

APPENDIX C: CLIMATE ACTION AND CLEAN ENERGY





Appendix C.1:2016 Greenhouse Gas(GHG) Emissions Inventory Methodology





St. Petersburg, FL, Community-Scale Greenhouse Gas Emissions Inventory (CY2016) – Methodology, July 2018

Overview

This city-wide greenhouse gas (GHG) emissions inventory attempts to account for all GHGs generated from activities occurring within the City of St. Petersburg, Florida in 2016. These emissions are generated because of activities of the municipal government, as well as from activities of residents and businesses within the city. The methodology described below is consistent with the *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories* (GPC).¹ The GPC requires the measurement and disclosure of a comprehensive inventory of GHG emissions in addition to the totaling of these emissions based on production and consumption activities that take place within the city boundary (i.e., city-induced framework²) and based on where these emissions are physically released (i.e., Scopes Framework). For categorizing emissions by scope, the GPC provides the following definitions:

- Scope 1 (also known as territorial) GHG emissions from sources located within the city boundary;
- Scope 2 GHG emissions occurring because of the use of grid-supplied electricity, heat, steam, and/or cooling within the city boundary; and
- Scope 3 All other GHG emissions that occur outside the city boundary because of activities taking place within the city boundary.

² According to the GPC, the City-induced framework totals GHG emissions attributable to activities taking place within the geographic boundary of the city. It covers selected scope 1, 2 and 3 emission sources representing the key emitting sources occurring in almost all cities, and for which standardized methods are generally available.



¹ World Resources Institute, C40 Cities Climate Leadership Group, and ICLEI – Local Governments for Sustainability (ICLEI). (2014). Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). Retrieved from <u>http://www.ghgprotocol.org/sites/default/files/ghgp/standards/GHGP_GPC_0.pdf</u>

The GPC requires cites to report emissions using both the Scopes framework and the Cityinduced framework.

- > Scopes framework: This totals all emissions by scope 1, 2 and 3. Scope 1 (or territorial emissions) allows for the separate accounting of all GHG emissions produced within the geographic boundary of the city, consistent with national-level GHG reporting.
- > City-induced framework: This totals GHG emissions attributable to activities taking place within the geographic boundary of the city. It covers selected scope 1, 2 and 3 emission sources representing the key emitting sources occurring in almost all cities, and for which standardized methods are generally available.





Inventory Boundary and Emissions Sources

The community-scale inventory boundary aligns with the administrative boundary or jurisdictional boundaries of the City of St. Petersburg. The inventory covers the four main sectors of the GPC for the reporting year of 2016 (calendar), including:

- > Stationary energy;
- > Transportation;
- > Waste; and
- > Agriculture, forestry, and other land use (AFOLU).

Due to a lack of available data, this inventory does not include emissions from the Industrial Processes and Product Use (IPPU) sector. Based on this exclusion, along with the exclusion of select sub-sectors as outlined below, this inventory uses the BASIC reporting level under the city-induced framework. The BASIC level covers scope 1 and scope 2 emissions from the Stationary Energy and Transportation sectors. It also includes scope 1 and scope 3 emissions from the Waste sector. The other reporting level option offered by the city-induced framework, BASIC+, "involves more challenging data collection and calculation processes, and additionally includes emissions from IPPU and AFOLU and transboundary transportation." Both reporting levels allow for direct comparisons between cities, however, the GPC encourages cities to report on IPPU and AFOLU and transboundary transportation when they are significant and relevant. To include IPPU emission sources in future inventories, the City of St. Petersburg would need to inventory and understand the large industrial operations within its boundaries that chemically or physically transform materials such as those in cement production and glass production, as well as those in the electronics industry. Efforts were made to reach out to such industries for the 2016 inventory, but data was unavailable at this point in time.





Emissions by Sector

The following sections describe how emissions were calculated for the sectors and their respective sub-sectors included in this inventory.

Stationary Energy

The sub-sectors in this inventory under the Stationary Energy sector include residential buildings, commercial and institutional buildings, manufacturing industries and construction, and fugitive emissions from oil and natural gas systems. There are no energy industries within the City of St. Petersburg, such as power plants, and energy consumption data specific to agriculture, forestry and fishing and non-specified sources were not available at the time of this inventory. Although not unusual for cities of its size, the City of St. Petersburg does not have and is not associated with any utility-scale renewable energy projects. Further, information on behind the meter renewable energy projects was also not available. Renewable energy production only indirectly impacts scope 2 emissions by lowering the grid average emission factor; however, such projects can be reported separately from emissions reporting if offset credits are generated and sold. Identifying the lack of such projects and monitoring provides the City with the incentive to engage in these activities in the future.

Natural Gas

To calculate emissions from the combustion of natural gas, data on natural gas usage by rate class (i.e., Residential, Commercial, and Industrial) were provided by Peoples Gas (TECO Energy) in terms of therms per year and multiplied by emission factors from the United States Environmental Protection Agency (USEPA). These emission factors were: 53.06 kg CO₂ per mmBtu, 1.0 g CH4 per mmBtu, and 0.10 g N2O per mmBtu. Emission values were then multiplied by their respective 100-Year Global Warming Potentials (GWPs) to approximate CO_2 equivalents (CO2e) and converted into metric tons (mt) for the purpose of maintaining consistency in reporting across sectors and in accordance with the GPC. Peoples Gas is the only natural gas utility that serves the City of St. Petersburg along with its residents and businesses.

Fugitive emissions from natural gas consumption are associated with equipment leaks, evaporation losses, venting, flaring, and accidental releases. Such emissions were calculated using Intergovernmental Panel on Climate Change (IPCC) Tier 1 Emission Factors for Fugitive Emissions from Oil and Gas Operations in Developed Countries/Developing Countries and Countries with Economies in Transition. These emission factors were: 5.10E-08 CO2 per m3



utility sales and 1.10E-06 CH4 per m3 utility sales. Natural gas consumption data by rate class were multiplied by these emission factors, the results of which were then multiplied by their respective GWPs to approximate their total CO2e and then converted into metric tons.

GWPs utilized in these calculations and throughout this inventory are CO2 = 1, CH4 = 25, and N2O = 298.

Electricity

City-wide data on electricity usage by sector were provided by Duke Energy in the form of total kWh per year. Sectors provided by Duke Energy included Residential, Commercial, Industrial, Sales to Public Authority (i.e., municipal and state facilities and infrastructure), and Street and Highway Light. For the purposes of aligning with the sub-sectors of the GPC, usage attributable to the sectors of Sales to Public Authority and Street and Highway Light were consolidated with the Commercial sector. Duke Energy is the only electric utility providing service to the City of St. Petersburg along with its residents and businesses.

To calculate emissions from the consumption of grid-supplied electricity, usage data by sector were multiplied by emission factors specific to St. Petersburg's eGrid sub-region (FRCC) deriving from USEPA. These emission factors were: 1,011.7 lbs/MWh CO₂, 0.075 lbs/MWh CH4, and 0.010 lbs/MWh N2O. Emission values were then multiplied by their respective GWPs to approximate CO2e and converted into metric tons.

This inventory accounts for transmission and distribution losses associated with electricity consumption. Emissions from such losses were calculated using rates of loss as estimated by Duke Energy (2.0 percent for transmission and 3.2 percent for distribution). These loss factors were applied to the usage data by sector and multiplied by the same eGrid sub-region emission factors as above. The results were multiplied by their respective GWPs to approximate their total CO2e and then converted into metric tons.

Transportation

GHG emissions from the Transportation sector result from the combustion of fuel in vehicle engines and through the indirect use of grid-electricity in electric vehicles (e.g., plug-in hybrid electric vehicles [PHEVs] or battery electric vehicles [BEVs]). The transportation subsectors included in this inventory are on-road, waterborne navigation, and aviation. No passenger rail service travels within or through the city, and though freight rail exists, no data on such activities could be acquired due to that data being classified as proprietary.³ Data on off-road transportation (e.g., agricultural tractors, forklifts) was also not available at the time of this inventory; however, such activities are not prevalent in St. Petersburg's predominantly urban setting.

On-Road Transportation

Emissions from fuel used by on-road vehicles (e.g., electric and fuel-powered cars, trucks, buses, etc.) were calculated using the geographic or territorial method, as outlined in the

3 O'Malley, B. (2018). RE: City of St. Petersburg ISAP and GHG Inventory - CSX Data Request.



GPC, which focuses on all travel taking place within the city's boundary. This method does not account for activities that occur outside the boundary, even if such activities are associated with trips that cross or originate within the boundary.

Activity data on fuel consumption was determined through a combination of vehicle miles traveled (VMT) and national average fuel economies by vehicle class. VMT was not directly available for the City of St. Petersburg. Instead, this information was inferred using county-level data. County-level VMT was calculated on an annual basis by multiplying the daily values provided in *Public Road Mileage and Miles Traveled Report* from the Florida Department of Transportation (FDOT) by 365 days.⁴ VMT within the city was allocated based on the percent of total county centerline roadway mileage within the city as identified in FDOT's *2016 City County Mileage*.⁵

To determine miles traveled by different vehicle classes, first a breakdown of vehicle classes needed to be estimated. The Federal Highway Administration (FHWA) Scheme F was used to define the classifications, which are Motorcycles, Passenger Cars, Light-Duty Trucks, Buses, and Medium and Heavy-Duty Trucks. Vehicle class distribution in the city was estimated using sampled portable and telemetered survey locations from FDOT's Annual Vehicle *Classification Report.*⁶ Geographic information systems (GIS) processing tools were used for sample selection to ensure randomness. Ten locations in St. Petersburg were sampled and their respective vehicle class distributions were recorded and summed; total vehicles included within this sample were 423,252. The percentage of total vehicles counted by the FHWA classification is listed in Table C.1-1, column "Percentage of Total Vehicle in Sample". Fuel economy figures from FHWA⁷ for the defined classifications (see Table 1, column "Average Miles Traveled per Gallon of Fuel Consumed") were used to compute the final VMT calculation. This was done by multiplying the "Percentage of Total Vehicles in Sample" by the allocated County-level VMT to produce the total miles travelled by that classification. This total miles figure was then multiplied by the "Average Miles Traveled per Gallon of Fuel Consumed" to provide an estimate of gallons consumed per classification.

⁷ FHWA. (2016). Annual Vehicle Distance Traveled in Miles and Related Data – 2016; BY Highway Category and Vehicle Type. Retrieved from http://www.fhwa.dot.gov/policyinformation/statistics.cfm



⁴ FDOT. (2016). Public Road Mileage and Miles Traveled Report, 2016. Retrieved from http://www.fdot.gov/statistics/mileage-rpts/

⁵ FDOT. (2016). 2016 City County Mileage (Data as of September 30, 2016). Retrieved from http://www.fdot.gov/statistics/mileage-rpts/

⁶ FDOT. (2016). Annual Vehicle Classification Report – Report Type: All, Count Year 2016. Retrieved from http://flto.dot.state.fl.us/website/FloridaTrafficOnline/viewer.html

| Vehicle Class | Vehicle Type | Percentage of Total Vehicles in Sample ¹ | Average Miles Traveled per Gallon of Fuel Consumed |
|---------------|--|---|---|
| 1 | Motorcycles | 0.4 | 43.9 |
| 2 | Passenger Cars | 77.0 | 24.0 |
| 3 | Light Duty Trucks (SUVs, Pick-ups, Vans) | 18.1 | 17.4 |
| 4 | Buses | 0.3 | 7.3 |
| 5 through 8 | Medium-Duty Trucks (up to 4 axles) | 3.2 | 7.4 |
| 9 through 13 | Heavy-Duty Trucks (5 or more axles) | 0.7 | 5.9 |

Table C.1-1 Estimated On-Road Vehicle Class Distribution and Fuel Economies in the City of St. Petersburg

Sources: City of St. Petersburg

1 Percentages do not add up to 100 percent. The vehicle class category of 'Other' was excluded. This category represents less than 1 percent of the total vehicles that comprise the sample.

To estimate CO_2 emissions, emission factors from USEPA for both gasoline (8.78 kg CO_2 / gal) and diesel (10.21 kg CO_2 / gal) fuels⁸ were applied. Since the referenced studies did not provide a breakdown of gasoline and diesel-powered vehicles, and it would be cost-prohibitive to collect such data, it was assumed that the lighter vehicle classes of Motorcycles, Passenger Cars, and Light Duty Trucks consumed gasoline exclusively, while the heavier vehicle classes of Buses, Medium-Duty Trucks and Heavy-Duty Trucks consumed diesel exclusively.

To calculate the amount of CH_4 and N_2O emitted from on-road transportation, emission factors from USEPA were applied for gasoline and diesel fuel consumption. These emission factors are provided in **Table C.1-2.**

Table C.1-2 CH₄ and N₂O Emission Factors by Fuel and On-Road Vehicle Type

| Fuel and Vehicle Type | CH₄ (g / mile) | N ₂ O (g / mile) |
|--------------------------------------|---|-----------------------------|
| Gasoline | | |
| Motorcycles | 0.0672 | 0.0069 |
| Passenger Cars | 0.0173 | 0.0036 |
| Light-Duty Trucks | 0.0163 | 0.0066 |
| Diesel | | |
| Buses | 0.0051 | 0.0048 |
| Medium-Duty | 0.0051 | 0.0048 |
| Trucks | | |
| Heavy-Duty Trucks | 0.0051 | 0.0048 |
| Source: USEPA. (2015). Emission Fact | ors for Greenhouse Gas Inventories. Ret | rieved from |

https://www.epa.gov/sites/production/files/2015-11/documents/emission-factors_nov_2015.pdf

8 USEPA. (2015). *Emission Factors for Greenhouse Gas Inventories*. Retrieved from <u>https://www.epa.gov/sites/production/files/2015-11/documents/emission-factors nov 2015.pdf</u>



Once the total CO_2 , CH_4 , and N_2O emission values were determined, their respective GWPs were applied to approximate CO_2e . These values were subsequently converted into metric tons.

Waterborne Navigation

Emissions from fuel consumed by waterborne vehicles (e.g., power boats) were calculated by obtaining the number of boat slips (wet and dry) and fuel sales estimates from a sample of marinas located within the inventory boundary. As this method relies on total fuel sales, it cannot discern routes, and therefore, does not distinguish activities that occur outside the boundary. As such, this inventory excludes international waterborne navigation; IPCC allows for the exclusion of such activities. The marinas for which the number of slips and fuel estimates were available included:

- > St. Petersburg Municipal Marina (500 1st Avenue S.E., St. Petersburg, FL 33701)
- > Harborage Marina (1110 3rd Street South, St. Petersburg, FL 33701)
- > IGY Maximo Marina (4801 37th St. South, St. Petersburg, FL 33711)
- > Tierra Verde Marina (100 Pinellas Bayway South, St. Petersburg, FL 33715)

To determine the number of boats in St. Petersburg, 2015 boat registration data for Pinellas County, as reported in the *Tampa Bay Times*,⁹ was used. The change in county population between 2015 and 2016 was applied to approximate 2016 boat registrations. The percent of population in the City of St. Petersburg in 2016 was used to scale the number of boat registrations in the county down to the city level.

Fuels sold at the identified facilities included REC-90 (ethanol-free), 89 octane, and diesel; this list encompassed the scope of fuels including under the Waterborne Navigation sector in this inventory. It was not possible at the time of this inventory to determine emissions from grid-supplied energy consumed within the city boundary specifically for waterborne navigation (i.e. directly plugging boats into electrical outlets when docked); however, such fueling is captured under stationary energy and marina power sources that are owned by the City are accounted for within the municipal operations inventory.

To determine consumption by fuel type, an average annual fuel consumption value per boat was calculated. This was accomplished by totaling the gallons of fuel sold at the reporting facilities (i.e., approximately 2.6 million) and dividing that figure by the total number of slips at these locations (i.e., 2,847). The number of boats by fuel type was determined by multiplying the percent of total fuel sales by fuel type (e.g., gasoline fuel sales amounted to 65.4 percent of total fuel sales during the inventory year) to the total number of slips. The average annual fuel consumption per boat (i.e., 197.7) was then multiplied by the number of boats by fuel type (e.g., 8,632 gasoline-powered boats were active during the inventory year) to obtain total fuel consumed by fuel type (e.g., of the 2.6 million gallons of fuel sold, gasoline-powered boats consumed approximately 1.7 million gallons).

9 Tampa Bay Times. (2016). *Pinellas ranks fifth in number of serious boating accidents*. Retrieved 30 March 2018, from http://www.tampabay.com/news/pinellas-ranks-fifth-in-number-of-serious-boating-accidents/2278526



Fuel consumption estimates were then used to calculate CO_2 emissions using emission factors from USEPA for both gasoline (8.78 kg CO2 / gal) and diesel (10.21 kg CO₂ / gal).¹⁰ **Table C.1-3** provides the emission factors used to calculate the amount of CH₄ and N₂O emitted.

Table C.1-3 CH₄ and N₂O Emission Factors for Ships and Boats by Fuel Type

| Fuel Type | CH₄ (g / gallon) | N₂O (g / gallon) |
|-----------|------------------|------------------|
| Gasoline | 0.64 | 0.22 |
| Diesel | 0.06 | 0.45 |

Source: USEPA. (2015). Emission Factors for Greenhouse Gas Inventories. Retrieved from https://www.epa.gov/cites/production/files/2015_11/documents/emission_factors_pov/2015_t

https://www.epa.gov/sites/production/files/2015-11/documents/emission-factors_nov_2015.pdf

Once the total CO₂, CH₄, and N₂O emission values were determined, their respective GWPs were applied to approximate CO₂e. These values were subsequently converted into metric tons.

Aviation

Emissions from fuel consumed by airborne trips were calculated by obtaining fuel sales data and the number of aircraft operations by type (i.e., itinerant [i.e., those that depart or leave the airport area] versus local [i.e., those that stay within the airport's airspace]). This information was collected directly from the Albert Whitted Airport, which is located within the City of St. Petersburg.¹¹

Fuel sold at Albert Whitted is either Jet A/A-1 or aviation gasoline (avgas). Operation types at the airport include general aviation (local and itinerant), military (local and itinerant), and air taxi. For simplicity, and to align with the GPC, all local operations were considered to take place within the city boundary and all itinerant operations, including air taxi operations, were considered to be transboundary journeys taking place entirely outside the city boundary.

To determine the amount of fuel consumed by operation type (i.e., local or transient), total fuel sales was multiplied by the percent of each operation type relative to total operations (e.g., local operations accounted for 52.7 percent of total operations, and this value was multiplied by total fuel sales, which comprised 275,246 gallons). These values were then multiplied by the percent of total sales for each fuel type relative to total fuel sales (e.g., total gallons of fuel consumed by local operations amounted to 144,760 gallons, but only 42.9 percent or 62,139 gallons of that was Jet A fuel). It was not possible at the time of this inventory to determine grid-supplied energy consumed by aircraft charging at the airport; however, such fueling is captured under stationary energy.

¹¹ Lesniak, R. (2018). RE: City of St. Petersburg ISAP and GHG Inventory - Albert Whitted Data Request.



¹⁰ USEPA. (2015). *Emission Factors for Greenhouse Gas Inventories*. Retrieved from <u>https://www.epa.gov/sites/production/files/2015-11/documents/emission-factors nov 2015.pdf</u>

Fuel consumption estimates were then used to calculate CO_2 emissions using emission factors from USEPA for both Jet A/A-1 (9.75 kg CO2 / gal) and avgas (8.31 kg CO₂ / gal).¹² **Table C.1-4** provides the emission factors used to calculate the amount of CH₄ and N₂O emitted.

Table C.1-4 CH₄ and N₂O Emission Factors by Aircraft Fuel Type

| Fuel Type | CH₄ (g / gallon) | N₂O (g / gallon) |
|-------------------------------|------------------|------------------|
| Jet Fuel Aircraft (Jet A/A-1) | 0.00 | 0.30 |
| Aviation Gasoline Aircraft | 7.06 | 0.11 |

Source: USEPA. (2015). Emission Factors for Greenhouse Gas Inventories. Retrieved from

https://www.epa.gov/sites/production/files/2015-11/documents/emission-factors_nov_2015.pdf

Once the total CO₂, CH₄, and N₂O emission values were determined, their respective GWPs were applied to approximate CO₂e. These values were subsequently converted into metric tons.

Waste

GHG emissions from the Waste sector result from the generation and disposal/treatment of solid waste and wastewater. Disposal or treatment may occur within the city or outside the city. The waste sub-sectors included in this inventory are solid waste disposal, incineration and open burning, and wastewater treatment and discharge. This inventory does not include any biological treatment of waste, as data on composting was not readily available and there are no known anaerobic digesters within the City's boundaries.

Solid Waste

The City of St. Petersburg sends its solid waste to the Bridgeway Acres Landfill (Bridgeway), a solid waste disposal and treatment facility managed by the Pinellas County Solid Waste Department/Pinellas County Resource Recovery which is located outside the jurisdictional boundaries of the city. Less than 15 percent of waste received at this facility is landfilled and the remaining is either recycled or converted to energy.¹³ Solid waste generation recorded by this facility is reported to USEPA on an annual basis. In turn, USEPA calculates associated emissions and publishes the results on its website (https://ghgdata.epa.gov/ghgp/main.do).

To calculate emissions associated with solid waste, USEPA-reported emissions for Bridgeway¹⁴ were scaled using City of St. Petersburg provided data. The City's portion of waste landfilled at Bridgeway was calculated by multiplying the weight of the total waste stream generated within the City by 15 percent, the percentage Pinellas County estimates is

¹⁴ USEPA. (2016). Pinellas County Resource Recovery: Facility Information. Retrieved 12 March 2018, from https://ghgdata.epa.gov/ghgp/service/facilityDetail/2016?id=1001884&ds=E&et=&popup=true



¹² USEPA. (2015). *Emission Factors for Greenhouse Gas Inventories*. Retrieved from <u>https://www.epa.gov/sites/production/files/2015-11/documents/emission-factors_nov_2015.pdf</u>

¹³ Pinellas County Florida. (2018). Solid Waste - Landfill / Garbage Disposal. Pinellascounty.org. Retrieved 12 March 2018, from http://www.pinellascounty.org/solidwaste/landfill-garbage.htm

landfilled at the facility. The volume of waste combusted at Bridgeway and related city estimates were not available at the time of this inventory, but can be coordinated between the two entities for future inventories. The City of St. Petersburg Department of Sanitation Department supplied the data on the city's total waste stream (i.e., either sent to Bridgeway or otherwise recycled).¹⁵

Wastewater

As also described in the Government Inventory, the City of St. Petersburg owns and operates three well-managed wastewater treatment plants (WWTPs) that are all located within its jurisdiction and serve the city as well as a small population that resides outside the city. These facilities include Northeast Water Reclamation Facility (WRF), Northwest WRF, and Southwest WRF.

