CADMUS

Sustainability and Climate Action Plan – Opportunities for Action

CITY OF TAKOMA PARK

November 2019

Prepared for:

City of Takoma Park

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Executive Summary

The City of Takoma Park has demonstrated a long-term commitment to sustainability and acknowledges that communities around the world are in the midst of a climate-related emergency. From preparing one of the pioneering community greenhouse gas inventories under the ICLEI methodology in 2000 to determining pathways to sustainable energy in 2014, Takoma Park has played an active role in Maryland's 80% by 2050 and Montgomery County's 100% by 2035 GHG emissions reduction goals. The next phase of Takoma Park's climate planning offers an opportunity to integrate equity and resilience into greenhouse gas reduction strategies and the City's long-term trajectory towards the achievement of Maryland's 2050 emissions reduction target.

The development of a Sustainability and Climate Action Plan represents Takoma Park's next stage of planning, placing an emphasis on social equity and resilience. This Opportunities for Action Report provides a set of recommended priority actions that the City and the Takoma Park community can pursue for its Sustainability and Climate Action Plan. It will help inform a future, more detailed implementation roadmap to achieve Takoma Park's "Net Zero by 2035" goal, which will require a mix of local collaboration, regional coordination and advocacy for state-level action.

This report captures efforts oriented around three primary tasks: a greenhouse gas (GHG) inventory update, development of prioritized emissions reduction strategies, and climate preparedness and resilience considerations pertinent to Takoma Park. Stakeholder engagement was integrated throughout the process through a stakeholder workshop, a series of six focus groups, four outreach events, and an online survey completed by 219 participants.

A GHG inventory update for the year 2017 indicated that the City of Takoma Park produced 129,015 metric tons of CO_2 equivalent ($MTCO_2e$). On a per capita basis, this is lower than emissions for Montgomery County as a whole. Over half of Takoma Park's emissions were the result of stationary energy (i.e., electricity and natural gas) consumption, which was made the focus of the emissions strategy development. Takoma Park has also seen a reduction in overall residential energy use, indicating that initiatives proposed in the 2014 Sustainable Energy Action Plan, such as energy efficiency retrofits, have likely had some uptake. Conversely, natural gas usage has increased in the commercial sector and may be an area for future focus.

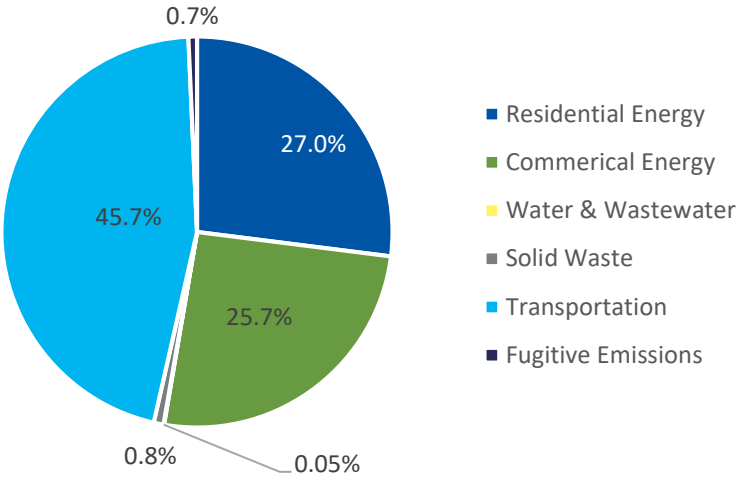

Figure ES 1. 2017 Greenhouse Gas Emissions Summary by Source

An initial list of 15 strategies was developed and shared with the community through various stakeholder engagement channels. These strategies were assessed and, in consultation with the City, eight strategies were selected for further evaluation:

- Renewable Thermal Community Outreach Campaigns
- Transit Accessibility and Outreach
- Residential Energy Assessments
- Commercial & Multifamily Energy Disclosure Ordinance
- Commercial & Multifamily Building Performance Requirements
- Community Choice Aggregation
- Natural Gas Elimination- New Residential Construction
- Virtual PPA Opportunities

Analysis of these eight strategies, presented in Table 4, included an evaluation of high and low mitigation potential, costs, and barriers to implementation. In the high mitigation scenario, 20% of Takoma Park's projected 2035 emissions will be mitigated by the priority strategies analyzed in this report. This results in an emissions reduction of 48% of 2017 levels in 2035. In the low mitigation scenario, 12% of the projected 2035 emissions will be mitigated by the priority strategies. This would result in an emissions reduction of 42% of the 2017 emissions levels.

The emissions reduction strategies presented and evaluated in this report indicate that there are a number of actions the City of Takoma Park can undertake to further reduce greenhouse gas emissions over the 2035 time horizon. The declaration of a climate emergency in March 2019 further highlights the expedience with which emissions must be reduced, and mandates development of a full implementation plan to specify the steps and timeline for meeting emissions reduction goals. The City of Takoma Park plans to move forward with development of an implementation plan. A comprehensive implementation plan should include:

- Comprehensive pathways for emissions reduction, which entail examination of sectors of the economy that will need to undergo a transformation to reach the 2035 targets and a map of how to achieve these goals.
- An examination of strategies where regional collaboration and state policy actions will create opportunities for further emissions reduction through 2050;
- Timeline for implementation and sequencing of tasks and actions;
- Outline of potential partners for each project component as well as key opportunities for the City to involve its residents in accelerating the implementation and uptake of climate action programs; and
- Estimated implementation costs and budgets.

Introduction

The City of Takoma Park has demonstrated a long-term commitment to sustainability, acknowledging that communities around the world are in the midst of a climate-related emergency. The City has consistently worked to be a leader on sustainability, preparing one of the pioneering community greenhouse gas inventories under the ICLEI methodology in 2000 and determining pathways to sustainable energy in 2014. Most recently, Takoma Park has made a commitment to play an active role in Maryland's 80% by 2050 and Montgomery County's 100% by 2035 GHG emissions reduction goals. Takoma Park seeks to engage with other like-minded communities, including serving as a member community of the Urban Sustainability Directors' Network (USDN) a signatory of the Global Covenant of Mayors (GCOM), and an active participant in other national and international organizations dedicated to addressing climate change via local efforts. In 2017, Takoma Park received the Sustainable Maryland Certified Award as a pioneer of sustainability actions in Maryland. Other historical actions associated with climate planning include:

- 2000 Local Action Plan for Climate Change
- 2010 Task Force on Environmental Action Final Report
- 2014 Sustainable Energy Action Plan
- 2019 Climate Emergency Declaration

However, to prevent debilitating climate impacts in the coming decades, communities, such as Takoma Park, must continue to aggressively pursue GHG reductions, sustainability objectives, and energy goals, particularly where these pursuits can alleviate social inequities and support climate resilience. The next phase of Takoma Park's climate planning offers an opportunity to integrate equity and resilience into greenhouse gas reduction strategies and the City's long-term trajectory towards the achievement of Maryland's 2050 emissions reduction target.

Purpose and Scope

The development of a Sustainability and Climate Action Plan represents Takoma Park's next stage of planning, placing an emphasis on social equity and resilience. This Opportunities for Action Report provides a set of recommended priority actions that the City and the Takoma Park community can pursue for its Sustainability and Climate Action Plan. It will help inform a future, more detailed implementation roadmap to achieve Takoma Park's "Net Zero by 2035" goal, which will require a mix of local collaboration, regional coordination and advocacy for state-level action.

Development Process

The development of this report took approximately seven months and included three primary elements, with stakeholder engagement emphasized throughout: a greenhouse gas inventory update, emissions reductions strategy prioritization and evaluation, and adaptation and resilience considerations. The process and timeline are illustrated in in Figure 1. A stakeholder mapping exercise was included as part of the project kickoff to aid the City in identifying key groups or stakeholders to include in the process. The kickoff also included a brief training on integrating equity considerations into the planning process.

Representatives from multiple City agencies (Public Works; Housing and Community Development; and Economic Development) participated in this meeting to ensure cohesiveness in the development process. The kickoff was followed by a presentation to the Committee on Environment to generate feedback on the proposed process and objectives.

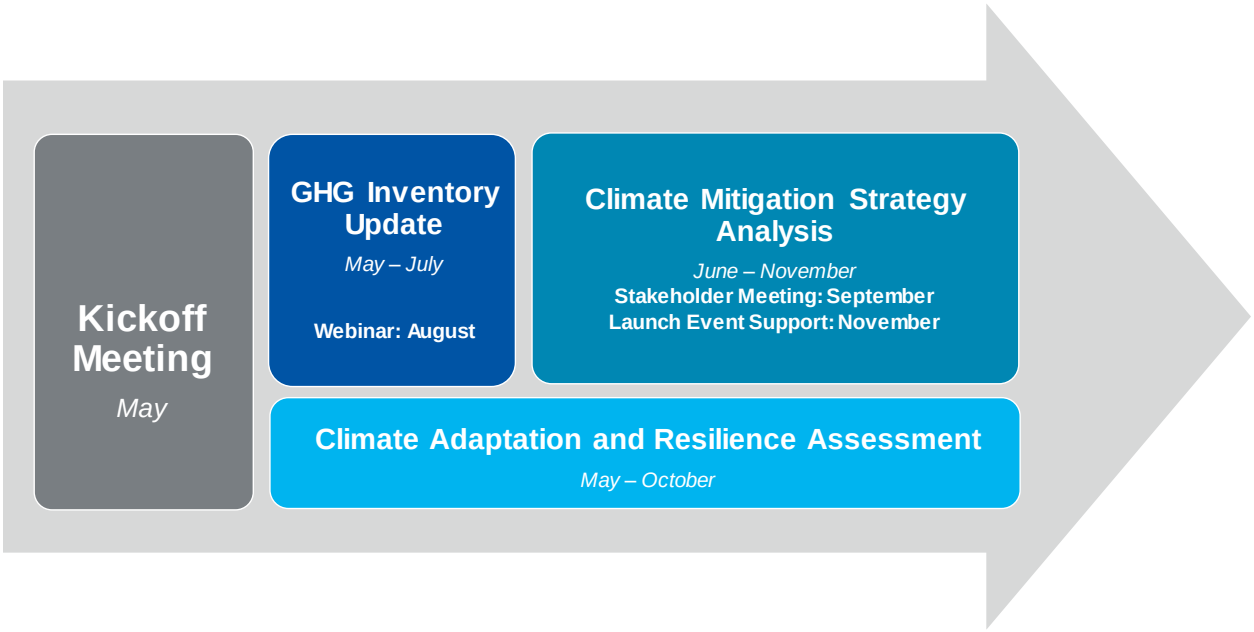

Figure 1. SCAP Opportunities for Action Report Development Tasks and Timeline

The greenhouse gas (GHG) inventory update provided an assessment of sources and the magnitude of GHG emissions from Takoma Park. The final inventory delivery was accompanied by a webinar for the Committee on Environment and other stakeholders invited by the City to review results and trends, and to provide initial reactions to policies that the City may wish to pursue.

Drawing upon the GHG inventory results and webinar feedback and informed by a wide range of successful strategies in comparable municipalities across the United States, a list of 15 potential emissions reduction strategies were developed and shared with the community via multiple avenues. In addition to a large community workshop, the City supplemented engagement through community focus groups, tabling at community events, and an online survey to collect feedback on which strategies the community would like to see prioritized. A subset of eight strategies were selected based on this feedback for further evaluation of GHG mitigation and associated costs.

Parallel to these tasks, climate adaptation and resilience considerations were explored. This included desk research and a series of key stakeholder interviews to identify climate stressors and trends affecting Takoma Park and examine critical climate vulnerability and equity considerations. Recommended strategies to improve climate resilience across the identified stressors were also developed, informed by stakeholder input as well as resources capturing best practices. Finally, climate preparedness and resilience co-benefits were identified across all potential emissions reduction strategies.

Greenhouse Gas Inventory

Greenhouse gases are gases in the atmosphere that absorb radiation and contribute to a warming effect. There are three primary greenhouse gases that are typically considered in greenhouse gas inventories: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These gases are produced by a range of typical industrial activities, the most notable of which is fossil fuel combustion from stationary energy sources (e.g., natural gas heating, electricity) or vehicles.

An updated GHG inventory is valuable as it illustrates the GHG emission sources as well as their corresponding fraction of total generated emissions. The update also enables the City to see impacts from strategies implemented from the 2014 Sustainable Energy Action Plan.

The GHG inventory update was conducted for calendar year 2017, as this was the most recent year for which complete data was available. The inventory is performed using broadly accepted methodologies developed by ICLEI, including the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (**GPC**) and U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (**Community Protocol**).

These methodologies are also used to align with Metropolitan Washington Council of Governments (MWCOG), which produces periodic GHG inventory updates for member communities (including Takoma Park). The methodologies are also selected to align with the Global Covenant of Mayors (GCOM), an organization created to serve cities and local governments by mobilizing and supporting climate and energy action in their communities by working with city and regional networks, national governments, and other partners. Over 9000 cities in 130 countries have signed on with GCOM to tackle emissions reduction, including Takoma Park.

