Cost and Cost-Benefit Analyses:** This recommendation has zero cost, only benefits, when third-party financing is used, which is typically the case in other Maryland counties.

**Finance:** The National Association of State Energy Officials have produced the report, "Private, State, and Federal Funding and Financing Options to Enable Resilient, Affordable, and Clean Microgrids" (2021). Similar content is available from the Department of Energy (2020). Within Maryland, MEA provides funding as well, through its Resilient Maryland Program (2021).

**Recommended Actions:**

- Identify locations in Frederick County where microgrids would serve the County, The City of Frederick, or a specific community or municipality with improved safety and reliability, such as medical facilities, elderly housing, and emergency response locations such as fire and police stations, and shelters for travelers and nearby residents.

- Request funds from the MEA for a feasibility study(ies) for these projects, or move directly to soliciting competitive proposals from firms that have experience designing and building microgrids. Note that the MEA has only limited funds and must use them throughout the state each time it makes funding awards. It is unlikely that any county will receive more than one or two awards each year.

- Provide educational opportunities for business owners and residents to encourage the development and implementation of microgrids to improve resiliency.

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## Technical Addendum to Recommendation 10: Community Choice Energy (CCE) Program

Microgrids are designed to operate continuously, both when electricity is and is not available from the grid. For most, relatively brief interruptions in the supply of electricity is just an inconvenience, but geographically widespread and long-duration outages with roads blocked by ice and blowing snow, downed power lines, debris from a hurricane or tornado, etc., can quickly become major problems for police and fire departments and other emergency responders; those operating hotels and their guests; grocery stores; travelers in need of food and gasoline, diesel fuel, or a battery recharge; and all residents of the affected area. Hospitals, nursing homes, jails, and prisons typically have back-up power supplies because being without power for more than a few seconds to a few minutes is likely to be life-threatening, but when a power outage is widespread and extends for a long period, there may be some uncertainty about the reliability of the temporary power source unless it has some

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## Technical Addendum to Recommendation 10: Community Choice Energy (CCE) Program

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redundant backup. The redundancy of power sources is one of the major microgrid advantages.

Batteries are a valuable component in most microgrids that include a time-varying source of power, such as a solar PV system or one or more wind-driven generators, and they are necessary when the variable source constitutes a major portion of the microgrids' total power capacity. Although battery costs have been dropping, their cost would be unreasonably high if they are relied upon as a long-term source of power. The current cost when the kWh per kW or MWh per MW ratio is less than 5 is often reasonable — a smaller ratio would be less costly but if the ratio were twice as large, the cost is likely to be nearly twice as high, which may cause the microgrid to be uneconomical. The solution is to include a highly efficient and highly reliable source of power and heat (i.e. a CHP system backed up by another generator) in the microgrid to recharge the battery and provide a source of heat for the building and water heating.

In principle, a large microgrid could serve multiple co-located buildings and homes where each is a utility customer, but at the present time electric utilities do not permit this. Because microgrids are so new, Maryland and other states have not been asked whether this policy should be changed. Therefore, at the present time, with only rare exceptions, all microgrids in the U.S. serve only a single electric utility account. However, some large facilities, such as a university campus or military base like Fort Dietrick, that owns the wires and cables that distribute power to the various buildings at the facility and have only a single utility account, can and do serve multiple buildings from their microgrid. In addition, if two or more adjacent buildings or portions of a single building with separate utility accounts seeks a microgrid, this can be accomplished by electrically dividing the solar PV system into two or more groupings of panels, each with its own inverter and battery and serving only one building or portion of a single building with multiple electrical accounts. The heat output from a CHP system can be simultaneously delivered to multiple buildings or portions thereof, and the electrical output could be switched from building to building, or building-portion to building-portion, to charge multiple batteries.

### Microgrids in Maryland

For the past several years the U.S. Department of Energy has made available to the public a database listing all the CHP systems that are in operation in each state. Recently, it started noting which CHP system is a component of a microgrid. The latest listing for Maryland shows 8 CHP systems with a total capacity rating of 72.2 MW in this category. Two other installations with a 12.9 MW total rated capacity may be incorporated into microgrids. In addition, for the past few years the MEA (https://energy.maryland.gov/business/Documents/MEA-FY21-Resilient-Maryland-Award-List.pdf) has been supporting microgrid development in the state by providing funding grants to support microgrid feasibility studies and construction, including six of the CHP projects mentioned above. In June, 2020, MEA announced the award of a total of $1.05 M in grant awards for feasibility and preliminary-design studies for 14 potential microgrid projects in the state (Wood, 2020), one to District Farms in Frederick County for an agricultural project. In May 2021, MEA made a similar announcement, awarding $566,000 to 8 potential microgrid projects for feasibility and preliminary design studies. One of the awardees was the Jefferson Ruritan Club, which is considering a microgrid system that can serve both an emergency shelter at its Community Building and the self-contained Jefferson Volunteer Fire Department that is housed in a separate part of the same building structure.

## 11 Reduce solar soft costs

**Expected GHG Reduction or Climate Adaptation:** Reduction of the non-hardware portion of solar installation costs will help to further reduce the cost of solar energy, thus making this type of renewable energy even more attractive from a budgetary standpoint (Solar Energy Industries Association, 2019). This will help promote further growth in the use of solar power and help reduce greenhouse gas (GHG) emissions. Progress can be tracked by increases in solar installations across the City and County once cost reductions are implemented and announced.

**Timeline for Action:** Initiate regulatory change exploration and advocacy options in FY 2021 and 2022 and track through time noting meeting dates and outcomes.

**Rationale:** Already highly competitive, and now considered the "cheapest electricity in history" (Evans, 2020), the price of solar power can be reduced further by shrinking associated 'soft costs' [Fig. 1, Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE), 2016b]. These include labor hours, permitting and licensing, inspection and interconnection, installation processes, and solar developer company costs, including customer relations and marketing.

Some options for lowering costs include training of new labor, perhaps through modules developed by the solar industry and offered through the Frederick County Office of Economic Development; once trained, installation should be faster and hours worked lower, reducing costs. This would also

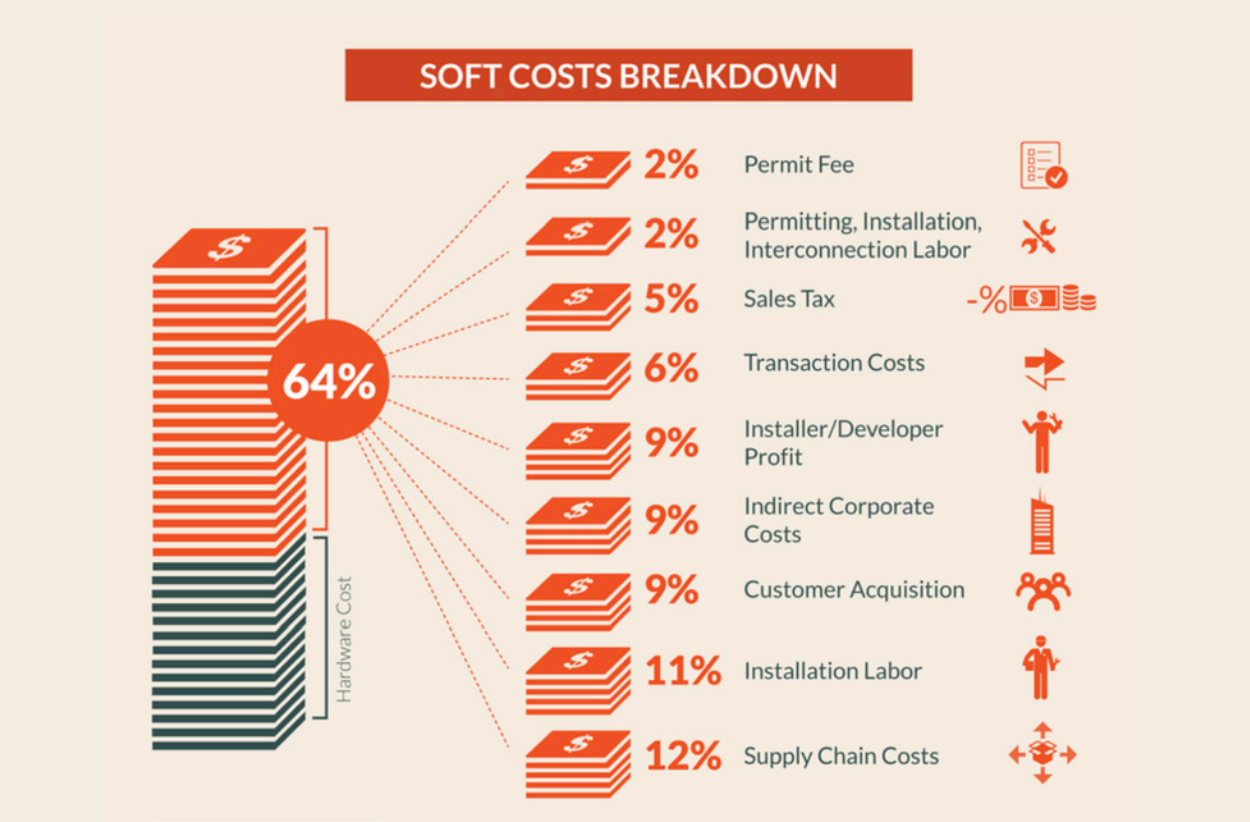


**Figure 1. Breakdown of 'soft costs' that make up 64% of the purchase and installation of solar systems in the U.S.** (EERE, 2016b)

reduce improper installation by less skilled workers and minimize future repair and maintenance costs. Training of others who also must know something of solar use, pluses/minuses, and layout, should also occur, including real estate agents, code officials, and firefighters. And, as solar energy demand increases due to the ever-increasing knowledge of the energy benefits from the technology, there should be less need for lengthy 'sales pitches' by industry representatives, thereby reducing company labor costs.

Some of these efficiencies have already been effected in countries where solar energy deployment is more widespread. Solar photovoltaic (PV) soft costs in Australia, for example, average just 25% of total system cost and only 15% in Germany, compared with 65% in the U.S. (Calhoun et al., 2014). From this analysis, the following interventions are suggested: "1. Optimizing the pre-installation process; 2. Redesigning the base installation process for asphalt shingle and tile roofing applications; 3. Utilizing integrated racking and mounting systems to reduce and eliminate non-value-add activities; and 4. Reducing the number of separate meters to monitor the PV system output." Progress is underway in the U.S. as well. With sponsorship by the DOE's EERE, teams in New York, California, Florida, and the Mid-Atlantic region have successfully developed solutions in three major areas — standardizing permitting and interconnection processes, facilitating bulk purchasing, and supporting online applications (EERE, 2016a).

To tackle these excessive costs, five New England states — Connecticut, Massachusetts, New Hampshire, Rhode Island, and Vermont — have partnered to pursue four broad objectives: "1) Increase coordination among participating states and with key stakeholders in those states; 2) Refine, combine, and deploy innovative tools and practices from Connecticut and Massachusetts Rooftop Solar Challenge I projects, and from other earlier efforts in those states and Vermont; 3) Implement other best practices more widely across the region, with a particular focus on achieving more consistent policies and practices across state lines; and 4) Communicate lessons learned and best practices beyond New England" (Hausman, 2014). Options include fiscal changes in a number of areas as well as examining zoning in the five states to reduce these costs (https://www.cesa.org/wp-content/uploads/RSCII-Progress-Report-August-2014.pdf).

This idea supports the 2020 City of Frederick Comprehensive Plan quality of life and sustainability vision (City of Frederick 2020, 1–32) while directly implementing the plan's Land Use Policy No. 7 (City of Frederick 2020, 2–78). Reduced PV system costs will also help implement the environment vision of the Livable Frederick Master Plan (Frederick County, 2019).

**Co-Benefits:** For urban and rural parts of Frederick, in addition to helping increase the use of renewable solar energy, and thereby reducing GHGs, the proposed changes will help reduce overall energy costs, saving money for electricity consumers. In rural, agricultural areas, cheaper solar energy could expand solar deployments for farm buildings, increasing future net income for the valued agricultural sector of the area.

**Equity Considerations:** Efficient solar energy has the potential to improve lives across the economic and demographic spectra, urban and rural. Flexible implementation options such as community solar and versatile on-premises solutions make it possible to support a very wide range of communities. The proposed changes will result in lower energy bills and thereby reduce economic burdens for all consumers. Improved air quality through fewer high ozone days will lower incidences of illness and lost work days.

**Cost and Cost-Benefit Analyses:** Most sources agree that in the U.S., roughly 65% of total PV system costs are 'soft costs' (e.g., Calhoun et al., 2014). Of these however, about 50% are outside the sphere of direct government influence (solar developer profit, corporate costs, customer acquisition, supply chain costs, labor, etc.; EERE, 2016b).

But City and County governments do have some leverage over permit fees (2%) and labor required for interconnection, permitting and inspection (2%). Local governments might possibly also exert some influence regarding sales tax (5%) and transaction costs (6%). In addition, reducing permitting delays

can indirectly reduce labor and overall costs, for additional impact (National Conference of State Legislatures, 2021).

Meanwhile, some advances, like the DOE 'Sun Shot' (DOE, n.d.) which inspired remote site assessment and remote design processes, can reduce labor costs (Aurora, 2019), as can integrated racking and metering, installation process optimization, etc. (Calhoun et al., 2014). Frederick City and County governments can help promote these innovations to further reduce costs.

Potential savings estimates for permitting vary from an implied 2-4% (EERE, 2016b) to roughly 20% (Aurora, 2019). For a fairly typical residential system with 6kW capacity costing approximately $18,000:

- A minimum 2% reduction would be $360
- More savings are possible, up to 6-8%, or $1,000-$1500
- Optimistic estimates place the savings even higher, 20% or more, or approximately $3600

**Finance:** Staff should explore Federal funding opportunities, available from the DOE, to identify, and refine process simplification and standardization possibilities. A first option would be the Solar Energy Technologies Office (https://www.energy.gov/eere/solar/funding-opportunities) for current funding opportunities. The DOE SunShot Initiative provides funds for reducing solar soft costs (https://www.energy.gov/eere/solar/sunshot-2030). Maryland has multiple solar incentives as grants, rebates, and tax credits, sumarized at https://www.solarenergyworld.com/maryland-solar-panel-install/2021-maryland-solar-incentives/. Broader approaches would be to promote MD state sales tax rebates and other incentives.

**Recommended Actions:**

- Reduce City and County permit and inspection fees for solar installations.
- Initiate application, permitting, inspection, and interconnection process simplification efforts.
- Explore funding opportunities with the DOE Solar Energy Technologies Office. Foster solar developer installation process improvement efforts.
- Expand Frederick County Office of Economic Development training modules for technologies associated with solar panel installation and maintenance.
- Support process standardization efforts through outreach to other cities and counties.

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## 12 Transition all bus fleets to electric and enhance ridership experience

**Recommendation:** Develop, announce, and begin to act on a plan to transition the County transit fleet and the Frederick County Public School (FCPS) bus fleet to all electric buses.

**Expected GHG Reduction or Climate Adaptation:** Shifting from diesel to electric buses will achieve significant greenhouse gas reductions. This transition should include a requirement that the electricity is 100% carbon free, adding to the overall GHG reduction and air quality improvement. Formally creating and announcing a transition plan will add to the demand signals already being sent to the market. Bus electrification has been proven and primarily needs scaled adoption to drive down capital costs.

The $CO_2$ reduction impact potential is substantial. According to an estimate from FCPS staff, pre-COVID–19, the FCPS fleet of 446 buses were driven just under 8 million miles each year, with an average fuel efficiency rating of 7.5 miles per gallon (MPG). According to the Environmental Protection Agency (EPA, 2015a), using a gallon of diesel fuel results in 22.44 lbs of $CO_2$ therefore the FCPS fleet's consumption of over 1 million gallons of diesel fuel produces almost 12,000 tons of $CO_2$ emitted annually. Progress against this recommendation can be measured by tracking electrified bus purchases over time.

**Timeline for Action:** Initiate and complete plans by the end of 2022 for both the transit and school bus fleet transitions to electric buses. These plans should include a date when replacement buses will all be electric, a timeline for the complete transition, and an analysis of the financial implications.

**Rationale:** The transportation sector has the largest share of greenhouse gas emissions in the U.S. with 29% in 2019 according to the EPA (EPA, 2015b). Significant reductions in greenhouse gas emissions from County bus fleets is not possible without electrification. Electric propulsion is much more efficient than combustion propulsion (O'Dea, 2018). The figure below shows the MPG equivalent emissions comparing diesel and electric buses; in our region an electric bus has three times better MPG than a diesel bus. Additionally, over time, the electric bus performs better as the grid gets cleaner, or as 100% clean electricity is adopted.

Electric buses are now important parts of many bus fleets in North America, from Houston (Mass Transit, 2021a) and Los Angeles (Royal, 2021) to Halifax, N.S., Canada (Mass Transit, 2021b). Frederick is also transitioning its transit fleet, with four new buses added to reduce 327,750 pounds of CO2 emissions (Maryland Energy Administration, 2020). Beverly, MA (School Transportation News, 2020) has committed to transitioning its fleet of 27 school buses to all electric and Montgomery County plans to electrify all of its school busses in 12 years (Doll, 2021). The importance of reducing energy and maintenance costs and emissions is driving substantial fleet changes everywhere.

The City and County have documented these transition goals for transportation. The Livable Frederick Master Plan (Frederick County, 2019) indicates the County's intentions. An initiative includes, "Support the expansion of the electric and alternative fuel vehicle fleet, including transit fleet vehicles, and explore the expansion of covered charging stations for fleet as well as private electric vehicles" (p. 101). Later, the Plan offers, "Future reductions will come from…more electric vehicles" (p. 182). The City Comprehensive Plan (City of Frederick, 2020) indicates, "Encouraging the adoption of electric vehicles…" as a commitment for the future.

**Co-Benefits:** There are several co-benefits in addition to the reduction in greenhouse gas emissions. Emissions from diesel engines result in higher air pollution emissions than other transportation fuels. Diesel exhaust is a key source of particulate matter 2.5 micrometers or less in size [(PM2.5); EPA, n.d.] which is increasingly found to be more harmful than previously understood. Numerous studies, including Xing et al. (2016), highlight the impact of PM2.5 on the human respiratory system.

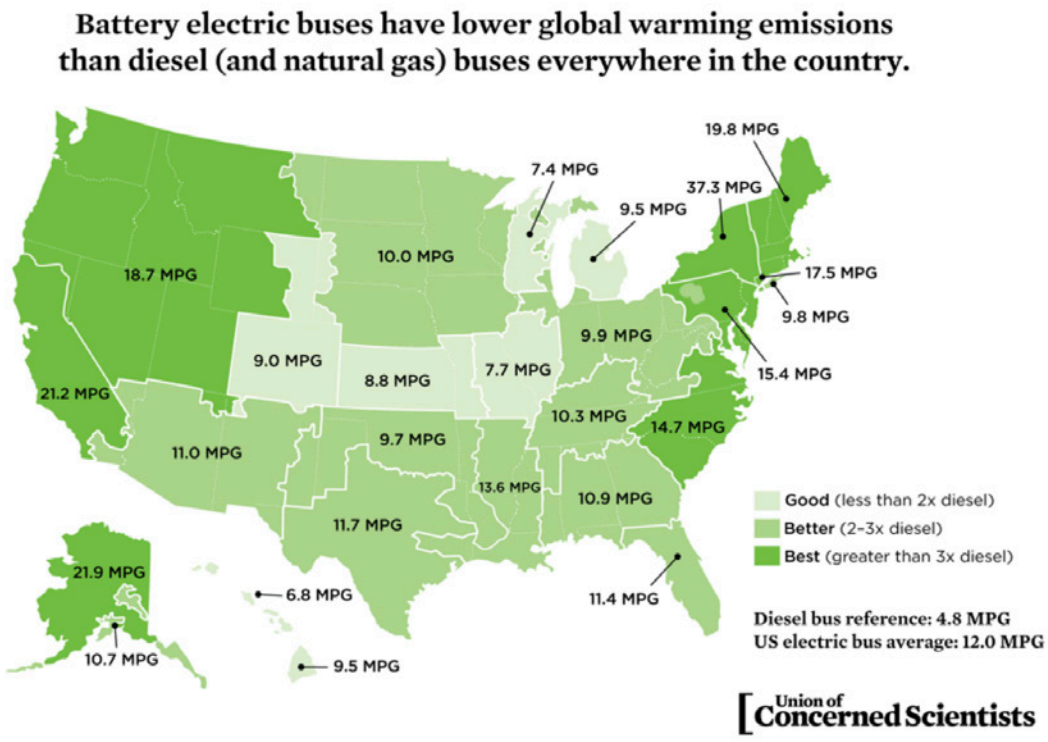


**Figure 1. Electric buses have lower emissions across the U.S. (O'Dea, 2018)**

Unlike smog and some pollutants, PM2.5 is very small, much smaller than the diameter of a human hair, and not visible to the human eye.

PM2.5 and other air pollution from diesel emissions leads to a variety of negative impacts to human health and higher healthcare costs. As noted in the American Lung Association Road to Clean Air Report (2020), exposure to ozone (derived from volatile hydrocarbons in exhaust plus heat) and particulate pollution is especially dangerous to children, seniors, people with health conditions, and lower income communities.

There are also long term financial and resiliency benefits to electrifying buses. Lower operating costs will improve the long term financial picture for transit systems and schools. With greater efficiency, grid demand would no longer climb year-to-year as it has in the past. By electrifying buses, this new load demand will be beneficial for sharing grid costs and providing for further expansion of renewables.

**Equity Considerations:** As noted in co-benefits above, there are many health benefits with the transition to electric bus fleets. This has important equity benefits since lower income groups tend to use bus transit at higher rates (Manville et al., 2018), therefore having greater exposure to the harmful effects of fumes from diesel buses as well as cumulative impacts associated with poor air quality and heat that accompany elevated GHGs.

**Cost and Cost-Benefit Analyses:** The operational costs (OPEX) of electric buses are lower than diesel buses (O'Dea, 2018). The challenge today is the upfront capital costs (CAPEX). Frederick County has already experienced operational savings with the electric buses it has deployed (Frederick County Staff, personal communication, n.d.). Casale & Maloney (2018) found that lifetime fuel and maintenance savings of electric transit buses are around $400,000 while lifetime fuel and maintenance savings of electric school buses

approximate $170,000. Maloney (2019) determined that electric buses for mass transit systems are cost effective. As deployment scales and purchase costs decline, electric transit buses will become even less costly.

**Finance:** A variety of grants are available to address the higher initial upfront costs of electric buses. Sources include the state of Maryland (MD School Bus Replacement Program), federal funds (e.g., U.S. Department of Transportation Low or No Emission Vehicle Program - 5339(c) grants), and Volkswagen DieselGate settlement funds ($25 billion; Parloff, 2018). When considering financing, the full lifecycle costs should be considered. Although electric bus purchases today are more expensive from a CAPEX perspective, they have lower OPEX costs over the life of the vehicle in addition to the climate and health benefits.

School buses have some unique possibilities for financing or added revenue generation. Most of a school bus fleet sits idle during the summer months just when power demands increase to meet air conditioning needs. Using the batteries in a group of school buses as a virtual power plant, charging them at night at times of low demand, and discharging them to the grid during the day at times of high demand, can have several advantages. For the power system, this can flatten the demand curve for electricity, reducing stress on the system and increasing resilience. For a school system, the arbitrage between the low-cost nighttime electricity rates and the high daytime peak demand rates can result in significant financial benefit. Note that a system like this requires planning and cooperation with local electric utilities. Pilots for Vehicle to Grid (V2G) systems with school buses are occurring: a V2G school bus project was implemented in White Plains, New York in the fall of 2020 (Morris, 2020).

The following cost scenario uses data from Pennsylvania Public Interest Research Group (Evans & Folger, 2021). While the electric school bus is more expensive in this scenario, this does not take into account various incentives, potential for V2G revenue, and future cost declines considering the longer operational life of the electric buses.

Pay-As-You-Serve (PAYS) programs are also available. Through these, electric companies provide upfront costs in purchasing electric buses and

| | Diesel School Bus | Electric School Bus |
|---|---|---|
| Purchase Cost | $ 110,000 | $ 312,600 |
| Fuel Cost Over 12 Years | $ 118,080 | $ 27,360 |
| Higher Maintenance Cost Over 12 Years | $ 52,800 | $ — |
| | $ 280,880 | $ 339,960 |
| Cost Difference | | $ 59,080 |

| Assumptions | | |
|---|---|---|
| Annual Miles | 12,000 | 12,000 |
| Fuel Cost / Mile | $ 0.82 | $ 0.19 |
| Annual Fuel Cost | $ 9,840 | $ 2,280 |
| Annual Higher Maintenance Cost | $ 4,400 | |

charge the transit authorities a fixed tariff on their electric bill. Utilities supply the additional electricity to power the buses and PAYS will allow transit authorities to leverage the limited public funds to buy more electric buses and transition to a zero emission fleet faster. Additionally, transit authorities can partner with local utilities to obtain beneficial rate structures to help save on charging costs and work to secure charging infrastructure investments.

**Recommended Actions:** Due to varying requirements, funding options, and other factors, separate transit and FCPS bus electrification plans should be created. However, it would be beneficial if FCPS and County staff worked together as knowledge is compiled and plans are developed. While current electric bus ranges do not meet all transit and school bus needs, this is not necessary for a transition plan. A migration to electric buses should be undertaken according to normal bus replacement/depreciation cycles. Current electric bus options can meet many existing uses with more viable uses over time.

- With nine electric buses in its transit bus fleet, Frederick County is moving forward on bus fleet electrification. The next step is for Frederick County to create a Transit Bus 100% Electrification plan by the end of 2022. Elements of the plan should include:
  - Date for no longer purchasing non-electric buses
  - Date for full transition of the bus fleet
  - Plan for powering the fleet with 100% carbon-free electricity
  - Identification of any unique use cases

- With two electric school buses on order, FCPS has taken the first step in electrifying the FCPS school bus fleet. The County should provide additional funding to FCPS for creating an FCPS School Bus Electrification plan within one year of receiving funding. Elements of the plan should include:
  - Date for no longer purchasing non-electric school buses
  - Date for full transition of the bus fleet
  - Plan for powering the fleet with 100% carbon-free electricity
  - Identification of any unique use cases
  - Exploration of use of creative financing options such as V2G technology.

- Facility Upgrades
  - All new/updated bus facilities that are built should include infrastructure for future charging needs. This includes the addition of charging equipment to cover short-term needs (i.e., buses planned for the next few years). It should also include infrastructure such as cabling, conduit, etc. to support a longer term full electric transition.
  - All bus fleet depots should explore and plan for the addition of as much on-site solar as possible to support vehicle charging.
  - The Transit and FCPS bus fleet systems should explore whether sharing bus fleet facilities between the transit and FCPS systems is practical. This could be accomplished during early days in the transition effort or over the long term.

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## 13 Transition light and medium duty vehicles to all electric

**Recommendation:** Develop, announce, and implement a plan to transition City and County light and medium duty vehicles to all electric vehicles. As part of this effort, develop the needed vehicle charging infrastructure and encourage residents and businesses to make a similar transition.

**Expected GHG Reduction or Climate Adaptation:** Significant GHG reductions can be achieved by shifting light and medium duty vehicles (LDV and MDV, respectively) to electric. This transition should be accomplished with the requirement for 100% carbon-free electricity for battery charging, adding to the benefit. For every 1 million fossil fuel-driven miles that move to zero emission electric, over 500 tons of local CO2 would be saved annually. This does not include the upstream emissions saved from not needing to produce, refine, and transport the gasoline/diesel fuel that was not used.

Formally creating and announcing a transition plan will add to the signals already being sent to the market to further stimulate demand for and production of these energy-efficient vehicles. Many vehicles in these classes are available today and even greater options have been announced and will be available soon. Progress can be monitored by tracking numbers of fossil fuel-powered government vehicles replaced with electric LDV and MDV after development and adoption of the replacement plans.

**Timeline for Action:** Plans should be completed by the end of 2022 for all relevant vehicle classes. Plans should include a date and/or criteria for when replacements will all be electric, a timeline for the complete transition, and an analysis of the financial implications. Note that there may be some special use case vehicles for which a detailed path is unknown at this time. This should not derail this effort and these cases can be handled by including criteria based on availability and feasibility of suitable models.

**Rationale:** The transportation sector is responsible for the largest share of greenhouse gas emissions in the U.S. with 29% in 2019 according to the Environmental Protection Agency (EPA, 2015b). Significant reductions in GHG emissions are not possible without electrification as electric propulsion is much more efficient than combustion propulsion (O'Dea, 2018). A key benefit of electric vehicles (EVs) is that over time their GHG reductions improve as the grid gets cleaner or as 100% clean electricity is adopted.

Shifting to EVs provides other benefits as well. Gasoline- and diesel-powered vehicles emit a toxic mix of fumes when in motion, when idling, and even when being fueled. Some are volatile organic compounds (VOCs) that are carcinogenic (Soni et al., 2018) and the VOCs and nitrogen oxides (NOx) from exhaust interact with heat to yield ozone (Zhang et al., 2019) and its respiratory problems; NOx is also deposited on terrestrial and aquatic systems to increase eutrophication, algal blooms, and associated health problems (Paerl, 2008). Diesel exhaust includes minute particulates (PM2.5), which cause severe respiratory distress (Xing et al., 2016).

California (all vehicles) and New Jersey (85% of LDV) have set deadlines of transitioning to all electric vehicles by 2030 and 2040, respectively (Cui et al., 2020).

The City and County have documented their commitments for this transition. The Livable Frederick Master Plan (Frederick County, 2019) indicates the County's intentions. An initiative includes, "Support the expansion of the electric and alternative fuel vehicle fleet, ... and explore the expansion of covered charging stations for fleet as well as private electric vehicles" (p. 101). Later, the Plan offers, "Future reductions will come from…more electric vehicles" (p. 182). The draft City Comprehensive Plan (City of Frederick, 2021) indicates a similar goal, "Encouraging the adoption of electric vehicles…" and hence, both governments see EVs as a substantial investment in the future.

**Co-Benefits:** There are several co-benefits in addition to the reduction in greenhouse gas emissions. The most important are the health benefits due to the zero tailpipe emissions of electric vehicles, thereby eliminating the public health threats described above for gasoline- and diesel-powered vehicles. Because many of the lower income members of the community constantly cope with managing limited resources for basic living needs (rent/mortgages, utility payments, insurances, food), improving air quality through reducing vehicular GHG emissions reduces the ongoing issue of medical access and treatment that accompany GHG-generated extreme heat and large flooding events. EVs bring unique capabilities and options that will only increase as people become more familiar with them and as vehicle designers learn to take advantage of new designs not possible in vehicles with a combustion-based engine. Some examples of these benefits include:

- More interior space — Without a gasoline or diesel engine, and the related components such as exhaust systems, more of the volume of an EV can be useful interior space.
- Front trunks — Many fully electric vehicles have an additional "front trunk" under the hood of the vehicle where the engine would typically be found. This adds some useful extra storage space. A police officer can now remotely open the front trunk and allow a citizen to provide assistance and retrieve equipment. This capability will be available in many electric vehicles.
- On-board power — An emerging feature is providing power outlets so that an EV can power equipment. The new all-electric Ford F-150, scheduled to be available spring of 2022, will have multiple outlets for both 110 and 220 volt power. With charging equipment from Ford, it will also be able to provide power to a home or building. This has interesting possibilities for responding to power outages and extreme weather events.

**Equity Considerations:** As noted above, there are many health benefits with the transition to EVs, some which may ease ongoing threats to low income communities. Therefore, air quality improvements will be greater for this portion of the population relative to other groups.

**Cost and Cost-Benefit Analyses:** The operational costs (OPEX) of an EV are generally lower than of a non-electric vehicle. The challenge today is the upfront capital costs (CAPEX); however, these are rapidly decreasing. The following chart compares the fuel and CO2 impact of gasoline-powered vehicles vs. EVs. This does not include the added savings from reduced maintenance for EVs (no exhaust system, no

| | | | | | |
|---|---|---|---|---|---|
| **CO2/Gallon of Gasoline:** | 19.6 lbs | | **Miles per Year:** | 12000 | |
| **Grid Mix CO2/kWh:** | 1.18 lbs | | **Miles/kWh:** | 3.5 | |
| **Gallon of Gasoline Cost:** | $ 2.75 | | **kWh Cost:** | $ 0.07 | |

| | MPG | | | EV | |
|---|---|---|---|---|---|
| | 15 | 25 | 35 | Grid Mix | CO2 Free Mix |
| **Gallons or kWh** | 800.0 | 480.0 | 342.9 | 3428.6 | 3428.6 |
| **CO2 lbs** | 15680.0 | 9408.0 | 6720.0 | 4043.0 | 0.0 |
| **CO2 Tons** | 7.8 | 4.7 | 3.4 | 2.0 | 0.0 |
| **Yearly Fuel Costs** | $ 2,200.00 | $ 1,320.00 | $ 942.86 | $ 243.60 | $ 243.60 |
| **Yearly Fuel Savings for an EV** | $ 1,956.40 | $ 1,076.40 | $ 699.26 | | |

| | Annual CO2 Tons Saved | | |
|---|---|---|---|
| **Yearly CO2 Savings vs Grid Mix EV** | 5.8 | 2.7 | 1.3 |
| **Yearly CO2 Savings vs CO2 Free Mix EV** | 7.8 | 4.7 | 3.4 |

**Notes:**
- Grid Mix CO2/kWh is for Frederick County MD
- kWH Cost is the average of Frederick County Commercial and Residential rates

**Figure 1. Yearly EV savings vs. gasoline vehicle**

tuneups, etc.). In Westport, CT, the police department found that the upfront cost premium for a Tesla Model 3 was about $15,000 more than the Ford Explorer that would normally be purchased. However, projected operational cost savings recovered this added cost in approximately four years (Koskinas, 2019). Many police departments are exploring all electric police pursuit vehicles with popular options being the Tesla Model 3, Tesla Model Y, and the Ford Mach E (John, 2021).

**Finance:** There are a variety of financing options available. Grants and related incentives are one option (e.g., Department of Transportation Low or No Emission Vehicle Program - 5339(c) grants), along with Volkswagen DieselGate settlement funds ($25 billion, Parloff, 2018). Leasing allows governments access to the value of federal tax credits that normally would not be available. The most important source of financing is the savings from operational costs.

**Recommended Actions:** Both Frederick City and Frederick County have begun purchasing several EVs and are working on some elements of these recommendations. The recommendations below will accelerate these efforts and set goals for 100% electrification of LDVs and MDVs. This is another opportunity for Frederick City and Frederick County to work together and to invite other municipalities in the county to participate in group purchasing, thereby lowering costs.

Create a plan, by the end of 2022, for 100% LDV/MDV electrification.

This plan should strive for no new purchases of non-electrified vehicles as soon as possible. EVs come in three categories: hybrid, plug-in hybrid, and full electric. While the goal is full electric vehicles, intermediate goals may include hybrids and plug-in hybrids.

For vehicle types without full electric options, intermediate steps should include increasing minimum value for miles per gallon of fuel.

With noted exceptions based on availability and feasibility criteria, a goal of only purchasing electrified vehicles starting in 2023 and only full electric vehicles starting in 2025 is recommended. In some use cases, even earlier deadlines may be feasible.

Infrastructure for charging each municipality's fleet from clean energy should be part of the plan and part of any upgrades to places where vehicles are parked/stored.

An education campaign should be initiated so that residents and businesses in the City and County can learn by example (see Recommendation 2) and are encouraged to electrify their own vehicles.

Electrification of heavy-duty vehicles, class 7 and 8, should also be explored. Specific recommendations for bus fleets are covered elsewhere in this document (see Recommendation 12). Since the nature of the work of this vehicle class generally involves heavy loads and not high speeds, the torque of an electric drivetrain can be beneficial. Early examples of vehicles such as garbage trucks and fire trucks are appearing on the market and are starting to be adopted.

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## 14 Support and promote telework

**Expected GHG Reduction or Climate Adaptation:** Telework reduces vehicle miles traveled (VMT) and therefore reduces GHG emissions from commuting to work. Additionally, reduced VMT can also reduce road congestion, which can also result in less traffic and idling of cars. Results can be tracked through surveys of local businesses (e.g., through collaboration with the Chamber of Commerce) to identify the number of employees and hours spent teleworking.

**Timeline for Action:** Telework policies should be explored and public policies, if warranted, implemented immediately. Progress can be documented through listing workshops and outcomes with business owners, and time and support required to establish any future policy.

**Rationale:** The COVID-19 pandemic brought telework into the mainstream of employment practices for many companies. The advent of teleconferencing software allowed isolated employees to communicate virtually and allowed businesses to continue to operate. After the pandemic ends, telework will still be a resource that businesses can use to attract employees and simultaneously address climate change.

Telework strategies have an immediate benefit by reducing auto commuting trips by significant numbers. Between December 1, 2019, and March 31, 2020, there was a 30–40% drop in VMT in Los Angeles and Ventura counties according to Institute of Transportation Engineers (n.d.) data. Similar data were noted for Denver (Eshelman, n.d). The drop in vehicle miles traveled was experienced through the County during the pandemic. This is a benefit that impacts climate change by reducing auto-related pollution. Figure 1 provides the average reductions in traffic volumes in the Metro Washington, D.C. region due to the pandemic.

The magnitude of the decline in emissions from reduced VMT seems obvious, i.e. less gasoline consumed and hence lower CO2 generated. However, there is considerable debate on the net change in GHGs due to cooling and heating, multiple small local trips, and daytime energy consumption in the telework site (Larson & Zhao, 2016; Cerqueira et al., 2020; Hook et al., 2020) but even small reductions in emissions are regarded as a necessary step for the changes in fossil fuel consumption needed.

The net effect on energy use from increased telework is complicated to estimate. The key is understanding the impact on office vs. residential building energy usage. While home energy use can increase with telework, office energy use should decline. Office declines would be less significant during the pandemic-induced telework since the offices did not go away, compared to planned, systemic telework, which should result in smaller office spaces and lower energy use. Home energy

| Month and Year | Percent change in traffic volume from prior year |
|---|---|
| January 2020 | +3.8% |
| February 2020 | +2.4% |
| March 2020 | –21.9% |
| April 2020 | –50.5% |
| May 2020 | –37.5% |
| June 2020 | –25.5% |
| July 2020 | –19.8% |
| August 2020 | –19.2% |
| September 2020 | –18.5% |
| October 2020 | –17.4% |
| November 2020 | –18.5% |

**Figure 1. Monthly Average Percent Change from Equivalent 2019 Month Regional Traffic Volumes Washington Metro Region (adapted from Meese, 2021).**

Source: Metropolitan Washington Council of Governments Transportation Planning Board (Meese, 2021)

use increases should not be automatic nor large and will depend on several factors, such as whether or not there are already people at home during the work week, and the energy efficiency of the home. Someone who teleworks a significant portion of the work week may be encouraged to improve the energy efficiency of their home.

From an air pollution standpoint, telework should be a positive improvement. Reduced VMT from telework improves local air quality and reduces the number of pollution point sources (thousands of cars). Any potential uptick in building energy use (offices vs. homes) would result in emissions from fewer point sources with easier-to-apply pollution controls. It is also likely that some of the potential uptick in home energy use would be from clean renewable energy.

As the effects of the pandemic subside there will be a return to "business as usual" to a certain degree but telework will have to be part of normal operating procedures. There is no ideal model that is emerging yet concerning telework vs. in person, but some percentage of the work week will likely be done at home. The Livable Frederick Master Plan (Frederick County, 2019) supports exploration of telework and GHG reductions through its Transportation Initiative to, "Reduce greenhouse gas emissions tied to roadway congestion by working with regional employers to shorten or eliminate commute times by developing incentives for telecommuting, staggered work schedules, car and van pools, and shuttles for employees" (p. 195). The City Comprehensive Plan (City of Frederick, 2020) has outlined likely future increases in telework within the City, including broadband/internet needs (p. 1–45), and poses a similar commitment as noted for the County, "Work with partner jurisdictions and agencies to *support increased telework*, both by providing greater incentives for employers to adopt telework and by better advertising telework planning support" (p. 13–269).

**Co-Benefits:** In addition to reductions in VMT, telework aids families through increased flexibility, improves work/life balance via a reduction in time spent commuting, saves costs associated with commuting, improves air quality, and reduces GHG emissions, which will result in eventual regional public health improvements.

**Equity Considerations:** By reducing VMT, telework improves air quality, resulting in fewer illnesses associated with poor air quality. In addition, because many lower income individuals are employed in outdoor venues and jobs, heat-induced illnesses from the GHG-induced extreme heat events should decline as lower emissions lead to fewer extreme heat days, preventing lost days of work and income.

**Cost and Cost-Benefit Analyses:** Depending upon the nature of the organization, the infrastructure for remote work may already exist. Any needed increase or deployment of IT infrastructure to support remote work should be offset by reductions in needed office space. Therefore, from a cost perspective for governments and businesses increased telework should range from cost neutral to a cost savings.

**Finance:** The Coronavirus Aid, Relief, and Economics Security (CARES) Act provided 14 federal agencies with $4.6B in new funding, a portion of which will be used for telework and telehealth requirements (Rossino, 2020). Maryland has an Online Sales and Telework Assistance COVID-19 RELIEF Grant Program as well. For increasing connectivity, there is Emergency Broadband Benefit funding now available (https://www.fcc.gov/broadbandbenefit) and multiple federal agencies (e.g. USDA, Department of Commerce, Department of Education and others) have a number of grant and loan options (see https://broadbandusa.ntia.doc.gov/resources/federal/federal-funding for the extensive list).

**Recommended Actions:**

- Update City and County plans to increase telework options where it is feasible for each type of job.

- Adopt lessons learned during the pandemic and continue good practices that support remote access to government services, remote inspections, etc.

- Continue to assess broadband needs throughout the City and County and seek federal and private investments to improve access until 100% of residents have dependable service.

- The City and County Offices of Economic Development should encourage businesses to telework and create a Telework Directory of Business that features telework opportunities.

- Utilize the expertise and resources available through the state's newly created Office of Telework Assistance (https://www.billtrack50.com/BillDetail/1255345) to expand local telework options.

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### Helpful links for implementation

Federal News Network

One year into Covid, working from home is here to stay

Actually, remote working may not be the 'new normal' after all

The pandemic forced a massive remote-work experiment. Now comes the hard part

Working from Home — will we welcome the new normal? — The Oxford Student

Benefits of Maintaining Telework Policies — Local Government Commission

Appendix E: "Telecommuting: A Case Study in Public Policy Approaches"

The Promise of Telework

2020 ITE Developing Trends

## 15 Study the feasibility of electric rapid transit bus service

**Recommendation:** Study the feasibility, cost effectiveness, and impact of implementing electric Bus Rapid Transit (BRT) routes from the County to key high-volume commuting destinations. The initial target system would be to connect Frederick County to the Shady Grove Metro Station.

**Expected GHG Reduction or Climate Adaptation:** Implementation of BRT routes has the potential to remove many vehicles from the roads targeted for this system. The scope of the impact is not available without further study. Results will include a comprehensive report in two years outlining the feasibility for electric BRT, detailing ridership, GHG emission reductions, and cost savings.

**Timeline for Action:** Study efforts should be started immediately. There are many opportunities for grant funding in this area. However, these opportunities can have short lead times for applying. Being prepared for opportunities that occur is therefore very important. Steps forward include defining the project plan scope and funding the plan's completion.

**Rationale:** With transportation the second largest sector in Frederick County for greenhouse gas emissions, reducing vehicle miles traveled (VMT) and making those miles less polluting is key to addressing climate change. Additionally, road congestion worsens the climate effect of VMT as it increases greenhouse gas emissions. Congestion mitigation, traffic smoothing, and other techniques can reduce this impact (Barth & Boriboonsomsin, 2008).

While dreams of extending the DC Metro system to Urbana or Frederick persist, this is extremely unlikely to occur. BRT routes between downtown Frederick and/or Urbana and the Shady Grove Metro Station are much more feasible projects.

BRTs have been explored for societal benefits in mobility and climate impacts as well. Major U.S. cities with established BRT systems are found in CA, CT, OH, NM, OR, and PA (Global Traffic Technologies, 2019). For GHG emission reductions, using the International Energy Agency's (IEA) mobility model (2021), Trigg & Fulton (2012) noted that BRT's world-wide impact may lead to "...cumulative savings ... estimated to be 17–27% of CO2 emissions in the transport sector by 2050. Annual savings of CO2 emissions in the year 2050 are estimated to be in the range of 25–39%." The IEA projects that "BRT can contribute substantially to global CO2 savings, potentially up to 0.5 GtCO2 cumulative in the 2010 to 2050 time frame" (Trigg & Fulton, 2012). After comparing emissions from BRT and private cars, Imam and Jamrah (2012) concluded,"... that the use of BRT systems resulted in significant reductions in CO2 emissions…". In Dublin, McDonnell, Ferreira, & Convery (2012) estimated that peak travel in a Quality Bus Corridor would reduce CO2 emissions by 50% vs. without the corridor. Hence, BRT systems offer substantial promise for reducing GHG accumulations.

City and County plans document commitments to improving access to the metropolitan Washington, D.C. area. For example, the 1991 I–270 Corridor Cities Transit Easement — Frederick County Extension Study (n.d.) in the Livable Frederick Master Plan (Frederick County, 2019) identifies BRT as a possible transportation improvement option, even more beneficial now due to electrified buses and low-emission hybrid buses that could be employed to reduce transportation-generated GHGs. The Livable Frederick Master Plan also identified a BRT route (Interstate Corridor) along I-270 that would stimulate mixed use development along the route. The option is described in the Initiative: Capacity Expansion to "Improve and expand capacity in our transportation and public infrastructure systems…" by "Support(ing) expansion and improvement of local and regional multimodal commuter options, especially efforts to provide commuter relief along Interstate 270 in the form of *Bus Rapid Transit (BRT)*,..." (p. 100). The City

Comprehensive Plan (City of Frederick, 2020) also supports a similar effort: "Enhance transit options including: Bus Rapid Transit (BRT) from Frederick to Gaithersburg, Shady Grove, North Bethesda, and Tyson's corner (along I-270)" (p. 10–234).

**Co-Benefits:** The BRT reduction in personal vehicles on roads would eliminate the air pollution (volatile organics, NOx, GHGs, and $PM_{2.5}$) from those vehicles with the associated health and environmental (e.g., water quality) benefits. With the use of electric buses, even more reductions and associated benefits would arise. Reduction in traffic volume and road congestion would improve every resident's quality of life.

**Equity Considerations:** Many low-income populations rely on public transit or have vehicles that are unreliable or costly to operate. A BRT system that connected County residents to the DC Metro system could open job opportunities for people without adequate transportation resources. Subsidized fees for low-income riders should be considered. Transportation-dependent people, especially those with disabilities who require ADA accessibility, have no reasonably affordable transportation options to points south of Frederick, and a BRT system would be advantageous in connecting them to jobs and cultural and social opportunities the rest of the population takes for granted.

**Cost and Cost-Benefit Analyses:** The costs for such a system would need to be determined as part of a feasibility study. As an option to reduce congestion on roads such as I-270, a BRT system would almost assuredly be less expensive and faster to implement than other alternatives such as light rail or monorail systems.

**Finance:** The Maryland Department of Transportation offers Transit Innovation Grants to municipalities and transit systems in the state (Maryland Department of Transportation, n.d.). These grants can be used for a variety of activities including corridor studies, feasibility studies, and bus rapid transit corridors. There are also funding opportunities at the federal government level (Federal Transit Administration, 2021).

**Recommended Actions:**

Before any BRT system can be implemented, the feasibility and implementation details need to be studied. Below are recommendations for proceeding from study to possible implementation. As part of these efforts, Frederick County should work with Montgomery County and the Metropolitan Washington Council of Governments. The Montgomery County Department of Transportation has experience with BRT systems in their county (2021).

- Start with an internal study with staff and knowledgeable citizens. Use this effort to develop grant proposals for a full feasibility study.
- Commission a full feasibility study, with grant funding if available.
- Implement any BRT system that study efforts deem useful and cost effective.

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## 16 Facilitate the availability of renewable fuels for all vehicle types and home heating

**Expected GHG Reduction or Climate Adaptation:** Until technology advances and provides a future where all engines are powered by electricity, biofuels provide a bridge fuel that lowers CO2 emissions, a short-term approach many jurisdictions are taking to lowering emissions as a means for meeting interim GHG reduction targets. Biofuels are especially useful for existing vehicles that have many years of useful life remaining. Biofuels should be phased out as soon as clean, renewable energy and associated technology are available at a capacity to meet energy needs. GHGs should decline and reduce the associated impacts of extreme heat, major storms and flooding, and extended dry periods. Tracking can be accomplished through annual reporting of the shift to renewable fuels by numbers of gas stations offering biofuels and sales of biofuel to gas station customers, public fleets, local farms, and at the Frederick Municipal Airport.

**Timeline for Action:** Increasing contributions of ethanol in gasoline and using other renewable fuels in government and private vehicles, home heating, and aircraft should occur over the next five years. Progress metrics should include establishing the tracking database and working with City and County officials and state legislators to establish incentives to encourage renewable fuels in existing vehicles.

**Rationale:**

- *Heavy Duty Vehicles, Buses, Trains, Agricultural, and Other Equipment*

From delivery trucks to construction and farm equipment to long haul trucks to boat and locomotive engines, diesel (compression ignition) engines are likely to remain in use for a long time because they last for many years. At least a third of these engines are expected to be replaced by other drivetrains by 2035 (Clevenger, 2019; Hurd, 2019).

Renewable alternative fuel options for compression ignition engines include biodiesel, renewable diesel [hydrotreated vegetable oil (HVO)], hydrogenation-derived renewable diesel (HDRD), hydroprocessed renewable diesel (HRD), and several others. Possible alternatives also include co-processed diesel, straight vegetable oil (SVO), renewable dimethyl ether (rDME), ethanol, and lignin ethanol oil (LEO).

Each of these will have a different carbon intensity and varied environmental impacts. For example, biodiesel significantly reduces life cycle GHG emissions. Life cycle analysis using Argonne National Laboratory's GREET analysis found that greenhouse gas emissions for B100 (100% biodiesel) are 74% lower than those from petroleum diesel with similar values for its life cycle analysis of biodiesel from various sources (Alleman et al., 2016; Batres-Marquez, n.d.).

Renewable diesel has some of the largest lifecycle GHG reductions with a carbon intensity of about 30 compared to 102 for ultra low sulfur petroleum diesel (U.S. Energy Information Administration, 2018). This can vary depending on the feedstock and generally ranges from 50% to 85% lower than baseline petroleum-based diesel fuel (Leonard & Couch, 2017). Biodiesel or renewable diesel are most likely to replace petroleum diesel.

- *Light Duty Vehicles*

Light duty gasoline vehicles commonly use E10 gasoline (10% ethanol) as that is the main fuel sold in the U.S. Some fueling stations in the region offer E15 (15% ethanol) that, consistent with Environmental Protection Agency guidance (EPA), can be used in vehicles built in 2001 and later (EPA E15 Fuel Registration). However, some automobile manufacturers do not agree with these findings, in some cases even with 2021 model year vehicles (Renewable Fuels Association, 2021). Flex fuel vehicles can use blends of gasoline and ethanol up to 85% (Department of Energy [DOE]). E85 (Flex Fuel).

Because there is only one fueling station in Frederick City or County that offers E15 (Rutters), increasing the availability of E15 could lower the carbon

footprint of the vast majority of vehicles in the City and County. Only two retail stations offer E85 (Rutters & W Express).

Currently, most ethanol in fuel is made from corn. The latest report from the U.S. Department of Agriculture (USDA) indicates that corn ethanol's current greenhouse gas emissions profile is 39–43% lower than gasoline, with significant improvements on the horizon (Lewandrowski et al., 2020). Some light duty vehicles in the City and County and many long haul heavy duty vehicles use diesel fuel. It is possible for those to use up to 5% biodiesel (B5) or 100% renewable diesel as a complete replacement for petroleum diesel. Biodiesel up to 5% is considered an additive approved for all diesel engines, although some manufacturers approve biodiesel blends up to 20% (B20) for some engines (DOE, n.d.).

Frederick City and County also have major heavy duty and long haul vehicles and many light duty vehicles passing through on major highways and stopping to refuel.

Some light duty and heavy duty vehicles may also use compressed natural gas. Depending on the source of renewable natural gas, the carbon intensity can be negative, for example, when manure that would otherwise have emitted methane into the air is captured and converted to renewable natural gas (RNG; Sanchez, 2021).

