Inventory of Community and Government Operations Greenhouse Gas Emissions: Springfield, MA

Prepared for the City of Springfield
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Executive Summary

The City of Springfield recognizes that greenhouse gas (GHG) emissions from human activity are catalyzing profound climate change, the consequences of which pose substantial risks to the future health, wellbeing, and prosperity of our community. In Springfield, as throughout the United States, these risks are disproportionately shouldered by those with the least resources to respond. Furthermore, Springfield has multiple opportunities to benefit by acting quickly to reduce community GHG emissions.

Springfield was an early adopter of the state's Green Communities program and was one of the first communities in the state to reduce its municipal energy usage by 20%. Since 2010, Springfield has been able to obtain $1.25 million in grant funding to implement energy efficiency projects in city owned vehicles and buildings. With this endeavor, Springfield is now looking to track energy usage and emissions beyond just the municipal level, and is inventorying greenhouse gas emissions from all uses within the City. This report provides estimates of greenhouse gas emissions resulting from activities in Springfield as a whole in 2015. This inventory sets the ground work for understanding where emissions must be reduced to combat the progression of climate change.

Key Findings

There are a variety of emissions sources and activities included in the community-wide inventory. The emissions calculated in this report are considered local government significantly influenced emissions and are the most relevant to local policy and practices that can be adopted or modified to reduce greenhouse gas emissions. The largest contributor in this set is energy use in buildings which accounts for 68.4% of Springfield's overall emissions. The next largest contributor is transportation (vehicles, transit, trains) with .5% of the overall emissions. Actions to reduce emissions in both of these sectors will be a key part of the climate action and resilience plan. Water/wastewater processing, solid waste management and fugitive emissions were responsible for the remainder of emissions within the City of Springfield and actions to reduce emissions in these segments will also be developed.

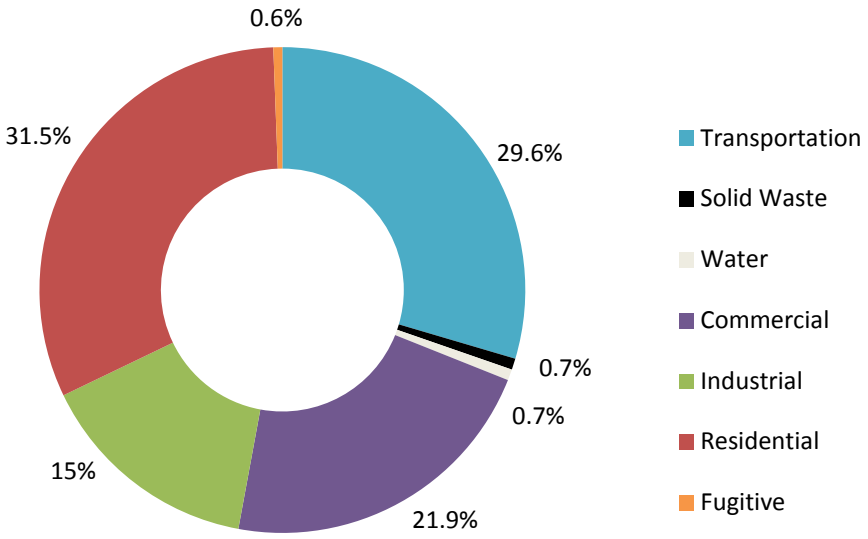

Figure 1: Community-wide GHG emissions results by sector

As a part of this process the City undertook work to assess the amount of emissions coming directly from facilities or buildings they operate. While these emissions are, for the most part, captured in the community-wide inventory, it was important to isolate them in the process to determine what portion of emission reduction the City has direct control over. The local government emissions account for approximately 3.7% of total community-wide inventory. Similarly to the community-wide inventory, buildings and transportation make up the largest segment of local government emissions.

Next Steps

The City has set an ambitious goal to reduce emissions by 80% by 2050. In order to hit this target, Springfield officials, residents, businesses and visitors will all need to play a role in this climate action plan. Community outreach was done to not only educate residents about the main sources of greenhouse gas emissions, but to better understand what actions they felt would be achievable today base on local government support and personal resources and what actions would only be achievable with support first from the City. In order to track emissions over time, ICLEI's protocol recommends carrying out a thorough greenhouse gas emissions inventory every five years at a minimum.

Climate Change Background

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise.

As these greenhouse gas emission concentrations increase and climate change progresses Springfield will be impacted. In fact, we are already seeing some of these impacts. Springfield could be impacted by hotter summers and wetter winters. Springfield is also likely to see an increased number of strong storms that will impact the City annually. These storms will bring strong winds and heavy amounts of rain and snow, which could lead to severe wind and flooding damage. For a more in depth analysis on how Springfield is expected to be impacted by climate change see the Vulnerability Assessment Section of this plan.