Inventory Update

Greenhouse gas inventories capture emissions from stationary energy, transportation, and waste/water processing. A detailed methodology is included in Appendix A. The stationary energy evaluation divides emissions between residential and commercial buildings, where commercial buildings also include intuitional buildings (e.g., churches) and multifamily buildings of approximately four units or more. Within each of these sectors, there are three emission scopes, or boundaries within which emissions are generated. They are defined as follows:

- **Scope 1**: Occur **within city** boundary (e.g., natural gas combustion)
- **Scope 2**: Occur as a **result of use of grid-supplied electricity, heat, or cooling** within city (e.g., electricity generation)
- **Scope 3**: Occur **out of city** boundary as a result of in-city activities (e.g., landfill outside of city)

Overall GHG emissions for calendar year 2017 in the City of Takoma Park were **129,015 metric tons of CO_2 equivalent ($MTCO_2e$)**, which is **approximately 7.31 $MTCO_2e$ per person**. This is notably lower than the Montgomery County emissions per capita of 9.9 $MTCO_2e$. As illustrated in Figure 2, over half of the total emissions are attributed to stationary energy (building-related emissions). Another 46% comes

from on-road transportation. The remainder - waste and water treatment - are relatively minor contributors. Other emissions consist of fugitive emissions, particularly from natural gas distribution.

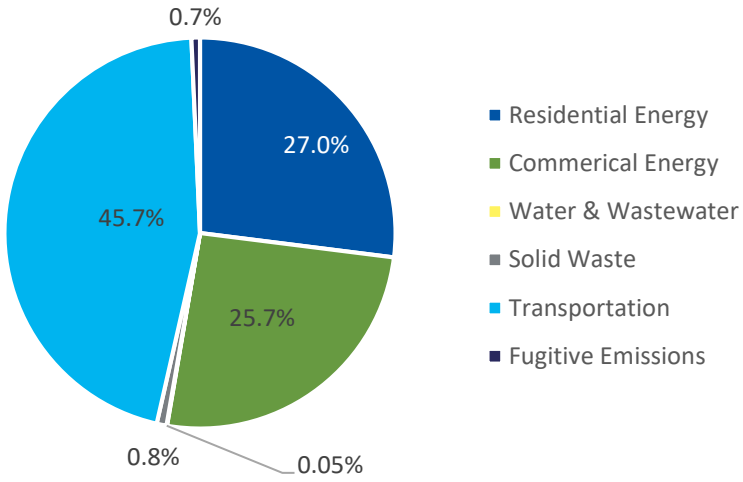

Figure 2. 2017 Greenhouse Gas Emissions Summary by Source

Within stationary energy, total residential and commercial emissions are nearly comparable, though the emission composition differs significantly. Natural gas emissions for the residential sector are over twice as high as those for the commercial sector, and emissions from electricity comprise about 70% of commercial sector emissions. The comparison of residential versus commercial emissions sources within the stationary energy sector is illustrated in Figure 3.

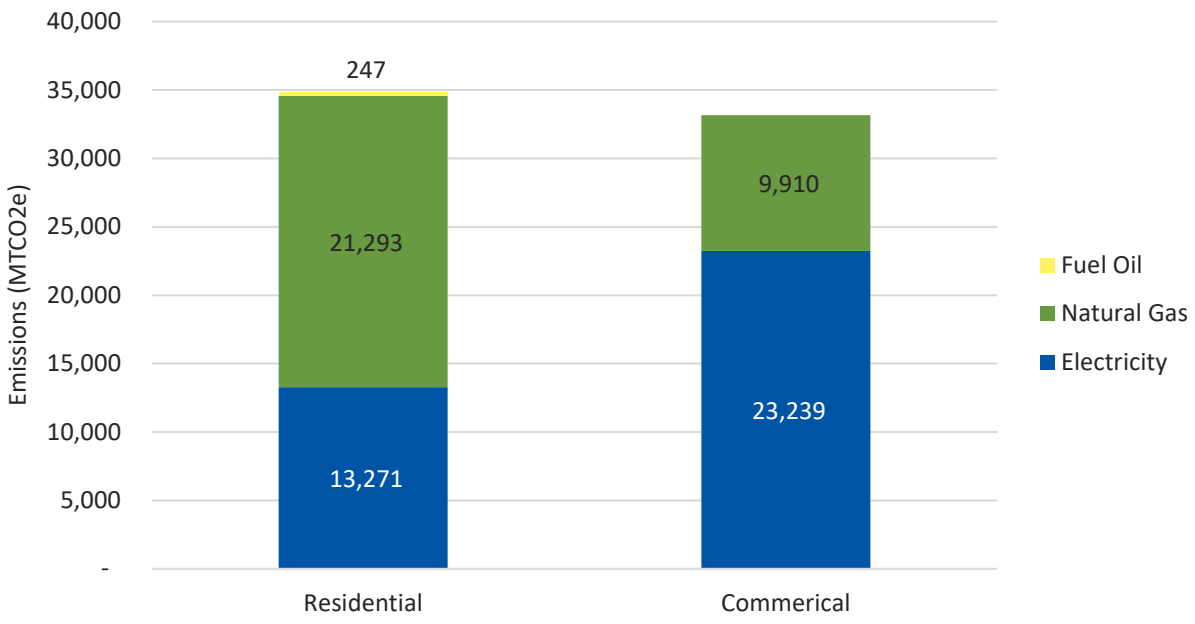

Figure 3. Stationary Emissions by Building Sector and Fuel Source

Trends Analysis

The updated 2017 inventory was compared to the 2012 and 2015 inventories developed by MWCOG, to maintain methodological consistency and comparable results. Figure 4 illustrates the breakdown of total emissions for 2012, 2015, and 2017 by source, with both total emissions and emissions per capita noted. Between 2012 and 2015, while total emissions increased, the emissions per capita stayed relatively constant. The results from the 2017 inventory indicate that gross emissions and emissions per capita have decreased.

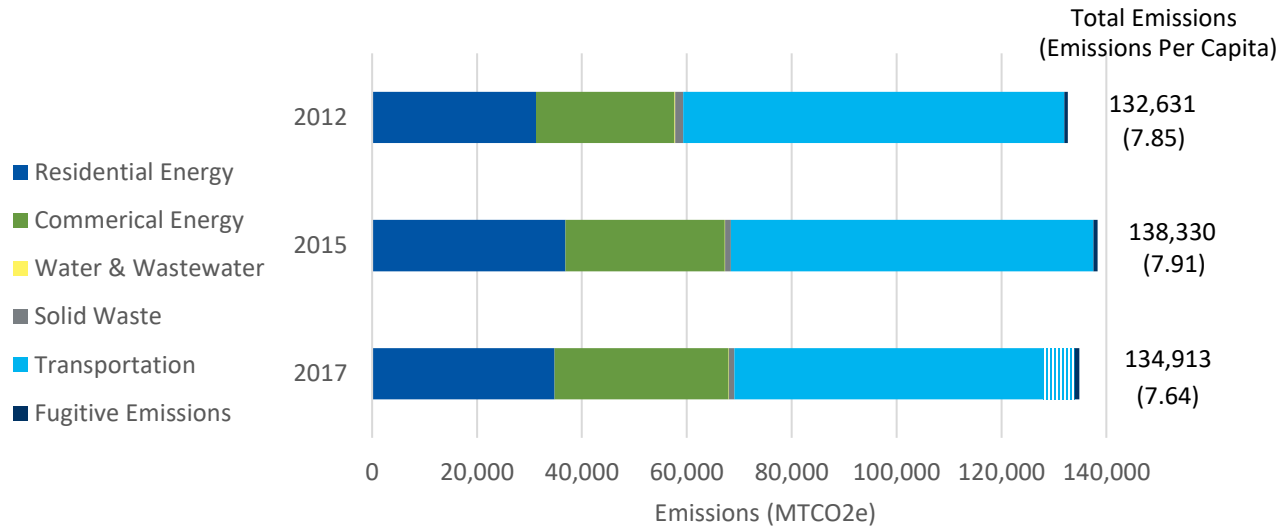

Figure 4. 2012 - 2017 Greenhouse Gas Emissions Composition

The shaded blue bar in the transportation section for 2017 is included to account for discrepancies in vehicle miles traveled (VMT) estimation methods. The method used in 2017 produced values 10% lower than the MWCOG values when applied to 2012 and 2015. To enable a better comparison, an additional 10% of transportation emissions were included in 2017, as indicated by the shaded bar. This figure illustrates a decrease in residential emissions as well as transportation.

Conclusions

Results from the updated inventory indicate that Takoma Park's emissions per capita are lower than those of Montgomery County as a whole, for which MWCOG reported 9.91 MTCO2e per capita in 2015. Stationary energy and transportation contribute 98.5% of Takoma Park's emissions, with on-road transportation contributing 46% of emissions. Waste emissions are modest contributors to Takoma Park's emissions.

Since 2012, the share of natural gas emissions to total stationary energy emission has grown and is attributed to the growth of natural gas use in the commercial sector. While the residential sector uses more natural gas than the commercial sector, commercial natural gas use has increased from 2015-2017, while residential natural gas use decreased from 2015-2017.

Takoma Park has also seen a reduction in overall residential energy use, indicating that initiatives proposed in the 2014 Sustainable Energy Action Plan, such as energy efficiency retrofits, have likely had some uptake. Conversely, natural gas usage has increased in the commercial sector and may be an area for future focus.

With respect to transportation, it can be more difficult to discern trends given the lack of granularity of available data. However, as VMT have increased and emissions decreased, adoption of emerging technologies and more fuel- efficient vehicles have counteracted VMT growth.

The GHG inventory results were shared during a webinar with the Committee on Environment to solicit initial reactions and feedback, as well as to provide initial considerations for emissions reductions strategies targeting high emissions sectors and sources. Given the results of the GHG inventory update, the strategies included in this report focus primarily on the stationary energy sector. Regional coordination for transportation emissions could produce further emissions reductions than those discussed in this report. A summary of the webinar discussions and outcomes is provided in Appendix B.

Emissions Reduction Strategies

The initial list of 15 emissions reduction strategies, captured in Table 1, was compiled from a variety of sources, including feedback received during the Takoma Park GHG Inventory Webinar, guidance from Takoma Park's sustainability team, and review of Cadmus' environmental actions database of strategies employed by other communities in the US. This database was filtered for communities with a similar regulatory context and governance structure to Takoma Park. The policies in this list focus largely on reducing natural gas consumption and promoting building efficiency, as these address two main sources for GHG emissions in Takoma Park. This list was also cross-checked with a list of actions already implemented or considered by Takoma Park from the Sustainable Energy Action Plan (2014), as provided by the City's Sustainability Manager. Any redundant policies were removed, and additional strategies from the region were also incorporated. Finally, the initial strategies list was amended to adapt or include new strategies in response to community interest and feedback. These new or amended strategies are italicized in the list captured in Table 1 below.

Embedding equity[1] is critical to the successful implementation of emissions reduction strategies, and is aligned with City Council Resolution 2017-28, through which the Council resolved to apply a racial equity lens in decision making This report focuses primarily on distributional and procedural equity (see definitions in box to the right). Equity considerations are an essential part of the analysis and have been described qualitatively rather than via a scoring mechanism. Quantitative values could not

What is Social Equity?

There are four key aspects of equity: procedural, distributional, structural, and transgenerational

Distributional Equity ensures programs result in a fair distribution of benefits and burdens across segments of the community

Procedural Equity ensures inclusive, accessible, and authentic engagement in program development

Structural Equity includes making decisions based on historical, cultural, and institutional dynamics

Transgenerational Equity involves decision-making that considers the burden on further generations

[1] USDN. 2018. A Guidebook on Equitable Clean Energy Program Design for Local Governments and Partners. As a member of USDN, Takoma Park has sought to adopt principles expressed by the organization. This report utilizes the USDN definition of equity, a widely accepted definition within this field. Should Takoma Park wish to develop their own definition, a stakeholder engagement process should be considered to develop a community-driven outcome.

easily be assigned to gauge the level of equity associated with a strategy, given that many strategies are not inherently equitable or inequitable; the level of equity largely depends on the means of implementation.

Strategies were assigned to one of four categories based on the means by which they achieve emissions reductions:

- **Maximize Efficiency**: Reduce the amount of energy required on-site by buildings
- **Utilize Renewables**: Ensure the energy used by buildings comes from renewable sources
- **Electrification Initiatives**: Shift fossil fuel generation to electricity, which can be generated by renewables
- **Other Demand Reductions**: Alternative pathways for reducing emissions and energy use

Takoma Park has many avenues to make strides in emissions reduction independently, but achieving net-zero emissions will require larger, systemic changes – particularly in relation to electricity generation. The proposed strategies list includes strategies that require coordination at the City and regional levels. Regional strategies include engaging in collaborative efforts with other communities or supporting county or state-level efforts with local benefits.