- *Heating Oil/Fuel*

With regard to propane as a heating fuel, a study was done to explore a cost-effective approach to phasing out heating oil and coal in European Union Member States. The study determined that by tapping into the potential of liquefied petroleum gas (LPG) and BioLPG in rural areas, their policy targets could be reached at lower cost. They also emphasize the benefit of finding fuels that can be used in existing infrastructure (Future of Rural Energy in Europe, n.d.).

The graphic below summarizes those findings.

During discussions with several people who use heating oil and propane and with heating fuel providers, the lack of natural gas alternatives and cost of conversion to electricity come up. Renewable alternatives that can be used with existing infrastructure are preferred. Also mentioned, however, are questions about using renewable fuels that may "clean out" old tanks resulting in clogs and problems. Government programs might be needed to help mitigate transition expenses (Tobias, 2018).

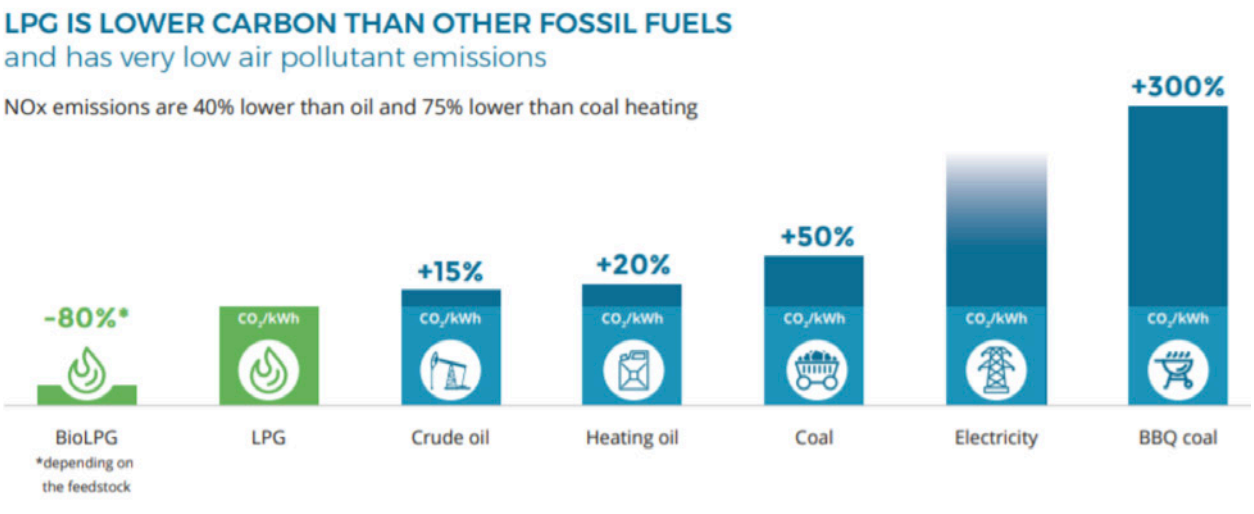


**Fig. 1. LPG vs other fossil fuels**

- *Aviation Fuel*

Aviation fuels are kerosene-based and GHG emissions are high. To reduce these emissions, sustainable aviation fuel (SAF) is being pursued. SAF is produced from sustainable resources such as waste oils from a biological origin. Signature Flight Support, the fixed base operator (FBO) for Frederick Municipal Airport, claims its Signature Renew SAF, certified for use in all jet aircraft, is an economical way to reduce aircraft carbon emissions by more than 25% (Signature Flight Support, n.d.). Signature has a company-wide global sustainability initiative that includes becoming the first FBO worldwide to offer a permanent supply of SAF, Jet A, to business aviation. However, Jet A SAF is currently offered only at San Francisco International Airport and London-Luton Airport and due to the extremely limited supplies, is not likely to be available for a number of years at other airports that are in locations that do not offer incentives.

As fuel producer, Neste, explains "As more states, such as Washington, New Mexico, and New York, progress and adopt clean fuel standards, Neste will be ready to move quickly and supply renewable diesel and sustainable aviation fuel into these markets" (National Academies of Sciences, Engineering, and Medicine, 2016; Neste, 2021a). The GHG impact also depends on the amount of petroleum fuel replaced. For example, by replacing a part of the fossil jet fuel with Neste's SAF on its flights departing from Helsinki Airport, Finnair will reduce its greenhouse gas emissions by 900 tons of CO2 equivalents (Neste, 2021b).

Avfuel Corporation reports that each truckload of SAF that they deliver to Monterey Jet Center will provide a 22 metric ton reduction in carbon emissions over the lifecycle compared to petroleum-based jet fuel—the equivalent of making five passenger vehicles zero emissions for one year (Avfuel Corporation, 2021).

Due to limited production of SAF for jet fuel, a Transportation and Climate Initiative (2021) suggests that the D910 fuel (blended for use in aviation reciprocating engines and meeting ASTM Specification D910 or Military Specification MIL-G-5572a) might be looked at as a fuel to be replaced by renewable fuel in the near-term, not only for carbon mitigation, but because it is a leaded fuel (for which there exist alternatives). The possibility of using E85 in these engines was suggested in conversations with a number of stakeholders and has been studied and considered by the aviation industry (Miller, 2013). Environmental justice benefits would accrue not only to the people working at the airfield and traveling in these planes, but to communities located near the airfield to prevent lead poisoning.

**Co-Benefits:**

*Biodiesel and Renewable Diesel:* Cleaner, less-polluting (Trinity Consultant and National Biodiesel Board, 2021; Skor, 2020; Clark et al., 2021), and less expensive (E85 Prices) options will benefit the health of residents, businesses, visitors and agricultural workers. In the transportation sector, benefits include a potential 45% reduction in cancer risk when heavy-duty trucks such as semis use B100 and 203,000 fewer or lessened asthma attacks (Trinity Consultant and National Biodiesel Board, 2021). Concerns about particulate matter and hydrocarbon emissions from diesel engines which may be toxic and/or carcinogenic are mitigated by use of biodiesel (Steiner et al., 2013; Bass et al., 2015; Shvedova et al., 2013).

Diesel exhaust contains substances that can pose a risk to human health and to the environment. Containing more than 40 toxic air contaminants (California Office of Environmental Health Hazard Assessment, 2001), the exhaust itself is a complex mixture of thousands of gases and fine particles. These include many known or suspected carcinogens and other harmful pollutants. Older diesel engines are substantial emitters of particulate matter (PM) and nitrous oxides (NOx), but relatively small emitters of carbon monoxide (CO) and volatile organic compounds (VOCs). New emissions controls reduce all types of emissions and pending U.S. regulations will reduce NOx potentially by another 90% (Chevron Corporation, 2007).

Other environmental impacts vary depending on the feedstock. For example, recycling used cooking oil for fuel keeps contaminated oil out of use and prevents it from being dumped into municipal sewer systems where it can cause clogs and additional expense for water treatment.

Renewable diesel can help improve air quality. Based on limited data, the California Air Resources Board (CARB, 2018) determined that RD100 can decrease NOx by roughly 10% when used in older heavy-duty engines that do not have state-of-the-art emission controls. Preliminary data also indicate renewable diesel can reduce particulates emitted from older diesel engines by about 30%. When used in newer engines or vehicles with diesel engines compliant with 2010 standards, the NOx and particulate reduction benefits are likely to be reduced significantly (GNA, 2017; California Air Resources Board, 2018).

In addition, the use of biodiesel and renewable diesel fuel results in improved lubrication, zero aromatics, and minimal sulfur output. It has a very favorable energy balance — the difference between the energy produced by one kilogram of fuel and the energy necessary to produce it — of 3.2 to 1. This means a gallon of biodiesel provides 3.2 times the energy it takes to produce it, which is a higher ratio than most alternative fuels (Gehm, 2021).

The Local Production for Local Use (http://vermontbioenergy.com/local-production-for-local-use-is-the-biofuel-model-that-works-in-vermont/#.VUKHOJNBGAU) model results in two products from one crop: oil and meal (animal feed or fertilizer). By growing oilseed and pressing the seed to extract the oil, farms are creating a valuable livestock feed at home, rather than importing it. The oil can be sold as a food product, or used directly in a converted engine or converted to biodiesel for use in a standard diesel engine. In this way, oilseed crops offer flexibility in the end-use of the products (Vermont Bioenergy Initiative, 2013).

*Heating Oil/Fuel:* Researchers found that switching to 100% biodiesel for home heating oil and transportation would annually bring the 13 communities studied 340 fewer premature deaths, 46,000 fewer lost workdays, and $3 billion in avoided health care costs. When Bioheat® (see below) fuel made from 100% biodiesel is used in place of petroleum heating oil, the study found an 86% reduced cancer risk and 17,000 fewer lung problems. The study also considered the economic cost of premature deaths, asthma cases, reduced activity due to poor health, and work impacted due to sick days (Trinity Consultant and National Biodiesel Board, 2021).

According to the U.S. Department of Energy, when biodiesel is used in boilers or home heating oil applications, NOx tends to decrease because the combustion process is different (open flame for boilers, enclosed cylinder with high-pressure spray combustion for engines; Alleman et al., 2016) .

In a March 17, 2021 announcement, the National Energy & Fuels Institute stated, “Renewable liquid heating fuels are already supplanting millions of gallons of conventional heating oil across the country; thereby increasing energy and environmental security, driving down greenhouse gas emissions, supporting rural economies and local small businesses, and avoiding expensive heating system conversions” (Fuel Oil News, 2021).

Bioheat® contains no nitrogen or offensive odors. When one uses biodiesel, NOx, CO, hydrocarbons, sulfur, and PM are reduced. B20 blends reduce $CO_2$ emissions by 15.66%. Pure biodiesel would reduce $CO_2$ emissions by 78%, nitrated polycyclic aromatic hydrocarbons by 80%, unburned hydrocarbons by 67%, CO by 48%, particulate matter by 47%, and sulfates by an impressive 100%. Bioheat® passes the EPA’s tier 1 and 2 health effects (http://www.healtheffects.org/Workshops/ACES2003/Costantini.pdf). The biodiesel Tier 2 testing reported no significant exposure-related effects on food consumption, mortality, neuropathology, reproduction, or ophthalmology. Bioheat® is non-toxic and is suitable for environments with children, seniors, and pets. Bioheat® also requires a higher temperature to ignite and burn than heating oil (Smart Touch Energy, 2016).

*Aviation Fuel:* Cleaner, less-polluting options will be available to those who fly in and out of the municipal airport. If the leaded fuel is replaced with less toxic renewable fuel, air quality improvement will benefit residents and businesses in the area as well (Miller, 2013)

*Ethanol:* A review of scientific literature suggests that ethanol-blended fuels result in less toxic emissions from vehicles and present a lower risk to human health than regular gasoline. The study,

a collaboration between The Hormel Institute, University of Minnesota, and the Energy Resources Center, University of Illinois Chicago, shows that gasoline containing ethanol produces lower emissions of toxic chemicals known to cause cancer (Mueller et al., 2021).

**Experience of Other Cities and Counties:** For specific examples of transition to renewable fuels by city public works fleets, see the experiences of Washington, D.C. and Ames, Iowa converting heavy duty vehicles to use B100 (100% biodiesel) using the Optimus System (Renewable Energy Group, 2021). Cities such as Oakland, California, have transitioned to renewable diesel with Richard Battersby, CAFM, CPFP, assistant director of Oakland Public Works saying, "Although at first renewable diesel seemed too good to be true, it truly has proven to be a 'miracle fuel.' Making the switch to renewable diesel is absolutely the easiest alternative fuel implementation I have ever experienced" (Schaeffer, 2020).

*Agriculture:* The Vermont Bioenergy Initiative suggests that the model developed in Vermont and described elsewhere in this recommendation has wider-reaching implications in that this can be replicated in rural farm communities across the U.S., although the specifics will vary (Vermont Bioenergy Initiative, 2013).

*Heating Oil/Fuel:* Since 2013, Rhode Island has had state legislation requiring renewable content in heating fuel with current legislation amending that to require up to 50% renewable content by 2030 (State of Rhode Island General Assembly, 2021). New York has had legislation since 2015 that "requires all heating oil sold for use in any building in Nassau, Suffolk, and Westchester counties on and after July 1, 2018 be bioheating fuel that contains at least five percent biodiesel" (The New York State Senate, 2017). Maine has been heating buildings with B10 since 2004. In 2009, Pennsylvania mandated that every gallon of on-road diesel sold in Pennsylvania must contain 2% biodiesel. In 2010, Connecticut signed into a law a requirement that all heating oil sold in the state contain less than 0.3% sulfur and at least 2% biodiesel.

In 2012, the New York City Council (https://www.smarttouchenergy.com/heating-oil/service-areas/new-york/nyc), with the assistance of the New York Oil Heating Association, mandated the use of B2 blend Bioheat® for oil-heated buildings. At the time, this decision resulted in the replacement of 20 million gallons of petroleum with an equal volume of renewable, domestically produced biodiesel. In 2014, New York City issued a mandate to utilize a B5 biodiesel blend for the city's fleet, and required a B20 blend from April to November beginning in 2016. The city plans to study the possibility of year-round usage of B20 for at least 5% of the city fleet. The city is also considering public biodiesel requirements that may impact private companies. Massachusetts may mandate that home heating oil contain 2% biodiesel (B2), and may eventually increase that number to 5% (Smart Touch Energy, 2016).

*Aviation:* Avfuel Corporation (2021) reports that each truckload of SAF that they deliver to Monterey Jet Center in California will provide a 22 metric ton reduction in carbon emissions over the lifecycle compared to petroleum-based jet fuel—the equivalent of making five passenger vehicles zero emissions for one year. As noted above, Avfuel considers SAF to be the most effective way to reduce a flight's carbon footprint; and, in the future, SAF could deliver up to 80% less greenhouse gas emissions versus traditional jet fuel if used in its neat form (AvFuel Corp, 2021). Also in California, Clay Lacy Aviation offers SAF at the company's two FBOs at Van Nuys Airport and John Wayne Orange County Airport. They have also transitioned to renewable diesel for ground support vehicles (Clay Lacy Aviation, 2021). As noted earlier, Signature's Jet A SAF is currently being offered only at San Francisco International Airport and London-Luton Airport (Signature Flight Support, n.d.).

**Interface with the Livable Frederick Plan and Frederick City Master Plan:** As the goals of the City and County plans are to become more energy efficient and reduce emissions, the recommendation is consistent with the objectives of both and should reduce costs and improve health of local residents.

**Cost-Benefit Analysis:** As Allen Schaeffer of Diesel Technology Forum located in Frederick explained, consumers of biodiesel and renewable diesel fuel will have to pay about the same for their fuel as regular petroleum diesel. Those looking for B20 will

typically pay about 21 cents less per gallon compared to regular petroleum diesel, according to the most recent data collected by the Department of Energy as of October 2019 (Table 1 below).

Since renewable diesel fuel volumes are lower than biodiesel, government agencies do not track prices as they do for biodiesel. Recent surveys of fleets that have made the switch to renewable diesel fuel report that they pay a 21-cent premium above petroleum diesel fuel. Much of the fluctuation in price reflects change in demand. With more interest and demand for the fuel, survey respondents expect that price fluctuation will even out (Ernst, 2020; Schaeffer, 2020).

Because California and other states have enacted low carbon fuel standards or clean fuel standards or policies, fuel producers of limited quantities of renewable diesel are selling into those markets due to the advantage of their incentives. Until more production facilities are built, and unless Maryland also adopts incentive programs for renewable fuels, renewable diesel sources will be limited.

Ethanol blends and biodiesel do not have the same production limitations. Use of higher ethanol blends should result in fuel cost savings as higher ethanol blends, up to E30, "the Sweet Spot," do not show significant mileage decrease. Depending on local prices, using E85 may also save fuel costs (E85 Prices). Research done by DOE on optimizing engines and fuels may result in engines that run more efficiently on higher ethanol blends (Jung et al., 2013; EPA, 2021).

| Region | B20 prices ($/gal) | Diesel prices ($/gal) | Price difference* |
|---|---|---|---|
| New England | $2.74 | $3.14 | -$0.40 |
| Central Atlantic | $2.64 | $2.89 | -$0.25 |
| Lower Atlantic | $2.52 | $2.93 | -$0.41 |
| Midwest | $2.90 | $2.95 | -$0.05 |
| Gulf Coast | $2.78 | $2.69 | $0.09 |
| Rocky Mountain | $3.03 | $2.91 | $0.12 |
| West Coast | $3.25 | $3.89 | -$0.64 |
| **National average** | **$2.87** | **$3.08** | **-$0.21** |

*Negative numbers represent average B20 prices that are lower than diesel, on a $/gal basis.

**Table 1. Biodiesel blends: Biodiesel (B20) relative to diesel**

The costs of Bioheat® are similar to traditional heating oil, although slightly lower. Even when price differences are not considered, Bioheat® burns more efficiently and lasts longer due to the use of renewable energy components from soybeans and other plants. Bioheat® has the highest British Thermal Unit (BTU) content for any alternative fuel, containing 11% oxygen by weight (Smart Touch Energy, 2016).

Use of SAF will likely cost more. As noted above, because California and other states have enacted low carbon fuel standards or clean fuel standards or policies, fuel producers of limited quantities of SAF are selling into those markets due to the advantage of their incentives. Until more production facilities are built and unless Maryland also adopts incentive programs for renewable fuels, SAF sources will be limited (Neste, 2021). Without financial incentives, there is a premium price for SAF.

Ethanol blends, similar to E85, to replace aviation gasoline do not have the same production limitations and could be priced lower than Avgas. For current comparisons, see these resources: AirNav.com and E85prices.com.

**Finance:** Many fuel retailers have used state funding and federal USDA funds (currently the Higher Blends Infrastructure Incentive Program) to upgrade tanks and pumps to be able to sell competitive higher blends of renewable fuels (USDA, n.d.).

All transitions to renewable fuels may pay for themselves with savings in fuel prices as described above. This is true for public transportation as part of City and County sustainability programs with funding from budgets appropriated for that purpose. Transitions to renewable fuels also should be part of farm sustainability programs, especially those that are encouraged or required by customers. Fleet transitions and shifts for aviation fuels to renewable fuels fall into this area as well, i.e., as part of City and County sustainability programs with funding from budgets appropriated for that purpose.

**Recommended actions:**

It is recommended that the City and County encourage the public and businesses to explore use of renewable fuels in existing compatible vehicles and building heating systems. It is also recommended that as soon as possible the City and County work with local fuel supply businesses (heating oil, aviation, and retail/wholesale gasoline and diesel suppliers) to increase the renewable fuel options available to private consumers as well as to businesses for fleets and equipment and for agricultural purposes. The City and County are encouraged to work as quickly as possible with civic, business, and agricultural organizations to provide consumer education, encouragement, and facilitation of implementation of renewable fuel. The City should quickly work with Signature to determine what actions would be needed to facilitate obtaining SAF at Frederick Municipal Airport. In addition, the City should work with owners of reciprocating engine aircraft to help them transition to renewable fuel options.

### Local Legislative Action

With regard to heating oil/fuel, legislation from other states and localities listed above should be studied as models for City and County legislation and for encouragement of state legislation. As noted above, priority for limited supplies of SAF is given to states that have low carbon fuel standards or clean fuel standards. As a member of the Transportation and Climate Initiative, Maryland is considering proposals related to a cap-and-invest strategy for on-road transportation fuels, but it does not include aviation fuels (Transportation and Climate Initiative, 2021).

California (California Air Resources Board) and Oregon (Department of Environmental Quality Action on Climate Change) have low carbon fuel standards and Washington state is in the process of implementing a clean fuel policy (Green Car Congress, 2021). Other states such as New Mexico, New York, and Minnesota are considering clean fuels policies (Biotechnology Innovation Organization, 2021), appropriate for Maryland.

### Administrative Action by City and County

Frederick City and County should explore use of renewable fuels in existing compatible vehicles and equipment as part of their sustainability programs.

#### *Obtain Sustainable Aviation Fuel for Sale at Frederick Municipal Airport*

The City airport managers and other City staff should:

- Meet with the FBO and local fuel suppliers to learn from their experiences complying with the referenced requirements for use of renewable fuels.
- Meet with airport users, managers, and suppliers to develop a plan to bring SAF, including unleaded aviation gasoline substitutes, to Frederick Municipal Airport.
- Obtain SAF for the airport.

#### *Encourage and Facilitate Commuter Rail Transition to Renewable Fuel*

- Dialog with MARC train officials on use of renewable fuels should be considered.
- The County and City should meet with local agricultural groups to encourage and facilitate use of more renewable fuel in agricultural equipment.

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## 17 Protect farmland and encourage local food production in developed areas

**Recommendation:** Implement policies and provide resources to 1) encourage the production of local food and support the preservation of 160,000 acres of productive farmland and 2) maintain at least 200,000 acres of total agricultural land or at least enough land to produce 50% of the food consumed in the County.

### Expected GHG Reduction or Climate Adaptation:

**Carbon Sequestration:** By broadly adopting healthy soils practices, Frederick County has the opportunity to increase soil organic matter (SOM) over time, pulling carbon from the atmosphere and acting as a carbon sink. Approaches to adopt healthy soils practices to increase SOM and other conservation or regenerative agriculture practices are described in more detail in Recommendations 19 and 20. The Livable Frederick Master Plan (Frederick County, 2019) set forth a goal of preserving 100,000 acres of farmland. The Maryland Department of the Environment Greenhouse Gas Emissions Reduction Act (2021) provides a set of 24 practices that may be implemented on Maryland's farmlands to reduce GHG emissions, ranging from 0.11 to 2.47 Mt $CO_2e$ per acre per year; the practices with the greatest reductions are those associated with high SOM concentrations. Hence, similar relationships, even with high variability, indicate that as SOM increases, GHG emissions should substantially decline.

**Water Holding Capacity:** Preserving agricultural land can provide significant flood mitigation by absorbing and holding stormwater in the soil, reducing flooding, erosion, and damage to infrastructure. Farmland has the capacity to hold 81,000 gallons per acre (assuming 3% SOM; Natural Resources Conservation Service, n.d.). For every 1% SOM is increased, land holds 27,000 more gallons of water per acre [United States Department of Agriculture (USDA), 2013].

**Food Security:** According to a number of studies, including the most recent food and agriculture review completed by the Metropolitan Washington Council of Governments (MWCOG) What our Region Grows (MWCOG, 2019), "agricultural production in the region does not fulfill food demand from the region's residents." Preserving farmland and encouraging local food production improves the reliability of the County's food supply, mitigating the impacts of food shortages or supply chain disruptions resulting from climate change [Food and Agriculture Organization of the United Nations (FAO), 2020].

**Economy:** Preservation of agricultural land supports a stronger, more resilient local economy, not just through the products produced and sold, but through support for local businesses supplying farmers and their families.

### Timeline for Action:

#### Short Term (12–18 months)

- Implement a reporting mechanism to tabulate the number of farmland acres preserved, estimated increases in carbon sequestration, estimated expansion of water storage capacity, proportion of food consumption produced locally, and carbon benefits. **Progress metric:** Resources and process identified to compile and report on progress.

- Adopt policies and practices to encourage County residents, businesses, and public institutions to purchase as much food locally as possible (see Recommendation 22 for proposed actions). **Results metric:** Percentage of County food supply produced locally.

- Allocate funding to perform an assessment of the financial impact of land-use changes to include food resilience, water quality, and climate change. **Progress metric:** Funding source identified, funding allocated.

- Adopt a resolution to restrict changes in land use from agricultural to non-agricultural uses until assessment is completed. **Progress metric:** Resolution drafted, presented, and passed.

- Conduct analysis to identify highest-priority farmlands for preservation. Include contiguous smaller parcels in order to meet acreage thresholds for some preservation programs. **PROGRESS METRIC:** Resources identified to conduct analysis; identification of parcels that are candidates for preservation.

- Establish partnerships with non-profit land preservation groups such as the Catoctin Land Trust (n.d.), The Nature Conservancy, etc. **PROGRESS METRIC:** Resources identified, partnerships established. **RESULTS METRIC:** Acres of farmland preserved.

- Increase the Agricultural Land Preservation goal from 100,000 to 160,000 acres. **PROGRESS METRIC:** Process identified to update preservation goal, change presented and approved. **RESULTS METRIC:** Acres of farmland preserved.

- Evaluate feasibility of carbon banking programs to provide income to farmers following healthy soils practices. **PROGRESS METRIC:** Resources identified to conduct analysis, opportunities to join regional programs identified, timeline developed, proposal created.

- In partnership with the Frederick Office of Economic Development and MD agriculture extension service, increase awareness of LandLink and other programs to link beginning farmers with available land. **PROGRESS METRIC:**Develop communications plan. **RESULTS METRIC:** Number of farmers needing land matched with landowners.

- Meet with farmers to understand additional support needed to maintain viability of their farms (investment, marketing, business planning, labor etc.) while conducting strategic planning for Frederick County agriculture as per Recommendation 36. **PROGRESS METRIC:** Resources identified to facilitate discussions; outreach program created to maintain dialogue between farmers, the Office of Economic Development, and other key stakeholders.

### Mid Term (18 months–5 years)

- Establish funding for a sustainable agriculture working group composed of farmers, conservation groups, agricultural extension, and County sustainability and economics resources to monitor health of the County agricultural economy, adoption of sustainable farming solutions, and progress against climate mitigation goals (Recommendation 18). **PROGRESS METRIC:** Funding allocated, key stakeholders identified, and communications channels established.

- Develop and implement recommendations developed through meetings with farmers as described above. **RESULTS METRIC:** Number of farms preserved; number of active farms in the County.

- Work in partnership with existing land trusts to protect at least 160,000 acres of agricultural land. **RESULTS METRIC:** Total acreage of land preserved.

- Evaluate and implement incentives to protect land for urban agriculture (tax incentives, easements, lease backs, etc.). **PROGRESS METRIC:** Evaluate examples of urban agriculture incentives, develop a proposal for Frederick.

- Expand the Agricultural Preservation program to fund additional acreage and to include smaller farms and more diverse farm types (for example equestrian facilities). **PROGRESS METRIC:** Updates to program drafted, reviewed, and approved. **RESULTS METRIC:**Total acreage of land preserved.

- Implement a tax credit for urban agriculture programs. **PROGRESS METRIC:** Legislation drafted and passed. **RESULTS METRIC:** Number of urban agriculture programs; amount of food produced through urban agriculture programs.

### Long Term (>5 years)

- Implement a Carbon Credit program to provide additional economic support to county farmers.

**Rationale:** Protecting and preserving Frederick County's agricultural land has the potential to reduce County greenhouse gas emissions by sequestering carbon in the soil, while also providing many other highly valuable co-benefits. Agriculture in Frederick County faces a number of challenges and potential opportunities. Farmers are already facing challenges to farming within the County as a result of more severe storms, droughts, flooding, and increasing temperatures due to climate change. In addition, agricultural land is under development pressure based on the County's proximity to two major metropolitan areas and the amenities offered by the

City and County. At the same time, interest in local food and concerns about security of the food supply are growing. Much of US produce is grown in a small number of states that are already being impacted by climate change (MWCOG, 2019; Reilly, 2021). County farmers have the opportunity to capitalize on the desire for more local food, increasing the local food supply, and strengthening the local agricultural economy (see Recommendation 22).

The FAO has developed a framework called climate-smart agriculture (CSA; FAO, 2013) that is composed of three main pillars:

- sustainably increasing agricultural productivity and incomes;
- adapting and building resilience to climate change; and
- reducing and/or removing greenhouse gas emissions, where possible.

It is useful to keep these three pillars in mind when considering all of the potential climate change mitigation opportunities and co-benefits afforded by preserving farmland and supporting local food production.

**Sustaining Agricultural Productivity and Incomes:** Preserving Frederick County farmland is largely dependent on an economy and food system that supports local farms to the extent that they are economically viable. If farming is not profitable, economic necessity drives the decision to sell land for residential or commercial development. Frederick County should encourage the growth of a robust local food system that provides reliable markets for County farmers (Recommendation 22).

Implementing healthy soils practices and other conservation measures also has the potential to improve the economic viability of County farms. These practices and their potential economic benefits are described in Recommendation 19.

Other measures such as Carbon Banking provide income based on amounts of carbon sequestered on farmland. The USDA has been exploring a number of options and pilot projects for carbon banking programs. The Food and Agriculture Climate Alliance has compiled a report detailing a proposed USDA carbon banking program (Food and Agriculture Climate Alliance, n.d.).

Maintaining agricultural land also means maintaining jobs — both on farm and in the local businesses that support farming.

**Building Resilience to Climate Change:** Frederick County has more farms than any other county in Maryland (Homegrown Frederick, n.d.), but only a small percentage of the food consumed is produced here (MWCOG, 2019). This leaves County residents vulnerable to food shortages and supply chain disruptions resulting from extreme weather events driven by climate change. As reported in the Washington Post, in 2021, the United States has seen price increases for tomatoes and tomato products as a result of the ongoing drought and excessive heat in California and other western states that has been exacerbated by climate change. According to the Post's reporting, there may be shortages of tomato products and other produce grown in these areas (Reilly, 2021). Detailed recommendations for building a more resilient local food system are provided in Recommendation 22.

The County should establish a goal of producing at least 50% of the food consumed by County residents locally. At present, very little of the food consumed in Maryland is grown in the state (Johns Hopkins Center for a Livable Future, 2015). Frederick County currently has approximately 250,000 acres of farmland, with just over 60,000 acres of that in some form of agricultural land preservation. The current agricultural preservation goal for the county is 100,000 acres (Frederick County, 2019). It is recommended that the County increase this preservation goal to at least 160,000 acres or more to ensure that there is enough land available to meet 50% of the County's food needs.

Urban agriculture, producing food in community and/or rooftop gardens in developed areas (USDA National Agricultural Library, n.d.), is another approach to building food resiliency, often in underserved parts of the community where access to fresh produce may be limited. The City and County should support the expansion of urban agriculture in the county as outlined in Recommendation 22.

Farmland also provides climate resiliency through the ability of agricultural land to retain and filter water. As the climate has changed, the frequency and intensity of severe rainfall and flooding events has increased. The Chesapeake Bay Foundation reported that EPA data showed a 70% increase in the amount of rainfall measured during heavy precipitation events in the Northeast between 1958 and 2012 (Chesapeake Bay Program, n.d.). Farmland has the capacity to hold 81,000 gallons per acre (assuming 3% SOM; Natural Resources Conservation Service, n.d.). Retaining stormwater mitigates downstream flooding, damage to infrastructure, polluted runoff washing into streams and rivers, erosion of waterways, and loss of valuable topsoil from land (American Farmland Trust, 2003).

**Reducing and/or Removing Greenhouse Gas Emissions:** Conserving farmland that is managed using healthy soils practices has been identified as one of the most important solutions to mitigate climate change. According to the University of Maryland's Dr. Sara Via: "Land-based carbon sequestration is (sic) the most practical & effective strategy to remove carbon from the atmosphere" (Via, 2018). The USDA Natural Resources Conservation Service (NRCS), in conjunction with Colorado State University (CSU), has created a tool called the Comet Planner that can be used to estimate the amount of carbon that can be sequestered in farmland managed using a number of different conservation practices (NRCS & CSU, n.d.).

Preserving farmland and increasing consumption of local foods also reduces greenhouse gas emissions by reducing the number of miles food has to travel to reach consumers. It may also reduce food waste caused by shipping. Food that is disposed of in landfills produces methane, which is a potent greenhouse gas. Additional details regarding food waste impacts on climate change are included in Recommendation 24.

**Connections to City and County Reports:** The Livable Frederick Master Plan establishes a goal of increasing agricultural lands in protection programs from approximately 60,000 acres in 2019 to 100,000 acres and retaining an overall agricultural land base of at least 200,000 acres (Frederick County, 2019).

Frederick County also developed an Agricultural Strategic Plan in 2008 that focused on the importance of agriculture in the county and recommended preservation of agricultural lands (ACDS, 2008). It is recommended that the County's agricultural strategy be reviewed and updated based on climate change impacts and mitigation needs as per Recommendation 35.

**Equity Considerations:** Preservation of existing farmland and expansion of urban agriculture offer many opportunities to increase diversity in the farming community. Expanding the pool of potential farm owners and workers will also help to address labor shortages often experienced in the agriculture sector.

Urban agriculture in particular has the potential to bring farming to communities that have not typically had the opportunity to grow food. It also brings fresh, nutritious food into communities that are often underserved by grocery stores and farm markets.

Additional details regarding equity considerations in farming are included in Recommendation 22.

**The experience of other Cities and Counties:** Montgomery County, Maryland expanded on their 1964 General Plan to create the Montgomery County Agricultural Reserve (Montgomery County, n.d.) in 1980. Despite intense development pressure coming from Montgomery County's proximity to Washington, D.C. and dense development in Northern Virginia, the Agricultural Reserve encompasses 93,000 acres and supports more than 500 farms. The Agricultural Reserve contributes millions of dollars to Montgomery County's economy while protecting the public water supply, providing tourism opportunities, and preserving access to open green spaces (Montgomery County, n.d.).

Lancaster County, Pennsylvania is another widely cited example of farmland preservation success. The Lancaster County farmland preservation program, initiated in 1983, is managed through a partnership between the Lancaster County Agricultural Reserve Board, the Lancaster Farmland Trust, and the Brandywine Conservancy. This group has successfully preserved over 100,000 acres of farmland (Daniels & Payne-Riley, 2017). The Lancaster Farmland Trust has a goal to

preserve double the amount of land currently under preservation, which would account for more than half the land zoned for agriculture in the county. In addition to conservation easements, the preservation program works with municipal officials to establish and maintain zoning and planning practices that channel development to areas already zoned for development. They also work with philanthropic organizations to provide funding to purchase development rights on agricultural lands (Lisi, 2021).

Urban Agriculture has been growing in popularity with many programs across the country. Baltimore, MD currently has both a city run program called Homegrown Baltimore (under the Baltimore Office of Sustainability) and a grower-led non-profit known as the Farm Alliance of Baltimore. The Homegrown Baltimore plan focuses on three components: Grow Local, Buy Local, and Eat Local. They work to provide resources and guidance to identify available land, improve access to water, ensure rich, safe urban soils, reduce financial barriers, and strengthen support networks (Baltimore Office of Sustainability, n.d.). The Farm Alliance of Baltimore is "a membership organization of urban farms, neighborhood growers, and friends." The organization has 3 full time staff members, 16 full farm members, 9 community gardens, and 7 individual members. The Farm Alliance was able to procure $103,500 in funding to support operations during COVID-19 and actually increased overall production in 2020. They plan to leverage the lessons learned in 2020 going forward in 2021 (Farm Alliance of Baltimore, n.d.). The Baltimore City Council enacted legislation in 2015 to implement tax credits for urban agriculture as allowed by a 2014 update to Maryland's Tax Code. Baltimore's tax credit gives urban farmers 90% off of their property taxes as long as the parcel is used for urban agriculture for 5 years, meets minimum production thresholds, and is not used for any other purpose that would normally subject it to property taxes (Baltimore Office of Sustainability, n.d.).

**Cost and Cost-Benefits Analyses:** There are two approaches to consider for agricultural land preservation. The first is to provide the infrastructure, training, educational, zoning, and marketing support that helps farmers earn a living from their agricultural enterprises. Successful farms are less likely to be sold for development. The second is to purchase conservation easements for farmland to ensure that the land continues to be used for agriculture and/or forestry and wetlands protection.

The Maryland Agricultural Land Preservation Foundation (MALPF), established in 1977, purchases perpetual agricultural conservation easements on eligible farmland throughout the state (MALPF, 2021). The state incurs costs of approximately $4,476 per acre when purchasing the easements (according to the MALPF annual report for 2020, 6 easements were purchased in Frederick County preserving 803 acres at a cost of $3,592,815 or $4,476 per acre, MALPF, 2020). Conservation easements on the additional 94,000 acres needed to reach the goal of 160,000 acres in this recommendation would cost $420,744,000 or $21,037,200 per year over the course of 20 years.

Although the up-front costs are significant, longer term benefits of maintaining farmland outweigh the cost of purchasing easements through:

- Lower infrastructure costs for farmland than for developed land
- Revenue from farm income
- Jobs created for farm workers
- Farm-related businesses
- Agrotourism
- Green infrastructure benefits (carbon storage, water storage and filtration, reduced air pollution, green space)

A hypothetical case study was completed by the New Jersey Farm bureau in 2014. In this scenario, the one-time cost to preserve a 250-acre farm was $672,350. Estimated infrastructure and community amenity costs and lost revenue associated with developing the same 250 acres was $1,751,300. Based on these estimates, the municipality would have saved $1,078,950 by preserving rather than developing the farmland (New Jersey Farm Bureau, 2014).

**Co-Benefits:** Preservation of farmland offers many co-benefits in addition to carbon storage and food resilience (American Farmland Trust, 2003).

- **Economic:** Working farms contribute to the economy through farm revenues, job creation, farm-

related businesses such as equipment suppliers, support for local businesses, agrotourism, and general tourism to protected open spaces.

- **Environmental:** In addition to crop-producing land, farms typically included forested stream buffers and wildlife habitat. Farms following conservation practices can store and filter significant quantities of water from rainfall events and help protect against erosion and water pollution. The Chesapeake Bay Foundation has identified farmland preservation as a key element in protecting the health of the Chesapeake Bay (Chesapeake Bay Foundation, 2007).

- **Cultural:** Agricultural land provides linkage to the county's agricultural heritage, Civil War history, access to scenic views, opportunities for recreational activities, and educational opportunities.

**Finance:** There are a number of state and federal land preservation programs that preserve land through conservation easements (Chesapeake Bay Foundation, 2007):

- MALPF (Maryland Department of Agriculture, n.d.)
- Maryland Environmental Trust (Maryland Department of Natural Resources, n.d.)
- Program Open Space (Maryland Department of Natural Resources, n.d.)
- Rural Legacy Program (Maryland Department of Natural Resources, n.d.)
- Farm and Ranchland Protection Program (Natural Resources Conservation Service, n.d.)
- USDA Farm Service Agency Conservation Reserve Enhancement Program (USDA Farm Service Agency, n.d.)

The 2018 Farm Bill includes the following programs (USDA Natural Resources Conservation Service, n.d.):

- Environmental Quality Incentives Program
- Conservation Stewardship Program
- Agricultural Management Assistance Program
- Healthy Forests Reserve Program
- Regional Conservation Partnership Program

Private land trusts, such as the Catoctin Land Trust (n.d.) work with landowners to preserve farmland in Frederick County.

Funding can also come from potential savings on existing programs. For example, if the actions in Recommendation 20 were implemented, cost savings from reduced maintenance on public lands could be used for farmland preservation or investment in infrastructure to support farm activities such as a value-added processing facility. Another example is provided in Recommendation 21 that would provide a fund established as an alternative for builders of small developments to meet stormwater mitigation requirements in certain cases.

**Recommended Actions:**

### Legislative

- Expand Agricultural Preservation program to fund additional acreage and to include smaller farms and more diverse farm types (for example, equestrian facilities).

- Evaluate and implement incentives to protect land for urban agriculture (tax incentives, easements, lease backs, etc.).

- Implement a tax credit program for Urban Agriculture.

### Administrative

- Implement a reporting mechanism to tabulate the number of farmland acres preserved, estimated increases in carbon sequestration, estimated expansion of water storage capacity, proportion of food consumption produced locally, and carbon benefits.

- Increase farmland preservation goal from 100,000 acres to 160,000 acres or enough land preserved to produce 50% of the food consumed in the County.

- Adopt policies and practices to encourage County residents, business, and public institutions to purchase as much food locally as possible (as per Recommendation 22).

- Allocate funding to perform an assessment of the financial impact of land-use changes to include food resilience, water quality, and climate change.

- Adopt a resolution to restrict changes in land-use from agricultural to non-agricultural uses until assessment is completed.

- Conduct analysis to identify highest-priority farmlands for preservation. Include contiguous smaller parcels in order to meet acreage thresholds for some preservation programs.

- Establish partnerships with non-profit land preservation groups such as the Catoctin Land Trust (n.d.), The Nature Conservancy, etc.

- Evaluate feasibility of carbon banking programs to provide income to farmers following healthy soils practices.

- In partnership with the Frederick Office of Economic Development and MD Agriculture Extension Service, increase awareness of LandLink and other programs to link beginning farmers with available land.

- Meet regularly with farmers to understand additional support needed to maintain viability of their farms (investment, marketing, business planning, labor etc.).

- Establish funding for a sustainable agriculture working group composed of farmers, conservation groups, agricultural extension, and county sustainability and economics resources to monitor health of the County agricultural economy, adoption of sustainable farming solutions, and progress against climate mitigation goals (Recommendation 35).

- Work in partnership with existing land trusts to protect at least 160,000 acres of agricultural land.

### Requests of State and/or Federal delegations

- Implement a statewide carbon trading program to provide carbon credits for farmland carbon sequestration.

### Community

- Buy local produce.

- Encourage restaurants, grocery stores, and City and County institutions to buy local as much as possible.

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## 18 Provide outreach and coordination to expand conservation practices on agricultural lands

**Expected GHG Reduction or Climate Adaptation:** Through expanded funding opportunities and implementation of funded conservation practices, multiple on-farm practices can be increased to reduce soil erosion and build soil organic matter, the latter important in sequestering carbon as well as increasing nutrient availability and below-ground water storage capacity as described in detail in Recommendation 19, thereby minimizing runoff and poor water quality in local waterways. Effectiveness can be measured by recording the number of farms reached through outreach efforts, and the increased use of best management practices (BMPs) on farms.

Soil has powerful carbon sequestration potential. If conventional tillage is changed to "reduced" tillage, nutrient management plans are followed, and cover crops are used, it is estimated that soil on the County's 188,500 acres of farmland will sequester 128,180 MT of $CO_2$ each year (Via, 2019). These practices build soil organic matter (SOM) as described in Recommendation 19. With a 1% increase in topsoil SOM, soil holds an additional 27,000 gallons of water [U.S. Department of Agriculture (USDA), 2013]. A 1% increase of SOM maintains corn yield production with a 50% reduction of nitrogen fertilizer (Via, 2019).

**Timeline for Action:** The first action would be to establish a coordinator position and job description within a year. This would include identifying the skills required for the staff member, posting a position announcement, interviewing, and hiring. Thereafter, year two on, the coordinator would work across County government divisions to enlist local staff, engage outside organizations and their representatives, and compile a list of funding sources that might be leveraged or combined to expand conservation practice awareness and implementation in the farming community.

**Rationale:** Frederick County farmers are State and National leaders in implementing conservation practices improving water quality and soil health. These practices combat factors impacting climate change. According to Dr. Sara Via, Maryland has more acres in cover crops and no-till as a percentage of farmland than any other state in the US (S. Via, personal communication, 2021). And, according to the Natural Resources Conservation Service (NRCS) District Conservationist, Frederick County farmers are implementing as many conservation programs as the rest of the State, combined (B. Cammauf, personal conversation, 2021). County farmers have been implementing healthy soil conservation practices for generations and have adopted practices as science and local experiences have shown new best farm management practices. In meetings/discussions with County Farm Bureau members, the County farmers continue to support the Maryland Department of Agriculture Healthy Soils programs identifying practices to improve water quality and build healthy soils. Over several stakeholder meetings, feedback was clear — more programs are not needed, but more training, education, and support for existing programs would be well received.

Conservation practices, frequently called best management practices, or BMPs, are tools that farmers can use to reduce soil and fertilizer runoff, properly manage animal waste, and protect water and air quality on their farms. These practices also have the potential to help improve a farm's profitability by reducing operational costs. According to the Chesapeake Bay Foundation (CBF, 2021), the five most cost-effective conservation practices are: streamside buffers, streamside fencing, nutrient management plans (NMPs), continuous No-Till, and cover crops. Several federal and state agencies and nonprofit organizations implement conservation practices on agricultural land in Frederick County. The most commonly tapped are the NRCS and the Catoctin and Frederick Soil Conservation Districts. These agencies use federal and state funds to share costs with farmers implementing conservation plans using a variety of BMPs and grant programs. The Chesapeake Bay Foundation and Streamlink Education, nonprofit organizations receiving grants

from federal and state sources, also implement programs, such as planting buffers and installing fencing for grazing pastures and to prevent cattle from entering streams. The County's Creek ReLeaf program also plants riparian buffers. The Maryland Department of Transportation funds contractors to implement stream restoration projects to offset erosion caused by highway construction. These programs are effective, and have much untapped potential, but do not have the resources needed to reach all farmers. To bridge this gap, several limitations could be addressed by increasing County investments in these practices. First, farmers have to know about them to tap these resources. The 2017 Census of Agriculture reports that 20% of farms in Frederick County did not have internet services (USDA, 2017). A need for more outreach to make sure farmers are aware of these programs was identified by area agricultural leaders in 2021 (CEMWG Farm Team Meetings, 2021). Another limiting factor could be farm size. Some programs only fund projects for farms over a certain acreage. The 2017 census reported that 54% of Frederick County's farms, a total of 734, are 49 acres or less, with 16%, or 214, under 9 acres. These farmers could either be ineligible, or too stretched for time, to seek out cost share programs that would benefit their operations.

Another limitation may be a lack of coordination and follow-through. These projects have multiple steps and take time to implement. A group of stakeholders in winter of 2021 identified follow-through, including training and education, as an issue, estimating that half of all farms in Frederick County have conservation plans, and half of those are not implemented (CEMWG Farm Team Meetings, 2021). The NRCS District Conservationist reported a three-year backlog of projects in the fall of 2020, simply due to lack of staff time to process and implement requests (B. Cammauf, personal communication, July 14, 2020).

Finally, there is no coordination of these multiple programs within the County. From time to time, these agencies work together informally, leveraging their resources for more impact, but there is not an expectation within the State or the County that they coordinate efforts. This can cause unnecessary and wasteful misuse of resources with less than optimal results. For example, a stream mitigation project was implemented that resulted in the removal of a riparian buffer made up of 20 acres of 30 foot trees installed on a farm by the CBF 12 years ago, a wasteful and unnecessary project (R. Schnable, personal communication, August, 2020). In some cases, farmers contact and rely on the NRCS to fix problems after consulting firms have completed projects even though NRCS was not included in the initial conservation project (B. Cammauf, 2020). Another common issue is that farmers are often in the position of working on a project with one agency and learning later that other, more long-term options were available to them.

The solution proposed for coordination is based on a model implemented years ago. Known as the Monocacy Catoctin Alliance, it operated regionally with a watershed focus. This proposal focuses on County-wide coordination. In such a scenario, all agencies listed above would meet once a quarter, describe upcoming project plans not yet underway, and identify opportunities for combining resources and coordinating efforts. For example, rather than a farmer limiting conservation efforts to one initiative, such as stream bank fencing, coordination may result in converting a field to pasture, and adding fencing for prescribed grazing, accomplished by leveraging funding of several agencies. Because nearly all of these options are voluntary for farmers, they would remain the ultimate decision makers about projects on their property. Quarterly planning and coordination of projects at a watershed level would enable the involved agencies to achieve greater conservation impact over time and more effective use of public funds.

Consistent with the Maryland Healthy Soils Initiative and regenerative agriculture principles, the potential for conservation practices to accelerate climate goals is very high. The five cost-effective BMPs listed above provide more resilience for the County in terms of soil's water retention capacity and cleaner water, and are much less expensive than other mitigation strategies. These practices improve soil health, an important factor in effective carbon sequestration. According to the Agricultural Census, No Till is used by 28% of the County's farms and cover crops by 20% of the farms in Frederick County (USDA, 2017), an indication of the great potential for expanding BMPs to achieve climate mitigation and

resilience goals through additional outreach.

Outreach programs are found throughout the U.S. to expand awareness of, familiarity with, and funding for conservation practices important to maintaining farm productivity, protecting soil health, and safeguarding water quality. The Foundation for Food and Agriculture Research (n.d.) is one example of an organization committed to increasing familiarity with a suite of programs and technologies to engage farmers in best management practice implementation. Because there are specific sub-groups within the farming community that receive and implement information differently, developing multiple outreach approaches to best address preferences and needs within this diverse community will be necessary (Upadhaya et al., 2021). Based on survey results, Lemke et al. (2010) noted, "that more intensive outreach efforts, such as one-on-one landowner visits, localized workshops, and tours, can increase adoption of conservation practices associated with cost-share programs" suggesting the more interactions the better for BMP implementation.

The Livable Frederick Master Plan (Frederick County, 2019) strongly emphasizes the importance of agriculture in the County's economy, efforts to maintain this critical industry in the area, and working with the farming community. Under Natural Resources and Green Infrastructure, an initiative on local agriculture states, "Support locally produced agricultural products and sustainable and innovative farming practices, such as regenerative farming, which build healthy, biologically active soil and protect water resources." Further, outreach to complete this initiative is found in, "1) Draw on State resources *to create or enhance an outreach and educational program* for farmers regarding new agricultural practices that increase soil organic matter and have less intensive chemical applications. Another outreach effort mentioned is "2) Create a farming community *information sharing network*" (p. 187). These are both commitments to communication with the farming community to continue agriculture's important role in the County for production, land use/new technology applications, and water quality.

**Equity Considerations:** Small farmers managing less than 49 acres of land make up 54% of farms in Frederick County and only 2.4% of the County's 2,416 farmers are Black, Hispanic, and/or Asian (USDA, 2017). An effort intended to engage smaller, less connected farms may reach those who traditionally "fall through the cracks" and help them gain access to conservation projects they are otherwise ineligible for or unaware of.

**Cost and Cost-Benefit Analyses:** The County has responsibilities for meeting Phase 3 Watershed Implementation Plan (WIP III) goals and Municipal Separate Storm Sewer System Permit (MS4) requirements. Public data (Sellner & Ferrier, 2020) show that nitrogen concentrations in the Monocacy River double as the river passes through Frederick County, with agriculture as the largest of several nitrogen sources (Chesapeake Bay Program, 2018), posing a significant threat to the long-term health of the watershed, the Potomac, and the Chesapeake Bay. The CBF reports nitrogen flowing into the Bay must be reduced by 47 million pounds annually to meet clean water goals (CBF, 2021). Coordinating public funds to meet those goals will be time well spent and result in more efficient and effective projects, reaping long-term conservation benefits. Avoiding wasteful expenditures of public funds is a good governance measure that benefits all County taxpayers.

**Recommended Actions:**

Invest in County farms by hiring a skilled Conservation Project Coordinator to serve out of the County's Office of Sustainability and Environmental Services to:

- Coordinate with all agencies operating conservation projects in the County and leverage resources as described above, and assist them in meeting requests of farmers.

- Target farms without internet services, as well as other underserved farms, to update them on an annual basis of funding, practice, and mentoring opportunities related to BMPs and assess interest in adopting BMPs.

- Maintain a database of conservation projects within the County to track implementation and need for follow-up. Coordinate with agencies to identify and respond to meet those needs. Keep track of barriers to implementing conservation practices on farms to identify additional solutions and increase implementation.

- Identify interested farms/farmers that may not meet eligibility requirements.

- Administer the reserve fund created by Recommendation 21.

- Work with NRCS, Soil Conservation Districts, and other conservation projects operating in the County to identify and work through a "waiting list" using a variety of sources, and including funds created by Recommendation 21 to fill in gaps.

- Provide help and share resources with collaborating agencies to improve outreach, follow-through, and education to farmers.

- In collaboration with the farming community, work with the Agriculture Preservation program staff and the Agriculture Business Development staff to support and promote annual farm tours to showcase conservation practices on farms, involving County and State elected officials and the general public.

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## 19 Support and encourage the regeneration of natural systems on agricultural land

**Expected GHG Reduction or Climate Adaptation:** Regenerative land management (or regenerative agriculture) improves soil health and increases soil organic matter. Healthy soils require far less chemical fertilizer, made with nitrous oxide, a greenhouse gas 300 times more potent than carbon dioxide. Agriculture is responsible for 75% of nitrous oxide greenhouse gas emission and hence, any reduction in nitrogen-based synthetic fertilizers is a plus for GHG emission reductions. Regenerative land management practices increase soil organic matter, critical in sequestering carbon from the atmosphere, thereby ameliorating local climate-driven impacts of extreme heat, major storm events, and prolonged dry periods. Importantly, besides these obvious benefits, water storage capacity and nutrient cycling in near-surface soils are enhanced, which protect crops and natural vegetation from drought and reduce the necessity for synthetic fertilizer for cropland. More water percolates, decreasing flooding potential and thereby providing some resilience for public and private infrastructure (buildings, roads, culverts, treatment plants, etc.) and cropland. Less flood damage to homes and businesses not only reduces repair costs but lessens public health threats from flooded basements with pathogens and mold from backed-up stormwater or sewer conveyance systems. Tracking can be done through recording acres shifted to regenerative practices on agricultural lands through time.