Emissions from wastewater treatment were calculated separately for the in-boundary population and for the out-of-boundary population using raw data provided by the City of St. Petersburg by way of their consultant, Jacobs Engineering Group.¹⁶ These data included the following pertinent parameters by facility:

- > Total volume of wastewater treated by domestic and industrial sources;
- > Total population served by location (i.e., inside or outside the city);
- > Volume of wastewater discharged to open water; and
- > Influent biochemical oxygen demand (BOD) concentrations.

While this inventory follows the GPC methodologies, because the City is utilizing the ClearPath tool for reporting its community-scale GHG emissions, the calculators for wastewater treatment emissions within the tool were utilized. These calculators reference methods outlined in Appendix F of the US Community Protocol. Following Chart WW.1 Decision Tree for Reporting Emissions from Wastewater Treatment Technologies within Your Community (**Figure C.1-1**), and with the assumption the lagoon systems are not in use, it was determined to utilize methods in **Figure C.1-2**, and specifically Methods WW.8 and WW.12.b. Data was entered into the ClearPath calculators for these referenced methods to calculate total in-boundary and out-of-boundary N₂O process emissions from effluent discharge to open waters as well as nitrification/denitrification process N₂O emissions. In future updates to this GHG inventory, Water Department staff should confirm wastewater treatment methods, particularly if those change over time due to facility upgrades or similar, and select the most applicable methods and calculators as referenced in the ClearPath tool and US Community Protocol.

15 Turner, R. (2018). Sanitation info.

¹⁶ Pica, L. (2018). FW: Greenhouse Gas Inventory Assistance.









Figure C.1-2: Chart WW.4, Appendix F, US Community Protocol for Accounting and Reporting of GHG Emissions



Figure C.1-3 shows the list of calculators available within the ClearPath tool, which align with the methods described in the US Community Protocol, Appendix F.

Figure C.1-3: List of Available Calculators, ClearPath Tool

Available Calculators

Pick a calculator to enter a new record.

Emissions from Wastewater Treatment Energy Use ③ Emissions from the Combustion of Digester Gas ③ Emissions from the Supply of Potable Water ③ Emissions from Combustion of Biosolids and Sludges ③ Fugitive Emissions from Septic Systems ③ Nitrification/Denitrification Process N2O Emissions from Wastewater Treatment ③ Process Emissions from Wastewater Treatment Lagoons ③ Process N2O from Effluent Discharge to Rivers and Estuaries ③ Emissions from Flaring of Digester Gas ③ CO2 Emissions from the Use of Fossil Fuel Derived Methanol ③ Notation Keys for Water and Wastewater ③



In accordance with the GPC, wastewater process emissions for community-scale inventory reports both in-boundary and out-of-boundary emissions separately. The municipal operations inventory claims and reports the combined total of both in- and out-of-boundary emissions since the City owns and operates the facilities.

AFOLU

The Agriculture, Forestry, and Other Land Use (AFOLU) sector addresses GHG emissions emanating from land use changes and land management practices, as well as methane produced in the digestive processes of livestock. The sub-sector of AFOLU included in this inventory is aggregate sources and non-CO₂ emission sources on land, as the City's Parks & Recreation Department and Golf Courses utilize fertilizers in their landscape maintenance practices. As there were no measurable changes to land use during the inventory year and no substantial agricultural or forestry-related activities in the urban setting that comprises the City of St. Petersburg, there are no significant sources of emissions deriving from land use (e.g., forest lands, croplands, grasslands) or livestock (i.e., enteric fermentation and manure management). This inventory excludes these sub-sectors.

Aggregate Sources and non-CO₂ Emission Sources on Land

Among the emission sources associated with this sub-sector, only N₂O from managed soils is addressed. This involves direct emissions of N₂O from the addition/release of nitrogen (N) into managed soils and indirect emissions through volatilization of N from these soils. Data on the amount of synthetic fertilizers was obtained from the City of St. Petersburg Parks & Recreation Department¹⁷ and the City's Golf Courses,¹⁸ which include the Twin Brooks, Mangrove Bay, and Cypress Links Golf Courses.

Direct N₂O from managed soils (Figure C.1-4) provides the calculation that was used to estimate direct N₂O emissions by fertilizer type by location of application. This calculation is Equation 10.10 in the GPC. It was assumed that soils at the City's facilities were organic, and as such, N₂O-N_{N inputs} was the only variable that was applicable to the city's context; N₂O-N_{OS} (Direct N₂O-N from managed inorganic soils) and N₂O-N_{PRP} (Direct N₂O-N from urine and dung) were consequently omitted.

Direct N_2O -N from managed soils (Figure C.1-5) shows the calculation used to estimate N_2O - N_N inputs (Equation 10.11 in the GPC). Variables related to animal

Figure C.1-4: Direct N₂O from Managed Soils

| $\label{eq:N2O-N_singula} \begin{split} & $N_2O_{blend} = $$ (N_2O-N_{sc}+N_2O-N_{os}) \times 44/28 \times 10^{-3}$ \end{split}$ | | | | | | | |
|--|---|--|--|--|--|--|--|
| Njo | = | Direct N_O emissions produced from managed soffs, in tonnes | | | | | |
| NjO-N _{nimin} | = | Direct N_O-N emissions from N inputs to managed soils, kg N_O-N peryear | | | | | |
| Njo-N_ | = | Direct N_O-N emissions from managed inorganic soils, kg N_O-N perÿear | | | | | |
| Njo-N _{eer} | = | Direct N_O-N emissions from urine and dung inputs to grazed soils, kg N_O-N per year | | | | | |
| 44/28 | = | Conversion of N (N.O-N) to N.O | | | | | |

Source: Equation adapted from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Agriculture, Forestry and Other Land Use available at: www.ipcs-nggipiges.or.jp/public/2006gl/vol4.html

17 Vineyard, M. (2017). FW: Greenhouse Gas Inventory Assistance.

¹⁸ Hollis, J. (2018). FW: Greenhouse Gas Inventory Assistance.



manure, crop residues, and mineral soils were omitted; F_{SN} , the amount of synthetic fertilizer N applied to soils (kg N per year), was maintained.

 F_{SN} was calculated by multiplying the fertilizer concentrations by their respective application weights. These values were then multiplied by the default

emission factor for N₂O emissions from N inputs (EF₁) (0.01 kg N₂O–N (kg N input)-1 from Table 11.1 of IPCC 2006 Volume 4 Chapter 1: N₂O Emissions from Managed Soils, and CO₂ Emissions from Lime and Urea Application¹⁹ to calculate N₂O-N_N inputs. As rice cultivation is not a relevant component within the city, the related emissions factor (EF_{1FR}) was omitted from the N₂O-N_{N inputs} equation. Once the value for N_2O-N_N inputs was known, it was then multiplied by the equation constants of 44/28 and 10⁻³ to estimate the direct N₂O emissions produced from managed soils in metric tons.

 N_2O from atmospheric deposition of N (Figure C.1-6) shows the calculation the estimation of indirect N_2O emissions by fertilizer type by location of application (Equation 10.19 in the GPC). Similar to Equation 10.11, F_{SN} was the only variable maintained, all others with exception to the emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces (EF₄) and the fraction of synthetic fertilizer N that volatizes as NH₃ and NO_{X'} kg N volatilized per kg

Figure C.1-5: Direct N₂O-N from Managed Soils

$$N_2$$
O- $N_{H \ layabs} =$
 $(F_{SN} + F_{ON} + F_{CR} + F_{SOM}) \times EF_1$
 $+ (F_{SN} + F_{ON} + F_{CR} + F_{SOM})_{re} \times EF_{1re}$

| N ₂ O-N _{Ninpile} | = | Direct NgO-N emissions from N inputs to managed soils, kg NgO-N peryear |
|---------------------------------------|---|--|
| F | = | Amount of synthetic fertilizer N applied to soils, ko N per vear |
| F _{cN} | = | Amount of animal manure, compost, sewage sludge and other organic N additions applied to soils (<i>Note:</i> If including sewage sludge, cross-check with Waste sector to ensure there is no double counting of N ₂ O emissions from the Nin sewage sludge), kg N peryear. See Equation 10.14 |
| F | | Amount of Nin crop residues (above- ground and below-ground), including N-fixing crops, and from forage/pasture renewal, returned to soils, kg N per year. See Equation 10.17 |
| F | 8 | Annüal amount of N in mineral soils that is mineralized, in association with loss of soil C from soil organic matter as a result of changes to land use or management, kg N per year. See Equation 10/18 |
| EF | = | Emission factor for NgO emissions from N inpūts, kg NgO-N (kg N inpūt)-1 |
| EF | = | Emission factor for N_O emissions from N inpūts to flooded rice, kg N_O–N (kg N inpūt)-1 |

Source: Equation adapted from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Agriculture, Forestry and Other Land Use available at: www.ipcc-nggip.iges. orijp/public/2008gl/xol4.html

N applied ($Frac_{GASF}$) were omitted. F_{SN} was multiplied by default values for $Frac_{GASF}$ (0.10 [kg NH₃–N + NO_x–N] [kg N applied]) and EF_4 (0.01 kg N₂O–N [kg NH₃–N + NO_x–N volatilized])

¹⁹ IPCC. (2006). 2006 Volume 4 Chapter 11: N2O Emissions from Managed Soils, and CO2 Emissions from Lime and Urea Application, Table 11.1 Default Emission Factors to Estimate Direct N2O Emissions from Managed Soils. Retrieved from <u>http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_11_ch11_N2O&CO2.pdf</u>



to estimate the amount of N_2O produced from atmospheric deposition of N volatilized from managed soils in metric tons ($N_2O_{(ATD)}$). These default values were pulled from Table 11.3 of IPCC 2006 Volume 4 Chapter 1: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application.²⁰

Finally, direct and indirect N_2O emissions were summed by fertilizer type and by location of application and multiplied by the GWP for N_2O to approximate CO_2e . This value was then converted into metric tons.

Figure C.1-6: N₂O from atmospheric deposition of N

$$N_2O_{(AD)} = [(F_{SN} \times Frac_{GASP}) + ((F_{ON} + F_{FBP}) \times Frac_{GASM})] \\ \times EF_4 \times 44/28 \times 10^3$$

| N ₂ O _(AID) | = | Amount of N ₂ O produced from atmospheric deposition of N volatilized from managed soils in tonnes |
|-----------------------------------|---|---|
| F | = | Amount of synthetic fertilizer N applied to soils, kg N per year |
| F _{ON} | = | Amount of animal manure, compost, sewage sludge and other organic N additions applied to soils (<i>Note</i> : If including sewage sludge, cross-check with Waste sector to ensure there is no double counting of N ₂ O emissions from the N in sewage sludge), kg N per year. See Equation 10.14 |
| F _{PPP} | = | Annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock, kg N per year (<i>Note:</i> the subscripts CPP and SO refer to Cattle, Poultry and Pigs, and Sheep and Other animals, respectively) See Equation 10.16 |
| 44/28 | = | Conversion of N (N,O-N) to N,O |
| Frac _{case} | = | Fraction of synthetic fertilizer N that volatilizes as NH3 and NO _x , kg N volatilized per kg N applied |
| Frac _{GASM} | = | Fraction of applied organic N fertilizer materials (F_{ON}) and of urine and dung N deposited by grazing animals (F_{PBP}) that volatilizes as NH ₃ and NO ₄ , kg N volatilized per kg N applied or deposited |
| EF ₄ | = | Emission factor for N ₂ O emissions from atmospheric deposition of N on soils and water surfaces, kg N ₂ O-N per kg NH ₃ -N and NO ₂ -N volatilized |
| | | |

Source: Equation adapted from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Agriculture, Forestry and Other Land Use available at: www.ipce-nggip.iges.or.jp/public/2006gl/vol4.html

²⁰ IPCC. (2006). 2006 Volume 4 Chapter 11: N2O Emissions from Managed Soils, and CO2 Emissions from Lime and Urea Application, Table 11.3 Default Emission, Volatilization and Leaching Factors for Indirect Soil N2O Emissions. Retrieved from <u>http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_11_Ch11_N2O&CO2.pdf</u>





St. Petersburg, FL, Municipal Greenhouse Gas Emissions Inventory (CY2016) – Methodology, July 2018

4

Overview

The municipal greenhouse gas (GHG) emissions inventory for the City of St. Petersburg, Florida (the City), was prepared in accordance with the *Local Government Operations Protocol* for the quantification and reporting of greenhouse gas emissions inventories (the LGOP).¹ The following sections detail the methodology used to estimate the municipal GHG emissions attributable to the City of St. Petersburg's municipal operations.

4.1 GHG Emissions Assessed

| Greenhouse Gas | Included in St. Petersburg Municipal Inventory |
|--|--|
| Carbon dioxide (CO ₂) | Reported |
| Methane (CH₄) | Reported |
| Nitrous oxide (N₂O) | Reported |
| Hydrofluorocarbons (HFCs) | Not Reported |
| Perfluorocarbons (PFCs) | Not Reported |
| Sulfur hexafluoride (SF ₆) | Not Reported |

The municipal GHG inventory reports three of the six internationally-recognized GHG regulated under the Kyoto Protocol:

The City's inventory does not report emissions from HFCs, PFCs, or SF_6 typically associated with refrigerants and fire suppression equipment due to limitations in available data but will consider including emissions from these sources in future inventories. The City is currently developing a robust asset management system and will likely have more readily available data to support such analysis in the future.

The inventory reports GHG emissions in terms of metric tons of CO_2 equivalent (CO_2e). CO_2e allows GHGs to be compared on a common basis: the ability of each GHG to trap heat in the

¹ California Air Resources Board; California Climate Action Registry; ICLEI – Local Governments for Sustainability; the Climate Registry. *Local Government Operations Protocol, for the quantification and reporting of greenhouse gas emissions inventories.* Version 1.1. May 2010. Available online at: https://www.arb.ca.gov/cc/protocols/localgov/pubs/lgo_protocol_v1_1_2010-05-03.pdf.



atmosphere. CO_2e is calculated by converting non- CO_2 gases to a CO_2 equivalent by using internationally recognized global warming potential (GWP) factors for each gas. The formula used to calculate the combined CO_2e for CO_2 , CH_4 , and N_2O is shown below. (Factors, References, and Sources, Lines 11 through 14).

Given the GWP factors:

 $CO_2 GWP = 1$ $CH_4 GWP = 25$ $N_2O GWP = 298$

Therefore:

 $CO_2e = CO_2 + (CH_4 \times 25) + (N_2O \times 298)$

4.2 Inventory Year

The municipal GHG inventory was prepared for the 2016 calendar year.

4.3 Organizational Boundaries

Organizational boundaries define the rules by which GHG emissions will be consistently calculated and describe the activities and operations that constitute the City's GHG emissions. The municipal GHG inventory was prepared in accordance with the Operational Control approach because this approach allows the city to take full ownership of all of the GHG emissions that it can directly influence and reduce. Other, financially-based approaches are more for corporations with varying economic stakes and control.

Under the Operational Control approach, the City's GHG emissions include all emissions sources over which the City has the authority to introduce and implement its operating policies at the operation. In accordance with the LGOP, this includes operations that meet the following conditions:

- > Wholly owning an operation, facility, or source; or
- Having the full authority to introduce and implement operational and health, safety, and environmental (HSE) policies (including both GHG and non-GHG related policies. There are multiple departments that constitute the City's municipal government, many of which operate in service sectors with very different characteristics. The City's municipal GHG inventory includes all City-owned and City-controlled operations, including the Albert Whitted Airport, Port St. Pete, and City wastewater treatment facilities.

While the City does not control any solid waste disposal facilities, the City has elected to voluntarily include estimated GHG emissions from government-generated municipal solid waste (MSW) in this municipal GHG inventory. Estimated GHG emissions from MSW were calculated based on waste stream estimates from City-controlled operations.



4.4 GHG Scopes and Sectors

The LGOP requires the reporting of emissions by sectors and by scopes. **Table C.1-5** lists the emissions sectors, the sources, and the scope under which they fall.

| TABLE C.1-5 GHG Inventory Sectors and Scopes | | | | | | | | | |
|---|---|-------|--|--|--|--|--|--|--|
| Sector | Emission Source | Scope | | | | | | | |
| Buildings & Other Facilities ² | Electricity - purchased | 2 | | | | | | | |
| | Natural Gas | 1 | | | | | | | |
| | Propane | 1 | | | | | | | |
| Streetlights & Outdoor Lighting | Electricity - purchased | 2 | | | | | | | |
| Wastewater Facilities | Process and fugitive emissions | 1 | | | | | | | |
| Vehicle Fleet | Mobile combustion (vehicle fuels) | 1 | | | | | | | |
| Solid Waste | Emissions from govt-generated waste | 3 | | | | | | | |
| Employee Commute | Mobile combustion (gasoline and diesel) | 3 | | | | | | | |
| Other Process & Fugitive Emissions ³ | | 1 | | | | | | | |

³ The intent was to include any stationary sources of fugitive emissions from refrigerants or fire suppression equipment, but after speaking with City representatives, it was determined that records of the required information to calculate these emissions are not kept.



² Heating oil consumption would typically be included as a Scope 1 source, but the City facilities operate on electricity, natural gas, and propane only and do not use heating oil.



Facilities

The facilities category represents all properties under the operational control of the City of St. Petersburg. The inventory reports two emissions scopes from facilities: Scope 1 emissions from burning heating fuel like natural gas or propane, and Scope 2 emissions from consuming electricity.

The City's facilities, including buildings, pumping stations, outdoor lighting, and other miscellaneous energy-consuming property, run on electricity, natural gas, and propane. Purchased electricity is a source of Scope 2 emissions⁴ and the combustion of natural gas and propane used in City facilities is a source of Scope 1 emissions. Calculating emissions from these sources required multiple steps.

Facility addresses, names, square footages and apartment codes were provided by the City through a variety of sources as shared by Lisa Glover-Henderson, Sr Energy Engineer of the Engineering & Capital Improvements Department. All electrical usage data was collected from the MARS Energy Cost Allocation System via a City Department of Technology report request which provided the Duke Energy account number and usage by month. Natural gas usage was collected from monthly invoices, and propane usage was provided by Erika Langhans in the City Accounting. Facility addresses were gathered from a Master report of all City electric accounts provided by Duke Energy. Square footage and age of the buildings was collected from the City's Insurance department. Lisa Glover-Henderson also maintains a Portfolio Manager[™] account that contains the data for the City's facilities and this information was also referenced as well and incorporated into the calculation spreadsheet – Facilities worksheet.

In the calculation spreadsheet, all utility records for facilities were entered on the "facilities" worksheet. This worksheet includes all aggregated information identified for City properties, including the scanned utility records for natural gas and propane (manual input) and Portfolio Manager[™] records (digital download). Not all information is critical for the GHG calculations; information such as address, square footage, bill account, and Portfolio Manager[™] ID number are not necessary for the calculations, but were included for

⁴ Emissions are being generated outside of St. Petersburg by Duke Energy, but the City is responsible for the end-use of that electricity and for the demand for it.



informational purposes to assist in identifying properties in future iterations and updates of the GHG emissions inventory.

The carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) emissions factors for electricity were taken from the Environmental Protection Agency's most recent Emissions and Generation Resource Integrated Database (eGRID) data (2016 data)⁵ released in 2018. EPA's eGRID is the preeminent source of air emission data for the electric power sector; eGRID is based on available plant-specific data for all U.S. electricity generating plants that provide power to the electric grid and report data to the U.S. government. The City of St. Petersburg is located in the Florida Reliability Coordination Council (FRCC) sub-region and its eGRID factors are:

CO₂: 1 MWh = 1011.7 lbs CO₂ CH₄: 1 MWh = 0.075 lbs CH₄ N₂O: 1 MWh = 0.010 lbs N₂O

5.1 Heating Fuels (Scope 1)

Heating fuels used in properties under the operational control of the city consist of natural gas and propane.

5.1.1 Natural Gas

Consistent with the LGOP, the inventory reports emissions from natural gas in terms of metric tons of CO2e. The formula used to calculate the combined CO2e emissions for natural gas is shown below (Factors, References, and Sources, Lines 14 through 25).

Given the conversion and emission factors:

1 therm = 0.1 million British thermal units (MMBTU) 1 metric ton (MT) = 1,000 kilograms (kg) [CO_2 emissions factor]: 1 MMBTU natural gas = 53.06 kg of CO_2 [CH_4 emissions factor]: 1 MMBTU natural gas = 0.001 kg of CH_4 [N_2O emissions factor]: 1 MMBTU natural gas = 0.0001 kg of N_2O

Therefore:

Convert total therms consumed to MMBTU: [therms] x [0.1] = [MMBTU]

Calculate CO₂ emissions: [MMBTU] x [natural gas CO₂ emissions factor] / [1,000] = [CO₂ emissions]

Calculate CH₄ emissions:

⁵ EPA eGRID: http://www.epa.gov/cleanenergy/energy-resources/egrid/

[MMBTU] x [natural gas CH₄ emissions factor] / [1,000] = [CH₄ emissions]

Calculate N_2O emissions: [MMBTU] x [natural gas N_2O emissions factor] / [1,000] = [N_2O emissions]

Calculate total CO₂e: CO₂e = CO₂ + (CH₄ x 25) + (N₂O x 298)

5.1.2 Propane

Consistent with the LGOP, the inventory reports emissions from propane in terms of metric tons of CO2e. The formula used to calculate the combined CO2e for propane is shown below (Factors, References, and Sources, Lines 26 through 37).

Given the conversion and emission factors:

1 gallon = 0.091 million British thermal units (MMBTU) 1 metric ton (MT) = 1,000 kilograms (kg) [CO_2 emissions factor]: 1 MMBTU propane = 62.87 kg of CO_2 [CH_4 emissions factor]: 1 MMBTU propane = 0.003 kg of CH_4 [N_2O emissions factor]: 1 MMBTU propane = 0.0006 kg of N_2O

Therefore:

Convert total gallons consumed to MMBTU: [gallons] \times [0.091] = [MMBTU]

Calculate CO₂ emissions: [MMBTU] x [propane CO₂ emissions factor] / [1,000] = [CO₂ emissions]

Calculate CH₄ emissions: [MMBTU] x [propane CH₄ emissions factor] / [1,000] = [CH₄ emissions]

Calculate N₂O emissions: [MMBTU] x [propane N₂O emissions factor] / [1,000] = [N₂O emissions]

Calculate total CO₂e: CO₂e = CO₂ + (CH₄ x 25) + (N₂O x 298)

5.2 Electricity (Scope 2)

Consistent with the LGOP, the inventory reports emissions from electricity consumption in terms of metric tons of CO₂e. The formula used to calculate the CO₂e emissions for electricity use is shown below (Factors, References, and Sources, Lines 38 through 50).