Table 1. Initial Emissions Reduction Strategies List

Category	Short Name	Description	Explanation and Examples	Social and Equity Context
Maximize Efficiency	Promote EmPOWER Maryland Offerings	Promote commercial and multifamily energy efficiency and gas programs available through the EmPOWER Maryland offerings with Pepco and Washington Gas	EmPOWER Maryland provides a range of incentives for residential and commercial energy customers. Promotion of programs would be designed to increase their uptake and ease of use by customers. Example Program: EmPOWER Maryland	Outreach should be targeted to commercial properties within Takoma Park, which currently have limited awareness or use of energy efficiency programs. This could include small or minority-owned businesses, multifamily affordable housing, larger houses of worship, and other organizations which provide critical services directly to residents. These types of facilities can use significant amounts of energy and may not already have been engaged in energy efficiency by other means. If buildings have their choice of vendors, they could select woman or minority-owned businesses to deliver services.
Maximize Efficiency	*Commercial & Multifamily Energy Disclosure Ordinance*	*Develop an energy use reporting requirement for commercial and multifamily (4+ unit) buildings in Takoma Park*	Commercial buildings over a specified square footage threshold would provide annual energy use data to the City, which will be made publicly available. Analysis of this data would be used to establish future requirements for GHG and/or energy use reduction for buildings, and energy disclosure would be used to verify buildings are meeting such requirements. Underperforming buildings could be targeted for retrofits to aid in meeting requirements. Example Program: City of Boston Building Energy Reporting and Disclosure Ordinance (BERDO)	Assuming multifamily housing is included, the disclosure ordinance can be used to help inform residents about where some of the highest-energy users in the community are and can inform comparisons of expected utility bills at given properties. The City would need to conduct outreach to ensure that all residents are comfortable reviewing disclosure data to inform their decision-making and that all property owners are comfortable with ENERGY STAR Portfolio Manager. As the County also uses ENERGY STAR Portfolio Manager for its reporting ordinance, the City could coordinate with County trainings, as Montgomery County has a related disclosure policy for large commercial buildings. Implementation must ensure that energy reporting does not place an undue burden on small businesses that have limited capacity for non-operations tasks.
Maximize Efficiency	*Commercial & Multifamily Building*	*Use information from energy disclosure reporting to establish performance requirements every 3-5 years*		Development should include a stakeholder engagement process with less-resourced building owners to ensure any requirements are feasible and will not pass undue costs to occupants.

Category	Short Name	Description	Explanation and Examples	Social and Equity Context
	Performance Requirements	*and target specific buildings for energy retrofits*		
Maximize Efficiency	Residential Energy Assessment	Require energy efficiency assessments for residential buildings at periodically and/or at time of sale, coupled with minimum upgrade requirements	Periodic energy assessments would evaluate lighting, water, HVAC, insulation, and other home features and identify aspects that could be improved. This will gradually upgrade existing housing stock and also save residents money on utility bills. Example Program: City of Berkley Building Energy Saving Ordinance (BESO)	Implementation must ensure that minimum upgrades can be completed in a cost-effective way, not placing undue cost on residents. Assessments should be paired with information on EmPOWER offerings, and potentially with green bank-provided credit enhancements and lower interest rate loans for income-qualified individuals where possible. Takoma Park could also consider providing informational resources to community members on energy education opportunities to foster a local workforce to provide the assessments. Implementation must also ensure that there are not unintended consequences of upgrades (e.g., air quality issues arising from tighter building envelopes without adequate ventilation; increased rent; and gentrification).
Maximize Efficiency	Promote Cogeneration	Encourage increased natural gas efficiency through use of cogeneration in large commercial buildings	Cogeneration, or combined heat and power (CHP) is the process by which a heat engine can generate both electricity and heat simultaneously. This increases energy efficiency for large facilities that use boilers to meet thermal loads. This strategy would promote existing grants to incentivize cogeneration installation. Example Program: Maryland Energy Administration CHP Grant Program	CHP and micro-CHP systems require facilities with continuous heating loads - this has traditional been hospitals and some large office buildings. There has been some success installing CHP systems in multifamily buildings in New York City. If Takoma Park considers this policy, it should consider all types of potential commercial users. Example Program: NYSERDA Multifamily CHP Installations
Electrification Initiatives	Renewable Thermal Community Outreach Campaigns	Launch of a "solarize" style campaign (community-based outreach and education program) for heat pumps/renewable thermal	Strategy entails developing marketing and outreach materials about heat pumps, holding informational sessions, and contracting with an installer to conduct assessments and installations for interested residents. The impact of bulk purchasing lowers the costs of	Takoma Park should work to integrate pathways for all residents to access the renewable thermal technologies through a Solarize-style campaign. This should include targeted education on the costs and benefits of the technologies. In addition, even with the bulk purchase discount, some of the technologies may still be out of

Category	Short Name	Description	Explanation and Examples	Social and Equity Context
		technology by the City of Takoma Park	investing in renewable thermal technologies for individual homes and businesses. Example Program: HeatSmart/CoolSmart Somerville	reach for some residents. Financing mechanisms, deferred payments and other options should be used to increase affordability for all residents. The City of Somerville recently developed an income-qualified pathway under their renewable thermal outreach campaign. The City should also conduct an analysis to ensure that heat pumps would not displace more affordable forms of heating or cooling. Ideally, heat pumps would be increasing occupant occupancy in situations with limited to no cooling or aging equipment. Example Program: HeatSmart/CoolSmart Somerville
Electrification Initiatives	Natural Gas Elimination - New Residential Construction	Pass ordinance preventing natural gas from being installed in new residential construction	This strategy would require all new residential construction to be fully electrified, including heating, cooling, and operation of appliances. Retrofits of the existing housing stock would largely be covered by renewable thermal campaigns to convert heating systems. Example Program: Berkeley Natural Gas Ban	The City should conduct an analysis to understand the economic impacts of natural gas alternatives in residential construction. There are often differences in incentives values in electricity versus heating assistance subsidy programs. Affordability considerations, waivers or assistance should be provided to families that may be financially challenged by the transition.
Electrification Initiatives	EV Charger-Ready Parking Requirements	Pass ordinance requiring new commercial and residential development to provide EV charger-ready street parking	New construction may not have the funding or developer interest to include EV charging stations at time of construction. However, ensuring development is EV charger-ready enables easier and more cost-effective installation at a later time. Example Program: Atlanta EV Ready Ordinance	Ordinances may make special consideration for multifamily affordable housing to ensure that requirements match development and financing timelines. It should be noted that EV infrastructure-related strategies only provide a benefit to the EV-owning subset of the Takoma Park population.
Electrification Initiatives	EV Charging Station Expansion	Coordinate with the Old Takoma Business Association (OTBA) to create a bulk purchase of EV charging stations to encourage workforce charging	Bulk purchase of EV charging stations enables a volume discount for charging infrastructure. Partnering with the Old Takoma Business Association (OTBA) would provide an opportunity for interested businesses to purchase chargers at a discount by aggregating	In addition to discounts associated with the group purchase, Takoma Park may wish to explore additional incentives for small, minority- or women-owned businesses in the community to more broadly implement EV charging. It should be noted that EV infrastructure-related strategies only provide a benefit

Category	Short Name	Description	Explanation and Examples	Social and Equity Context
			the demand. Presence of charging stations decreases barriers to EV adoption. Example Program: Northern Colorado EV Workplace Charging	to the EV-owning subset of the Takoma Park population.
Electrification Initiatives	Montgomery County Green Bank Electrification Programs	Encourage Montgomery County Green Bank (MCGB) to create financing or incentive programs for key technologies, such as heat pumps and EV charging	Green banks exist to accelerate the development of clean energy and implementation of energy efficiency measures by providing low-cost financing for applicable projects. MCGB is currently developing a homeowner program, and Takoma Park can help advocate for heat pump or EV related programs. Example Program: Connecticut Green Bank	To facilitate access to financing and increase affordability for all income-levels, green bank programs should consider credit enhancements and lower interest rates for income-qualified individuals where possible. In Massachusetts, for example, the Mass Solar Loan has special provision for low-to-moderate income consumers interested in pursuing solar PV. In addition to enhancements, the Green Bank and Takoma Park should work with community partners and local organizations to distribute information about any future available offerings. Electrification for heating for low-income residents should be approached with caution so that they do not replace more affordable forms of heating. Example Program: Mass Solar Loan
Utilize Renewables	Solar-Ready Construction Requirements	Require new commercial and multi-family construction in Takoma Park to be solar-ready or include renewable electricity generation as part of zoning ordinances	New construction may not have the funding or developer interest to include solar PV panels at time of construction. However, ensuring development is solar-ready enables easier and more cost-effective installation at a later time. Example Program: Tucson Solar Ready Ordinance	Ordinances may make special consideration for multifamily affordable housing to ensure that requirements match development and financing timelines. This may create challenges for small property owners, where solar readiness may impose additional costs, and grants to provide additional solar-ready infrastructure could be considered to mitigate such costs.
Utilize Renewables	Virtual Power Purchase Agreement (PPA) Opportunities	Explore Virtual Power Purchase Agreement (PPA) opportunities for municipal and commercial buildings, potentially in collaboration with other communities.	Virtual PPAs allow municipalities to purchase renewable electricity generated from offsite resources. Commercial businesses can also aggregate their demand and secure a virtual PPA as well. Takoma Park could explore a public-private virtual PPA, by aggregating both municipal and private electricity demands. This	For projects to be cost competitive, a large aggregation of power is needed. The City should evaluate aggregation feasibility and, if appropriate, include small- and minority-owned businesses in the City within in outreach, should procurement go beyond municipal facilities, to aggregate their energy usage and provide

Category	Short Name	Description	Explanation and Examples	Social and Equity Context
			would be among the first in the country. These large power purchase agreements can encourage the development of new solar farms within Maryland's electric grid to provide energy to municipal and commercial buildings in Takoma Park. Example Program: A Better City Virtual PPA	an opportunity for these businesses to receive renewable power.
Utilize Renewables	Community Choice Aggregation	Encourage Montgomery County/Maryland to pursue community choice aggregation (CCAs). A CCA would allow the City to procure power on behalf of residents and businesses, increasing purchasing power for renewable options. Electricity with a higher percentage of renewables than the current grid would be automatically available to residents and businesses through such a program.	This strategy requires Maryland to pass legislation allowing CCAs in the state. CCAs are currently allowed in other states, such as California, New York and Massachusetts, but not yet in Maryland. If legislation were to pass, Montgomery County would have to agree to county participation. Once available, the City would select an alternative power supplier and energy resource mix, leveraging the aggregated demand to secure lower rates and more renewable resources. Example Program: CleanPowerSF	The CCA should ideally provide power cleaner than the grid at a price cost-competitive with utility-provided electricity to maintain or reduce current energy burden in Takoma Park. If 100% renewable energy options are provided at a premium, these offerings would ideally be opt-in, with a clear articulation of the difference in price in tiers between consumers. For example, CleanPowerSF, San Francisco's CCA, provides a plain English explanation of the difference in costs per year between their standard and 100% clean energy option for business and homeowners. Residents also maintain energy discounts they were receiving from the investor-owned utility.
Other Demand Reductions	Carbon Impact Statements	Adding "carbon impact statements" to all major city policy decisions and projects to incorporate GHG reductions in city planning	The City would develop a checklist or series of criteria related to resulting GHG emissions against which City decisions must be evaluated. Projects such as land development or capital improvement plans would thus have GHG impact data associated with them, and climate change would be institutionalized in all City decision-making processes. Example Program: Austin Climate Plan	Implementation of carbon impact statements provides an opportunity to consider how policy decisions may impact emissions community wide. As part of the assessment, criteria may also wish to consider how implementation may affect low- to moderate-income residents, and evaluate who would be responsible for any emissions reduction and/or offset associated with the policies.