**Timeline for Action:**

**Short Term (12–18 months):** There are a number of actions that can be rapidly implemented. These include establishing a strong working relationship with the University of Maryland Extension Agent (2021 hire) on options to induce/encourage regenerative management across Frederick County; hiring a full time county regenerative specialist to advise and coordinate across all County agencies, residents, businesses, and institutions; establish a working relationship between these two experts and the Natural Resources Conservation Service (NRCS) Technical Assistance agent assigned to the County to identify funding opportunities and resource leveraging to increase regenerative practice adoption (Recommendation 18); incorporating regenerative management scoring/metrics into land preservation programs (Recommendation 17); establishing a food hub that markets products from farms implementing regenerative practices (Recommendation 22); and setting up demonstrations at local farms using regenerative practices as an incubator for education, value-added processing, and marketing of locally produced food. In addition, more systemic changes could also be implemented relatively quickly, such as streamlining County regulations and procedures for landowners who wish to implement regenerative management; commissioning a study to produce a cost/benefit analysis of a broad-scale shift to regenerative management; and if substantial long term cost savings are projected by the study, using part of the anticipated savings to establish a voluntary program that rewards landowners who achieve measured improvements in soil health, water infiltration, biodiversity, and water quality.

**Mid Term (18 months–5 years):** City and County officials will examine and adjust annual budgets to assist this transition as it continues with interested landowners and producers. With input from the County's NRCS Technical Assistance agent, the extension agent, and regenerative specialist will prepare and distribute annual reports detailing City and County steps, workshops, ordinances, funding, acres, and food distributed from the transition to regenerative land management.

**Long Term (>5 years):** Documentation of changes resulting from a shift to regenerative practices — such as an increase in local food production, green infrastructure, and economic benefits, including increased profitability for farmers — will be used to attract new businesses whose employees will enjoy the improved quality of life from local foods, parks, wildlife, and biodiversity.

**Rationale:** Over billions of years, Earth's natural systems have evolved the ability to balance the interaction of diverse energetic, living, and geological forces. For eons, these systems have been resilient and highly productive. Unfortunately, human activity to improve daily lives and the quality of life for all inhabitants has disrupted many of these natural systems and the basic processes that supply clean air, water, and nutrients that, in turn, provide food, shelter, and a comfortable quality of life for many.

There are multiple land management strategies pursued to provide basic human needs but many of these ignore or sacrifice nature's processes and, as a result, lead to remedies for the lost benefits of the natural environment. One such effective option is regenerative land management that applies long-understood, common-sense techniques to return surface soil conditions to the biology, chemistry, and hydrology of highly productive natural lands common to highly vegetated, undisturbed areas of the past. The best example is the U.S. Great Plains of the 19th century, with thousands of miles of grassland and clean waters that, under western expansion, lost its deep, organic-rich soil to yield the Dust Bowl and its devastation of farming communities. Before the Dust Bowl, the upper 10-20 feet of soil, i.e. roots, microbes, fungi, worms, insects, and other minute organisms, broke down the dead plant material to recycle nutrients to support continued plant growth and feed the huge bison herds and extravagant birdlife. That soil menagerie of organisms was self-perpetuating and maintained a simple hydrological cycle for not only the plants and animals above but the clean water of nearby streams through recycling of nutrients in groundwater. It is that healthy soil biology and its associated chemical reactions and water availability that regenerative land management seeks to "regenerate" and continuously sustain.

Regenerative land management practices can accomplish multiple processes important to future local productivity, economic prosperity, and quality of life. Aspects of the shift include:

- Carbon cycle repair. GHG emission reduction ($CO_2e$), avoidance or sequestration can be accomplished via reforestation and afforestation as trees/forests are huge carbon sinks (Woodbury et al., 2007) and shifting to healthy soil practices on farmland (Jarecki & Lal, 2010; McGuire, 2020), parks (Thompson & Kao-Kniffin, 2019), school grounds (Kabisch et al. 2017), roadways (Baldauf, 2017), and residential and commercial properties (Pastore et al., 2017).

- Water cycle repair. Stormwater resiliency is increased via improved water infiltration and water holding capacity of healthy, biologically diverse soils (Basche & Edelson, 2017; Devine & O'Geen, 2019), reducing stormwater management costs while decreasing flood frequencies and severities and associated infrastructure damage and public health threats. Additionally, the improved water quality (Bergtold & Sailus, n.d.; Frye & Blevins, 1997; Via, 2020) in streams and rivers that can be attributed to regenerative practices reduces local eutrophication and algal blooms, lowering drinking water treatment costs and protecting drinking water and citizens.

- Nutrient cycle repair. Regenerative land management improves soil fertility, nutrient availability, and soil structure (Via, 2020; Wood et al., 2018). Increasing availability of soil nutrients thereafter reduces synthetic fertilizer input requirements (Oldfield et al., 2019; McGuire, 2020) and costs, resulting in increased farm productivity and profit. For the latter, Via (2020) reports that three farmers in an American Farmlands Trust project (2019) increased soil health through no-till reduced fertilizer applications; GHG emissions declined as well.

- Local climate cooling. Moist, shaded, biologically active soil, covered in vegetation year-round, cools the local atmosphere as well as adjacent waterways. These cooling features are important for reducing heat stress and associated medical treatment/ lost work days (Recommendation 27) as well as protecting native brook trout that require cold water temperatures (Hitt, 2021).

- Food resiliency. Regeneratively managed soil can support the local production of healthier, nutrient-rich food for human consumption (Reeve et al., 2016; Wood et al. 2018) although other factors (weather variability, maturity at harvest, post-harvest handling and storage, anti-nutritive compounds, and chemical treatments) can lead to high variability in food quality (Hornick, 2010).

- **Improved human health.** There are obvious benefits to expanding the implementation of regenerative land management practices throughout the area. As noted above, there will be improved water and air quality. There should also be a reduction of toxic chemical applications (pesticides, herbicides) as native insects and fauna return to intercede against destructive pests. Healthy soils also produce stronger, healthier plants that are more disease-resistant.

- **Improved farm profitability.** The principles of regenerative agriculture are straightforward: reduce soil disturbance and compaction; cover soil year-round, preferably by maintaining plants with deep-penetrating roots; reduce inputs that harm beneficial soil biology (such as pesticides; Prashar & Shah, 2016); increase biodiversity above ground and below through crop rotations or a mix of crops and grazing animals; and consistent with the latter, integrate livestock onto the land.

There are multiple case studies indicating the advantages and economic gains derived from implementing regenerative agricultural practices. Locally, Holterholm Farms and Open Book Farms plant multispecies cover crops and use planned grazing with high profitability and lower environmental impacts. A list of other Maryland farms with similar practices can be found at Future Harvest (https://www.futureharvestcasa.org/resources/amazing-grazing-directory). Many farm managers adopt regenerative practices gradually as they receive additional support and test out new practices. Within the Chesapeake watershed, Macauley Farms in New York is a beef and crop farm that, through the use of no-till, cover crop mixes, and split application of commercial fertilizers, has reduced nitrogen (N), phosphorous (P), and sediment losses by 72, 90, and 99%, respectively; additionally there has been a 69% reduction in total GHGs, which corresponds to taking 10 cars off the road (American Farmland Trust, 2020b). In another New York example, use of striptill, cover crops, and nutrient management reduced N, P, and sediment losses by 40, 92, and 96%, respectively while soil health practices resulted in a 56% reduction in total GHG emissions or taking three cars off the road (American Farmland Trust, 2020a). Manure management and application may be challenging issues for larger farm operations.

There is substantial support for regenerative land management in City and County documents. The Livable Frederick Master Plan (Frederick County, 2019) has the following initiative and sub-initiatives: "Carbon Sequestration and Soil Health — Capitalize on the mutually reinforcing benefits of soil health and carbon sequestration to reduce or prevent the emission of greenhouse gasses." Supporting Initiatives include: 1) Improve soil health and increase soil carbon sequestration in Frederick County through farmer outreach and incentives. 2) Promote and support existing programs that help farmers with regenerative practices (e.g. Grazers Network, Future Harvest CASA, Community FARE). 3) Assess the potential for increasing the soil organic matter and carbon sequestration on all Frederick County agricultural lands. 4) Assess and monitor percentages on land in Frederick County where regenerative agriculture practices are applied. And 5) Establish a pilot program in Frederick County's Agricultural Preservation Program to establish, support, and showcase regenerative agriculture operations. For non-agricultural commitments, there is the development of a Green Infrastructure Plan, increasing forest acres, and protecting water quality, all accomplished through increased soil health. The City's draft Comprehensive Plan (City of Frederick, 2020) includes text to replant developed sites with native vegetation that can reduce runoff, save water, save energy, and improve air quality; it also includes restoring tree canopy to improve air and water quality while helping to reduce energy consumption (p. 7–188). These practices, across City and County, are key components of regenerative land management, i.e. increasing soil organic matter and its associated direct carbon sequestration capacities and indirectly increased resilience for agriculture and protection of public health and properties.

**Equity Considerations:** Regenerative land management has positive impacts on the health of residents because of improvements in water and air quality, particularly important for lower income residents with little discretionary resources for medical care. Locally grown, highly nutritious food will also improve health and nutrition when made available to communities that currently have limited or no access to fresh food through the services of a food hub and other food distribution strategies (Recommendation 22).

**Cost and Cost-Benefits Analyses:** Regenerative land management reduces energy consumption by 30–70% per unit of land through reduced application of synthetic fertilizers and by using internal farm inputs (e.g., manure as a nitrogen source), thus reducing fuel used for transportation. From the two American Farmland Trust case studies described above, net increases in profit were $44/acre, a 135% return on investment for the Macauley Farm (American Farmland Trust, 2020b) and $55/acre for the Swede Farm (American Farmland Trust, 2020a).

**Co-Benefits:** The documented improvements in air and water quality and their benefits to public health are critical to area residents as well as maintaining low water treatment costs for public drinking water.

**Finance:** The U. S. Department of Agriculture (USDA) offers multiple grant and loan programs; one example is the Agriculture and Food Research Initiative — Sustainable Agricultural Systems Grants Program (https://nifa.usda.gov/funding-opportunity/afri-sustainable-agricultural-systems-competitive-grants-program). The USDA National Institute of Food and Agriculture has multiple programs for new farms/farmers and funding for climate-reducing activities. The Environmental Quality Initiatives Program (through the Natural Resources Conservation Service) provides funds and cost-sharing for implementation of conservation practices useful in increasing soil organic matter. The Regenerative Agriculture Foundation (https://regenerativeagriculturefoundation.org/) can also provide funding. Other philanthropic organizations with potential funding are summarized here: "Building off the success of 11th Hour, Jena King, Rathmann Family Foundation and many other family donors, larger philanthropic initiatives (from Earth's Call to One Earth to the Regenerative Agriculture Foundation and Sustainable Agriculture & Food Systems Funders) are all placing photosynthetic carbon drawdown in their core giving when it comes to climate change" (Nerds for Earth https://nerdsforearth.com/funding-the-transition-to-regenerative-agriculture/). Loan programs are also available (go to https://www.farmers.gov/fund/farm-loan-discovery-tool). State funds can be sought from the Maryland Healthy Soils Program and Green Banks may offer funding for small projects that fall beneath acreage requirements for Federal funds or projects deemed too risky for conventional loans.

**Recommended Actions:**

Legislative & Administrative

- Hire a full time county regenerative specialist to advise and coordinate regenerative land management options and opportunities across all County agencies, residents, businesses, and institutions. Establish collaborative relationships and ongoing discussions with the University of Maryland Agricultural Extension Agent, the Soil Conservation District, the Natural Resources Conservation Service, the Maryland Department of Agriculture Healthy Soils Program, and the Million Acre Challenge (https://millionacrechallenge.org/) on regenerative land management and options to increase its adoption in Frederick County. This individual will assist with Recommendations 20 and 29 as well.

- Incorporate regenerative management scoring/metrics into land preservation programs.

- Stay attuned to the evolution of carbon markets and payment strategies for ecosystem services for farmers, and be ready to leverage these programs when they become available for local implementation.

- Consider the establishment of an equipment rental program, or provide start-up resources for an equipment rental co-op, for farm equipment needed to implement regenerative agriculture, such as roller-crimpers, etc.

- Establish a food hub (as per Recommendation 22) that includes products from farms using regenerative practices.

- Set up demonstrations at local farms using regenerative practices as an incubator for education and marketing of locally produced food.

- Commission a study to produce a cost/benefit analysis of a broad-scale shift to regenerative management; and if substantial long term cost savings are projected by the study, use part of the anticipated savings to establish a voluntary program that rewards landowners who achieve measured

improvements in soil health, water infiltration, biodiversity, and water quality.

- Prioritize all or a portion of agricultural innovation grants for farmers who request financial support for adopting regenerative practices. Consider a special grant program for farmers ineligible for federal conservation grants (due to farm size, etc.).

- Direct funds generated through implementation of Recommendation 21, "Pilot an alternative for stormwater mitigation for better results" to fund regenerative land management projects.

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## 20 Restore and sustain natural systems on private and public lands

**Expected GHG Reduction or Climate Adaptation:** Implementation of simple strategies to maintain public and private lands can substantially reduce GHG release through deeper-rooted plants and the accompanying accumulation of soil organic matter (SOM). Increased SOM stores more water to reduce drought effects for surface vegetation as well as runoff and flooding, which is expected to increase as a result of climate change. Results can be tracked by recording acres shifted to regenerative practices on private and public lands through time.

**Timeline for Action:**

### Short Term (12–18 months)

- Adopt a **Turf Management Policy** for all non-sportsfield public and park lands, including public school lands, that defines and identifies low-traffic turf areas (LTTAs) on public lands. **Progress metric:** Policy drafted, submitted, and approved.

- Begin planning a **Regenerative Landscapes Campaign**. **Progress metrics:** Number of partner entities committed to initiative; number of planning meetings held; implementation strategy completed.

### Mid Term (18 months–5 years)

- Implement the **Turf Management Policy** for all non-sportsfield public and park lands, including public school lands, that defines and identifies LTTAs on public lands. **Progress metric:** Document County and City steps to adopt and fund the policy. **Results metric:** Number of parks and schools with identified LTTAs under less intensive management; number of acres under less intensive management.

- Adopt **Frederick City and County Pesticides Law** modeled after the Montgomery County Pesticide Law that (a) restricts the use of certain pesticides and identifies approved products for use on public and private lawns, parks, playgrounds, mulched recreation areas, and childcare facilities; (b) includes a public outreach campaign based on children's safety, protecting the public health and welfare, and minimizing the potential pesticide hazard to people, animals, pets, and the environment; and (c) identifies a joint City-County position to implement the law, educate businesses and the public, and monitor and enforce adherence. **Progress metric:** Law drafted, submitted, and approved.

- Implement the **Regenerative Landscapes Campaign** County-wide. **Progress metrics:** Identify approach, staff, and training modules. **Results metrics:** Acres of native regenerative landscapes installed; number of regenerative landscape demonstration sites; number of homeowners, schools, institutions, businesses, and golf courses implementing native regenerative landscapes; number of gas-powered lawn maintenance equipment replaced with electric equipment by the City and County and by the public; number of local nurseries with Regenerative Landscaping Certification; number of local nurseries carrying, labeling, and promoting native plants.

- Adopt legislation that imposes a **ban on the installation of artificial turf fields** (new or replacements) in parks and public schools, requires that old tire infill products be replaced with plant-based products, and provides guidelines for the replacement of old artificial turf fields with organically managed grass. **Progress metrics:** Track City and County discussions, workshops, and ordinance adoption through time. **Results metrics:** Number of artificial turf fields converted to organically managed grass; number of fields that have replaced old tire infill with plant-based products.

### Long Term (>5 years)

- Enforce and monitor adherence to the Frederick City and County Pesticide Laws. **Progress metrics:** Establish standard procedures for inspection, reporting, and fines/fees for violations. **Results metrics:** Number of retail inspections, number of law violations reported, and fees/penalties collected.

**Rationale:** The management of public and private lands provides a significant opportunity to increase carbon sequestration, reduce water runoff, and reduce air pollution. Sellhorst and Lal (2013) report that the average rate of carbon sequestration for home lawns in the U.S. is 2.8 Mg C/ha/year and the estimated mean potential SOC (soil organic carbon) sink capacity for home lawns in the U.S. is 45.8 Mg C/ha/year. These numbers do not account for public lands, like parks and public schools. Estimated carbon emissions due to home lawn turfgrass maintenance (i.e., fertilizer application and mowing fuel combustion) is 254.2 kg $CO_2$e/ha/year (64.5 kg $CO_2$e/ha/year for fertilizer application and 189.7 kg $Co_2$e/ha/year for mowing fuel combustion; Chen et al., 2018).

Standard lawn maintenance equipment creates significant amounts of air pollution. The U.S. Environmental Protection Agency (EPA) estimates that a gasoline-powered lawn mower emits 11 times the air pollution of a new car for each hour of operation (EPA, n.d.). Gasoline-powered lawn and garden equipment (GLGE) like mowers, trimmers, and leaf blowers account for as much as 5.7 million tons of the United State's annual $CO_2$ emissions (Chen et al., 2018). This fossil-fueled lawn maintenance equipment emits high levels of carbon monoxide, hydrocarbons [volatile organic compounds (VOCs)], and nitrogen oxides (NOx), which contribute to the formation of ground level ozone (smog), toxins, and other particulates (Banks & McConnell, 2015). Smog is a noxious irritant that impairs lung function (Foulger, 1954) and inhibits plant growth (Taylor, 1958). The EPA (n.d.) states that gasoline lawn and power equipment, on average, produce 5% of smog — forming VOCs in non-attainment areas (areas considered to have air quality worse than the National Ambient Air Quality Standards). In addition, the operator of such equipment is typically positioned where exposure to such carbon monoxide and toxic emissions is greatest. Frederick County as a whole has not met current EPA National Ambient Air Quality Standards (NAAQS) attainment standards for ozone since they began in 1992 (EPA, 2021).

Small gasoline spills evaporate and pollute the air as well. The EPA (n.d.) estimates that every summer, the few ounces spilled during each refueling of lawn and garden equipment adds up to 17,000,000 gallons of gasoline nationwide.

Native regenerative landscaping can significantly reduce the need for fossil-fueled lawn and garden equipment, reducing the associated air pollution and health risks. Native plants themselves can help to improve air quality by reducing particulates and gaseous air pollutants. An Oak Forest, Illinois Clean Air Counts campaign (City of Oak Forest, Illinois, n.d.) stated that for every 1,000 acres of natural landscaping, 50 tons of VOCs and 5 tons of NOx are avoided per year. According to a study by Ohio State University (2019) plants, not technologies, may also be cheaper options for cleaning the air near a number of industrial sites and roadways. In fact, researchers found that in 75% of the counties analyzed, it was cheaper to use plants to mitigate air pollution than it was to add technological interventions — things like smokestack scrubbers — to the sources of pollution (Montgomery Parks IPM, 2021).

- Turf management policy for LTTAs: LTTAs should receive less intensive management than high-traffic turf areas. This less intensive management should include the elimination of herbicide and pesticide use, reduced annual mowing, and the elimination of grass clipping collection. These changes would help LTTAs (a) maintain the ability of the grass to sequester more carbon, (b) reduce the amount of GHGs released into the atmosphere from using gasoline-powered lawn and garden equipment, (c) reduce the need for applying fertilizers to maintain turf quality, (d) increase the water storage capacity of the soil, and (e) support greater biodiversity above and below ground that maintains high nutrient cycling.

Higher frequency mowing, at lower heights (especially during the hottest months of the year), results in greater levels of respiration than photosynthesis in turf grass, causing the turf to emit more carbon than it is sequestering (Selhorst & Lal, 2013). GLGE such as mowers, trimmers and leaf blowers account for as much as 5.7 million tons of the United State's annual $CO_2$ emissions (Banks & McConnell, 2015). Fresh grass clippings are a valuable source of nitrogen (Vinther, 2006); leaving clippings on the turf (and encouraging a

healthy population of soil decomposer organisms) minimizes the need for synthetic fertilizers. The City and County can therefore save money and reduce the risk of watershed contamination from excess fertilizers, which can lead to eutrophication and other environmental issues. Maintaining turf at higher mowing heights allows for greater root biomass that penetrates deeper into the soil (Vinther, 2006). Greater root biomass allows for greater soil water retention, increased soil carbon sequestration, reduction in chemical and fertilizer leaching, reduction in fertilizer needs, and greater turf resilience in the face of disturbances like drought. Eliminating the use of pesticides and allowing the maintenance of turf at 3–4 inches protects local biodiversity of insects (especially pollinators) and soil organisms (Lerman et al., 2018); protecting these biological communities allows for healthier, more resilient local ecosystems, which provides soil carbon sequestration, water and air purification, natural nutrient cycling and supply, and pollination of commodity plants.

- **Legislative ban on artificial turf fields:** Prioritizing natural turf grass over artificial turf will (1) increase carbon sequestration and other ecosystem services on public lands in the county, (2) reduce the risk of environmental pollutants leached from artificial turf infill products, and (3) protect the health of all individuals using publicly managed turf fields. Healthy (minimally disturbed, biologically rich) soils provide many crucial benefits to humans, including soil carbon sequestration, water retention and filtration, and soil stabilization (Franzluebbers, 2002). Covering prepared ground (bare and compacted) with artificial turf eliminates all benefits of a functioning ecosystem on the site. There is also a significant reduction in biodiversity on or near a site with artificial turf due to the elimination of grass habitat (particularly insects that feed on or burrow below the grass; Montgomery County, 2011). Artificial turf infill products (predominantly recycled tires) have been shown to contain a number of heavy metals and carcinogenic chemicals that can volatilize or leach out in rain water (Llompart et al., 2013). Replacing rubber infill with plant-based products, or removing artificial turf fields altogether, will eliminate any risk of environmental contamination from these carcinogens and protect the health of athletes and other citizens using public sports fields. Removal of rubber infill will also significantly lower the temperature on the playing field, reducing the risk of heat exhaustion (Jim, 2017). The production of artificial turf requires substantial energy ($17.17/sq. meter vs. $2.60 for sod, Adachi et al., 2016), thereby generating GHGs; with use and degradation, microplastics are created, which is an increasingly recognized threat to many terrestrial and aquatic animals, the nutrient cycling associated with their food web, and human health (e.g., Coffin et al., 2021).

- **Pesticide Law:** According to the Chesapeake Stormwater Network home lawns make up 70% of the turf grass in the Chesapeake Bay Watershed. Roadside right-of-ways, parks, schools, churches, and cemeteries make up another 20%. Turf grass is now the largest crop grown in the Chesapeake Bay watershed (Chesapeake Stormwater Network, n.d.). In Frederick County, 96,309 acres, nearly 23% of our land mass, are in turf grass (Chesapeake Stormwater Network, n.d.). Over 45,000 pounds of pesticides and nearly 516,000 pounds of fertilizer are applied each year, and nearly 137,000 gallons of gas is needed to cut grass, generating more than 18 tons of clippings. The annual volume of water run-off that enters the Potomac river from Frederick County land is 419 billion gallons (Frederick County, 2010).

  Pesticides, which by definition include herbicides, fungicides, insecticides, and rodenticides, are designed to kill weeds, fungi, insects, and rodents that are harmful to lawns, gardens, plants, etc. The chemicals used in most pesticides kill more than just garden pests and weeds - they also kill the helpful organisms that live in the soil (Gerber, n.d.; Hussain et al., 2009), the organisms that consume plant detritus and work symbiotically with plant roots to build soil organic matter and promote deep root growth (Liu & Huang, 2002), both resulting in carbon sequestration and increased water retention. Some of these chemicals can remain in the soil for years, effectively keeping necessary micro-organisms from working the soil, recycling nutrients, and supporting plant health. Because of this detrimental effect on soil biology, the abilities of plants and soils to sequester carbon decreases. Pesticides also have detrimental effects on other critical components of a healthy environment: pollinators, water quality, biodiversity, etc. (Gilliom, 2007). Equally important, pesticides are detrimental to human health and in

particular, may have harmful developmental effects on children. Even low levels of pesticide exposure can affect young children's neurological and behavioral development (Liu & Schelar, 2012). There is evidence showing links between pesticides and neonatal reflexes, psychomotor and mental development, and attention-deficit hyperactivity disorder. Other researched negative human health impacts associated with pesticide use include dermatological, gastrointestinal, neurological, carcinogenic, respiratory, reproductive, and endocrine effects. As detailed in the technical report Keep Pets Safe Around Pesticides (Stone & Bunch, 2012), pets too suffer numerous detrimental effects from exposure to pesticides, several of which can be attractive to dogs, cats, and other animals. Exposure can result in fatal poisoning, seizures, convulsions, vomiting, severe irritation of the mucous membranes, diarrhea, and weight loss. Options to reduce pesticide use include implementing Integrated Pest Management (IPM; Recommendation 30), such as the standards already used on public lands in Frederick County (Maryland Department of Agriculture, n.d.).

- Native Regenerative Landscapes Campaign: According to the Sourcebook on Natural Landscaping for Local Officials (Northeastern Illinois Planning Commission, 2004), native regenerative landscaping minimizes air-polluting greenhouse gas emissions and noise pollution from lawn maintenance equipment, and the environmentally detrimental effects of pesticides and fertilizers. It virtually eliminates the need to use water for irrigation, as is required for turf grass lawns. While not maintenance free, native regenerative landscaping requires less time and money for ongoing maintenance than conventional landscapes. It reduces the stress that a "weed-free" lawn places on clean air, clean water, soil stability, and other environmental qualities of life. It also attracts wildlife, such as butterflies and birds, thus increasing biodiversity. In addition, by eliminating randomly timed boom mowing along rural roads, the life cycle of roadside flora that support pollinators can be protected.

**There are multiple examples of other jurisdictions applying these actions.**

Turf Management policy for LTTAs: In 2016, Montgomery County, MD enacted County Code Chapter 33B — Pesticides Regulations (Montgomery County, n.d.). This code presents guidelines for pesticide use on public lands in the county. The code specifies that "The Parks Department does not use pesticides for cosmetic purposes. Pesticides are used as a last resort to control noxious and invasive pests, maintain safe and playable athletic fields and courts, and prevent significant economic damage, including degradation of park infrastructure." George Leventhal, the Montgomery County Council president and a sponsor of the bill stated, "The cost benefit analysis suggests that it is more important to protect the public health than it is to have an absolutely clover-free, dandelion-free lawn" (Gordon, 2015).

In 2008, The University of Colorado at Boulder enacted a new Integrated Turf Management plan (University of Colorado, 2008) which established that conventional turf management in the U.S. is "characterized by intensive use of synthetic chemicals including water-soluble fertilizers, herbicides, insecticides, and fungicides." The plan then notes "A review of current science suggests that these practices may be harmful to human and wildlife health, and also negatively impact the turfgrass ecosystem, contributing to significant declines in populations of beneficial soil organisms, soil acidification and compaction, thatch accumulation, and diminished resistance to diseases." The rest of the document establishes goals and recommendations for "ecological turfgrass management."

Legislative ban on artificial turf fields: In 2011, a Montgomery County staff work group published a review of the benefits and issues of both natural grass and artificial turf on public lands. Recognizing numerous potential concerns with artificial turf fields (including costs of installation and maintenance, and health risks from exposure to infill products), the work group makes numerous suggestions about establishing criteria for when artificial turf fields are or are not appropriate for installation and use (Montgomery County, 2011).

**Pesticide Law:** In 2015, Montgomery County, MD enacted the first County pesticide law (a.k.a. Healthy Lawns Act) in the U.S. It is recommended that Frederick County model a pesticide law on the Montgomery County law. A summary of the Act is in the Addendum and is also available on the SafeGrow Montgomery website (SafeGrow Montgomery, n.d.).

In October 2020, the Baltimore City Council voted in favor of a new comprehensive regulation on pesticides (CB 20-0495; Baltimore City Council, 2020). The bill restricts the use of chlorpyrifos, neonicotinoids, and glyphosate (the main ingredient in the popular weed killer RoundUp®) in Baltimore City. The regulation will go into effect on July 1, 2022.

**Native Regenerative Landscapes Campaign:** There are many examples of municipalities and institutions that have implemented native regenerative landscapes. The Glenstone Art Museum located in Potomac, MD is a national leader in the implementation of organic natural landscaping. Their Environmental Center (https://www.glenstone.org/landscape/) highlights the museum's sustainability efforts in composting, organic landscape management, waste reduction, materials recycling, and water conservation (Glenstone, n.d.).

According to Portland's Parks & Recreation (City of Portland, Oregon, n.d.), Ecologically Sustainable Landscapes & Nature Patches bring nature to neighborhood parks. Nature patches within underused areas in existing parks use natural materials like native Pacific Northwest plants, logs, boulders, paths, and learning elements to encourage people to play and explore. Nesting boxes, flowering plants, and other additions improve the habitat for birds, pollinating insects, and wildlife. Community members of all ages and abilities are welcome to volunteer to help with planting and stewardship activities.

The city of Houston's Memorial Park Golf Course is undergoing an $18 million facelift to transform the municipal course with a new design that will be a model for creating sustainable golf courses across the country (Wright, 2019).

Seattle University Grounds and Landscaping (Seattle University, n.d.) "has been a leader in sustainable landscape management practices since 1986." The Grounds staff is "...committed to stewarding an environmentally friendly campus that provides educational opportunities for students, that functions as an urban wildlife sanctuary and that serves as a safe and inviting space for the campus and our surrounding community."

Clemson University Sustainable Landscape Demonstration Garden (Clemson University, n.d.) is the result of a campus-wide collaborative effort that brought together multiple departments within the College of Agriculture Forestry and Life Sciences, university landscape services, campus planning, extension, and the South Carolina Botanical Garden. Garden research and maintenance is completed by students enrolled in an interdisciplinary horticulture course. The Sustainable Landscape Demonstration Garden aims to serve as a model for urban organizers and extension agents and has become a gathering place for people from across the Clemson University campus. This list of actions that the County and City should adopt is integral to many goals and initiatives of the City and County plans. The Livable Frederick Master Plan (Frederick County, 2019) has multiple relevant references: Green Space initiative, p. 161; Outreach for Ecology initiative, p. 187; Environment Supportive Design initiative, p. 188; Evaluation of Impact initiative, p. 189; Best Practices initiative, p. 190; Wetlands initiative, p. 191; Hazard Planning initiative, p. 194; Emission Control initiative, p. 194; Stormwater Impacts initiative, p. 194; and Carbon Sequestration and Soil Health initiative, p. 194. The City's draft Comprehensive Plan (City of Frederick, 2021) has a strong commitment to green infrastructure for its multiple benefits: "The Plan identifies tools intended to improve the City's "green infrastructure" as new development and redevelopment occur. For example, compact site design techniques can minimize the impact of new construction on natural systems. Replanting developed sites with native vegetation can reduce runoff, save water, save energy, and improve air quality. Restoring the tree canopy also improves air and water quality while helping to reduce energy consumption" (p. 7-188). Hence both governments have strong goals to ensure as much carbon sequestration and accompanying quality of life attributes for its citizens as possible.

**Co-Benefits:**

Turf Management policy for LTTAs

- Allowing the grass to grow more in between mowing events allows for a greater increase in grass root biomass, which leads to a reduction in urban and rural stormwater runoff due to greater water percolation and retention on public lawns (Liu & Huang, 2002).

- Creating less-frequently mowed spaces and gardens provides habitat and forage for a number of important pollinating insect species (Lerman et al., 2018).

- Garden spaces and greater biodiversity increase the aesthetic appeal and mental/emotional benefit of residents interacting with those public spaces (Lovell et al., 2014).

Legislative ban on artificial turf fields

- There is a growing body of research that points to the danger of regular proximity to a number of carcinogenic compounds found within shredded tire infill products for artificial turf fields. Replacing artificial turf with natural grass will help to protect the long-term health of athletes and other citizens using sports fields on public land (Cheng et al., 2014; Safe Healthy Playing Fields, Inc., n.d.; Montgomery County, n.d.).

Pesticide Law: Co-benefits resulting from an implemented Pesticide Law include:

- Improved human health, especially in children, due to having safer lawns, schoolyards, and parks to enjoy, play on, and maintain.

- Reduction in urban and rural stormwater runoff due to greater water percolation and retention on private and public lawns.

- Reduction in water use for lawn watering during times of drought due to greater water percolation and retention on private and public lawns.

Native Regenerative Landscapes Campaign:

Co-benefits related to a Native Regenerative Landscapes Campaign include:

- Soil Stabilization: Native plants are effective on steeply sloped sites, stream banks, and in areas where moving water is present (Northeastern Illinois Planning Commission, 2004). The roots of some native plants are very dense, fine, and often very deep (in some cases, 5 to 10 feet in mature plants) and hold soil well.

- Water Conservation: According to the Sourcebook on Natural Landscaping for Local Officials (Northeastern Illinois Planning Commission, 2004), native regenerative landscaping virtually eliminates the need to use water for irrigation.

- Education, Leadership, Reputation: Implementing native regenerative landscapes on educational and commercial campuses and public lands offers educational opportunities for students, employees, and the community. Such landscapes create testing grounds for innovative practices and demonstration areas for the public; they also create a positive impression on alumni and donors .

- Maintenance Cost Savings: According to the Sourcebook on Natural Landscaping for Local Officials (Northeastern Illinois Planning Commission, 2004), approximately nine-tenths of conventional landscape maintenance costs can be eliminated through native regenerative landscaping.

- Community Identity and Increased Property Values: According to the Sourcebook on Natural Landscaping for Local Officials (Northeastern Illinois Planning Commission, 2004), distinctive natural landscaping that preserves the unique characteristics of a community is a community asset. Real estate within a well-designed distinctive landscape setting can possess a marketing edge and positively affect property values.

- Local Economy: As sources for native regenerative landscaping materials must come from businesses rather than from the 'wild,' native regenerative landscaping projects require materials and local labor and professional services that generate income and help the local economy. Nurseries, landscape architects, environmental restoration professionals, environmental groups, and neighborhood organizations will respond to the market for natural landscaping materials

and professional expertise. There is economic development potential in local cultivation of native plants and seed products for environmental restoration projects.

**Equity Considerations:**

- Turf management policy for LTTAs: There will likely be concerns from the public about the increased likelihood of exposure to disease vector ticks (Health & Human Services, n.d.; Recommendation 30) on public land from proximity to taller grasses in LTTAs. A large part of this concern can be assuaged by the initial criteria that designate an area as a LTTA. Low-traffic areas should be places with turf grass that the public does not use, or is very unlikely to use. Therefore, potential exposure to ticks from being near or passing through these areas is already low. LTTAs converted into garden spaces are meant for public engagement, and should be managed for potential insect disease vectors with the current County IPM practices (Maryland Department of Agriculture, n.d.).

- Legislative ban on artificial turf fields: Research shows that the use of artificial turf for sports fields increases the risk of a number of sports- and heat-related injuries. Therefore, the use of artificial turf fields in public parks and schools puts athletes, specifically student athletes, at greater risk of injury and chronic illness. The minimization of artificial turf field use, and the conversion from rubber infill to plant-based infill products, would reduce the risk of injury and chronic illness to athletes using sports fields on public land (Drakos et al., 2013; Safe Healthy Playing Fields, Inc., n.d.).

- Pesticide law: Families and children from low-income families are more likely to rent and live in apartments and multifamily residences where they have little control over what products are used to maintain properties. They have more health risks and are more dependent on public spaces and parks for recreation. A Healthy Lawns Act (see Addendum Pesticide Law) will ensure that all people have access to the safest public places and parks where they are exposed to the least amount of pesticides that can adversely affect their health and development.

- Native regenerative landscapes campaign: Increasing the number of natural landscapes on school grounds, municipal parks, and other public institutions such as museums and health and social service departments increases access to the benefits of nature for inner city residents, apartment dwellers, and people of all communities and economic backgrounds. Trees and greenery offer a host of health advantages including heat-stroke protection, cleaner air, better breathing, sounder sleep, stress relief, disease prevention, and defense from depression (see Recommendation 27). Planting more trees beautifies urban neighborhoods while helping residents feel better (Esposito, 2016).

Recruiting residents from urban and low-income communities as volunteers to help with planning and implementing natural landscapes within their communities builds community and empowers people to take ownership of community health (Ellery & Ellery, 2019).

**Cost-Benefit Analyses:**

- Turf management policy for LTTAs: This action calls for a reduction in the use of pesticides, herbicides, and annual mowing time on public lands deemed LTTAs. This action would create a reduction in annual maintenance costs for these areas.

- Legislative ban on artificial turf fields: Examining costs of initial installation and maintenance, natural turf fields can be cheaper to maintain than artificial fields. Installation of artificial turf systems can cost three to four times more than a natural turf field installation (Safe Healthy Playing Fields, Inc.,n.d.) while daily maintenance costs of artificial turf are cheaper, on average, than natural turf. However, taking into account the purchase of new equipment to maintain artificial turf (most current County equipment is for natural lawn care), and the long-term replacement costs, natural turf is cheaper to maintain overall. Further, accounting for lifetime replacement costs, two independent studies found that the average annual maintenance cost of a sand-capped natural turf field is ~$36,000, while the average annual costs of maintaining an artificial turf field is ~$109,000. These numbers do not include the cost of removing non-reusable materials during artificial turf field replacement

(which occurs approximately once every decade). The heavy backing material on artificial turf does not burn well during waste incineration; it is considered "non-proccesible waste" and must therefore be separated from the trash stream and trucked (usually by contract) to a landfill that can accept the material (Safe Healthy Playing Fields, Inc., n.d.).

- Pesticide law: Implementing a pesticide law would involve costs associated with the personnel needed to implement ongoing educational efforts to inform the public about the law, and continuing efforts to enforce the law through actions such as checking for required signage in retail stores. Other costs could entail public surveying, and other outreach efforts and materials. The financial impact on retailers could be another factor to assess. The broad multi-faceted, high-value benefits, ranging from protection of human health to restoring soil health and biodiversity, are outlined above. Little published work was found that addressed the cost-benefits of pesticide laws not related to agriculture. Further research would be needed for quantifying this economic cost.

- Native regenerative landscapes campaign: According to the Sourcebook on Natural Landscaping for Local Officials (Northeastern Illinois Planning Commission, 2004), the "bottom line" can be a strong motivation for municipalities, park districts, school-districts, corporations, and institutional campuses to install and maintain native regenerative landscaping instead of a conventional lawn. In multiple examples, approximately nine-tenths of conventional landscape maintenance costs were eliminated.

According to the Association for the Advancement of Sustainability in Higher Education Sustainable Landscape Guide (Walton & Sweeney, 2013), native regenerative landscape practices can save money and produce revenue in a variety of ways. For example,

- Sustainable landscapes can frequently be accomplished with little capital expenditure since in many cases sustainable practices are more a question of changing maintenance rather than building and installing new and costly features.
- Composting and chipping wood and other plant matter into mulch or pathway material (as done at the County landfill) reduces the costs of waste disposal and recycles nutrients back into the soil, improving soil structure.
- Integrating fruit and nut trees and other edibles into campus landscapes can provide low-cost food for campus dining halls, as well as for students and community members. A campus can earn revenue from sales of herbs, nuts, and produce grown on campus.
- Shade provided by trees cools buildings during summer and reduces energy demand, which can provide significant cost savings. A reduction in energy demand due to the shade benefit of trees or green roofs also means less air pollution from power generators and reduced need for additional generators.

**Finance**: The Chesapeake Bay Trust (CBT, n.d., grants up to $75,000) encourages outreach and community engagement activities to increase the stewardship ethic of natural resources and on-the-ground restoration activities that demonstrate restoration techniques and engage Maryland citizens in the restoration and protection of the Chesapeake Bay and its rivers.

The CBT Community engagement Mini-grant, and Environmental Education Mini-grant programs provide funding (up to $5,000) for projects that engage people within communities and schools as volunteers on outreach, education, and restoration projects. The trust seeks to engage groups that have traditionally been under-engaged with environmental issues as well as new applicants and organizations from a diverse array of communities.

The Arbor Day Foundation TD Green Space Grant Program supports green infrastructure development, tree planting, forestry stewardship, and community green space expansion. Municipalities in the select states, including Maryland, are eligible to receive $20,000-25,000 grants in support of local forestry projects in areas of need within a community. Preference is given to Tree City municipalities (PlantsMap, 2020).

The Fruit Tree Planting Foundation (n.d.) strategically donates orchards where the harvest will best serve communities for generations, at places such as community gardens, public schools, city/state parks, and low-income neighborhoods. Applications are accepted on a rolling basis.

The Salazar Thriving Cities Challenge (Salazar Center, n.d.) supports breakthrough projects that use innovative nature-based solutions to advance climate resilience, advance racial equity, and strengthen cities and urban communities.

Other grant programs can be found at the National Recreation and Parks website (National Recreation and Parks, (n.d.) and Plants Map (n.d.).

**Recommended actions:**

### Legislation and Policy

- **Policy:** Adopt and implement a Turf Management Policy for all non-sportsfield public and park lands, including public school lands, that defines and identifies LTTAs on public lands. LTTAs can benefit from less intensive management in order to improve soil carbon sequestration and reduce GHG emissions from GLGE. This would include, for example, the significant reduction and eventual elimination of herbicide and pesticide use, adoption of IPM procedures, reduced annual mowing, the elimination of grass clipping collection, planting of alternative ground covers that do not require mowing under trees and along fence lines, the establishment of demonstration sites for native regenerative landscapes, native edible food 'forests,' community gardens, and/or pollinator gardens, as well as reporting requirements. Progress/Results Metrics: Number of parks with demonstration sites, distribution of demonstration sites to address equity, number of acres of LTTAs under less intensive management, and number of acres converted to regenerative landscapes.

- **Policy:** Adopt legislation that imposes a ban on the installation of artificial turf fields (new or replacements) in parks and public schools, requires that old tire infill products be replaced with plant-based products, and provides guidelines for the replacement of old artificial turf fields with organically managed grass. Results Metrics: Number of artificial turf fields converted to organically managed grass and number of fields with replaced old tire infill.

- **Policy, outreach & education:** Adopt a Frederick County Pesticides Law modeled after the Montgomery County Pesticide Law that (1) restricts the use of certain pesticides and identifies approved products for use on public and private lawns, parks, playgrounds, mulched recreation areas, and childcare facilities; (2) includes a public outreach campaign based on children's safety, protecting the public health and welfare, and minimizing the potential pesticide hazard to people, animals, pets, and the environment; and (3) creates a County position to implement the law, educate businesses and the public, and monitor and enforce adherence. Results Metrics: Documenting declines in pesticide purchases as well as outreach and education activities over time.

### Administrative and/or Community

- **Programs/education:** Create a Regenerative Landscapes Campaign organized collaboratively with City and County personnel, community organizations (such as Master Gardeners, Friends of Rural Roads, etc.), and nonprofit organizations (such as the Chesapeake Conservation Landscaping Council, n.d.), that (1) educates, supports, and incentivizes municipalities, golf courses, and commercial and institutional property owners, including school campuses, to develop native regenerative landscapes, native edible food "forests," community gardens, or pollinator gardens that can serve as educational demonstration sites; (2) discourages boom mowing along rural roads to protect the natural life cycle of pollinator friendly flora; (3) educates and incentivizes homeowners to replace turf lawns with native and regenerative landscaping capable of sequestering more carbon; (4) creates an incentive program to replace gas-powered lawn maintenance equipment with corded or cordless electric models; (5) builds community partnerships to develop and expand volunteer corps (e.g., the Office of Environmental Sustainability Resource's Green Leader Brigade (Frederick County, n.d.), the Chesapeake Bay Conservation Corps (n.d.), for plantings and education at demonstration sites, or the Climate Corps described in Recommendation

36; (6) promotes and incentivizes certification of landscaping contractors and professionals through the Chesapeake Bay Landscape Professional (n.d.) Certification program and prioritizes certified vendors in City and County bids; and (7) creates an incentive program to attract organic native nurseries to Frederick County and encourage existing nurseries to offer and label organically grown native plants. Results Metrics: Acres of native regenerative landscapes installed; number of regenerative landscape demonstration sites; number of homeowners, schools, institutions, businesses, and golf courses implementing native regenerative landscapes; amount of gas-powered lawn maintenance equipment replaced with electric equipment; number of local nurseries with Regenerative Landscaping Certification; and number of local nurseries carrying, labeling, and promoting native plants.

**Community actions:**

- Stop using pesticides on properties.
- Learn about the Maryland Fertilizer Law.
- Learn about organic lawn care effective alternatives currently approved by Montgomery County (n.d.).
- Use a lawn care company certified through the Chesapeake Bay Landscape Professional Certification program (n.d.) that focuses on organic lawn care.
- Create wildlife habitats in backyards and seek certification through the National Wildlife Federation's Certified Wildlife Habitat program (National Wildlife Federation, n.d.).

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## Addendum to Recommendation 20: Montgomery County's Healthy Lawns Act

What Montgomery County's Healthy Lawns Act Does: Healthy Lawns Act (amended bill 52–14) was passed by Montgomery County Council, MD by vote of 6–3 on October 6, 2015 and enacted on October 20, 2015.

### What does the Healthy Lawns Act do?

**1.** Stops the routine use of harmful pesticides on the following County property (as of July 1, 2016) and private property (as of Jan. 1, 2018):

- lawns (which excludes golf courses, playing fields, trees/shrubs, agriculture),
- playgrounds,
- mulched recreation areas,
- children's facilities & their grounds

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## Addendum to Recommendation 20: Montgomery County's Healthy Lawns Act

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Allows safer products (referred to as "listed pesticides") (Article 3. Application Restrictions) that are

- EPA registered pesticides for which active ingredients are approved by the National Organics Standards Board; and
- Pesticides which ingredients do not require EPA registration but ANY EPA registered pesticide may be used for
  - Chapter 58 weeds (poison ivy; ragweed; kudzu; Canada, musk, nodding, plumeless, and bull thistles; any plant, except another thistle, identified as a noxious weed under State law; and any other plant which the Director finds by regulation endangers public health or safety if allowed to grow unchecked)
  - invasive species (to be listed by DEP by Mar. 1, 2016. *Sec. 2 & Article 1. General Provisions Sec. 33B–5*)
  - control of indoor pests, even when applied outside around/near foundation of building
  - agriculture
  - gardens (areas where food crops, flowers, or other ornamental plants are grown), and
  - to control a pest outbreak that poses an imminent threat to human health or significant economic damage (must notify DEP within 7 days)

**2.** Enacts neighbor notification (*Sec. 1. Article 2. Notice Requirements Sec. 33B–9*) — private property owners or tenants must post signs approved by DEP when they

- apply pesticides to a lawn area over 100 square feet; or
- to lawn area of any size if within 5 feet of property line

**3.** The County will conduct a public outreach and education campaign before and during the implementation of restrictions.

**4.** Restricts the use of neonicotinoid pesticides on County–owned property (even on areas other than lawns, playgrounds, mulched recreation areas, and children's facilities and grounds), except for agricultural use. The broader prohibition on neonicotinoids does not apply to Parks Department–maintained County property (*Sec. 1. Article 3. Application Restrictions. Sec. 33B–11*).

**5.** The DEP will adopt an Integrated Pest Management (IPM) program for all County–owned property that requires monitoring, record-keeping, and use of non–chemical methods and safer "listed pesticides" before using other treatments. All County employees responsible for pest management will be trained on IPM by the DEP (*Sec. 1 Article 4. County Property and Parks Sec. 33B–12*).

**6.** The Parks Department will implement (and inform the public about) a pesticide–free parks program including (*Sec. 1. Article 4. County Property and Parks Sec. 33B–13*)

- certain parks maintained only with safer "listed pesticides" (or organic–compatible pesticides)
- a pilot program of at least 5 playing fields maintained with only safer "listed pesticides" conducted in consultation with an expert with experience in successful conventional to organic transitions
- maintenance of all other playing fields using IPM, and a plan due by Sept. 1, 2019 for transitioning all playing fields to safer "listed pesticides" beginning 2020
- protection of water with restriction of use of registered pesticides (other than safer "listed pesticides") within 25 feet of a waterbody (subject to exceptions)
  - 48 hour advance and 48 hours post–notice on appropriate Parks Department website and in the area where registered pesticide (other than safer "listed pesticides") will be applied.
- Twice–yearly reports to County Executive and Council including status of pesticide free parks and detailed registered pesticide usage; reports will be available to the public (*Sec. 1. Article 4. County Property and Parks Sec. 33B–14*).

## 21 Pilot an alternative for stormwater mitigation for better results

**Recommendation:** The purpose of this recommendation is to create a system that allows builders of spot-lot and small clusters of residential construction to continue to mitigate stormwater (SWM) runoff and environmental site design (ESD) by the current standards and methods of enforcement OR opt-out and participate in a new program that allows for less aggressive mitigation measures and directs saving to an account to fund other more impactful mitigation, soil retention, and soil health efforts in agriculture, lawn conversion, or along streams and waterways. This project would be initiated as a pilot and implemented over a sufficient period to adequately assess its impact on SWM and flood mitigation and prevention, with the goal of formal adoption within the next decade.

**Expected GHG Reduction or Climate Adaptation:** A reallocation of existing dollars from low-impact to high-impact mitigation measures will improve flood prevention and mitigation, soil health, and carbon sequestration capacity. Annual tracking can record development size and required SWM, reduced SWM, funds transferred to the mitigation reserve, and final use of the funds for specific projects.

**Timeline for Action:** A request should be prepared for consideration in Annapolis in Frederick County's 2022 legislative package for local deference in permitting the County to pilot a program to assess shifting of SWM fees as described. Progress would be assessed as legislation is proposed and adopted.

**Rationale:** Current standards and methods of SWM and ESD at spot-lot and small cluster residential development sites often require 100%, or near 100%, re-introduction of rain water into the ground. Calculations for impervious areas are made, volumes calculated, and various structures built such as drywells, infiltration trenches, calming berms, and bioretention swales. The design and construction of these structures often cost approximately $10,000 per lot. Once completed, these structures on residential properties are immediately covered in vegetative materials and then tended by an owner-occupant. SWM and ESD devices that prevent minimal soil moving on site until the ground is covered in plant material are extremely expensive with low benefit. This recommendation is an argument for proportionality. Ten thousand dollars to prevent loss of a few 'shovels of dirt' may not be the most effective use of funds. On proper residential lots, simple grading and bioswales are almost as effective and cost 80% less to construct. Fee-in-lieu funds can be paid by the builder and earmarked for projects with much more impact., i.e. those protecting against large soil losses common throughout the County.

There is substantial literature on 'targeting' resources to maximize nutrient and sediment load reductions. Locally, a group of staff worked with the United States Department of Agriculture (USDA) more than 10 years ago to distribute Farm Bill funds to the highest nutrient and sediment loading areas within Pennsylvania, in contrast to its normal method of equitable distribution of funds across the jurisdiction. That 'targeting' of funds for best management practice implementation at identified hot spots was designed to reduce the largest pollutant inputs to the Chesapeake Bay. Pennsylvania Chesapeake Watershed Implementation Plan Phase 2 reports the success of that effort: "NRCS Chesapeake Bay Watershed Initiative funding goes to high priority watersheds" (Corbett & Krancer, 2012). It was highly successful for two years until limited USDA technical staffing resulted in a return to former equitable fund distributions and the long-term benefits (load reductions) of targeted conservation practice implementation could not be assessed. In a separate summary, Gellis and Noe (2013) determined that storm-induced erosion of stream banks in the Linganore watershed contributed 53% of the annual fine-grained suspended sediment load, agriculture contributing 44%, and forests 3%. Focusing environmental reserve funds on buffering these areas could reduce

delivery of phosphorus-rich sediment to Lake Linganore, reducing potentially toxin-producing cyanobacteria blooms (Recommendation 34) and maintaining low drinking water treatment costs as well as slowing the filling of the lake with upstream sediments to delay the need for future dredging.

Park and Sawyer (1985) document the importance of focusing limited resources on restoration in highly erodible areas, discovering such a targeted approach led to a 34% savings in costs and with a few more best management practices (BMPs) installed, a 32% greater decline in sediment load. Using a complex model, Dickinson et al. (1990) reached the same conclusion for both rolling terrain and flatlands, i.e. focus on highly erodible areas, particularly those with easily eroded fine grain sediments (Malhotra et al., 2020).