Given the conversion and emission factors:



1,000 kilowatt hours (kWh) = 1 (MWh) 1,000 MWH = 1 gigawatt hour (GWh) 2,204.62 pounds (lbs) = 1 MT [CO₂ emissions factor]: 1 MWH = 1,011.7 lbs of CO₂ [CH₄ emissions factor]: 1 MWH = 0.075 lbs CH₄ [N₂O emissions factor]: 1 MWH = 0.010 lbs N₂O

Therefore:

Convert total kWh consumed to MWh: [kWh] / [1,000] = [MWh]

Calculate CO₂ emissions: [MWh] x [electricity CO₂ emissions factor] / [2,204.62] = [CO₂ emissions]

Calculate CH₄ emissions: [MWh] x [electricity CH₄ emissions factor] / [2,204.62] = [CH₄ emissions]

Calculate N₂O emissions: [MWh] x [electricity N₂O emissions factor] / $[2,204.62] = [N_2O$ emissions]

Calculate total CO₂e: CO₂e = CO₂ + (CH₄ x 25) + (N₂O x 298)





Vehicles

The vehicles category represents all vehicles under the operational control of the City of St. Petersburg. The inventory reports vehicle emissions as Scope 1 emissions from burning vehicle fuels like gasoline, diesel, and compressed natural gas (CNG).

The vehicles and other fuel-powered equipment owned and operated by the City are a source of Scope 1 emissions. Four information sources and, therefore, methods were used to estimate emissions from vehicles:

- > City fleet department records
- > Sanitation fleet vehicles
- > Expensed employee travel
- > Golf equipment

Information on the City fleet department records was provided by the City by Fleet Administration Services Manager Brandy Colandrea and Fleet Management's Flori Lehart. The information was for all on and off-road fleet vehicles that the City owns and maintains and included the vehicle year, make, and model, the total mileage on each vehicle, and the mileage over the prior 12-month period.

| 4 060-10/CHASING & MATERIALS MANAGEM 060-10/CHASING & MATERIALS M | 1 | Department Name * | Division Name | * | Dept-Div | | Unit No 👻 | Year * | Make • | Model | * L | license 💌 | Status * | In Service Date | Current Meter 💌 | Type - | Usage LTD 👻 |
|--|----|--------------------------------------|--|---|----------|---|-----------|--------|------------|----------|-----|-----------|----------|-----------------|-----------------|--------|-------------|
| 5 060 - URCHASING & MATERIALS MANAGEM 060-1053 - Procuremel Supply Management 060-1053 - C702 2005 CLARK NPR17 A 1/12/2006 200 PL 7 060 - URCHASING & MATERIALS MANAGEM 060-1053 - C701 2008 STIHL 652000/X A 810/30/2007 0 N 0 9 060 - URCHASING & MATERIALS MANAGEM 060-1033 - C701 2008 STIHL F5200 A 11/14/2009 0 N 0 9 060 - URCHASING & MATERIALS MANAGEM 060-1033 - Procuremel Supply Management 060-1131 11/14/2010 1111 Neglobanic Materials A 11/14/2010 N 0 N 0 0 N 0 0 N 0 N 0 0 N 0 0 N 0 N 0 N 0 N 0 N 0 N 0 N 0 N 0 N 0 N 0 N 10/12/2012 0 N 0 N | 4 | 060 - PURCHASING & MATERIALS MANAGEM | 060-1053 - Procuremen Supply Management | | 060-1053 | | C701 | 1988 | CATERPILAR | R50 | | | A | 6/1/1992 | 2,532 | н | 2,532 |
| 6 060-DURCHASING & MATERIALS MANAGEM 060-1033 - Procuremen Supply Management 060-1053 - C701 2010 VAIL E GIP OPURCHASING & MATERIALS MANAGEM 060-1053 - Procuremen Supply Management 060-1053 - C701 2000 STIHL FS250 XA3774 A 11/4/2000 N 00 060 - PURCHASING & MATERIALS MANAGEM 060-1033 - Procuremen Supply Management 060-1035 - C701 2010 STIHL FS250 XA3774 A 11/4/2000 N 200 060 - PURCHASING & MATERIALS MANAGEM 060-1033 - Procuremen Supply Management 060-1031 C702 2015 STIHL FS250 XA3774 A 11/1/2016 N 200 1000 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 S216 2002 FORD F2505D 10.445 A 10/2/2012 13.45.30 M 17.866 1080 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 S220 FORD F2505D XD324 A 10/2/2012 13.48.48 M 106.432 10 080 - INTERNAL SERVICES ADM | 5 | 060 - PURCHASING & MATERIALS MANAGEM | 060-1053 - Procuremen Supply Management | | 060-1053 | | C702 | 2005 | CLARK | NPR17 | | | A | 1/25/2006 | 280 | н | 280 |
| 7 060 - PURCHASING & MATERIALS MANAGEM 0660 - 1033 - Procurremel Supply Management 0600 - 1131 - Neighborho N Team 080 - 1131 - Neighborho N Team | 6 | 060 - PURCHASING & MATERIALS MANAGEM | 060-1053 - Procuremen Supply Management | | 060-1053 | | C703 | 2012 | YALE | GLP040VX | | | A | 8/10/2012 | 918 | н | 918 |
| B 060 - PURCHASING & MATERIALS MANAGEM 060-1033 - Procurement Supply Management 060-1033 SPS 2006 FORD E250 XA374 A 11/1/2005 0 N 0 900 - PURCHASING & MATERIALS MANAGEM 060-1033 FORD E250 XA374 A 11/1/2015 0 N 0.00 10 060 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 060-1131 Stole 1199 FORD F250D 11281 A 01/1/2/012 187,110 M 17,255 10 080 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 Stole FORD F250D 12851 A 10/2/2/012 87,110 M 17,850 10 080 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 S220 FORD F250D 7502 A 11/1/5/2012 106,438 51/1/2002 88,710 M 43,743 10 080 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 082-1089 FORD F2505D 7502 | 7 | 060 - PURCHASING & MATERIALS MANAGEM | 060-1053 - Procuremen Supply Management | | 060-1053 | | C7801 | 2008 | STIHL | FS250R | | | A | 10/30/2007 | 0 | N | 0 |
| 9 000 - PURCHASING & MATERIALS MANAGEM 000-193 - Procurement Supply Management 0003 S955 2006 FORD F250 XA374 A 2/1/2014 116.196 M 2028 10 080 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 S216 1999 FORD F2505D 103445 A 6/1/2/2012 134,530 M 127,555 12 080 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 S226 2002 FORD F2505D 124.45 A 10/2/2012 134,530 M 177,866 10 080 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 S225 2005 FORD F2505D XD224 A 21/2/2/013 106,438 106,438 10 080 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 S225 1999 FORD F2505D XD224 A 21/11/2/2012 106,438 106,438 10 082 - INOUSING 082-10031 - Community Public Service Repr 08 | 8 | 060 - PURCHASING & MATERIALS MANAGEM | 060-1053 - Procuremen Supply Management | | 060-1053 | | C7911 | 2010 | STIHL | BR420 | | | A | 11/4/2009 | 0 | N | 0 |
| 10 100 1000 INTERNAL SERVICES ADMIN 080-1131 Neighborho IN Team 080-1131 S216 199 PORD F250SD 121851 A 6/14/2010 127.555 M 127.555 10 080-INTERNAL SERVICES ADMIN 080-1131 S216 199 PORD F250SD 212851 A 10/29/2012 134,530 M 177.855 10 080-INTERNAL SERVICES ADMIN 080-1131<-Neighborho IN Team | 9 | 060 - PURCHASING & MATERIALS MANAGEM | 060-1053 - Procuremen Supply Management | | 060-1053 | | \$955 | 2006 | FORD | E250 |) | KA3774 | A | 2/1/2014 | 116,196 | M | 2,028 |
| 10 1000-INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 5216 1999 FORD F2505D 103445 A 6/14/2010 127,555 M 127,555 12 080- INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 5226 2005 FORD F2505D XD5245 A 10/2/2012 134,300 M 177,866 14 080 - INTERNAL SERVICES ADMIN 080-1131 S227 2005 FORD F2505D XD5245 A 2/28/2013 109,334 M 106,388 16 082 - HOUSING 082-1089 Housing Housing Administrat 082-1089 C109 2005 FORD ESCAPE 22828 A S/12/2005 43,743 M 43,743 16 082 - HOUSING 082-1089 Housing Housing Administrat 082-1089 C109 2005 FORD ESCAPE 22828 A S/12/2005 43,743 M 43,743 10 82-100UNINTY SERVICES 083-1001 C083-1021 Community | 10 | 080 - INTERNAL SERVICES ADMIN | 080-1131 - Neighborho N Team | | 080-1131 | | C7502 | 2015 | STIHL | FC90 | | | A | 1/12/2015 | 0 | N | 0 |
| 12 DBO - INTERNAL SERVICES ADMIN OBD-1131 - Neighborho IN Team 000 - 1131 S226 2002 FRDD FJSOD 21281 A 10/2/2012 134.330 M 17.866 100 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 S227 2005 FORD FJSOD XDS245 A 10/2/2012 87.110 M 87.110 10 080 - INTERNAL SERVICES ADMIN 080-1131 - Neighborho IN Team 080-1131 S235 2005 FORD FJSOD XDS245 A 10/2/2012 87.710 M 87.710 10 802 - INDUSING 080-1131 - Neighborho IN Team 080-1131 S250 1999 FORD FJSOD 7722 A 111/2/2012 58.788 M 58.788 10 82 - INDUNINT G82 - INDUNINT SERVICES 083-1021 - community Public Service Repr 083-1021 CZ80 207 FORD RANGER X83776 A 4/5/2010 56.459 M 56.459 M 56.459 M 56.459 M 56.459 | 11 | 080 - INTERNAL SERVICES ADMIN | 080-1131 - Neighborho N Team | | 080-1131 | | \$216 | 1999 | FORD | F250SD | 1 | 103445 | A | 6/14/2010 | 127,555 | M | 127,555 |
| 13 100 100 NETRAL SERVICES ADMIN 080-INTERNAL SERVICES ADMIN 082-INTERNAL SERVICES ADMIN 083-INTERNAL SERVICES ADMIN <td>12</td> <td>080 - INTERNAL SERVICES ADMIN</td> <td>080-1131 - Neighborho N Team</td> <td></td> <td>080-1131</td> <td></td> <td>S226</td> <td>2002</td> <td>FORD</td> <td>F250SD</td> <td>2</td> <td>212851</td> <td>A</td> <td>10/29/2012</td> <td>134,530</td> <td>M</td> <td>17,866</td> | 12 | 080 - INTERNAL SERVICES ADMIN | 080-1131 - Neighborho N Team | | 080-1131 | | S226 | 2002 | FORD | F250SD | 2 | 212851 | A | 10/29/2012 | 134,530 | M | 17,866 |
| 1 108 NETRNAL SERVICES ADMIN 080-INTERNAL SERVICES ADMININT SERVICES ADMI | 13 | 080 - INTERNAL SERVICES ADMIN | 080-1131 - Neighborho N Team | | 080-1131 | | \$227 | 2005 | FORD | F150 |) | (D5244 | A | 10/2/2012 | 87,110 | M | 87,110 |
| 15 USE NUMERNAL SERVICES ADMIN 060 1131 - Neighborho IN Team 080 1 S250 1999 FORD FZSOB 7702 A 11/15/2012 106,438 M 106,438 16 082 - HOUSING 082-1089 - Housing [Housing administrat 082-1089 CIND ESCAPE 232827 A 5/12/2005 58,758 M 58,758 17 083 - COMMUNITY SERVICES 083-1021 - Community [Public Service Repr 083-1021 CR0 ESCAPE 232827 A 5/12/2005 58,758 M 43,743 10 083 - COMMUNITY SERVICES 083-1021 - Community [Public Service Repr 083-1021 CR0 FORD RANGER XA3772 A 10/13/2006 B8,264 10 NEIGHORHOLOO SERVICES 083-1021 - Community [Public Service Repr 083-1021 CR0 FISD KS033 A 9/21/2012 27,215 M 27,125 10 NEIGHORHOLOO SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 CI11 2017 FORD ESCAPE XF1598 A 6/17 | 14 | 080 - INTERNAL SERVICES ADMIN | 080-1131 - Neighborho N Team | | 080-1131 | | S235 | 2005 | FORD | F250SD | 2 | KD5245 | A | 2/28/2013 | 109,334 | M | 109,334 |
| 16 082-1003-Housing Housing Administrat 082-109 C109 2005 FORD ESCAPE 22828 A 5/12/2005 58,758 M 52,728 32,723 A 517,27005 43,743 M 48,743 9 083 - COMMUNITY SERVICES 083 + 001 - Community [Public Service Repr 083 + 001 C108 2005 FORD ESCAPE XF1598 A 517,2700 A 40,27,125 M 40,220 M 40,220 M 40,220 <td>15</td> <td>080 - INTERNAL SERVICES ADMIN</td> <td>080-1131 - Neighborho N Team</td> <td></td> <td>080-1131</td> <td></td> <td>S250</td> <td>1999</td> <td>FORD</td> <td>F250SD</td> <td>7</td> <td>78702</td> <td>A</td> <td>11/15/2012</td> <td>106,438</td> <td>M</td> <td>106,438</td> | 15 | 080 - INTERNAL SERVICES ADMIN | 080-1131 - Neighborho N Team | | 080-1131 | | S250 | 1999 | FORD | F250SD | 7 | 78702 | A | 11/15/2012 | 106,438 | M | 106,438 |
| 17 082-1003/NG 082-1089 -1003/ng/16 C100 2005 FORD ESCAPE 22827 A 5/12/2005 43,743 M < | 16 | 082 - HOUSING | 082-1089 - Housing Housing Administrat | | 082-1089 | | C109 | 2005 | FORD | ESCAPE | 2 | 232828 | A | 5/12/2005 | 58,758 | M | 58,758 |
| 18 083-COMMUNITY SERVICES 083-1021 - community (Public Service Repr 083-1021 C280 2007 FORD RANGER XA372 A 101/3/2006 B2.441 M 22.481 10 083-COMMUNITY SERVICES 083-1021 - community (Public Service Repr 083-1021 C280 2010 FORD RANGER X83576 A 4/5/2010 56.459 M 55.459 20 083-COMMUNITY SERVICES 083-1021 - community (Public Service Repr 083-1021 C21 FORD FSG0 K5033 A 9/21/2012 27.125 M 70.725 21 101-NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho) Codes Compliance 110-1125 C112 2017 FORD ESCAPE XF1598 A 6/17/2016 4.138 M 3.912 21 101-NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho) Codes Compliance 110-1125 C112 2017 FORD ESCAPE XF1598 A 6/17/2016 4.5426 M 4.5426 21 10-NEIGHBORHOOD SERVICES - CODE C 110-11 | 17 | 082 - HOUSING | 082-1089 - Housing Housing Administrat | | 082-1089 | | C110 | 2005 | FORD | ESCAPE | 2 | 232827 | A | 5/12/2005 | 43,743 | м | 43,743 |
| 19 083-COMMUNITY SERVICES 083-1021 - community [Public Service Repr 083-1021 C289 2010 FORD RANGER R8357 A 4/s/2010 56.459 M 56.459 21 083-COMMUNITY SERVICES 083-1021 - community [Public Service Repr 083-1021 K214 2012 FORD FLSD KC5803 A 9/21/2012 27.125 M 27.125 21 101-NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho] Codes Compliance 110-1125 C111 2017 FORD ESCAPE KF1598 A 6/17/2016 6,975 M 6,753 21 101-NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho] Codes Compliance 110-1125 C112 2017 FORD ESCAPE KF1507 A 6/21/2016 6,975 M 6,753 21 101-NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho] Codes Compliance 110-1125 C114 2006 FORD ESCAPE 238051 A 9/16/2005 77.856 A 53.640 M 53.640 M 53. | 18 | 083 - COMMUNITY SERVICES | 083-1021 - Community Public Service Repr | | 083-1021 | | C280 | 2007 | FORD | RANGER |) | (A3772 | A | 10/13/2006 | 82,841 | M | 82,841 |
| 20 DB3 - COMMUNITY SERVICES DB3 - LOZ - community (Public Service Repr DB3 - LOZ + LOZ - LOZ - LOZ + | 19 | 083 - COMMUNITY SERVICES | 083-1021 - Community Public Service Repr | | 083-1021 | | C289 | 2010 | FORD | RANGER | | (B3576 | A | 4/5/2010 | 56,459 | м | 56,459 |
| 21 110 - NEGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C108 2005 FORD ESCAPE KF1598 A 5/12/2005 40.320 M 40.320 22 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C111 2017 FORD ESCAPE KF1598 A 6/17/2016 4.133 M 40.320 21 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C112 2017 FORD ESCAPE XF1507 A 6/21/2016 6.753 21 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C114 2006 FORD ESCAPE 238050 A 9/16/2005 77.856 A 77.856 21 110 - NEIGHBORHONDO SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C118 2006 FORD ESCAPE 238051 A 9/16/2005 53.640 M 53.391 210 NEIGHBORHOND SERVICES - CODE C </td <td>20</td> <td>083 - COMMUNITY SERVICES</td> <td>083-1021 - Community Public Service Repr</td> <td></td> <td>083-1021</td> <td></td> <td>K214</td> <td>2012</td> <td>FORD</td> <td>F150</td> <td>)</td> <td>KC5803</td> <td>A</td> <td>9/21/2012</td> <td>27,125</td> <td>M</td> <td>27,125</td> | 20 | 083 - COMMUNITY SERVICES | 083-1021 - Community Public Service Repr | | 083-1021 | | K214 | 2012 | FORD | F150 |) | KC5803 | A | 9/21/2012 | 27,125 | M | 27,125 |
| 22 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C111 2017 FORD ESCAPE KF1598 A 6/17/2016 6,975 M 6,375 21 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C112 2017 FORD ESCAPE KF1507 A 6/12/2016 6,975 M 6,753 24 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C114 2006 FORD ESCAPE 238050 A 9/16/2005 45,426 M 45,426 210 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C116 2006 FORD ESCAPE 238051 A 9/16/2005 53,640 M 53,640 210 - NEIGHBORHOROD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C118 2006 FORD ESCAPE 238054 A 9/19/2005 53,331 M 53,331 210 - NEIGHBORHOROOD SERVICES - CODE C | 21 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C108 | 2005 | FORD | ESCAPE |) | (F1598 | A | 5/12/2005 | 40,320 | M | 40,320 |
| 23 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol [Codes Compilance 110-1125 C112 2017 FORD ESCAPE XF1507 A 6/21/2016 6,975 M 6,753 24 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol [Codes Compilance 110-1125 C114 2006 FORD ESCAPE 238050 A 9/16/2005 45,426 M 45,426 21 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol [Codes Compilance 110-1125 C116 2006 FORD ESCAPE 238051 A 9/16/2005 77,856 M 77,856 21 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol [Codes Compilance 110-1125 C118 2006 FORD ESCAPE 238051 A 9/16/2005 53,364 M 53,450 28 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 C118 2006 FORD ESCAPE 238051 A 9/19/2005 53,391 M 53,391 29 110 - NEIGHBORHOOD SERVICES - CODE C | 22 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C111 | 2017 | FORD | ESCAPE | | (F1598 | A | 6/17/2016 | 4,133 | M | 3,912 |
| 24 110 - NEGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C114 2006 FORD ESCAPE 238050 A 9/16/2005 74,8426 M 45,246 25 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C114 2006 FORD ESCAPE 238051 A 9/16/2005 77,856 M 77,856 26 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C118 2006 FORD ESCAPE 238051 A 9/16/2005 77,856 M 53,640 M | 23 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C112 | 2017 | FORD | ESCAPE |) | KF1507 | A | 6/21/2016 | 6,975 | M | 6,753 |
| 25 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C115 2006 FORD ESCAPE 238051 A 9/16/2005 57,860 M 57,860 21 10- NEIGHBORHOOD SERVICES - CODE C 110-1125 Neighborhol Codes Compliance 110-1125 C116 2006 FORD ESCAPE 238051 A 9/16/2005 53,460 M 53,640 27 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 Neighborhol Codes Compliance 110-1125 C118 2006 FORD ESCAPE 238051 A 9/19/2005 53,391 M 53,391 28 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 Neighborhol Codes Compliance 110-1125 C120 2006 FORD ESCAPE 238053 A 9/19/2005 53,391 M 53,391 30 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 Neighborhol [Codes Compliance 110-1125 C121 2006 FORD ESCAPE 238050 A 9/19/2005 643,476 M | 24 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C114 | 2006 | FORD | ESCAPE | 2 | 238050 | A | 9/16/2005 | 45,426 | M | 45,426 |
| 26 1010 NEIGHBORHOOD SERVICES - CODE C 110:1125 NEIGHBORHOOD SERVICES - CODE C 110:1125< | 25 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C115 | 2006 | FORD | ESCAPE | 2 | 238052 | A | 9/16/2005 | 77,856 | M | 77,856 |
| 27 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C118 2006 FORD ESCAPE 238054 A 9/19/2005 81.356 M 81.338 2110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C119 2006 FORD ESCAPE 238053 A 9/19/2005 53.331 M 53.331 29 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C120 2006 FORD ESCAPE 238050 A 9/19/2005 45.876 M 45.876 30 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C121 2006 FORD ESCAPE 238050 A 9/19/2005 46.409 M 45.876 3110 - NEIGHBORHONDO SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C122 2006 FORD ESCAPE 238050 A 9/19/2005 55.024 M 55.024 3110 - NEIGHBORHONDO SERVICES - CODE C 110-11 | 26 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C116 | 2006 | FORD | ESCAPE | 2 | 238051 | A | 9/16/2005 | 53,640 | M | 53,640 |
| 28 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C119 2006 FORD ESCAPE 238053 A 9/19/2005 53,391 M 53,391 29 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C120 2006 FORD ESCAPE 238059 A 9/19/2005 45,876 M 45,876 30 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C121 2006 FORD ESCAPE 238050 A 9/19/2005 64,009 M 64,009 31 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C122 2006 FORD ESCAPE 238056 A 9/19/2005 55,024 M 55,024 31 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 C123 2006 FORD ESCAPE 238057 A 9/19/2005 55,024 M 58,940 310 / NEIGHBORHOOD SERVICES - CODE C 110-1125 <td>27</td> <td>110 - NEIGHBORHOOD SERVICES - CODE C</td> <td>110-1125 - Neighborho Codes Compliance</td> <td></td> <td>110-1125</td> <td></td> <td>C118</td> <td>2006</td> <td>FORD</td> <td>ESCAPE</td> <td>2</td> <td>238054</td> <td>A</td> <td>9/19/2005</td> <td>81,358</td> <td>M</td> <td>81,358</td> | 27 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C118 | 2006 | FORD | ESCAPE | 2 | 238054 | A | 9/19/2005 | 81,358 | M | 81,358 |
| 29 101 - NEGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho] Codes Compliance 110-1125 C120 2006 FORD ESCAPE 238059 A 9/19/2005 45,876 M 55,024 M 55,024 M 55,024 M 55,024 M 55,024 M 55,024 M | 28 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C119 | 2006 | FORD | ESCAPE | 2 | 238053 | A | 9/19/2005 | 53,391 | M | 53,391 |
| 30 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho Codes Compliance 110-1125 C121 2006 FORD ESCAPE 238060 A 9/19/2005 64,009 M 64,009 31 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho Codes Compliance 110-1125 C122 2006 FORD ESCAPE 238056 A 9/19/2005 55,024 M 55,024 32 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho Codes Compliance 110-1125 C123 2006 FORD ESCAPE 238056 A 9/19/2005 55,024 M 55,024 32 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho Codes Compliance 110-1125 C124 2006 FORD ESCAPE 238057 A 9/19/2005 58,598 M 58,598 31 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 C124 2006 FORD ESCAPE 238057 A 9/19/2005 58,598 M 58,598 31 110 - NEIGHBORHOOD SERVICES - CODE C | 29 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C120 | 2006 | FORD | ESCAPE | 2 | 238059 | A | 9/19/2005 | 45,876 | м | 45,876 |
| 31 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C122 2006 FORD ESCAPE 238056 A 9/19/2005 55,024 M 55,024 32 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborhol Codes Compliance 110-1125 C123 2006 FORD ESCAPE 238057 A 9/19/2005 55,024 M 55,024 31 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 C123 2006 FORD ESCAPE 238057 A 9/19/2005 55,824 M 55,824 31 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 C124 2006 FORD ESCAPE 238057 A 9/19/2005 58,940 M 58,940 31 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 C124 2006 FORD ESCAPE 238058 A 9/19/2005 58,940 M 58,940 | 30 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C121 | 2006 | FORD | ESCAPE | 2 | 238060 | A | 9/19/2005 | 64,009 | M | 64,009 |
| 32 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho Codes Compliance 110-1125 C123 2006 FORD ESCAPE 238057 A 9/19/2005 58,598 M 58,598 33 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neighborho Codes Compliance 110-1125 C124 2006 FORD ESCAPE 238057 A 9/19/2005 58,598 M 58,598 M 58,598 M 58,598 M 58,940 | 31 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C122 | 2006 | FORD | ESCAPE | 2 | 238056 | A | 9/19/2005 | 55,024 | M | 55,024 |
| 33 110 - NEIGHBORHOOD SERVICES - CODE C 110-1125 - Neishborhol Codes Compliance 110-1125 C124 2006 FORD ESCAPE 238058 A 9/19/2005 58.940 M 58.940 | 32 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho Codes Compliance | | 110-1125 | | C123 | 2006 | FORD | ESCAPE | 2 | 238057 | A | 9/19/2005 | 58,598 | M | 58,598 |
| | 33 | 110 - NEIGHBORHOOD SERVICES - CODE C | 110-1125 - Neighborho I Codes Compliance | | 110-1125 | _ | C124 | 2006 | FORD | ESCAPE | 2 | 238058 | A | 9/19/2005 | 58.940 | M | 58.940 |