Many communities in the United States have taken responsibility for addressing climate change at the local level. Reducing fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions. More efficient use of energy decreases utility and transportation costs for residents and businesses. Retrofitting homes and businesses to be more efficient creates local jobs. In addition, money not spent on energy is more likely to be spent at local businesses and add to the local economy. Reducing fossil fuel use improves air quality, and increasing opportunities for walking and bicycling improves residents' health. These are just some of the co-benefits to addressing climate change at the local level.

ICLEI Climate Mitigation Program

In response to the problem of climate change, many communities in the United States are taking responsibility for addressing emissions at the local level. Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, waste diversion, and more, local governments can dramatically reduce emissions in their communities. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts.

ICLEI provides a framework and methodology for local governments to identify and reduce greenhouse gas emissions, organized along Five Milestones, also shown in Figure 2:

1. Conduct an inventory and forecast of local greenhouse gas emissions;
2. Establish a greenhouse gas emissions reduction target;
3. Develop a climate action plan for achieving the emissions reduction target;
4. Implement the climate action plan; and,
5. Monitor and report on progress.

Figure 2 ICLEI Climate Mitigation Milestones

The greenhouse gas emissions inventory results below represent the completion of ICLEI's Climate Mitigation Milestone One for the community as a whole. It also serves as the foundation for the GHG emission reduction strategies proposed in the remainder of this report. The Springfield Climate Action and Resilience Plan, as a whole completes, ICLEI's Climate Mitigation Milestones One, Two and Three.

Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible greenhouse gas emission reductions requires identifying baseline emissions levels and sources and activities generating emissions in the community. This report presents emissions from the Springfield community as a whole; emissions from operations of the Springfield government are also presented in this report. The government operations inventory is mostly a subset of the community inventory, as shown in Figure 3. For example, data on commercial energy use by the community includes energy consumed by municipal buildings, and community vehicle-miles-traveled estimates include miles driven by municipal fleet vehicles.

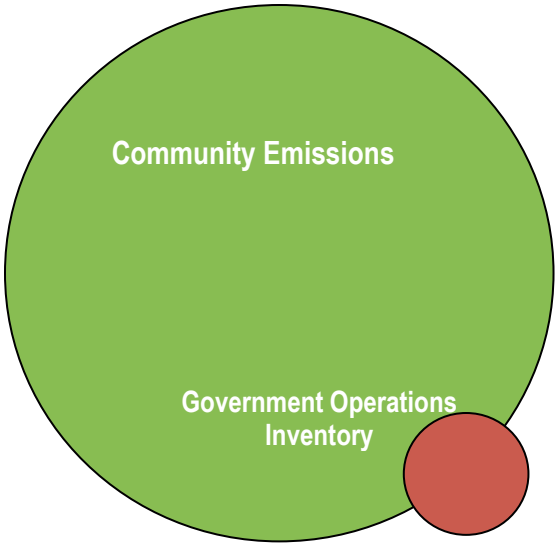

Figure 3: Relationship of Community and Government Operations Inventories

As local governments have continued to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. This inventory uses the approach and methods provided by the Community Greenhouse Gas Emissions Protocol (Community Protocol)[1], which was released by ICLEI in October 2012, and represents a new national standard in guidance to help U.S. local governments develop effective community GHG emissions inventories.

Quantifying Greenhouse Gas Emissions

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Springfield's community greenhouse gas emissions inventory utilizes 2015 as its base year.

Quantification Methods

Greenhouse gas emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.

[1] http://www.icleiusa.org/tools/ghg-protocol/community-protocol

- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used: *Activity Data x Emission Factor = Emissions*

All emissions sources in this inventory are quantified using calculation based methodologies. Activity data refer to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please see appendices for a detailed listing of the activity data used in composing this inventory. Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. lbs CO_2/kWh of electricity). For this inventory, calculations were made using the ICLEI's ClearPath.

Community Emissions Inventory Results

Introduction

The primary sources of community emissions are organized into five sectors: Buildings, Transportation, Solid Waste, Water/Wastewater, and Fugitive Emissions. Emissions from these five categories equal 1,217,955 metric tons of CO2e. These emissions include activities that are not necessarily within the city's direct control. (For example, all vehicles driven by residents and energy usage in residential, commercial and industrial buildings.) While the City does not have direct control over these emissions sources, they do have the ability to pass policies or adopt programs that could incentivize the reduction of emissions. Thus, they are captured in the community-wide inventory.