Category	Short Name	Description	Explanation and Examples	Social and Equity Context
Other Demand Reductions	Green Roof/Green Space Requirements	Require new commercial construction in Takoma Park to include cool roof, green roof, or water quality facilities exceeding current stormwater requirements. Green roofs are building roofs partially or completely covered by vegetation, while cool roofs are designed in a way to reflect back more sunlight and absorb less heat than standard roofs.	Increased development reduces permeable surfaces that capture and absorb runoff.; introducing permeable, plant-filled areas on top of buildings to mitigate runoff issues, reduce energy use, and combat the urban heat island effect. By reflecting sunlight, cool roofs also help reduce building energy demands and urban heat island effects. Example Program: Denver Building and Roof Permits	The City should ensure that new requirements would not introduce high cost increases or transactional barriers for affordable housing developers, non-profits, and other small property owners, which may be seeking to develop projects in the City. The City could consider directing a portion of its stormwater fee towards incentives for green roofs for qualifying properties.
Other Demand Reductions	Install Protected Bike Lanes	Promote bicycling within Takoma Park by making the city easily navigable by bicycle via installation of protected bike lanes and/or cycletracks, and making whole areas only accessible by bike or foot	Improved bike infrastructure, particularly infrastructure that includes protected bike lanes, makes cycling more accessible to a range of community members, as it provides an increased level of safety and comfort for cyclists and improves the convenience of biking. Increased bike use can result in decreased emissions from vehicle fuel combustion. Example Program: Montgomery County Bicycle Master Plan	To aid in the prioritization of bike lanes and cycletracks, the City should conduct an analysis of which segments of the community currently have limited access to protected bike or pedestrian ways.
Other Demand Reductions	*Targeted Tree Planting*	*Conduct strategic tree planting in areas of Takoma Park identified by the City as vulnerable to the urban heat island effect based on the presence of limited shade trees or green space.*	Tree planting would require a study on where additional trees could most strategically be placed to increase community wellness and mitigate heat island effects. A public-private partnership would enable the purchase and planting of trees. Example Program: Growing Boston Greener	Studies in Washington D.C. and Baltimore have indicated that the urban heat island impact is exacerbated in frontline communities. Communities of color and low-income communities are often disproportionately exposed to extreme heat and targeted tree plantings could provide relief to these locations. Example Program: Washington D.C. Heat Islands

Category	Short Name	Description	Explanation and Examples	Social and Equity Context
Other Demand Reductions	*Transit Accessibility and Outreach*	*Maintain and improve pedestrian and bike access on key routes to the Takoma Park Metro station and conduct targeted outreach in the community to encourage further use of public transit*	Improved access to the Takoma Park Metro station would increase ridership, accompanied by information on how to most effectively utilize transit options. Outreach campaigns by the City may consist of event-based outreach, distribution of informational materials, and car-free events. Example Program: Oregon Mosaic Outreach Campaign	Takoma Park could amplify City messages by working with community partners and organizations. These organizations can support messaging by conducting outreach at their own events. These organizations can also help survey community members to help understand why they may not be using existing transit options. Some barriers may be within the City's control to remove or address. The City should evaluate priority routes for pedestrian and bike access for Takoma Park residents, ensuring an array of routes are available to service as much of the community as possible efficiently and effectively. The City may also wish to consider improving routes that also include business districts, linking transit and businesses to encourage foot/bike traffic and increased economic development.

Strategy Feedback and Prioritization

The best actions for a community to take to reduce emissions are the result of their priorities. Thus, community feedback was critical to the development of these recommendations. Stakeholder input was used to gauge interest in the initial proposed strategies, collect feedback on the vision Takoma Park residents have for their community, and determine what aspects residents value most with respect to climate action (e.g., expedience, GHG reduction, cost-effectiveness, or equity). The outcomes from the stakeholder engagement described below were used in consultation with the City to develop a list of eight priority emissions reduction strategies for further analysis.

Stakeholder Engagement

The stakeholder engagement process associated with strategy prioritization included a workshop attended by over 50 community members, a series of six focus groups, in-person surveys during four separate tabling sessions at community events, and an online survey completed by 219 participants. Appendix B provides summaries and key outcomes across all stakeholder engagement activities. The workshop included a high-level presentation on the GHG inventory results, a description of the strategies for emissions reduction, and an opportunity for attendees to discuss strategies and provide their feedback in breakout groups. During the workshop, the community expressed interest in more aggressive actions, focused around solar and public transit.

For community members who could not attend the workshop, and for workshop attendees who wished to share additional feedback, the City distributed an online survey. According to the survey results, the most important strategy was to improve/build out biking infrastructure, and the most common write-in feedback was focused around increasing tree cover and improving public transit. In the focus groups and tabling surveys conducted by the City, Community Choice Aggregation was the top strategy highlighted, followed by improving biking infrastructure.

As a result of the stakeholder engagement process, two additional strategies were added for consideration in the prioritization process. These include Targeted Tree Planting and Transit Accessibility and Outreach. The Commercial and Multifamily Energy Disclosure Ordinance and Building Performance Requirements strategies were created by segmenting a single, initial strategy into these two separate, but interrelated strategies. These strategies are included in italics in Table 1.

Strategy Prioritization

Feedback received from the City, stakeholders and the broader community through these avenues was used to prioritize a subset of strategies for further investigation. All strategies were subjected to analysis using prioritization criteria, in collaboration with City staff. Each strategy was rated as advantageous, disadvantageous, or neutral for each criterion, in terms of impacts on the City, residents, and businesses. A rationale was provided with each rating, and the ratings were averaged for each strategy across all criteria to determine priority. Table 2 **Error! Reference source not found.**lists the strategy prioritization criteria designed to qualitatively evaluate strategy feasibility and impact. Additional details for ranking across criteria are provided in the rubric located in Appendix C.

Table 2. Strategy Prioritization Criteria

Category		Description
Feasibility	Community Interest	Level of support or opposition for the strategy by the City, general public, Committee on Environment, or other organizations, as well as anticipated utilization or uptake of associated programs offered by the City other entities
	Technical Feasibility	Extent to which a strategy is feasible in an appropriate timeframe considering potential technical or policy barriers
	Timeline	Consideration of both the expedience of initial implementation (<6 months to multi-year effort) and potential for delay
	Cost	Evaluation of both capital costs associated with the strategy, and potential for it to provide cost savings or introduce new revenue streams
Impacts	Equity Impacts	Degree to which the benefits of any strategy can reach many segments of the Takoma Park community, and degree to which any potential burdens can be minimized (Please note these results were presented above)
	Emissions Impacts	Degree to which the proposed strategy is expected to reduce greenhouse gas emissions for Takoma Park
	Climate Preparedness Benefits	Ability of the strategy to address climate change impacts specific to Takoma Park, including extreme heat, flooding, and severe storms (e.g. green roofs and green space can provide cooling and shelter from extreme heat as well as reduce energy usage in buildings)

Climate Preparedness and Resilience Co-Benefits

In addition to reducing emissions, preparing for climate change also means that communities across the country must understand their future climate risks. As part of this report, recommendations were provided to increase Takoma Park's climate preparedness. Recommended adaptation and resilience strategies are listed in Appendix D. The study also analyzed how the emissions reductions actions could

also support climate preparedness and community resiliency.[2] The community's primary climate stressors include extreme heat, flooding, and storms, with drought arising as a secondary concern.[3]

Extreme Heat

Across the State of Maryland, summertime extreme heat events have more than doubled between 1980-2000 when compared to 1960-1970. Some neighborhoods experience heatwaves more acutely than others due in part to the urban heat island effect (UHIE), which may increase temperatures by 2-10 degrees Fahrenheit relative to more vegetative areas. UHIE is the result of heat absorption by dark rooftops and pavement, heat emitted by buildings and vehicles, reduced airflow and low vegetation cover (i.e., limited shading), all of which can be exacerbated by surrounding urban areas.[4] The significant tree canopy across much of Takoma Park and the concerted efforts to maintain tree coverage can have a significant impact on mitigating the UHIE in particular areas. Temperatures across Maryland are rising and expected to increase by 2 degrees Fahrenheit by 2025 (from a 1998 baseline).[5] If population growth or increasing development in Takoma Park result in additional pavement and/or vehicles, the heat island effect across the city could intensify and expand in spatial extent.

Flooding

The City of Takoma Park has been impacted by numerous flood events, mostly due to flash flooding from sudden and brief extreme precipitation and stormwater management issues.[6] Across Montgomery County, the region has been impacted by 234 flood events between 1964 and 2018. The area as a whole experienced a slight increase in average annual precipitation between 1950 and 2008, and high-intensity precipitation events have been growing in intensity.[7] Flood risks are expected to increase, particularly if

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[2] This summary is an excerpted version of a more detailed Resilience and Adaptation Memo provided to the City of Takoma Park.

[3] While winter storms are a key concern for Takoma Park and the region, they are not included in this discussion given that climate change projections for the region indicate increased likelihood of mild winters and reduced winter weather impacts (Maryland Commission on Climate Change 2018 and MWCOG 2013). Considerations around projections for increased overall precipitation in the winter can be addressed through the storm and flooding risks discussed below. The 2018 Montgomery County Hazard Mitigation Plan includes valuable information on mitigating current winter storm risks.

[4] State of Maryland. (2011). Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change – Phase II: Building societal, economic, and ecological resilience. Retrieved from https://climatechange.maryland.gov/wp-content/uploads/sites/16/2014/12/ian_report_2991.pdf

[5] State of Maryland (2011)

[6] City of Takoma Park. (2009). City of Takoma Park Flood Mitigation Plan. Retrieved from https://s3.amazonaws.com/publicworks-takomapark/public/stormwater/city-of-takoma-park-flood-mitigation-plan.pdf

[7] Metropolitan Washington Council of Governments (MWCOG). (2013). Summary of Potential Climate Change Impacts, Vulnerabilities, and Adaptation Strategies in the Metropolitan Washington Region: A synopsis of lessons learned from the Metropolitan Washington Council of Government's climate adaptation planning

precipitation continues to fall with greater intensity and duration, as is projected, regardless of changes in high-precipitation event frequency. These changes can increase flood risks both from overbank flooding, caused by the volume of water exceeding a river's capacity (particularly along Sligo Creek), and urban drainage flooding, caused by water exceeding a storm sewer's capacity.

Storms

High wind speeds can impact infrastructure, particularly communications and utilities. Damages from thunderstorms, hurricanes, lightning, hail, wind, and tornados combined cost the Metropolitan Washington region overall an average of $14 million annually.[8] Takoma Park and the region are anticipated to continue to regularly experience thunderstorms between early spring and late autumn, the intensity of which is expected to increase due climate change. These storms can be associated with flash floods, tornadoes, downbursts and derechos and can generate debris, causing damage and requiring cleanup with costs in the millions. While the frequency of high-wind events is not generally expected to increase, the intensity of associated rainfall is projected to increase in a warming climate.[9]

Drought

While drought has not historically been a significant stressor for Takoma Park with respect to either observed climatological conditions or social and economic impact, drought conditions can negatively impact the city's residential and community gardens and also require increased watering to sustain municipally-managed trees. The latter issue could divert staff time and resources from the Public Works Department.[10] Projected increases in temperatures, particularly during summer months, combined with changing rainfall patterns are likely to increase drought intensity and/or during across the region.[11]

Climate Vulnerability Considerations

In seeking to understand and address climate risks across Takoma Park, it is critical to consider the role of equity in shaping vulnerability and resilience to climate stressors. In particular, the City is encouraged to pay special attention to the following communities: elders/senior citizens, children, those with fragile health, homeless individuals, renters, low (and middle)-income individuals, and those with limited English proficiency.[12] These frontline communities are likely to be affected first and worst by climate change, and many are less able to prepare for, adapt to, and bounce back from climate impacts. Some specific considerations are highlighted below.

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initiatives from 2010-2012. Retrieved from https://www.mwcog.org/asset.aspx?id=pub-documents/pl5cXls20130701111432.pdf

[8] MWCOG (2013)

[9] Maryland Commission on Climate Change. (2018). 2018 Annual Report. Retrieved from https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Documents/MCCC_2018_final.pdf

[10] Interview with Pamela Sparr, Environmental and Climate Justice Consultant. October 10, 2019.

[11] Maryland Commission on Climate Change. (2018).

[12] Interview with Pamela Sparr, Environmental and Climate Justice Consultant. October 10, 2019.

- Many residential properties across Takoma Park experience some degree of flooding or other climate-related impact. While approximately 50 percent of Takoma Park residents are renters, affordable housing is not equally distributed through the City. Climate change threatens to increase housing costs for many Takoma Park households, disproportionately impacting low- to moderate-income families, and those who spend a high percentage of monthly income on housing expenses.
- Climate-related extreme events could increasingly impact small businesses in Takoma Park. The primary climate-related stressor affecting the small businesses within the Old Takoma Business Associated is power loss associated with storms.
- Extreme heat is the leading cause of weather-related illnesses and fatalities within the Metropolitan Washington Council of Governments area. Populations at increased risk from extreme heat events include those who rely on public transportation (particularly given the lack of covered structures), children and others with underlying health concerns and sensitivity to heat, and homeless individuals. While not historically an identified priority concern among seniors in the three agree-segregated rental buildings in Takoma Park or among over-housed seniors who are aging in place and facing significant economic challenges, heat and other climate-related stressors could become a more significant threat in the future.

Climate Preparedness and Resilience Co-Benefits Across Strategies

As noted in Table 2, climate preparedness and resilience co-benefits were one of the principal criteria used in prioritization of the GHG mitigation strategies. Table 3 captures the co-benefits across all initial proposed strategies.