City and County documents endorse care of the natural environment that defines this area. The Livable Frederick Master Plan (Frederick County, 2019) repeatedly refers to the natural landscape and its important role for air quality, storing water, protecting local water quality, reducing flooding and ensuring wildlife habitat (pp. 178–179). In another section, the importance of green infrastructure and SWM is emphasized, "Combine accessible passive green space with stormwater management and natural resource areas in new and existing developments in the county" (p. 141). This suggests that the two can work in combination to minimize runoff damage in new developments and 'natural resource areas,' i.e. heavily polluting areas of the County. The Plan also suggests, "The stormwater criteria of the Maryland Stormwater Management Act of 2007 prioritizes the use of environmental site designs that capture and retain enough rainfall so that the runoff leaving a site is reduced to a level equivalent to a wooded site in good condition for the most frequent storm events" (p. 181). Some flexibility might be feasible as a supporting initiative on p. 191 states, "*Explore* new techniques, technologies, and *regulation* to reduce the impacts to waterways (sedimentation and soil erosion) during mass grading for land development."

If modeling results (see Recommended Actions) indicate that the minimal changes to existing vegetation on a to-be-developed location would meet this criterion, then redirecting funds to an environmental fund to reduce high loads elsewhere is justified. The City of Frederick Comprehensive Plan (City of Frederick, 2021) tries to address state mandates, including two that follow: "Construction site runoff control and post-construction runoff control." By assessing local loads from these, redirecting some portions of SWM funds to an environmental fund for remediating load 'hot spots' would be appropriate. The City's forested watershed has 36% of its area with inadequate riparian buffers and 25% with eroded stream banks (p. 7–189). The City encourages non-structural practices (p. 5–149) and there is none more effective at load reduction than increasing and improving natural wooded areas with resources from this proposed fund.

**Co-Benefits:** If adopted, sediment and phosphorus loads to local waterways would decline from the largest contributing sectors of the community, i.e. City and County areas built prior to required SWM implementation and the agricultural community, the latter still the largest sediment-contributing sector in the watershed (see Sellner & Ferrier, 2020). Reducing sediment inputs improves water clarity and oxygenation of local waters as well as minimizes the addition of phosphorus, a nutrient critical to algal blooms in fresh and brackish waters. Additionally, vegetated areas of spot-lots and small development clusters would not be needlessly removed as often occurs during construction to meet SWM requirements, thereby maintaining valued habitat as well as carbon sequestering capacity that reduces GHGs in the area. Reserve funds could also fund tree plantings and stream restoration projects by staff, contractors, and environmental groups. New home purchasers would also know that they are paying into an environmental fund that will make meaningful differences locally.

**Equity Considerations:** This pilot project takes funds from current residential construction (generally middle to upper class families) and utilizes those funds for environmental projects that benefit the whole community.

**Cost and Cost-Benefit Analyses:** Frederick County has more than 6,000 lots remaining that fall into spot-lot, minor subdivision, or ag-cluster concepts. Believing that an 80% reduction in on-site SWM/ESD mitigation is a reasonable expectation, this concept plan would, at the rate those lots are

developed, create an environmental revenue stream of $48,000,000 over time (an average of $8,000 per lot), with no new cost to taxpayers or home buyers. There is additional economic benefit of not removing lot vegetation, particularly trees, through carbon sequestered ($51/MTCO$_2$e, Recommendation 25) and not lost through removal, as well as maintenance of biodiversity through not fragmenting local forests for development (Recommendation 26).

**Finance:** The reserve fund would be self-financed with no new taxes or fees. Administrative staff time would be required once legislation has been adopted, easily supported by funds in the environmental reserve.

**Recommended Actions:**

Legislative — City and County

- Request that the Frederick County delegation to Annapolis seek 'local deference' in permitting the County to pilot a program to assess shifting of SWM fees as outlined above.

Administrative — City and County

- The Frederick County Building Industry Association, Soil Conservation District, and City and County staff should work together to create guidelines for this program.

- Select several local builders to undertake the pilot program over 12 months.

- Site design and post-construction site conditions are evaluated by an independent authority (e.g., field staff followed by use of the Chesapeake Bay Program modeling suite or other models) to determine if 80% reduction in dislocated soils are mitigated by a 20% investment.

- County staff, in cooperation with the Soil Conservation District, the Natural Resources Conservation Service and non-profit staff working in the area (e.g., Chesapeake Bay Foundation) should develop a fair and transparent mechanism to select projects for the new fund to finance and that provide the largest reductions in sediment loads. This could be accomplished through addressing projects on waiting lists, through a competitive grant program, and other strategies that identify high priority needs.

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## 22 Facilitate the expansion of a robust local food system

**Expected GHG Reduction or Climate Adaptation:** By building a more robust local (within Maryland or 100 miles of Frederick; Precision Nutrition, n.d.) food system (access to food, availability of food, nutrition, waste, and the use of natural resources; Rosen, 2012) comprised of local regenerative farms, reductions of emissions from food production can be anticipated, but perhaps more importantly, a resilient food system can be developed that can serve our communities in the changing climate of increased storms, natural disasters, and disruptions in food distribution systems (Slusser & Mazur, 2016).

**Recommended Timeline for Action:**

**Short Term (12–18 months)**

- Encourage policy adoption and participation in the Real Food Challenge or the Good Food Purchasing Program by Frederick Community College, Hood College, and Mount St. Mary's University. These programs provide standards and frameworks that encourage large institutions to direct their buying power toward core values such as local economies, environmental sustainability, valued workforce, animal welfare, and nutrition (Real Food Challenge, Good Food Purchasing Program, n.d.). **Results metric:** Track purchase of local food as a percentage of total food purchased. **Progress metric:** Number of institutions that have adopted the policy; number of institutions that have begun participation in the program.

- Develop a training and communications program to help farmers become aware of new markets and purchasers aware of local producers and products. **Results metric:** Number of farmers selling products locally; volumes of local products sold. **Progress metric:** Identify resources and funding to develop the training and communications program; obtain funding for program; kick-off training and communications program; track number of events and participants.

Expand on the work done by Community FARE (Community FARE, n.d.) to build and strengthen the Frederick County Food Council (Frederick County Food Council, n.d.) by providing annual City or County funding to provide paid leadership staff. **Results metric:** Document hiring of at least a half-time paid director. **Progress metric:** Identify funding sources; develop plan for long term sustainability of the Council.

- Help sustain the Frederick Food Security Network (Hood College, n.d.), an urban community gardening program addressing food deserts, with annual operational funding or grants. **Progress metric:** Number and amounts of contributions or grants awarded on yearly basis.

- Collaborate among local food producers, nonprofits such as The United Way, the Community Foundation, and others serving needy families to develop a Community Farm Share program that pays for weekly Community Supported Agriculture (CSA) shares for food insecure families (Community FarmShare, n.d.). **Results metric:** Number of food insecure families in the City of Frederick and Frederick County who have access to fresh local produce. **Progress metric:** Number of CSA shares provided to food insecure families; number of local food producers participating in Community Farm Share.

- Create a verification and reporting process to ensure that restaurants claiming to purchase local foods and displaying the Homegrown Frederick decals actually do so. **Results metric:** Percentage of food purchased by local restaurants sourced from local producers. **Progress metric:** Reporting and verification process developed and implemented.

- Develop creative initiatives and incentives within the County and City Offices of Economic Development to drive customers to farmers markets and other sources of local food, e.g., vouchers for farmers markets used to reward employees. **Results metric:** Percentage of food consumed from local

sources. **Progress metric:** Number of incentives created; number of incentives distributed.

- Designate unused or abandoned plots of land for community farming and provide funding and educational resources to support local community farming. **Progress metric:** Maintain an inventory of community farming land and utilization of those areas.

### Mid Term (18 months–5 years)

Integrate food systems planning into the Frederick County comprehensive planning process. **Progress metrics:** Planning staff trained to integrate food systems planning; food systems planning incorporated into Frederick County's 2030 Comprehensive Plan.

- Provide resources, business incubator support, and financial incentives for younger farmers and farmers of color to start farming operations in Frederick County. Partner with Maryland FarmLink (Maryland FarmLink, n.d.) and Land Link Montgomery (Land Link Montgomery, n.d.) (or create a Land Link Frederick platform) to match beginning farms with available farm land to lease. **Progress metrics:** Number of new young farmers and farmers of color farming in Frederick County enrolling; number of acres farmed by young farmers and farmers of color.

- Provide incentives for established farmers to convert land in production from commodity crops to holistic planned grazing lands for meat production and vegetable, fruit, and grain crops for local sale and human consumption. **Progress metrics:** Number of acres of commodity crop lands converted.

- Develop a multi-participant plan to support (with financial incentives, grants, etc.) the scaling up of necessary local infrastructure such as slaughterhouses, cold storage, processing facilities, mills, distribution, etc. **Progress metric:** Plan completed and announced to the agricultural community and the public.

- Establish a collaborative Farm to Food Bank program (modelled after Montgomery County's) with local organizations and philanthropists that pays local farmers to grow food for food banks (Maryland Food Bank, Farm to Food Bank, n.d.). Develop a partner Farm to Food Bank Capacity Building Grant Program [United States Department of Agriculture (USDA) Emergency Food Assistance Program, n.d.] to assist Frederick County food-producing farms with the purchase of equipment and/or to build food production capacity and infrastructure in order to sell and contribute to a Frederick County Farm to Food Bank program. **Results metric:** Volume of local produce supplied to food banks. **Progress metrics:** Programs established and funded; number of farmers participating in Farm to Food Bank.

- Collaborate county-wide to assess the feasibility, benefits, and sustainability of creating a regional or Frederick County food hub. If shown to be viable, provide infrastructure, business incubator support, funding, and personnel to house and sustain a food hub, value-added processing center, the Frederick Fresh Online virtual farmers market (Frederick Fresh Online, n.d.), and year round indoor farm market. **Progress metrics:** Collaborative stakeholder group established; Community FARE's food hub feasibility study updated; food hub, value-added processing center, and Frederick Fresh Online fully operational within one facility within five years.

- Create a Farm to Freezer social enterprise coordinated among Economic Development offices, local nonprofits, farmers, and the Frederick County Food Council to turn surplus local vegetables into nutrient-rich frozen foods that are purchased at a deep discount by hunger relief agencies and those in need (Farm to Freezer, n.d.) **Progress metrics:** Coordinating body established; commercial kitchen identified; pounds of surplus produce processed, frozen, and purchased by hunger relief agencies.

### Long Term (>5 years)

Most proposed actions can be implemented within five years, but all would need to continue beyond five years to make a significant impact.

**Rationale:** According to the European Commission Joint Research Center's first global food emissions inventory, 34% of all man-made greenhouse gas emissions are generated by food systems. The researchers also determined that food generates an average of two tons of carbon dioxide equivalent ($CO_2e$) emissions per person annually (Vetter,

2021). The production of food accounts for 83% of emissions while transportation only accounts for 11% of food-related emissions (Cho, 2012). More environmentally beneficial production methods result in decreased emissions regardless of where the food is grown by minimizing greenhouse gas emissions and maximizing carbon sequestration. Moreover, small farms can more readily adopt environmentally friendly practices that sequester carbon (Cho, 2012).

Decentralized/localized food systems are more socio-economically resilient by nature (Maitin-Shepard, 2020). The Texas deep freeze in February 2021 and the COVID-19 impact on production/processing/distribution are good examples of the weaknesses of our current centralized system. According to the Food and Agriculture Organization (FAO) of the United Nations, in order to cope with shocks such as COVID-19, cities with suitable socio-economic and agro-climatic conditions should adopt policies and programs to empower local producers to grow food, and promote short food chains to enable urban citizens to access food products. Cities need to diversify their food supplies and food sources, reinforcing local sources where possible, but without shutting off national and global supplies (FAO, 2020).

If a robust inclusive local food system is built, including increasing farmer and crop diversity as well as infrastructure and facilities for processing animals and aggregating, storing, and processing foods, the resiliency of the local food supply will be greatly increased. For example, before World War II, slaughterhouses were local operations; now they are centralized and producers often have to transport animals across multiple states to have livestock processed (Corkery & Yaffe-Bellamy, 2020) adding time and expense to production costs [Metropolitan Washington Council of Governments (MWCOG), 2019] as well as the GHG emissions associated with transport.

Most regions consume only about 5-15% of their food from local sources (National Academy of Sciences, 2020). Most of the food produced in Maryland is sold for consumption outside of the state (Johns Hopkins University, 2015). This leaves Frederick County vulnerable to food distribution disruptions as a result of climate change and natural or other disasters, such as the COVID-19 supply chain disruptions.

Currently Frederick County farmers producing food for human consumption have the following challenges to increasing production to meet the needs of Frederick County residents:

- Lack of ability to aggregate produce with other farms to meet the volume requirements of institutional buyers such as hospitals, senior living facilities, schools, etc. which will have the greatest economic impact on our local food system. Institutional buying power can drive demand for and increase production of local food (1 hospital, 3 colleges, 1 adult detention center, many senior living facilities, Fort Detrick/National Cancer Institute) as well as lower prices.

- Lack of infrastructure to support aggregation, storage, processing, and value-added product processing.

- Access to affordable land for beginning farmers.

- Lack of marketing capabilities and inadequate time to focus on marketing and institutional customer relations.

- Historic systemic racism that has hampered access to land, equipment, loans, relief aid, and agricultural support programs for farmers of color.

- Insufficient numbers of skilled workers to support production, processing, and distribution of food products.

Returning to a more local system with expanded agricultural infrastructure and greater varieties of food production on small farms operated by increasing numbers of younger diverse farmers has the potential to generate a number of benefits, including:

- Strengthened local agricultural economy; for example, if all Maryland institutions purchased 10% of their food from local sources, nearly $29 million dollars would be added to the local economy (Johns Hopkins Center for a Livable Future, n.d.).

- Diminishment of historic disenfranchisement of farmers of color.

- Preservation of farmland, which can act as a carbon sink and provide flood mitigation (Russell, 2011).

- Reduced emissions associated with transportation and processing (Cho, 2012).

- Greater resilience during disasters; fewer food distribution disruptions (FAO, 2020).

- Increased number and types of markets that can attract younger and more diverse farmers during a time when average age of farmers is increasing (Metropolitan Washington Council of Governments, 2019).

- Elimination of food deserts such as the 6 identified by the Hood College Food Security Network within the City of Frederick (Hood College, n.d.).

- Greater availability, accessibility, and supply of healthier nutrient-dense local foods, which can lead to better health outcomes for all residents (Messenburg, 2013).

- With large-volume sales, food prices may decline, expanding access across all economic sectors of the community.

**The experience of other cities and counties:** Just to the south of Frederick County, Montgomery County's Food Council was able to rapidly implement a number of programs to assist farmers and families during the COVID-19 crisis in 2020 (Montgomery County Food Council, n.d.).

- Purchase of over 135,000 pounds of food from local farms to support food assistance programs in the county.

- Over $236,000 in funds for Farm to Food Bank Capacity Building Grants.

- Significant ongoing coordination, communication, and facilitation between local food producers and community food service organizations.

- Resources and guidance for accessing grants and other funding mechanisms.

Vermont has committed significant state resources for a decade through its Farm to Plate Investment Program, with leadership from a Farm to Plate Network representing, in its words, "farms, food production businesses, specialty food producers, educational institutions, nonprofit organizations, funders, capital providers and government personnel." Through that sustained effort, the percentage of local food expenditures increased from 5% in 2011 to 13.9% by 2020 (Farm to Plate, n.d.). The 2019 Farm to Plate annual report also noted the following progress made since Farm to Plate's founding in 2009 (Farm to Plate, 2019):

- From 2007 to 2017, Vermont food system economic output expanded 48%, from $7.5 to $11.3 billion.

- From 2009 to 2018, net new food system employment increased by 6,529 jobs (+11.2%).

- In total, over 64,000 people and 11,500 businesses are now part of Vermont's food system.

A number of areas across the country have seen significant increases in purchases of local food as a result of implementing the Center for Good Food Purchasing's program (Stephens, n.d.). According to the Center for Good Food Purchasing, the Los Angeles Unified School District increased the purchasing of locally produced fruits and vegetables from 9 to 75% within two years of implementing the program. The results have been significant enough that many other jurisdictions in California, including the Oakland school district and University of California system, are implementing similar programs.

Washington, D.C. Public schools adopted the Good Food Purchasing program for their 114 schools and became the 9th public school district to sign on to the program. They completed their first baseline assessment for the 2018/2019 school year (Good Food Purchasing Program Washington, D.C., n.d.).

Iowa's Field to Family non-profit organization (Field to Family, n.d.) has implemented a number of programs, including an online farmer's market (in response to COVID-19 impacts in 2020), free local food provided to food security organizations and directly to families in need, aggregating food from local producers through a food hub to support wholesale customers as well as direct-to-consumer sales, and supported

farm to school education programs. One example of this program's success is in the purchase of locally grown food for PK–12 schools, increasing farm to school procurement 54% in 2020.

**Connections to City and County Reports:** The Livable Frederick Master Plan includes the following goal: Support and protect Frederick County's agricultural community and existing and emerging agricultural industries, to promote an environment where agriculture operations continue to be competitive, sustainable, and profitable in Frederick County (Frederick County, 2019). In addition, the plan includes a Local Agriculture initiative that proposes support for locally produced agricultural products and sustainable and innovative farming practices. One of the supporting initiatives is, "Provide incentives to the local farming community to sell products locally." The draft 2020 City of Frederick Comprehensive Plan (City of Frederick, 2021) also supports local food sourcing as it states, "Support local farms and farmers to grow produce for local use, resulting in a reduction in greenhouse gases from transportation and fresher healthy options for our people." This recommendation supports these goals and initiatives.

**Equity Considerations:** When disasters or supply disruptions strike, low-income communities are often impacted the most. Families in these communities are often living paycheck to paycheck and may not have ample food supplies in their homes to carry them through emergencies. When food supply chains are disrupted, so are the capabilities of social service agencies providing emergency food. When more locally grown and processed food is available in amounts that can supply institutional needs, grocers and social service agencies have more options available to meet the needs of the local population at lower prices and will be less dependent on centralized supply chains.

Even in the best of times, poorer communities do not typically have access to nutritious locally produced fresh produce and meats, nor may families be able to afford them if they are available. This results in negative health outcomes in these communities (e.g., ver Ploeg, 2010). As noted above, increasing production and local markets should make these foods less expensive and more accessible through equitably distributed and accessible farmers markets, sales to schools, the Farm to School program, Meals on Wheels, Senior Centers, etc. By increasing the amount of nutrient-dense fresh local foods provided by institutions such as K–12 schools, grocery stores, and food pantries, health outcomes can improve.

As catalogued in Nadra Nittle's article, "Black-Owned Farms are Holding on by A Thread" (Nittle, 2021), from Reconstruction, through the Depression, the Dust Bowl and the New Deal, to the recent COVID-19 crisis, farmers of color have suffered from systemic racial discrimination and disenfranchisement by local and state governments, financial institutions and loan programs, and federal agricultural support and crisis relief programs. Today White landowners possess 98% of all farmland, and 95% of farmers are white. From 2017–2021, White business owners received 99.5% of the subsidies designed to help farmers survive the trade war with China. And although record subsidies were provided to help farmers rebound from COVID-19, African Americans working in agriculture for the most part did not receive these monies or obtain federal Paycheck Protection Program and Coronavirus Food Assistance Program aid designed to help businesses weather the pandemic.

It is hoped that by building more local food demand and market opportunities, demand for farmers will increase and more farmers of color could be attracted and incentivized to grow here in Frederick County. The movement of African Americans to reclaim their roots and livelihoods in farming could be bolstered by the Justice for Black Farmers Act introduced in the Senate, which seeks to give Black farmers the training, financial resources, and farmland they need to succeed (Abbott, 2021). In addition, of the $10.4 billion in the American Rescue Plan that will support agriculture, approximately half would go to disadvantaged farmers, about a quarter of which are Black. These funds would provide debt relief as well as grants, training, education, and other forms of assistance aimed at acquiring land (Reilly, 2021).

**Cost and Cost-Benefits Analyses:** The Johns Hopkins Center for a Livable Future reported in

2019 that Maryland institutions, including hospitals, universities, and K–12 schools, purchased just 1–2% of their foods from local sources. If they increased that to just 10%, $28,821,666 would be returned to the local economy; if it increased to 25%, $72,054,166 would be put back in the local economy (Johns Hopkins Center for a Livable Future, n.d.). These estimates do not include the substantial impact other institutions, such as senior living facilities, nursing homes, and adult detention centers, could have on local economies.

According to the Feasibility Analysis for the Frederick Food Hub conducted in 2016 by Community FARE (Community FARE, 2016), creating the infrastructure to connect farmers to fair and transparent market opportunities is perhaps the best way to improve the vibrancy, viability, and diversity of regional agriculture. The researchers suggest that the disappearance of this infrastructure — both social and physical — has contributed to the decline of rural economies in many regions of the country while food systems have shifted from a regional orientation to a global one. In communities like Frederick and the surrounding counties, the disappearance of farm activity has been exacerbated by suburban sprawl from Washington, D.C. and Baltimore. A Food Hub in Frederick County could (a) counter these trends by offering a viable economic alternative for farmers and policy makers to justify investment in the growth of sustainable (regenerative) agriculture, and (b) establish itself as a fair and transparent intermediary between regional demand segments and food producers in Frederick and surrounding counties.

In order for a food hub to be an effective and sustainable intervention, it needs to operate as a viable social enterprise and demonstrate the ability to sustain itself financially after a period of startup investment. This study analyzed the potential economic impact of a Frederick food hub using a regional development tool provided by the Bureau of Economic Analysis (BEA) called the Regional Input-Output Modeling System (RIMS II; BEA, n.d.). According to the analysis, which was built upon the study of the food hub business model that has emerged in more than 225 communities throughout the country, a Frederick food hub has a potential regional economic impact of nearly $8 million over five years while creating close to 50 local jobs. This includes all the linked industries, such as the farms, farm-input industries, and service providers, as well as the markup on products, which covers internal operating costs and the external services of a food hub.

Many studies have also shown that a healthy local agriculture economy has impacts on the broader economy. According to the 2019 MWCOG report, What Our Region Grows (MWCOG, 2019), local agriculture is not just a feel-good marketing strategy, it benefits both the farmers and the local economy. Buying local food allows farmers to keep more of the retail food dollar and creates benefits through the *multiplier effect*. The baseline multiplier for buying local is 1.4 to 2.6 depending on the locale and commodity. The larger the multiplier, the more a dollar circulates in a region and can create more income, wealth, and jobs.

**Co-Benefits:** Increasing local food production could lead to more ancillary businesses that improve the local economy such as a food hub; value-added products and processing; meat processing facilities; feed stores, agricultural supply and equipment businesses; and delivery services. Local food keeps local money in the community and local land in production, reducing the economic needs of some farm families to sell their farms to developers. Local food often costs less than conventionally produced food (Cho, 2012), and builds community relations.

Decentralized food production also reduces food safety risks, as long-distance food can potentially be contaminated at many points during transportation (Cho, 2021). Local food grown with regenerative practices produces more local nutrient-dense foods resulting in healthier county residents. Regenerative agriculture improves soil health, which leads to increased environmental resilience of land, increased water retention, and stronger stormwater mitigation, and is discussed in more detail in Recommendation 19.

Another important environmental benefit of local food is that it keeps nutrient cycling at the local level, while conventional agriculture can upset a region's natural nutrient balance. For example, plants need nitrogen and phosphorus to grow, and

both are contained in fertilizer and in agricultural waste. If phosphorus in fertilized grain grown in the midwest is shipped to the northeast for dairy cow feed, and then dairy cow manure is applied to fields in the northeast, the excess phosphorus runs off into streams, lakes, and finally the ocean. Such runoff can result in eutrophication, a serious form of water pollution where algae bloom, then die, creating a dead zone. If nutrients were cycling locally, there would be no excess (Cho, 2012).

Urban food production using sustainable practices brings nutrient-dense foods to underserved populations, resulting in improved health outcomes and greater food security (Messenburg, 2019).

**Finance:** The work needed to increase markets and demand for local food combined with advocacy and training to encourage and expand the adoption of regenerative agriculture practices requires input and support from a broad range of City, County, State, and Federal governments as well as both nonprofit and for-profit enterprises. Similar efforts in many communities across the United States illustrate the need for many different funding approaches. Most communities rely on a mix of public funding coming from the City, County, or State budgets, grants coming from philanthropic organizations, as well as government agencies, and community funding coming from local non-profits and individual donations. Enterprises such as food hubs may be non-profit, for-profit, or cooperatives. Examples of potential funding options include the following:

- On May 5, 2021 United States Department of Agriculture (USDA) Agricultural Marketing Service (AMS) announced the availability of $15.3 million in funding for the second ever Request for Applications (RFA) for the Regional Food Systems Partnership (RFSP) Program. RFSP is a new program that supports foodshed-level approaches to developing regional food economies (National Sustainable Agriculture Organization, 2021).

- The Sustainable Agriculture Research and Education (SARE) program is a decentralized competitive grants and education program operating in every state and island protectorate. Funded by the USDA's National Institute for Food and Agriculture, the program is run by four regions (North Central, Northeast, South, and West) hosted by land grant institutions. SARE Outreach provides communication and technical support at the national level (Sustainable Agriculture Research and Education, n.d.).

- Appropriate Technology Transfer for Rural Areas provides training and research on sustainable farming practices and maintains a repository of regional as well as national funding opportunities (Appropriate Technology Transfer for Rural Areas, n.d.).

- USDA Agricultural Marketing Service issues grants under the Local Food Promotion Program (USDA Agricultural Marketing Service, n.d.).

- The American Rescue Plan includes $10.4 billion that will support agriculture. Approximately half of that would go to disadvantaged farmers, about a quarter of which are Black. The money would provide debt relief as well as grants, training, education, and other forms of assistance aimed at acquiring land.

- Many Food Councils are at least partially funded by County or State Public Health agencies and by public health-focused philanthropies such as the Kaiser Family Foundation because of the significant health benefits associated with addressing food security issues and consumption of local, sustainably produced food.

- The USDA Farmers Market Promotion Program funds projects to help increase access to and availability of locally and regionally produced agricultural products by developing, coordinating, expanding, and providing outreach, training, and technical assistance to domestic farmers markets, roadside stands, community-supported agriculture programs, agritourism activities, online sales or other direct producer-to-consumer (including direct producer-to-retail, direct producer-to-restaurant, and direct producer-to-institutional marketing) market opportunities (USDA Farmers Market Promotion Program, n.d.).

- The Mid-Atlantic Food Resilience and Access Coalition (MAFRAC) Local Food Grant Application is offering funding to help local businesses and nonprofits source food from local farmers and food

businesses (MAFRAC, n.d). The Local Food Grant is an initiative that supports food relief by nonprofits and businesses that are distributing food free of charge or pay-what-you-can models. MAFRAC will pay for the locally grown foods to be donated, up to $15,000.

**Recommended Actions:**

### Legislative

- Enact the Good Food Purchasing Policy and encourage participation in the Good Food Purchasing Program from the Center for Good Food Purchasing for Frederick County and City of Frederick institutions and Frederick County Public Schools. Include a goal of purchasing at least 20% of food from local suppliers by 2025 in each policy. The Good Food Purchasing Program provides a metric-based, flexible framework that encourages large institutions to direct their buying power toward five core values: local economies, environmental sustainability, valued workforce, animal welfare, and nutrition (Good Food Purchasing Program, n.d.). Alternatively, implement legislation similar to Maine's Act to Expand the Local Foods Economy by Promoting Local Foods Procurement (Maine Legislature, n.d.).

- Implement tax incentives to promote urban agriculture as described in Recommendation 17.

### Administrative

- Integrate food systems planning into the Frederick County comprehensive planning process. By combining economic development, local infrastructure and commercial services, natural resources, land use, open space, and conservation under the overall umbrella of tying together food producers, processors, distributors, retailers, restaurateurs, and consumers, Frederick County can create a coherent system that focuses on protecting local agricultural lands, making farms economically profitable, and producing, buying, and selling as much local food as possible (Russell, 2011).

- Provide resources, business incubator support, and financial incentives for younger farmers and farmers of color to start farming operations in Frederick County. Partner with Maryland FarmLink (Maryland FarmLink, n.d.) and Land Link Montgomery (Land Link Montgomery, n.d.) (or create a Land Link Frederick platform) to match beginning farmers with available farm land to lease.

- Provide incentives for established farmers to convert land in production from commodity crops to grazing lands for meat production (for example, Chesapeake Bay Foundation Farm Stewardship Program) and vegetable, fruit, and grain crops for local sale and human consumption.

- Develop a plan to support the scaling up of necessary local infrastructure such as slaughterhouses, cold storage, processing facilities, mills, distribution, etc. Support the initiative with grants and incentives. Recommendations are available in the Farming at Metro's Edge Report (Montgomery County, MD, 2013).

- Expand on the work done by Community FARE to build and strengthen the Frederick County Food Council by providing City and County funding to enable paid leadership staff. Food councils are community-based coalitions consisting of multiple organizations and individuals that help promote more resilient food systems. Effective Councils build connections across stakeholders and collaborate to improve human health, food access and security, natural resource protection, economic development, production agriculture, and consumer education and food literacy (i.e., understanding the impact of your food choices on your health, the environment, climate resilience, and our agricultural economy; Montgomery County, MD, 2013). Using this cross-sector approach, food councils solve broad food system issues and give communities more control over the food they consume. Model the work done by Montgomery County to establish and maintain the Montgomery County Food Council (Montgomery County Food Council, n.d.).

- Provide operational funding or grants for the Frederick Food Security Network, a community gardening program from the Hood College Center for Coastal and Watershed Studies. The Frederick Food Security Network has established a network of community gardens in Frederick to improve food security for residents of local food deserts, reduce local water pollution by diverting rooftop runoff for use as irrigation, and promote better eating habits and environmental stewardship in the Frederick community (Hood College, n.d.).

- Create a verification and reporting process to ensure that restaurants claiming to purchase local foods and displaying the Homegrown Frederick decals actually do so.

- Develop a training and communications program to help farmers become aware of new markets and purchasers aware of local producers and products.

- Replicate Montgomery County's Farm to Food Bank Capacity Building Grant Program (USDA Food and Nutrition Service, n.d.). to assist Frederick County-based food producing farms with the purchase of equipment, and/or to build food production capacity and infrastructure, in order to sell and contribute to a Frederick County Farm to Food Bank program (see program description under Community, below).

- Develop creative initiatives and incentives within the City and County Offices of Economic Development to drive customers to farmers markets and other sources of local food. For example, Maine's Federation of Farmers Markets created Bumper Crop vouchers for farmers markets that companies can use to reward employees (Maine Federation of Farmers Markets, n.d.).

- Designate unused or abandoned plots of land for community farming and gardens, and provide educational resources to support local community farming.

### Community

- Assess the feasibility, benefits, and sustainability of creating a regional or Frederick County food hub in conjunction with the planned value-added processing center for purchasing by wholesale customers that also incorporates the Frederick Fresh Online virtual farmers market for retail customers. If shown to be viable, provide infrastructure, business incubator support, funding, and personnel to house and sustain a food hub, value-added processing center,the Frederick Fresh Online virtual farmers market, and an indoor farmers market (Frederick Fresh Online, n.d.).

- Support a program similar to the Montgomery County program that pays farmers to grow food for food banks. Encourage local governments, health and human service organizations, philanthropists, food banks, soup kitchens, local food producers, and farmers markets to collaborate to model the Farm to Food Bank program of Montgomery County (Maryland Food Bank, n.d.) and the Manna Food Center in Silver Spring, MD (Manna Food Center, n.d.). Farm to Food Bank strengthens the local food system by enabling affordable purchasing of fresh food from local producers, as well as fresh produce rescue and donations, the bounty of which is distributed to food insecure families.

- Encourage policy adoption and participation in the Real Food Challenge or the Good Food Purchasing Program by Frederick Community College, Hood College, and Mount St. Mary's University. These programs provide standards and frameworks that encourage large institutions to direct their buying power toward core values such as local economies, environmental sustainability, valued workforce, animal welfare, and nutrition (Real Food Challenge, n.d.; Good Food Purchasing Program, n.d.).

- Collaborate among food producers, nonprofits such as The United Way and the Community Foundation, and others serving needy families to develop a Community Farm Share program that provides weekly CSA shares to food insecure families (Community Farm Share, n.d.).

- Create a Farm to Freezer social enterprise coordinated among Economic Development offices, local nonprofits, farmers, and the Frederick County Food Council to turn surplus local vegetables into nutrient-rich frozen foods that are purchased at a deep discount by hunger relief agencies and those in need (Farm to Freezer, n.d.).

- Expand outreach and training programs to teach food insecure families and others how to use fresh produce. The Manna Food Center in Montgomery County, Maryland has a Community Food Education Program that could be a model for efforts in Frederick County (Manna Food Center, n.d.).

### What individuals can do

- Commit to buying locally grown food at stores, farmers markets, CSAs, Frederick Fresh Online, and online directly from farmers. Participate in the Frederick County Food Council.

- Donate to, and volunteer with, organizations supporting local farms and working to build local food systems.
- Frequent restaurants sourcing their food locally.
- Participate in municipal, school, college, and corporate Green Teams and advocate for locally sourced food initiatives (Real Food Challenge, n.d.).

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## 23 Encourage adoption of plant rich-diets

**Expected GHG Reduction or Climate Adaptation:** Total emissions associated with producing the average U.S. diet are estimated at 5.0 kg $CO_2e$ per person per day, equaling 1.8 metric tons of $CO_2e$ per person each year, or 11% of per capita GHG emissions in Frederick County [Heller et al., 2020; Metropolitan Washington Council of Governments (MWCOG), n.d.]. If 10% of the county (26,000 people) decreased their intake of animal-based food by half, the food-based emissions could be reduced to 1.2 metric tons $CO_2e$/person/year. The savings of 0.6 $MTCO_2e$ is equivalent to removing 3,393 cars from the road each year (Environmental Protection Agency [EPA], 2021).

**Timeline for Action:**

### Short Term (12–18 months)

- Establish a program within the Climate Response and Resilience Office (Recommendation 1) to promote education and awareness regarding the importance of plant-rich diets to both mitigate climate change and improve health. **Progress metric:** Creation of the Climate Response and Resilience Office; completion of a plant-rich diets education and outreach plan.

- Integrate education and awareness of the importance of plant-rich diets in the development of a robust local food system (Recommendation 22). **Progress metric:** Draft components of virtual and print materials for distribution.

- Amend City and County purchasing processes to prioritize purchase of sustainably (and preferably locally) produced plant-rich food at all City and County facilities and events. **Progress metric:** Completed updates to purchasing guidelines. **Results metric:** Number of plant-rich options available in City and County facilities; percentage of food that is plant based and sourced locally.

- Mount an extensive and highly visible County-wide campaign on the climate and health benefits of a plant-rich diet that includes meat produced sustainably. **Progress metric:** Allocation of resources to support outreach campaigns; development of materials; number of outreach engagements completed.

- Encourage and incentivize restaurants to add more vegan/vegetarian and regeneratively farmed meat entrees, and to indicate on their menus which items have a lower carbon footprint. **Progress metric:** Development of materials to support restaurants; number of restaurants consistently offering vegan/vegetarian options.

- Institute community-wide diet challenges aimed at individuals, schools, religious and service organizations, and restaurants. **Progress metric:** Development of diet challenge program.

- As noted in the City of Frederick Sustainability Plan, explore options to improve food choices in areas that currently do not have grocery stores or healthy food options, such as mobile food trucks offering locally grown fresh vegetables or a year-round farmer's market in the City (City of Frederick, 2016; also see Recommendation 22). **Results metric:** Reduction in number of food deserts; reduction in number of food-insecure people reporting challenges to purchasing healthy food options.

### Mid Term (18 months–5 years)

- Extend the prioritization of plant-rich food purchases to Frederick County Public Schools (FCPS), favoring local sustainably grown purchases when possible. Support and build upon Community FARE's partnership with FCPS and the Farm to School program. Examples of similar programs can be found at D.C. Central Kitchen (n.d.) and Green Bronx Machine (n.d.). **Progress metric:** Development of guidelines and plans for schools to implement additional plant-rich options. **Results metric:** Number of schools offering plant-rich options; percentage of meals purchased that are plant rich.

- Encourage and support curricula at FCPS schools that increase the knowledge of food production and its relation to human and environmental health. **Progress metric:** Identification of curricula to be used in FCPS schools at various grade levels; outreach to schools regarding plant-rich diets/healthy eating curricula. **Results metric:** Number of schools that incorporate plant-rich diets/healthy eating curricula.

- Provide training and opportunities for food ambassadors to local faith-based and service organizations, schools, and businesses to encourage dietary change and purchase of locally produced products from farms using regenerative practices. **Progress metric:** Selection or development of training program; identification of organizations to provide food ambassadors. **Results metric:** Number of food ambassadors trained; number of engagements completed by ambassadors.

- Promote and support community gardens (see Recommendations 17 and 22). **Results metric:** Number of community gardens; number of people participating in community gardening programs.

### Long Term (>5 years)

- Ongoing development of short- and medium-term actions

**Rationale:** With the exception of carbon-sequestering managed grazing practices (grazing used in regenerative agriculture), the production of meat and dairy contributes significantly more emissions than growing plants as food sources. The most conservative estimates suggest that raising livestock accounts for nearly 15% of global GHGs emitted (Hawken, 2017) and 8% of total U.S. GHG emissions (Birney et al., 2017).

Agriculture has had one of the largest impacts on the environment by transforming habitats and reducing biodiversity. Producing livestock accounts for 77% of global farmland but provides only 18% of global caloric intake and 37% of its protein supply, highlighting the inherent inefficiency of livestock-based nutrition (Ritchie, 2019). Additionally, almost one-third of the total water footprint of agriculture is related to the production of animal products. The water footprint of any animal product is larger than that of crop products with equivalent nutritional value (Mekonnen & Hoekstra, 2012).

Industrial beef production is the top driver of tropical deforestation. Because of increasing global demand for meat, increasing acres of forest are converted either to pasture for livestock or to farmland to raise livestock feed (World Wildlife Federation, 2018). The United States imports approximately 8–10% of the beef consumed in this country. Because beef and pork products are exempt from the Country of Origin Labeling Law, foreign-raised beef can be labeled as "Product of the USA;" thus, American consumers may unwittingly contribute to deforestation (Cummins, 2018).

The health benefits of a diet based on less meat and more plant-based protein are well known, including reduction of risk of diabetes, cardiovascular disease, and cancer (Qi & Shen, 2020). According to the Proceedings of the National Academy of Sciences, "transitioning toward more plant-based diets... could reduce global mortality by 6–10% and food-related GHG emissions by 29–70% compared with a reference scenario in 2050" (Springmann et al., 2016). Project Drawdown ranks Plant-Rich Diet as the #4 solution (out of 100 ranked solutions) to reducing GHG emissions and states, "Among the most fundamental research findings on this topic is that healthier diets tend to also be low-emission diets" (Hawken, 2017).

Although selection of plant-rich diets is a personal and growing global commitment, some jurisdictions have instituted several specific actions to transition to low-meat diets. Starostinetskaya (2021) reports that the city council of Berkeley, California passed a resolution to reduce the amount of animal products the city purchases by 50% by 2024, the first U.S. city to commit to vegan meals. New York City's Department of Education (2021) has set up vegetarian meals across the city. The Physicians Committee for Responsible Medicine (n.d.) indicates that the city also serves plant-based meals exclusively to all 1 million of its students on Mondays as part of its Meatless Mondays campaign. As well, the Santa Barbara Unified School District provides approximately 50% of its meals (or 1 million) as vegan. The Los Angeles Unified School District set up a pilot program for vegan choices in 2017 and it

was so successful that vegan options may now be across the entire district (Szymanski, 2017). It also appears that increasing the proportion of vegetarian meals in the choices offered in cafeterias results in greater selection of vegetarian dishes, i.e., >14% with similar reductions in meat sales (Garnett et al., 2019).

In the Healthy Choices section of the Livable Frederick Master Plan (Frederick County, 2019), multiple statements suggest making diet choice information routine throughout the community. Several specific points include, "support the awareness of nutrition and the availability of healthy food choices" with incorporation of locally grown or prepared foods into school meals and snacks, visits from food producers, cooking classes, nutrition and waste-reduction efforts, and school gardens as supporting initiatives. Another example is "support efforts to modify lunch food environments to prominently display, market, and increase the convenience of healthy foods and provide healthy options." A third example is "collaborate with local hunger relief organizations and agencies to ensure the connection of hunger relief efforts with nutrition information" (Frederick County, 2019, p. 142). In the City, the Comprehensive Plan (City of Frederick, 2021) commits to appropriate food for its residents, stating, "This Plan's policies support a strong local economy with access to jobs, services and amenities, a healthier lifestyle by promoting and accommodating alternative transportation options, improved parks and recreational activities, as well as access to *nutritious food choices*" (p. 1-40). Through these adopted plans, the City and County have indicated the intent to educate its residents of the most beneficial diet choices for local public health as well as to reduce local GHG emissions.

**Co-Benefits:** Improved human health is the primary co-benefit of adopting a plant-rich diet. A study published in the Journal of the American Heart Association, which followed over 12,000 patients for 30 years, conclusively demonstrated that diets higher in plant foods and lower in animal foods were associated with a lower risk of cardiovascular morbidity and mortality in the general population (Kim et al., 2019). A more recent study that followed over 100,000 men and women for 30 years concluded that higher intakes of fruit and vegetables were associated with significantly lower mortality attributable to cancer, cardiovascular disease, and respiratory disease (Wang et al., 2021).

In addition, decreasing the impact of animal agriculture on deforestation, biodiversity, and water use are significant co-benefits.

An added economic benefit is that decreased consumption of animal protein can shift food-related resources and consumers to local farmers: A recent Washington Post editorial by a regenerative farmer noted "If Americans eat less meat, but better meat, we can help keep smaller, local farms in business..." (Jaster, 2021).

**Equity Considerations:** Underserved communities are more susceptible to the health risks of poor diet. Several epidemiological studies document the excess burden of cardiovascular diseases and diabetes among these communities compared to the general population (Micha et al., 2017). By placing an emphasis on prevention of disease, a strong commitment of the County Health Department (Recommendation 1), by altering diet, a positive impact on health can be anticipated.

**Costs and Cost-Benefit Analyses:** The cost savings to an individual can be substantial by substituting less expensive foods such as legumes for meat. The potential for savings in community health care costs is significant, with a decrease in direct health care costs such as medical visits, hospitalizations, and prescription costs related to diet-related diseases, in addition to indirect costs such as lost days of work (Springmann et al., 2016). According to Eddington et al., (2020), chronic illnesses, all linked to dietary choice, comprise 90% of the nation's annual healthcare expenditures, and lifestyle medicine programs that emphasize diets rich in fruits and vegetables report up to $3.92 saved on each dollar spent. This recommendation is aligned with the goal outlined in 2015 when the City of Frederick, citing health care costs in Maryland attributable to diet and inactivity, adopted the Healthy Eating Active Living Policy in order to combat obesity (City of Frederick, 2013).

**Finance:** Besides the suite of Federal grant programs listed in Recommendation 22, there are several

private organizations that offer grants for exploring plant-based diets and supply chains. One is Eat the Change grant program that provides small grants to shift production practices and diets to plant-based systems. The Vegan Society offers small grants to educate local community members about shifting to non-meat diets; it also lists multiple other sources for encouraging plant-based diets (https://vegfund.org/resource/funding-and-grant-sources-for-vegan-advocacy).

**Recommended Actions:**

Administrative and Legislative, City and County:

- Establish a program within the Climate Response and Resilience Office (Recommendation 1) to promote education and awareness regarding the importance of plant-rich diets to both mitigate climate change and improve health.

- Integrate education and awareness of the importance of plant-rich diets in the development of a robust local food system (Recommendation 22).

- Lead by example (Recommendation 2): Amend City and County purchasing processes to prioritize purchase of sustainably (and preferably locally) produced plant-rich food at all City and County facilities and events. "Meat of the Matter: A Municipal Guide to Climate-Friendly Food Purchasing" (Hamerschlag et al., n.d.) provides tools and examples. Encourage outreach programs such as Meals on Wheels, the Community Action Agency, and others that receive local government grants to provide more locally sourced, plant-rich-focused meals to the extent possible.

- Extend the prioritization of plant-rich food purchases to FCPS, favoring local sustainably grown purchases when possible. Support and build upon Community FARE's partnership with FCPS and the Farm to School program. Examples of similar programs can be found at D.C. Central Kitchen (n.d.) and Green Bronx Machine (n.d.).

- Encourage and support curricula at FCPS schools that increase the knowledge of food production and its relation to human and environmental health.

Community:

- Mount an extensive and highly visible county-wide campaign on the climate and health benefits of a plant-rich diet that includes meat produced sustainably.

- Encourage and incentivize restaurants to add more vegan/vegetarian and regeneratively produced meat entrees, and to indicate on their menus which items have a lower carbon footprint. Recognition of their efforts could be pursued through the Sustainability Awards from the Frederick County Sustainability Commission. Publishing and marketing of these organizations' efforts could be promoted through the Chamber of Commerce or the Downtown Frederick Partnership. Cool Food is a nonprofit organization that can help larger organizations decrease their GHG emissions related to food procurement. This organization has experience particularly with health care systems and universities through their Cool Food Pledge program: Members pledge to decrease their food-related emissions by 25% by 2030 and, in turn, are provided various interventions to assist with that goal (Cool Food, n.d.).

- Institute community-wide diet challenges aimed at individuals, schools, religious and service organizations, and restaurants. Meatless Monday is a global campaign created in association with Johns Hopkins Center for a Livable Future to improve health promotion strategies. It offers free resources and marketing materials (Meatless Monday, n.d.). A program/challenge for individuals similar to Frederick County Sustainability Commission's Green Homes Challenge (n.d.) could be instituted. Many of the above initiatives can be organized and amplified through the already existing LiveWellFrederick (n.d.) partnership.

- Provide training and opportunities for food ambassadors to local faith-based and service organizations, schools, and businesses to encourage dietary change and purchase of locally produced products from farms using regenerative practices. Ambassadors could be paid or volunteer — possibly students from the culinary program at FCC or students from the sustainability studies program at Hood College.

- As noted in the City of Frederick Sustainability Plan, explore options to improve food choices in areas that currently do not have grocery stores or healthy food options, such as mobile food trucks offering locally grown fresh vegetables or a year-round farmers market in the City (City of Frederick, 2016).

- Promote and support community gardens (Recommendations 17 and 22).

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## 24 Prevent disposal of organic material

**Expected GHG Reduction or Climate Adaptation:** Using the Environmental Protection Agency's (EPA) Waste Reduction Model (WARM) Tool (EPA, n.d.-g) to calculate GHG emissions benefits, it is estimated that if Frederick County composted the 31,958 tons of food waste currently sent to landfill, 15,703 $MTCO_2e$ would be reduced annually. This estimate is derived by combining emissions eliminated (11,957 $MTCO_2e$) with carbon sink benefits of 3,746 $MTCO_2e$ accrued from composting the food. If the County was using the Social Cost of Carbon of $51 per metric ton to calculate real costs, the *additional* costs associated with this waste is $1,629,858 each year. The reduction of 15,703 $MTCO_2e$ per year is equivalent to removing 3,334 passenger vehicles from the road annually (EPA, n.d.-b). Tracking tonnage of food waste diverted over time will identify reductions in $MTCO_2e$ as landfill loads decline.

**Timeline for Action:** Set an implementation goal of diverting at least 10% of organic material from disposal per year, so that almost all will be eliminated from landfills or incineration within 10 years.

### Short Term Actions:

- Within the first two years, Frederick County should hire/contract for an Organics and Compost Manager and focus on piloting residential and large generator waste reduction education efforts.

- Frederick County's program should focus initially on school waste reduction efforts and expansion of food discard diversion (through food waste reduction education, food rescue share tables, and composting) from its current level of eight schools (pre-pandemic) to half the school system. To further the program's impact, a coordination plan for food rescue among Frederick County partners should also be developed and implemented.

- A goal should be established to develop composting facilities with efforts to expand public/private facility locations, while seeking communities to pilot models of compost collection and thereafter, distribution strategies.

### Long Term Actions:

- Waste reduction education should be accomplished not only in the educational sector but should be expanded to commercial/institutional, business, and residential audiences.

- While results of the compost pilot collection methods are analyzed, an additional facility location should be selected and opened to create more capacity as composting scales up. Overhead/operational savings from diversion should be made available to fund grant programs for compost equipment and education to expand food waste reduction.

It should be noted that composting and food waste reduction have been discussed within the County since 2006, when citizens suggested alternatives to the proposed waste-to-energy facility that was later abandoned.

**Rationale:** According to the U.S. Department of Agriculture, 40% of food is never eaten, while up to 38 million tons of food — worth $168 billion — are thrown out each year (EPA, 2016a). Almost 30% of the municipal solid waste (MSW) stream generated in the U.S. is organics, and nearly all of it is disposed of in landfills or incinerators (Bilgri & Darby, 2020). Organic materials are comprised of food and other plant and animal wastes, such as soiled paper and yard debris. Waste sorts in the region (Montgomery, Howard Counties) show that food represents roughly 21% of MSW (Sierra Club Maryland Chapter, 2019).

Diverting organics from a landfill decreases methane ($CH_4$) produced. These sites yield about 15% of the U.S. methane emissions caused by human activities (EPA, 2021). Methane is 84 to 86 times more potent than $CO_2$ in the first two decades after it's released, and while methane doesn't remain in the atmosphere

as long as $CO_2$, methane traps radiation more efficiently than $CO_2$ contributing to the extreme heat and storms now common.

Frederick County sends 152,185 tons of municipal solid waste to a landfill each year (P. Harris, County Public Waste director, April 8, 2021), 31,958 tons as food waste. Composting or otherwise diverting this food will save disposal costs and prevent generation of methane as well as GHG emissions from hauling waste to the landfill that Frederick County contracts with in Chambersburg, PA.

In addition to direct GHG reduction benefits associated with reduction of methane from food waste in landfills, food that is not diverted to landfills is a valuable resource that can be used in a number of different ways. The Environmental Protection Agency's Food Recovery Hierarchy (n.d.-a; Fig. 1) provides a six-tier model to understand and approach food waste reduction. The first, and most preferred option, is Source Reduction, which has the benefit of reducing GHGs and resource use (water, land, etc.) that goes into producing food that is never consumed. The second tier is Feed Hungry People by donating extra food to food banks, soup kitchens, and shelters, which helps to support communities in need as well as potentially providing additional markets for local producers (Recommendation 22).

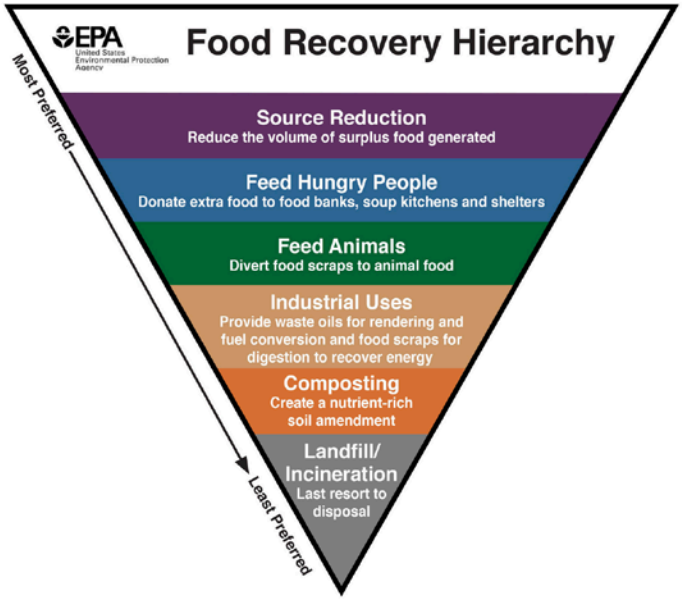


**Figure 1. Food recovery hierarchy (EPA, n.d.-a)**

The third tier is to Feed Animals, which again has potential co-benefits for local farmers. The next three tiers for diversion are Industrial Uses (for example waste oil as fuel, Recommendation 16), Composting, and finally, Landfills/Incineration. Ideally, the vast majority of food waste should be addressed via the top five tiers of the Food Recovery Hierarchy, with a minimal amount of waste remaining to be sent to the landfill.