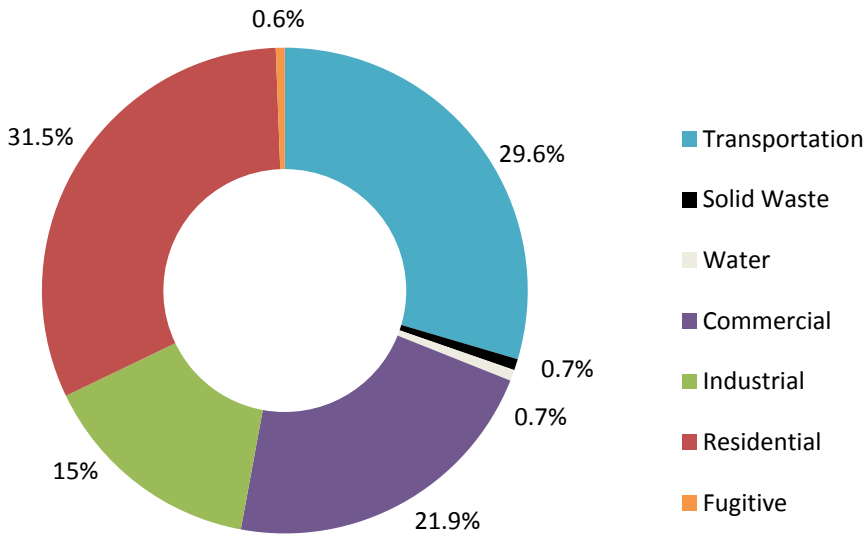

Figure 4: Community-wide Greenhouse Gas Emissions Inventory

The table below highlights the data used in the community-wide emissions inventory.

Table 1: Main GHG Inventory Data Points and their emissions equivalent			
Source or Activity	**Activity Data Quantity and Unit**	**MMBTU**	**Emissions (metric tons CO2e)**
Residential Use of Electricity	431,448,503 kWh	1,472,102	114,358
Commercial Use of Electricity	554,887,448 kWh	1,883,029	147,077
Industrial Use of Electricity	182,219,395 kWh	621,732	48,299
Residential Stationary Combustion	27,502,739 therms 1,590 barrels (LPG) 368 cords (Wood) 186,547 barrels (Fuel Oil)	2,750,273(Nat Gas) 570,002 (LPG) 7,380(Wood) 1,172,827(Fuel Oil)	146,194 (Nat Gas) 36,221 (LPG) 58.582 (Wood) 82,273 (Fuel Oil)
Commercial Stationary Combustion	2,2405,504 therms	2,240,550	119,099
Industrial Stationary Combustion	5,890,443 therms + Previously calculated Solutia Emissions	589,044	133,991
On-road Vehicle Travel	791,385,408 vehicle miles	--	351,793
PVTA Transit	843,730 gal of Diesel 126,253 gal of Gasoline	117,278 15,655	2,738.36 1,111.1
Trains (Passenger and Freight)	430,211 gallons of diesel	59,409	4,434
Use of Energy in Wastewater Treatment	16,409,300 kWh 144,549 therms	55,988 14,454	5,117.8
Wastewater Nitrification	--	--	3,842.58
Generation of Solid Waste	129,715 tons	--	9,089

Buildings

Collectively buildings make up the largest segment of emissions in Springfield's Community-wide inventory (approximately 68.4%). Within this segment though, buildings can be distilled into three sectors: Residential, Commercial and Industrial. There are over 61,000 housing units in the City that house 153,947 residents. Additionally the commercial and industrial buildings in Springfield host 73,266 jobs[2], which employ 21,000 people that live in Springfield and another 52,000 that travel to Springfield from around the region for work. The sections below outline where emissions from each sector are coming from in more detail.

Improvements to buildings can have a direct impact on reducing building-related emissions and could also save the occupants money. For example, improved insulation would result in the need for less fuel for heating on cold days, which would result in not only a reduction of emissions, but also a reduction in heating costs and money saved for residents. Personal decisions like turning off lights and unplugging appliances could also lead to reductions in greenhouse gas emissions and a modest monetary saving on electric bills.

[2] LEHD Inflow/Outflow Analusois. 2014. City of Springfield, MA. All industries.

Residential

Residential buildings make up just under a third of Springfield's overall community emissions (31.5%) or 384,105 metric tons of CO2e. These emissions are a result of people heating and cooling their homes and powering the lights and technology within them. There are approximately 61,617 housing units in Springfield and of those 55,644 are occupied.[3] These housing units use a variety of fuels to heat and power their homes. These include electricity, natural gas, wood, fuel oil and propane.

Sixty percent of residents use natural gas to heat their homes equating to 146,193 MT CO2e being released into the atmosphere. The next biggest source of emissions in the residential building sector comes from electricity usage for power and heating. All homes in Springfield use electricity to power electronics, but an additional 18.5% also use electricity for heating their homes. Combined residential electricity use accounts for 114,358 metric tons of CO2e. The remaining 20% of housing units in Springfield heat their homes with propane, wood, or fuel oil totaling approximately 123,552 metric tons of CO2e. Almost 70% of the emissions from residential units in Springfield can be attributed primarily to heating homes and not to electrical usage within the home. Thus incentivizing or assisting in better insulation is likely to have a greater impact on lowering emissions, than educating people about conserving energy or switching to LED lightbulbs would.