Table 3. Climate Preparedness and Resilience Co-Benefits Across Strategies

Strategy	Climate Preparedness and Resilience Co-Benefits
Promote EmPOWER Maryland Offerings	This strategy could have notable benefits to climate preparedness and resilience by supporting energy efficiency measures that enable buildings to maintain more habitable temperatures during extreme weather events or power outages.
Commercial & Multifamily Energy Disclosure Ordinance	This strategy could be somewhat beneficial to climate preparedness and resilience by indirectly helping improve the durability of residences and their ability to withstand extreme weather (particularly extreme heat events) more efficiently. Programs like LEED, a high-performance building standard, are exploring ways to use energy efficiency to encourage passive survivability, a term which means that a building can maintain a habitable temperature for occupants in the event of a power outage.
Commercial & Multifamily Building Performance Requirements	This strategy could be somewhat beneficial to climate preparedness and resilience by indirectly helping improve the durability of residences and their ability to withstand extreme weather (particularly extreme heat events) more efficiently. These benefits could be strengthened if the requirements have a more direct impact on improvements, including if the standards are paired with targeted improvement incentives.

Residential Energy Assessment	This strategy could be somewhat beneficial to climate preparedness and resilience by indirectly helping improve the durability of residences and their ability to withstand extreme weather (particularly extreme heat events) more efficiently. It is possible that residential energy assessments could be combined with resiliency audits, which identify pathways for homes to adapt to flooding. Washington D.C. is exploring this through their multifamily energy and resilience audit tool.
Promote Cogeneration	This strategy may have limited benefit to climate preparedness and resilience through reducing electrical grid demand and potentially lowering household utility costs. CHP can also be a back-up power source, if it is enabled to operate independently from the grid in the event of a power outage or emergency. This capability is called islanding. Montgomery County's Public Safety Headquarters Microgrid demonstrates this capability.
Renewable Thermal Community Outreach Campaigns	This strategy could be somewhat beneficial to climate preparedness and resilience, particularly in cases where heat pumps are added to buildings with no central A/C or limited cooling capability; the heat pumps can help offset the impacts of extreme heat events. Any heat pumps must have access to back-up power to provide support during a power outage.
Natural Gas Elimination - New Residential Construction	This strategy has the potential to provide benefits for climate preparedness and resilience. If homes pursue on-site distributed energy and battery back-up storage as part of new construction projects, this may improve individual home resilience to extreme events. However, the elimination of natural gas also has tradeoffs as all power for homes will come from the electric sector as opposed to having a diversity of fuel sources.
EV Charger-Ready Parking Requirements	This strategy may have limited indirect benefit to climate resilience by improving air quality due to decreased emissions of GHGs and other pollutants; this could reduce the impact of extreme heat events on individuals with lung diseases and other health concerns.
EV Charging Station Expansion	This strategy may have limited indirect benefit to climate preparedness and resilience by improving air quality due to decreased emissions of GHGs and other pollutants; this could reduce the impact of extreme heat events on individuals with lung diseases and other health concerns.
Montgomery County Green Bank Electrification Programs	This strategy may have limited indirect benefit to climate preparedness and resilience by improving air quality due to decreased emissions of GHGs and other pollutants; this could reduce the impact of extreme heat events on individuals with lung diseases and other health concerns.
Solar-Ready Construction Requirements	This strategy may have limited benefit to climate preparedness and resilience through reducing electrical grid demand and potentially lowering household utility costs.
Virtual Power Purchase Agreement (PPA) Opportunities	This strategy may have limited benefit to climate preparedness and resilience through reducing electrical grid demand and potentially lowering household utility costs.
Community Choice Aggregation	This strategy may have limited benefit to climate preparedness and resilience through reducing electrical grid demand and potentially lowering household utility costs.

Carbon Impact Statements	This strategy has limited direct benefit to climate preparedness and resilience, but could be extended to also consider resiliency or climate preparedness impacts of city policy decisions. For example, the City of Boston provides a climate resilience checklist alongside green building and sustainability projects, for all new development within the City. While this is not for internal projects, the process is still valuable for keeping climate change in discussions and conversations.
Green Roof/Green Space Requirements	This strategy could have benefits to climate preparedness and resilience by improving stormwater management and reducing the impacts of extreme heat in targeted areas. While individual buildings introduce relatively small benefits, broad implementation is a viable way to manage flood impacts in communities.
Install Protected Bike Lanes	This strategy may have limited indirect benefit to climate preparedness and resilience by improving air quality due to decreased emissions of GHGs and other pollutants, if increased bike usage were to result in decreased car usage; this could reduce the impact of extreme heat events on individuals with lung diseases and other health concerns.
Targeted Tree Planting	This strategy could have benefits to climate preparedness and resilience by improving stormwater management, mitigating extreme heat impacts, and increasing green space.
Transit Accessibility and Outreach	This strategy may have limited indirect benefit to climate preparedness and resilience by improving air quality due to decreased emissions of GHGs and other pollutants, if increased transit usage were to result in decreased car usage; this could reduce the impact of extreme heat events on individuals with lung diseases and other health concerns. Transit accessibility actions can also be paired with improvements (e.g., shaded bus stations) that reduce climate vulnerability. Note that increased transit traffic in some areas could decrease overall air quality.

Prioritized Strategies and Evaluation

The list of all strategies and accompanying priority determinations were shared with the City for review. In consultation with the City, eight strategies, as defined in Table 1, were selected for further investigation:

- Renewable Thermal Community Outreach Campaigns
- Transit Accessibility and Outreach
- Residential Energy Assessment
- Commercial & Multifamily Energy Disclosure Ordinance
- Commercial & Multifamily Building Performance Requirements
- Community Choice Aggregation
- Natural Gas Elimination- New Residential Construction
- Virtual PPA Opportunities

Though the community expressed much interest in the Targeted Tree Planting strategy added as a result of stakeholder discussion, it ultimately was not included as a prioritized strategy. The City is considering adopting a tree canopy goal and enhancing tree planting programs, thus, inclusion in this report would be duplicative.

Strategy evaluation entailed considering, at a high level, the way in which programs could be implemented in Takoma Park and the emissions reduction potential associated with such scenarios. Research drew upon available data for Takoma Park, as well as outcomes from similar programs in other jurisdictions. Table 4 includes the list of final strategies, accompanied by their associated GHG reduction potential, costs, and barriers to implementation. Cost data primarily refers to the cost facing the City to implement the strategies, before any grants or other funding sources are applied. Instances where costs are borne by other parties are specified in the table entries. Additional information on data sources and assumptions (including for cost estimates) associated with each strategy are included in Appendix E.

Table 4. Prioritized Strategies Evaluation Summary[13]

Strategy	Action Level	Assumptions	Level of GHG Reduction	Costs	Challenges & Opportunities
Renewable Thermal Community Outreach Campaigns	City	High GHG mitigation potential assumes electricity is supplied by renewable energy, while the low GHG mitigation potential assumes existing grid conditions. The assumed adoption rate was based on Takoma Park's 2015 Solarize Campaign, and subsequent campaigns are assumed to decrease in efficacy over time.	Eliminate 100 - 390 $MTCO_2e$ in 2035	$8,500 - $10,000 per year to conduct campaign, including development of outreach materials and volunteer support	Challenges: At current electric rates, air source heat pumps are generally not cost-effective compared to natural gas heating, as electricity costs more per MMBTU than natural gas, even at a coefficient of performance (COP) of 2-3. Opportunities: Offer incentives in conjunction with outreach and target residents with electric resistance heating in addition to natural gas, as the cost advantage of heat pumps over electric resistance heating is clear.
Transit Accessibility and Outreach	City	Scales values of 1.5 - 2% GHG reduction from the Montgomery County Bicycle Master Plan to Takoma Park	Eliminate 280 - 590 $MTCO_2e$ in 2035	$20,000 per mile to construct protected bike lanes; $10,000 per year in outreach activities to promote public transit and cycling	Challenges: Space constraints can pose an issue for installation of protected lanes, and may require acquisition of private easements. This strategy may face opposition if it interferes with parking availability. Opportunities: Takoma Park should consult with community members on the optimal design and placement of lanes.

[13] See Appendix E for additional information on costs, data sources, and assumptions.

Strategy	Action Level	Assumptions	Level of GHG Reduction	Costs	Challenges & Opportunities
Residential Energy Assessment	City	High GHG mitigation potential reflects average GHG reduction per install from Mass Save, low GHG mitigation potential reflects 50% of high savings	Eliminate 780 - 1,600 $MTCO_2e$ in 2035	$75,000 in startup costs (e.g., program development, training, and data tracking system), $50,000 in ongoing operational costs to perform outreach and ensure compliance. 0.25 full-time equivalent (FTE) to manage program. $200 - 300 cost per assessment for homeowners may be offset by EmPOWER Maryland offerings	Challenges: If implemented at time of sale, implementation will be gradual as home turnover is not frequent. This would then present a barrier in accessing homes of long-term residents who do not plan to sell in the near-term. Costs to homeowners depending on available incentives may also pose a barrier. Opportunities: Provide incentives to cover the cost of the home energy assessments and consider an implementation route in addition to time of sale (e.g., assessments required every 10 years).
Commercial & Multifamily Energy Disclosure Ordinance	City	Applied to buildings over 10,000 square feet. High GHG mitigation potential assumes 2% energy use reduction per year, low GHG mitigation potential assumes 1.5% reduction per year	Eliminate an additional 960 - 1,100 $MTCO_2e$ in 2035	$150,000 in start-up costs, $75,000 in ongoing operational costs for monitoring and data review, with a 1 FTE staffing requirement. Covered buildings can anticipate a 3% savings on energy bills for a community-wide total of approximately $170,000 per year.	Challenges: An ordinance may face opposition from business community, and there will be a need for education and outreach to businesses on how to report. Opportunities: Incorporate a marketing campaign to illustrate the energy savings that have been associated with disclosure ordinances and to generate support from the business community.

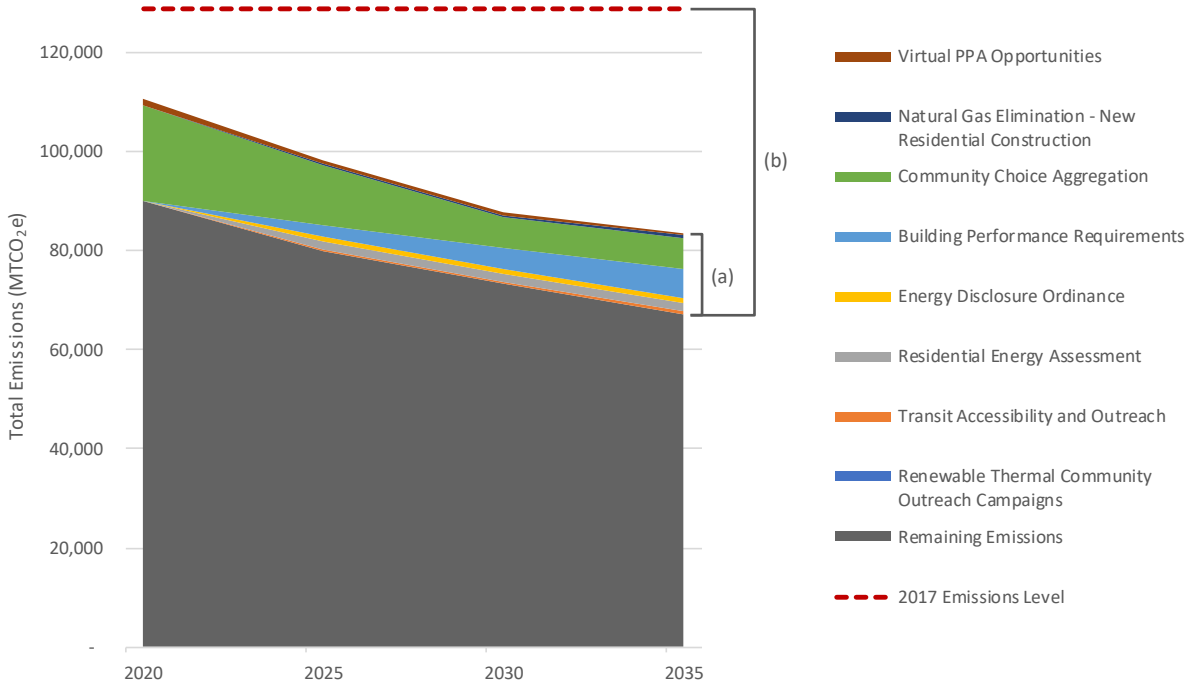
Strategy	Action Level	Assumptions	Level of GHG Reduction	Costs	Challenges & Opportunities
Commercial & Multifamily Building Performance Requirements	City	Applies to buildings over 10,000 square feet. The high GHG mitigation potential assumes 15% EUI reduction requirement in buildings every 5 years, while the low GHG mitigation potential scenario assumes requirement for retrocommissioning every 10 years.	Eliminate an additional 2,200 - 6,000 $MTCO_2e$ in 2035	Ongoing 0.5 - 1 FTE dedicated to performance requirements (data review, compliance, implementation). This represents City staff time to administer the program and is not inclusive of any upgrade costs to meet stated requirements.	Challenges: Requirements may face opposition from business community. Additional savings over time may diminish as initial retrofits are implemented. Opportunities: Incorporate a stakeholder engagement process to include the business community in setting of requirements to ensure community buy-in.
Community Choice Aggregation	Region	Assumes program is configured as an "opt-out" program. High GHG mitigation assumes 95% participation and low GHG mitigation potential assumes 85% participation.	Eliminate 5,500 to 6,200 $MTCO_2e$ in 2035	0.5 FTE to issue and process an RFP to procure an electricity supplier. Electric customers would pay $0.011 - 0.038 per kWh above current Pepco rates, based on electricity generation mix.	Challenges: State-level legislation must be passed to enable CCAs. CCAs introduce a need for technical and legal expertise at the city-level needed to implement a program. There may also be uncertainty in electricity rates associated with a CCA. Opportunities: Takoma Park could explore coordination with Montgomery County, which has publicly expressed support for CCAs.
Natural Gas Elimination - New Residential Construction	City	High GHG mitigation potential assumes electricity is supplied by renewable energy, while the low GHG mitigation potential assumes existing grid conditions.	Eliminate 320 - 790 $MTCO_2e$ in 2035	Installation of electric appliances by homeowners will cost as much as 50% less than gas appliances upfront, however, operational costs for electric appliances could be up to 3x more than gas.	Challenges: Strategy may face opposition from developers, utilities, and/or homeowners who prefer natural gas to remain an option. New construction represents a small subset of total building stock, minimizing the impact from this strategy. Opportunities: Provide incentives for retrofit pathway; consider