Snapshot of Fleet Data Report provided by Fleet Department



An additional report was later provided by Brandy Colandrea that included fuel type and gallons fuel consumption by department.

Information on the City sanitation vehicles was provided by the City Sanitation Department Environmental Manager, Robert Turner. Sanitation vehicle information included a list of all sanitation fleet vehicles and fuel consumption data for gasoline, diesel, and compressed natural gas (CNG). Information for expensed employee travel was provided by City Controller Erika Langhans from internal City accounting records; this information provided the dollar value for all vehicle expense records for calendar year 2016. Golf equipment fleet information was provided by the City by Golf Courses Director Jeff Hollis. This information included equipment make and model information and estimated gasoline and diesel consumption for each asset for the Mangrove Bay and Twin Brooks golf courses.

The recommended approach from Chapter 7 of the LGOP was used to calculate the emissions from the City's vehicle fleet. The standard emissions factors for unleaded gasoline (8.78 kg CO₂/gal) and diesel (10.21 kg CO₂/gal) were used to calculate the carbon dioxide emissions. To calculate the nitrous oxide and methane emissions, the vehicles and equipment were categorized based on the classifications provided in the LGOP, the annual mileage was totaled or estimated⁶ by category and/or model year, as applicable, and the appropriate emissions factor was used for each classification and/or model year (See LGOP tables below).

For the equipment, the carbon dioxide emissions were calculated using the same standard emissions factors for unleaded gasoline (8.78 kg CO₂/gal) and diesel (10.21 kg CO₂/gal). The EPA Climate Leadership Emission Factors for Greenhouse Gas Inventories⁷ provided the emissions factors for both nitrous oxide and methane.

6.1 Fleet Department Records (Scope 1)

Consistent with the LGOP, the inventory reports emissions from city fleet vehicles consumption in terms of metric tons of CO_2e . Emissions from city fleet vehicles were calculated based on internal city records on vehicle department/division and fuel type and fuel consumption (gasoline and diesel) for the 2016 calendar year period. While an earlier Fleet Department report included mileage data, it did not include fuel consumption or fuel type and it was determined that estimating consumption based on mileage was producing an underestimation of consumption. Therefore, a report by department with fuel consumption was utilized to calculate CO_2 emissions and mileage estimates from the previously generated report were utilized to calculate CH_4 and N_2O emissions. Future updates to this inventory will benefit from a more complete report that is inclusive of mileage, fuel type, and gallons consumption, by unit⁸. Fuel consumption and mileage for the Sanitation Department and Golf vehicles (discussed in the next sections) were removed from

⁸ Brandy Colandrea has already requested that this report be developed, but was not available in time for completion of the 2016 inventory.



⁶ Where actual mileage was unavailable, mileage was estimated using the US DOT, Bureau of Transportation Statistics. National Transportation Statistics. Table 4-23: Average Fuel Efficiency of U.S. Light Duty Vehicles. https://www.bts.gov/topics/national-transportation-statistics.

⁷ EPA. Climate Leadership Emission Factors for Greenhouse Gas Inventories. November 2015. Tables 1, 2, and 4. https://www.epa.gov/sites/production/files/2015-12/documents/emission-factors_nov_2015.pdf.

this calculation. The formula used to calculate the CO_2e emissions for fuel consumption in city fleet vehicles is shown below (Factors, References, and Sources, Lines 51 through 62).

Given the conversion and emission factors:

1 MT = 1,000 kg 1 kg = 1,000 grams [CO₂ gasoline emissions factor]: 1 gal gas = 8.7775 kg of CO₂ [CH₄ gasoline emissions factor]: 1 mile = 0.0173 g of CH₄ [N₂O gasoline emissions factor]: 1 mile = 0.0036 g of N₂O

 $[CO_2 \text{ diesel emissions factor}]$: 1 gal gas = 10.21 kg of CO_2 $[CH_4 \text{ diesel emissions factor}]$: 1 mile = 0.001 g of CH_4 $[N_2O \text{ diesel emissions factor}]$: 1 mile = 0.0015 g of N_2O

Therefore:

Calculate CO₂ emissions: [gallons gas] x [CO₂ emissions factor] / [1,000] = [CO₂ emissions metric tons]

Calculate CH_4 emissions: [vehicle mileage] x [CH₄ emissions factor] / [1,000] / [1,000] = [CH₄ emissions metric tons]

Calculate N₂O emissions: [vehicle mileage] x [N₂O emissions factor] / [1,000] / [1,000] = [N₂O emissions metric tons]

Calculate total CO₂e: CO₂e = CO₂ + (CH₄ x 25) + (N₂O x 298)

6.2 Sanitation Fleet (Scope 1)

Consistent with the LGOP, the inventory reports emissions from city sanitation vehicles consumption in terms of metric tons of CO2e. Emissions from city sanitation vehicles were calculated using vehicle fuel consumption information provided directly from the sanitation department. Information on sanitation vehicles was included in the overall city fleet information and was also provided separately by the city sanitation department. To avoid duplicate accounting, the information on sanitation vehicles was removed and not counted in the overall city fleet information and was instead accounted for using the information provided directly from the sanitation provided directly from the sanitation department.

City sanitation vehicles use gasoline, diesel, and CNG. Calculations for emissions from gasoline and diesel fuel vehicles were completed based on individual vehicle consumption and mileage. A different approach was required to estimate vehicle emissions from CNG. The City provided a total estimated number of therms of CNG consumed by the whole sanitation fleet in total; the City did not have a record of therms of CNG consumed by each vehicle. In order to estimate the CNG consumption per vehicle, the inventory calculations assumed that the total CNG use was distributed evenly among all CNG vehicles based on vehicle mileage in the prior 12-month period. A hypothetical example demonstrating this calculation is described below.



A hypothetical city vehicle fleet has 3 CNG vehicles. The first vehicle had 10,000 miles in the prior year, the second vehicle had 15,000 miles in the prior year, and the third vehicle had 20,000 miles in the prior year. The total fleet mileage was 45,000 miles. The total fleet consumed 200 therms of CNG. The first vehicle was responsible for approximately 22 percent of the total fleet mileage, and therefore was assumed to have consumed 22 percent of the total therms of CNG (44.4 therms). The second vehicle was responsible for approximately 33 percent of the total fleet mileage, and therefore was assumed to have consumed 22 percent of the total second vehicle was responsible for approximately 33 percent of the total therms of CNG (66.7 therms). The third vehicle was responsible for approximately 45 percent of the total fleet mileage, and therefore was assumed to have consumed 45 percent of the total therms of CNG (88.9 therms).

The formula used to calculate the CO2e emissions for fuel consumption in city sanitation vehicles is shown below.

6.2.1 Gasoline Vehicles

(Factors, References, and Sources, Lines 63 through 71).

Given the conversion and emission factors:

1 MT = 1,000 kg 1 kg = 1,000 grams [CO₂ gasoline emissions factor]: 1 gal gas = 8.7775 kg of CO₂ [CH₄ gasoline emissions factor]: 1 mile = 0.0173 g of CH₄ [N₂O gasoline emissions factor]: 1 mile = 0.0036 g of N₂O

Therefore:

Calculate CO_2 emissions: [gallons gas] x [CO_2 emissions factor] / [1,000] = [CO_2 emissions]

Calculate CH_4 emissions: [vehicle mileage] x [CH_4 emissions factor] / [1,000] / [1,000] = [CH_4 emissions]

Calculate N₂O emissions: [vehicle mileage] x [N₂O emissions factor] / [1,000] / [1,000] = [N₂O emissions]

Calculate total CO₂e: CO₂e = CO₂ + (CH₄ x 25) + (N₂O x 298)



6.2.2 Diesel Vehicles

(Factors, References, and Sources, Lines 72 through 80).

Given the conversion and emission factors:

1 MT = 1,000 kg 1 kg = 1,000 grams [CO₂ diesel emissions factor]: 1 gal gas = 10.21 kg of CO₂ [CH₄ diesel emissions factor]: 1 mile = 0.001 g of CH₄ [N₂O diesel emissions factor]: 1 mile = 0.0015 g of N₂O

Therefore:

Calculate CO₂ emissions: [gallons diesel] x [CO₂ emissions factor] / [1,000] = [CO₂ emissions]

Calculate CH₄ emissions: [vehicle mileage] x [CH₄ emissions factor] / [1,000] / [1,000] = [CH₄ emissions]

Calculate N_2O emissions: [vehicle mileage] x [N_2O emissions factor] / [1,000] / [1,000] = N_2O emissions]

Calculate total CO₂e: CO₂e = CO₂ + (CH₄ x 25) + (N₂O x 298)

6.2.3 Compressed Natural Gas (CNG)

(Factors, References, and Sources, Lines 81 to 95).

Given the conversion and emission factors:

1 MT = 1,000 kg 1 kg = 1,000 grams 1 standard cubic foot (scf) CNG = 1,020 British thermal units (BTU) 1 MMBTU = 1,000,000 BTU 1 therm = 0.1 MMBTU [CO₂ CNG emissions factor]: 1 scf = 0.05444 kg of CO₂ [CH₄ CNG emissions factor]: 1 mile = 1.966 g of CH₄ [N₂O CNG emissions factor]: 1 mile = 0.175 g of N₂O

Therefore:

Convert total therms to MMBTU: [therms] x [0.1] = [MMBTU]

Convert MMBTU to BTU: [MMBTU] x [1,000,000] = [BTU]

Convert BTU to scf:



[BTU] / [1,020] = [scf]

Calculate CO_2 emissions: [scf CNG] x [CO₂ emissions factor] / [1,000] = [CO₂ emissions]

Calculate CH₄ emissions: [vehicle mileage] x [CH₄ emissions factor] / [1,000] / [1,000] = [CH₄ emissions]

Calculate N₂O emissions: [vehicle mileage] x [N₂O emissions factor] / [1,000] / [1,000] = [N₂O emissions]

Calculate total CO₂e: CO₂e = CO₂ + (CH₄ x 25) + (N₂O x 298)

6.3 Expensed Employee Travel (Scope 1)

Consistent with the LGOP, the inventory reports emissions from fuel consumed for expensed vehicle travel for regular city operations in terms of metric tons of CO2e. The City allows employees to use personal vehicles for travel for city business and provides reimbursement for gasoline consumption through expense reporting. Expensed employee travel does not include travel for employee commuting or airplane travel (both classified as Scope 3 emissions).

Emissions from expensed vehicle travel were calculated using expense records information provided directly from the City accounting system. The City accounting system keeps records on dollar values for expense reports. The information provided by the City only recorded expense and cost information; for calculation purposes, the emissions for these vehicles were calculated using gasoline emissions factors. The formula used to calculate the CO2e emissions for fuel consumption from expensed vehicle travel is shown below (Factors, References, and Sources, Lines 96 through 109).

Given the conversion and emission factors:

Average fuel cost per gallon of gasoline = 2.057 dollars / 1 gallon gasoline National average vehicle fuel efficiency = 22 miles / 1 gallon gasoline 1 MT = 1,000 kg 1 kg = 1,000 grams [CO₂ gasoline emissions factor]: 1 gal gas = 8.7775 kg of CO₂ [CH₄ gasoline emissions factor]: 1 mile = 0.0173 g of CH₄ [N₂O gasoline emissions factor]: 1 mile = 0.0036 g of N₂O

Therefore:

Estimate gallons consumed by each vehicle: [expense cost] / [2.057] = [gallons gas]

Calculate CO₂ emissions:



[gallons gas] x [CO₂ emissions factor] / [1,000] = [CO₂ emissions]

Estimate mileage for each vehicle: [gallons gas] / [22] = [vehicle mileage]

Calculate CH₄ emissions: [vehicle mileage] x [CH₄ emissions factor] / [1,000] / [1,000] = [CH₄ emissions]

Calculate N₂O emissions: [vehicle mileage] x [N₂O emissions factor] / [1,000] / [1,000] = [N₂O emissions]

Calculate total CO₂e: CO₂e = CO₂ + (CH₄ x 25) + (N₂O x 298)

6.4 Golf Equipment

Consistent with the LGOP, the inventory reports emissions from fuel consumed for golf equipment in terms of metric tons of CO₂e. Emissions from golf equipment were calculated using fuel consumption records provided directly from the City. The City provided records on gallons of gasoline and diesel fuel consumed for golf equipment. The formula used to calculate the CO₂e emissions for fuel consumption from golf equipment is shown below.

6.4.1 Gasoline Equipment (Scope 1)

(Factors, References, and Sources, Lines 110 through 118).

Given the conversion and emission factors:

1 MT = 1,000 kg 1 kg = 1,000 grams $[CO_2 \text{ gasoline emissions factor}]^*: 1 \text{ gal gas} = 8.7775 kg of CO_2$ $[CH_4 \text{ gasoline emissions factor}]^*: 1 \text{ gal gas} = 0.050 \text{ g of CH}_4$ $[N_2O \text{ gasoline emissions factor}]^*: 1 \text{ gal gas} = 0.22 \text{ g of } N_2O$

*As noted in the Factors, References, and Sources attachment, these factors are EPA's recommended emissions factors for gasoline agricultural equipment.

Therefore:

Calculate CO_2 emissions: [gallons gas] x [CO_2 emissions factor] / [1,000] = [CO_2 emissions]

Calculate CH₄ emissions: [gallons gas] x [CH₄ emissions factor] / [1,000] / [1,000] = [CH₄ emissions]

Calculate N₂O emissions: [gallons gas] x [N₂O emissions factor] / [1,000] / [1,000] = [N₂O emissions]



Calculate total CO₂e: CO₂e = CO₂ + (CH₄ x 25) + (N₂O x 298)

6.4.2 Diesel Equipment (Scope 1)

(Factors, References, and Sources, Lines 119 through 127).

Given the conversion and emission factors:

1 MT = 1,000 kg 1 kg = 1,000 grams [CO₂ diesel emissions factor]*: 1 gal diesel = 10.21 kg of CO₂ [CH₄ diesel emissions factor]*: 1 gal diesel = 0.057 g of CH₄ [N₂O diesel emissions factor]*: 1 gal diesel = 0.26 g of N₂O

*As noted in the Factors, References, and Sources attachment, these factors are EPA's recommended emissions factors for diesel agricultural equipment.

Therefore:

Calculate CO₂ emissions: [gallons diesel] x [CO₂ emissions factor] / [1,000] = [CO₂ emissions]

Calculate CH₄ emissions: [gallons diesel] x [CH₄ emissions factor] / [1,000] / [1,000] = [CH₄ emissions]

Calculate N₂O emissions: [gallons diesel] x [N₂O emissions factor] / [1,000] / [1,000] = N₂O emissions]

Calculate total CO₂e: CO₂e = CO₂ + (CH₄ x 25) + (N₂O x 298)





Wastewater Treatment

As also described in the Community Inventory Methodology, the City of St. Petersburg owns and operates three well-managed wastewater treatment plants (WWTPs) that are all located within its jurisdiction and serve the city as well as a small population that resides outside the city. These facilities include Northeast Water Reclamation Facility (WRF), Northwest WRF, and Southwest WRF.

Emissions from wastewater treatment were calculated separately for the in-boundary population and for the out-of-boundary population using raw data provided by the City of St. Petersburg by way of their consultant, Jacobs Engineering Group.⁹ These data included the following pertinent parameters by facility:

- > Total volume of wastewater treated by domestic and industrial sources;
- > Total population served by location (i.e., inside or outside the city);
- > Volume of wastewater discharged to open water; and
- > Influent biochemical oxygen demand (BOD) concentrations.

While this inventory follows the LGOP methodologies, because the City is utilizing the ClearPath tool for reporting its community-scale GHG emissions, the calculators for wastewater treatment emissions within the tool were utilized. These calculators reference methods outlined in Appendix F of the US Community Protocol. Following **Figure C.1-1**, and with the assumption the lagoon systems are not in use, it was determined to utilize methods in **Figure C.1-2**, and specifically Methods WW.8 and WW.12.b. Data was entered into the ClearPath calculators for these referenced methods to calculate total in-boundary and out-of-boundary N₂O process emissions from effluent discharge to open waters as well as nitrification/denitrification process N₂O emissions.

Figure C.1-3 shows a list of calculators available within the ClearPath tool, which align with the methods described in the US Community Protocol, Appendix F.

The municipal operations inventory claims and reports the combined total of both in- and out-of- boundary emissions since the City owns and operates the facilities. In accordance with the Global Protocol for Communities (GPC), wastewater process emissions for community-scale inventory reports both in-boundary and out-of-boundary emissions separately.

⁹ Pica, L. (2018). FW: Greenhouse Gas Inventory Assistance.





Solid Waste

Consistent with the LGOP, the inventory reports emissions from solid waste disposal activities in terms of metric tons of CO₂e. The City disposes of waste generated at City-owned facilities at the Pinellas County Solid Waste facility, Bridgeway Acres. According to the operational control organizational boundary, the City inventory claims emissions from solid waste disposal as Scope 3 emissions.

Emissions from solid waste disposal were calculated based on the total tonnage of solid waste (in short tons) generated by City facilities; this information was provided by the City by Sanitation Department Environmental Manager Robert Turner. Pinellas County Solid Waste reports solid waste disposal activities and estimated emissions information to the US Environmental Protection Agency (USEPA) which is available through the USEPA's Facility Level Information on Greenhouse Gases Tool (FLIGHT) system¹⁰. The inventory reports the City's estimated share of emissions based on the fraction of the solid waste generated by City facilities compared to the overall waste handled at the facility. The formula used to calculate the CO₂e emissions from solid waste is shown below (Factors, References, and Sources, Lines 148 through 158).

Given the conversion and emission factors:

facility total annual waste = 224,630 MT facility CO₂e from combustion = 304,307 MT CO₂e facility CO₂e from landfill = 218,499 MT CO₂e facility CO₂ total = 289,387 MT CO₂e facility CH₄ total = 224,318 MT CO₂e facility N₂O total = 9,102 MT CO₂e facility CO₂e total = 522,807 MT CO₂e

Therefore:

Calculate the City's share of total annual emissions: [city total solid waste tonnage] / [facility total solid waste tonnage] = [city share of emissions]

Calculate CO_2 emissions: [city share of emissions] x [facility CO_2 total] = [CO_2 emissions]

Calculate CH_4 emissions: [city share of emissions] x [facility CH_4 emissions] = [CH_4 emissions]

Calculate N_2O emissions: [city share of emissions] x [facility N_2O emissions] = [N_2O emissions]

Calculate total CO₂e:

 $CO_2e = [city share of emissions] x [facility CO_2e total]$

¹⁰ USEPA's Facility Level Information on Greenhouse Gases Tool (FLIGHT) system: https://ghgdata.epa.gov/ghgp/main.do.





Employee Commute

The City of St. Petersburg GHG inventory includes estimated emissions from vehicles used for employee commutes. To estimate GHG emissions from employee commute, the City administered an employee commute survey. The survey was distributed digitally (and in hard copy upon request) to all St. Petersburg employees, including part time and seasonal/contracted employees. The survey period was open to all responses from March 7, 2018 to March 16, 2018. The City had approximately 1,062 total survey responses (a 32 percent response rate). The survey consisted of 14 questions related to employee commuting patterns and took an average of 7 minutes to complete. The reporting year for the employee commute survey is 2018, however, the total number of employees (and the full-time / part-time split) used in the calculations was for the GHG inventory year of 2016 as provided by the City of St. Petersburg Human Resources Department. A complete copy of the survey is attached.