Commercial

Commercial buildings account for almost 21.9% of Springfield's overall community emissions or 266,176 metric tons of CO2e. The two main sources of energy usage in commercial buildings captured in this audit are electric and natural gas usage. In the near future, commercial emissions are likely to increase as the MGM casino and Union Station come online.

It should be noted that this inventory does not take into account commercial emissions from the use of fuel types other than natural gas or electric (fuel oil, propane, wood, etc.) given the lack of available data. Private business can choose from a plethora of vendors for this service and there is no centralized agency keeping track of who uses what quantity of each fuel type.(These additional fuel types are included in the residential inventory, because the US Census Bureau tracks that types of fuels used in residential units and the US Energy Information Administration[4] tracks the residential sector energy consumption by fuel type.)

Industrial

Industrial buildings account for 15% (182,290 metric tons of CO2e) of Springfield's overall community emissions. In the near future, industrial emissions across Springfield are likely to increase

[3] 2011-2015 American Community Survey- 5-year Estimates.
[4] https://www.eia.gov/state/seds/sep_use/total/pdf/use_MA.pdf

as the rail car factory comes online. A large portion of the industrial emissions in Springfield are coming from Solutia, Inc., a large factory in the city. As a large emitter Solutia is required to report to the EPA's greenhouse gas emissions database annually. In their plant, Solutia uses natural gas, bituminous coal and distillate fuel oil. For the purpose of this inventory, only emissions from the coal and fuel oil were included to avoid double-counting natural gas emissions likely captured in the information received from Columbia Gas. While Solutia is a large emitter, their emissions have been trending down since 2013.

It should be noted that MassPower, one of the state's largest emitters is located in Springfield. MassPower is a power plant creates electricity which is fed into the grid. It was omitted from this inventory because the power plant is generating electricity and could therefore lead to double-counting of emissions throughout the inventory.

Transportation

Transportation accounts for the approximately 29.5% of Springfield's total community emissions—the second largest source of emissions if you consider emissions from each building sector separately. This includes on-road vehicles, public transportation and passenger and freight rail. In Springfield, there are 58,626 residents commuting to work daily. Out of these trips, 75% are made by people driving alone. Additionally, 11% carpool, 5.2% take public transport, 4.1% walk, 2.8% work at home, 0.3% ride their bicycle and 1.2% use another form of transportation (taxi, motorcycle, etc.). The following sections breakdown the emission by transportation type and provide additional information.

On-road vehicles

Ninety-nine percent of the emissions from the transportation sector come from on-road vehicles. This includes heavy trucks, light trucks, motorcycles and passenger vehicles. It is assumed that 791, 385,408 miles are driven annually within Springfield's boundaries. These miles drive equate to approximately 351,793 metric tons of CO2e annually based on the fleet mix and relevant emissions factors. A reduction in vehicle miles driven each year, either by taking transit, walking or bicycling, would result in a direct drop in emissions from the transportation sector. Strategies that make active transportation easier and more desirable will be integral to decreasing emissions from on-road vehicles.

Public Transportation

Included in the transportation emissions sector is emissions from PVTA services within the City of Springfield. Springfield is home to PVTA's biggest transit hub and they operate nineteen different bus lines throughout the City. These nineteen lines make up 43% of the regional system's revenue miles. Annually PVTA's buses use approximately 843,730 gallons of diesel, which equates to approximately 2,738.5 metric tons of CO2e emitted annually—a very small percentage of the overall

transportation emissions. As the PVTA adds more hybrid and all-electric buses to its fleet, the emissions from transit usage will continue to drop.

The PVTA also operate para-transit services in Springfield. These services provide shared-ride, door-to-door van transportation for individuals with disabilities that prevent them from using the agency's fixed-route system. Thirty-one percent of PVTA's para-transit trips have an origin and/or destination in Springfield. Annually, it is estimated that the trips in Springfield consume 126,253 gallons of gasoline, which equate to 1,111 metric tons of CO2e emissions.

Rail

Both passenger and freight rail operate on rail lines throughout Springfield. Currently Amtrak operates three lines (the Northeastern, Vermonter and Lake Shore Limited) which run through and stop in Springfield. Emissions from passenger rail are extremely low, with 659 metric tons of CO2e emissions annually. With additional rail service planned for the valley and additional trains stopping at Union Station in Springfield, emissions from passenger rail are likely to rise in the future—albeit minimally.

Emissions from shipping freight via rail account for approximately 3,775 metric tons of CO2e annually. There are two major freight companies (CSX and Pan-American) shipping goods via rail in Springfield. On these lines approximately 15 million tons of freight move through the state annually. In this greenhouse gas emissions inventory, because of limited available freight data, we have assumed that all of this tonnage at one point or another moves through Springfield. (This means that emissions from freight rail are likely over-estimated.)