Strategy	Action Level	Assumptions	Level of GHG Reduction	Costs	Challenges & Opportunities
					property tax incentives for properties without natural gas supply.
Virtual PPA Opportunities	Region	High GHG mitigation assumes all municipal electricity + 10% of commercial electricity is provided via virtual PPA, low GHG mitigation assumes only municipal electricity is provided by virtual PPA,	Eliminate 30 - 370 $MTCO_2e$ in 2035	0.5 FTE to develop and issue and RFP for a developer. The levelized cost of electricity via solar PPA is $0.0322/kWh, creating an opportunity for electricity savings for electric customers depending on degree of developer markup for electricity.	Challenges: There is risk associated with price fluctuations and the City will need for advisor support to ensure acceptable developer performance. Opportunities: The City can seek technical assistance and explore best practices through organizations such as the Urban Sustainability Directors Network, the Renewable Energy Buyers Alliance and a collaborative of nineteen communities exploring large-scale PPAs.

Accompanying the summary of prioritized strategies is an emissions wedge analysis. Each strategy is represented as a "wedge" or section of emissions reduction between 2020 and 2035. This assessment is included to illustrate the potential for each strategy to reduce GHG emissions by 2035, as well as the combined potential of the eight strategies.

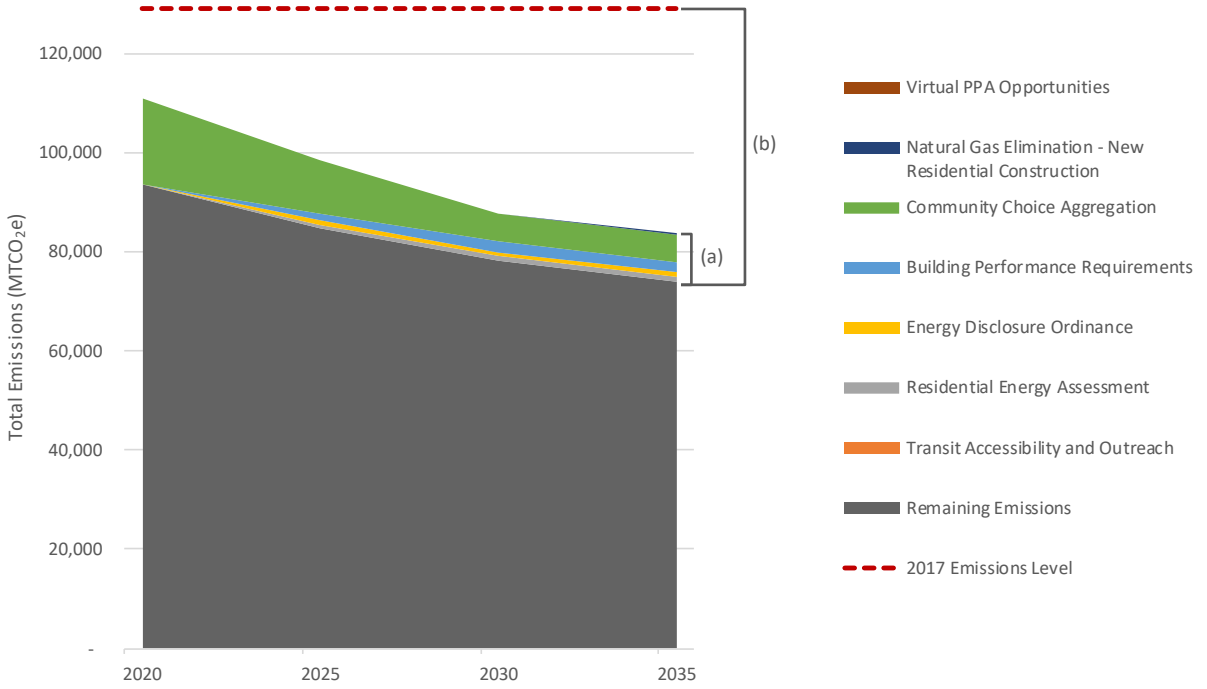
The analysis is bounded by a high GHG mitigation scenario and a low GHG mitigation scenario. The former assumes higher or more optimistic adoption and effectiveness of the selected strategies based on desk research and precedents from other communities, while the latter assumes a more conservative level of adoption or effectiveness of the selected strategies. Both cases assume Maryland meets the renewable portfolio standard (RPS) targets of 50% renewable energy by 2035, as outlined in legislation.

Figure 5 and Figure 6 illustrate the emissions reduction potential of the high GHG mitigation scenario and low GHG mitigation scenario, respectively. The 2017 emissions baseline is included in the figures as the red dashed line. The sum of the wedges in each figure adds up to the emissions projection for 2035. This projection accounts for no additional action by Takoma Park, but assumes the State of Maryland meets its stated RPS targets, thus reducing electricity emissions. In the high GHG mitigation scenario (Figure 5), 20% of the projected 2035 emissions will be mitigated by the priority strategies analyzed in this report, denoted as (a). This results in an emissions reduction of 48% of 2017 levels in 2035, denoted as (b). In the low GHG mitigation scenario (Figure 6), 12% of the projected 2035 emissions will be mitigated by the priority strategies in this report, denoted as (a). This results in an emissions reduction of 42% of the 2017 emissions levels, denoted as (b).



(a) denotes the emissions projected for 2035 that could be mitigated by the analyzed strategies
(b) denotes the total emissions reduction from 2017 levels that could be achieved by the analyzed strategies

Figure 5. High GHG Mitigation Potential Wedge Analysis.



(a) denotes the emissions projected for 2035 that could be mitigated by the analyzed strategies
(b) denotes the total emissions reduction from 2017 levels that could be achieved by the analyzed strategies

Figure 6. Low GHG Mitigation Potential Wedge Analysis

In the figures, remaining emissions represent the difference between estimated emissions reduction from the 8 represented strategies and the estimated emissions in a given year. Community choice aggregation provides the greatest opportunity for emissions reduction of all the strategies examined. Residential energy assessments, commercial and multifamily building performance requirements, and an energy disclosure ordinance for commercial and multifamily buildings also offer notable reductions. It should be noted that as the electric grid becomes less carbon intensive due to the implementation of the Maryland RPS, the amount of emissions reduction attributed directly to these strategies decreases. This is because there are fewer emissions to mitigate from the inherent presence of renewables in the standard electricity mix.

As these strategies are largely oriented around stationary energy, deeper emissions reductions would require additional focus on transportation, likely needing to be approached at the regional level to develop strategies oriented around robust public transit or low-emission vehicles. Within its jurisdiction, the City may also be able to promote transit-oriented development to encourage greater transportation mode shifts.

Conclusion

The emissions reduction strategies presented and evaluated in this report indicate that there are a number of actions the City of Takoma Park can undertake to further reduce greenhouse gas emissions

over the 2035 time horizon. The declaration of a climate emergency in March 2019 further highlights the expedience with which emissions must be reduced, and mandates development of a full implementation plan to specify the steps and timeline for meeting emissions reduction goals. The City of Takoma Park plans to move forward with development of an implementation plan. It is recommended that the implementation plan and climate action activities be overseen by the Committee on Environment or another body representative of the residents, businesses and key stakeholders In the Takoma Park community. The Committee would serve to guide the development of an in-depth report and facilitate additional stakeholder engagement throughout this process. The process should continue to engage with the broader community, ensuring equity and inclusiveness and taking care to reach historically underrepresented groups such as low to moderate income residents, non-English speaking communities, and communities of color. A comprehensive implementation plan should include:

- Comprehensive pathways for emissions reduction, which entail examination of sectors of the economy that will need to undergo a transformation to reach the 2035 targets and a map of how to achieve these goals. This should also include an examination of strategies where regional collaboration and state policy actions will create opportunities for further emissions reduction through 2050;
- Timeline for implementation and sequencing of tasks and actions;
- Outline of potential partners for each project component as well as key opportunities for the City to involve its residents in accelerating the implementation and uptake of climate action programs; and
- Estimated implementation costs and budgets.

Appendix A. GHG Inventory Methodology

Stationary Energy

Electricity

Pepco, the electric utility serving Takoma Park, provided 2017 electricity data. Data was obtained through MWCOG, who conducted QA/QC and iterated with Pepco to ensure the data reflected the appropriate municipal boundaries and number of accounts. Data included disaggregated values for commercial and residential electricity. The EPA eGrid emission factor for the RFC East Subregion was applied to calculate electricity emissions.

Natural Gas

Washington Gas, the natural gas provider for Takoma Park, provided 2017 gas data. Data was acquired through MWCOG, who worked to ensure sufficient data quality. Washington Gas provided data disaggregated by four account types: residential (RES), commercial & industrial (CI), group metered apartment (GMA), and interruptible delivery service (INTR). GMA values were allocated 90% to residential, and 10% to commercial. INTR accounts were allocated as commercial consumption. The EPA Natural Gas emission factor was used to calculate emissions.

Fuel Oil

Fuel oil represents a small fraction of energy consumption in Takoma Park, and an estimate of fuel oil consumed in Takoma Park was derived using publicly available data sources. The number of homes in Takoma Park that use fuel oil was extracted from the U.S. Census Bureau American Community Survey, and amount of fuel oil consumed in the Maryland was found in the EIA State Energy Data System (SEDS). Dividing the number of gallons of fuel oil consumed in Maryland by number of Maryland homes using fuel oil generated a household average fuel oil consumption value, which was applied to the number of homes in Takoma Park with fuel oil. The EPA Fuel Oil #2 emission factor was used to calculate emissions.

Transportation

Transportation emissions were calculated using publicly available 2017 Montgomery County vehicle miles traveled (VMT) data. The VMT data was distributed between vehicle types based on data from the 2016 Montgomery County Vehicle Census, obtained from MWCOG, as outlined in Table 5.

Table 5. Vehicle Types Captured in Transportation Emissions Data

Fuel	Vehicle Type
Gasoline	Light Trucks
	Passenger Cars
	Buses
Diesel	Heavy Trucks
	Light Trucks
	Passenger Cars

	Buses
CNG	Buses
Hybrid	Light Trucks
	Passenger Cars
Electric	All
Ethanol (E85)	Passenger Cars
	Light Trucks
	Heavy Trucks

Emission factors were derived from the EPA Emission Factors for GHG Inventories, drawing upon EPA fuel efficiency estimates where needed to converted to emissions per mile. Per mile emission factors were multiplied by the VMT values per vehicle typed and added to produced total on-road vehicle emissions for the County. These results were scaled to Takoma Park by population relative to the total Montgomery County population.

Waste

Solid waste tonnage for 2017 was provided by the 2017 City of Takoma Park. The 2017 Montgomery County Waste Characterization Study was used to derive an emission factor for landfilled waste, based on the composition of different materials in the waste stream. The ICLEI GHG accounting methodology provides an approximated emission factor for waste, based on a generic waste characterization. The Montgomery County Waste Characterization Study provides a locally-specific estimate, though it may not capture Takoma Park specifically. The calculated emission factor was 60.496 kg CH4/short ton of waste. A 75% landfill gas collection efficiency was assumed for the landfill at which the waste is deposited.

Recycling is not directly accounted for using the ICLEI methodology, but benefits are instead captured through mitigation of waste to landfill.

Water

Wastewater treatment process emissions for 2017 were derived from the Washington Suburban Sanitary Commission (WSSC) 2018 Greenhouse Gas Action Plan Update, published in June 2019. The fraction of these emissions attributed to Takoma Park were derived by proportionally scaling the population of Takoma Park in 2017 to the total WSSC population serviced in 2017.

Emissions from effluent discharge were estimated from the 2015 Takoma Park GHG Inventory conducted by MWCOG and included for completeness.