Calculations were based on a series of estimates and assumed that the responses were a representative total of the total population of St. Pete employees. In the future, a regular employee commute survey may help normalize the data and provide a more consistent picture of the City's employee's commuting patterns.

Consistent with the LGOP, the City inventory claims emissions from employee commuting as Scope 3 emissions. The formula used to calculate CO₂ emissions from employee commutes is shown below (Factors, References, and Sources, Lines 159 through 188)

Given the conversion and emission factors and survey response fields:

number of work weeks per year = 50 national average vehicle fuel efficiency = 22 miles / 1 gallon gasoline 1 MT = 1,000 kg 1 kg = 1,000 grams [CO₂ gasoline emissions factor]: 1 gal gas = 8.7775 kg of CO₂ [CH₄ gasoline emissions factor]: 1 mile = 0.0173 g of CH₄ [N₂O gasoline emissions factor]: 1 mile = 0.0036 g of N₂O [CO₂ bus emissions factor]: 1 mile = 0.0007 g of CH₄ [N₂O bus emissions factor]: 1 mile = 0.0007 g of CH₄ [N₂O bus emissions factor]: 1 mile = 0.0004 g of N₂O [CO₂ motorcycle emissions factor]: 1 mile = 0.197 kg of CO₂ [CH₄ motorcycle emissions factor]: 1 mile = 0.07 g of CH₄ [N₂O motorcycle emissions factor]: 1 mile = 0.007 g of N₂O


[total number of city employees] – from City [fraction of total employees FTE] - from City [fraction of total employees PTE] – from City [total number of responses] - from survey data [# of responses FTE] – from survey data [# of responses PTE] – from survey data [# of responses seasonal or contracted] - from survey data [# of responses 5-day commute] – from survey data [# of responses 4-day commute] – from survey data [# of responses 3-day commute] – from survey data [# of responses drive alone] - from survey data [# of responses carpool with one other] – from survey data [# of responses carpool with two others] – from survey data [# of responses dropped off] – from survey data [# of responses take the bus] - from survey data [# of responses take motorcycle] – from survey data [# of responses cycle] - from survey data [# of responses walk] - from survey data [# of responses drive a hybrid] – from survey data [# of responses drive a plug-in electric] - from survey data [# of responses drive a fully electric] - from survey data

[average one-way commute] - calculated*

*For more information on how the average commute distance was calculated, refer to Section 6.1.

Therefore:

Calculate the City's total number of employee commute days: ([num_5_day_commute] / [total_number_of_responses] * [total_city_employees] * 5 * 50) + ([num_4_day_commute] / [total_number_of_responses] * [total_city_employees] * 4 * 50) + ([num_3_day_commute] / [total_number_of_responses] * [total_city_employees] * 3 * 50) = [total employee commute days]

Calculate the fraction of total employees who commute by each mode: [drive alone fraction] = [number drive alone] / [total number of respondents] [carpool with one fraction] = [number carpool with one] / [total number of respondents] [carpool with two fraction] = [number carpool with two] / [total number of respondents] [dropped off fraction] = [number dropped off] / [total number of respondents] [bus fraction] = [number take the bus] / [total number of respondents] [motorcycle fraction] = [number who take a motorcycle] / [total number of respondents] [cycle fraction] = [number who cycle] / [total number of respondents] [walk fraction] = [number who walk] / [total number of respondents]



Calculate the fraction of total employees who drive a hybrid, plug-in electric, or fully electric vehicle:

[hybrid fraction] = [number who drive hybrid] / [total number of respondents] [plug-in electric fraction] = [number who drive plug-in electric] / [total number of respondents] [electric fraction] = [number who drive electric] / [total number of respondents]

Calculate CO₂ emissions from employee commute by mode:

 $[CO_2 \text{ from drive alone}] = ([drive alone fraction] – [hybrid fraction] – [plug-in electric fraction] – [electric fraction]) x [total employee commute days] x [average one-way commute] x 2 / 22 x [CO_2 emissions factor] / 1,000$

 $[CO_2 \text{ from carpool with one}] = [carpool with one fraction] x [total employee commute days] x [average one-way commute] x 2 / 22 x [CO₂ emissions factor] / 1,000$

 $[CO_2 \text{ from carpool with two}] = [carpool with two fraction] x [total employee commute days] x [average one-way commute] x 2 / 22 x [CO₂ emissions factor] / 1,000$

 $[CO_2 \text{ from dropped off}]^{11} = [dropped off fraction] x [total employee commute days] x [average one-way commute] x 2 / 22 x [CO_2 emissions factor] / 1,000$

 $[CO_2 \text{ from bus}] = [bus \text{ fraction}] \times [total employee commute days}] \times [average one-way commute] \times 2 / 22 \times [CO_2 emissions factor] / 1,000$

 $[CO_2 \text{ from motorcycle}] = [motorcycle fraction] x [total employee commute days] x [average one-way commute] x 2 / 22 x [CO_2 emissions factor] / 1,000$

Calculate CH₄ emissions from employee commute by mode:

 $[CH_4 \text{ from drive alone}] = ([drive alone fraction] - [hybrid fraction] - [plug-in electric fraction] - [electric fraction]) x [total employee commute days] x [average one-way commute] x 2 x [CH_4 emissions factor] / 1,000$

 $[CH_4 \text{ from carpool with one}] = [carpool with one fraction] x [total employee commute days] x [average one-way commute] x 2 x [CH_4 emissions factor] / 1,000$

 $[CH_4 \text{ from carpool with two}] = [carpool with two fraction] x [total employee commute days] x [average one-way commute] x 2 x [CH_4 emissions factor] / 1,000$

 $[CH_4 \text{ from dropped off}] = [dropped off fraction] x [total employee commute days] x [average one-way commute] x 2 x [CH_4 emissions factor] / 1,000$

 $[CH_4 \text{ from bus}] = [bus \text{ fraction}] \times [total employee commute days}] \times [average one-way commute] \times 2 \times [CH_4 emissions factor] / 1,000$

¹¹ Emissions from employees dropped off is calculated in the same manner as employees who drive alone; this assumes that this mode still represents two separate vehicle trips (to work, and from work).





 $[CH_4 \text{ from motorcycle}] = [motorcycle fraction] x [total employee commute days] x [average one-way commute] x 2 x [CH_4 emissions factor] / 1,000$

Calculate N₂O emissions from employee commute by mode:

 $[N_2O \text{ from drive alone}] = ([drive alone fraction] - [hybrid fraction] - [plug-in electric fraction] - [electric fraction]) x [total employee commute days] x [average one-way commute] x 2 x [N_2O emissions factor] / 1,000$

 $[N_2O \text{ from carpool with one}] = [carpool with one fraction] x [total employee commute days] x [average one-way commute] x 2 x [N_2O emissions factor] / 1,000$

 $[N_2O \text{ from carpool with two}] = [carpool with two fraction] x [total employee commute days] x [average one-way commute] x 2 x [N_2O emissions factor] / 1,000$

 $[N_2O \text{ from dropped off}] = [dropped off fraction] x [total employee commute days] x [average one-way commute] x 2 x [N_2O emissions factor] / 1,000$

 $[N_2O \text{ from bus}] = [bus \text{ fraction}] x [total employee commute days] x [average one-way commute] x 2 x [N_2O emissions factor] / 1,000$

 $[N_2O \text{ from motorcycle}] = [motorcycle fraction] x [total employee commute days] x [average one-way commute] x 2 x [N_2O emissions factor] / 1,000$

Calculate total CO₂e:

($[CO_2 \text{ from drive alone}] + [CO_2 \text{ from carpool with one}] + [CO_2 \text{ from carpool with two}] + [CO_2 \text{ from dropped off}] + [CO_2 \text{ from bus}] + [CO_2 \text{ from motorcycle}]) + ([CH_4 \text{ from drive alone}] + [CH_4 \text{ from carpool with one}] + [CH_4 \text{ from carpool with two}] + [CH_4 \text{ from dropped off}] + [CH_4 \text{ from bus}] + [CH_4 \text{ from motorcycle}] \times 25) + ([N_2O \text{ from drive alone}] + [N_2O \text{ from carpool with one}] + [N_2O \text{ from carpool with two}] + [N_2O \text{ from motorcycle}] \times 298)$



9.1 Estimating Employee Commute Distance

The following section describes the methodology for estimating the average employee commute distance. Information was derived from the online employee survey.

The raw response information was downloaded in Excel format. Employee commute distance was estimated based on the zip codes provided for where employees reside. Due to the open response nature of the question the zip code data was scrubbed for typos, consistency, and local zip codes only. For instance, a zip code entry of 34614-1940 was changed to 34614.

The scrubbing consisted of:

- Removing the four digits following the zip code – this data is more detailed than needed. (Red Box)
- Any cells left blank were labeled
 Blank. Blank cells were excluded from calculations. (Yellow Box)

| ZIP/Postal Code | Edited Data |
|-----------------|-------------|
| | |
| 33707 | 33707 |
| | |
| 33712 | 33712 |
| 33705 | 33705 |
| 33710 | 33710 |
| 34684 | 34684 |
| 33611 | 33611 |
| 33773 | 33773 |
| 33614 | 33614 |
| 33716 | 33716 |
| 34614-1940 | 34614 |
| 33712 | 33712 |
| 33777 | 33777 |
| 33598 | 33598 |
| 33713 | 33713 |
| | Blank |

Using aerial online mapping each zip code was assigned an estimated distance to City Hall in miles. Then, the number of respondents who indicated they resided in each zip code was calculated, providing an approximation of how many St. Petersburg employees live within each zip code.

The average commute distance was calculated by using a weighted average based on the number of employees that live in each zip code. The weighted average formula multiplies the number of miles (commute distance) by the number of respondents (which is the weighted portion of the formula), then divides the sum by the total number of respondents (or weight).¹²

Based on this analysis, the average St. Petersburg employee commutes approximately 11.76 miles each direction, or 23.52 miles per day in the office. **Table C.1-6** lists a breakdown of the estimated commute distances based on survey responses.

¹² SUMPRODUCT Function. Microsoft Office Excel Formula Help. <u>https://support.office.com/en-us/article/sumproduct-function-16753e75-9f68-4874-94ac-4d2145a2fd2e</u>



| Miles Driven (One-Way) | Number of Respondents | Percent of Employees |
|------------------------|-----------------------|----------------------|
| <u><</u> 10 | 630 | 61.17% |
| 10.1-20 | 191 | 18.54% |
| 20.1 - 30 | 97 | 9.42% |
| 30.1 - 40 | 77 | 7.48% |
| 40.1 - 50 | 19 | 1.84% |
| 50.1 - 60 | 11 | 1.07% |
| 60.1 - 70 | 3 | 0.29% |
| 70.1 + | 2 | 0.19% |

Table C.1-6 Estimated Commute Distances Based on Zip Code Analysis





Appendix C.2: 2016 Greenhouse Gas (GHG) Emissions Inventory Results





2016 Greenhouse Gas Inventory Results

Introduction

The City of St. Petersburg is taking bold action to reduce its contributions to global climate change, shift to clean energy sources, and enhance the overall sustainability and resiliency of the city. For the first time, the City is comprehensively developing an Integrated Sustainability Action Plan (ISAP) to guide this action. The purpose of the ISAP is to advance the City's sustainability & resiliency initiatives including 100% clean energy goals. A significant component of the ISAP is to assess the city's greenhouse gas (GHG) emissions and identify opportunities to reduce them. The ISAP will utilize the information gathered by the City's first-ever GHG inventory and focus on activities that can achieve the greatest emission reductions in the most cost-effective manner, while also promoting equity and resiliency throughout St. Petersburg.

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GHG Inventory Summary Results

Greenhouse gases (GHGs) are gases generated by natural and man-made activities that trap heat in the atmosphere. Carbon Dioxide (CO₂), Methane (CH₄), Nitrous Oxide (N₂O), and fluorinated gases like hydroflourocarbons contribute to global warming. While some

amount of GHGs are necessary to trap enough heat within our atmosphere to maintain life, there are now too many GHGs, which trap increasing amounts of solar heat, thus causing global warming.

CO₂ is the primary greenhouse gas and driver of climate change.



Source: W. Elder, National Park Service

While other emissions have a higher global warming potential, it is common practice to report all GHGs as carbon dioxide equivalents.



Human activities are responsible for most of the increase in greenhouse gases in the atmosphere over the last 150 years¹. Significant sources from human activity in the U.S. include the burning of fossil fuels for electricity, heat, and transportation, as well as process emissions from decomposition or incineration of solid waste,

Why do a Greehouse Gas Inventory?

Conducting a greenhouse gas (GHG) inventory allows the city to understand its contribution to accelerated global climate change. It is essential to understand the largest sources of emissions to target them for reductions and to measure reduction progress over time. Because most emissions are related to energy and fuel use, a GHG inventory also helps the city to identify cost savings opportunities.



St. Petersburg is

conducting a GHG inventory with other leading communities in Florida and around the world to be a part of the solution in reducing emissions and the acceleration of climate change. St. Petersburg is also currently planning and constructing projects that will adapt to current and projected changes in climate like the extreme weather events experienced in recent years.

¹ IPCC (2007). Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis.



How Did St. Petersburg Complete its GHG Inventory?

The City utilized nationally and internationally recognized methodologies for completing its GHG emissions inventories for both municipal operations as well as community-wide. The inventory was completed for the baseline year 2016. Data was collected from representatives within the City of St. Pete, Pinellas County, State agencies, as well as Duke Energy and TECO Energy.

The municipal operations inventory was prepared in accordance with the *Local Government Operations Protocol* (LGOP), which standardizes the quantification and reporting of GHG emissions associated with government operations.² The preparation of the community-scale inventory is consistent



with the *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories* (GPC),³ a protocol that has the expressed purpose of establishing a consistent methodology of calculating and reporting city-wide GHG emissions. The following sections summarize the results of these two inventories.

Community-Scale Inventory

This community-wide greenhouse gas (GHG) emissions inventory attempts to capture all GHGs generated from activities that occurred within the City of St. Petersburg, Florida in 2016. These emissions include those resulting from municipal government operations, as well as from activities of the residents and businesses within the city.

The sources of community-wide emissions include: fuel combustion in buildings (and associated fugitive emissions); grid-supplied electricity consumption (and associated transmission and distribution losses); fuel burned in road vehicles, during waterborne navigation, and by aircraft; the decomposition and incineration of solid waste; process emissions from wastewater treatment; and from fertilizer applications in the City's parks and golf courses.

³ World Resources Institute, C40 Cities Climate Leadership Group, and ICLEI – Local Governments for Sustainability (ICLEI). (2014). Global Protocol for Community-Scale Greenhouse Gas Emission Inventories. Retrieved from <u>http://www.ghgprotocol.org/sites/default/files/ghgp/standards/GHGP_GPC_0.pdf</u>



² California Air Resources Board, California Climate Action Registry, ICLEI – Local Governments for Sustainability, and The Climate Registry. (2010). Local Government Operations Protocol: For the quantification and reporting of greenhouse gas emissions inventories. Retrieved from <u>https://www.arb.ca.gov/cc/protocols/localgov/pubs/lgo_protocol_v1_1_2010-05-03.pdf</u>



The GPC requires the measurement and disclosure of GHG emissions based on production and consumption activities that take place within the city boundary (i.e., city-induced framework). It also requires that the reporting of these emissions be based on where they are physically released (i.e., scopes framework). For categorizing emissions by the location of their release, the GPC provides the following scope definitions:

- > Scope 1 GHG emissions from sources located within the city boundary;
- Scope 2 GHG emissions occurring because of the use of grid-supplied electricity, heat, steam, and/or cooling within the city boundary; and
- Scope 3 All other GHG emissions that occur outside the city boundary because of activities taking place within the city boundary.



Figure C.2-1: Global Protocol for Community - Scopes Framework

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Total community-wide emissions in St. Petersburg in calendar year (CY) 2016 were approximately 2.7 million metric tons of CO₂e. Figures 3 and 4 provide the results by Scope and Sector respectively. It would require new forest one and a half times the size of Yellowstone National Park to sequester this amount of annual community-wide emissions.





Figure C.2-2: Community GHG Emissions by Scope





St. Pete's GHG emissions are 10.9 metric tons of CO_2e per capita based on the population of the city in 2016 (253,585).⁴ As seen below, St. Pete's per capita GHG emissions are lower than national and state averages, but still greater than the global average and that of denser and more transit-oriented cities like New York.



Figure C.2-4: Emissions Per Capita Comparison (Metric Tons CO₂e)

⁴ United States Census Bureau. (2016). 2012-2016 American Community Survey 5-Year Estimates. Retrieved from https://factfinder.census.gov/



As shown in **Figure C.2-5**, stationary energy consumption is responsible for the largest portion of community-wide GHG emissions in St. Pete. A more detailed breakdown of this significant source of emissions can be seen in Figure 5 below.

As the Stationary Energy and Transportation sectors are the largest contributors to St. Petersburg's community-wide GHG emissions, they represent the greatest opportunities for overall emissions reduction. Reductions in the Stationary Energy sector could be achieved through significant energy efficiency programs and a large-scale shift to cleaner sources of fuel used to condition homes, businesses, institutions, and industries; such strategies will be highlighted in the Clean Energy Roadmap being developed as part of the ISAP.



Figure C.2-5: Breakdown of Stationary Energy Emissions



The benefits of just a 20 percent reduction in electricity consumption would be significant for reducing GHG emissions, enhancing grid resilience, and saving residents and business-owners money.



Targeting energy reductions/shift to clean energy



Regarding the Transportation sector, emissions reduction could similarly be achieved by transitioning to cleaner sources of fuel used to power vehicles traveling within and across the City's boundaries. This could be achieved by advancing the adoption of electric and other alternative fuel vehicles and the provision of related infrastructure, as well as through improved efficiency of on-road vehicles through transportation system management (i.e., managing flow and speed through synchronized and adaptive traffic controls). Importantly, reduction in this sector will also need to be achieved by reducing single occupancy vehicle miles traveled and shifting people into different transportation modes. This will require investments in bike, pedestrian, and transit infrastructure, as well as smart transit-oriented land use development decisions to ensure residents have efficient access between home, employment, and services. Doing so will also meet an important need in attracting and retaining the workforce needed to support a growing local economy.

| ······································ | | | | |
|--|---------|--------------------|--|--|
| Sector | Scope | CO2e (metric tons) | | |
| Stationary Energy | | | | |
| Natural gas consumption | 1 | 71,314 | | |
| Fossil fuels extraction and processing | 1 | 1,027 | | |
| Electric grid-supplied energy | 2 | 1,356,551 | | |
| Transmission/distribution losses from electric grid | 3 | 70,541 | | |
| Transportation | | | | |
| On-road transportation | 1 | 1,119,824 | | |
| Waterborne transportation | 1 | 24,480 | | |
| Aviation | 1 and 3 | 2,501 | | |
| Waste | | | | |
| Solid Waste Disposal (landfills) | 3 | 20,171 | | |
| Incineration and Open Burning | 3 | 92,316 | | |
| Wastewater treatment and discharge | | | | |
| Generated and treated within the city boundary | 1 | 6,124 | | |
| Generated outside the city boundary but treated within the city boundary | 1 | 1,405 | | |





Municipal Government Operations Inventory

The municipal GHG inventory for the City of St. Petersburg, Florida categorizes the government's emissions by what the municipality owns and controls, identifying emissions as either direct or indirect, and reported by scope. For the purposes of reporting, the LGOP provides the following scope definitions:

Scope 1 – All direct GHG emissions from sources owned by city.

Scope 2 – Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling.

Scope 3 – All GHG emissions from sources not owned or directly controlled by city such as emissions from the extraction and production of purchased materials, transport-related activities (employee commuting, outsourced activities such as waste disposal).

In CY 2016, the City of St. Petersburg's municipal operations were responsible for the emission of 87,364 metric tons of carbon dioxide equivalent (CO_2e). The breakdown of emissions by scope, sector, and source is listed in **Table C.2-2**.

| TABLE C.2-2: Municipal Operations GHG Emissions Summary (2016) | | | |
|--|---|--------------------------------------|--|
| Sector | Source | 2016 CO ₂ e (metric tons) | |
| SCOPE 1 | | | |
| Buildings and Other Facilities | Non-electric energy consumption | 815 | |
| Vehicle Fleet | Mobile and Stationary combustion of fuel | 12,044 | |
| Waste Water Facilities | Process and Fugitive Emissions | 7,529 | |
| | | SCOPE 1 TOTAL 20,388 | |
| SCOPE 2 | | | |
| Buildings and Other Facilities | Purchased Electricity | 42,330 | |
| | | SCOPE 2 TOTAL 42,330 | |
| SCOPE 3 | | | |
| Solid Waste | Emissions from landfill and combustion of MSW | 17,769 | |
| Employee Commute | Mobile combustion of vehicle fuel | 6,877 | |
| | | SCOPE 3 TOTAL 24,647 | |
| | | TOTAL 87,364 metric tons | |



Typical of municipal governments, the largest source of emissions is from Buildings and Facilities. The majority of this is from electricity use in buildings, outdoor lighting, and water/wastewater pumping equipment.



Figure C.2-6: Municipal Operations GHG Emissions by Sector

| Table C.2-3: Municipal Energy Consumption and Emissions, by End Use Type | | | | |
|--|-------------------------------|-------------------------------|--|--|
| Facility Type | Energy Consumption (MMBtu) | Metric Tons CO ₂ e | | |
| Buildings | 228,696 | 29,640 | | |
| Outdoor Lighting | 87,109 | 11,772 | | |
| Pumps | 10,709 | 1,447 | | |
| Marine Power Source | 1,287 | 174 | | |
| Outdoor Power Source | 790 | 107 | | |
| Security Equipment | 33 | 4 | | |
| TOTAL | 328,624 | 43,145 | | |



As Buildings and Other Facilities are the largest contributor to the City's overall emissions, it represents the greatest opportunity for significant emissions reduction. The City completed a series of energy audits for its facilities, but the majority of these were completed nearly a decade ago, and the City should consider re-commissioning energy audits at its portfolio of facilities and incorporate any resulting recommendations into its capital improvement program. Significant reductions will also be achieved as the City continues the process of converting streetlights and outdoor lighting to more efficient LEDs. The City has already begun such conversions and should see significant energy savings, associated cost savings, and emissions reductions after this baseline year of 2016. The City may also consider leading by example in St. Pete's clean energy commitments by pursuing renewable energy opportunities for its facilities and operations, which will also reduce GHG emissions.

The second largest source of emissions within municipal operations comes from the solid waste, which generates emissions through decomposition in a landfill as well as through incineration. Reductions in this sector could be achieved by conducting waste audits at the City's facilities, reducing overall waste produced by reviewing purchasing policies and procedures, and/or increasing the diversion rate through enhanced signage and recycling and composting opportunities. Any efforts to improve the City's diversion rate should be accompanied by a robust educational campaign to ensure human behavior supports these coordinated efforts.