Solid Waste

The majority of emissions in the solid waste sector are emitted from the combustion of solid waste at the Covanta-Springfield facility in Agawam. In 2015, a total of 7,672.34 metric tons of CO2e were emitted based on the 38,357 tons of rubbish sent to the incinerator from residents of Springfield. (Note that this figure does not account for rubbish collected by private contractors at businesses and multi-family buildings in Springfield, some of which may also be incinerated at Covanta-Springfield but is not collectively tracked.)

Covanta-Springfield is privately owned and incinerates the mixed solid waste of fifteen communities, including Springfield's curb-side rubbish. Though only one of fifteen communities (albeit the largest), waste from Springfield in 2015 accounted for close to one-third (29.57%, or 38,357.5 tons) of all waste incinerated at the plant (129,715 tons in 2015). The recycling rate in Springfield in 2015 was 15.21%, which is below average. Ash from Springfield and other communities' solid waste incineration is dumped at the Bondi's Island Ash landfill next door.

Residential trash pickup in Springfield generates greenhouse gas emissions itself. This includes transport of the trash to the Covanta facility, and fuel burned by dumptrucks collecting trash from neighborhood streets. The combined greenhouse gas emissions between transport and collection emissions is 767.17 metric tons of CO2e, though this is a calculation based on population served and tons of waste transported, not actual mileage traveled by dump and transport trucks (for which data at the time of this writing is unavailable).

Bondi's Island landfill closed to mixed-solid waste in the late 1980s and has been used only for landfilling ash and yard waste ever since. In 2015, 8,228.02 tons of organic yard waste was composted at Bondi's Island, the biological process of which generated 616.410 metric tons of CO2e. Since ash is inert, no 2015 emissions are recorded from this source. Emissions from existing waste, however, continue to be emitted and are captured in the local government inventory since the landfill is owned by the City of Springfield.

Water/Wastewater Treatment

The distribution/collection and processing of water and wastewater consume electricity and generate other sources of greenhouse gas emissions within the City. In Springfield, the Springfield Water and Sewer Commission (SWSC) is a public utility whose commissioners are appointed by the mayor and approved by city council, giving the City operational control, but SWSC is not a department directly under the financial control of the City. SWSC provides all of Springfield's water and wastewater supply and services.

Electricity used to process the City of Springfield's wastewater is the largest generator of greenhouse gas emissions within the Water/Wastewater sector of this inventory, generating 5,117.76 metric tons of CO2e in 2015. Other N2O emissions emerge once treated wastewater is released back into the Connecticut River. According to ICLEI:

> Effluent discharge is treated wastewater that flows out from a treatment facility or industrial plant and is discharged into waterways, lakes, or the ocean. Effluent discharge originating from a conventional wastewater treatment facility without advanced processes is treated to secondary treatment standards and is therefore called secondary effluent. Conventional WWTPs are not able to remove all of the nitrogen content in wastewater, leaving about 10% in the effluent (Scheehle 2001). However, N_2O is only present in trace amounts (if at all) in the effluent, and most of the nitrogen is in other forms. Only when this nitrogen containing effluent reaches a natural watershed will indirect N_2O emissions occur through side reactions. Using methodology from the EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2010, N_2O emissions through these side reactions could make up to 95% of the total N_2O generated from a WWTP.[5]

[5]ICLEI, *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions Appendix F: Wastewater and Water Emission Activities and Sources, Version 1.1*, p. 53, July 2013.

The de-nitrification process (removal of nitrogen) at the wastewater treatment plant also generates 415.18 metric tons of CO2e.

Springfield's drinking water originates from the Cobble Mountain Reservoir. While there is electricity usage associated with treatment and distribution processes, electricity is also generated as water flows downhill from the reservoir to the treatment plant in Agawam. These calculations do not take into account more recent climate research, however, that indicates reservoirs are larger sources of greenhouse gas emissions than previously thought due to the organic processes involved in converting land cover to aquatic habitat.[6]

Fugitive Emissions

Fugitive emissions are leaks of gas or vapors due to leaks or other unintended releases. Based on the data available, fugitive emissions were only tracked for the natural gas distribution system in the City. Using data on the amount of natural gas consumed in the city as well as a default leakage rate, 7,261.52 metric tons of CO2e were estimated as fugitive emissions in 2015.

[6] Mooney, Chris. "Reservoirs are a major source of global greenhouse gases, scientists say." *Washington Post*, September 28, 2016. Accessed on May 4, 2017 at: https://www.washingtonpost.com/news/energy-environment/wp/2016/09/28/scientists-just-found-yet-another-way-that-humans-are-creating-greenhouse-gases/?utm_term=.cb701117c459.