Appendix B. Stakeholder Engagement Results

Summary

Community involvement and feedback is critical to the City of Takoma Park's Sustainability and Climate Action Plan. To generate robust stakeholder engagement and in-depth conversations about the plan, the City of Takoma and Cadmus created a range of opportunities for community members to engage with the plan content. Avenues for engagement included a webinar presenting findings from the GHG inventory update, a stakeholder workshop, community focus groups, in-person tabling with surveys, and an online survey. Details about and notes from each feedback mechanism are included in this appendix.

Greenhouse Gas Inventory Update Webinar

On August 12th, 2019, The City of Takoma Park and Cadmus hosted a Greenhouse Gas Inventory Update Webinar to receive input and feedback from the stakeholders. Kate Mueller, Kathryn Wright, and Gina Mathias presented the update to assist in framing the discussion around the Climate Action Plan. Stakeholders were very interested in the methodology of the inventory update, and the presentation was opened with discussion questions multiple times through the duration of the webinar. The first discussion was held at the end of the Methodology and Results section:

Were there any clarification questions about the results?

Do waste values include both city-hauled and non-city-hauled waste?

- While waste values were consistent with previous inventories, they need to be checked to see if they include non-city hauled waste.

Does the volume of waste generated include leaves picked up by fossil fuel trucks?

- Yard waste is not incorporated into solid waste, all leaves are composted on-site at a public works facility. Instead, the emissions-emitting trucks that pick up the yard waste would be accounted for in the Transportation sector, but not disaggregated as such.

Why is Montgomery County data being scaled to Takoma Park, and why was that county chosen as the point of analysis?

- Montgomery County was the most granular data that the team received. The Metropolitan Washington Council of Governments (MWCOG) confirmed the process that the team used and stated that collecting more granular data would be difficult.

The second discussion was held after the Trends Analysis section.

Were there any particular trends that stood out?

Please go over the methodology for the transportation sector and the adjustment made to the sector in 2017 again.

- The team had GHG inventories that were produced by MWCOG for 2015 and 2012, which report VMT for those previous years. In the process of calculated VMT for 2017, the team found that those values were 10% less (they matched with 2012 and 2015 as a sanity check). As such, they did not want an artificially high drop in transportation in 2017, so the team added that 10% artificially back in for the 2017.

Does the team get the actual attributes (emissions/kWh) that specific customers of TP consume? (If a higher % of TP's houses purchase from green sources, is that accounted for)?

- Data from electricity comes from Pepco. They are just reporting electricity used from residential or commercial side. If there is a green energy arrangement, the team did not account for that.

Are emissions trends weather normalized?

- The utility data provided by Pepco and Washington Gas were aggregated annually. Since weather normalized analysis is conducted on a monthly basis, the team did not normalize the data.

How are emissions applied per kWh?

- The team used EPA's eGRID 2016 emissions factors.

What is the increase in natural gas consumption for heating and cooling in commercial buildings? Does the team have any info on how much of that is due to new commercial activity as opposed to increased use from existing buildings and businesses?

- The Washington Gas data that the team has does not make any distinction. However, the team does report the number of accounts, so if new accounts could be discerned, then the team could potentially include that analysis.

Has the team looked on the supply side? There is a considerable increase in rooftop solar in Takoma Park. Has the team measured the capacity of solar and how it has changed over the past 5 years, and if anyone is looking for potential for solar on commercial and residential buildings?

- We have not conducted any measures on rooftop solar over the 5 years. If that rises to the top, or TP decides to invest in it, then Cadmus will look further into it. There is the option to work with SolSmart to do feasibility assessments, which Cadmus has worked on in the past.

How much of transportation emission are due to passenger cars, buses, commercial vehicles? What work has been done to electrify the fleet of vehicles?

- The team has estimates on breakdown based on vehicle census data, not specific to Takoma Park, but the team can make reasonable estimates based on the data that they have. Takoma Park's electric fleet is small and will not be replaced soon. However, as city cars are being sold, the city is looking at purchasing electric vehicles. Code enforcement has one electric vehicle, and the city is trying to convert one of our trucks to biodiesel.

Does Cadmus have a methodology to help communities look at their specific transportation emissions?

- Cadmus does have methodologies for communities. The team has typically looked at emissions at a regional level, due to commuters and so on. But there are aspects that could be adapted to Takoma Park, but it is a time-intensive process that we might not have time for.

In what areas or programs have you been successful in reductions, and where have you seen less success? Are there any actions that could be motivated on a state or regional level? Has there been any previous work done that could be an indicator of the success of the ideas that Cadmus suggested?

The city has conducted group purchasing programs for residential solar for 5 years with the Solar United Neighbors of Maryland. We started group purchasing for renewable energy. We had a campaign for REC purchasing and will be holding a campaign again in Spring 2020. We want to have the same campaigns around heat pumps and electric vehicle charging. Could multifamily or commercial be contemplated?

Workshop

On September 17th, 2019, The City of Takoma Park hosted a Sustainability and Climate Action Planning Workshop to solicit feedback from the community on the SCAP creation process. The workshop opened with remarks from Kate Stewart, Mayor of Takoma Park. At the workshop, Cadmus presented high level results from the 2017 GHG inventory update and shared an overview of 15 proposed strategies for emissions reduction. Following a period of question and answer, the 50+ attendees divided into 4 groups for facilitated discussion about their vision for Takoma Park and priorities for emissions reduction in the community. The workshop presentation and handout are both available online. Consolidated notes from questions asked during the session are as follows:

Overarching Themes

- Community emphasized taking radical, aggressive action, while also expressing a desire for stronger individual action
- Strategies to further promote on-site or community solar and public transit options were recurring themes
- There is likely a need to clarify the scope of our analysis in the context of Takoma Park's net zero goal; we are proposing emissions reduction strategies but not developing a net zero implementation plan
- There was a desire for additional information and explanation for some of the proposed strategies, which would have helped the community members better assess and prioritize among the options

Postcard from the Future

"Postcards from the Future" is an exercise in which participants each draft a short postcard from their future selves, describing their community in the year 2035:

What themes are you hearing in these visions?

- On-site solar
- Community solar
- Electrified transit
- Bike and pedestrian friendly community
- 100% renewable electricity
- Affordable, accessible public transit

- Life lived outside of homes
- Trees and green
- Equity concerns
- Housing density
- Affordability
- Individual empowerment
- Energy efficient buildings
- Composting and healthy soil

What about these visions surprised you?

- Emphasis on local food sufficiency
- Focus on life, people, and nature

What are you excited about?

- Emphasis on social capital
- Fewer cars
- Better quality of life

Prioritization Criteria

Facilitators briefly shared the 7 primary criteria with which the strategies will be further evaluated, to ensure elements important to the community were captured.

Do you have any clarifying questions on these criteria?

- Cost-Effectiveness: Emphasized cost of implementation for each strategy
- Technical Feasibility: Include municipal collaboration and legality of implementation

Are there other things we should consider?

- Cost effectiveness should not just assess cost to the City, but residents and businesses as well
- Consider reevaluating the ICLEI framework, which does not capture how some stakeholders view the role of waste
- Categorize strategies by City level of control or influence
- Include scalability and/or replicability for other cities as a factor to illustrate Takoma Park's opportunity to be a leader in each area

Strategy Prioritization

Facilitators guided discussion of the 15 strategies shared with the large group to solicit additional feedback.

What strategies are you most excited about or would you prioritize for the City to pursue?

- Energy Disclosure and residential energy assessment
- Renewable Thermal Community Outreach
- Virtual PPA
- Community Choice Aggregation

Which (if any) would you de-prioritize? Why?

- EmPOWER: Not a new strategy
- Cogeneration: Not as applicable to this community given the types of building stock
- Green Roofs
- EV Initiatives: Less interest in infrastructure, more interest in easier access to affordable vehicles
- Natural Gas Ban: does not account for biogas options

Are there particular challenges you see with implementation of this strategy?

- Concerns surrounding cost, ability, standards, and enforcement for energy audits
- Split incentives given the distribution of renters vs. owners. Takoma Park is about 50/50 (anecdotal from participant)
- Ensure Takoma Park is coordinating with and/or aligning with County initiatives
- Requirements around ensuring solar-ready development may need to be re-considered if this would require removal of or negative impact on trees

Is anything missing from the strategies we've identified? Ways in which you would adjust these strategies?

- Split the energy disclosure ordinance strategy into two: one for disclosure and one for retrofits, and also apply to residential
- For residential energy assessments
    - Coordinate with EmPOWER offerings
    - Recommend requiring at more points than just point of sale
    - Consider requiring through tiered code that includes penalties for non-compliance as well as rebates and incentives to address equity considerations; payments could be tied to property taxes
- Consider opportunities for regenerative agriculture and soil health for sequestration
- Consider a car combustion ban
- More strategies surrounding public transportation
    - Decarbonized public transit
    - Explore transit subsidies, as the cost of WMATA is high
- Implement rooftop and ground-mounted solar, including radical action to mandate more
- Explore opportunities for community solar
- Extend building code/ordinance strategies beyond new construction
- Do not limit to just EV charging stations, but consider super charge strategies
- Consider packaging strategies into pathways (e.g., solar pathway, electrification pathway, heat pump/thermal pathway)
- Want to better understand what is within Takoma Park's purview vs. county, state, or larger
- Consider developing "more European" strategies as opposed to "California" strategies
- Implementation should connect to incentives and connect to art and culture
- The plan should be at the very least very tree positive and include strong mention of role of trees and related strategies
- Nuclear power could be considered, though there is generally strong opposition with Takoma Park to nuclear (power and weapons)

Do any of these strategies improve or reduce the City's preparedness to climate impacts?

- Natural gas ban is not resilient as it eliminates a backup power source

Report-Out

Participants summarized parting thoughts with a few words:

- Informed and committed community
- The hardest solutions may be the best solution
- Add tree planting to strategies
- Need to be more radical with strategies
- Can implement sooner than 2035. 2025, even.

Online Survey

The City of Takoma Park created an online survey as a means of gathering additional feedback from workshop participants and those unable to attend the workshop. The online survey received 219 responses. The survey requested information on current sustainability related practices community members undertake, and their opinions on the proposed strategies, including ones they would most like to see implemented. The most popular strategies, in order, from the response include:

1. Make the city easily navigable by bicycle via installation of protected bike lanes and/or cycletracks, and making whole areas only accessible by bike or foot
2. Pursue community choice aggregation (if Maryland HB0730 is passed) allowing the City to procure green power on behalf of residents and businesses
3. Develop an energy use reporting requirement for commercial buildings in Takoma Park, using this information to establish performance requirements and target specific buildings for energy retrofits
4. Require new commercial and multi-family construction in Takoma Park to be solar-ready or include renewable electricity generation as part of zoning ordinances
5. Require new commercial construction in Takoma Park to include "cool roof", green roof, or water quality facilities exceeding current stormwater requirements
6. Adding "carbon impact statements" to all major city policy decisions and projects to incorporate GHG reductions in city planning
7. Encourage Montgomery County Green Bank to create financing or incentive programs for key technologies, such as heat pumps and EV charging
8. Explore opportunities for the City, along with other partners, to utilize a virtual Power Purchase Agreement (PPA).

The most common write-in and in person suggestion was to include a specific strategy regarding trees. The tree comments ranges from including the carbon sequestration potential, the cooling effects of trees, and not cutting down trees to make way for solar, among other specific benefits or concerns. The second most common response was regarding public transportation and wishing to see attention to improving access in some way.

The sentiment ranged from indignation and disapproval for the strategies and process, to overwhelming approval and support. Many comments shared the theme that the respondents want to see much more

aggressive and unique solutions, but that balance not being too burdensome for the residents and business owners of the city.

The following word cloud provides a visual representation of the survey responses, with more frequently recorded words appearing larger and bolder. The numbers in parentheses indicate the number of times the word appeared.

Focus Groups and In-Person Surveys

A series of additional in-person opportunities for feedback were held to further engage community members in their neighborhoods at other frequented events. These included hour-long focus groups, which mirrored the facilitated discussion from the larger workshop, and tabling events, in which City of

Takoma Park staff were present and community events and provided brief in-person surveys to capture feedback on emissions reduction strategies. Events included the following:

- September 8 – Tabling at Folk Festival
- September 9 – Committee on the Environment Meeting Focus Group
- September 15 – Longbranch Sligo Neighborhood Meeting Focus Group
- September 15 – Tabling at Takoma Park Farmer's Market
- September 16 – Focus Group at Mansa Kunda
- September 19 – Ward 3 Focus Group
- September 22 – Ward 2 / Forest Park Neighborhood Focus Group
- September 22 – Tabling at Farmer's Market
- September 24 – Ward 1 Focus Group
- September 25 – Tabling at Crossroads Community Market

The top strategies based on focus group and in-person survey feedback were as follows:

1. Pursue community choice aggregation (if Maryland HB0730 is passed) allowing the City to procure green power on behalf of residents and businesses
2. Make the city easily navigable by bicycle via installation of protected bike lanes and/or cycletracks, and making whole areas only accessible by bike or foot
3. Require new commercial and multi-family construction in Takoma Park to be solar-ready or include renewable electricity generation as part of zoning ordinances
4. Require new commercial construction in Takoma Park to include "cool roof", green roof, or water quality facilities exceeding current stormwater requirements
5. Develop an energy use reporting requirement for commercial buildings in Takoma Park, using this information to establish performance requirements and target specific buildings for energy retrofits
6. Require energy efficiency assessments for residential buildings at periodically and/or at time of sale, coupled with minimum upgrade requirements
7. Promote energy efficiency and gas programs available through the EmPOWER Maryland offerings with Pepco and Washington Gas
8. Launch of a community-based purchasing campaign for heat pumps/renewable thermal technology by the City of Takoma Park

Appendix C. Prioritization Matrix Summary

The evaluation criteria by which the strategies included in the initial strategies list, plus strategies added following processing of workshop and survey feedback, is included in

Table 6.