Other opportunities to reduce the City's municipal GHG emissions can be achieved by continued replacements within the vehicle fleet with more efficient and alternative fueled vehicles, as well as through efforts that attempt to shift employees to different modes of transportation for their daily commutes (i.e., away from single-occupancy vehicles). This may include a carpool program, the provision of more enhanced public transportation incentives, or incentives to encourage walking or biking to work.

Municipal Operations



In CY 2016, the City of St. Petersburg's municipal operations were responsible for 87,364 mtCO₂e.

Approximately 49% of this was from buildings and operations.

Reducing Overall Waste



The second largest contributor of emissions within municipal operations is from the generation of solid waste (17,769 mtCO2e).

Solid waste sector reductions could be achieved through an increased diversion rate.

Daily Commuting Habits



Additional opportunities for reduction can be achieved by shifting employee commutes to different modes (i.e., away from driving alone).

Employee commutes were responsible for 6,877 mtCO2e.





Appendix C.3: Clean Energy Roadmap



CLEAN ENERGY ROADMAP



1

Overview

Cities are increasingly seeking to transition to 100% clean energy, thanks to sources that create low or zero greenhouse gas emissions. Given differences among and within cities, there is not a single one-size-fits-all solution to making this transition. Therefore, the City of St. Petersburg will need to pursue multiple, integrated pathways, to achieve its near- and long-term goals. The following five "ABCDE" pathways are presented for St. Petersburg to reach its 100% clean energy goal:

- Pathway 1: **A**dvance Energy Efficiency in Existing Buildings
- Pathway 2: **B**uild Infrastructure that is Efficient and Renewables-Ready
- Pathway 3: **C**reate, and Procure Renewable Energy through Collaboration
- Pathway 4: Develop a Smart, Reliable, and Resilient Energy System
- Pathway 5: Enhance and Electrify Transportation to Reduce Energy Use





2

Introduction

In 2016, the City of St. Petersburg became the first city in Florida and the 20th city nationally to commit to 100% clean energy, part of a national trend of clean energy commitments at municipal levels that now have been adopted by more than 70 U.S. cities¹ (see **Figure C.3-1**). As a critical part of the City's Integrated Sustainability Action Plan (ISAP), this document provides a "roadmap" for how St. Petersburg will reach its goal of 100% clean energy by 2035.

Getting to 100% clean energy is an ambitious task. Currently St. Petersburg, like most cities, relies heavily on the combustion of fossil fuels to power its buildings, infrastructure, and transportation. This 100% clean energy goal will only be achieved through aggressive and immediate action to create an energy network that is clean, reliable, affordable, and equitable.

Pathway 2

Build Infrastructure that is Efficient and Renewables-Ready

Pathway 4

Develop a Smart, Reliable, and Resilient Energy System

Pathway l

Advance Energy Efficiency in Existing Buildings

Pathway 3

Create and Procure Renewable Energy

Pathway 5

Enhance and Electrify Transportation to Reduce Energy Use

¹ https://www.sierraclub.org/ready-for-100/commitments



FIGURE C.3-1: U.S. Cities with Renewable Energy Commitments²



Source: Sierra Club.

Why Clean Energy?

St. Petersburg aims to become a healthy, resilient, and sustainable city, which requires the city to cut greenhouse gas (GHG) emissions that contribute to climate change, reduce environmental impacts, and enhance the resiliency of the city to changing climate conditions and disruptions. Stationary energy consumption (electricity and natural gas consumed in the operation of the built environment) accounted for more than half (54%) of the city's community-wide GHG emissions in 2016. This percentage indicates that any significant

reductions in GHG emissions will need to come from this source. Transitioning to clean energy also has the related benefits of improving air quality, reducing demands on an aging grid infrastructure, enhancing resiliency of energy systems, and providing opportunities for job creation and economic growth. These benefits can improve the health, livelihoods, and quality of life of St. Petersburg's residents and visitors.

St. Petersburg embraces the concept of *energy equity* and a *just transition* to a local clean energy economy. According to the Just Transition Alliance:

United Nations Intergovernmental Panel on Climate Change (IPCC)

In October 2018, the IPCC released an <u>updated report</u> that warns the world has already warmed by 1°C since the middle of the 19th century, and could reach 1.5°C before the middle of this century at the current rate of warming. The report stresses the need to reduce GHG emissions to net zero by 2050 – greater than the 80 percent reduction detailed in the ISAP - to have a reasonable chance of limiting global warming to 1.5°C.

² <u>https://www.sierraclub.org/ready-for-100/commitments</u>



"Just Transition is a principle, a process and a practice. The principle of just transition is that a healthy economy and a clean environment can and should co-exist. The process for achieving this vision should be a fair one that should not cost workers or community residents their health, environment, jobs, or economic assets. Any losses should be fairly compensated. And the practice of just transition means that the people who are most affected by pollution – the frontline workers and the fenceline communities – should be in the leadership of crafting policy solutions."³

St. Petersburg's transition to a clean energy economy must educate and engage its low-income and communities of color to help lead this transition, including influencing decisions about land use, housing, transportation, and energy infrastructure development to ensure that the community is achieving a transition away from a fossil-fuel based economy while simultaneously reducing and eliminating existing disparities in economic opportunity and access to resources.

Case Study: The Partnership for Southern Equity (PSE) and Energy Equity Initiatives

Increasingly, governments, nonprofit organizations, and other stakeholders are approaching sustainability and clean energy initiatives through equity lenses, integrating social, economic, and environmental interests and goals. Located in Atlanta, Georgia, the nonprofit organization Partnership for Southern Equity (PSE) exemplifies this approach. Through its work in "consensus building, issue framing, training, policy advocacy, and collective impact organizing," PSE focuses its efforts on economic development and growth that distribute burdens and benefits in an equitable manner across communities, especially working with and for historically marginalized, disadvantaged, and vulnerable groups. The organization targets three critical issues, all through an equity emphasis: "just energy," "just opportunity," and "just growth." In one representative project, PSE collaborated with a committee of partners to develop the Metro Atlanta Equity Atlas (MAEA), a web-based, publicly-available data and mapping tool that allows users to access and analyze data on community wellbeing, especially related to access and opportunity.

Other organizations and initiatives engaging in similar work include the following:

• Partnership for Opportunity and Workforce and Economic Revitalization (POWER) provides federally-funded training and education for those affected by the shifting coal industry in the Appalachia Region.

https://www.arc.gov/funding/power.asp

- Emerald Cities Collaborative (ECC) is a national nonprofit organization that seeks to create equitable and sustainable local economies. http://emeraldcities.org/
- Vital Brooklyn is a state-funded program that targets eight areas of investment for community development and wellness in disadvantaged communities. https://www.ny.gov/transforming-central-brooklyn/vital-brooklyn-initiative-0
- The Center for Neighborhood Technology (CNT), based in Chicago, advances urban sustainability and shared prosperity through transportation, water, climate, and public policy initiatives https://www.cnt.org/

³ <u>http://jtalliance.org/what-is-just-transition/</u>



WHAT IS CLEAN ENERGY?

Clean energy does not strictly refer to renewable energy generation. Clean energy can include both *low* and *zero* emissions options, but the intent is to transition away from energy sources that result in GHG emissions or air particulates that reduce air quality and contribute to global climate change. Clean energy also considers ways to maximize efficiency in how buildings and infrastructure are powered, and to increase reliance on renewable sources derived from nature, such as wind, solar, and geothermal power (see **Figure C.3-2**). In broad terms, clean energy can refer to any energy source that does not rely on combustion of fossil fuels. However, some sources under that definition can still lead to environmental problems, including air pollution or harmful waste products. For example, other energy sources and technologies that were considered but are *not* part of this Clean Energy Roadmap include the following:

- Waste-to-energy (WTE) technologies Although waste-to-energy technologies represent an innovative reuse of solid waste, can result in reduced GHG emissions, and have environmental benefits, this roadmap does not rely on such technologies for the long-term so as to also align with emissions reduction and waste reduction goals. WTE facilities are not always emissions free, can result in disincentivizing waste reduction, and would need to transition as communities succeed in waste *reduction* and *reuse*.
- Nuclear energy While nuclear energy is GHG emissions-free after plant construction, there are numerous other environmental and health related hazards (e.g., harmful waste, safety and security concerns) associated with the technology that run counter to other sustainability goals.
- Natural gas Natural gas is a *cleaner* alternative to many petroleum-based fuels, however it is not renewable, nor free of emissions, and there are often negative social and environmental impacts associated with its extraction and distribution. Therefore, it is not considered a clean energy solution. In fact, for environmental and financial reasons, many analysts now highlight the long-term viability of renewable energy sources over any fossil fuels, including natural gas.⁴

For the purposes of this document, clean energy includes only long-term energy sources that come from renewable sources in tandem with efficiency gains. Those items are displayed as "Green Power" in **Figure C.3-2**.

⁴ https://www.top1000funds.com/2018/10/fossil-fuel-on-last-legs-lovins/





Figure C.3-2: U.S. Electricity Supply – Conventional, Renewable and Green Energy

Source: U.S. Environmental Protection Agency (EPA).

State of Florida and Duke Energy Florida Context

Currently, approximately 4 percent of Florida's electricity generation is from renewable sources (see **Figure C.3-3**). While most states require energy providers in the state to provide a certain portion of their energy from renewable sources, Florida is one of only 12 states with no state Renewable Portfolio Standards (RPS). Partnerships with utility providers are critical to achieve an ambitious 100% clean energy goal. Duke Energy Florida and the City of St. Petersburg are partnering on a highlyvisible solar generation project at the new St. Pete Pier with photovoltaic (PV) panels creating shaded parking in the vehicle lot. The PV installation will generate enough electricity to power about 60 homes.





Figure C.3-3: Florida Net Electricity Generation by Source (April 2018)



Florida's electricity is generated by a range of sources, with renewables⁵ making up only approximately four (4) percent of the portfolio.

In addition, there are several barriers in state policies that dampen momentum for increased solar power in Florida, especially related to third party sales, existing laws, and utility planning:

> Third-party sales – Florida is one of four states where the law prohibits the sale of power to the public by any entity other than a "public utility" (i.e., no third-party sales). This policy limits the simple transfer of surplus energy produced at one city building to another city building or any other building or facility. This policy also hinders community solar and microgrid development.



⁵ In this case, renewables refers to non-hydroelectric sources of renewable energy (e.g., wind and solar). Frequently, this distinction is made because of concerns over the potential environmental impacts of hydroelectric energy generation, especially from large dams, even though hydroelectric energy does not come from combustion of fossil fuels.

- Existing energy laws The Florida Energy Efficiency and Conservation Act (FEECA) did not include energy efficiency goals and deployed a two-year payback screen, limiting opportunities and creating restrictions for advancing energy efficiency programs in Florida.
- > **Utility planning** Utility planning is disjointed, and not all systems are up to date yet with smart metering, streamlined net metering and billing; in addition, public information, especially during campaigns, can be confusing (e.g., Amendment 1, 2016).

While Duke Energy Florida (DEF) has been a key collaborator with the City and the community with demonstration projects, LED streetlight conversion, donations for a Financial Empowerment Center, and development of a highly visible solar carport on the St. Pete Pier, DEF's electricity generation profile indicates that only about six (6) percent of its generated electricity is from renewable sources (solar and wind).⁶ Duke Energy is one of the largest electric utilities in the country and Florida. It is the City's belief that Duke can have a much greater role in transitioning to 100% clean energy, while still maintaining the company's strengths in infrastructure, safety, and reliability.

According to the Duke Energy *2017 Climate Report to Shareholders*,⁷ the utility has reduced carbon dioxide (CO₂) emissions by 31 percent since 2005 and established a goal to reduce CO₂ emissions 40 percent from 2005 levels by 2030 – an additional 9 percent reduction from 2017 to 2030. Beyond 2030, the company's long-term strategy will further reduce carbon intensity, but specific anticipated levels remain undefined. Duke and its local customers (e.g., municipalities and Pinellas County) are making a concerted effort to transition away from coal-fired power plants, while also investing in renewable sources. However, there is still significant ground to cover. Indeed, Duke's report indicates that the company anticipates that fossil fuels will still contribute 58 percent of its energy generation in 2030 with hydroelectric, wind, and solar still only making up 10 percent of its generation capacity at that time. Additionally, energy efficiency is the first pathway in the ISAP. St. Petersburg is seeking a much bolder commitment from Duke Florida in supporting energy efficiency programs.

The City is steadfast in its commitment to assist Duke Energy in a more ambitious transition to clean energy, if the will of the utility is evident. Should Duke Energy goals and plans more closely match those of their municipal customers, those commitments should be made clear as soon as possible for more advanced collaboration as well as in consideration of the renewal of the City's current franchise agreement (agreement term ends in 2026). The City and its community partners should continue to look for ways to make such a DEF transition successful. Some approaches to this are articulated in the *State and Utility-Wide Recommendations* section that follows.

⁷ https://www.duke-energy.com//_/media/pdfs/our-company/shareholder-climate-report.pdf



⁶ https://www.duke-energy.com/_/media/pdfs/our-company/duke-energy-fast-facts.pdf?la=en



3

State-and Utility-Wide Recommendations

The following recommendations can help the State, Duke Energy, and local jurisdictions transition to 100% clean energy. These strategies are not presented as prerequisites for the St. Petersburg-specific pathways presented later in the document, but rather as a framework that would improve effectiveness and implementation of St. Petersburg's (and other municipalities') clean energy efforts.

- 1. Collaborate with Key Business and Community Stakeholders to Establish Implementation Milestones and Progress Criteria - This Clean Energy Roadmap outlines numerous strategies requiring significant collaboration from business, community, utility, and state level stakeholders. As a first step, the City should convene key stakeholders and leverage resources from the American Cities Climate Challenge technical team to set a timeline for completion of key milestones and criteria for satisfactory progress. Criteria for satisfaction should include commitment and progress from Duke Energy Florida in advance of the end of the City's current franchise agreement in 2026, as well as actions that could be taken to establish an independent municipal utility if such progress is not met.
- 2. Adopt an Inclusive, Accessible, and Transparent Utility Integrated Resource Plan Process - There is a need for the state to reform the utility planning process to make it more transparent and inclusive of stakeholder participation to ensure the selection of low cost, low risk resource options such as energy efficiency and distributed solar power. This integrated resource plan (IRP) process should allow stakeholder intervention to analyze utility resource plans and to present evidence on how to integrate the lowest cost options and how to reduce long-term risk to customers.
- 3. Allow Third Party Sale of Power Florida's existing prohibition of the sale of power to the public by any entity other than a "public utility" prevents Florida residents and businesses from utilizing third party power purchase agreements (PPAs), one of the most popular methods of financing in the solar industry. Third party PPAs are a form of third-party ownership financing, whereby a commercial business owns and operates a customer-sited renewable energy system (typically photovoltaic, or PV) and either leases the system equipment or sells the power (via a power purchase agreement) to the



building occupant. Lifting this prohibition would allow for more opportunities for solar power.

- 4. Set Targets and Goals for Energy Efficiency, Conservation, and Renewables_– These benchmarks would help the state guide municipalities and create a statewide framework reducing energy use and/or increasing energy generation by renewables. It would also create metrics by which the state and other entities could measure and review progress.
- 5. Adopt a Renewable Portfolio Standard (RPS) An RPS that sets targets and timelines for renewable energy development and creates Renewable Energy Credits (REC) would provide another income stream for renewable energy developers, making renewable energy projects more viable for both third-party projects and utility self-build projects. The Federal Energy Regulatory Commission (FERC) has ruled that RPS policy is the purview of a state and thus not preempted by federal law. A state is allowed wide latitude in designing an RPS policy.
- 6. Establish Policies that Promote Electric Vehicles (EV) Florida is ranked fourth overall in the nation for the number of EVs, and that number is evenly split between EVs and plug-in hybrid electric vehicles (PHEVs). In terms of charging, Florida is ranked 34th in the nation in terms of DC Fast Chargers (DCFC) (i.e., Level 3 charging stations) per 1,000 people and 23rd in the nation in terms of Level 2 charging stations per 1,000 people. The local-, state-, national-, and utility-level actions listed below can help Florida and municipalities improve infrastructure for EVs.

Local laws and policies should particularly target deployment of EV infrastructure and EVs themselves through a variety of mechanisms:

- Local EV ordinances for EV ready developments and building code streamlining for developers
- Bulk purchase agreements and/or programs to assist in low-cost EV fleet acquisition
- Incentive programs for businesses to install Electric Vehicle Supply Equipment (EVSE), such as charging stations
- Electric vehicle acquisition goals and preference for low or zero emission vehicles in procurement policies
- Electric local rental programs, prioritizing low-income communities
- Parking benefits to EV drivers, such as dedicated spaces or free parking

State level actions should create financial tools and regulations promoting EVs:

- Financial incentives for vehicles (e.g., sales tax rebate, tax credit)
- Financial incentives for charging infrastructure, both public and private
- Simplified state permitting for charging infrastructure to add installation
- Revised building codes to include support EV infrastructure deployment
- Incentives for developers to include EV infrastructure
- EV fleet requirements for state fleets



The Federal government should raise the cap of EV tax credits.

Utilities can adjust regulations and programs to promote EVs:

- Exemptions for EV infrastructure providers from regulation as a utility
- EV rates, such as time of use rates for EV drivers
- Utility EV pilot programs
- Definitions and clarifications of utility's role in EV charging stations via utility commission proceedings
- Funding mechanism to support EV charging infrastructure deployment

These different approaches can support local efforts to reach 100% clean energy. However, they are not without challenges and concerns. For example, net metering is currently being challenged across the country. Florida should anticipate similar efforts to seek to undermine the current net metering rule.





4

St. Petersburg Context

Cities have different profiles when it comes to sources of greenhouse gas emissions. **Figure C.3-4** shows a summary of the results for the community GHG emissions inventory and the amount that municipal (City of St. Petersburg) operations contribute to community emissions. With a large residential and commercial base, nearly all (96 percent) of St. Petersburg's greenhouse gas emissions come from stationary (primarily buildings) and transportation sectors (see **Figure C.3-5**). As a result, the City's clean energy strategy directly targets these sectors, whereas other cities with larger industrial or agricultural sources of greenhouse gas emissions might target those sectors.



Figure C.3-4: St. Petersburg GHG Emissions Inventory Summary Results (2016)

Source VHB, 2018.



Figure C.3-5: Community GHG Emissions (2016)



Source VHB, 2018.

WHAT DOES A CLEAN ENERGY TRANSITION LOOK LIKE FOR ST. PETERSBURG?

The City of St. Petersburg is committed to transitioning to clean energy for its communitywide stationary energy use by 2035, primarily in the form of electricity use, since 95 percent of current emissions are associated with electricity consumption and electricity transmission and distribution losses (see **Figure C.3-6**). By targeting these sectors that are currently the source of the largest portions of St. Petersburg's current emissions, the City can more effectively transition to clean energy. Figures on the following pages demonstrate the level of reductions needed to reach the city's clean energy goals (**Figures C.3-7 and C.3-8**) and the pathways to get there (**Figure C.3-9**).





Figure C.3-6: St. Petersburg Community Stationary Energy Emissions

Source: VHB, 2018.

St. Petersburg Commitments

St. Petersburg has joined many cities in the U.S. and around the world in commitments to GHG emissions reductions and clean energy. In the U.S., cities have aligned targets to reduce emissions by 80% by 2050. According to the climate science community, that target is necessary to keep global temperature increases to only two degrees Celsius above pre-industrial levels, often cited as the threshold that global temperatures must be kept below to prevent catastrophic climate change impacts. For example, with a two degrees Celsius global temperature increase, much of St. Petersburg and Tampa Bay are projected to be underwater, including all coastal areas and as far inland in Downtown St. Petersburg as First Street North.⁸ In response to these types of projections, St. Petersburg and other cities have committed to emissions reductions targets including those under the national and international efforts:

- Global Covenant of Mayors for Climate Change Chicago Climate Charter
- America's Pledge and the Carbon Disclosure Project
- We Are Still In
- Ready for 100

The following GHG emissions forecasts (**Figures C.3-7 and C.3-8**) show the St. Petersburg community-wide emissions through 2050 with a "business-as-usual" (BAU) forecast trend if no significant action is taken to reduce emissions. The charts also show the trend line for

⁸ https://seeing.climatecentral.org



transitioning to 100% clean energy by 2035 and the 80 percent reduction in greenhouse gas emissions by 2050, thus demonstrating the reductions needed to reach those goals.

Two charts are depicted below because of uncertainties in the transportation sector. Reductions in the transportation sector (representing 42% of total emissions in St. Petersburg) are necessary to achieve an overall 80% emissions reduction by 2050. Recently, there has been inconsistency and debate at the federal level and within the automobile manufacturing industry regarding fuel efficiency requirements for new automobiles. As a result, two business as usual scenarios are presented below, based on different potential policy futures, related to federal fuel efficiency standards. Figure C.3-7 considers Corporate Average Fuel Economy (CAFE) standards as currently outlined through 2025, with an assumption of comparable improvements year over year through 2050. Figure C.3-8 reflects a rescinding of these standards currently being considered by the U.S. Environmental Protection Agency (EPA), with standards essentially frozen as of 2020. The forecast still includes a moderate expectation of fuel efficiency improvements. This assumption is based on an expectation that the international automobile market and consumer demand will continue to push manufacturers to increase the fuel efficiency of new models of automobiles. Indeed, many companies have made such commitments, independent of federal requirements.



Figure C.3-7: St. Petersburg Community GHG Emissions Forecast, Metric Tons CO2e (2016-2050)

Source: VHB, 2018.





Figure C.3-8: St. Petersburg Community GHG Emissions Forecast, Metric Tons CO2e (2016-2050) – Potential Rescinding of CAFE Standards

There is not a single one-size-fits-all solution to transitioning to 100% clean energy for every city. To achieve its near- and long-term clean energy goals, the City of St. Petersburg will need to pursue its own unique set of multiple **pathways**, not independently, but rather in conjunction (see **Figure C.3-9**).

In addition to these pathways, St. Petersburg's goals for a clean energy transition will emphasize several principles:

- Energy equity and affordability Research has indicated low-income and African-American and Latino households, along with renters pay more for utilities per square foot than average, reflecting inefficiency in this housing stock and a higher "energy burden."⁹ In the Tampa-St. Petersburg-Clearwater Metropolitan Statistical Area (MSA), median percentage of household income spent on energy bills, known as "energy burden," for the median household was 3.32%, but for low-income households it was 7.28%.¹⁰ This discrepancy indicates that economically disadvantaged populations face higher cost burdens for energy use. Clean and efficient energy strategies can and should aim to reduce this burden for St. Petersburg's most vulnerable residents.
- Economic feasibility The path to clean energy should emphasize low-cost strategies in the near-term, while planning for longer-term investments and leveraging the continued decline in the cost of renewable energy technologies.