Local Government Emissions Inventory Results

Introduction

As explained earlier in this report, local government emissions are captured in the community emissions inventory above. However, a local government emissions inventory was completed to better understand what emissions are coming from facilities and processes that the City of Springfield has direct control over. Local Government operations account for 41,991.27 MT of CO2e emissions. This is approximately 3.7% of the overall emissions within the community.

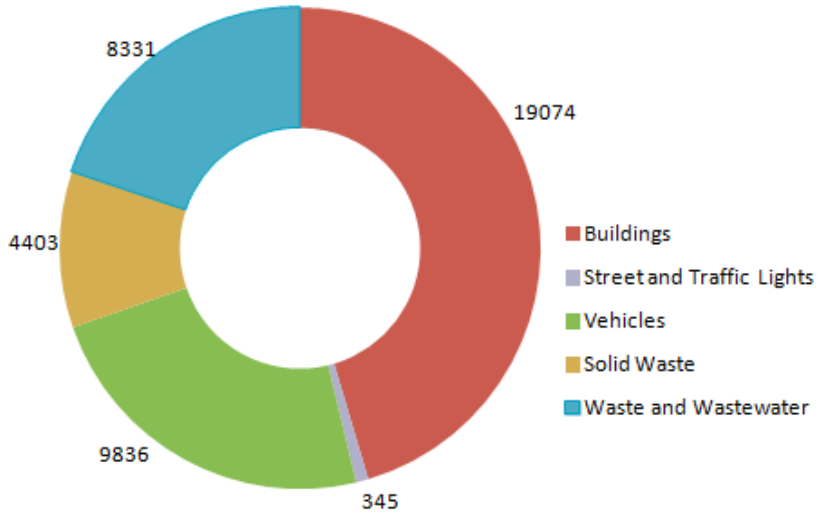

Figure 5: Results of the Local Government GHG Inventory

The table below highlights the data used in the local government emissions inventory.

Table 2: Main GHG Inventory Data Points and their emissions equivalent (Local Government)			
Source or Activity	**Activity Data Quantity and Unit**	**MMBTU**	**Emissions (metric tons CO2e)**
Building Energy			
Parks	21,2497 kwh 41,789 therms	7252.2 4178.9	563.22 222.13
School	22,415,167 kwh 1,668,054 therms	76,502 16,805	5,941.3 8,866.7
Public Safety	2,782,337 kwh 101,238 therms	9,496 10,124	737.48 538.14
Admin	3,434,905 kwh 243,974 therms	11,723 24,367	910.45 1295.3
Streetlights	556,585 kwh	1899.6	147.53
Traffic lights	745,627 kwh	2544.8	195.55
Wastewater/Water Electric Nitrification	 16,409,300 kwh --	 58,787 --	 4565.57 3766.39
Transportation School Buses Vehicle Fleet (Gas) Vehicle Fleet (Diesel)	 420,000 gal (diesel) 380,539 gal (gasoline) 216,102 gal (diesel)	 57,977 47,548 29,831	 4,289.2 3,341.1 2,206.4
Solid Waste (Waste in Place)	1,676,808	---	4,403.7

Buildings

The City of Springfield is responsible for approximately 100 buildings across numerous departments including public safety, education and public works. The energy needed to power and heat these buildings emits approximately 19,074 metric tons of CO2e. The largest source of building emissions (77.6%) is educational facilities. This segment of buildings also account for the vast majority of Springfield's large buildings. The remaining 23%of building emissions are from administration, public safety and park facilities. The city entered into a contract with an energy service company (ESCO), which was responsible for identifying and implementing energy efficiency improvements in most municipal facilities. Using a combination of municipal funds, Green Communities grants, Mass Save Rebates, funding from the Massachusetts School Building Authority and federal grants, the City has been able to implement a number of measures that have lowered fuel and electric usage in facilities and in turn has helped reduce emissions. Projects have included interior and exterior lighting upgrades and controls, replacing old boilers with new high-efficiency boilers and installing energy monitoring systems. [7] Work continues to make the City of Springfield's buildings increasingly more energy efficient.