Multiple jurisdictions have established a suite of programs to reduce food waste diversion to landfills. The Pew Foundation reports that at least eight states in the Northeast, mid-Atlantic, and CA, require re-processing of food waste (Povich, 2021). New York is converting waste into compost and gas and smaller cities like Portland, OR, San Francisco, CA, and Seattle, WA all have mandatory programs (Reub, 2017). Fife (2020) reports on conversion of food waste into animal feed with examples from the U.S., Japan, South Korea, and New Zealand. Similar processing should be considered locally. Sustainable America (n.d.) outlines multiple ways to divert food to the hungry, with many U.S. examples.

The Livable Frederick Master Plan (Frederick County, 2019) includes the Solid Waste and Recycling Goal: "Plan for a 'zero waste' future by 2040." There are several initiatives outlined, including "increase recycling and composting for all residential dwellings, businesses, and institutions." In the City of Frederick's Strategic Plan in Appendix 2, Suggested Action Items, a suggested action under 1.03.002 Implement and Resource the approved Sustainability Plan, is to mandate or incentivize composting for all residents and buildings (City of Frederick, 2019).

The City of Frederick's Sustainability Plan (City of Frederick, 2016) describes that City staff conducted an informal study of the City's residential trash to determine recycling and home composting potentials. The potential compostables made up about 22% of the waste that was taken to the landfill, though meat, dairy, bones, and fats were not included in the compostable weight. Based on information from this informal study, staff estimated that City residents could potentially reduce compostables thrown into the landfill by more than 136,000 pounds each year. The report also indicated that the City

realizes the value of doing a waste study, ideally in partnership with the County, and that the City would like to explore materials management options such as Pay as You Throw (EPA, n.d.-f). Another recommendation related to reducing food waste was, "Encourage local grocers and restaurants to donate usable food to local soup kitchens. Several restaurants in the downtown area already contribute food to soup kitchens, but there are many others that could donate."

**Co-Benefits:** Composting and food diversion programs have multiple benefits for the government and the local community. Compost becomes available as a valuable soil amendment for farms and gardens adopting healthy soils practices. More food becomes available for food insecure people in the community. New green businesses that collect and process organic material into compost or other products will be created, along with new clean economy jobs in these businesses (Platt, 2013). The author determined that "in addition to direct jobs at composting sites (such as skilled equipment operators for windrow turners, front-end loaders, grinders, and screeners), further jobs are supported in the use of compost, which also tends to take place regionally."

Upcycling unused food into other products such as dried fruit snacks or value-added products offer opportunities for producers or other businesses to generate revenue from products that are currently being thrown away or possibly never harvested. Other waste products may be diverted for animal feed, benefiting farmers as well as potentially providing business opportunities for services that get these products to the farmers who can use them (e.g., brewery byproducts for animal feed). Businesses and consumers will waste less food and therefore lose less money, as technology and education becomes available to create awareness and access.

**Equity Considerations:** According to Feeding America, about 9% of Frederick County's families are food-insecure (Hunger and Poverty in Frederick (https://map.feedingamerica.org/county/2018/overall/maryland/county/frederick). Food waste diversion programs in other communities have experienced the following benefits for their traditionally underserved communities: increased availability of new jobs and job training from organics diversion, composting, and distribution businesses and nonprofits, as happened in Vermont after their ban on food in landfills (DeLeon, 2021); increased food donations to organizations that serve hungry people, as in Massachusetts following a food waste ban there (Jolicoeur & Mullins, 2019); a better understanding of how our food systems work; the importance of resource stewardship and community sustainability; and a reduction of the need for additional disposal methods, which are often placed in or near economically disadvantaged communities.

**Costs and Cost-Benefit Analyses:** Initiatives to reduce and recover food waste include localizing nationally developed public education programs, such as the NRDC's Food Matters Project toolkit (NRDC, n.d.) of templates and food waste calculators for residential and business sectors, which can assist all possible components of the community.

For the calculations below, a 21% food waste diversion number is used, which is midway between Frederick County estimates from several years past and more current regional estimates of food waste, such as Montgomery County's estimate of 23% (Montgomery County, Maryland, n.d.).

- Household: Potential household savings from reducing food waste are significant. A recent summary published in Nutrition Journal (Conrad, 2020) aggregated data from numerous studies, including one that involved 40,000 adults over a 16-year period and measured food waste, food prices, eating location, and food price inflation. Summarizing their findings, the average U.S. adult spends over one-fourth of their food budget on food that is wasted, more than the annual expenditure on vehicle gasoline, apparel, household heating and electricity, property taxes, and household maintenance and insurance. The study estimated that daily per capita food expenditure was $13.27 with only 59% of that actually consumed (about 1 lb of food every day). Most at-home waste (estimated to be $0.63–0.73 per day) was fruits and vegetables. Meat and seafood, the highest expenditure of wasted food overall at $0.90–0.99, could not be segregated into categories of at-home consumption and restaurant/takeout consumption, but it can be deduced that

education about improved at-home practices would also impact consumer savings. Consumer education could save a household of four between $919 and $1,576 per year, if one assumes that half of the study's estimated wasted meat could be saved in the home, in addition to a conservative estimate for non-wasted fruits and vegetables.

- **Municipal:** Frederick County will realize reduced overhead costs of handling 31,958 tons of waste at the landfill (using assumption of 21% food waste diverted) because there will be less to manage on the transfer tipping floor, less to bill, etc.

- **Business:** The food-related business sector can also benefit. Clowes et al. (2019) found in a survey of 114 restaurants that for every $1 restaurants invested in programs to reduce kitchen food waste, on average $7 was saved in operating costs.

Rescued food/edible food diverted to local food banks and soup kitchens may be able to fill in gaps for needed staples at those organizations, but stakeholder interviews (M. Spurrier, past director of the Frederick Community Action Agency and D. Sisson, Middletown Food Bank, personal communication, April, 2021) cautioned that rescue efforts must be well-managed to match need with available edible food. While potential exists, unfortunately, the actual savings could not be quantified for this report.

- **Avoided disposal costs:** Direct cost benefits for businesses, homeowners associations, and municipalities can accrue from both waste reduction and composting in contracts paid by tonnage or volume because every ton/yard avoided is a direct cost savings. With the current Frederick County tipping fee at $69 per ton (Frederick County MD, n.d.), municipal, commercial and homeowners association contracts that are weight-based would see a direct reduction in cost. If their billing is volume based, they will experience a direct reduction in "pulls" of trash dumpsters.

As to overall Frederick County solid waste user fee savings, at the county-contracted fee of $53/ton for transport and disposal of waste at the Waste Connections Chambersburg, PA Blue Ridge landfill (P. Harris, Director of Solid Waste and Recycling, personal communication, April 8, 2021), even half of the estimated 18% of Frederick County solid waste that is estimated to be food waste (Land and Materials Administration Resource Management Program, 2018) would save $1.6 million in fees annually at 2017 waste generation rates quoted in the Solid Waste Options Study (Frederick County, 2015). Note that Frederick County's estimated food waste numbers are conservative; regional estimates of food waste are higher, such as Montgomery County's estimate at 23% (Montgomery County, MD, n.d.).

For diverted, inedible food, well-managed composting facilities that charge lower fees than landfill tipping fees can also contribute to avoided waste costs for businesses and organizations. Nearby Howard County, MD has operated a successful program since it was piloted in 2010, with 14,000 households participating weekly (40% of those eligible have "opted in"). On average, they are collecting 10.5 lbs of food scrap and green waste per home per collection week (DeLuca, 2021).

Encouragement, facilitation, and education for such efforts in the recommendations below can be managed by an organics and compost manager. This could also be a contracted non-profit position, at a salary range of $55,000-$65,000 (Maryland Association of Counties, 2020). The county, while managing such programs, should be open to emulating public-private partnership or non-profit models that have proven fruitful in other communities.

**Finance:** Numerous grant programs, from the federal government (EPA) to private foundations, have become available in the past decade as food waste and hunger have entered public consciousness. These programs can assist with the initial investment in staff and educational programs for food reduction, food rescue, and composting. After startup, the return on investment from reduced waste fees can be allocated to pay for program education and implementation, including subsidizing collection of organics. The USDA Food and Agriculture Service Learning Program (National Institute of Food and Agriculture, n.d.) offers funding for school and college level food waste-management programs.

As overall Frederick County solid waste enterprise fund user fee costs decrease, managers should track

how overhead management costs change due to declines in waste tonnage (especially liquefied food waste that normally would be handled on the transfer station floor). Those savings could directly finance programs aimed at reducing food waste.

### Recommended Actions — Legislative City and County

- The organics and compost manager should coordinate Frederick County's efforts to comply with a state law passed in April 2021 to ban food waste from disposal and instead direct it to reduction, rescue, feed to animals, or composting. For best results, this should be done in stages by user type: beginning in 2023 with businesses generating two tons or more to coincide with the State mandate (State of Maryland, 2021) and 2024 with businesses generating one ton or more to coincide with the same state mandate; and locally, beginning in 2023, requiring public and private school sites generating two tons or more, and transitioning to one ton or more in 2023.

- To stimulate use of compost in local applications, pass a countywide resolution and municipal ordinances requiring use of compost in highway and stormwater projects in the City of Frederick and Frederick County. Increasing soil organic matter improves the ability of soil to hold and filter stormwater, which is increasingly important as climate change-driven storms become more frequent (U.S. Composting Council, 2008). The timing of using compost in municipal stormwater projects can be tied to availability of compost from regional producers as the recommendation above is implemented and compost production increases. An excellent model for such a policy is King County's CompostWise program begun in 2020 (King County, n.d.). Maryland has a state law in force for use of compost in State Highway Administration applications (Maryland Department of Transportation, 2019).

- Approve a budget that includes appropriate funding for grants for private sector (both as farm accessory use or primary use) compost facility expansion as outlined in the 2017 Solid Waste Options Study (What's Next; Frederick County, 2015).

### Recommended Actions — Administrative City and County

- Fund a Frederick County organics and compost manager, to be either a City or County employee, or as a contracted private/non-profit effort.

- Design a local version of EPA's (EPA, n.d.-b) program, "Food Too Good to Waste" under the auspices of the new organics and compost manager's responsibilities. This would avoid duplication and fill gaps between non-profit, school, and government efforts in food rescue and reduction programs. This resource would also be responsible for locating, facilitating, and managing grant-funded programs to educate consumers about reducing residential food waste, including programs about food date labelling and food rescue, and educating the institutional/business sector about programs such as Lean Path (Foodtank, 2018) and other cost-saving ways to reduce business and institutional food waste.

- Implement the system outlined by the Frederick County Solid Waste Management Options Study of 2017 (Geosyntec, 2017) by encouraging small- to medium-scale compost facilities as private-public partnerships (see Freestate Farms, Prince William County, VA as a model; Goldstein, 2020) across the county as the composting program evolves over the 10-year period. From the savings, establish a grant fund for equipment and siting — or provide siting on public property — to encourage the opening of these facilities.

- Slowly fund and ramp up diversion from households, farms, and the commercial sector by effective use of pilot programs in educating each sector on the benefits of food rescue, food waste reduction, and composting.

- Work with the local agricultural community to quantify and showcase local successes in food waste generators to farm animal feed connections and provision of unsellable edible food to food banks, and inventory where those programs can grow.

- Fund a test of the effectiveness of recycling/composting participation in two communities, one with subsidized organics collection, the other with a

Pay as You Throw (EPA, n.d.-f) program, in the first year rollout of residential composting. Use the data to decide how to roll out future phases.

- To incentivize food waste reduction/diversion programs at all levels, municipalities should explore Full Cost Accounting (EPA, n.d.-c) and/or revisions in billing to their residents so that trash disposal costs are listed on a separate line on their tax bills, demonstrating the power their individual actions have in reducing overall citizen taxes on services involving composting, recycling, and waste. A March/April 2021 survey of municipalities by this workgroup indicated that no municipality is providing this information to their residents, although all express a wish to increase diversion of waste materials to reuse.

### Recommended Actions — Community

- Establish a joint Food Recovery Network (Food Recovery Network, n.d.) among the three colleges in Frederick County to serve the community. Working in tandem with Hood College's Frederick Food Security Network (Hood College, n.d.), the Food Recovery Network could leverage partnerships and fill gaps in food supply. The organics and compost manager noted in City/County Administrative Actions (above), could be housed in a community non-profit group or project, such as a college Food Recovery Network or Hood College's Food Security Network. Coordinate college and secondary level "share table" programs to feed the network.

- Food Banks in Frederick County are unable to effectively leverage connections due to lack of storage space (M. Spurrier, past director of the Frederick Community Action Agency and D. Sisson, Middletown Food Bank, personal communication, April, 2021) and ineffective connection between types of food most needed by food bank customers. The organics and compost manager should coordinate group efforts to problem-solve and increase diversion to decrease food insecurity.

- Frederick County Public Schools should institute education for school Food and Nutrition Services staff regarding requirements for items to serve to students, such as adjusting serving sizes by grade, making fresh fruits easier to eat by slicing, and instituting a system of share tables in all public schools to coordinate with both local school needs and larger community food rescue efforts. This can be accomplished in stages, scaling throughout the first five years to encompass the entire public and private school system. The Lunch Out of Landfills program has provided a good pilot model for this program (Mountainside Education and Enrichment, n.d.).

- Initiate a restaurant recognition program for food waste reduction, recovery, and composting, in concert with the Frederick County Chamber of Commerce.

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## 25 Increase the county forest canopy by 10% over current levels

**Recommendation:** Increase County forest acres for their natural climate benefits of sequestering carbon, representing 20% of current County $CO_2$ emissions by 2050.

**Expected GHG Reduction or Climate Adaptation:** By increasing forest acres by 10%, up to 720,000 MT of $CO_2$ emissions can be sequestered annually by 2050, exceeding the current Frederick County canopy sequestration of 540,000 MT $CO_2$ each year from the existing 180,000 forest acres. That increase in forest will increase sequestration from 15% of total annual County emissions to 20%. Tracking year-to-year increases in canopy, and associated carbon trapped, can provide the public with routine indications of progress toward more locally focused greenhouse gas emission reductions and better public health prospects through time.

**Timeline for Action:** The goal for reforestation/afforestation is to increase the county canopy of 180,000 acres by approximately 10% between 2023 and 2050, a goal requiring planting approximately 640 acres (one square mile) annually. Planting and the implementation of best forest management practices can increase $CO_2$ capture by our County forests by 20%. Progress toward this increasingly important forest sequestration role can be tracked by documenting public education workshops, ordinance adoption in Years 1–2 , and acres planted each year..

**Rationale:** Healthy, managed forests sequester more carbon than aged, unmanaged forests due to faster growth rates and $CO_2$ capture in photosynthesis than slower growing old and unmanaged forests (Ruddell et al., 2007). However, old growth forests still capture considerable carbon, perhaps 10% of the global net ecosystem productivity (Luyssaert et al., 2008) and should not be lost. Forests are considered by many to be the best natural land use for capture of $CO_2$ (e.g., Fargione et al., 2018; Lewis et al., 2019) and there is a building literature on the emission reductions gained in shifting to agroforestry or natural revegetation from classical single grain crop farming or abandoned lands (Mahli et al., 2002; Lewis et al., 2019). Forests lead to substantial increases in soil organic carbon (e.g., De Stefano & Jacobson, 2018), the largest terrestrial carbon reservoir, which absorbs water to prevent surface runoff of nutrients and particulates (with bound phosphorus and attached bacteria), thereby protecting local water quality and pathogen distribution. The increase in soil organic matter, in turn, through the associated increase in water storage capacity, protects crops against drought while minimizing the need for external synthetic fertilizer applications (Recommendation 19).

Forest trees are also huge carbon reservoirs and can provide not only a carbon sink but benefits to GHG emission reductions through their use in construction instead of cement and steel (Catanzaro & D'Amato, 2019; Bellassen & Luyssaert, 2014), two very high GHG emission industries worldwide. Hence, establishing a local, managed wood products industry could partially counter emissions from other local sources, i.e., transportation, heating/cooling, etc.

Tree canopy is also important in reducing urban heat island impacts and improving local public health benefits (Recommendation 27), maintaining habitat (e.g., brook trout), biodiversity, and wildlife corridors (Recommendation 26), and in riparian areas along creeks and streams, providing particulate organic matter as leaves, twigs, etc. for needed nutrients that support food webs (Sweeney, 1992) and important recreational fisheries in local waters.

There are examples throughout the world where forest plantings (reforestation/afforestation) are key portions of national efforts to reduce emissions under the Kyoto Protocol (1997), including India, Africa, Latin and South America, and Europe, likely to increase as an inexpensive means to sequester generated carbon. In the U.S., the Department of Agriculture's (USDA) Forest Inventory and Analysis National Program (USDA, n.d.) lists state forest acres

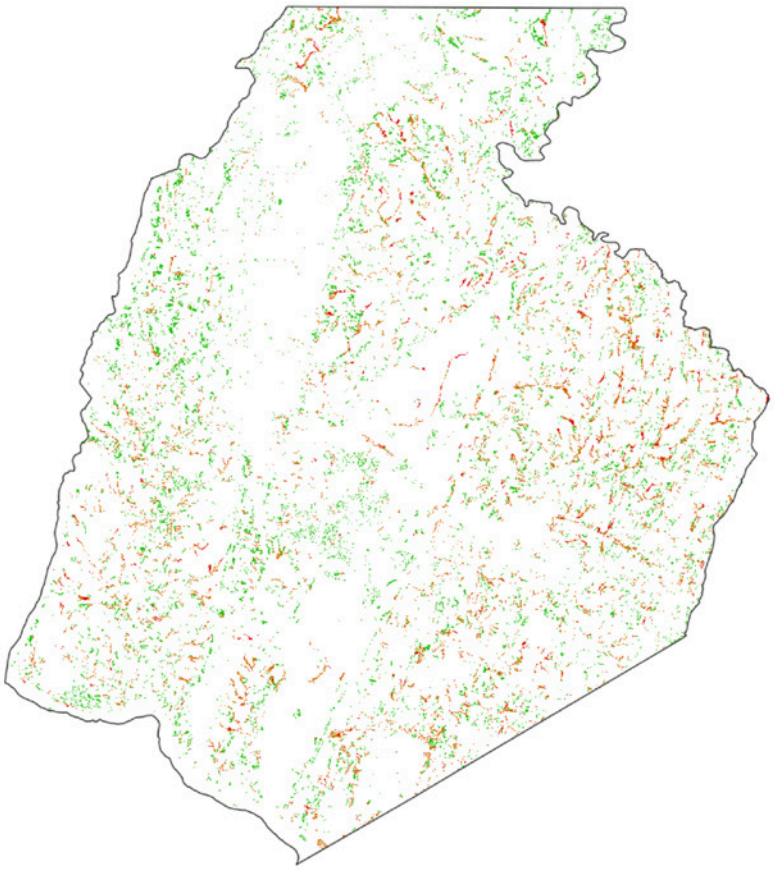

**Figure 1. Riparian areas suitable for afforestation (red) as well as non-riparian barren areas near existing tree canopy (yellow) that also would be considered for tree introduction. Green areas represent existing tree canopy** (E. Goodnough, CEMWG)

important for estimating carbon sequestration. U.S. forest carbon has also been estimated by the Congressional Research Service (2021) to inform future Congressional decisions, including climate impacts. Multiple states (e.g., OR, WA, FL, VA) have state-sponsored forestation programs, some with private partners.

Within the state, riparian areas in all Maryland watersheds have been mapped by the Department of Natural Resources and the Frederick County Planning Department has its own mapped distribution. As part of future recommendation implementation, a geographic information system (GIS)-based mapping tool that has been created through the CEMWG effort could be used for future mapping of riparian areas suitable for afforestation as well as non-riparian barren areas near existing tree canopy that also would be considered for tree introduction (Fig. 1). Expansion would be through incentives, tax breaks, and other funding options and potentially expand the County acreage for more trees in the "Room for more trees" section of the Livable Frederick Master Plan (Frederick County, 2019, p. 178).

Increasing forests in the County will be an ongoing challenge. The Livable Frederick Master Plan (Frederick County, 2019) reports that 420 acres of forest have been lost each year for the period 2001–2014 so reversing this pattern will be difficult. There is some room for optimism, however, as the plan states that the County "Support the multiple benefits of forested conditions that can be sustained over time in a cost-effective manner through viable forest products markets and good forest management" (p. 166). The City owns and protects its 7500–acre Municipal Forest and seeks to preserve the forest as part of its environmental stewardship and to protect an estimated 20% of its water supply (City of Frederick, 2021). There is also a tree farm in the forest, established under the Maryland Tree Farm Program, indicating the value of long-term carbon storage in wood products from the site. These elements can be considered in the Forest Conservation Plan that is currently being updated. The draft Plan also addresses the need for an Urban Tree Canopy to reduce the urban heat island effect. Approximately 45% of the City has low levels of vegetation and could serve as future areas for increasing tree canopy, consistent with the goals for green infrastructure in areas of most need, perhaps using the Equity Index tool referred to in Recommendation 1.

The City and County have both successfully tapped enthusiastic volunteers and groups who understand the multiple benefits trees present for climate mitigation and resilience. This initiative to increase the County's tree canopy to a net growth of 20% is ideal for a community-wide campaign with many educational and event-oriented elements.

The longevity of trees, the long-term use of wood products, public health benefits, environmental water quality, and wildlife protections tied to forests and trees are critical elements in the perceived high quality of life in the County.

**Co-Benefits:** The forest products industry can assist in increasing forest cover and in encouraging forest management. This industry provides a market for forest products such as lumber, wood pulp for paper, firewood, and pellets. While 2021 lumber prices are dramatically higher than in the recent past, over time a sustainable market will assist in providing incentive for forest management activities such as selective thinning to improve the forest base. Employment opportunities will increase for the region as well, through silviculture managers, harvesters, and positions at processing and distribution centers. Garrett-Peltier and Pollin (2007) have estimated that each $1 million invested in forest restoration can support as many as 40 direct, indirect, and induced jobs. Additionally, public health and wellbeing increases (Recommendations 26, 27), maintaining a treasured quality of life in the area.

As noted above, secondary forest benefits include water filtration and storage, oxygen release, and prevention of sediment and fertilizer runoff into waterways. In addition, forests increase habitat for native wildlife species while riparian plantings filter and cool water, and forest tracts contribute to biodiversity (Recommendation 26).

**Equity Considerations:** Deliberately increasing tree canopy and its beneficial shading is an important equity consideration in traditionally underserved communities. The Equity Index referred to in Recommendation 1 demonstrates a powerful example of intentionally increasing canopies in these neighborhoods, especially for their cooling and air quality enhancing benefits. Planting trees where underserved people live, work, and play is a strategy used in other jurisdictions, such as Philadelphia, to mitigate the climate impacts of heat islands, flooding, and stormwater run-off, while at the same time, improving quality of life.

**Cost and Cost-benefit Analyses:** The County can take advantage of market conditions and the need for forest restoration due to damage caused by the ash borer and other invasives and begin actions to balance county forest diversity, forest age, and implementation of forest best management practices.

Applying the social cost of carbon of $51 per MT/acre (Interagency Working Group on Social Cost of Greenhouse Gases, 2021) helps define the benefit of carbon stored and sequestered by Frederick County forests. Planting cost per tree referenced in the Tree Solutions Now Act of 2021 (for planting on agricultural, public, or private land, LegiScan, 2021) is $9.50 x 303 trees per acre = $2878.50 per acre. Annual carbon capture benefit based on 3 MT/acre x $51 = $153/acre/year, or over 100 years to forest maturity = $15,300 for that acre, undiscounted. Additionally, the planting costs go back into the local economy.

**Finance:** A clearinghouse should be considered, providing linkages to knowledge of forest benefits and needs, and connecting current and prospective landowners with sources of funding for reforestation/afforestation and implementation of best forest management practices in Frederick County. Partnerships with community groups could act as force multipliers to engage and educate potential and current landowners, from initial identification of program eligibility to enrollment of local residents in the implementation of agreements and planting activities. The recently enacted Tree Solutions Now Act (5M Trees, HB991; LegiScan, 2021) makes this expansion of tree canopy much more feasible as it provides additional funding that builds on existing and new forestry programs (Healthy Forests Healthy Waters, TreeFrederick, Conservation Reserve Enhancement Program [CREP], Creek ReLeaf). Enhanced forestry actions can leverage existing relationships with state and local environmental groups, forestry experts (e.g., Forestry Board, Department of Natural Resources Forest Service), and begin building relationships with county/municipality program offices and sustainability commissions. The Maryland Department of Natural Resources provides cost-share programs (Maryland Department of Natural Resources, n.d.) and the Maryland Tree Solutions Now Act increases funding for both urban and rural tree planting, with a goal of planting 5 million additional trees in the state through 2030. If a green bank is established in Frederick County, it could be a source of funding for property owners interested in silviculture as an environmental and business opportunity.

### Recommended Actions: Administrative — County and Municipalities

- Resolve to reach a net increase in County Forest Canopy of 10% by 2050. Publish metrics on County and municipality forest growth/loss/health/value of climate services provided. Build a community-wide public education and events calendar around this goal.

- Evaluate and/or audit success of county forest banking offset programs [such as the Forest Resource Ordinance (FRO)].

- Adopt the assistance of science-based data evaluation techniques such as the GIS tool developed through the CEMWG effort or the Equity Index tool (Recommendation 1) to assist in optimizing forest plantings that do not impinge on other priority land use activities such as cropland.

- Consider, in addition to plantings to meet goals in Frederick County, reducing mowing of a portion of county roadway edges beyond 50' (or wider in select cases) to allow "rewilding," and create an easement plan or other program to encourage rewilding of open land adjacent to existing forests.

- Assess the current status of and need for support for the forest products industry in Frederick County, with stakeholder input and goals included.

- Educate/engage prospective and current landowners to increase enrollment in Forest Stewardship programs.

### Recommended Actions: Administrative and Legislative — County and Municipalities

- Utilize the recent increase to real property recordation taxes targeted to preserve agricultural land for forest management (e.g., tree farms) as allowed.

- Consider a property tax credit per acre for landowners owning forest acreage below the current minimum to allow entry into a stewardship program with tax credits (often 10 acres or more). This small forest management credit will help maintain the current 180,000 acres we have, while supporting the creation of more.

- Build on County and municipal funding efforts and leverage successful programs such as TreeFrederick, CreekRelief, and agriculture preservation.

- Support and build community "ownership" of local forest, parkland, and tree health through a community-wide public education campaign with goals and metrics.

- In the development of future small area plans as well as future land management decisions, seek opportunities to link contiguous areas of forests and expand forest corridors for benefits to wildlife, 'healthy' terrestrial and aquatic ecosystem functions, and associated public health benefits.

- Update and increase goals for expanded urban tree canopy to reduce urban heat island impacts, focusing on underserved communities, and accompanying improved community health.

### Recommended Actions: State/Federal Support

- The Maryland Tree Solutions Now Act of 2021 funds increases to both urban and rural tree planting, with a goal of planting 5 million additional trees in Maryland through 2030. Funding studies to be completed in 2022 will enable funding allocations to accomplish tree planting at County and municipality levels.

- Coordinate with Maryland programs to increase markets for wood products. Increased markets for wood products provide a market incentive to potential landowners to plant more trees and manage forests.

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## 26 Facilitate the enhancement and protection of regional biodiversity

**Recommendation:** Develop and implement a Green Infrastructure Sector plan to identify and establish contiguous wildlife corridors that protect nature, connect fragmented populations of plants and animals, and enable species movement and migration to adapt to the changing climate.

**Expected GHG Reduction or Climate Adaptation:** Intact ecosystems with healthy forests, meadows, wetlands, and biologically active soils support and are supported by the species that live within them. These ecosystems are a crucial component of climate mitigation as they sequester carbon that otherwise remains in the atmosphere. The amount of carbon that can be sequestered in these environments varies by ecosystem. Detailed estimates have been included in Recommendations 20 and 25.

Increased temperatures from climate change coupled with development pressure-induced fragmented habitat has led to biodiversity loss and water pollution indicative of lost resilience in the area (Maryland Department of Natural Resources [DNR], 2005). Plants and animals that cannot adapt to the changes will seek to move north or to higher elevations. If this migration is prevented, species will face extinction. Corridors and a long-range plan to identify and protect natural green infrastructure are critical to mitigating greenhouse gas emissions, maintaining biodiversity, and providing health and economic benefits for residents and visitors. Following adoption of legislation that protects wildlife corridor tracts and wildlife endangered areas in wetlands and meadows, results can be tracked through annual reporting of acres of contiguous forest tracts (i.e., unfragmented), protected wetlands, and meadows remaining.

**Timeline for Action:** Significant foresight and planning is required to address habitat reduction and fragmentation due to human encroachment. Since natural areas are difficult to protect and restore once developed, time is critical. The following actions should be implemented:

- In the first two years, establish a database to identify and monitor protection of wildlife corridor tracts.
- In year three, draft and adopt legislation to identify and protect natural vegetation corridors into the Appalachian Mountains and other areas as needed to provide wildlife corridors and contiguous tracts of healthy ecosystems.
- In year three, draft a functional natural Green Infrastructure plan that includes policies and specific actions for protecting wildlife endangered areas.
- In year four, approve, fund, and implement the Green Infrastructure plan that embeds smart growth policies and/or protects natural green infrastructure of City and County vegetated habitats.

It is critical to maintain existing unfragmented contiguous forest tracts, reforest multiple fragmented tracts, and protect ecologically sensitive natural wetlands and meadows into the future.

**Rationale:** Maintaining a connected landscape is a widely cited strategy in the scientific literature for building climate change resilience (Heller & Zavaleta, 2009). Protection of nature and its biodiversity must occur at the local level, where land use decisions are made. Protecting and connecting habitat that allows for migration along the Appalachian Mountains will ensure continued biodiversity for our remaining flora and fauna. Across the County, corridors are not only important but multiple areas have been identified by state and federal agencies where multiple plant and animal species are jeopardized. These natural areas conserve ecosystem functions and sustain clean air and water (Benedict & McMahon, 2006), important benefits for residents and visitors. Planning options to protect these areas from climate impact threats should be a central piece of a Green Infrastructure Plan for natural areas.

*Biodiversity.* The natural world is our life-support system (Coutts & Hahn, 2015). Biodiversity in nature enables the functioning of ecosystems - the

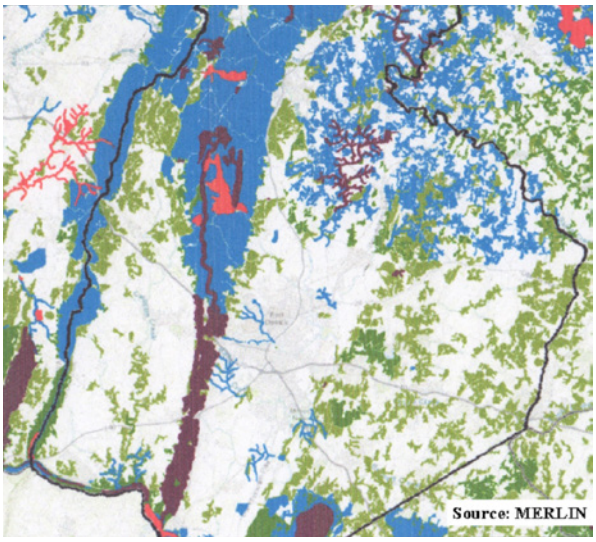


**Figure 1. Bionet priority areas for conservation for Frederick County. Red, black, blue, green, and light green refer to Critically Significant, Extremely Significant, Highly Significant, Moderately Significant, and Significant conservation areas for protection, respectively** (Source: extracted from MD DNR Bionet Fact Sheet)

functions of the natural world that enable life to exist (Kellert & Wilson, 1993). These functions include providing clean air, clean water, and food (Seymour, 2016). For example, one-third of all agricultural output depends on pollinators (United States Department of Agriculture [USDA], n.d.) and about three-quarters of the more than 240,000 species of the world's flowering plants rely on pollinators - insects, birds, bats, and other animals - to carry pollen from flowers for pollination (National Research Council, 2007).

Biodiversity provides a buffer against climate change, in that, if a species is lost, over time others can replace it. However, present global extinction rates are about 1000 times higher than those before the spread of humanity (Wilson, 2016) and natural restoration will require five million years or longer, several times that of the span needed to evolve the modern human species (Wilson, 2016).

The Maryland DNR Natural Heritage Program collects, manages, analyzes, and distributes spatial data regarding the habitats of the state's rarest plants and animals, high quality and rare natural communities, and other living resources of conservation concern. These data are collected in a five-tiered ranking system called Biodiversity Conservation Network, or Bionet (Maryland DNR, 2016), and include:

- 1,000 rare, threatened, or endangered plants and animals;
- 1,500 places where rare, threatened, or endangered species live;
- 200 additional animals of greatest conservation need;
- 200 watch list plants; and
- 27 of 75 ecological communities that are considered rare in Maryland.

Within Bionet, even those in Tier 5, the lowest in biological significance, are still important to conserve, both for the species they directly support, as well as for the maintenance of the larger fabric (and processes) of our natural landscape (Bionet Fact Sheet, 2016). These areas will be impacted by the new climate extremes so assessing likely vulnerabilities and options to best protect them should be a priority. Figure 1, extracted from the fact sheet, shows biodiversity in Frederick County ranked by Bionet priority areas for conservation.

Figure 2 shows Bionet Tier 1-3 sites within the Catoctin Mountain corridor (blue outlined polygons and linear waterways) overlaid on Federal, State, and local protected lands (red) and private land (brown) leading from the Potomac River to the Catoctin Mountains. The greatest portion of priority conservation area is held privately.

*Species requiring specialized habitats.* Some species require specialized habitats in order to survive. Brook trout, our only native trout, are currently at the limit of suitable habitat in Frederick County. Brook trout require cold, clean freshwater as well as gravels on streambeds for fall spawning (Hitt, 2021). Current populations are trending downward in the Catoctin Mountains, threatened by rising stream temperatures; however, efforts to preserve their habitat could succeed if measures are taken to protect groundwater and stream water quality (Hitt, 2021). The Livable Frederick Master Plan (Frederick County, 2019, p. 191) specifically addresses brook trout, with an initiative to protect and re-stabilize

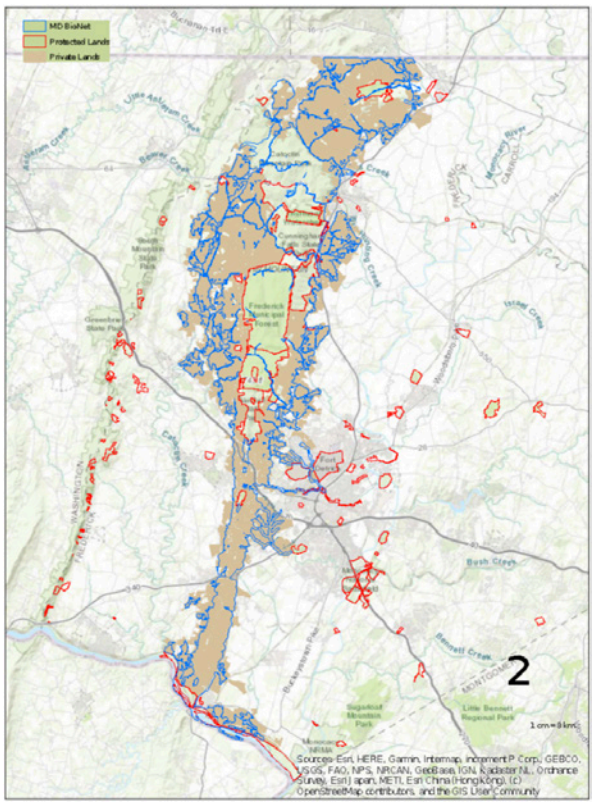


**Figure 2. Bionet Tier 1-3 sites within the Catoctin Mountain corridor (blue outlined polygons and linear waterways) overlaid on Federal, State, and local protected lands (red) and private land (brown) leading from the Potomac River to the Catoctin Mountains** (Source: P. Stango, unpublished)

populations. Without this work, assisted migrations may be required and this once plentiful native fish could be lost.

Other species need the insulating effect of a large forest interior free from human disturbance to breed successfully and maintain viable populations. Identified as Forest Interior Dwelling Species (FIDS), examples include birds such as owls, the Allegheny woodrat (commonly called the pack rat), the wood thrush, scarlet tanagers, the eastern box turtle, bats, frogs and salamanders. The Natural Resources Conservation Service (USDA, n.d.) describes forest interior wildlife habitat as:

- Forests of at least 50 acres with 10 or more acres of forest interior habitat;
- Riparian forests of at least 50 acres containing streams; or
- Forests of at least 10 acres containing isolated depressional wetlands of one acre or more; and
- Forested corridors must connect areas meeting any of the habitats identified above, and have a minimum forested width of 100 feet.

Still other species thrive in warm-season grassland habitat which has steadily declined in Maryland (Maryland DNR, n.d.), but which existed in large portions of the northeastern area of Frederick County. Wild turkeys often nest and rear broods in dense grasses. Songbirds such as field sparrows, indigo buntings, prairie warblers, eastern meadowlarks, loggerhead shrikes, and grasshopper sparrows use warm season grasses for cover while raptors like American kestrels and northern harriers use the areas as hunting grounds. Raptors are often attracted to the cottontail rabbits, voles, and field mice that make their homes in the grasses (Maryland DNR, n.d.).

*Increased Temperatures:* Average temperatures have increased since the industrial revolution. Projected warming will continue to move northward (Jones, 2018). Flora and fauna now in areas such as Greenville, Mississippi will be more adapted to our area (Mongilio, 2019), as shown in Figure 3.

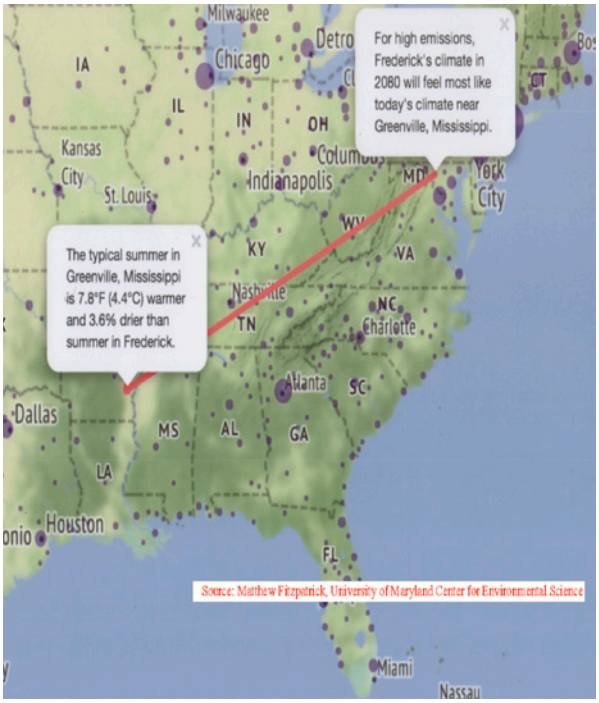


**Figure 3. Latitudinal biological displacement under coming climate conditions** (Mongilio, 2019)

*Water Pollution.* Another threat to regional flora and fauna is poor water quality. One of nature's most important roles is filtering water via vegetation and soils to keep it clean. Water sources also provide fish and wildlife for use as food. Degraded water quality compromises natural systems and Frederick County water is already jeopardized. The Gas House Pike wastewater treatment plant was forced to add enhanced nutrient removal equipment at a cost of about $50 million (paid with public funds) to filter out excess nitrogen runoff (Panuska, 2019). According to a water quality assessment of the Monocacy River, U. S. Geological Survey researchers have identified multiple compounds that may be responsible for 70-100% frequencies of intersex (male and female sex tissue in the same fish) in Monocacy River smallmouth bass populations, with potential reductions in the ability to reproduce and resist disease (Sellner & Ferrier, 2020).

*Development Pressure.* The Maryland Department of Planning (2020) projects a Frederick County population increase of approximately 100,000 by 2050, based on a 2020 population approximating 260,000 and an average yearly increase of 1.1%. This prediction assumes a business-as-usual scenario, but does not take into consideration climate migrants, including regional movement away from Maryland's more than 3,000 miles of receding shoreline in response to sea level rise and/or coastal damage from more extreme storms (Recommendation 33). Increased demand for housing will place pressure on the City, County, and municipal governments to accommodate development, which is the most often cited pressure placed on rural and natural areas.

*Migration Corridors.* Colonizing in new territory requires finding suitable microclimates that allow species to persist and reproduce sufficiently to sustain their populations. This process takes generations but the climate is changing faster than at any time in recorded history. Adding to the challenge, the landscape is fragmented by roads, dams, development, and other barriers to movement (Anderson et al., 2016).

The Nature Conservancy's (n.d.) Migrations in Motion digital map (Fig. 4) shows the directions animals, birds, and amphibians need to move to find hospitable habitats across the landscape.

The Appalachian Mountains are the most significant wildlife migration corridor in the U.S., and as Frederick County is a gateway to the Appalachians, maintaining contiguous forest corridors and connecting fragmented habitat that facilitates species movement along the Appalachians ensures continued biodiversity in the changing natural systems on which survival depends. Vegetated corridors and hubs are found throughout the County but are declining due to development and other human activity. Figure 5, from the Livable Frederick Master Plan (Frederick County, 2019), shows obvious corridors along the Catoctin Mountain and South Mountain ranges, as well as vegetated floodplains along waterways such as the Monocacy River. The C&O Canal National Historic Park is a dramatic corridor along the Potomac River, with tributaries such as Catoctin Creek leading from the river to the Catoctin and South Mountain ranges. Hence, it is important to maintain and possibly expand vegetated corridors to ensure persistence of the current animal populations under the increasing threat of fragmentation and the extremes of temperature now in the region.

There is substantial literature on the impacts of forest fragmentation and biodiversity loss. Importantly, the impact of losing species on a wide variety of ecosystem processes is also well documented, such as primary production and nutrient cycling (reviewed in Byrnes et al., 2014). In other examples, riparian buffers are strongly tied to healthy stream macroinvertebrates and fish (Yirigui

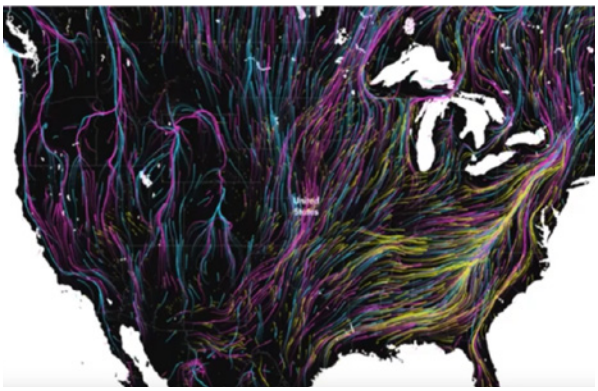

**Figure 4. Migration patterns for mammals (pink), birds (blue) and amphibians (yellow)** (Source: The Nature Conservancy, n.d.)

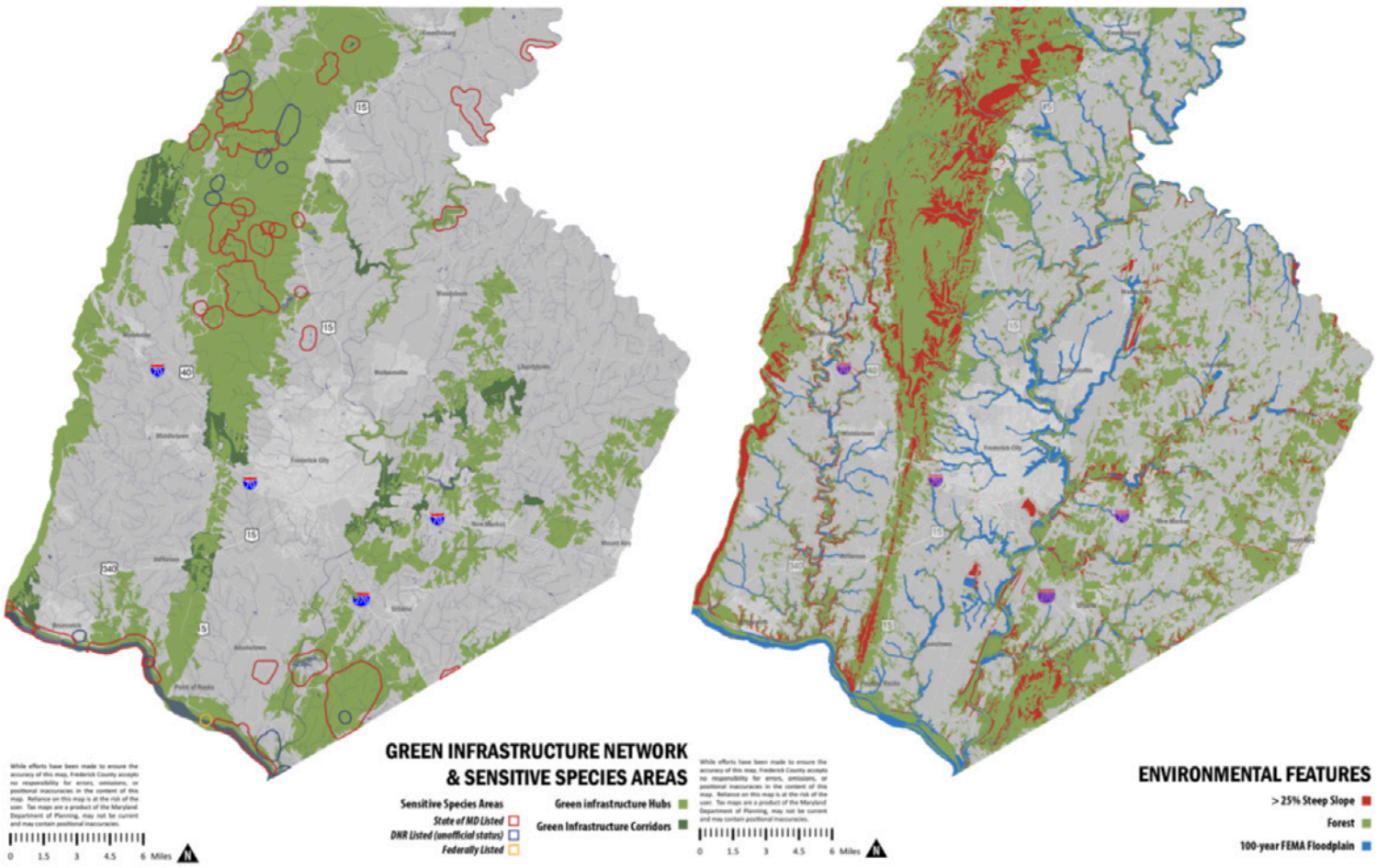


**Figure 5. Left: County natural vegetation hubs (light green), corridors (dark green), Maryland sensitive species areas (red), unofficial areas (blue), and federally listed areas. Right: important environmental features (steep slopes (red), forests (green), and 100 yr Federal Emergency Management Agency floodplains (blue)** (Frederick County, 2019, pp. 50 and 56)

et al., 2019) and forests have dramatic effects on local hydrology (Hertzog et al., 2019). 'Who-eats-who' dynamics and how they can change and how predation pressure in isolated parcels can increase are also well described (Peh et al., 2014). Thus, addressing species diversity as an aspect of climate resilience is important as it has and will determine the environment around us and therefore, public health for decades to come.

The Livable Frederick Master Plan (Frederick County, 2019) highlights the ongoing fragmentation of our natural resource areas, specifically stating that in the future it is important "… to direct urban/suburban growth away from green infrastructure and sensitive areas, and to ensure the protection and integration of green infrastructure where it exists within areas targeted for growth" (p. 48). To accomplish this, the County will pursue the "…development of a Livable Frederick Green Infrastructure Sector Plan" (p. 48), re-stating a similar commitment from the County in 2010 (Frederick County, 2010).

*The Experience of Other Communities:* Other cities and counties have adopted several strategies. Volunteers in Montgomery County (Climate Yogi, n.d.) are working through Rewild Montgomery County to create community-supported wildlife corridors through neighborhoods and County parks that allow travel to the C&O Canal National Park (Fig. 6). Along the C&O Canal National Park, wildlife can travel through Frederick County toward the Appalachians. Howard County's Natural Places Committee protects and enhances open space for the benefit of wildlife.


**Figure 6. Sierra Club's flyer depicting the proposed route of a local wildlife corridor** (Source: Sierra Club, n.d.)

Greenways have grown in popularity in cities across North America. The Town of Gibsons, Canada has pioneered a natural asset strategy (Town of Gibsons, 2019) to:

- Manage risk by ensuring understanding of the civil services received from natural assets;
- Reduce costs by managing natural assets to provide services at a lower cost and in perpetuity;
- Maintain healthy ecosystems as a result of sound asset management strategies; and
- Manage the asset effectively to provide civil services for future development by employing (rather than degrading) natural assets that may exist on site.

Austin, Texas adopted Gibsons' model with the Barton Creek Greenbelt, a green area consisting of about 1200 acres in and around the city (Austin Parks Foundation, n.d.).

Baltimore is developing a 35-mile Greenway Trails Network (Bikemore, n.d.) that weaves nature into pedestrian and bike-friendly infrastructure. Trails connect neighborhoods to anchor institutions, such as universities, hospitals, museums, parks, schools, and bus districts. They serve to strengthen public health by increasing access to parks for residents, without the need for cars (Fig. 7).

The Livable Frederick Master Plan (Frederick County, 2019) includes initiatives consistent with protecting biodiversity and accommodating wildlife movement. These include:

- Ensuring Frederick County's green infrastructure is protected through the adoption and implementation of a functional green infrastructure plan (p. 189);
- Advocating for wildlife and pedestrian connections over roads, e.g., I-270 (p. 189);
- Evaluating infrastructure projects in terms of their capacity to facilitate wildlife survival by preserving contiguous habitats and connecting habitats that are fragmented (p. 104);
- Respecting the stewardship of natural resources in the provision of water and sewer infrastructure (p. 101);
- Studying methods to mitigate the conflict between wildlife and motorists by examining the concentration of wildlife crash incidents along county and state roads…(p. 100); and
- Creating options and incentives that encourage voluntary landowner participation in the establishment of greenways and trails (p. 101).

The City of Frederick Draft Climate Action Plan (City of Frederick, 2020) Section 605 Landscaping Standards 1 and 2 are:

- Further encouraging green infrastructure for stormwater management as well as urban heat island mitigation.
- Using flood- and drought-tolerant vegetation.
- Resilience recommendations include increasing tree canopy for shade.

### Co-Benefits:

*Human Health.* The natural environment is fundamental to the ecosystem services that support human life and health (Coutts & Hahn, 2015). Greenspace that conserves natural ecosystem values and functions provides protection against

floods and hurricanes and a place for outdoor recreation, relaxation, and exercise to improve health (Seymour, 2016). Increased access to green space lowers the likelihood of obesity (Coutts & Hahn, 2015). Exposure to nature reduces stress and improves mental clarity and emotional well-being. Hospital patients exposed to natural scenery from a window view after surgery were shown to experience decreased levels of pain and shorter recovery time (Seymour, 2016). Other benefits include reduced blood pressure and improvements in neurological and circadian rhythms related to exposure to natural sunlight from walking in forest environments (Antonelli et al., 2019).

*Economic benefits.* Recreational fishing is a popular activity in Frederick County. A 2016 survey of Maryland non-tidal anglers estimates that about $2.5 million was spent on approximately 60,000 non-tidal fishing trips taken in 2015 to the following Frederick County water bodies: Monocacy River, Fishing Creek, Big Hunting Creek, Owens Creek, and Friends Creek. Frederick County also borders and provides access to a portion of the non-tidal Potomac River, which is the most frequently fished non-tidal river/stream in the State of Maryland. In 2015, there were an estimated 239,000 fishing trips taken to the non-tidal Potomac River (from North Branch/South Branch junction to Little Falls), with anglers spending an estimated $23,000,000 on these trips (Hitt, 2021).


**Figure 7. Baltimore Greenway Trails Network**
(Bikemore, n.d.)

The County's tourism industry benefits from those who explore the outdoors. Pageviews from the Visit Frederick website (https://www.visitfrederick.org) show a steady increase in people interested in parks and outdoor activities such as biking, from 51,926 in 2018 to 110,374 in 2020. In October 2020, the year of the COVID-19 pandemic, the Maryland Park Service reported 17.1 million park visitors compared to 14.9 million in 2019, with three months remaining in the year. A 2010 Maryland State Parks Economic Impact and Visitor Study (Dougherty, 2011) showed that visitors spent more than $567 million on food and drinks in restaurants or grocery stores and on camping supplies during their trips, producing a total economic impact of more than $650 million annually. Calculating for inflation (Saving.org), those figures equate to about $684 million and $780 million, respectively. The study did not break out parks by county; however, positive economic impacts of park visits were documented.