Table 6. Strategy Evaluation Rubric

Category	Criteria	1 (Disadvantageous)	2 (Neutral)	3 (Advantageous)
Feasibility	Community Interest	Strategy faces opposition from community members, or is anticipated to have little utilization or uptake	Strategy receives neither strong support or opposition from community, and is anticipated to have modest utilization or uptake	Strategy receives strong support from the community, and is anticipated to have high utilization or uptake
	Feasibility	Strategy faces significant technical or political barriers that call ultimate implementation into question	Strategy faces moderate technical or political barriers, though these are not considered fatal flaws	Strategy is expected to be implemented without significant technical or political complications
	Timeline	Strategy is expected to take more than three years to implement, or has a highly uncertain timeline	Strategy is expected to take 2 - 3 years to implement, with manageable risk of delay	Strategy is expected to be implemented within 2 years with limited risk of delay
	Cost	Strategy is anticipated to be costly, create unrecoverable costs, and/or add additional expenses	Strategy is anticipated to require moderate investment, and associated costs can be recovered in a reasonable timeframe	Strategy is anticipated to require relatively low investment, reduce costs, and/or provide a new revenue source
Impacts	Equity Impacts	Benefits of strategy are limited to a subset of the community and/or there are notable burdens from implementation	Benefits of strategy reach a moderate number of segments of the Takoma Park community, with modest burdens from implementation	Benefits of strategy are anticipated to reach many segments of the Takoma Park community, and burdens can be minimized
	Emissions Impacts	Strategy is expected to have no impact or only a small impact on GHG emissions in Takoma Park	Strategy is expected to provide modest progress towards GHG emissions reduction in Takoma Park	Strategy is expected to provide significant progress toward GHG emissions reduction in Takoma Park

	Climate Preparedness Benefits	Strategy does not address existing climate preparedness concerns and/or is likely to be adversely impacted by changing climate	Strategy provides limited climate preparedness benefits with modest impacts from changing climate	Strategy is responsive to existing climate preparedness concerns and/or is unlikely to be adversely impacted by changing climate

Appendix D. Recommended Adaptation and Resilience Strategies

The suite of strategies listed below are intended to provide a menu of recommended options based on the critical climate-related risks identified for Takoma Park. These strategies were selected in consideration of the existing policy context in the city and informed by interviews, stakeholder recommendations, and a database of successful strategies implemented by municipal across the United States. Prioritization, selection, and implementation staging from among these strategies requires additional stakeholder engagement and input from Takoma Park staff.

Extreme Heat

- Continue to expand the tree canopy to mitigate the urban heat island effect
- Work with first responders and health institutions to track Takoma Park heat-related illnesses and fatalities
- Develop a heat risk outreach and services strategy
- Increase public access to water
- Improve shade and other bus shelter amenities (e.g., real-time arrival information)
- Implement a cool and/or green roof retrofit program to reduce cooling costs and mitigate the urban heat island effect; consider other basic, affordable weatherization measures as well

Flooding

- Increase awareness of existing flood insurance coverage for residential and commercial properties for all vulnerable residents; promote increased flood insurance uptake where appropriate
- Update the Department of Public Work's 2009 Flood Mitigation Plan
- Improve outreach to targeted communities and business around flood preparedness and recovery
- Establish a flood impacts reporting and monitoring program to identify current and changing vulnerability, including changing runoff patterns, and help target investments in preparedness and recovery

Storms

See also recommendations above for flood-based impacts from storms

- Retrofit critical facilities and infrastructures with distributed energy resources (DERs- e.g., rooftop solar) to improve their resilience

Drought

- Consider participation in the MWCOG Drought Coordination Technical Committee
- Monitor climate stress and increases in water demand
- Support provision of rain barrels and similar water-capture devices
- Encourage garden practices that promote drought resilience

- Promote xeriscaping, rainwater capture, grey water and water-efficient appliances and fixtures

Overall

- Ensure equity considerations are prioritized in the identification, development, and adaptation of all adaptation and resilience measures
- Actively leverage the resources and tools from the City's participation in the Government Alliance on Race and Equity
- Improve individual and community climate preparedness through community outreach tools
- Integrate adaption language on climate stressors into policies, plans, and programs

Appendix E. Strategy Evaluation Assumptions

All strategy analysis assumes success in meeting the State of Maryland Renewable Portfolio Standard targets, which progressively increase to 50% by 2030. An adjusted emission factor was developed by using the current EPA eGRID RFC East emission factor, and assuming all new RPS-qualified resources displace fossil fuel, as opposed to nuclear, resources. The overall emission projection through 2035 includes updating the electricity-related emissions based on changes to the RPS, and a 1% annual decrease in emissions from other sectors and sources per GHG inventory report.

Renewable Thermal Community Outreach Campaigns

Participation in a renewable thermal outreach campaign was assumed to be comparable to the 2015 Takoma Park Solar United Neighbors campaign. The emissions reduction captured in the analysis is the difference between the natural gas used for gas heat and the emissions from electricity associated with the same amount of heating via heat pump. Two scenarios are considered for renewable thermal implementation: (1) the electricity supplied to the heat pump comes from 100% renewable energy and (2) the electricity supplied to the heat pumps comes from the grid, which is assumed to meet the Maryland RPS targets.

Cost data was scaled from the USDN HeatSmart/CoolSmart Somerville Case Study based on the number of housing units in Takoma Park:

- 4,404 housing units with natural gas heating in Takoma Park (American Community Survey)
- 22,420 housing units with natural gas heating in Somerville (American Community Survey)
- 34 housing units in Takoma Park install heat pumps in first year (Solar United Neighbors)
- Subsequent annual campaigns result in 50% fewer installations
- Assumed a campaign covering 20% of the number of homes in Somerville would incur one-third of the costs

Transit Accessibility and Outreach

Increased transit accessibility through improved bike infrastructure is assumed to align with the Montgomery County estimates of a 1.5 - 2% reduction in transportation emissions annually (Montgomery County Bicycle Master Plan, Appendix L). The Master Plan incorporates improved infrastructure, as well as outreach and education to encourage bicycling.

Project costs were estimated at a cost of $20,000 per mile, the conservative cost associated with bike lanes with some form of moderate structural delineation (PeopleForBikes Bike Lane Cost Estimates). Outreach costs drew from relevant activities in the Oregon Metro Regional Travel Options Strategic Plan evaluation report, scaled by population.

Residential Energy Assessment

Analysis assumes 10% of homes in Takoma Park undergo assessments an upgrades per year, with all homes having been assessed and upgraded by 2030. The high GHG emissions reduction is based on data

from the Massachusetts Mass Save program via the Mass Save Data portal. These estimates represent an upper bound of reduction potential given the Mass Save program's maturity, and scaled to Takoma Park based on number of housing units. While EmPOWER Maryland reports program uptake information, it did not provide the level of granularity necessary to confidently estimate emissions savings per home. Assumptions include:

- 106,540 Mass Save Home Energy Assessments in 2018
- 32.30% deal closure rate
- Total 2018 GHG reduction of 87,020 $MTCO_2$
- Average GHG reduction per installation of 2.53 $MTCO_2$

Scaled to Takoma Park's 3,342 single family homes (American Community Survey), these savings scale to 845 $MTCO_2$ per year, and assume assessed homes also make the improvements recommended in the assessment. The low GHG emissions reduction scenario assumes 50% of this level of savings is achieved.

Energy audit costs are presented before any utility contributions; residents may be able to access free assessments through the EmPOWER Maryland Program.

Commercial & Multifamily Energy Disclosure Ordinance

Analysis assumes implementation of an energy disclosure ordinance for commercial and multifamily buildings in 2020, with reduction benefits first materializing in 2021. This is based on the experiences of other communities, which have required at least a year to collect stakeholder feedback and implement their ordinances. The ordinance is assumed to apply to the 44 commercial and apartment buildings in Takoma Park of 10,000 or more square feet, determined through analysis of Maryland Property Data - Parcel Points from the State Department of Assessments and Taxation. The summary of parcels in Takoma Park and associated building square footage extracted from the dataset is included in Table 7 for reference. Buildings over 10,000 square feet in the italicized categories were included in the assessment.

Table 7. Takoma Park Structure and Parcel Data Summary

Land Use Description	Total Structure Sq. Ft.	% Total Structure Sq. Ft.	Number of Parcels	% of Total Parcels
Residential	6,392,100	63.52%	4,285	77.24%
Exempt Commercial	1,356,259	13.48%	43	0.78%
Commercial	1,354,469	13.46%	135	2.43%
Residential Condominium	569,529	5.66%	665	11.99%
Apartments	191,387	1.90%	282	5.08%
Exempt	149,795	1.49%	103	1.86%
Commercial Condominium	40,213	0.40%	30	0.54%
Commercial Residential	9,754	0.10%	5	0.09%
Total	**10,063,506**	**100.00%**	**5,548**	**100.00%**

Most implementation and cost assumptions were derived from Lawrence Berkley National Laboratory's Evaluation of U.S. Building Energy Benchmarking and Transparency Programs report.

- 1.5 - 2% reduction in energy use for covered buildings (LBNL)
- 3% reduction in utility bills for covered buildings (LBNL)
- $1,010.68 average commercial electricity bill in Maryland (EIA 861)

Ongoing costs included account for annual data collection and processing and trainings for commercial building staff to be able to properly collect and report data.

Commercial & Multifamily Building Performance Requirements

Analysis assumes implementation of building performance requirements for commercial and multifamily buildings in 2020, with the first reduction requirement to be met in 2025. Similar to the energy disclosure ordinance, performance requirements apply to the 44 commercial and apartment buildings in Takoma Park of 10,000 or more square feet, determined through analysis of Maryland Property Data - Parcel Points from the State Department of Assessments and Taxation.

An approximation of electricity and natural gas usage per square foot for buildings in Maryland was developed using the EIA Commercial Building Energy Consumption Survey (CBECS) (Tables C20 and C30 - Mixed Humid) to develop EUI for tiers of square footage. These values were applied to Takoma Park building square footage within the documented ranges and emission factors to develop emissions from covered buildings.

The high scenario assumes a 15% reduction in GHG emissions requirement every 5 years, and the low scenario assumes a 14% reduction every 10 years (NYC Energy and Water Use 2014 and 2015 Report)

Community Choice Aggregation

Analysis assumes application to residential and commercial building electricity consumption, beginning in 2020. The program is structured as an opt-out program, automatically enrolling unless they choose to not participate and includes 100% renewable energy. The high emissions reduction scenario assumes 95% participation and low reduction scenario assumes 85% participation (NREL, Community Choice Aggregation: Challenges, Opportunities, and Impacts on Renewable Energy Markets). As a result, this strategy assumes 85 - 95% of emissions associated with residential and commercial electricity are eliminated by replacing 85-95% of electricity use with 100% renewable energy.

Pricing estimates of a $0.0106 - $0.0376/kWh price increase include:

- $0.0854/kWh (Pepco Standard Offer Service (SOS) Pricing Information, Schedule "R")
- $0.0960 - $0.123/kWh (CleanChoice Energy Pricing and Plans, 20910 zip code)

Natural Gas Elimination - New Construction

Analysis assumes 10 new housing units per year through 2035 in the high emissions reduction scenario, and 4 new housing units per year in Takoma Park through 2035 in the low GHG reduction scenario based on information provided by the City. This analysis does not include a pathway for retrofits, as this largely overlaps with the renewable thermal/heat pump strategy.

- Average natural gas consumption of 1,078 Therms per residential account per year based on 2017 residential natural gas use of 4,008,865 Therms for 3,718 accounts (Washington Gas)
- Annual heat production of 84,084,000 BTU
- Heat Pump coefficient of performance (COP) of 2.

Virtual PPA Opportunities

Analysis assumes a virtual PPA provides 100% renewable electricity to participating accounts. The high GHG emissions reduction assumes the virtual PPA covers all municipal electricity use plus 10% of commercial electricity use. The low GHG emissions reduction assumes the virtual PPA covers all municipal electricity use only.

Cost data is derived from the Level10 Energy PPA Price Index: Q2 2019.