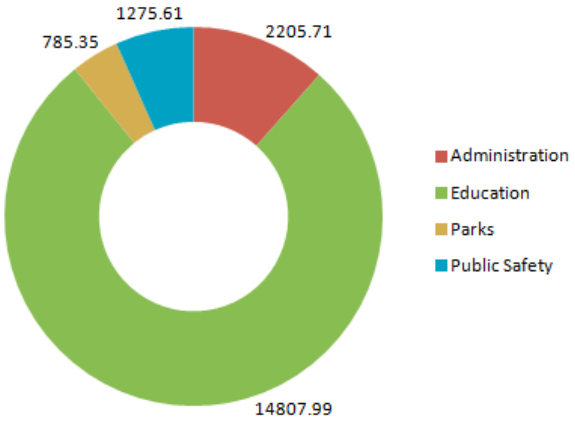

Figure 6: Breakdown of building emissions (MT CO2e) by building type

Transportation

The City of Springfield operates approximately 520 on-road vehicles in its fleet that are used for a wide variety of functions including plowing, policing, and transportation to meetings. They also operate many off-road vehicles (wood-chippers, pavers, lawn mowers, etc) in order to maintain City streets and greenspaces. Almost half of the City's fleet is heavy trucks which are typically used by the department of public works and the parks department. The other half of the fleet is composed of light trucks/passenger vans and passenger vehicles. As a Green Community, the City has adopted a fuel efficient vehicle policy, which requires them to select vehicles that meet fuel efficiency standard set by the Massachusetts Department of Energy Resources. While large vehicles, like dump trucks, and emergency response vehicles, like police cars and fire trucks, are exempt from this policy, the City has replaced a large number of the passenger vehicles in its fleet with newer more efficient models.

[7] http://www.mass.gov/eea/docs/doer/green-communities/pubs-reports/green-communities-case-study-springfield.pdf

In this inventory year, the City of Springfield used 380,539 gallons of gasoline and 216,102 gallons of diesel to fuel its fleet. Over the last few years, fuel usage has been fairly stable in the fleet, with only slight ebbs and flows in the diesel usage—likely explained by winters with more or less snow than usual. This fuel usage equates to 5,547 metric tons of CO2e emissions.

In addition to its vehicle fleet, Springfield contracts with First Student, Incorporated to provide busing services to students. While the City does not have direct control over the buses, it does have the ability to decide who it will contract with for these services and was therefore included in the local government audit. In Springfield, busing eligibility is determined by the distance of the child's home to the school that they attend. Children in kindergarten through 5th grade that live more than 1.5 miles away from school are eligible for free transportation and children in 6th – 12th grade that live more than 2 miles from school are eligible for free transportation. It is estimated that 420,000 gallons of diesel are used annually to provide school bus transportation to Springfield Public Schools. This equates to 4,289.15 metric tons of CO2e emissions annually.

Solid Waste

The City of Springfield did not maintain operational or financial control over the disposal of mixed solid waste generated by or in the city in 2015. While the City provides curb-side rubbish pickup for residents, commercial buildings (including City municipal buildings) must contract with private companies for waste disposal. Covanta-Springfield is a privately-owned entity, and since the City has no control over what or how much waste is processed there, emissions from Covanta-Springfield were not accounted for in the Local Government Inventory. Data on waste generated specifically by City of Springfield municipal operations were not available during the inventory.

Bondi's Island Landfill closed in the late 1980s to mixed solid waste, but waste accumulated there between that time and 1968 when it opened still generates emissions today. The City of Springfield owns and operates Bondi's Island and currently uses it for ash (inert) and organic/compost disposal only. The landfill has a methane collection system, but the collection system does not capture all emissions from the decomposing waste in the landfill. In 2015 fugitive methane emissions from Bondi's Island were an estimated 4,403.7378 metric tons of CO2e.

Water/Wastewater Treatment

As mentioned earlier in this report, the City of Springfield has operational control over the Springfield Water and Sewer Commission, which also provides wastewater and drinking water services and treatment so several other communities. Because SWSC is under operational control of the City, emissions associated with the treatment and processing of drinking and wastewater from ALL customer communities, not just the City of Springfield, are accounted for in the emissions calculation.

In 2015 the most emissions associated with water and wastewater were derived from electricity use (4,349.400 metric tons CO2e). Another 3,427.35 metric tons of CO2e were generated from the biological processes associated with the discharge of treated wastewater back into the Connecticut River. The de-nitrification process accounted for 338.99 metric tons of CO2e, and emissions from electric grid transmission and distribution losses for the wastewater treatment plant accounted for 216.165 metric tons of CO2e.

Emissions from the treatment of drinking water were not included in ICLEI's local government protocol.

Fugitive Emissions

Based on available data (or lack of), no fugitive emissions generated by the City of Springfield were calculated.

Conclusion

This inventory marks completion of Milestone One of the Five Milestones for Climate Mitigation. The remainder of the Climate Action and Resilience Plan outlines the strategies that need to be implemented in order to work towards an 80% reduction in greenhouse gas emissions by 2050. As Springfield begins to implement this Climate Action and Resilience Plan, they should continue to track key energy use and emission indicators on an on-going basis. ICLEI also recommends completing a re-inventory at least every five years to measure emissions reduction progress.

Important strategies to consider for the climate action plan include energy efficiency, renewable energy, vehicle fuel efficiency, alternative transportation, vehicle trip reduction, land use and transit planning, and waste reduction among others. This inventory shows that buildings (across all sectors) and transportation will be particularly important to focus on. Through these efforts and others the City of Springfield can achieve additional benefits beyond reducing emissions, including saving money and improving Springfield's economic vitality and its quality of life.