*Other important green infrastructure co-benefits.* Vehicle collisions with wildlife are reduced when wildlife passages over or under roads are created (World Geography, n.d.; Gonzales, 2021) and green infrastructure can increase the value of adjacent development (Benedict & McMahon, 2006) and increase carbon sequestration (Jaffee, 2010). Riparian buffers naturally protect water sources (Spruill, 2000), saving the public expense of enhanced water treatment facilities and dredging.

**Equity Considerations:** Locating natural areas within walking distance of traditionally disadvantaged populations provides convenient access to low-cost recreational and human health benefits. "Responding to climate change by strengthening green infrastructure can specifically benefit individuals from low socioeconomic status populations, where it has specifically been shown

that a decline in levels of depression and anxiety is related to an increase in exposure to green space and infrastructure. In addition, socioeconomic inequalities in mental health outcomes are higher among those urban dwellers who indicate they have difficulty with access to recreational and green spaces within their neighbourhood" (Bowen & Lynch, 2017, p. 91).

**Costs and Cost-Benefit Analyses:** Cost of community services studies show the cost to taxpayers for various types of land uses and demonstrate the economic advantages of preserving green space and working lands. They examine a community's overall balance of revenues and expenditures at any given point in time and attempt to determine the proportion of municipal revenues and expenditures attributed to major categories of land use (residential; commercial and industrial; farmland; forest; and open land). For example, a parks and recreation program would be classified as costs of residential development; the costs of roads would be allocated across all types of development; local expenditure on the farm services agency would be assumed to be benefiting farm and forestland. The resulting totals for revenues generated and expenditures incurred can be presented as a ratio of expenditure-to-revenues for different land-use types (Benedict & McMahon, 2006).

A cost of community services analysis in Loudoun County, Virginia, found that the costs to service one thousand new development units exceeded their tax contribution by as much as $2.3 million. In Bucks County, Pennsylvania, a similar study focused on the costs of schools. The study looked at the school district costs associated with developing a hypothetical 100-acre farm as compared to purchasing the land or a conservation easement and found that developing the farm would result in a $273,834 shortfall per year, whereas the community would break even in 8.5 years if it purchased the land and in 6.2 years if it purchased a conservation easement on the farm (Benedict & McMahon, 2006).

**Finance:**

*Voluntary landowner conservation and/or land donations.* Sometimes simply notifying landowners of the value of green space features and explaining the purpose of a green infrastructure network are sufficient. Owners who are made aware of important resources on their properties are often willing to protect them once they learn of their existence or significance. People value what they understand and protect what they value (Benedict & McMahon, 2006). Some landowners have already donated or willed property to the County or to an entity such as the Audubon Society for conservation.

Several other financing options exist, such as the ones identified in the following list:

*Tree Solutions Now Act of 2021 (HB991)*:
This recently passed State bill (see League of Conservation Voters, 2021) earmarks Federal Funds available through the Conservation Reserve Enhancement Program (USDA, n.d.) to contract with agricultural producers so that environmentally sensitive agricultural land is not farmed or ranched, but instead set aside for conservation. CREP is part of the USDA Conservation Reserve Program (CRP), (USDA, n.d.). CREP participants establish permanent, resource-conserving plant species, such as approved grasses or trees to control soil erosion, improve water quality, and develop wildlife habitat. In return, the Farm Service Agency provides participants with rental payments and cost-share assistance. In 2021, Frederick County landowners are earning about $5,000 per acre for CREP easements.

*Agriculture Cost-Sharing Program* – State Cost-Sharing Funds (MD SB 344, LegiScan, 2021): This State bill, which takes effect in July 2021 and remains effective for 5 years, provides funding for projects that prevent or control agriculture-related nonpoint source water pollution. Funds for a project may be up to 100% of eligible costs, not to exceed $200,000. The Maryland Agricultural Land Preservation Fund purchases conservation easements that forever restrict development on prime farmland and woodland, for the continued production of food and fiber, to curb the expansion of random urban development, and to protect wildlife habitat. Through

the Environmental Quality Incentives Program (EQIP), the Natural Resource Conservation Service offers technical and financial assistance to farmers to restore and manage forest interior habitat in Maryland. EQIP will pay for:

- Enhancing existing suitable forest habitat by increasing the total size of contiguous forest, closing gaps in large forest tracts, and increasing the interior-to-edge ratio;
- Establishing new forest plantings or augmenting existing forests;
- Improving forests by use of treatments to remove invasive species and increase vegetative diversity; or
- Establishing corridors to large contiguous forest areas.

Conservation easements are voluntary legal agreements between a landowner and local government or land trust that are used to preserve open land, such as farmland, forest land, and significant natural resources. Frederick County's Creek ReLeaf program is a multi-year conservation easement program designed to increase the total amount of forested area within the County. It provides private landowners with planting of native trees and shrubs on their property, five years of maintenance to establish a forest stand, and payment for the easement placed on the parcel. The Catoctin Land Trust works with other land trust partners, such as the Forever Maryland Foundation, Maryland Environmental Trust, and the Frederick County Land Preservation Program to protect working farmland and land with significant natural, scenic, and historic values.

The Installment Purchase Program (IPP) is a County-funded farmland preservation program. The IPP works through the County's bonding authority to acquire easements at today's prices and pay for them with a deferred principal payment and annual tax-exempt interest payments. Rather than pay lump sum amounts for easements, the County invests in a zero coupon bond that matures to the full principal value of the easement. The property owner then receives the annual tax-free interest as well as lump sum principal payment at the end of a 20-year term.

Program Open Space makes County land acquisition funds available through the State property transfer tax. It funds open space and recreational facilities for the public good.

Stream-Link Education is a local non-profit that creates community volunteer tree planting experiences on streamside properties to improve the health of the Monocacy River and its tributaries. The organization is supported by sponsors such as the Canam Steel Corporation and by grants from sources such as Maryland DNR.

**Recommended Actions:**

### Legislative

- Review existing County policies, codes, and ordinances to better protect the natural green infrastructure network; recommend legislative changes as necessary.

- In year three, draft and adopt legislation to identify and protect natural vegetation corridors into the Appalachian Mountains and other areas as needed to provide wildlife corridors and contiguous tracts of healthy ecosystems.

- In year four, approve, fund, and implement the Green Infrastructure plan that embeds smart growth policies and/or protects natural green infrastructure of City and County vegetated habitats, and establish incentives to protect forest tracts and corridors.

### Administrative

- Review administrative structures and operational procedures to develop and implement a green infrastructure plan for natural lands; recommend administrative changes as necessary.

- Within the first two years, establish a database to identify and monitor protection of wildlife corridor tracts.

- Examine zoning for areas of contiguous forest and explore ways to protect these lands.

- Work with private landowners to protect Tier 1-3 conservation and sensitive species areas.

- In year three, draft a functional natural Green Infrastructure plan that includes policies and specific actions for protecting wildlife endangered areas.

### Community

- Through public and non-governmental organizations, educate the community on the value of natural green infrastructure and involve stakeholders in protecting it in the future.

### Advocacy with State and/or Federal delegations

- Advocate for the C&O Canal National Park to be a designated wildlife corridor.

- Press for passage of the Federal Wildlife Corridor Act.

- Pursue national wild and scenic status for the Monocacy River.

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## 27 Improve community public health resilience to extreme heat events

**Expected GHG Reduction or Climate Adaptation:** As summer extreme heat events continue to increase in the United States, trusted community partners such as state and local health departments can help communities prepare for and respond to the event-related health impacts (Centers for Disease Control [CDC], 2020]. Public and private partnerships will allow for programs that expand access to cooler spaces for individuals considered to be at high risk of negative health outcomes. As the County Health Department officer states, preventing conditions that create illness is the largest role that public and private organizations can take to combat climate health impacts. The incidence of heat-induced illness can be tracked by establishing procedures and monitoring hospital, clinic, and health center visits due to heat stress, respiratory distress (e.g., asthma), and dehydration, and possibly by tracking lost days of work for those who work outside.

**Timeline for Action:** The City and County should initiate public and private partnerships for extreme heat adaptation within a year. Progress metrics include establishing a reporting database and procedures, and generating annual summaries of heat-related illnesses.

**Rationale:** Immediate health impacts of extreme heat include heat stress, heat stroke, and death, along with increased risk of heart attacks, renal failure, and negative impacts on fetal health (Sapkota et al., 2016; Reidmiller et al., 2018). In Maryland, summertime extreme heat increased the risk of hospitalization for asthma and heart attack by 22 and 11%, respectively (Sapkota et al., 2016). In Washington County, Frederick City and County's neighbor, this risk was considerably higher for asthma hospitalization with summertime extreme heat exposure increasing risk by 76% (Sapkota et al., 2016). Extreme heat will likely increase concentrations of secondary pollutants such as ozone in the coming decades (Archer et al., 2019), increasing respiratory threats. This may likely reverse the decline in ozone documented in the Livable Frederick Master Plan (Frederick County, 2019, p. 183).

Options used elsewhere have proven effective in reducing heat impacts. Lanza and Durand (2021) state, " For climate change adaptation, we recommend tree planting at bus stops to protect from ridership losses and unhealthy exposure to extreme heat." During one CEMWG meeting, a participant discussed the need for shading at bus stops as an immediate priority for himself and other riders (J. Taylor, personal communication, December 10, 2021). Cooling centers in Maricopa County, AZ served many unemployed and homeless individuals (Berisha et al., 2017). Among the cooling center visitors in Maricopa County, 11% of those with a permanent residence did not have an air conditioning (AC) unit at their residence, and 27% indicated that their AC could not be utilized due to costs, repair needs, or other reasons (Berisha et al., 2017). Baltimore City accommodates senior citizens through the CARE's Taxi Card voucher program to make cooling centers more accessible (Baltimore City, 2020). Some jurisdictions also implement heat health alert systems to disseminate timely messages about safety and resources. For example, North Carolina's Department of Health and Human Services communicates heat-health alerts through farm worker health training, information campaigns with local housing authorities, nutritional assistance site staff training, and parks and recreation staff training to reach vulnerable populations (CDC, 2020). The Rhode Island Department of Health has a system where emails are sent to ~1,760 Licensed Primary Care Providers (CDC, 2020). Maryland's Office of Human Services (2021) has private home energy assistance and weatherization programs. In New York City, a two-year pilot program was implemented to conduct a door-to-door or building level check on vulnerable individuals during extreme events through buddy systems between


**Figure 1. Buddy program in New York City** (Source: Centers for Disease Control, 2020)

social service and community organizations, volunteers, and vulnerable New Yorkers (Fig. 1, Cool Neighborhoods NYC, n.d.). Community organizations and volunteers were trained on emergency protective measures and ways to assist vulnerable adults during emergencies. Community engagement also increased since they had to identify alternative resources in their neighborhoods to stay cool and to use trusted messengers to communicate protective health messages in hard-to-reach populations.

The effectiveness of these extreme heat adaptation activities include reduced hospitalizations related to heat stress and heat stroke (CDC, 2020) and decreased disease burden in vulnerable populations (i.e. elderly, disabled, ALICE). Increasing community resilience to extreme heat will protect public health and reduce health care costs. Cooling centers in the community are effective in prevention of stroke-related deaths and reduction of hospitalizations due to heat stress (Nayak et al., 2019). Likewise, heat health alert systems reduce excess death and dispatch of emergency medical services (Toloo et al., 2013).

The Livable Frederick Master Plan (Frederick County, 2019) has the following Healthy Habitat goal: ensure that "...the habitat we build supports and corresponds to our biological needs" (p. 140). This goal can be achieved through upgrading construction requirements that protect residents from extreme heat and protections for outdoor workers. In the Environmental Sustainability section of the City Comprehensive Plan (Frederick City, 2021), the heat island effect is addressed through recommending increasing tree canopy (ES Policy 1.1.c) and outlining Operation REHAB, the single family rehabilitation program in the Community Development Block Grant program that assists low income families in addressing housing problems that include heating and cooling (p. 9-220). The draft City Climate Action Plan (Frederick City, 2020) indicates that "... the Building Department may have the jurisdiction to adopt and enforce updated or enhanced codes that reflect resilient design standards and best practices for buildings" (p. 51), potentially compelling improvements in rental property and affordable housing of at-risk, fiscally constrained populations in homes with inadequate cooling capacities, etc. Importantly, the City's strategic plan, CommUNITY 2030 (City of Frederick, 2019), includes specific initiatives to protect its residents, through its strategic initiative 1.01.005, to "implement measures to help ensure safe high quality rental housing units throughout the City;" other pertinent public health-related initiatives can be applied to protecting climate-vulnerable residents as well, i.e. 2.05.001 and. 002, and 2.06.001 and .002 (City of Frederick, 2019, Appendix 1).

**Co-Benefits:** Beyond the critical health benefits cited above, these heat-related resilience measures also reduce costs to the community by reducing emergency room visits and first responder calls as previously mentioned. In addition, energy assistance programs help low-income families pay for their electricity bills when temperatures are extremely high (CDC, 2020). Cost can be a deterrent for air conditioner use, so these programs might allow qualified households (disabled, seniors, low income, specific medical conditions) to continue to use their air conditioners during extreme heat events (CDC, 2020).

Weatherization programs specifically have been shown to not only lower utility bills for homeowners, but also reduce greenhouse gas emissions and resolve health and safety issues (CDC, 2020). Enhanced surveillance data can be shared with public health practitioners, community partners, and in technical reports (CDC, 2020). Any spikes in emergency room visits during, or immediately following, days with extreme heat can be identified to enhance preparedness for hospitals and families, which has been done in the Oregon Climate and Health Program (CDC, 2020).

**Equity Considerations:** Most public and private partnerships for adaptation activities related to extreme heat are intended to assist low-income families, disabled, seniors, those with underlying medical conditions, and culturally and linguistically diverse (CALD) communities. For example, a family has to be between 110–150% of the Federal Poverty Level (FPL) to get home energy assistance (Paying for Senior Care, 2019). In terms of weatherization programs, utility bills are reduced, allowing impacted families to pay for other necessary expenses such as healthcare, medicine, groceries, and childcare (U.S. Department of Energy [DOE], 2018). In addition, lower income residents generally live in neighborhoods with little tree canopy or other green infrastructure to reduce urban heat island temperatures, which also makes them more

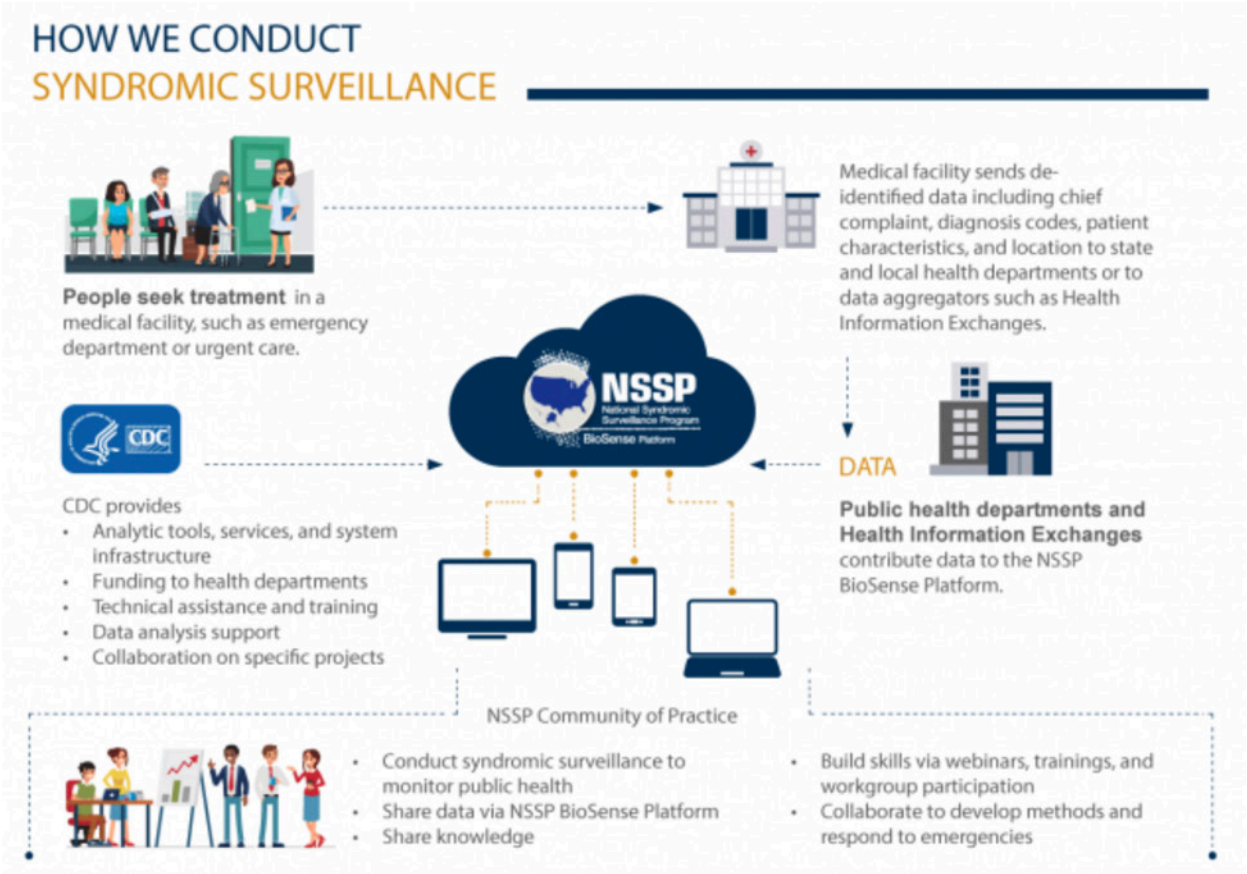


**Figure 2. Syndromic surveillance in partnership with the CDC** (Source: CDC, 2020)

vulnerable to elevated ozone levels. This inequity can be overcome by using tools such as the Equity Index (Recommendation 1) to identify areas for enhancing tree canopy.

**Costs and Cost-Benefit Analyses:** Nationally, there were $78 billion in losses due to heat waves and droughts from 2004 to 2013 (Reidmiller et al., 2018).

Cooling centers are relatively low-cost due to the use of existing infrastructure and personnel (CDC Climate and Health Program, n.d.; Nayak et al., 2019); in Frederick, these might include places such as the Talley Center and other locations within the Equity Emphasis Areas identified by the Metropolitan Washington Council of Governments (2020). A lack of transportation may be a barrier to the use of cooling centers because of bus fare, waiting at a bus stop, long travel distances, and prolonged travel time due to multiple stops (Nayak et al., 2019). Most facilities do not report additional operational costs, but those that do may require additional staff hours, water purchases, and higher utility bills (Berisha et al., 2017). Some monetary assistance or donations of water, food, and clothing may offset these costs (Berisha et al., 2017).

- Heat health alert systems: A study in Philadelphia from 1995-1998 revealed that the estimated cost-benefits of a heat warning system to be $210,000 for the cost of running the system. However, this system was highly cost-effective compared to the $468 million benefits of saving 117 lives (Ebi et al., 2004).

- Home energy assistance: State requirements for home energy assistance benefits vary. For instance, as of 2019, in Delaware, the maximum heating benefit was $1,852/year, the maximum cooling benefit was $1,000/year, and the maximum emergency benefit was $5,000/year as of 2019 (Paying for Senior Care, 2019).

- Weatherization: The DOE has a weatherization program with an average weatherization cost of $4,695 per unit. This program supported 8,500 jobs and resulted in a $238 annual energy savings cost for a household (DOE, 2018). There are also overall community benefits, with a $2.78 return in non-energy benefits and $1.72 in energy benefits for every $1.00 invested in weatherization. Non-energy benefits include fewer missed days of work and decreased out-of-pocket medical expenses due to the improvement of a more livable home. Average health and household benefits were $14,148 per unit.

- Surveillance: Maricopa County and Pinal County in Arizona conduct surveillance for heat-related illnesses using the existing National Syndromic Surveillance Program (NSSP) BioSense Platform and the Electronic Surveillance System for Early Notification of Community-based Epidemics (ESSENCE) (Fig. 2). Other jurisdictions have partnered with local health department surveillance teams to separately analyze data (CDC, 2020).

- Buddy program: The City of New York invested $930,000 in the aforementioned two-year pilot buddy program to increase social networks and connect vulnerable populations to resources during periods of extreme heat.

**Finance:** As cited in the recommendation on Mold Growth and Upper Respiratory Distress (Recommendation 28), the U.S. Department of Energy (DOE) has a Weatherization Assistance Program (WAP) that provides state grants for partnerships with local agencies for weatherization assistance. The EmPOWER Maryland Program also offers assistance for energy efficiency upgrades with participating utility companies. Within Maryland's Office of Human Services (n.d.), the Office of Energy Programs has various grant programs that provide bill assistance to low-income households that are energy-related: the Maryland Energy Assistance Program (MEAP), the Electric Universal Service Program (EUSP), Arrearage Retirement Assistance, the Utility Service Protection Program (USPP), and Weatherization and Energy Efficiency Services (Maryland Department of Human Services, 2021). Frederick City's Community Development Block Grant funds and the Maryland Department of Housing and Community Development (DHCD) Single Family Rehabilitation Loan Programs assist qualified low-income homeowners with loans for rehabilitation.

**Recommended Actions:**

Administrative — City & County

- Early warning: Heat health alert systems
  - Establish an early warning system for heat alerts with 24-48 hour lead time. This should be used by the Mayor's office to declare code red alert, triggering emergency response and opening of cooling centers. This should offer a heat alert service that allows residents to opt in to receive email or text notifications and information on associated health risks, at-risk populations, and heat response instructions as well as location of nearest cooling centers.
- Cooling centers & transportation
  - Possible cooling centers should be identified (e.g., libraries, schools, community/recreation/religious centers, private businesses, etc.).
  - Transportation

    — Cooling centers alone will not help if high-risk individuals do not have transportation. Establish travel accommodations (i.e., public transportation, taxi service, etc.) to and from cooling centers.

    — Increase bus shelters and tree canopy in urban areas, particularly in locations where public transportation is critical for employment access.
  - Awareness

    — Increase knowledge about cooling centers and where they are located.
- Home energy assistance
  - Establish a partnership with low-income individuals to subsidize electricity bills during extreme heat events.
  - Establish agreements with utility companies to limit power shut-downs during extreme heat events.
  - Establish agreements with utility companies to loan or subsidize air conditioning units or fans to at-risk individuals.
- Weatherization
  - Encourage and financially support the installation of energy efficiency measures (e.g., building shell, repairing and/or replacing heating, cooling (see Recommendation 4), and water heating systems, and replacing lighting, appliances, and water fixtures) for low-income homeowners and renters.
- Surveillance
  - Partner with epidemiology surveillance groups to monitor health outcomes during periods of extreme heat.
- Buddy program
  - Establish a community-based program where community members are paired with at-risk individuals to ensure they have access to resources such as water, air conditioning or fans and ability to get to a cooling center if needed during extreme heat events.

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## 28 Prepare for public health in extreme precipitation events

**Expected GHG Reduction or Climate Adaptation:** Extreme precipitation can increase risk of flooding-related deaths, food and waterborne illness, and road accidents (Sapkota et al., 2016). It can also cause an increased burden of respiratory illnesses from exposure to molds (e.g., Brandt et al., 2006). Consistent with the County Health Department's mission, prevention of exposure is the most important means to protect public health. Therefore, rather than reactive responses after the disasters, proactive measures geared toward enhancing community resilience to extreme precipitation need to be implemented, including expanded green infrastructure; development of early warning systems with longer lead times; waterproofing basements in high flood risk areas to avoid mold exposure; and enhanced surveillance of food/waterborne illness and data coordination with the State Health Departments. An option to track progress in minimizing extreme precipitation-induced illness, injury, or deaths would be to contrast these public health outcomes between dry vs. wet and post-flood periods to identify climate-related threats, presenting results in annual reports. Progress also can be assessed annually as acres protected or stormwater/sewage discharge reduced.

**Timeline for Action:** Within a year, the City and County should initiate public and private partnerships for improving the resilience of green infrastructure and wastewater treatment plants to extreme precipitation, along with updating zoning policies to reflect any changes recommended through the partnerships. Establishing a working relationship for County-wide data with County Public Health officials for hospitalizations, reported injuries, or deaths should be initiated within one year, and annual reporting procedures drafted and implemented thereafter. Development of the tracking databases for wet and dry year illnesses and County and City plans for retrofit or new conveyance and storage system capacities, based on projected population increases, can be initiated and completed within the first year.

**Rationale:** Extreme precipitation can impact human health, both directly and indirectly. In Maryland, there was a 23% increase in the risk of motor vehicle accidents during extreme precipitation events, with a considerably higher risk (46%) observed on roads with defects or obstructions (Sapkota et al. 2016). This points to a need to not only update infrastructure but to make it less hazardous by ensuring the visibility of signs are not compromised during extreme events. Exposure to extreme precipitation also led to a significantly increased risk of *Salmonella* infections in Maryland and increased risk of *Campylobacter* infections in the coastal areas of the state (Sapkota et al., 2016).

Development of and exposure to mold following flooding of basements is frequent in the humid, warm areas of the region, leading to respiratory distress, allergic reactions, and in very young children, life-long asthma (National Institutes of Health [NIH], 2012). Previous studies indicate that mold and damp building exposure results in a 37–56% increase in asthma and asthma-related health conditions (Fisk et al., 2007). This is of significant concern given the asthma prevalence among Frederick County residents has increased from 7.5% in 2011 to 9.8% in 2014 (Frederick County, 2019, p. 136). Therefore, it is important to protect populations from the increased exposure and damage from a variety of physical, biological, and chemical hazards that may accompany extreme precipitation events.

In Baltimore City, zoning policies were upgraded to incorporate climate risks, which can protect existing buildings and strengthen improved buildings (Teodoro & Nairn, 2020) to minimize health-related impacts. Independent of climate concerns, Frederick County has adopted wider buffer zones in local watersheds while floodplain building restrictions are already in place (Frederick County, 2019, p. 57). Further, the City and County have also agreed that there should be no building in a floodplain, exemplified in the ongoing discussions in the 2020–2021 South Frederick Corridor planning

process. The City of Frederick is now considering updating its floodplain ordinance to require higher building standards (Marshall, 2021), thereby not only protecting buildings but those who occupy them from the bacteria and mold that could develop. For the past several years (2019–2021), the City has been working with the U.S. Army Corps of Engineers to identify flood-prone areas and stormwater management options to prevent future City flooding. The results of this work may perhaps be a tool for assessing flooding potential and pathogen and mold exposure for areas the City is considering in future annexation.

For new construction or building renovations, as cited in Recommendation 4, construction practices should be changed to prevent flooding basements with pathogen-laden stormwater (SW) and sewage; possibilities include requiring foundation sealants, vapor barriers, and backflow valves. Insights from the Frederick County Building Industry Association (FCBIA) should be solicited to help identify new technologies to minimize flood damage and subsequent exposure to contaminants. Public funds should also be established to assist owners with building repairs from flooding damage due to inadequate stormwater or sewage conveyance/storage (Recommendation 4), thereby preventing future pathogen or mold exposure. For example, grants through the Federal Water Pollution Control Act have been used for various wastewater treatment projects to reduce accidents and pathogen exposures, such as for treatment plants, related interceptor sewers, correction of infiltration or inflow of sewer lines, construction of equalization tanks, and sewer rehabilitation (Ramseur, 2018). Smaller upgrades for homes and businesses can be funded through City Block Grants or the Maryland Department of Housing. Similar changes in wastewater treatment plant infrastructure prevented production losses and reduced hospitalization durations and medical treatments in Brus, Serbia, with health benefits of EUR 93.00 (~$110) per household per annum (Djukic et al., 2016). Green infrastructure practices are also effective in slowing runoff, retaining bacteria-associated particles, and infiltrating water, thereby reducing down-gradient flooding potential for some storms. Increased soil organic matter (SOM) performs a similar service, with every one percent increase in SOM increasing water storage capacity by 27,000 gallons per acre (Recommendations 19, 20). There are also simple steps that can be taken to help prevent or minimize flooding in existing homes, such as not packing mulch directly against a building's foundations, using downspouts or drains to move water away from buildings, etc. The City and County could support these efforts through distributing landscaping factsheets to home or business owners and hosting public education events.

The Livable Frederick Master Plan (Frederick County, 2019) recognizes the threat posed by climate change-induced severe storms and increased rainfall and the associated health threats that arise. In one statement, the Plan states that stormwater management is designed to try to reduce rain runoff volumes to amounts that would be expected if the site were all woodlands (p. 181) but goes on to say that "...the increasing size of flooding events...may require a reexamination of this standard..." and indicates that an increase of green infrastructure is necessary to address storms that produce greater than one inch of rainfall (p. 194). On p. 141, it recognizes the importance of accessible green space in stormwater management in new and existing developments and the need for particular focus on old neighborhoods built prior to SW management standards (p. 181). At the City level, the draft City Climate Action Plan (City of Frederick, 2020) warns of "...greater disruptions to public health and safety services..." from the changing climate provided by 80 City public and private critical facilities (p. 51) while the City Comprehensive Plan (City of Frederick, 2021) repeatedly cites expanding flood management through its ongoing work with the U.S. Army Corps of Engineers (p. 198). The City's strategic plan also offers possibilities for protecting residents through its strategic initiative 1.01.005, to "implement measures to help ensure safe high quality rental housing units throughout the City" (City of Frederick, 2019). Other initiatives pertinent to protecting climate-vulnerable residents include 2.05.001 and. 002, and 2.06.001 and .002. Reducing flooding and/or its damages reduces pathogen (bacteria and mold) exposure, thereby meeting the County Health Department's primary goal to prevent illness so medical attention is not required.

**Co-Benefits:** In addition to the documented benefits to public health noted above, there are important co-benefits to instituting policies to prevent building (and road) flooding. There are obvious benefits to residents such as uninterrupted transportation and emergency services, minimizing or eliminating employment disruptions, and fewer repair and replacement expenses. The green infrastructure options not only slow water but help to maintain ecosystem services that improve human health, including air and water quality improvements, erosion protection (e.g., riparian buffers), pollination and crop/food productivity, and runoff of other land-applied contaminants (Minnesota Pollution Control Agency 2018). Some of these technologies can promote vegetation and route runoff to pervious surfaces using infiltration, such as bioretention, tree trenches or tree boxes, green roofs, vegetated swales, and improved turf (Minnesota Pollution Control Agency, 2018), thereby increasing carbon sequestration, which further reduces both extreme heat and precipitation forecasted in climate change. A number of these projects were implemented with good results in the Hudson River Valley, along with rain gardens and stream buffer retention (New York State Department of Environmental Conservation, n.d.).

**Equity Considerations:** Older communities, built prior to current SW management regulations, often include income-limited families and individuals. Retrofitting conveyance systems and storage capacities is one option to limit flooding and pathogen exposure in buildings of these communities. Another, less advantageous, but perhaps necessary short-term option, is to establish public funds to 1) reimburse residents for flood damages, 2) provide installation and maintenance of backflow valves in basements of flood-prone homes to bolster inadequate public utilities for the area, and 3) provide ancillary medical assistance for underinsured individuals and families. A more proactive, less disruptive approach is to increase green infrastructure in these low-income communities to improve flood resilience (Save the Rain, n.d.), decreasing disease and pathogen exposure while ensuring continuous access to work sites, schools, and food. The City and County could employ an Equity Index (Recommendation 1) to identify the most impacted and lowest-income areas for targeted retrofits, flood prevention, and green infrastructure implementation and fund areas with the greatest need for protection.

**Costs and Cost-Benefit Analyses:** Between 2004 and 2013, the country faced $392 billion in losses due to hurricanes and $30 billion in losses due to flooding and severe storms (U.S. Global Change Research Program 2018). Various examples indicate cost options to reduce these flood impacts:

- Green infrastructure: Onondaga County, NY was one of the first jurisdictions to implement green infrastructure within the private sector and developed a Green Infrastructure Fund that provides over $7 million in project funding. These projects have captured over 29 million gallons of water across Syracuse (Save the Rain, n.d.). The program created 76 projects by July 2015, with construction costs of $8.3 million and redevelopment costs of over $18 million. For each hectare of impervious area, average costs are $462,000.

- Zoning: Hudson & Botzen (2019) have identified nonmarket benefits of flood zoning policies due to changes in local hydrology, including increased biodiversity; however, the primary benefit of such policies is the reduction of flood impacts (Fig. 1). Business interruption losses, especially in industrial areas, are reduced. Direct reduction in property losses is another benefit and intangible benefits such as psychological impacts must also be considered. The main costs associated with flood zoning policies are potential opportunity costs associated with lower tax revenues if the land is not developed, along with administrative costs to design, monitor, and enforce the policies over time.

**Figure 1: Flood-zoning policy that focuses development onto flood safe areas, along with land–use changes**
(Source: Hudson & Botzen, 2019)

- **Wastewater treatment plants:** One example of wastewater treatment plant improvements to address climate change comes from Anacortes, WA. Similar in size to the City of Frederick with 56,000 people vulnerable to current floods, the Anacortes, WA wastewater treatment plant was rebuilt, addressing climate risks including more frequent and intense storms. About $56 million was invested in the project, and some strategies to protect the community from flooding risk included minimizing penetration below current 100-year flood elevation, raising critical electrical equipment out of the 100-year flood zone, utilizing waterproofing techniques below 40 foot elevation, and designing ring dikes for flood protection (Environmental Protection Agency [EPA], 2021a).

**Finance:** The Board of Public Works approved funding for a number of green infrastructure projects through the Maryland Department of Natural Resources in Baltimore City, Anne Arundel County, and St. Mary's County (Maryland Department of Natural Resources, 2020). The EPA has many funding resources for infrastructure projects, including the Water Infrastructure and Resiliency Finance Center (WIRFC), Urban Waters Small Grant Program, Clean Water Act Nonpoint Source Grant (Section 319 Grants), and Greening America's Communities Program (EPA, 2021b). Grants through the Federal Water Pollution Control Act and Water Infrastructure Finance and Innovation Act (WIFIA) have also been used to fund wastewater treatment projects (Congressional Research Service, 2018). City Block Grants or the MarylandDepartment of Housing and Community Development Single Family Rehabilitation Loan Program can address upgrades to homes to minimize flood impacts.

**Recommended Actions:**

- Administrative — Include County Public Health officials in proactively identifying needed City and County policies to prevent future exposure of residents, particularly at-risk communities, to extreme precipitation events and the illnesses that follow

- Administrative and Legislative — City and County
  - Preventing illness: Develop a County-wide easily accessible public health database on extreme precipitation-related illnesses.
  - With public-private partnership, develop an early warning system for extreme precipitation-related threats and illnesses that can be used to warn residents living in high-risk areas to prevent illness before it occurs.
  - Increase green infrastructure, such as expanding riparian buffers, urban tree canopy, and stormwater management structures, to reduce impervious cover in flood-prone areas, thereby reducing flooding and potential pathogen and contaminant exposure.
  - Explore use of an Equity Index (Recommendation 1) for green infrastructure placement and U.S. Army Corps of Engineering model to best protect specific City and County areas from future flooding.
  - Zoning policies — Assess whether floodplain zoning policies are adequate for protecting mass floods and runoff that would threaten existing residents and infrastructure (downstream developments or municipalities) as well as placement of future developments.
  - Assess and plan for future retrofit and new construction of conveyance and storage systems for wastewater and stormwater service.
  - Strengthen the resilience of wastewater treatment plants to extreme precipitation through measures such as minimizing penetration, raising critical electrical equipment, expanding storage capacities, and waterproofing techniques as described in the *Livable Frederick Master Plan's* goal for wastewater and sewer adequacy, focusing on making this infrastructure sufficient for current and future populations (Frederick County, 2019).

- Establish a public fund for homeowners whose homes were built prior to current stormwater regulations that can be used to upgrade existing flood prevention technologies (foundation sealants, backflow valves, etc.) as well as reimbursement for flood damages experienced through inadequate neighborhood provision of public conveyance or storage systems.

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## 29 Minimize the impact of extended droughts

**Recommendation:** Identify public and private measures to minimize direct and indirect effects of water shortages on public health and food availability.

**Expected GHG Reduction or Climate Adaptation:** Programs will be needed to enhance storage and efficient use of drinking water, while building capacity for safe reuse of reclaimed water for agricultural purposes to maintain local food availability. Results can be tracked through enumerating existing and new water storage locations and volumes, identifying new uses of reclaimed or greywater, and costs associated with developing and implementing infrastructure to effectively store and reuse water.

**Recommended Timeline for Action:** Expand water storage capacity and explore alternatives for drinking water within one year; enhance capacity to use reclaimed water in agricultural settings within five years.

**Rationale:** Frederick County has experienced a few severe droughts in the past, with some requiring mandatory water restrictions (Roylance, 2002). In August, 2021, Emmitsburg had to limit water use due to severe drought (Keller, 2021) and the County will likely face extended dry periods much more frequently due to climate change. Some of these droughts affect food price instability for cornerstone crops (i.e., corn, soybeans, wheat, etc.), as noted in the 2012 drought across 2,245 counties in the nation (Center for Climate and Energy Solutions, 2021). In the temperate rainforest, Tongass National Forest, in Juneau, Alaska, there are moderate to extreme droughts that have sparked the need for adaptation strategies for the community and ecosystem, including building flexible trailheads, improving access to winter recreation, and placing logs in streams to help salmon habitat (Cutler & Johnson, 2019). And California's drought, in some areas since 2015, has exacerbated forest fires across the state and severely constrained Central Valley farming (Becker, 2021).

Adaptation measures for extended drought seek to expand the overall supply and availability of water by increasing the water retention capacity of soils (soil water storage capacity increases by 27,000 gallons/acre for every 1% increase in soil organic matter; United States Department of Agriculture [USDA], 2013; also see recommendations 17–20) and watersheds (Center for Resource Efficient Communities, 2017). Minimizing water use and consumption through more efficient practices would allow for a limited water supply to be distributed effectively for drinking water and other needs. This efficient use also reduces the risk of food insecurity and infectious diseases related to water quality (Salvador et al., 2020). The projected increases in population and frequency of drought will increase demands for municipal water in direct competition with agricultural water needs. It is prudent to build capacity that enables safe use of reclaimed/greywater for agricultural purposes, thereby enabling most freshwater for municipal usage.

Residents with shallow wells also have greater susceptibility to droughts than those with deeper wells, with recovery of these wells an additional issue, especially during spring and summer months (Fig. 1) (Swistock & Sharpe, 2016). Homeowners can conserve water with water-saving devices, behavioral changes, and by harvesting rainwater. Benefits of harvesting rainwater are wide ranging,

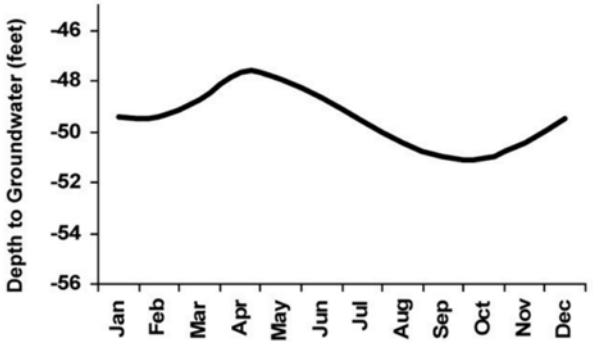


**Figure 1. Natural groundwater fluctuation during the year in a typical Pennsylvania water well.**

including low expense; augmenting the water supply; reducing stormwater runoff, pollution, and erosion; and reducing peak summer demands (Environmental Protection Agency [EPA], 2008). As an example, San Francisco has a Memorandum of Understanding (MOU) for permitting requirements that encourage harvesting rainwater and reusing it for non-potable applications, without treatment requirements (EPA, 2008). Businesses have also been taking on corporate responsibility to conserve water, especially industries with large water footprints, i.e., food and IT companies. Use of reclaimed or greywater is also feasible.

For agriculture, options to protect limited freshwater resources include working with farmers to promote the efficient use of water through the agricultural supply chain, water and fertilizer management practices, and water stewardship policies (Ceres, 2016). For wastewater, Sheikh et al. (2018) state, "...installing treatment technologies that produce water of adequate quality for indirect potable reuse can allow utilities to supply recycled water to agriculture during the irrigation season and recharge groundwater during the non-irrigation season." To provide future water, groundwater recharge has been implemented in the Hampton Roads Sanitation District (n.d.) area by injecting 120 mgd of treated wastewater into the Potomac Aquifer in its Aquifer Replenishment Program of its Sustainable Water Initiative for Tomorrow (SWIFT) program.

Climate Resiliency within the Livable Frederick Master Plan (Frederick County, 2019) seeks to protect the County from droughts in the future through its goal, "Plan and prepare for the impacts to public infrastructure, human health, private property and the environment from increasing flooding, fires, droughts, crop and tree damage, temperature extremes, and intense storm events" (p. 193). For the City, drought-tolerant plants are encouraged as part of the commitment to increase tree canopy to reduce the urban heat island effect (City of Frederick, 2020, p. 60).

**Co-Benefits:** A co-benefit of increasing water storage capacity through mechanisms such as raising dams includes flood control. Water conservation is likely to lead to reduced need for irrigation, allowing for proper management of dry-season baseflows of streams and native fauna (e.g., brook trout, Hitt, 2021) susceptible to low flows and elevated water temperatures. Another co-benefit of water conservation is using saved water to complete projects that reduce reservoir sedimentation and forest management projects to enhance carbon sequestration (Center for Resource Efficient Communities, 2017). Water conservation and reuse in agriculture provides the additional benefit of reducing the need for expensive facility upgrades for nutrient-removal processes (Sheikh et al., 2019) as well as lessening the threats to food production through use of greywater, which helps to maintain affordable food supplies.

**Equity Considerations:** Both droughts and extreme precipitation events threaten water supplies and impact water storage and treatment infrastructure (EPA, n.d.). Analysis of water use and availability of water in low-income and rural areas should be completed to identify those populations most vulnerable to water shortages. Droughts will also impact local food production and may increase food prices, which will have a disproportionate impact on low-income communities that already spend a higher percentage of income on food.

**Costs and Cost-Benefit Analyses:** Nationally, there were $78 billion in losses due to heat waves and droughts from 2004 to 2013 (Riedmiller et al., 2018). The estimated cost in Santa Clara Valley, California to perform diking to prevent flooding, modifications to water infrastructure, and well system repairs was $768 million (Water Research Foundation, 2015). On a national level, droughts in 2011 and 2012 led to increased commodity prices as a result of reduced crop production, as well as reduced livestock breeding inventory due to increased feed costs (Leister et al., 2015). Between 2011 and 2018, the total expected welfare loss to consumers was about $111 billion, including increases in land rent and reductions in consumer surplus (Leister et al., 2015).

Matos et al. (2014) suggested that a greywater decentralized reuse system or a wastewater centralized reuse system could provide irrigation water, with the former requiring only 12-38% of the energy, reducing $CO_2$ emissions and lowering energy costs. Further analysis is needed, such as an evaluation of the costs of implementing a greywater reuse system against the benefits of increased availability of water for irrigation.

**Finance:** The Maryland Department of the Environment's Drinking Water Revolving Loan Fund provides assistance for projects related to compliance with national drinking water standards, including those related to water treatment facilities, water storage facilities, and consolidation of water systems (Maryland Department of the Environment, n.d.). The Maryland Board of Public Works, Water Quality State Revolving Loan Fund loans, Bay Restoration Fund, and Comprehensive Flood Management Grants have approved funding for similar projects in Baltimore City and County, Harford County, and Somerset County (Maryland Department of Environment, 2020).

**Recommended Actions:**

Administrative

- Assess water volume need and then build capacity to increase the use of reclaimed water sources for irrigation (i.e., advanced treatment of municipal wastewater, return flows, and brackish waters) to address agricultural water shortages (Sapkota, 2019; Sheikh et al., 2018).

- Identify and track water use in historically drought-sensitive areas of the City and County to enable more effective targeting of water conservation or reuse practices.

- During severe droughts and mandatory water use restrictions, ensure traditionally underserved portions of the community have access to safe and affordable drinking and bathing water.

Administrative and Legislative: Increase water storage capacity — Because the City of Frederick is a part of the Potomac Drinking Water Source Protection Partnership, the City Climate Action Plan suggests examining how the water supply may be affected by drought or other disasters (City of Frederick, 2020). Options include:

- Implementing land management practices to increase soil organic matter for water storage.

- Practicing aquifer storage and recovery, removing accumulated sediment in reservoirs, or lowering water intake elevation (EPA, 2020).

- Sponsoring local distribution of rain barrels.

- Using alternative drinking water systems: Enhance alternative drinking water systems, including deep wells and rainwater cisterns that directly collect rainwater runoff from roofs and other surfaces into a storage system for later withdrawal on an as-needed basis (Waller, 1989).

- Support local community food banks and gardens to provide food during periods of drought-induced food price increases (Recommendation 22).

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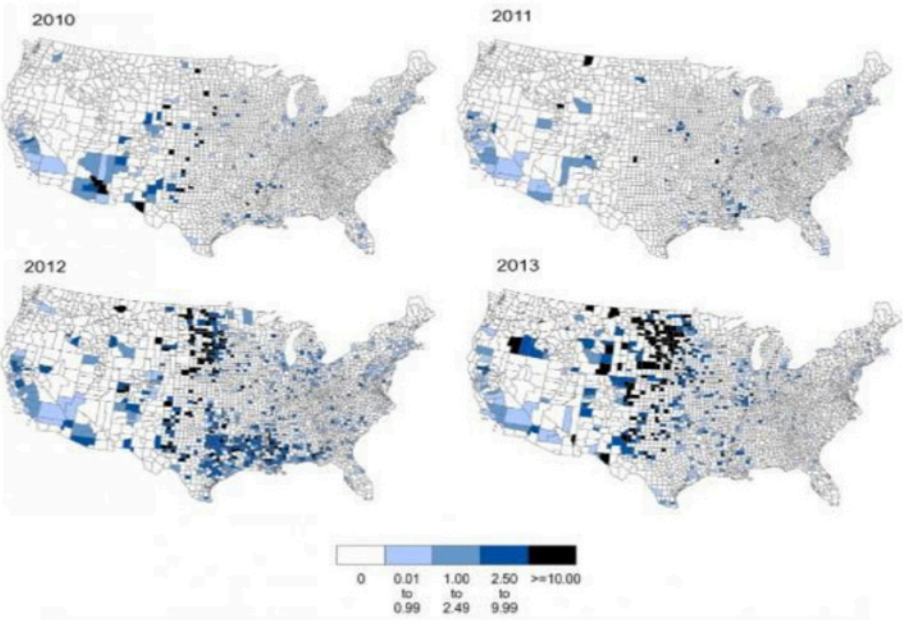
## 30 Reduce threats from pathogens, parasites, and pests

**Expected GHG Reduction or Climate Adaptation:** Preventing new pathogen or parasite exposure in the area is not likely but the numbers of infected individuals can be limited by establishing a robust monitoring system followed by a tracking system for illnesses and agricultural pest infestations and controls.

**Timeline for Action:** Initiate dialog with the County Health Department and County Environmental Health officer within six months to ascertain local health officials' understanding of the pathogen and parasite threat. Pending the outcome of these discussions, within the next six months, identify resources for monitoring pathogens and parasites and their vectors, establish standard collection and analytical procedures, and identify laboratories for sample receipt. Concurrently develop a standard tracking database for data entry and analyses, for fulfilling the weekly to twice/month outreach to the public and for annual reporting of areas and medical treatment. In a similar manner, within a year, work with local farmers, Master Gardeners, extension agents, the Natural Resources Conservation Service (NRCS), and Soil Conservation Districts to ascertain pest threats, locales, and procedures. If recommended, set up a monitoring program and design, identifying procedures within 18 months, databases within 24 months, and data collection (including crop losses to pests and crop successes/failures with integrated pest management [IPM]) within 30 months. These data should be distributed in annual reports and extension agent monthly newsletters.

**Rationale:** Currently, there is no active pest monitoring program in the City or County (B. Glotfelty, County Health Department) but an increase in activity from climate-resilient pests and pathogens is expected due to global climate change. Mosquitoes are climate adaptive as they thrive on increased carbon dioxide levels (Torgan, 2021) and due to climate change, their active period increases from April to October in the Mid-Atlantic, to March to November, increasing the possibility of transmission of vector-borne disease. Ticks are also favored by these conditions, especially in the 45–85% humidities common in the Mid-Atlantic (Bednar, 2021). This makes both mosquitoes and ticks a climate-driven problem for the health of the population in the area.

Mosquitoes are the most common vector insect in the region. In the United States, the most common mosquito-borne disease is West Nile Virus (WNV), with nearly 40,000 reported cases from 1999–2013;




Maps show the incidence of West Nile neuroinvasive disease in the United States for 2010 through 2013. Shown as cases per 100,000 people. (Data source: CDC 2014)

**Figure 1: Incidence of West Nile neuroinvasive disease by County in the United States** (Beard et al., 2016)

due to the majority of people who are asymptomatic, underreporting is substantial (Centers for Disease Control [CDC], 2020). The natural host of WNV is birds, and when migration patterns change due to a warming climate, mosquitoes are able to transmit the virus more in areas such as the Mid-Atlantic region. Also due to the rise in extreme weather events, water breeding areas are even more prevalent. Common symptoms of WNV include, but are not limited to flu-like symptoms, fever, headache, and body aches (American Pest, 2021). More severe symptoms can cause meningitis, encephalitis, other neurologic diseases, and even death. It should be noted that there is currently no vaccine for WNV and no antiviral treatment.

While Zika virus is rare in the United States, there are still several cases reported every year, and due to climate change, more are likely. While symptoms of initial Zika virus are mild (flu-like symptoms), there is extreme concern if a pregnant woman is infected (American Pest, 2021). Zika virus can cause severe harm to an unborn child, leading to significant neurologic problems and birth defects. Another rare disease spread by mosquitoes is Chikungunya. Unlike Zika and WNV, the majority of people who contract the virus become symptomatic, experiencing joint pain and fever which can disappear within a week, but in rare circumstances, can last for months (American Pest, 2021).

Over a span of 12 years from 2004 to 2016, the number of tick-borne diseases has doubled (Lampner, 2020). The most common tick in the Mid-Atlantic region is the blacklegged tick, which can be active year-round with above freezing temperatures (CDC, 2018). These ticks are the most common vector for Lyme disease (see Figure 2 below). Climate change will accelerate the development cycle of a tick, i.e., there will be increased egg production, which in turn will increase the population. Usually, ticks are dormant in winters due to cold temperatures, but with warmer winter days, ticks can remain active leading to larger populations the following year. Lyme disease is serious and starts with a bullseye-like rash after a tick bite (CDC, 2018). Common symptoms include fatigue, rashes, numerous neurologic symptoms such as numbness and inability to control facial muscles, and tachycardia. It is possible that even after treatment over 4 months, symptoms may persist a lifetime (CDC, 2020). Infected individuals also have a higher likelihood of developing another auto-immune disorder.

Ehrlichiosis is another severe tick-borne disease common in the Mid-Atlantic region. Common signs and symptoms of the disease include fever, chills, muscle pain, GI issues, and rash. It is crucial to get treatment immediately for this disease due to its increasing severity the more days the disease goes untreated. Fortunately, the disease is treatable with medication. The last common tick-borne disease in the Mid-Atlantic region is Rickettsiosis (Figure 3). These symptoms include fever, headache, and rash, along with the formation of an ulcer where the tick initially attached itself to the body. Along with all other tick related illnesses, these symptoms should be treated immediately due to worsening illness over days (CDC, 2020).

People who are immunocompromised are most at risk for infection with severe symptoms from any of these diseases. While no one is immune from getting bitten by a mosquito or tick, people who are overweight, pregnant, and sweating are more likely to experience an increase of pest activity surrounding them (American Pest, 2020).