⁹ https://energyefficiencyforall.org/sites/default/files/Lifting%20the%20High%20Energy%20Burden_0.pdf

¹⁰ Ibid.


- Economic growth and job creation Clean energy technology provides an opportunity for St. Petersburg to be a leader in innovation, expand its economy, and create new quality jobs, by supporting and incentivizing clean energy research, development, financing, and installation industries locally. As these industries grow, there can be opportunities for economic and employment growth, as well as new opportunities workforce development. For example, promoting solar energy can support economic activities, such as panel manufacturing and installation. Reducing energy use can provide cost savings for the city to reinvest in other resources and city services, improving the city's overall fiscal health and financial bottom-line.
- Innovation and smart city development The city can serve as a model for piloting and incubating innovative solutions that will not only help St. Petersburg meet its clean energy goals, but also provide best practices to share with other cities throughout the region and the country. New energy efficiency and renewable technologies are being developed alongside "smart" technology solutions that will allow for even more efficient, transparent, and data-driven management of resources. These data-driven approaches can provide improved management opportunities that can be shared across sectors and regions. For example, networked energy monitoring sensors and controls can help measure and automate energy consumption.
- Resilience and reliability The energy grid consists of aging infrastructure that is also becoming increasingly susceptible to extreme weather, climate change impacts, and even cybersecurity threats. Distributed energy generation with built-in flexibility and adaptability to changing conditions, as well as redundancies, will be critical to the city's future sustainability. In addition to the infrastructure and security work that energy providers are currently undertaking, it will be necessary to work with the Public Service Commission and local energy providers to implement recommendations.

As previously mentioned, it will take multiple pathways working in tandem to achieve 100% clean energy by 2035 and 80% emissions reduction by 2050. First, St. Petersburg must reduce overall energy demand by 25% by 2025, and 35% by 2035 through energy efficiency improvements in existing buildings (Pathway 1). It also must reduce projected increases in demand by implementing Pathway 2 strategies, working toward net zero construction for new development. Additional transition to clean energy comes from grid improvements as grid-supplied energy becomes decarbonized over time due to efficiency and renewable energy investments from Duke Energy.

In addition to these steps, St. Petersburg (City, businesses, and residents) will need to install the equivalent of 680 megawatts of solar capacity (Pathway 3) or equivalent procurement of renewable energy credits (RECs) or similar. This level of solar capacity is equivalent to roughly 68,000 households each generating energy with 10 kW solar installations by 2035, or the estimated roof area needed to accommodate 680 MW of solar is about 1,500 acres. Pathway 4 describes strategies for a smarter and more resilient grid, which will make the above strategies more efficient and effective. And finally, Pathway 5 outlines strategies in the transportation sector that will contribute to emissions reductions in that sector. Each Pathway is outlined in more detail in the following sections with a portfolio of strategies to support achieving these goals. Figure 9 presents a graphic summary of the Clean Energy Roadmap, by depicting the proposed contributions of each pathway toward meeting the 100% Clean Energy goal by 2050.



The following tables use the pathways discussed above to provide examples of specific actions and anticipated reduction in energy use along with increase in renewables that could result in progress toward the 100% clean energy goals. The steps in this initial roadmap need to be further developed by identifying additional steps, stakeholders, external organizations, and business and community investments that will be needed.

Table C.3-1 provides a summary of the primary actions and/or results for each pathway through 2035.

| Pathway | 2016-2025 | 2025-2035 |
|--|--|--|
| 1: Energy efficiency in existing buildings | 25% reduction in energy demand of existing buildings | 13% reduction in energy demand of existing buildings |
| 2: Efficient new buildings/renewables-ready infrastructure | Sustainability & Resiliency City Facility Building Ordinance | Net zero requirements for new buildings |
| 3: Create/procure renewable energy | Power approx. 45,000 homes & businesses with renewable energy (703,400 MWh) | Power additional approx. 25,000 homes & businesses with renewable energy (410,000 MWh) |
| 4: Smart, reliable, resilient energy system | Continued decarbonization of utility provider energy, and electric grid improvements to enable Pathways 1-3 | Continued decarbonization of utility provider energy, and electric grid improvements to enable Pathways 1-3 |
| 5: Enhance/electrify transportation | 13% reduction in transportation emissions (in addition to fuel efficiency standards) | 30% reduction in transportation emissions (in addition to fuel efficiency standards) |

Table C.3-1 Summary of Primary Actions/Results for each Pathway Through 2035

Source: VHB, 2018.

Based on the contributions of each Pathway that are described and listed above, **Table C.3-2** provides a summary of potential municipal investments through 2025 by Pathway. With an understanding that municipal facilities and operations contribute to just 3 percent of the total community GHG emissions (**Figure C.3-4**), the City must consider investments that directly address items within its control *and* influence actions within the community.



| Pathway | Program/Project | Description | Estimated Budget/ City Investment | Estimated Timeframe |
|--|--|---|--|--|
| 1: Energy Efficiency in Existing Buildings | Energy retrofits and retro- commissioning of municipal facilities (up to 500,000 square feet [sf])* | Enhance the energy efficiency of existing municipal facilities through energy audits and improvements | \$5 million | 2020 – 2021 |
| | | | \$5 million | 2021 -2022 |
| | | | \$15 million | 2022 – 2025 |
| | Private sector challenge program for energy efficiency in buildings | Implementation of policy focused on tracking the energy output of largest private buildings to help local commercial property owners drive efficiency, save money and foster cleaner/ healthier environment | Staff resources | 2020-2021 |
| | | | Staff resources | 2021-2022 |
| | | | Staff resources | 2022-2025 |
| 2: Efficient New Buildings/ Renewables-ready Infrastructure | Private sector incentives to build energy efficient facilities | Influence the energy efficiency of new private development within the City by incentivizing performance | To be determined regarding City funding, fee reductions, and staff resources | 2021 – 2025 |
| 3: Create/ Procure Renewable Energy | Solar Co-ops (business and residential) | Annual investment to scale up Solar and Energy Loan Fund (SELF) non- profit financing model (energy efficiency and weatherization strategies address Pathway 1) | \$70,000 | Bi-annually through 2035 |
| | Community Solar | Annual work to identify DEF partner sites; other community sites and products | In-kind or leased right-of-way access; staff resources | As-needed through 2035 for identified projects |

Table C.3-2 Potential City Investments in Clean Energy Roadmap Pathway Strategies





| Pathway | Program/Project | Description | Estimated Budget/ City Investment | Estimated Timeframe |
|---|---|--|--|--|
| | Other solar products – leases, third party leases, RECS, + more | Annual work to facilitate collaborations | Staff resources; possible \$50,000 annual budget request for RECS once demonstrated progress in energy efficiency + renewables | Annual; RECs 2030 – 2035 pending franchise and other foundational efforts |
| 5: Enhance/ Electrify Transportation | Municipal Green Fleet Policy | Reduction of municipal vehicle fleet emissions through right-sizing, procurement of efficient vehicles/ infrastructure, idle reduction, transition to EVs, and establishment of fuel and GHG emission reduction targets | 2020 budget request in development; followed by annual replacement cost/budget request analysis | 2020 - 2025 |
| | Electric Vehicle (EV) charging in municipally-owned parking lots | Initially part of the Duke Energy's Park and Plug pilot program that will install charging stations in the City | \$100,000 - \$500,000 per year depending on grants available, EV projections, Fleet Conversion Rate, technology | 2020 - 2025 |
| | EV education and incentives | Education and incentives for residents to purchase and use EVs in the City | Staff resources; initial loss of EV charging station revenue (transition to charging) | 2020 - 2025 |
| | Commuter incentives | Financial incentives for commuters to use public transportation to reduce single-occupancy vehicle use | \$50,000 or in-kind incentives annually | 2020 - 2025 |

Technical support provided by Bloomberg Philanthropies' American Cities Climate Challenge (ACCC).

Source: VHB, 2019.





Figure C.3-9: Clean Energy Roadmap Summary - Pathways' Contributions to 100% Clean Energy by 2050



Pathway 1: Advance Energy Efficiency in Existing Buildings

The first step in a transition to clean energy always must be to reduce energy demand, ensuring that existing energy-consuming buildings and infrastructure are operating as efficiently as possible. This initial step not only reduces demands placed on the existing electric grid infrastructure, but also reduces energy costs for building occupants. Whether lowering the "energy burden" for St. Petersburg residents or reducing operational costs for the commercial and industrial sectors, these efficiency enhancements provide economic benefits through energy cost savings in the near term.

By lowering energy use, this pathway also reduces GHG emissions. Equally important, this pathway reduces the generation capacity required to meet operational needs and therefore the renewable energy system size needed, which lowers overall costs for installing those systems. Thus, there is a (negative) feedback loop between this pathway and Pathway 3: The more energy efficiencies realized, the fewer investments in renewable energy systems needed. These savings are extremely important as the city continues to grow, adding more residents and businesses with associated energy demands.

In total, Pathway 1 strategies are aimed at reducing energy demand by 25% by 2025 and 35% by 2035 from energy efficiency improvements in existing buildings.

City-led Programs for Energy Efficiency

The City of St. Petersburg will continue to lead by example regarding energy efficiency in its operations. Completed and existing energy efficiency and reduction strategies employed by the City include:

> Benchmarking and Monitoring

- According to a 2011 compilation of sustainability actions in St. Petersburg, <u>Green St.</u> <u>Petersburg</u>, the city's power supplier conducted energy audits of all City facilities. From these audits, the City prioritized energy conservation measures, particularly projects with payback periods of two years.
- In 2017, a class of University of South Florida students conducted energy audits on three City facilities. Duke Energy also conducted Level 1 audits on those same facilities.
- The City of St. Petersburg has been entering energy use data into the Energy Star Portfolio Manager web-based program, run by the U.S. Department of Energy and Environmental Protection Agency. All the City's facilities have been entered into the program, enabling the City to track its energy use and compare facilities' energy use against national averages. Municipal staff conducted Level 1 energy audits on the 17 facilities with energy use levels higher than national averages.

> Building Upgrades

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 Using the data from benchmarking and monitoring, the city identified 51 priority projects at 12 City facilities. The estimated cost for design and implementation of these projects is \$3.25 M, with an estimated annual utility savings of \$320,500, a simple payback of 10.1 years, and an internal rate of return (IRR) of 11.7%. Based on St. Petersburg's analysis, if these projects were expanded, across every City facility, the



total cost would be \$28M, with an estimated annual energy savings of \$2M. The project would be implemented over five years, with a 15-year payback period.

- The City will implement deep energy efficiency retrofits and retro-commissioning of municipal facilities, including benchmarking and financing support, as well as completing energy projects, that are estimated to result in 6,700 metric tons CO₂e in GHG reductions.
- The City may consider entering into a performance contract with an energy service company to streamline the identification and implementation, and to maximize savings, of municipal facility efficiency upgrades.

> Infrastructure Retrofits

- In partnership with Duke Energy Florida, St. Petersburg recently began converting its approximately 31,000 streetlights to LEDs, anticipated to save the City \$240,000 in electricity costs ever year. In addition, the City is converting its 300 traffic signals from incandescent bulbs to LED lights, anticipated to save the City at least 68% in energy costs. LEDs last longer than standard lighting, which also will save St. Petersburg maintenance costs as well. The City's streetlight conversion project is expected to reduce 700 metric tons CO₂e by 2020 and 2,450 metric tons CO₂e by 2025.
- Since 2011, St. Petersburg has been working on the Southwest Water Reclamation Facility Biosolids Waste to Energy Project. Set to be completed in 2019, the project would convert wastewater and biosolids into biogas that could be integrated into the city's natural gas network run by TECO Peoples Gas, including potential infrastructure for the City to run its sanitation trucks and/or a generator on the gas. Depending on how the gas is used, the project is estimated to save the City \$14.8 M – \$31.6 M over 20 years.

Community-Scale Programs and Policies for Energy Efficiency

The City of St. Petersburg will also pursue the following strategies to improve energy efficiency and reduce overall energy consumption across the residential, commercial, and industrial sectors. The following are a few programs already in place that could be scaled up and marketed.

> Existing Programs

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- Solar and Energy Loan Fund (SELF) is a non-profit organization that provides lowinterest loans for home improvements to improve energy efficiency, water conservation, and storm preparedness. The program has no income requirements, but is particularly valuable to women, veterans, and low-income homeowners who have had trouble getting loans in the past. With this financing, individuals can reduce utility bills and improve quality of life. As of July 2018, SELF has originated 15 loans, totaling \$167,826, while also holding 40 community events, drawing over 1,500 participants, and adding 32 contractors to the network. The City anticipates that SELF expansion could reduce 700 metric tons CO₂e by 2020.
- Florida Solar United Neighbors (FL SUN) is a nonprofit that expands access to solar by educating Florida residents about solar energy and helps them organize group solar installations known as solar co-ops. Solar United Neighbors has facilitated more than

two-dozen solar co-ops across the state, including the first co-op in Florida in St Petersburg in 2016. Since then, they've helped hundreds of Floridians go solar. The city would like to scale up the program and is working on pathways to do so in 2019.

- Pinellas County Urban League is a non-profit organization that provides low-income home energy and weatherization assistance.
- Duke Energy Florida offers several programs to help support residential and commercial energy efficiency:
 - 1. Home Energy Check program provides information on home energy use, energy savings kits, recommendations for improvements, and information on available rebates.
 - 2. Free improvement and weatherization offerings provide services for income eligible customers.
 - 3. High bill alerts inform customers when hotter or colder weather might create higher bills, so that customers can plan accordingly.
 - 4. Demand response program provides energy bill credits for reduced energy use in response to periods of higher demand. Currently, St. Petersburg participates in Duke's demand response program for water reclamation facilities and pumping stations, facilities that are on standby electric tariffs. When Duke needs power, the City runs the facilities on backup generators (that meet EPA guidelines) and keeps track of credits owed. Historically, one City employee in one department has kept track of this program, so a more systematic approach across multiple City departments and facilities could help St. Petersburg take further advantage of Duke's demand response program.
 - 5. Business Energy Check program and incentives includes custom incentive programs, for reducing energy use.
 - 6. Attic insulation upgrades, window rebates, outdoor lighting services, and heat pump rebates provide funding for improving energy efficiency.
- > New Strategies
 - Adopt a Building Energy Benchmarking and Disclosure Policy Mandatory benchmarking is an increasingly popular practice among cities. Under such policies, municipal governments require certain buildings to measure energy and water consumption. To date, over 20 cities and other local jurisdictions have passed mandatory benchmarking policies. These cities range in size and location and include large cities like San Francisco, Chicago, and New York City, as well as mid-sized and small cities like Berkeley, CA, Portland, ME, and Cambridge, MA. Currently, Orlando is the only city in Florida to pass a benchmarking policy. Under this ordinance, passed in 2016, city-owned buildings larger than 10,000 gross square feet and commercial or multifamily residential buildings larger for benchmarking, including receiving a benchmarking score. Cities that have enacted similar laws have experienced a 1.6 to 14 percent reduction in energy use, energy cost, or energy intensity over two to four years, with most cities experiencing 3 to 8 percent reductions.



- Establish Property Assessed Clean Energy (PACE) PACE serves as a financing mechanism for commercial and residential properties to fund energy efficiency, renewable energy, and water conservation projects. The program pays for all of a project's cost, repaid through an assessment added to the property's tax bill over a period of up to 20 years. According to the program, the annual energy savings typically exceed the annual assessment payment, so these projects start paying for themselves immediately. PACE requires state and local government legislation and sponsorship. In 2010, Florida passed such legislation, enabling PACE. Pinellas County has also passed enabling legislation; however, no PACE providers have proposed to set up in the county at the time of this final document (January 2019).
- Create a Retrofit Accelerator Program Retrofit accelerator programs provide advisory services to improve adoption of energy efficiency retrofits. The New York Retrofit Accelerator conducts consultation, connecting interested parties with qualified contractors, incentives and financing, training, and additional support where needed. To start such programs, municipalities must first adopt building benchmarking and disclosure programs as described above. Developing the framework for the building energy law can take approximately three to six months, followed by the local vote for adoption. Next, the municipality should develop a timeline for a phased implementation and then an online tool and appropriate submittal application paperwork. Once implemented, such a program has the potential to create an overall building portfolio energy reduction of 20-30 percent.

Pathway 2: Build Infrastructure that is Efficient and Renewables-Ready

As St. Petersburg continues to grow, there is significant potential to transition to clean energy in the construction of new buildings and infrastructure. It is essential to plan now for a smart, efficient, resilient, and renewables-ready built environment. Since what is built today will be in operation for decades to come, it is critical to build in a way that can accommodate existing and potential future renewable energy technologies. While costs for sustainable building practices continue to decline, and technology continues to improve, a short-term transition to net zero energy will not be feasible; however, new construction should phase in net zero energy strategies.

The City has already implemented several policies and programs to support smart and sustainable new construction practices:

City-owned new construction or redeveloped buildings over 5,000 square feet are required to apply sustainable design and green building certification approaches to design, construction, and operations of new and significantly redeveloped buildings.

- City infrastructure must also implement sustainable design approaches with options for certification under the Institute for Sustainable Infrastructure's Envision program.
- St. Petersburg offers reduced building permit fees for private buildings certified as green buildings.



St. Petersburg will also pursue the following strategies for new construction and development:

- Introduce a "feebate" or Tax Abatement Program for New Developments over a Specified Size A feebate program typically targets low efficiency or high energy using facilities and charges them a surcharge, while providing a refund to high efficiency or low energy using facilities. Such a program can be structured so that developers would earn tiered levels of credits based on the levels of improvement over standard building code, encouraging green building performance standards. This system would provide developers with flexibility and incentives to incorporate sustainable and resilient building elements as they see feasible and economically viable. This program could be targeted to individual neighborhoods or areas of the city, so that proposed green building elements for buildings in each of these areas prioritize locally unique needs and opportunities. As a result, developers may be able to receive larger incentives for addressing such local needs and opportunities.
- Develop a Training or Education Program for Contractors and Building Inspectors to Improve Compliance with Florida Energy Conservation Code - It is not uncommon for buildings to be built out of compliance with existing energy codes, or at least inconsistent with their original planning and design. Commissioning is the process by which recently-completed buildings' components are evaluated to ensure that they have been installed and operated as intended, especially in terms of energy use. Research has shown that new construction building commissioning can create a 13 percent whole energy savings, with a payback of 4.2 years. These types of savings can be realized, through training of contractors and building inspectors to conduct such work, as well as basic compliance review.
- Adopt a More Stringent Local Energy Efficiency Code Municipalities are permitted to adopt energy codes that go beyond the requirements of the state's Florida Energy Conservation Code. Often referred to as "stretch codes," these regulations can lead to energy savings by reducing energy demand in new buildings. This will require development of a stretch code strategy with design standards (e.g., 40% improvement over ASHRAE 90.1-2013 standard) and/or performance standards (e.g., zero net energy) and adoption at the local level.
- **Require All New Construction be "Solar-Ready"** Similar to stretch codes, through local building code, municipalities can require that all new construction be able to accommodate solar power technologies. This "solar-ready" provision can require new buildings to include the ability to install solar photovoltaic (PV) panels, net metering, and inverters. Such provisions would also relate to design features of the building, including roof and electrical design. The City should consider including this provision within any adoption of more stringent energy code to only require one new code adoption.
- Adopt Green Building Standards for Affordable Housing Standards and policies requiring the integration of green building principles into affordable housing development can be developed through coordination with developers and funders of affordable housing. Further, green affordable housing development should be incentivized for builders. Because green building principles promote energy and water

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efficiency, they can play a critical role in keeping utilities affordable, thus contributing to homeownership and rental affordability. Green building standards also address indoor air quality, healthy building materials, and durability, sometimes directly related to energy use. These elements are all important to occupants, especially of affordable housing units, who are often disproportionately burdened by respiratory and other illnesses. Standards should also include siting decisions that will encourage improved mobility and access to community resources. By increasing mobility, particularly through modes other than private automobiles, this type of access can have positive connections to Pathway 5: Enhance and Electrify Transportation to Reduce Energy Use. The Enterprise Green Communities standards could serve as useful guidance for this strategy. For existing affordable housing, Duke Energy Florida could work with the City to develop incentives for low-income homeowners or affordable housing development owners to invest in energy efficiency improvements.

Pathway 3: Create and Procure Renewable Energy

As previously stated, it is critical for St. Petersburg to reduce overall electricity consumption throughout the city through Pathways 1 and 2 (already discussed). With the implementation of Pathways 1 and 2, overall energy demand would be reduced. As a result, the city then would have reduced – but by no means eliminated - needs for investments in renewable energy installations and/or procurement of clean energy generated elsewhere. While Pathways 1 and 2 can create substantial energy savings, alone, they are not enough to get St. Petersburg to 100% clean energy by 2035. An additional portion of energy would still need to be sourced from renewable energy installations beyond the increased renewables in Duke's energy grid. Pathway 3 describes strategies for the deployment of renewable energy installations and the role of clean energy procurement (including purchase of Renewable Energy Credits (RECs) in the city's transition to clean energy by 2035.

According to the Solar Energy Industries Association, solar costs in Florida have fallen by 53% in the past five years.¹¹ The state also ranks third in the nation for solar generation capacity. With an average of 361 days of sunshine per year and its nickname as "The Sunshine City," St. Petersburg is particularly well-suited to take advantage of solar energy. As costs continue to decrease at an accelerated pace, coming closer to parity with conventional electricity sources, there is a substantial opportunity for St. Pete to capitalize on the clean energy generation potential, as well as the economic growth and job creation potential, of solar energy.

- > Existing Programs
 - **Sunlit City Parks** St. Petersburg installed solar panels at 18 city parks and recreational facilities, generating an estimated 261,368 kWh every year, with a \$2.4 million federal grant.
 - Solar United Neighbors (Solar Co-ops) Solar United Neighbors has developed systems and processes by which residential customers can buy a lease or share in a community or neighborhood solar project, in return for a proportional credit on their

¹¹ <u>https://www.seia.org/state-solar-policy/florida-solar</u>



electricity bill. This set-up enables groups to leverage their resources to more effectively implement solar projects at larger scales than individuals. It also allows individuals to participate in solar projects, without necessarily installing the panels on their own property, often referred to as "virtual net metering." Currently, there are three Solar Co-Ops in St. Petersburg. In terms of energy cost savings, Solar United Neighbors estimates \$20,000 in savings and \$13,000 in net profit for a 4 kW system and \$40,000 in savings and \$26,000 in net profit for an 8 kW system over a 25 year lifetime of a project.