Springfield Community-wide GHG Emissions Inventory Data Sources		
Data	**Source**	**Notes**
Emission Factors		
Transportation Emission Factors	U.S. EPA " Emissions Factors for Greenhouse Gas Inventories." Last Modified: April 4, 2014.	Most recent Ch4 and N20 factors in each category (Typically 2008-present vehicles) was used.
Electric Grid Emission Factor	eGRID2014 GHG Annual Output Emission Rates . Released in January -2017	
Solid Waste Characterization	"Covanta Energy Springfield: Waste Characterization Study in Support of Class II Recycling Program." Prepared by MSW Consultatnts, February 2014.	
Buildings		
Electric Usage	Eversource Records. Year: 2016. Obtained from Edgar Alejandro at Eversource	
Natural Gas Usage	Columbia Gas Records. Year 2016. Obtained from Andrea Luppi at Columbia Gas	
Large Industrial Emitters	MassDEP GHG Reporting Program Summary Reprt and Facility List: Emissions Year 2015. Published August 2016.	
Non-Utility Residential Energy Use-Springfield Households	American Community Survey, 2011-2015; Selected Housing Characteristics-"House Heating Fuel"	
Non-Utility Residential Energy Use-Massachusetts - Massachusetts Households Use	U.S. Energy Information Administration. "2009 residential Energy Consumption Survey: Final Housing Characteristics Tables."	
State Residential Energy Data Consumption	U.S. Energy Information Administration. " State Energy Data 2014: Consumption. Table CT4: Residential Sector Energy Consumption Estimates, Selected Years, 1960-2014, Massachusetts."	
Transportation		

PVTA Revenue Miles (system wide and Springfield)	PVTA data. Year: FY2016. Obtained by David Elvin	
Diesel Purchased	PVTA data. Year: 2011. Obtained by David Elvin.	
Paratransit Data	PVTA data. Year: Calendar Year 2016. Obtained by David Elvin	31.16% of regional paratransit trips start and/or end in Springfield. Estimated that 31.16% of the miles and fuel used across the City was also used in Springfield. PVTA suggests this is best methodology.
VMT	Pioneer Valley MPO. "2016 Update to the Pioneer Valley Regional Transportation Plan." Year of data point: 2015.	
Fleet Mix	MA Department of Revenue's Municipal Databank. "Massachusetts Registry of Motor Vehicles, Registered Motor Vehicles in Springfield." Year: 2014.	
Amtrak-Service through Springfield	www.amtrak.com	
Amtrak-Energy Intensity of Service	Oak Ridge National Laboratory, "Transportation Energy Databook," 2016.	Assumes 399,000 BTU/train-mile, which is a national average. This is likely slightly overestimated, as the trains running through Springfield typically run fewer cars than the national average.
Freight-Rail	MA Department of Transportation, "Massachusetts Statewide Rail Plan," 2010.	Assumes that the 15 million tons of freight that moves through the state on the CSX lines and the Pan-American lines moved through Springfield. More than likely an overestimate.
Water/Wastewater		
WWTP Energy Use	Data from Springfield Water and Sewer Commission, 2015. Obtained from Bill Fuqua, Wastewater Director.	
Drinking Water Supply	Data from Springfield Water and Sewer Commission, 2015. Obtained from Bill Fuqua, Wastewater Director.	Negative electricity generation b/c reservoir ("extraction") generates electricity.
Solid Waste		
Solid Waste	Data from Covanta Springfield, 2015. Obtained from Scott	

	Porter, Covanta.	
Solid Waste	US Environmental Protection Agency, Facilit Level Information on GreenHouse gases Tool (FLIGHT). Facility Name: Covant Springfield, 2015.	
Yard Waste Compost	Department of Public Works, Total Waste Tonnage Spreadsheet,2015. Obtained from Chris Cignoli, DPW Director.	
Municipal Level Data		
Building Energy	City of Springfield data. Year: FY 2015. (Used annually reported Green Communities data.)	
Street Lights	Eversource Calculations. Obtained from Chris Gagnon, Senior Project Specialist-Operations Support-Eversource	
Vehicular Fuel Consumption	Springfield Department of Public Works, FY 2015. Obtained from Bob Houldson, DPW Information Technology Manager.	
School Bus Fuel Consumption	Data from First Student, Inc. Obtained from Brian Shaw, Location Manager	
Wastewater/Water	Data from Springfield Water and Sewer Commission, 2015. Obtained from Bill Fuqua, Wastewater Director.	
Solid Waste Emissions	US Environmental Protection Agency, Facilit Level Information on GreenHouse gases Tool (FLIGHT). Facility Name: Bondi's Island Landfill.	Used equation 9.1 in Local Gov scope to calculate fugitive emissions, per advisement of Eli Yewdall of ICLEI on 4/26/17