With the increased likelihood of pests in the area, especially new pests, additional training on IPM for farmers, gardners, landscape companies, and other land managers is needed (see Recommendations

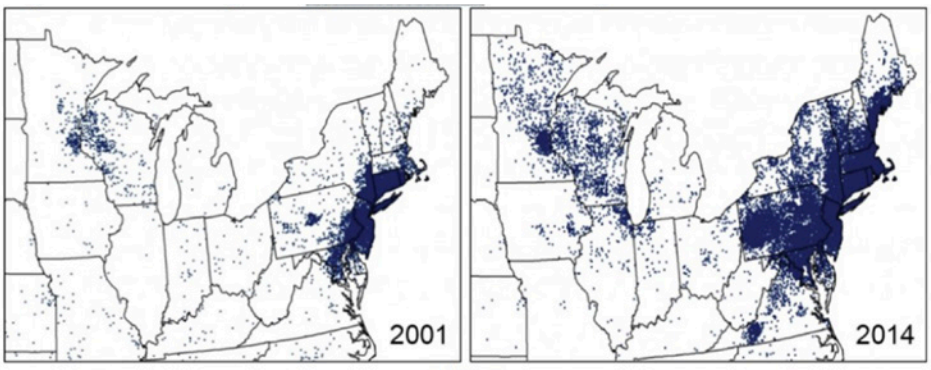



**Figure 2: Changes in Lyme Disease Case Report Distribution** (Beard et al., 2016)

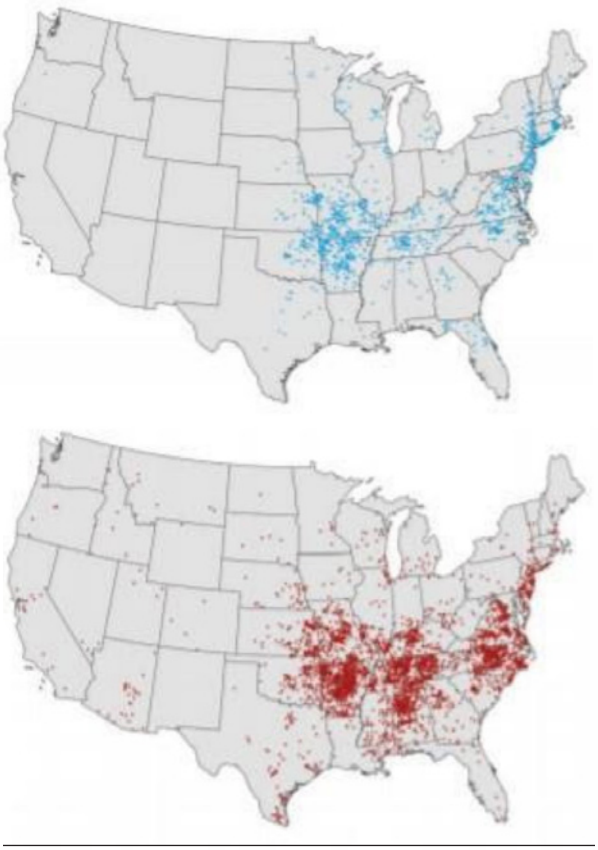


**Figure 3: Spotted Fever Rickettsiosis (including Rocky Mountain Spotted Fever**

19, 20). IPM is a management system (e.g., University of California, n.d.) that utilizes a variety of techniques to reduce the impact of pests, and to limit the use of pesticides that are needed to control these pests in agriculture. There are six IPM steps:

- Pest Identification — what is the pest of greatest concern to the producer?
- Monitoring and assessing pest numbers and changes — do pest numbers continuously increase?
- Guideline for when management action is needed - what is the threshold at which the producer would need intervention?
- Preventing pest problems - what are the best methods for control?
- Using a variety of management tools — biologic; cultural (i.e., changing irrigation practices to eliminate standing water); physical and mechanical (traps, weed management, incorporation of barriers); chemical — pesticides, but only as a last resort and in combination with other strategies for minimal usage and maximum efficiency.
- Assessing the impact and effect of pest management.

One example of an increasingly common pest in the Mid-Atlantic Region is the Brown Marmorated Stinkbug (BMSB). According to projections of climate change, the BMSB will continue to be in highly favorable conditions in Maryland until at least 2100. The BMSB lacks true natural enemies as an invasive species (Kistner–Thomas, n.d.), so IPM would be an ideal solution to tackle the pest. For example, since this is a new pest in the area, if a crop is impacted, even in small pockets, it should be controlled. There are many tools for management control, such as plants that repel BMSB, including garlic, catnip, thyme, and lavender. These are natural methods that do not require an increased usage of insecticides that can runoff into waterways, endangering the environment. Another approach is to attract wasps by planting marigold or buckwheat, which will then lay eggs in stinkbug eggs. These wasps are harmless to the plants and humans and can destroy stinkbug populations. Setting water traps at night can also limit the growth but can attract other pests such as mosquitoes (Heber, 2021).

The City and County have identified public health and agriculture productivity as critical attributes of our area. The Livable Frederick Master Plan (Frederick County, 2019) and the County Health Department (B. Brookmyer, personal communication, June 14, 2021) repeatedly stress the importance of public health in defining the high quality of life in the County (and City), inducing population growth and vitality for the area; hence protecting public health, the mission of the County/City Health Department (Frederick County, n.d.), warrants examination of whether a pest monitoring program is needed and should be implemented. Regarding IPM, the Plan documents the role of the Future Farmers of America (FFA) in training for young farmers in the County (p. 157), an excellent program that could include IPM as a core element; increasing "…agricultural education initiatives' (p. 173) could also increase IPM use. Further, providing "…technical assistance

to new or existing agricultural operators that seek opportunities to embrace agricultural innovations or value-added operations" (p. 170) could include broader IPM implementation and reduce "…less intensive chemical applications" (p. 187), whether synthetic fertilizers with high GHG emissions or pesticides that threaten waterways.

**Co-Benefits:** A surveillance system provides protection against infection, reducing the likelihood of illness and long-term medical care. Should infections progress, the resulting illnesses lead to lost employment, fiscal hardship, and expensive treatments and medications, threats to individuals and their employers. Preventing infection through avoidance of identified pest 'hot-spots' also reduces medical service, thereby freeing staff and medication/treatments for other community illnesses. For agriculture pests, monitoring and identification of infected crops allows more immediate intervention in the short-term, potentially saving the crop for harvest and sale but also its sequestration capacity. In the longer term, pest identification and IPM provides several benefits: planning for the next crop's natural defenses against the pest; protecting future production; and limiting the use and runoff of environmentally threatening pesticides, which protects plants and animals, and may prevent the need for more rigorous and costly drinking water treatment processes.

**Equity Considerations:** People most vulnerable to serious illness from pest-related infections are also likely to be over-represented in asset limited, disabled, or senior populations. These groups also would face a disproportionate risk for lost work, costly medical care, and other stressors should they become ill. Monitoring for human pests could assist members of these communities to avoid pest-rich locations and avoid infection from occurring.

**Cost-Benefit Analyses:** Monitoring programs are expensive due to the need for spatial and temporal coverage throughout the pest's life cycle. The MD Department of Agriculture maintains a mosquito monitoring program but its focus appears to be on the Eastern Shore; there are no cost data available. There are two published reports on mosquito monitoring, embedding both citizen and scientist collections. In one, data from citizen collections and identification were found to be equally accurate as compared to a scientist-run project, with the citizen monitoring project costing less than 20% of the more rigorous inspection (Braz Sousa et al., 2020). In the other study, Palmer et al. (2017) estimated that a citizen mosquito monitoring program cost in Spain was $1.50 per sq. kilometer vs. $11.20 per sq. kilometer for the scientist-based program with comparable results.

Substantial cost savings have been noted through the use of IPM. O'Neal and Obricki (2009) reviewed past literature on the use of biological control in six crops and found benefit/cost ratios over a 10-year period ranging from 15-202. Another option is planting pest-resistant crops. Genetically pest-resistant strains of Frederick crops like corn, wheat, soybeans, barley, rye, and tomatoes are all available (Smith, 2009), protecting crops and increasing the likelihood of profit. Mixing pest-resistant plants with valued crops can also reduce pest losses and increase profit (Nicholls et al., 2000 in Altieri et al., 2009). Overall, as indicated in cabbage production in MN, IPM provides substantial economic benefits (Fig. 1) while reducing use of pesticides (Mitchell and Hutchison, 2009).

**Finance:** For human diseases from pests, CDC's National Center for Emerging and Zoonotic Infectious Diseases announces annual funds for non-research related grants (CDC, 2021). USDA's National Institute of Food and Agriculture (USDA

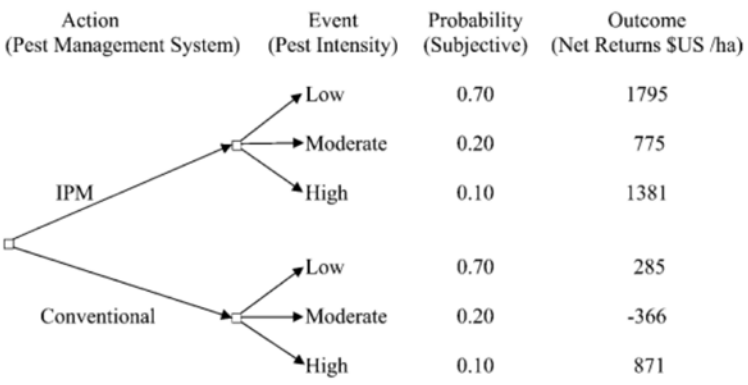



**Figure4. Decision tree representation of net returns ($US/ha) for the Minnesota 1998–2001 cabbage IPM case study using subjective probabilities based on 10-year experience of IPM specialist (data from multiple references in and figure from Mitchell and Hutchison, 2009). Conventional practices include use of pesticides.**

NIFA, n.d.) has multiple programs that provide grants and loans for IPM on agricultural lands. Other USDA programs are listed at the National Invasive Species Information Center (USDA NISIC, n.d.) with the Animal and Plant Health Inspection Service (USDA APHIS, n.d.) covering a wide range of agricultural pests.

**Recommended actions:**

Administrative

- City and County: At least once a year, meet with County Health Department staff, specifically the Chief Officer for Environmental Health and the database coordinator, to discuss vector-borne illnesses and ascertain whether a monitoring program is needed.

- County: In a similar manner, maintain quarterly communication with local agriculture technical staff (NRCS, extension agents, MD Department of the Agriculture and Department of the Environment) and local farmers and land managers (e.g. Master Gardeners) regarding observations of crop- or animal-specific pests in order to identify appropriate IPM approaches to reduce infestations and crop or animal production declines.

Administrative and Legislative — City and County

- Should human or agricultural pests increase, examine and adjust budgets for establishing rapid response monitoring/surveillance programs.

- Seek extramural funding for implementing a monitoring/surveillance program.

- Should vector-delivered human illness increase, provide County Health Department funding for human disease responses (outreach/education/awareness, home visits and care, medical center/clinic treatment).

- Add staff (such as the regenerative land management specialist, Recommendation 19) to provide additional training on IPM, increase monitoring, and develop draft grant proposals.

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## 31 Upgrade stormwater and wastewater conveyance and storage management

**Expected GHG Reduction or Climate Adaptation:** Included in the City and County's long-term growth strategy should be an inter-connected and comprehensive Stormwater (SW) and Wastewater (WW) permitting and planning effort with the impacts of climate change adaptation embedded throughout, specifically designed to accommodate the 100 year storms now common and increasing in the area. This effort should include input from all municipalities in the County and should include an updated study detailing future permitting and mapping requirements for the City and County for areas that are currently served with inadequate conveyance systems and all possible future growth areas. Recommendations for permit issuance and community planning efforts resulting from this new study should be swiftly incorporated into regulations. Tracking of areas that flood, new infrastructure, and subsequent flooding reductions should be put in place by the Climate Response and Resilience Office (see Recommendation 1).

**Timeline for Action:** An updated SW management plan should be completed within six months after funding is allocated for the study, no later than 2023. Then, legislative and administrative revisions to local codes should be adopted within a year. Assessment of progress could be done through a brief (1–2 year) adoption period during which City and County funding options for needed infrastructure improvements can be identified. By 2025, a tracking system for all built, proposed, or future SW conveyance systems should be established.

**Rationale:** Increased flooding in the subject area has a direct correlation to climate change. Between 1950 and 1994, annual precipitation in the Northeast was more variable and increased by approximately 0.39 inches per decade; Maryland's annual mean precipitation has been above average for the past two decades. In the Northeast of the U. S., the frequency of intense rainfalls has also increased 71% from 1958 to 2012 (Montgomery County, 2020).

Flooding as a result of inadequate SW planning and mitigation efforts has resulted in a large number of costly and damaging impacts to infrastructure and resources outside of the most widely known impact: damaged homes and businesses. Flash flooding can damage pavement or washout bridges and culverts, clog drainage systems with roadway debris, induce scouring that softens sub-grade, breaks or disrupts underground natural gas lines and electrical transmission wires inducing power loss, and jeopardizes emergency vehicle traffic access. Extreme runoff can also exceed wastewater treatment plant (WWTP) storage capacities leading to release of untreated pollutant- and pathogen-laden water into local receiving waters and back-up of these health threats into basements of homes and businesses, leading to costly clean-up and repairs. These damages can result in high-dollar capital project costs for the City and County, undefinable costs in human health impacts, and costly state fines for release of untreated sewage.

Recently, neighboring Montgomery County identified flooding and wind damage of more intense storms as one of the top four climate impacts that the county must address in its adaptation strategies (Montgomery County, 2020).

A flood resiliency study by the U.S. Army Corps of Engineers (Marshall, 2020) was conducted for the City of Frederick in 2019; however, this study did not include future impacts from climate change. As indicated in the City of Frederick's draft Climate Action Plan (City of Frederick, 2020) and through various other sources including the First Street Foundation (2020), flood risk is increasing in the City and County due to climate change and the resulting sea level rise. It is expected that in the City of Frederick alone, the number of properties currently exposed to a 5% annual chance of flooding is expected to increase 11% by 2050.

SW and WW management needs to be large-scale and interconnected with municipalities within the County as well as those of neighboring counties for them to be effective. A plan that does not consider where the downstream increase in SW outflow could impact the next municipality is incomplete and only partially effective. Similarly, sewer conveyance (including pumping stations) treatment capacities need to be adjusted for projected City and County 2050 population density increases. Planning for this likely growth may indicate necessary expansion of the smaller wastewater facilities near priority and secondary growth areas.

One way to address increased SW flooding probabilities is to prioritize the preservation of green space within new development and redevelopment parcels, as well as expanding green space in existing developments. Prioritizing green space increases soil water retention and captures particle runoff, reducing volumes of stormwater runoff and pollutants and bacteria associated with particles. Green space releases the water from storm events over time, rather than all at once in massive, unmanageable surges to the existing SW runoff systems of the City and County.

WW capture and storage is more difficult and expensive, largely due to costs in securing land for ponds or underground storage in equalization tanks. Equalization tanks store sewage within WWTPs or in conveyance systems to deliver sewage to the WWTP over the diurnal cycle to treat flood-induced sewerage as well as prevent washout of WWTP biology critical to normal sewage treatment. Current regional examples include Hampton Roads (5.2 million gallons, $32,000,000; Hampton Roads Sanitation District, n.d.), and Alexandria (130 million gallons, $424,500,000 RiverRenew, n.d.) where underground tanks and tunnels are being built to ameliorate extreme sewage water volumes, protecting the treatment plants as well as upstream buildings from backflow and damage.

Both City and County documents strongly support expanded SW and WW services for residents and businesses. In The Livable Frederick Master Plan (Frederick City, 2019), Water and Sewer Adequacy, Initiatives 2 and 3, are identified as priorities (p. 192). Specifically, text states, “Ensure that the provision of water and sewer infrastructure fulfills county planning goals and policies and that expansion of water and sewer system capacity maximizes efficiency, addresses public health issues,...” (p. 101).

For the City, SW and WW commitments are found in the Municipal Growth Policy 5 (p. 13–270), Water Resources Policies 3–5 (p. 13–272 and 13–273), Environmental Sustainability Policy 3, Implementation 3 (p. 13–278, prevent devastating flooding damage), and Economic Development Policy 7 (p. 13–288, prevent natural disaster impacts) of the 2020 City Comprehensive Plan (City of Frederick, 2021). These identified focus areas of our primary City and County plans provide the foundation for adoption of the proposed recommendation.

**Co-Benefits:** SW management can also have other co-benefits outside of direct economic flooding impacts. Habitat protection, green canopy proliferation, heat island reduction, etc. can all benefit from SW best management practices (BMPs) designed to inhibit, prevent, or respond to flooding events. Montgomery County (2020) recognized the importance of this co-benefit as follows: “Adjust the County Tree Canopy Ordinance that assesses builders a fee for removing trees to require functional mitigation that replaces the lost benefit of trees, e.g., cooling, stormwater abatement, watershed replenishment, etc. Require developers to seek revisions to their permits before removing trees. Use the fee to pay for off-site functional mitigation.”

Capturing and treating sewage has indirect benefits, including the protection of water quality and habitats, ensuring continued compliance with regional total maximum daily load (TMDL) requirements, the health of downstream communities using those receiving waters as drinking water sources, and ultimately Chesapeake Bay hypoxia.

**Equity Considerations:** Some indicators of pre-existing vulnerabilities/risk factors cannot be changed (e.g., age, gender, race, health conditions, etc.). However, it is critical that these characteristics be taken into account in planning because each may be indicative of the need for different design or adaptation planning  to accommodate differential

pre-existing vulnerabilities (National Association for the Advancement of Colored People, n.d.). For example, members of the ALICE population living in a flood-prone area may not have a vehicle nor flood insurance. This population would be disproportionately affected by a large or severe flooding event as compared to a median income resident who could escape the flooding event and recoup the losses incurred from the flood. Similarly, sewage back-ups into homes in areas with inadequate conveyance systems unfairly jeopardizes those same portions of our populations with limited funds for clean-up or repairs.

**Costs and Cost-Benefit Analyses:** The total cost for SW BMPs in Frederick County (without factoring in other associated Impervious Surface Restoration Plan costs such as debt service payments) for the FY19 and FY20 years was approximately $18.2 million dollars.

SW remediation fees are optional for Municipal Separate Storm Sewer System (MS4) jurisdictions. Frederick County is one of six of the ten Maryland (reportable) jurisdictions that reported having fees. These residential fees range from $0.01 to $170 across the State. According to this 2020 Maryland Department of the Environment report (Maryland Department of the Environment, 2020), approximately half of Frederick County's costs are derived from the General Fund and only $524 dollars were collected in SW remediation fees by the County

| State Resources | | |
|---|---|---|
| *Organization* | *Program Name* | *Link* |
| Maryland Water Quality Financing Administration | Water Quality Revolving Loan Program | mde.maryland.gov/programs/water/WQFA/Pages/water_quality_fund.aspx |
| | Bay Restoration Fund Wastewater Grant Program | mde.maryland.gov/programs/water/BayRestorationFund/Pages/index.aspx |
| Maryland Department of Natural Resources | Chesapeake and Atlantic Coastal Bays Trust Fund | dnr.maryland.gov/ccs/Pages/funding/trust-fund.aspx |
| | Chesapeake & Coastal Service Funding Opportunities (Various) | dnr.maryland.gov/ccs/Pages/funding/fundingopp.aspx |
| Maryland Sea Grant College at the University of Maryland | "Green Streets, Green Jobs, Green Towns" Grant Program | cbtrust.org/grants/g3 |
| | Maryland Watershed Restoration Assistance Directory (Various) | extension.umd.edu/watershed/watershed-restoration-assistance-directory |
| Sustainable Maryland | Grants Portal (Various) | sustainablemaryland.com/grants-resources/grants-portal/ |
| Environmental Finance Center at the University of Maryland | Various resources for financial and technical training | arch.umd.edu/research-creative-practice/centers/environmental-finance-center/programs/stormwater-financing-and-outreach |
| **National Resources** | | |
| *Organization* | *Program Name* | *Link* |
| Environmental Protection Agency | Green Infrastructure Funding Opportunities (Various) | epa.gov/green-infrastructure/green-infrastructure-funding-opportunities |
| | Water Finance Clearinghouse | epa.gov/waterfinancecenter |
| National Fish and Wildlife Foundation | Chesapeake Bay Stewardship Fund | nfwf.org/programs/chesapeake-bay-stewardship-fund |

**Figure 1: Maryland Department of the Environment financing opportunities for Maryland MS4 programs**

in FY2019 out of the 52,379 properties subject to a fee. The annual report does not detail why Frederick County collected the lowest percentage of SW remediation fees out of the six reportable counties (Montgomery County is not required to report).

SW prevention management can have direct cost benefits to the average homeowner as well as to the municipality. The University of Maryland (UMD) Center for Environmental Science (Wainger et al., 2019) utilized economic benefit transfer, in which values for the Maryland SW program were derived from published economic valuation literature, and transformed them to represent Maryland using local data. Values transferred from the literature for direct and indirect benefits ranged from $13–$1,121 per household per year, although the largest value is only applicable if people perceive SW projects as offering substantial flood control benefits. Perhaps the value that best reflects the willingness to pay to achieve a mix of environmental benefits, as would be expected from SW implementation, is the $162/household/year value estimated for achieving the Chesapeake Bay TMDL.

Costs for increasing sewage storage capacity in flood-prone areas to protect homes that are regularly flooded with sewage would likely be exorbitant. Providing tax breaks, incentives, or free public services for clean-up and repairs should be considered, including costs for purchase, installation, and maintenance of backflow valves. For new growth areas, however, projections of population and business increases as well as the increased impacts of climate change should drive decisions about conveyance and storage capacities of stormwater. Past aperiodic peak flows should be compiled and wastewater storage capacities estimated to ensure future buildings will not experience exposure to sewage through back-up of City or County WWTP capacities.

**Finance:** A number of financing opportunities for Maryland MS4 programs are outlined in the Maryland Department of the Environment 2020 Annual Report (MDE, 2020) on financial assurance plans. These programs include, but are not limited to, those shown in Figure 1, page 193.

**Recommended Actions:**

### Administrative — City and County

- Create a comprehensive and coordinated SW and WW Management Plan, with input from all County municipalities, that incorporates the predicted impacts from climate change for future primary and secondary growth areas, possible annex areas, as well as for new and existing developments.

- Evaluate the sequencing of agency approvals for new building development projects to determine the best point at which to incorporate stormwater and wastewater practices review.

### Administrative and Legislative — City and County

- Increase the percentage of Municipal Separate Storm Sewer System permitting costs that can be offset from the general overhead fund and passed onto new permitting, planning, and development in the City and County as well as other applicable State and Federal sources.

- Work with homeowners, businesses, and the building and services sectors to identify and require flood protection technologies in retrofits to existing homes and buildings to minimize flooding damage/threats during major renovation/improvement/expansion efforts.

- Amend post-permitting policies and City and County building codes and enforcement to ensure all runoff controls, including conservation plantings in place of structural controls, are maintained and effective. Revisit current policies enabling waivers, unenforceability of green infrastructure maintenance, and impacts on neighbors. Ensure that codes minimize impacts of increased flooding on immediately adjacent neighbors, taking into account both increased intensity of rainfall and increased impervious ground cover.

- Estimate future housing unit additions and sewage production and assess current and future storage capacity to prevent conveyance system back-ups into homes and businesses and discharge of untreated sewage into local receiving waters.

- Establish a public fund to retrofit existing buildings in flood-prone areas and reimburse property owners for SW or WW flood damages incurred through inadequate public conveyance systems or storage capacities.

- Require that before approval by City or County commissions, new private developments must employ a variety of climate-hazard mitigation techniques, such as SW retention, sewage storage, sequestration tactics, etc.

- Adopt aggressive county codes to limit impervious concrete surfaces and require the use of pervious pavements, especially in publicly funded projects. For example, sidewalks, driveways, and parking lots should use pervious pavements to reduce runoff and flooding that overwhelms the storm sewer system.

- For new and existing buildings, aggressively promote and incentivize use of green roofs, native plantings, rain gardens, rain barrels, runoff retention, and other nature-based technologies to reduce runoff and to minimize heat island effects. However, when used for SW management, ensure that green remedies are maintained and effective over time, and are combined with appropriate grey water infrastructure to manage excess water flow.

### State/Federal

- Identify grants and other financial incentives within federal and state programs that the City and County could pursue to provide funding for climate change adaptation.

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## 32 Build new and retrofit existing infrastructure to withstand anticipated threats

**Recommendation:** Build resilient new and retrofit existing roadways, overpasses, and culverts to meet the demands of more frequent extreme precipitation events and heat.

**Expected GHG Reduction or Climate Adaptation:** Proper funds and plans for retrofitting and repairs related to extreme precipitation and heat damage will ensure that residents of the County will be able to travel safely, that intense storm-induced road and culvert washouts will be minimized, and that the Public Works Department will be working toward transportation infrastructure resilience. Tracking progress will be done through initial identification of at-risk infrastructure (1–2 yrs) followed by annual tallies of repairs/upgrades to existing roads, bridges, and culverts as well as new construction of public assets.

**Timeline for Action:** The City and County should initiate transportation infrastructure resilience explorations within one year, followed by several-year budgeting/funding discussions for new/retrofitted transportation infrastructure over 5-10 years, partially supported by stormwater utility and water quality protection fees. Monitoring should focus on infrastructure assessment, prioritization of infrastructure construction, commitment of funds, and annual additions to Capital Improvement Projects (CIP).

**Rationale:** As required under the Maryland Commission on Climate Change Act, the Maryland Department of Transportation (MDOT) maintains a comprehensive action plan with five-year benchmarks to mitigate climate change impacts. The MDOT has identified the top weather-related hazards as extreme weather, winter storms, extreme temperature, high winds, and flooding (MDOT, 2020 Status Report, page 10). For highways, extreme heat causes concrete roads to expand and buckle after multiple days of exposure (Harlow, 2021); asphalt roadways can behave similarly as well as cracking that allows water seepage and eroding of the underlying subsurface layers leading to road damage/collapse. Reducing heat absorption through pigmentation or use of reflective coatings of the asphalt binders has proven effective (Badin et al., 2020; Qiao et al., 2020) in reducing damage. Train tracks can also buckle (Leviäkangas et al., 2010), a concern for the local MARC commuter trains as well as the B&O freight trains. The urban heat island effect can be reduced through shade from increased tree canopies in the areas of roadways, lowering the surface temperature of sidewalks and roads (Cheela et al., 2021).

Summarizing data, reports, and scientific literature, Maryland's Greenhouse Gas Emissions Reduction Act 2030 Plan (Maryland Department of the Environment, 2021, pp. 12-13) notes that the large quantities of runoff from extreme precipitation events may quickly overwhelm stormwater drainage system capacities. Additionally, the cost of damages from inland flooding in the region from mid-Virginia to eastern New York under a business-as-usual scenario will cost an estimated $1 to $2 billion by 2100. MDOT guidelines D–75–4(4) (MDOT, n.d.) plan for 100 year storms, important for the projected extreme precipitation events in the coming decades. For storms of this magnitude, several recommended procedures for road culverts include using the largest diameter pipes possible, exceeding the highest water levels observed, and placing the bottom of the culvert pipe at the bottom depth of the drainage ditch and tilting slightly upward at the far end; protecting the culvert inlet soil with stone to depths and widths that exceed the highest water levels, and vegetating the area to allow roots to help secure the soil (Hunker, n.d.). Frederick has experienced multiple road and culvert washouts in recent years (Fig. 1, May, 2018, $6.2M in public infrastructure) and reducing likely repeat damage is a priority for the City and County (Marshall, 2018). Several other strategies to reduce damage include stream restoration projects to reduce flood velocities

**Courtesy of FNP (Source: D. Gross in Marshall, 2018)**

(Ourloglou et al., 2020) or installing pond levelers to divert rising waters away from roads and culverts (Beaver Institute, n.d.).

Strategies to address current roadways, bridges, and culverts have been summarized at Climate Adapt (n.d.). Pavement mixtures can be modified to prevent asphalt disintegration, adapting road drainage systems to expected extreme precipitation events using intensity-duration-frequency curves (IDF curves), inspecting and upgrading bridges for the new higher flows, and maintaining perennial vegetation and drainage structures/debris removal along roads.

The Livable Frederick Master Plan (Frederick County, 2019) provides guidance for preventing future road, bridge, and culvert losses. It identifies "...maintenance and strategic resource capital replacement practices to ensure that our public infrastructure, including roads, ... remains operational and keeps pace with state-of-the-art technologies and practices" (p. 104). In addition, one of its goals is water quality and a supporting initiative to obtain this goal includes investigating the feasibility and implications of a stormwater utility or water quality protection fee to fund stormwater retrofits as well as inspection and enforcement operations (p. 190), easily applied to infrastructure. Livable Frederick also identifies climate resiliency as a goal of the County, with an initiative to plan for and anticipate the impact of increased stormwater flows. The supporting initiative for this goal is to implement green infrastructure capacities to address increased precipitation and ensure infrastructure is designed to accommodate new storm flows and is resilient to the increased severity of weather events (p. 194). Under its commitments to transportation, the City Comprehensive Plan (City of Frederick, 2021) identifies that transportation infrastructure is challenged by climate change and building resiliency is important for the future (p. 10–236). To address that challenge, the plan indicates a goal to "Leverage federal and state grants to ensure transportation improvements can be done concurrently with other in-road infrastructure projects" (p. 13–266).

**Co-Benefits:** Maintaining resilient highways, bridges, and culverts ensures public safety and reliable transportation, critical to commerce and routine travel within the City and County as well as access for emergency responders. Further, according to the 2019 Maryland Department of the Environment Climate Action Plan, the lowering of surface temperatures on sidewalks and roadways have multiple co-benefits such as lower surface temperatures, reducing the need for air conditioning in buildings, which in turn reduces electricity use and GHG emissions. The lower surface temperatures also reduce roadway infrastructure maintenance, which then reduces the need for raw materials to produce asphalt and concrete and decreases GHG emissions from manufacturing plants, transportation, and heavy equipment. The lower surface temperatures also reduce the evaporation of car engine chemicals and reduce the need for car air conditioning.

Green infrastructure helps maintain ecosystem services that improve human health, including air quality regulation, but importantly for public transportation infrastructure, offers erosion protection (e.g., riparian buffers) and water flow regulation through routing runoff to pervious surfaces for infiltration, such as bioretention, tree trenches or tree boxes, vegetated swales, and turf. Zoning policies can also help. Independent of climate concerns, Frederick County has adopted wider buffer zones in local watersheds while floodplain building restrictions are already in place. The City of Frederick is now considering updating its floodplain ordinance (Marshall, 2021) as well, with regulations limiting development in floodplains and thereby reducing impervious surfaces where normal floodplain percolation would be disrupted. Floodplains act as large infiltration areas, thereby moving water into the soil rather than channelizing high flows downstream to undercut bridges, roads, and culverts.

**Equity Considerations:** Maintaining transportation infrastructure is critical to lower income families where transportation costs are about twice the portion of income that the middle class and above portions of our population expend (Institute for Transportation and Development Policy, 2019). With many asset-limited families, transportation to potentially multiple jobs is critical to family incomes and hence roadway maintenance and use must be assured.

**Costs and Cost-Benefit Analyses:** According to the Frederick County CIP for fiscal years 2020-2025, the proposed budget for roads, watershed restoration and retrofit, and water and sewer will be $20,686,700, $37,519,245, and $215,233,400, respectively, ideally providing public capacities to repair water and heat damage to our transportation infrastructure. The revenue sources include general fund, general fund bonds/lease, taxes, impact fees, impact fee bonds, mitigation fees, enterprise fund pay-go, enterprise fund bonds, grants, cash (forward fund state), and other sources. Building resilient components for each of these public services will reduce the need for repeated extreme weather repairs of this critical infrastructure.

**Finance:** Working with state legislators and using the initial year's work that identifies climate-at-risk roads, bridges, and culverts, the City and County should secure MDOT funding for building climate resilience into the area's public transportation infrastructure. Further, the continued federal effort for a large national infrastructure program will likely provide substantial new funding specific to climate-resilient construction. Other revenue sources include Maryland Department of the Environment's Green Infrastructure Resilience program that provides funding to local governments for evaluations. The Maryland Department of Natural Resources offers grants for green infrastructure projects to address stormwater flooding, like highway swales and ponds. The Environmental Protection Agency (n.d.) also has numerous grant programs that can be searched for funding opportunities.

**Recommended Actions:**

Administrative — City and County

- Identify at-risk transportation infrastructure.
- Build and repair for 100 year storms, exploring new pavement technologies/mixtures.
- Hold budgeting/funding discussions for new/retrofitted transportation infrastructure over 5–10 years.

- Investigate the feasibility and implications of a stormwater utility or water quality protection fee to fund stormwater retrofits as well as inspection and enforcement operations (see https://www3.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf).

- Implement green infrastructure capacities along roadways and across floodplains as well as explore stream restoration projects to address increased precipitation and protect infrastructure to accommodate new storm flows resilient to the increased severity of weather events.

### State/Federal

- Delegations should seek State/Federal funding for highway/transportation infrastructure improvements.

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## 33 Prepare for climate migration to Frederick

**Recommendation:** Establish a plan to assist resettlement of and provide basic services to individuals and families migrating inland due to climate-related impacts in current living areas.

**Expected GHG Reduction or Climate Adaptation:** It is likely that City and County populations will increase in the next few decades as sea level rise floods coastal areas, inundates freshwater drinking water sources and productive farmland along the coasts, and eliminates jobs and entire industries. The City and County should collaborate on an area plan to increase affordable housing for resettlement, job training, and food, mental health, and medical access for displaced persons from the east coast as well as immigrants who qualify for entry into the U.S. The plan should list the adaptations, partners, and funding options to increase energy efficient affordable housing, food availability through community gardens and hubs, job training, school capacity, and information on local medical capacity and access. Results would be tracked through continuing discussions on public-private options to provide these services, numbers of migrants entering the City and County seeking assistance, numbers of provided homes, training opportunities, students trained, and jobs secured, and a database to document these new members of our community and their transition to self-sustaining local residents.

**Timeline for Action:** Discussions between City and County staff and appropriate local assistance agencies and non-governmental organizations should begin within one year to derive projected numbers of climate migrants likely to enter the area and from that, within year two, discuss existing and needed services (and funding options) should the numbers of migrants represent an unanticipated demand on local capacities. Tracking would entail recording dates and outcomes of year one and two planning steps with year three establishing appropriate budgets to cover these new costs.

**Rationale:** Extreme events associated with climate change are now identified as a world-wide crisis, forcing millions of people to flee their existing countries/areas due to flooding or sea level rise. In 2018, the World Bank estimated that three regions alone (Latin America, sub-Saharan Africa, and Southeast Asia) will generate 143 million climate migrants by 2050 (Rigaud et al., 2018). In the U.S., 13 million Americans could be displaced by sea-level rise and natural disasters by 2100 with about one-half from Florida, principally Miami (Hauer et al., 2020). The Chesapeake region faces a similar plight as major portions of the bay's coastal area of the lower Eastern Shore will face regular flooding, inundation, and salt intrusion in groundwater and soils, rendering both unsuitable for agriculture and potentially causing water shortages as well as frequent storm-induced property damage (Fig. 1).

The migrants are likely to be of modest income as wealthier individuals often have means to protect against or ameliorate these impacts. Migrants will often arrive after surviving a catastrophic natural disaster, losing their homes, communities and perhaps members of their immediate family (International Federation of Red Cross, n.d.). The City and County, as an attractive area with industry, jobs, and a high quality of life, should anticipate and plan for an influx of U.S. and global citizens and identify options to encourage resettlement, jobs, food, mental health, and medical access.

Montgomery County has identified services to assist climate migrants (Montgomery County, 2021). Its "Gilchrist Immigrant Resource Center is a go-to place for information related to food, rental housing, immigration advice, and more" (p. 59) and the county is convening an interagency team to develop and implement an action plan that will ensure that the county is prepared to receive unaccompanied minors and migrant family units, that schools have the necessary services, and that supports are in place for receiving families." The City of Frederick and Frederick County should prepare accordingly.

Creating new high-tech job centers (p. 35), expanding technical training, skilled job training, and retraining

(p. 173) are goals within the Livable Frederick Master Plan (Frederick County, 2019). The arrival of climate migrants increases potential workforce candidates for the new businesses of the area. The Plan also documents food availability and access as future commitments (p. 142–143), thereby acknowledging basic needs that can be expanded for new residents. The City of Frederick Draft Climate Action Plan (City of Frederick, 2021) also advocates for increased food access through community gardens and hubs (see Recommendation 22), again providing an opening for expansion of this service for people driven to the area by climate extremes in their 'backyards.'

**Co-Benefits:** Although initial costs for the basic services noted above might appear high, the advantages are considerable. First, there is potential that the plan could provide a competitive advantage to the City and County for affordable housing grants and additional funding. Plan authors would be charged with developing additional funding sources for this long-term area challenge, resulting in the construction of additional energy-efficient affordable housing, ideally providing needed housing for other low income earners as well. This, in turn, reduces use of electricity and GHG emissions, benefitting public health and the Health Department's commitment to preventing exposure to illness-causing environmental conditions, thereby protecting residents. Second, setting up training opportunities, as outlined in Recommendation 35, could increase the needed skilled labor force to construct passive housing, LEED buildings, green infrastructure, and emerging agricultural technology critical to a cleaner, healthier economy. With the considerable effort of both the City and County to bring high-technology companies to the area, increasing that workforce may assist local efforts in attracting these businesses.

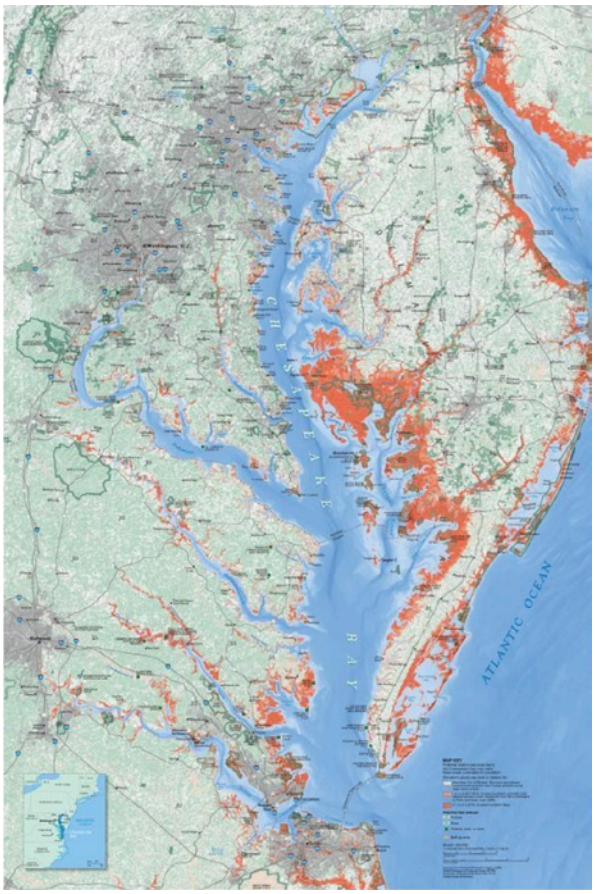


**Figure 1. Inundation areas of the Chesapeake Bay and likely regional locations generating climate migrants**
(Source: National Geographic Society, n.d.)

**Equity Considerations:** Many of the climate migrants will be seeking new opportunities with limited resources if their properties and jobs have been lost to climate impacts. Increasing numbers of low income people may shrink the limited public and private resources presently available for the already struggling ALICE community in the area, resulting in lower assistance per capita. A preparation strategy that includes a scan of funding options, including interaction with State and Federal delegations, will lead to a higher likelihood that current residents' needs can be met without being threatened by an influx of new community members.

**Costs and Cost-Benefit Analyses:** Funding limitations may arise if current public revenues remain constant. Estimating the magnitude of this new demand will be a priority. It is likely that future fiscal benefits would accrue if climate migrants are integrated into the local economy by quickly meeting their basic needs and for those interested and who qualify, training in skills required to meet local job opportunities in climate-resilient infrastructure and new technologies.

**Finance:** As in many other recommendations (1, 4, 22, and 35), federal, state, local, private, and social service organizations can be tapped to collaborate and assist in providing the services needed for new

community members. As a plan is developed across these entities in the first two years, grant options from specific agencies and groups (Housing and Urban Development, Volunteers of America [n.d.], Habitat for Humanity, United Way) can be identified and proposals submitted to increase services for new community members migrating from climate-impacted areas. For some affordable housing funding, Green Banks might be a source for increasing the likelihood of commercial loan support that, with the Green Bank underwriting, could be expanded to projects normally outside of commercial institution risk models.

**Recommended Actions:**

### Administrative and Legislative

- Establish a working group of public staff and officials, social service organizations, County Public Health staff, and creative builders focusing on energy-efficient affordable housing to begin assessment of the magnitude of potential climate migrant influx and the public service demand that would accompany this increase in the local population, and propose strategies to provide basic services and the means to fund this effort.

- If the working group identifies the potential climate migrant influx as sufficiently large to require more services, ask staff of the Climate Response and Resilience Office and appropriate City and County department/division staff to collaborate to prioritize funding options and begin grant submissions for needed capacity building and securing funding to provide basic services to these new residents.

### Legislative

- Work with City and County delegations to secure existing state or federal funds for housing infrastructure, social services, and additional training capacity for anticipated workforce growth areas.

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## 34 Install advanced treatment capacities for removal of natural toxins from drinking water

**Recommendation:** Investigate and install advanced treatment capacities for removal of natural toxins from drinking plant source waters.

**Expected GHG Reduction or Climate Adaptation:** Human health will be effectively protected by shifting within-utility treatment technologies to more advanced options to ensure drinking water is free of hepatoxins, neurotoxins, cytotoxins, and inflammatory dermal compounds, and treatment-derived derivatives of these materials. Results can be tracked through monitoring source waters for toxins pre-installation and then monitoring toxin concentrations in drinking water prior to and following infrastructure installation.

**Timeline for Action:** Using long-range capital improvement project (CIP) planning or bond issues, convert current drinking water utility infrastructure to technologies that are effective in removal of natural toxins produced in local source waters by high temperature-favored cyanobacteria (aka blue-green algae). The City and County should initiate treatment option explorations within one year followed by several-year budgeting/funding discussions for installation of drinking water utility infrastructure within 5–10 years. Progress to the upgrades can be tracked through discussions of officials and staff, workshops, identifying and securing funding options (CIP and grants), and purchase and installation of the necessary infrastructure.

**Rationale:** Local water supplies/sources for Frederick City drinking waters include Lake Linganore/Linganore Creek and the Potomac River, with 62% and 24% of the water for local residents from these two systems, respectively (City of Frederick, 2019b). Both of these sources are warming, with summer water temperatures often exceeding 88°. As local water temperatures rise, 'algae' common to our waters shift from multiple populations of free-floating and attached species considered 'healthy' to a group that prefers high temperatures, the cyanobacteria (formerly blue-green algae, Fig. 1). The 'healthy' populations die back, leaving this group with multiple strains that produce compounds that threaten human and wildlife health, including cancer-forming compounds, materials that curtail normal nerve transmission, alter cell integrity, and in mildest impacts, inflame the skin. Immediate health impacts include upset stomach, vomiting, and diarrhea; longer-term problems include liver and kidney damage (Environmental Protection Agency [EPA], 2016). Currently City and County drinking water utilities use chlorination to reduce concentrations of problematic organic compounds like those above. Unfortunately when toxins are abundant, chlorination may only be partially effective in toxin removal, with some portions of these unsafe molecules, their derivatives, and halogenated byproducts making it through the utilities for distribution (Zamyadi et al., 2012a,b).

Examples of the source water threat are evident in several water supplies in the County. First, Lake Linganore is

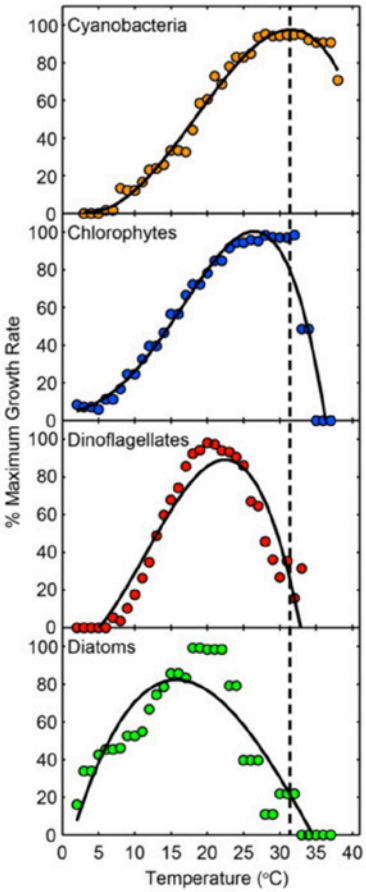


**Figure 1. Temperature optima for freshwater 'algae'** (Paerl et al., 2016)

now dominated by free-floating cyanobacteria from June into October, with many species identified in the scientific literature with toxin-producing variants, strains, or subspecies (Sellner et al., 2018). Current utility monitoring focuses on measuring concentrations of one of the toxins, microcystin, the most ubiquitous toxin in the world, but other toxins may be increasing because source species for these toxins are now prevalent in the lake. To date, incoming levels of microcystin are generally low and final drinking water appears free of the toxin. However, cylindrospermopsin, anatoxin-*a*, and saxitoxin are also likely present but not monitored; hence, low levels may be present. With time and higher temperatures, toxin prevalence may increase. Second, for the other group of cyanobacteria, bottom-dwelling species can dominate low flow conditions of the Potomac River during summer (Maryland Department of Natural Resources, 2016), producing microcystin as well as lyngbyatoxins, dermal irritants. These have become occasional concerns for the Metropolitan Washington Council of Governments for the drinking water facilities along the Potomac but again, and fortunately, toxin levels remain low and currently only rarely warrant focused attention.

The Livable Frederick Master Plan (Frederick County, 2019, p. 190) is committed to drinking water quality; its goal is to "...improve and protect water quality for human and environmental health..."; another initiative specifically states, "Ensure that wastewater treatment and water treatment plants have appropriate technology to remove algal toxins ..." (p. 192). The City has several documents indicating a need to protect its residents in the future. CommUNITY2030 (City of Frederick, 2019a), the City strategic plan, states that it must "Manage natural and other critical resources for long-term health, security, and welfare for its residents (p. 30)"; the City's Climate Action Plan (City of Frederick, 2020, p. 72) indicates a sectoral Sustainability Plan with a similar commitment, "...sustainability goals, policies, and actions for...water quality & water supply..." while the Comprehensive Plan for the City (City of Frederick, 2021) will "Provide an adequate and safe drinking water supply..." (pp. 5-140 and 5–141). To fulfill these commitments, future infrastructure changes in utility treatment should be considered. The catastrophe in Toledo, OH in 2014 indicates the potential severity of this problem (NEIWPCC, n.d.). Toledo draws its water supply from Lake Erie, overwhelmed by a free-floating cyanobacterium that produces microcystin. The drinking water facility opted not to pass the lake's water through the powdered activated charcoal beds of the facility, thereby distributing microcystin to the city's population and exposure to the liver-damaging toxin. The city was forced to enlist the National Guard to distribute bottled water for the population of 400,000. Currently, the drinking water facility operates each summer day to remove toxins, at an estimated cost of $10,000 daily. Similar upgrades were done in Waco, TX in 2010–2011 using dissolved air flotation (DAF) and ozone treatment (Dunlap et al., 2015).

**Co-Benefits:** Although the proposed utility infrastructure upgrades will protect the health of all consumers of finished drinking water, there are several important co-benefits to these changes. First, medical facilities will maintain low emergency room and hospital visits for exposures to these compounds, thereby ensuring no increased need for medical care and treatment. Second, should levels of toxins or their derivatives in finished water restrict drinking water consumption (through advisories), the ALICE and below poverty-line populations would be disproportionately impacted in spending limited unencumbered income on bottled water. Timely upgrades can prevent these outcomes.

**Equity Considerations:** As noted above, prevention of toxins and their derivatives in finished drinking water supplied to City and County residents through public utilities reduces economic burdens on economically disadvantaged population's purchase of bottled water or other alternative water supplies free of contaminants.

**Costs and Cost-Benefit Analyses:** Treatment options include retrofitting facilities with DAF, activated charcoal, and ozonation. Dunlap et al. (2015) have described DAF + ozone treatment at its Riverside Plant in Waco, TX, population 166,000; it provides 24–31 million gallons per day (MGD). Taste and odor compounds, also produced by the cyanobacteria (and other algae), were eliminated.

Total costs were $70.4 M for the 11-year period 2002–2012, resulting in an increased cost for water from $2.69 to $3.53/1000 gallons; the U.S. average cost in 2015 was $2/1000 gallons. Adams and Clarke (1989) estimated 10 cents to $1.00 per 1,000 gallons of water for granulated activated charcoal treatment, depending on the size of the system (specifically 150 mgd to 0.1 MGD respectively), likely revised in the EPA estimator (EPA, 2017). At the Collins Park facility in Toledo, OH serving its 400,000 residents, costs approximate $10,000/day for the harmful algal blooms season with a capacity of 160,000 MGD of finished water. For ozonation, Mundy et al. (2018) derive costs for 30 and 100 MGD plants and considerable savings in reductions in chemical supply costs used in routine treatment are reported.

**Finance:** Federal funds are available through EPA's Drinking Water State Revolving Fund and the Water Infrastructure Finance and Innovation Act, the latter for long-term, low interest loans. The Water Infrastructure Improvements for the Nation Act (WIIN) grants assist with water infrastructure. There are also Community Development Block Grants available. The Maryland Department of the Environment maintains the Drinking Water Revolving Loan Fund, which provides low-interest loans for infrastructure upgrades and the Water Supply Assistance Grant Program.

### Recommended Actions:

#### Administrative — City and County

- Toxin monitoring programs should be established in drinking water source areas and the intakes and distribution ports of local utilities.
- Possible alternative water supplies should be identified.
- Government and utility staff should consult with drinking water facility construction teams regarding the selection of appropriate toxin removal infrastructure for local facilities.

#### Administrative and Legislative — City and County

- Funding mechanisms should be explored for installation of appropriate utility infrastructure improvements and extended and ongoing maintenance/replacement.

#### State/Federal

- Delegations should seek State/Federal funding for drinking water facility upgrades.

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## 35 Lead the community toward a clean energy economy

A transition to a Clean Energy Economy is underway and is impacting industries in Frederick County and around the region. Important features of this transition are a workforce trained on new technologies; workforce transition plans for workers displaced by the transition from fossil fuels or climate impacts elsewhere; businesses that are "climate-forward" and responsive to consumer demands; and adequate secondary and post-secondary training.

**Expected GHG Reduction or Climate Adaptation:** Urgent action is needed to address climate change. Rapidly increasing energy efficiency, building climate-resilient infrastructure, and embracing new technology and innovation requires shifts in markets and workforce skills. This recommendation calls for a mechanism for all sectors of the community to work together to aggressively seek ways to bring about these changes. Results can be monitored through time by documenting climate-induced economic impacts and solutions presented and adopted, recording numbers of trained workforce members for climate-specific positions, and providing results of all grants and funding secured through individual or City-County-private partnerships.

**Timeline for Action:** A Clean Energy Advisory Council should be established in 2022, composed of representatives from a variety of stakeholder groups, including small and large employers, industry representatives, secondary and post-secondary education staff, technical experts, and members of the public. The Clean Energy Advisory Council's role is to advance Frederick City's and County's climate goals by: assessing climate-related economic impacts and needs and recommending technical, economic, and social solutions; working toward a more self-sustaining local economy; ensuring a trained and skilled workforce; and providing leadership for innovative funding arrangements. Progress metrics would include forming the council in Year 1 and documenting meetings and meeting outcomes in routinely distributed material from the assigned office, such as the City and County Offices of Economic Development or the joint Climate Response and Resiliency Office (see Recommendation 1).

**Rationale:** As the reality of a changing climate is becoming more widely accepted (by 70% of residents in Frederick County, Frederick News Post, 2021), the changes in the economy are more readily evident. Helped by federal tax incentives and state grants, homeowners are installing clean energy features, such as geothermal systems and solar arrays. These installers report high turnover of a skilled workforce, frequently losing trained staff to other jurisdictions where pay is higher (R. Nicholson, personal communication, May 12, 2021). According to the Columbia Climate School, the industry most vulnerable to climate change is agriculture, Frederick County's largest industry. Farm-to-table dining and farmers markets continue to be popular, and more farmers in Frederick County are responding by using regenerative agriculture principles to grow local food, such as planned grazing to improve soil health, raising vegetables and animals that are more nutritionally beneficial than food shipped in from longer distances. Learning opportunities for conservation (or natural) landscaping attract hundreds of participants and lead to waiting lists. The rapid shift to telework as a result of the COVID-19 crisis, involving at least one member of 54% working households locally (R. Griffin, personal communication), will have lasting impact, with associated ripples throughout the local economy. Tourism and outdoor recreation, both important areas of the local economy, are already impacted by climate change. Considering the fate of native brook trout and its vulnerability to warming stream temperatures, these changes will very likely strain the local economy, since fishing alone draws $2.5 million in local annual revenue (Hitt, 2015). Understanding these economic shifts is a key aspect of the Clean Energy Advisory Council's purpose.

Another area the Clean Energy Advisory Council should consider is the evaluation of current market-based barriers that make climate solutions difficult. For example, the external costs of impervious surfaces are tremendous, as they increase risks of flooding, stormwater treatment expense, damage to water quality throughout the surrounding watershed, and increases in surface heat. Frederick City and County would be well-served by promoting the use of permeable surfaces for back alleys, private and public parking lots, and residential driveways to reduce the risks. However, the minimum purchase for permeable surfacing material is 50 tons and a typical residential driveway only takes perhaps 5–10 tons. The current price for asphalt is $65 per ton and a permeable option is about $140 per ton, making it impractical for residential applications. An investigation with stakeholders may reveal some workable solutions, such as a request and/or mandate that manufacturers set aside days of the week when they produce permeable pavement, and then builders could, in theory, all plan to install that pavement on specific days, such as the second and fourth Tuesday, as an example. A first step is making it available in residential quantities, greatly reducing the cost differential (J. Rensberger, personal communication, June 16, 2021). Another option is buying in bulk for the construction community, thereby reducing cost. Solutions such as these could impact many areas, continuing to advance important transitions in the market.

Discontinuing investment in what will soon become stranded assets is also essential. In a conversation with Kirk McCaulty of WMDA Service Station and Automotive Repair Association (WMDA), it was learned that small gas station operators, which describes most local area vendors, are expecting demand for their services to seriously decline over the next 10 years. Given the reality of a rapid shift to electric vehicles, it makes little sense to allow new gas stations to be built, which leave behind underground tanks, one of the leading causes of petroleum brownfield sites in the country (Environmental Protection Agency, 2021). Perhaps a Clean Energy Advisory Council could recommend an announced phase-out of such businesses or sales of such products, and others that rely on fossil fuels and other pollutants.

These examples of economic impact highlight the need for economic development efforts to be viewed through the lens of climate change. Communities around the country are finding it necessary to ask - Which businesses are “climate-forward,” investing in projects that reduce GHG emissions in order to mitigate forecasted GHG emissions from “business as usual” operations? Is it worth attracting new businesses that leave polluting infrastructure, such as new gas stations? What will happen to members of the local workforce who are displaced by the departure from fossil fuels? Will there be a just transition to new employment? How will the community respond to an expected influx of “climate migrants,” forced to move from Maryland’s Eastern Shore, the coastal areas of the country, or the drought-stricken western states (Recommendation 33)? Which businesses are essential to a thriving, clean, local economy and what is their presence locally?

Another important area for consideration is the role local economic development efforts can play to catalyze a circular economy, which by definition, designs waste and pollution out; keeps products and materials in use; and regenerates natural systems. Circular economies are built with clean energy, and create resilience through a commitment to these principles (Ellen MacArthur Foundation, 2017). In other words, these communities reduce consumption of natural resources, restore natural systems and reduce waste. Incentivizing start-up businesses committed to these principles is appropriate, such as innovative reusers of discarded products into something usable and/or artistic; regenerative farms and gardens (land management practices that rebuild soil organic matter and restore degraded soil biodiversity — resulting in both carbon drawdown and improving the water cycle); food hubs, which support local agriculture and redistribute edible food disposed of by major grocers or institutions; green building renovation and construction companies; conservation (regenerative) landscaping; native plant nurseries; second-hand stores/consignors; and tool libraries. The Right to Repair Act (LegiScan, n.d.), introduced in the Maryland State Legislature in 2021, is just one example of legislation in support of this transition — monitoring and supporting its progress in future sessions will support this goal, along with

other legislative efforts underway at the state and federal levels.

The fastest growing career opportunities are in jobs related to climate change or healthcare (Peach, 2021). Solar and wind turbine installers and technicians, ventilation specialists, hydrologists, soil scientists, environmental science and health technicians, and environmental engineering are either in demand now or expected to increase in demand in the near future. An ongoing inquiry into the skills, needs, and gaps present in the City and County (Recommendation 36) as they relate to achievement of climate goals is needed to maintain a thriving local economy, and is an important function of the proposed Advisory Council.

Providing leadership and support for innovative funding mechanisms to drive transition to a clean energy economy is an important role for the government, described in the Leadership Sector (Recommendations 1 and 2) by establishing sustainable purchasing policies, leading by example, and using innovative funding mechanisms. Providing leadership to build capacity of private sector funding is also critically important, through innovation grants, support for the establishment of a local green bank (Coalition for Green Capital, 2021), and development of public-private partnerships. For example, the Connecticut Green Bank created a second loan loss reserve for its Smart–E loan product to provide local lenders the ability to offer better terms such as lower interest rates, longer terms, and more flexible qualifying criteria to residential customers planning to do energy efficiency retrofits, providing more equitable access to the program. Another example is Hawaii's innovative "on bill" financing program (State of Hawaii, 2021), which invests in renter and low-income households even with high turnover. All customers of Hawaii's electric companies, 95% of the state's population, are eligible to apply for the program. The program has three primary design features for success with these households: 1) approval is not based on creditworthiness, but instead on bill payment history; 2) the repayment obligation is transferable to the next tenant; and 3) the high upfront cost of renewables and energy efficiency are surmounted by a long repayment period of up to 20 years. A third example is from New York. The Home Advance program offered by Sealed (https://sealed.com/) uses a co-branding approach with utilities and green banks to offer homeowners an energy retrofit. The company finances the installation with a 20-year agreement, pays the utility bills, and takes monthly service fees based on actual energy savings. The homeowner pays slightly less than they did before. Sealed has worked successfully in New York and is expanding to other states. Other options can be found at Revolving Loan Funds (https://www.nrel.gov/climate-neutral/revolving-loan-funds.html), Energy Service Agreements (https://www.aceee.org/blog/2019/02/energy-service-agreements-potential), and Alternative Financing Mechanisms for Energy Efficiency (https://www.edisonfoundation.net/-/media/Files/IEI/publications/IEE_AltFinancingMech_McCaffree.ashx).

Finally, the Advisory Council should be the catalyst for or the facilitator of a Green Grant and Loan program. This would entail identifying, cataloguing, and aggregating public and private grants and incentive programs for a host of projects aligned with climate response and resilience, such as increasing the availability of energy efficiency retrofits for affordable housing, increased funding sources allocated for energy-efficient construction, providing electric vehicles to low income households at reduced or no cost, piloting lawn conversion and gas-powered equipment trade-in programs, and much more as outlined elsewhere in this report.

Multiple jurisdictions have advisory councils/groups to facilitate consideration and adoption of climate-related policies. A few of many include state groups like Pennsylvania (https://www.dep.pa.gov/Citizens/climate/Pages/CCAC.aspx) and New York (New York State Climate Action Council, (https://climate.ny.gov/Climate-Action-Council), regional partnerships (https://www.mwcog.org/committees/climate-energy-and-environment-policy-committee/), County panels (e.g. Montgomery County's Climate, Energy, and Air Quality Advisory Committee, https://www.montgomerycountymd.gov/green/energy/committees-and-partners.html), and large and small city examples like Portland, OR (https://www.portlandoregon.gov/bps/62920) and Reading, MA

(https://www.readingma.gov/climate-advisory-committee). Establishing a similar mechanism is a wise investment in the economic resilience of the community.

The Livable Frederick Master Plan (Frederick County, 2019) and the City of Frederick Comprehensive Plan (City of Frederick, 2020) include chapters on environmental stewardship and economic development. This recommendation recognizes that these two important responsibilities of local government are inextricably linked and establishing a Clean Energy Advisory Council as an intentional effort to plan for economic development is an important aspect of climate response and resilience.

**Equity Considerations:** The Clean Energy Advisory Council approach provides a mechanism by which Frederick City and County can "go the extra mile," anticipating employee dislocation before it occurs, seeing opportunity on the horizon and preparing to benefit from it, and structuring financing arrangements, such as sliding scale subsidies, that allow all people to benefit from improvements in efficiency and resulting cost savings. The core purpose of such an approach is equity, and should be a driving motivator.

**Costs and Cost-Benefits Analysis:** Facilitating the development and administration of an Advisory Council requires staff time. However, according to economists, the choice is to either aggressively plan for and build a new, clean energy economy, or allow the status quo to continue and live with the worsening results. Climate change response and resilience saves money, creates jobs, and provides for innovation and economic growth through an accelerated transformation of five areas: clean energy systems, smarter urban developments, smart water management, sustainable land use, and a circular economy. The Clean Energy Advisory Council's role is to seek opportunities to accelerate transformations in these areas.

**Financing Options:** A Green Grant and Loan program might be facilitated locally through a Frederick green bank, much as Montgomery County has done and promoted in the current federal administration's new climate plans. These green banks (https://greenbanknetwork.org/) facilitate private investment into domestic low-carbon, climate-resilient infrastructure. Providing grants or low interest loans for climate-focused projects not commonly in the portfolios of lending institutions could stimulate progressive implementation with little dependence on public funds.

### Recommended actions

The City and County should collaborate on the establishment of a Clean Energy Advisory Council in 2022. The Council should be directed to:

- Develop a strategic plan for attracting climate-forward, carbon-neutral, plastics-neutral businesses to this area.
- Review economic development goals through the lens of climate change and provide direction to align with climate goals.
- Recommend updated trades training and climate-forward business training to all workforce training options in the Offices of Economic Development and Frederick County Public Schools career center programs.
- Continually provide updates to vendor lists for City and County departments, and community-focused programs such as the Green Homes Challenge, to list businesses that are climate-forward, carbon-neutral, and plastics-neutral.
- Develop an Agriculture Transformation Strategic Plan (the most recent plan is from 2007) as the industry is the most at risk from climate change impacts.
- Establish a leadership position on the development of funding mechanisms to accelerate action on climate goals. Duties would include 1) identifying potential funders (foundations, corporations, and private donors, etc.), 2) establishing specific business operation requirements and leadership for the program, and 3) prioritizing initial shovel-ready projects to support in order to establish credibility of the Green Grant and Loan program.
- Seek stakeholder engagement on a continuous basis to identify market barriers to the acceleration of climate goals and develop public-private solutions to solve them.

**Resources**


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## 36 Create and deploy workforce transition plans

**Recommendation:** Create and deploy workforce transition plans that include funding of post-secondary education options, trades and apprenticeship opportunities, and local conservation corps programs for implementing green projects across the City and County.

**Expected GHG Reduction or Climate Adaptation:** Technology is changing rapidly and has the potential to have a great impact on transition to a clean energy economy. The pace by which the local workforce is able to learn and absorb the skills needed to integrate new technology into their working lives will matter. There are three main sectors of growth for technology advancement that have been identified by CEWMG:

- Building construction and retrofit
- Precision agriculture
- Conservation landscaping

This is not an inclusive list. Other industry sectors may have workforce development needs that are not yet identified, or have not surfaced locally. This recommendation stems from needs expressed by members of the community, most specifically the Frederick County Building Industry Association (FCBIA), where the need seems most pronounced. Reductions in GHG emissions and improvements to building resilience will be most impacted by the availability of training, modernized to include new technologies that address energy efficiency and soil health improvements. Results can be tracked through tallying technical training courses and trade-specific course completions.

**Timeline for Action:** Within 12-18 months, working with the FCBIA and other interested industry sectors, identify trades and techniques important to construction of energy efficient buildings, identify experts as trainers, and establish professional licensing training courses and apprenticeships through local sources, such as the Workforce Training staff of the County Office of Economic Development (OED), Frederick County Public School Career and Technology Center, Frederick Community College, National Association of Home Builders (NAHB), Home Builders Institute, and other public and private educational programs. Thereafter, County staff should routinely communicate with FCBIA to adopt new training programs for needed skills to guarantee that appropriately skilled labor is available as construction and property retrofits increase to meet Frederick County's projected population growth of 100,000 by 2040.

Additionally, over the following 18-24 months, establish a climate corps labor force to implement climate-related training and infrastructure projects, with new skills training that increases employment and career opportunities, not limited to, but targeting individuals who are low income, displaced, low skilled, or educationally deprived.

**Rationale:** There is an increasing interest in energy efficient new and rehab construction with accompanying new skills required. Local builders in these construction sectors have identified the lack of skilled tradespeople (plumbers, electricians, heating and air conditioning technicians, carpenters, etc.) as being the greatest barrier to selecting and installing clean energy technologies. They report finding tradespeople who are experienced, but not aware of or without the skills needed to select and install new, clean energy technologies, and when hired, seek higher fees for the new technology they are asked to install. This dilemma perpetuates the erroneous notion that energy efficient technologies cost the builder and eventual buyer substantially more. With proper training and skill development, up-front costs could be only slightly higher and cost recovery experienced over the first few years after installation, due to lower energy bills, and in some cases, less need for medical care as a result of improved indoor air quality.

A preliminary step could include providing public education to teach the guiding principles of passive

housing: prevention of thermal bridging; superior windows; mechanical ventilation with heat recovery; quality insulation; and airtight construction. Multiple venues throughout the City and County could offer this training to attract new customers and recruit new candidates into the workforce. To further the development of skills in the current workforce, expansion of educational programming like Skill Up Frederick, a program offered by the County's OED Workforce Training Program, could speed the delivery of the skilled tradespeople needed in the expanding energy efficient construction industry. Additional training topics could cover geothermal heating and cooling, water heating choices, energy efficient plumbing options, and solar photovoltaic systems in commercial and residential construction. The current MetrixLearning® does not include training for new ventilation or construction skills; however, FCBIA student and professional members may leverage the NAHB Green Courses and Modules. FCBIA could identify necessary programming, including instructors and institutions that offer the required training and educational opportunities, and provide input to the proposed Clean Energy Advisory Council (Recommendation 35), a strategy used by other jurisdictions, such as Wisconsin's state-wide approach. A proposed Green Grant and Loan program (Recommendation 35) could be tapped to fund innovative pilot projects, internship opportunities, retrofits for low income community members, and optimize a well-trained, technologically adept workforce.

A training approach is also needed to advance agriculture and land management transformations. The case for these needs is made in Recommendations 19 and 20. To recap, "precision" agriculture is viewed as the "future of agriculture" and includes expanded uses of drones, collection and interpretation of data, robotics, and many other technologies to increase productivity while measuring, protecting, and building soil and ecosystem health (United States Department of Agriculture, n.d.). Regenerative (or conservation) land management is benefited by using existing and emerging technologies that guide decision making by land managers. Implementation of these and other green infrastructure projects could be accelerated through development and support of Climate Corps or Americorps-like programs within the City and County. Climate Corps members, screened for aptitude and preference, could be placed in projects listed throughout these recommendations, such as skilled trades internships, conservation landscaping crews, parks projects, regenerative agriculture projects, ecosystem restoration projects, and pest surveillance teams. Other jurisdictions have implemented this approach with success (City of Oakland, 2021). California Governor G. Newsom has established the California Climate Action Corps program (United States Department of State, 2021) with 300 funded fellows seeking cross-state volunteers, and President Biden has proposed a reinstatement of a Civilian Climate Corps (The White House, 2021, January) to focus on implementing projects to minimize GHG emissions and increase resiliency. A local effort would increase carbon sequestration through projects implemented, attract new prospects into the workforce, and provide new career opportunities for those in the community who otherwise have limited job possibilities.

These actions promote implementation of much of the section 'Making our Economy Vision a Reality' of the Livable Frederick Master Plan (Frederick County, 2019). Public school, post-school training, and re-training are specifically referenced on pp. 173–174 for the current and new industries that the County maintains and seeks. The City of Frederick Comprehensive Plan (2020) has Economic Development Policies 1 and 8 that directly complement the proposed training opportunities: Policy 1 states, "Educate, retain, attract, and train a diverse, creative, and capable resident workforce to support existing and future employment needs" while Policy 8, Implementation 7 provides the following, "coordinate with FCPS, FCWS, FCC and others to ensure that employment skills training is targeted to underserved populations." The recommended climate-related training fulfills both City and County goals.

**Co-Benefits:** Transitioning our local economy to a clean energy economy has multiple benefits for residents, businesses, and City and County revenues. First, routinely building highly energy efficient, clean energy housing in the area not only provides new

skills, jobs, and potential career paths for current and future tradespeople, it also reduces costs for heating and cooling for all portions of our community. Likewise, accelerating this transition improves indoor and outdoor air quality for occupants and outside workers, improving community health.

**Equity Considerations:** A Clean Economy with the components noted above has potential to expand job opportunities to individuals with few professional skills and potential income and financial security. Participating in Project GUIDE (Empowered to Live, 2020) is a great option. It includes Understanding and Identifying Desired Employment, a 14-week pre-apprenticeship program that offers youth ages 16–24 job readiness and technical skills training and paid internship opportunities with local businesses in the construction and skilled trades industry. It is a direct response to the growing number of youths in the Frederick County area who are from households with income at or below the ALICE threshold (asset limited, income constrained, employed), with insufficient income to offset the basic cost of living. The program aims to create pathways that increase the economic mobility of youth identified as ALICE by equipping them with essential workplace readiness and financial literacy skills to gain access to living-wage jobs and make better financial decisions.

Beyond skill acquisition are the advantages of more energy efficient homes and healthier green infrastructure, lowering utility bills, and improving health. As the County Public Health Officer Dr. Barbara Brookmyer has stated, preventing illness through actions eliminating exposure is the most effective means to reduce climate-induced illness.

**Costs and Cost-Benefit Analyses:** The costs of additional training for tradespeople are low relative to the increased availability of more energy efficient and affordable housing made possible through a trained workforce. Climate corps volunteers are reported to experience increased future employment options, thereby reducing welfare or unemployment payments, offering 'a hand up, not a hand-out' (Feulner, 2020). Additionally, the Corps can undertake cross-community climate-related projects at less expense, accelerating projects that reduce energy demand and GHG emissions and increase resiliency in local infrastructure.

**Finance:** Financing options for needed training will likely expand due to the federal administration's commitment to climate action. Suggested funding includes the American Rescue Plan, which allows funds to be used for building, rehabilitating, and retrofitting affordable, accessible, energy efficient, and resilient housing, commercial buildings, schools, and child care facilities all over the country (The White House, 2021, March); Maryland SB 636 Neighborhood Revitalization — Passive House Pilot Program enacted May 30, 2021, to establish a Passive House Pilot Program in the Department of Housing and Community Development to assist a non-profit organization in partnership with neighboring high schools and institutes of higher education to provide students with career and technical educational experiences through the renovation of residential properties (TrackBill, 2021); and Maryland SB 764 Workgroup on Adaptive Reuse of Vacant Commercial Spaces enacted May 30, 2021, to establish the Workgroup on Adaptive Reuse of Vacant Commercial Spaces to study the potential for conversion of vacant or underutilized commercial spaces into residential, mixed-use, and commercial spaces in order to increase the affordable housing stock in the State (LegiScan, 2021). The City of Frederick OED lists funding sources for non-IT training or apprenticeships (City of Frederick, 2019); some require partnerships and commitments from local businesses to support the training.

Future topics for training could be coordinated with FCBIA. The Maryland Business Works Program Workforce Development and Adult Learning weblink (Maryland Department of Labor, n.d.) indicates that, "The Program funds classroom-based training, in-house staff training, apprenticeships, and other opportunities for Maryland's businesses as they create and foster their talent pipeline." The Carl Perkins Collaborative Resource Network apportions funding in the state for Career and Technical Education clusters, including Construction and Development (Maryland Department of Education, n.d.) that might be explored and possibly expanded to include the newer energy efficient technologies. The Workforce Innovation Opportunity Act (WIOA;

P.L. 113–128, as amended) is a large Federal program with many components that could include training modules. And as noted above, Project GUIDE is an example of a successful youth education in trades that is a partnership of public and private funding (Empowered to Live, 2020).

Finally, climate corps, like the 1930's Civilian Conservation Corps, Peace Corps, and AmeriCorps, needs financial support to acquire trainers, support fellows, and educate and pay local to national volunteers. California has provided funding for its effort and other states (WI) and cities (Oakland, CA) have followed or planned similar commitments individually or through partnerships with existing corporations or non-governmental organizations.

### Recommended Actions:

#### Administrative:

- Through executive action, request that the City and County Offices of Economic Development establish new training modules and apprenticeships for the application, installation, and maintenance of new technologies important for high energy efficiency standards.

- Establish collaborative working relationships with FCBIA to identify 1) technical training areas and 2) possible public and private institutions, instructors, and curriculum to develop and present training.

- Identify and secure non-local funding sources that provide fiscal support for vocational and post-secondary educational programs.

#### Legislative:

- Identify local (budget process) and non-local public funding sources to implement a Frederick City and County Civilian Climate Corps to 1) train climate-ameliorating techniques to individuals with limited employment opportunities who then 2) act as trainers for stipend-supported fellows and volunteers. The corps would then undertake implementation of multiple climate-specific recommendations to reduce local GHG emissions or increase resiliency in the infrastructure of the area.

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## 37 Build climate-resilient school communities

**Expected GHG Reduction or Climate Adaptation:** Climate education leads to more respectful and responsible environmental behavior community-wide as residents from all walks of life learn the environmental impact of their choices. These behavioral changes can lead to results that benefit the entire community, such as: reduced carbon emissions, habitat conservation and restoration, sustainable agriculture, environmentally friendly consumerism, and a more equitable society regarding climate justice issues. Results can be tabulated through time as environmental/climate content is added to the Frederick County Public Schools (FCPS) curriculum and can be measured by numbers of students enrolled, Green Schools in the FCPS system, and environmental education classes outside of the formal FCPS.

**Timeline for Action:** By 2035, all schools in the FCPS system should be certified as Maryland Green Schools with Maryland Environmental Literacy Standards fully integrated into the K-12 curriculum, and environmental/climate science classes and community service required for high school graduation. This includes identifying faculty at all FCPS schools (particularly high schools) to support this project. Community Green Leaders and Centers should be identified before the end of the 2022 school year. Documenting interest and action by the FCPS Board of Education, and other relevant departments (Parks and Recreation, Sustainability, etc.) will be a metric for meeting the 2035 goal. By 2025, City and County education venues other than schools (parks, nature centers, etc.) should support schools as Green Centers (there are no certified Green Centers in Frederick County as of 2021), and provide programming to educate residents and visitors of all ages about the concepts and actions necessary to meet the Maryland Common Qualities of Effective Environmental Literacy Programs for Local Education Agencies (Maryland State Department of Education, 2013) and the County's carbon emission reduction and sequestration goals.

**Rationale:** There are 46 new Green Schools, 86 recertified Green Schools, and 18 Sustainable Schools in Maryland public schools, but just nine Green Schools in Frederick County. Green School classrooms involve students in projects pertaining to water conservation, energy conservation, solid waste reduction, habitat restoration, structures for learning, transportation, and healthy schools, as explained by the Maryland Association for Environmental and Outdoor Education (MAEOE, 2021).

From 2019–2020, notably, Maryland Green Schools accomplished the following: 648,415 gallons of water have been conserved; energy use has been reduced by 2,157,757 kwh; 61,975 pounds of compost have been produced; and 1,729,076 pounds of materials have been recycled, saving schools money and improving the overall human and environmental health of the community (Fig. 1, MAEOE, 2021). The need for these sustainable practices in schools is more urgent and important as climate change impacts increase.

| | |
|---|---|
| Water Conserved | 648,415 gal |
| Rain Garden/Bio-retention area planted | 26,298 $ft^2$ |
| Stream Bank Planting | 25,925 $ft^2$ |
| Stream Cleaning | 86,197 $ft^2$ |
| Energy Use Reduction | 2,157,757 kwh |
| Green Energy Used | 2,365,008 kwh |
| Composting | 61,975 lbs |
| Recycled Materials | 1,729,076 lbs |
| Created Native Habitat | 25,961 $ft^2$ |
| Created/installed bird houses | 360 houses |
| Native Plants (shrubs and trees) | 3,203 plants |
| Invasive Plant Removal | 43,149 $ft^2$ |
| Outdoor Classroom | 150 classrooms |
| Outdoor Environmental Art | 666 pieces |
| No-idling Zone | 55 schools |
| Plants for indoor air quality | 3,468 plants |
| Edible Garden | 13,162 $ft^2$ |
| Outdoor running events and environmental festivals | 528 events |

**Figure 1. Maryland Green School Outcomes 2019–2020** (from MAEOE, 2021)

Quality environmental education is an effective, proven avenue for climate action, especially when combined with community behavior change strategies. For example, a 2015 study showed that project-based learning had a positive effect on students' environmental attitudes; students said this practice provided permanent learning that helped them define environmental problems more clearly and take on more active tasks in the solution process (Genc, 2015).

This type of learning, employed by Green Schools, would help to mobilize Frederick City and County youth. Additionally, there are important mental health benefits expected for youth. Research on adolescents and young adults suggests that they believe the future to be bleak. Many young children are also concerned about their future and the future of the environment in which they live. Incorporating environmental literacy and action into the public school system will provide learners with the conceptual tools to work toward a more positive future that could significantly improve future expectations (Fleer, 2002).

Students and teachers want to learn and teach about ways to help the environment, but at least one study revealed that secondary school teachers in different fields think that dealing with the social issues around science (climate change, climate justice, etc.) is the domain of a discipline other than theirs, resulting in gaps in education (Fleer, 2002). It is critically important to designate responsibility for climate education to a specific class or instructor, as well as to incorporate appropriate environmental literacy topics into all subject areas. Indeed, the interdisciplinary nature of environmental education promotes learning achievement, as reflected in the Common Core Standards of Learning (Common Core State Standards Initiative, 2021), and avoids "curriculum overload," resulting in an engaging, thought-provoking context for learning multiple subjects. Students further their understanding of human and natural systems interactions locally and globally, and develop knowledge necessary for making decisions crucial to our future (Lieberman, 2013). Fortunately, the state of Maryland is a leader in environmental literacy education and was recognized in 2015 for becoming the first state to require students to be environmentally literate as a high school graduation requirement. Excellent resources are already available at the state level for use and adaptation by Frederick County administrators and educators. Students also have a desire to learn about how to be environmentally sustainable on a local level, which is exactly what becoming a Green School would provide (MAEOE, 2021). Education of all K-12 students will be assisted through development of simple climate modules produced, posted, and rotated by a collaboration of Climate Response and Resiliency Office (CRRO) staff and appropriate FCPS teachers (Recommendation 1). The modules will be designed for elementary, middle, and high school populations and changed quarterly to provide students and other members of the community with the basics of the changing climate of the region, natural and human causes and consequences, and ways individuals, groups, businesses, and others can minimize local climate impacts.

An effective, participatory county government depends upon a strong education system to be successful. An educated, informed citizenry is best prepared to understand and solve any challenges, especially those presented by a changing climate. Thus, the State of Maryland implemented Environmental Literacy Standards, and in 2011 passed the first high school graduation requirement for environmental literacy. Prince George's County Public Schools has infused the Environmental Literacy Standards into the K-12 curriculum.

Research shows that environmental literacy and climate change education programs achieve a variety of positive outcomes. Most commonly, programs increase environmental knowledge, but they can also impact learners' level of concern about climate change, their problem-solving skills, and behaviors. Effective climate change education programs use engaging teaching strategies, encourage deliberative discussion to explore and navigate disagreements and controversial issues, engage participants in the scientific process, address misconceptions, and/or incorporate school or community projects for participants to take action. One long-established, well respected forest education program, Project Learning Tree (2016), sums it up as "teaching learners how to think, not what to think." Programs focused on making climate change information personally relevant and meaningful for learners and

activities or educational interventions designed to engage learners are most effective for achieving environmental literacy.

A 2019 National Public Radio/Ipsos poll found that 80% of parents (of those, 66% identify as Republicans, 90% as Democrats) want their children to learn about climate change in school and 86% of teachers agree, although 55% of teachers currently do not cover this topic for a variety of reasons. More than 9 million students experienced disruptions in education in just one semester (fall, 2017) because of climate-related natural disasters (Kamentetz, 2019).

Other benefits of environmental and climate education are increases in:

- Knowledge in science, mathematics, reading, and writing
- Emotional and social skills, such as self-esteem, character development, team work, and leadership skills
- Environmentally responsible behavior, such as reducing water use, increasing recycling, and participating in community cleanups
- Academic skills (21st century skills), such as critical thinking, oral communication, analytical skills, problem solving, and higher-order thinking
- Motivation to learn, including enthusiasm for and interest in school
- Civic interest and engagement, including feelings of civic responsibility, feelings of empowerment, and ability to take action (Monroe et al.,2017).

High-quality environmental education and climate education also increases awareness of potential careers in natural resources, environmental studies, and climate adaptation fields. By integrating the Maryland Environmental Literacy Standards into the K–12 Frederick County curriculum and ensuring that every Frederick County School becomes a Green School, the benefits for student achievement and a healthier, cleaner, and more cost-efficient school system will be realized with relatively little investment beyond current spending.

**Co-Benefits:** Implementing these programs will create a ripple of benefits for all citizens of Frederick County and the City of Frederick. By prioritizing environmental needs, FCPS will establish itself as a leader in the Green Schools movement, an attraction for parents interested in sending their children to local cutting-edge schools. With a more educated student body, environmental literacy will improve county-wide, ultimately creating a more informed constituency as well as expanding the potential workforce for science-demanding jobs (e.g. for 2015–2016, more than 30% of high growth industry jobs were in Education and Health Services in the County; *Livable Frederick Master Plan*, 2019, p. 153). By facilitating more sustainable practices in the community and offering fun, educational events, tourism (and associated dollars) will expand to treasured outdoor spaces (C&O Canal, Baker Park, Gambrill State Park, Monocacy River, etc.) and model sustainable practices. Furthermore, residents will enjoy health and well-being benefits from cleaner air and water, outdoor exercise, and spending time in nature (Ewart et al., 2014; Mitten et al., 2018; Kruger et al., 2010).

Tackling environmental problems will promote inclusivity by addressing social justice issues created by climate change. Youth will be educated not only about our environment but also about the often disparate impacts of environmental threats on poor and minority communities (Kushmerick et al., 2007). Addressing environmental literacy from preschool through adulthood builds relationships between the community and local government. School students and participants in climate education programs will feel acknowledged and empowered regarding their climate resiliency concerns.

The City and County strongly support expanded educational opportunities. Experiential learning for natural systems and agriculture is suggested in the Livable Frederick Master Plan (pp. 115, 117, 163, 166); education needs regarding environmental hazards and exposures is found on p. 141, relevant to addressing the climate impacts ahead. Expanding CREST (Center for Research, Education, Science, and Technology) is part of the County's long range plan (p. 163) and education specific to green infrastructure and climate is embedded in the Education, Jobs, and Workforce Development commitments (pp. 172–174). The 2020 draft City Comprehensive Plan states, "Promote environmental education…" (p. 13–278) to aid in green infrastructure design and

development; education beyond the public schools is advocated on p. 10–233 to prepare workers for green infrastructure innovations that must be considered in our future. These commitments by the City and County support the need to invest in climate education for all residents.

**Equity Considerations:** Environmental justice is an important component of environmental literacy. Implementing a curriculum that directly addresses environmental justice will heighten awareness of how certain sectors of our community are more negatively impacted by issues such as water contamination and air pollution. For example, households with lower income levels are at higher risk of exposure to air pollutants, increasing the likelihood of those households experiencing health issues (Miao et al., 2015). Funding will be provided for students who do not have the resources to attend activities such as field trips so that they can still gain the same knowledge and experience as students of higher socioeconomic standing.

Because Frederick County is home to myriad racial and social groups, implementing environmental education in all schools could greatly increase environmental literacy (Kushmerick et al., 2007). For the 2020–2021 school year, enrollment in Frederick County Public Schools was nearly 44,000 students. Student demographics include 55% White, 19% Hispanic/Latino, 13% Black/African American, 6% Asian, 6% two or more races, and less than 1% American Indian/Alaskan Native and Pacific Islander/Native Hawaiian students (Fast Facts, n.d.). Including communities of color and those of lower socioeconomic status in both formal and free-choice learning is vital for achieving environmental equity. Increased education and awareness of environmental hazards, their prevention and solutions, will decrease incidents of environmental injustice.

Thirty-two percent of Maryland's land mass is used for farming. Farmers make decisions every day that impact environmental health while dealing with increasing impacts of the changing climate. Although Maryland farmers, including those in Frederick County, lead the nation in adoption of sustainable practices (cover crops, no-till, etc.), agriculture will rely increasingly on more sophisticated methods as the climate continues to change (Conway & Pretty, 2013; Setterberg & Shavelson, 1993). Educating Frederick's younger generations about sustainable, regenerative methods, such as Integrated Pest Management (Recommendation 30), will allow them to help balance care for natural systems with farm business needs.

**Cost and Cost-Benefit Analyses:** Analyzing the costs and associated benefits of public education in any subject area is challenging, as often the benefits manifest over time, making it difficult to track an investment in education today to longer-term changes in societal awareness and behavior. However, some notable parallels in the health education field, when education has been combined with targeted behavior change efforts (e.g., drivers education and auto safety, and education about tobacco use and lung cancer), demonstrate that investments in education prove beneficial for residents' and communities' health and quality of life (McKenzie-Mohr, 2011; McKenzie-Mohr & Schultz, 2014; Monroe, 2003).

**Finance:** Often, environmental (EE) and climate (CE) education can be integrated into the K-12 curriculum without enormous added costs to a school or district. Many EE and CE resources are designed to address existing academic standards, making EE and CE a platform for helping students achieve knowledge and skills in a meaningful and locally relevant way. But providing teachers with the professional development needed to provide effective instruction in environmental content, use the schoolyard for hands-on learning, or integrate an off-site field experience into pre- and post-classroom instruction may require additional funds. Likewise, transportation for enriching experiences at nearby nature centers, public lands, or other program providers may be needed.

Funding for EE and CE are frequently available through small grants that may be offered through a state agency or local and regional private grant makers. Some federal agencies offer grant programs that support larger education initiatives each year. These funding opportunities are:

- EPA Office of Environmental Education Grants (2021) grants support work that expands

environmental education and promotes environmental stewardship, awareness, or skills. Local education agencies and their nonprofit partners are eligible for these grants and make up a large portion of awardees in the past (https://www.epa.gov/education/grants).

- Every School Succeeds Act (ESSA) Title IV, Part A

Title IV of the Every Student Succeeds Act allows federal funds to be used for EE and CE programming (American Institutes for Research, 2021). In Part A, EE is eligible for funding as part of a "well-rounded education," while Part B includes environmental literacy as an eligible activity within 21st Century Community Learning Centers (https://safesupportivelearning.ed.gov/ESSA-TitleIVPartA-SSAE).

- NOAA B-WET Grants

NOAA administers the Bay Watershed Education and Training (B-WET) grant program (NOAA, 2021). These grants are for programs that provide K-12 students with Meaningful Watershed Educational Experiences (MWEEs). MWEEs typically have both outdoor and in-class components. B-WET grants are open to the Chesapeake Bay region. Applications open in late summer or early fall and close in late fall or early winter. https://www.noaa.gov/office-education/bwet; https://www.noaa.gov/office-education/bwet/apply#Ches.

- Project Learning Tree's GreenSchools program (Project Learning Tree, 2016) inspires students to apply their STEM and investigative skills to create greener and healthier schools – and save schools money. PLT's Green Works! grants can provide funding (https://www.plt.org/greenschools/engage-your-students/).

- The Maryland Association for Environmental and Outdoor Education (MAEOE) offers grants for Maryland Schools and organizations that are pursuing or maintaining Green School or Green Center status (MAEOE, 2021).

In addition, the Chesapeake Bay Foundation ([CBF], 2021) recognizes that youth education is essential in developing environmentally literate and civically minded adults who will support the restoration and protection of the Chesapeake Bay. The CBF has set a goal for every student in Maryland to be empowered with the knowledge and skills to make informed decisions to ensure the health of their local environment and communities. Their Environmental Education Grant Program funds initiatives and programs that advance environmental literacy and result in students gaining the knowledge, skills, and appreciation for nature that inspire and empower them to take responsible actions to protect and restore their local environment. Maryland school districts, nonprofit organizations, public agencies, higher education institutions, and community associations can apply. In FY 2021, $450,000 was made available for this grant program. Mini-grants from the Chesapeake Bay Trust (2021) of up to $5,000 can fund meaningful outdoor learning experiences for watershed issue investigations including field trips, fieldwork, student-led action projects, schoolyard habitat projects, as well as teacher professional development training and programs to advance environmental literacy.

**Recommended actions:**

Administrative — FCPS

- Integrate the Maryland Environmental Literacy Standards into the K-12 Frederick County curriculum in all subjects and grade levels, and require all FCPS schools to become certified MD Green Schools by 2035.

- Provide professional development opportunities, funding, and technical support for teachers to support implementation.

- Tap opportunities to link with state resources (Maryland Department of Natural Resources, Maryland Green Schools, Project Learning Tree, Project Wild, etc.), the regional level (Chesapeake Bay Foundation), and the national level (NOAA, NASA, EPA, and other federal agencies) for funding, professional development, partnerships, and technical support.

- Work with the CRRO staff (Recommendation 1) to create unique climate-related modules for elementary, middle, and high school students.

### Administrative and Legislative — City and County

- Ensure that budget legislation includes funding for Green Schools and Environmental Literacy Standards integration, and that County and City parks and nature centers support schools and gain certification as Green Center laboratories.

- Establish funds and tasks for CRRO staff to collaborate with FCPS teachers in developing weblink climate-related modules for elementary, middle, and high school students.

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## 38 Climate actions for Frederick area residents, households, and homeowners associations

If every household reduced its "carbon footprint" (GHGs emitted per year) to a sustainable level (GHGs emitted being equal to or less than carbon sink capacity), estimated to be 3 metric tons per person, about 40% of the emissions reductions necessary to achieve net zero emissions will be achieved, leaving the rest up to business, industry, and government. This all adds up to individual action as a powerful force in motivating societal shifts — in fact, it is essential.

There are multiple individual household changes that climate experts recommend. HomeOwners Associations can be effective facilitators of change by arranging group purchasing agreements for solar installation and composting services — or adopting conservation landscaping practices and installing LED lighting, for example. Individuals and households can get started by learning what their carbon footprint is by using tools such as the calculator from the CoolClimate Network. Once that baseline is understood, then decide on actions that fit lifestyle and budget. Many of these options are surprisingly affordable because of tax credits, product rebates, or other incentives, which are expected to increase over the next several years. **Here are some of the possible areas of action to focus on:**

### Talk about it!

According to climate scientist Dr. Katharine Hayhoe, the most important thing to do is to talk about why the climate crisis matters. Encourage civic clubs, church groups, neighborhood associations, and other groups to have these conversations. She explains: "When I speak to people, it's not a case of needing new values … It is a very rare human being who does not already have a key value or part of their identity that connects directly to concern over changing climate." Dr. Hayhoe's GlobalWeirdingSeries.com is a great resource for learning more and assisting conversations across individual networks.

### Save energy and shift to clean power.

Conserving energy use at home provides examples of small actions leading to big societal changes as well as the added benefit of cost savings for homeowners. For instance, LED lighting uses 80% less energy than regular lighting and lasts much longer. In less than a decade, LED bulbs have become the main source of lighting in U.S. households and during that 10 year period, emissions from households overall decreased in the U.S. for the first time in more than a century. That's a powerful example of individual actions adding up.

Frederick County's Green Homes Challenge leads visitors through a variety of actions a household can take and provides local resources for incentives and guidance. It's possible to support wind energy through household energy bills by calling the electric company, or choosing a supplier that offers 100% green-e certified wind credits, such as Groundswell. Another clean energy option is to subscribe to a community solar project. Two companies with projects in the Potomac Edison territory are Common Energy and Neighborhood Sun. Groups of homeowners across Frederick, Hagerstown, and Morgantown, WV have come together to form a solar purchasing group to reduce costs through Solar United Neighbors (SUN), an option that is likely to expand in the future.

### Change food habits.

Changing household food practices may be the most economically effective way to make substantial contributions to GHG emission reductions. First, make sure to use all food that's been purchased. As much as 40% of the food bought in the United States ends up in landfills, which then emits methane, a GHG 28 times more potent than carbon dioxide. Eating a plant-rich diet makes a big difference in GHG reduction and in water conservation. Limiting meat consumption to a few servings a week and buying

meat from local farmers who graze their livestock are sustainable strategies. Area producers are listed in the Amazing Grazing Network Directory. Composting food scraps and waste in backyard compost bins or piles keeps waste out of landfills. Or, arrange for home, church, and business pick-up from Key City Compost.

**Limit fossil-fueled driving and reduce or eliminate airline travel.**

Think twice about how to travel from one place to the other. In some cases, biking or walking might be a better, even faster, option than a car. When local car travel is necessary, doing so during non-peak hours, or using navigational software and traffic alerts to avoid back-ups, can reduce emissions by as much as 50%. Adopting a personal "no-idle" policy has multiple benefits of improving air quality, eliminating wasteful emissions and saving vehicle engines from needless wear and tear. Consider an electric vehicle (EV) for the next car purchased. Used, good quality EVs are now on the market. EVs are more affordable than ever and are also fun to drive! Tax credits are available at the state and federal level. EVs offer a better driving experience than combustion engine counterparts and fuel savings combined with little to no maintenance expense makes transitioning to electric cars a great financial decision as well as a responsible choice.

Since air travel contributes to climate change in multiple ways, consider train travel — which reduces GHG impact by about seven-fold. When that's just not possible, choosing non-stop flights reduces emissions. Purchasing carbon offsets for miles traveled is also a good idea. There are several options — Terrapass and Native Energy are just a few of the sources recommended.

**Manage your land to draw down carbon.**

Healthy soil and trees draw carbon from the atmosphere and substantially reduce stormwater run-off, whereas turf grass, the lawns of most homes, provides very little benefit. Therefore, many homeowners are limiting the size of lawns or eliminating mowed grass completely! Even the smallest landscapes can invite nature back in by avoiding chemical fertilizers, fungicides, pesticides or herbicides, which destroy soil health, weaken plants, and harm people, pets, and ecosystems. Planting native trees and deep-rooted perennials, especially those that attract pollinators, contributes to the beauty of the landscape while facilitating crop production and building the natural systems necessary to make chemicals obsolete. Native shrubs and trees can be purchased from the Maryland State Nursery for $1.00 each.

**Put your money where your heart is.**

If you have investments, steer clear of fossil fuel and chemical companies. Purchasing from local producers, resale shops, retailers, and businesses for most household needs is a win-win for strengthening the local economy while cutting GHGs.

The acts of individuals to reduce GHGs and increase carbon sequestration are not unimportant. Rather, they add up and have the potential to become a social movement, a tipping point, when actions of a few can change the world.

**Work with others.**

Beyond one's household, many residents are hoping to support and/or join efforts to make a bigger impact on climate change, locally, state-wide, and nationally. Some local groups actively working on climate change solutions are:

**Mobilize Frederick** — https://www.mobilizefrederick.org/

**Multifaith Alliance of Climate Stewards (MACS)** — https://www.macsfrederick.org/

**Envision Frederick County** — https://envisionfrederickcounty.org/

**Streamlink Education** — https://www.streamlinkeducation.org/

**Community Fare** — https://www.communityfare.org/

**Fox Haven Farm** — https://foxhavenfarm.org/

**Mountainside Education and Enrichment** — http://www.meegreen.org/

**Climate Change Working Group** — https://envisionfrederickcounty.org/climate-change-working-group/

**Sierra Club Catoctin Group** — https://www.sierraclub.org/maryland/catoctin-group

**Smarter Growth Alliance for Frederick County** — https://smartergrowthfrederick.com/

### Suggested sources

**Common Energy:** https://www.commonenergy.us/

**Green Homes Challenge:** https://frederickgreenchallenge.org/

**Groundswell:** https://groundswell.org/about/

**Maryland State Nursery:** https://nursery.dnr.maryland.gov/default.asp

**Native Energy:** https://native.eco/product/carbon-offsets/

# 39 Climate actions for Frederick area businesses and institutions

A recent Deloitte Insights article encouraged businesses to change the way they approach business planning as it relates to climate change by viewing actions through a lens of long-term, sustainable profitability and value creation. From a cost perspective, sustainable solutions, which often combine mitigation and adaptation, are increasingly the least expensive option when both upfront and monthly operating costs are considered. Following initial investments, substantial cost savings are often experienced over the lifespan.

Beyond considering mitigation and adaptation impacts on the bottom line, an emerging trend is for businesses to recognize the value in climate stewardship at the community as well as global levels. **Responsibly addressing climate change will lead to a better future** — a resilient future with healthier children and adults, fewer lost school and work days caused by asthma and other climate-related diseases, and fewer extreme weather events than by continuing the status quo. A resilient and sustainable future seeks to address the staggering costs and equity issues for poor and minority communities and integrate sustainable solutions that lift up all communities, ensuring that future generations will have access to healthy food, clean water, and clean air. Without action, underserved communities are too often sacrificed: left with little fiscal flexibility, and often choosing between paying for rising utility bills, putting food on the table, or skipping needed medication.

What can businesses and institutions do? Even small actions can make a difference, so no business is too small to take steps to change the trajectory of the shared future for the better. And small steps add up to big results — just consider the lowly lightbulb. In 2017 alone, "the use of LEDs to illuminate buildings and outdoor spaces reduced the total carbon dioxide emissions of lighting by an estimated 570 million tons" according to LightED Magazine. LEDs compared to incandescent bulbs use about 80% less energy.

The Metropolitan Washington Council of Governments (MWCOG) estimates that 51% of the total greenhouse gas (GHG) emissions for Frederick County are from buildings and 42% from transportation. Reducing emissions from these two sectors is a priority. **Businesses can tackle this from two angles — by conserving energy and by purchasing from clean energy sources.**

## Buildings

Businesses have taken steps to conserve energy by using LED lighting, decreasing lighting at night, using smart thermostats, adding insulation to buildings, replacing or enhancing old windows, adopting cool roof technologies, and other "tighten the envelope" strategies. **Three online resources are useful for considering options:**

- Seek help from the Institute for Market Transformation. This Washington, D.C.-based non-profit helps businesses assess their energy uses and identifies ways to become more efficient.

- Participate in the Maryland Green Registry. This registry is free and provides tools and tips to increase energy efficiency and promotes a values-driven focus to customers. Participating businesses have reported $76 million in savings from adopting conservation and sustainability practices.

- A good way to understand opportunities for savings is by assessing a business's carbon footprint. This business carbon footprint calculator is designed for small business: https://coolcalifornia.arb.ca.gov/small-business.

Businesses (as well as individuals) can choose to purchase their energy from renewable sources. The City of Frederick just recently announced their decision to make this switch and many churches in the area also have used this option by calling 800-932-1569, or going to mycleanchoiceenergy.com/sun.

A few businesses in Frederick County have used the Commercial Property Assessed Clean Energy Loan (C-PACE) program, which provides commercial loans for businesses and nonprofits that want to invest in energy efficiency, renewables, and water conservation projects. As Joe Richardson, Commercial Property Owner of Bar-T Mountainside explains, "I see such benefit for other businesses to invest in green technology, green infrastructure, and *PACE really makes it possible*." Businesses are also making use of innovative financing options, such as Energy Service Agreements (ESAs), which can save utility costs from the beginning as long as the terms of the contract are well designed.

### Transportation

There is no doubt that changing the way of getting from one place to another, or whether travelling at all, will greatly impact the future climate. During the COVID-19 crisis, Frederick City's Office of Economic Development reports that 54% of all Frederick County households had at least one adult resident who telecommuted, improving air quality and reducing GHG emissions substantially. The strategies from this difficult year provide opportunities for the future. Experts are encouraging continued telecommuting and hosting meetings virtually whenever possible. When business needs mandate local travel, doing so during non-peak hours, or using navigational software and traffic alerts to avoid back-ups can reduce emissions by as much as 50%. And adopting a "no-idle" policy company-wide has multiple benefits of improving air quality, eliminating wasteful emissions, and saving vehicle engines from needless wear and tear.

Greening fleets is also a great strategy. Electric vehicles (EVs) are more affordable than ever and tax credits are still available at the state and federal level. EVs offer a better driving experience than combustion engine counterparts and fuel savings combined with little to no maintenance expense makes transitioning to an all-electric fleet a great business decision as well as a responsible choice.

Air travel contributes to climate change in multiple ways, including GHG emissions. When business needs call for air travel, think twice and consider train travel, which reduces GHG impact by about seven-fold. Or think about virtual meeting options. When that's just not possible, choose non-stop flights and consider purchasing a carbon offset. There are several options - Terrapass and Native Energy are just a few of the sources recommended.

### Other areas for consideration

Other GHG contributors are food waste and landscaping practices. According to Project Drawdown, about 40% of all food produced in the U.S. is wasted, contributing about 11% of U.S. greenhouse gas emissions. By focusing on reducing food waste and increasing composting on the consumer side, Frederick City and County can maximize reductions in GHGs from landfills and food production. One example where we are already seeing how this is possible is in a program called Lunch Out of Landfill (LOOL). LOOL has been launched in 13 Frederick County Schools and reducedfood waste by 70–80% during the 2019–20 school year, in the months before the COVID-19 pandemic lockdown (https://www.facebook.com/lunchoutoflandfills).

A growing number of local businesses are offering more plant-based food options. Not only are plant-based foods (veggies, fruits, grains, legumes, and nuts) healthy for humans, they are easier on the planet's resources than typically raised animal products by taking less land and water to grow *and* emitting far fewer GHGs to produce. Encouraging plant-rich diets by offering vegan and vegetarian entrees on restaurant menus and at events helps encourage residents and visitors to make better choices. And, for meat-based menu options, sourcing from local producers that use sustainable grazing practices eliminates transportation impacts and significantly reduces the carbon footprint of these products.

Altering local landscaping can also help. Businesses that own land can consider limiting or eliminating turf grass and non-native plants, improving soil's natural ability to draw carbon out of the atmosphere by as much as 75% and improving the landscape's ability to soak up stormwater. Businesses that make the transition from lawn to natural landscapes report as much as a 25% reduction in landscaping costs. The Chesapeake Conservation Landscaping Council offers resources for landowners.

## COMMUNITY

The best news about climate change is that the tools, technology, and knowledge to slow down and reverse the warming trajectory currently experienced are here and readily available. Multiple examples of tested and successful models are all around us. Collective action CAN reverse climate change, and making all business decisions by evaluating their impacts on climate change is a necessary part of the solution.

### Suggested Sources


**Deloitte Insights.** https://www2.deloitte.com/us/en/insights/topics/strategy/economic-impact-climate-change.html

**Native Energy.** https://native.eco/product/carbon-offsets/

**Terrapass.** https://terrapass.com/buy-carbon-offsets-2021

## 40 Charter a community–wide implementation team to support adoption of the recommended climate actions

The City and County governments will be tasked with implementing most of the recommendations described in this report. They will need support and cooperation from the community to act and be successful.

**A volunteer, community-based Climate Mobilization Implementation Team, known as Mobilize Frederick, should be developed for the following functions:**

- **Maintain a record** of the 37 climate actions recommended to City and County governments, as well as the Community Sector recommendations, **and track actions** and stated intentions for each, including budget allocations for action.
- **Meet quarterly to track and report** on progress related to each recommendation.
- **Communicate with stakeholders** when issues arise and help educate and problem solve to remove any questions or barriers to implementation.
- **Encourage stakeholder groups to "adopt" recommendations** in order to leverage existing expertise in the community to drive adoption and implementation.
- **Continually assist with outreach, communication, and expert advice** to members of the community and to both governments to promote adoption of recommendations.

To make their task easier, all records and reports from the CEMWG's year-long effort will be made available to them, and they will benefit from the CEMWG's website, FaceBook page, Instagram, and Twitter accounts, and their established presence and audience. As a community, we are in this together. Mobilize Frederick will consistently promote that message while helping to lead Frederick toward a climate resilient future.

**FOR MORE INFORMATION OR TO DOWNLOAD MORE COPIES OF THIS REPORT:**

**Frederick County, Maryland County Council web page:**

frederickcountymd.gov/8113/Climate-Change-Workgroup-Information

**Mobilize Frederick website:**

mobilizefrederick.org

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