• **Duke Energy** - Duke Energy allows customers to generate their own renewable electricity and offset their bill through net metering that effectively sells electricity back to the grid. Florida's Public Service Commission (PSC) sets the rules for these types of systems. For facilities generating less than 10 kW of solar power, Duke has an application and net metering process, but not fee. Facilities with larger generating capacities have more complicated processes and fees.

> New Opportunities

- Community Solar There are opportunities to expand community solar, building on the existing solar co-ops. Increasing the number of co-ops and/or participants in existing co-ops, especially with virtual net metering, would open numerous opportunities for independent solar developers to come into the state and build projects that could offer significant benefits and cost reductions across communities. This type of scale-up could reduce 4,000 -20,000 MT of CO₂e. over the next 5-10 years. Until state regulations are changed, scaling up community solar will not be possible without Duke Energy Florida taking the lead, but the City and Duke are committed to building on recent successful collaborations.
- **Rooftop Solar** St. Petersburg has limited open space and open parking lots that could host ground mount and carport solar installations, respectively, but there are large warehouse and commercial rooftops, as well as land outside of St. Petersburg that could host solar projects for use by the City. This effort could build on the Sunlit City Parks initiative, which included several rooftop sites on recreation centers. Future, large on-site rooftop projects could be built "behind-the-meter," meaning their primary goal would be to serve the load within the facility on which they are located or next to. As the cost of solar equipment keeps dropping, this type of project would become more cost competitive.
- Contract Opportunities with Duke Energy for Solar Energy St. Petersburg can explore competitive contract opportunities with Duke Energy for the purchase of Solar Energy. As mentioned previously, Duke is currently expanding its solar generating capacity, and the City could contract with Duke to ensure a larger portion of its energy is generated by solar facilities.
- Partnerships with Better Buildings Initiative to Implement a "Clean Energy for Low-Income Communities Accelerator" (CELICA) Program – These types of programs enhance clean energy production and consumption within low-income communities. The program will aim to expand financing options, increase availability, awareness, and connections to resources and programs, provide solutions to enable use of clean energy at different types of properties (e.g., rental and multifamily), and



create quality technical jobs in the process of supporting and expanding the clean energy industry.

- Incentives and Partnerships for Development of Clean Energy Technology
 Incubators Clean technology incubators frequently involve local government,
 academic institutions, and private industry coming together to grow the clean energy
 sector, with associated economic, employment, and environmental benefits. By
 establishing partnerships and financial structures (e.g., incentives), St. Petersburg can
 create the foundation for clean energy technology incubators.
- **Battery Storage Development and Deployment** Battery storage can be co-located with solar projects to store electricity when it is not needed and discharge it when it is. Batteries can be arranged behind the meter to address the energy needs of a home, business, or facility, or in front of the meter to help address fluctuations in demand on the local utility's system. Batteries can also provide resilience benefits, with stored electricity for use during disruptions to the grid, such as during extreme weather. Batteries are coming down in cost at a surprisingly rapid pace. Many states have added battery storage mandates or targets to their policies and regulations, and St. Petersburg should consider this approach as well.
- Other Technologies Clean energy technologies continue to evolve with new innovations. Given St. Petersburg's sunny climate, solar PV currently represents the city's best option for clean energy generation, but the city should also explore other existing and still-to-be developed technologies, including solar thermal, fuel cells, and geothermal. The city should develop mechanisms for piloting and scaling existing technologies, while also not precluding future technologies.
- Renewable Energy Credits (RECs) and/or Offsets The Pathways and strategies presented in this report can provide St. Petersburg with a clean energy roadmap, through its own direct actions and efforts. However, gaps in 100% clean energy might remain, particularly in the near term, due to forces outside the City's control. For example, if Duke Energy does not meet its solar generating capacity goals, it will be more difficult for St. Petersburg to source its electricity from clean energy. Renewable energy credits (RECS) and/or offsets can help fill those gaps. RECs allow generators of renewable electricity to sell their rights to others interested in supporting renewable electricity. Offsets enable purchasers to counter their greenhouse gas emissions by supporting activities that reduce greenhouse gas emissions. These options are especially attractive in cases where renewable energy or other greenhouse gas reducing activities are not available or economically feasible. While RECs and offsets support clean energy and greenhouse gas reducing activities, respectively, they do so indirectly, by financially supporting external projects. Therefore, St. Petersburg should prioritize its own clean energy projects, but RECs and offsets can play an important role in filling any gaps.



Pathway 4: Develop a Smart, Reliable, and Resilient Energy System

St. Petersburg's energy system is a critical component of its clean energy plan. Regardless of advancements in efficiency and renewable energies, a large portion of St. Petersburg's energy will still come from relatively large, centralized infrastructure. Given that nearly all of Duke Energy's electric generating capacity will continue to come from fossil fuels, it is critical that St. Petersburg explore opportunities for clean energy within the broader energy system, not just individual buildings or renewable energy installations. Strategies for more resilient energy infrastructure are necessary for protecting the city's businesses and residents from climate change impacts and typically have the dual benefit of improving efficiency and reducing overall demand. In other words, a clean and efficient energy system is a more resilient one.

Smart Grid (including syncrophasers) -

Smart grids use digital technology for sensing and communication in order to increase the ability to monitor the system and allow the electric system operator (the utility) to address issues more quickly, often, in an automated fashion. These approaches improve efficiency, security, and operations by providing more effective information and capacities to respond to that information.

The City is exploring opportunities to incorporate "Smart City" technologies and infrastructure into the future redevelopment of the Tropicana Field site. Smart City is a term that generally refers to the use of information and communication technologies to increase operational efficiency, share information with the public and improve both the quality of government services and the welfare of residents.

One increasingly valuable component of a smart grid are synchrophasers. Synchrophasers increase the utility's

visibility of the conditions on the electric lines by creating a high definition view of the system utilizing many data points per second, instead of one data point every 4 to 10 seconds, as with Supervisory Control and Data Acquisition (SCADA) system (the current standard). Utilizing this wealth of data, synchrophasers also provide an ability to address problems in close to real time. The technology has been used in numerous demonstration projects on the west coast and provides an opportunity for St. Petersburg.

• **Microgrid** - A microgrid, as its name suggests, is an energy system that utilizes distributed energy generation and storage as well as demand management technology to operate with or independently from the main power grid. A smart microgrid takes this concept a step further by incorporating metering and software components to manage energy demand. A smart microgrid also adjusts and controls which sources and components to be utilized, based on demand or other conditions. Smart microgrids are especially valuable in campus settings, neighborhood scales, and particularly when supporting critical facilities. They are also part of a more robust strategy for increased distributed generation, renewable energy sourcing, and smart demand management. Because of the distributed and flexible nature of smart microgrids, they also provide resilience benefits. For example, smart microgrids can



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relate to solar PV generation with backup energy storage at critical facilities, including district hurricane shelters.

 Provide Centralized and/or District Energy Plants for Large Institutional, **Residential, or Commercial Developments** – Centralized and/or district energy plants can improve energy efficiency and reduce energy demand by producing the energy in one location and distributing it to a network of connected buildings or units. Because of this set-up, centralized and/or district energy plants are particularly well-suited to large institutional, residential, and commercial developments, such as hospitals, universities, and residential and commercial complexes. These systems also provide flexibility and independence for these types of facilities. The energy reduction potential of such systems is at least 30% of cooling electrical energy usage. In addition, the diversity of buildings connected to a centralized and/or district energy plant can serve as an advantage because it increases flexibility across the system because these systems are designed to meet the collective peak load, which is generally lower than the total peak load. For example, residential buildings tend to need electricity for air conditioning at night and on weekends, while office buildings tend to need electricity for air condition during the day on week days. With a centralized and/or district energy plant providing energy across these types of buildings, it can balance these loads, providing a sense of load leveling to minimize collective peak load.

Centralized and/or district energy plants require master planning and three to five years from inception to system delivery. Regulatory requirements include easements for plant piping for possibly non-regulated utility companies, permitting approvals (e.g., federal and state Department of Transportation approvals if crossing roadways), and depending on ownership, a rate utility structure.

Pathway 5: Enhance and Electrify Transportation to Reduce Energy Use

The final Pathway for St. Petersburg involves the transportation sector, which represents over 40 percent of St. Petersburg's greenhouse gas emissions. The strategies listed under this pathway involve the city's municipal fleet, infrastructure for private vehicles, changes to the built environment, and policy innovations to encourage reduced vehicle miles traveled (VMTs) and use of clean energy when vehicles are used.

Municipal Fleet Improvements – St. Petersburg's municipal automobile fleet presents opportunities for clean energy savings through management, maintenance, tracking, and technology improvements. First, smart management of the fleet can reduce vehicles miles traveled (VMT) among municipal employees during the workday. St. Petersburg should explore creating a centralized, web-based vehicle pool that enables city employees to share vehicles across departments and share trips for common work destinations. In addition, whenever possible, virtual meetings should be encouraged, to reduce VMT.

Preventative maintenance also can ensure that existing vehicles run as efficiently as possible. The City should develop a comprehensive vehicle preventative maintenance



program for upkeep and tracking of vehicles. Portions of this program could be automated through tracking devices installed on municipal vehicles. Tracking information could help city employees identify and resolve maintenance problems leading to vehicle inefficiencies. This program would also have the additional benefit of tracking vehicle safety concerns and unsafe driving patterns.

The City should also continue to convert its municipal fleet to fuel efficient, hybrid, and alternative fuel vehicles. Small apparatus vehicles should also be considered wherever feasible. As electric vehicles are procured, and while Duke Energy's electric generation is still almost entirely fossil fuel-based, St. Petersburg should develop ways to charge electric vehicles with renewable energy, such as by solar PV installations. In addition, the City should continue developing the potential to run its sanitation vehicles (and any other heavy-duty vehicles) on the biogas produced at the Southwest Water Reclamation Facility. By replacing their vehicle fleets with EVs, the City can reduce both fleet emissions and operating costs. The City should establish incremental fleet targets for purchases of light-duty EVs and consider EV procurement for any vehicle replacements when suitable EV options are available with equivalent operational capability.

- Complete Streets The City adopted a Complete Streets policy in 2015, which encourages safe and accessible use of roadways for all users. The Complete Streets program aims to make strategic connections and improvements within the grid of streets such that a network of routes and facilities are provided for all modes to safely and comfortably reach all parts of the City. As the City continues to roll out this program, it will encourage more residents and visitors to consider transit, walking, and/or bicycling, thus reducing VMT and vehicle fuel consumption.
- Public Transportation Expansion of public transportation presents another opportunity to reduce VMT. St. Petersburg should work with Pinellas Suncoast Transit Authority (PSTA) to grow and/or improve the current bus network, including the St. Petersburg Trolley Downtown Looper, and increase ridership. There may also be potential to connect St. Petersburg with the Brightline high speed rail line, should it expand to Tampa, or the broader Florida High Speed Rail Plan, should it ever be revisited. While uncertainty remains, St. Petersburg can position itself to take advantage of these opportunities, especially connections to Tampa, including the existing Amtrak stop. In addition, St. Petersburg should continue to support the relaunch of the Tampa-St. Petersburg Cross Bay Ferry, with additional seasons and expansion to full-year service.
- Active Transportation Non-motorized transportation is another avenue for clean energy savings. Honored as a Silver-level Bicycle Friendly City by the League of American Bicyclists, St. Petersburg already has an extensive trail and bicycle route network and is part of the Coast Bike Share program. The City has also begun implementing Neighborhood Greenways as connected networks for bicyclists. Expanding and encouraging these offerings as alternatives to motorized vehicle travel can lead to energy savings.
- **Policy and Incentives** Non-physical transportation approaches, including policies and incentives, can also help St. Petersburg reach its goals. Policies and incentives can

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encourage people, starting with municipal employees, to use public or active transportation instead of personal automobiles. Options might include providing free or discounted transit passes (i.e., PSTA Flamingo Card or Passport), modifying parking fees, or creating "car-free" days. The City should continue to offer U-PASS for City employees to use transit.

 Electrical Vehicle (EV) Charging Stations and Network – EV charging stations are another opportunity for St. Petersburg to encourage clean energy. Currently, the city has 22 stations, including 13 that are city-owned and free to use, and several others that are privately owned by networks, such as Charge Point. The City should continue to provide and operate these facilities for the public to encourage electric vehicle use. Keeping the price free – or at least below the price of gas – will be critical. As mentioned previously, because Duke Energy sources nearly all its electricity from fossil fuels, St. Petersburg should also explore opportunities to tie these EV charging stations to renewable energy sources, such as solar PV, and build on successes of Duke Energy's "Park and Plug" program into the future, coupled with PV development. The City should also provide workplace charging for City employees by installing workplace charging at its parking facilities.

These systems should be tied to distributed battery infrastructure through home and local charging, enabling residents and the City to effectively utilize the EV network. In addition, operational energy savings can be realized by connecting these systems to batteries and facilities, enabling use of the electricity stored in the vehicles and batteries for peak load shaving and backup power. As described in *Pathway 3*, EV networks can be tied directly to PV installations, leading to GHG reductions. Additional EV purchases and use alone could reduce up to 300 MT of CO2e.

As described in *State- and Utility-Wide Recommendations*, St. Petersburg should also support EV-ready building codes that require new residential and commercial construction projects to include either a set number of installed EV charging stations and/or the electrical infrastructure to encourage the easy and affordable installation of future charging stations. The cost to install an EV charging station is significantly less expensive when infrastructure is provided at the time of construction as opposed to a retrofit.

 Streetlight and Traffic Signal Optimization – The City and County partners should continue to upgrade streetlights and traffic signals to the most energy efficient technology available, further enhanced with intelligent transportation system (ITS) technologies to improve efficiency. This should be implemented alongside signal reduction strategies such as putting in roundabouts.





Appendix C.4:Bloomberg PhilanthropiesAmerican Cities Climate Challenge (ACCC)Information



AMERICAN CITIES CLIMATE CHALLENGE Helping America's Leading Climate Cities Go the Distance

Since June 2017 when Washington turned its back on the Paris Agreement, mayors from 280+ cities and 2,000+ business and investors representing 154+ million Americans have said WE ARE STILL IN and will continue to support climate action to meet the Paris Agreement.

The American Cities Climate Challenge (ACCC) is an opportunity for 25 cities to significantly deepen and accelerate their efforts to tackle climate change and promote a sustainable future for their residents.

St. Pete is a Winner

As one of the ACCC winners, St. Pete is accepted into a two-year acceleration program with powerful new resources and access to cutting-edge support to help us meet – or beat – our near-term carbon reduction goals.

100 largest cities by population invited to apply

51 cities applied

- 37 cities short listed and site visits
- 20 cities awarded
 - 5 additional cities awarded due to overwhelming response

What St. Pete Receives through Dec. 2020

Leadership Cities



Atlanta, Boston, Charlotte, Chicago, Cincinnati, Columbus, Honolulu, Indianapolis, Los Angeles, Minneapolis, Philadelphia, Pittsburgh, Portland, Saint Paul, San Diego, San Jose, Seattle, St. Louis, St. Petersburg, Washington, DC, and five more!

Through the ACCC, Bloomberg Philanthropies will provide a robust technical assistance and support package, valued at more than \$2 million, including:

- A philanthropy-funded team member to facilitate the development and passage of high impact policies
- Data, design, and innovation resources to help city officials design and deliver bold programming
- Citizen engagement support to maximize community buy-in
- Polling and communications support to amplify your megaphone
- Implementation coaching to drive results

- Robust peer-to-peer learning and networking to ensure the 25 Leadership Cities learn from and push one another
- Rapid response grants to accelerate impact
- Access to resources from: Natural Resources Defense Council, Inc.; Delivery Associates; National Association of City Transportation Officials; Institute for Market Transformation; Rocky Mountain Institute; World Resources Institute





AMERICAN CITIES CLIMATE CHALLENGE St. Petersburg's Work Plan

Goals and Benchmarking

As one of the American Cities Climate Challenge (ACCC) winners, St. Petersburg is accepted into a **two-year acceleration program** with powerful new resources and access to cutting-edge support to help us meet – or beat – our near-term carbon reduction goals.

PRIMARY GOAL: Reduce St. Petersburg's greenhouse gas (GHG) emissions 20% by December 2020!

The City of St. Petersburg just finished its first-ever community-wide inventory of GHG emissions including municipal facilities.

GHG Emissions Reduction Goals

| Sector | 2016 Emissions (in MMT CO2e) | 20% by 2020 | 40% by 2025 |
|----------------------|---------------------------------|-------------|-------------|
| Municipal Operations | 87,364 | 69,891 | 52,418 |
| Buildings | 1,499,433 | 1,199,546 | 899,659 |
| Transportation | 1,146,805 | 917,444 | 688,083 |
| Total | 2,733,872** | 2,187,097 | 1,640,323 |



**Municipal Operations are counted also in community operations, so this total is higher than the community total of 2,693,166 CO2e in 2016. Municipal operations are 3% of community total.

Accelerating St. Petersburg's Climate Action

The following policies and action items were selected as some of the best ways to reduce St. Petersburg's GHG emissions 20% by 2020.

Building Sector

- Deep energy efficiency retrofits and retro-commissioning of municipal facilities
 Meet municipal electricity demand with renewable energy
- 7. Energy efficiency/renewables municipal financing/performance contracting mechanisms
- 3. EV charging in municipally owned parking lots
- 4. Energy code review and enforcement
- 5. Private sector challenge programs for energy efficiency in buildings
- 6. Workforce development programs

Transportation Sector

- 1. Improve public transit speed, reliability and user experience (e.g. bus-only lanes, all-door boarding, real-time arrival information, apps)
- 2. Implement high priority segments in the walking and bicycling network to be safe and inviting to all, including for those using transit

- 8. Scale up & expand residential solar co-op program
- 9. Scale up Solar and Energy Loan Fund (SELF) non-profit financing model: energy efficiency, weatherization, resiliency, and renewables
- Implement First Duke Energy community solar for energy equity benefiting low income area
- 3. EV Education and incentives
- 4. Encourage new mobility options
- 5. Commuter incentives
- 6. Electrify city fleets and buses







APPENDIX D: VULNERABILITY ASSESSMENT





Appendix D.1: Urban Land Institute (ULI) Tampa Bay: Realizing Resilience – social equity + economic opportunity



REALIZING RESILENCE

social equity + economic opportunity

UL Urban Land UL Institute

Tampa Bay



st.petersburg www.stpete.org We wish to thank the Urban Land Institute's Urban Resilience Program and the Kresge Foundation for the generous support that enabled the Urban Land Institute of Tampa Bay to host the "Resilient City Workshop" with the City of St. Petersburg.

Without this financial support, the in-kind backing and commitment of the City of St. Petersburg and the volunteer time of the ULI team of experts, the workshop and this report would not have been possible.

A special thanks to Sharon Wright, Sustainability Manager for the City of St. Petersburg, for partnering with ULI in this effort. Thanks to everyone who participated and contributed insights during the two-day workshop.

Report published April 2017

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THANK YOU

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URBAN LAND INSTITUTE















ST. PETERSBURG, FL

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ULI'S RESILIENT CITY WORKSHOP

ULI Tampa Bay received a grant from the Urban Land Institute's Urban Resilience Program and the Kresge Foundation to provide technical assistance to the City of St. Petersburg with a particular focus on economic development and social equity strategies.

On December 5th and 6th 2016, ULI Tampa Bay, in partnership with the City of St. Petersburg, convened ULI members and collaborators from New Orleans, Miami, Boston and the Tampa Bay region for a 'Resilient City Workshop'.

After reviewing extensive background materials on the region, the team spent two days in collaborative sessions with over 75 stakeholders, including Mayor Rick Kriseman, City Council members, community leaders, and staff from the city, county and region. At the culmination of the workshop, ULI and the City of St. Petersburg held a Public Open House to report on major take-a-ways from these sessions as well as lessons learned from past experiences. Addressing a changing environment in an equitable way is a challenge that all Tampa Bay communities must grapple with. This report is intended to be a helpful guide region-wide.

> "In order to be a resilient city, you have to be an equitable city too." Jeffrey Hebert, Deputy Mayor & Chief Resilience Officer, City of New Orleans





ST. PETERSBURG, FL INITIATIVES TO DATE

• August 2015: An Executive Order, by Mayor Rick Kriseman, inscribed key benchmarks for sustainability.

• November 21st, 2016: St. Petersburg City Council approved funding for an Integrated Sustainability Action Plan to address climate change and resiliency, for demonstration projects, and to support Pinellas County's Vulnerability Assessment.

• In January 2016: The City of St. Petersburg committed to working towards the goal of 100% clean energy.

• In December 2016: The City of St. Petersburg became a 3-STAR community - one of only 58 communities in the nation to complete a rigorous STAR certification process, a nationally recognized communitywide sustainability rating system.



WATER ALL AROUND

CHALLENGES AND OPPORTUNITIES

Anchored by the cities of St. Petersburg and Tampa, the Tampa Bay region is known as one of the most vulnerable in the world to wind damage, coastal flooding from storm surge and rising sea levels. The shallow West Florida shelf and the funneling effect of Tampa Bay creates conditions for severe storm surge. With over 50% of the population living less than 10 feet above sea level, these conditions create enormous risk to residents' safety, well-being and property.

The City of St. Petersburg, with 60 miles of coastal frontage, has already felt the impacts of storms over the last couple of years, including flooding that has stressed, damaged and disrupted the infrastructure and operations of the city.

MAPPING SEA LEVEL RISE

The map on the right illustrates a 6 foot sea level rise (SLR) scenario for the City of St. Petersburg and surrounding communities based on National Oceanic and Atmospheric Administration projections. Refer to the Recommended Projection of Sea Level Rise in the Tampa Bay Region for the consensus reached among the Tampa Bay Climate Science Advisory Panel (CSAP) on the future of SLR in Tampa Bay, regionally corrected using the St. Petersburg tide gauge data. The CSAP concludes that this region may experience SLR somewhere between 6 inches to 2.5 feet in 2050 and between 1 to 7 feet in 2100.

The map below illustrates a possible future for Florida. Warming oceans and melting glaciers and ice sheets are raising global sea levels.



COASTLINE MAPPING

Harold Wanless, University of Miami + Arlen Stawasz, Perkins+Will



FACTS

• St. Petersburg is surrounded on 3 sides by water.

- Total population of St. Petersburg is 259,906.
- Approximately 22% of the population of St. Petersburg was below the poverty line in 2015.

• Approximately 91,148 (48%) people live within the Special Flood Hazard Area (SFHA).

• 42,656 homes are within the SFHA.

• 46.6% of people are homeowners within the SFHA.

 \bullet 39.4% of population in the SFHA are Age 25 - 54 (many may plan to remain in homes for 20 to 30 more years).

• Riviera Bay and Shore Acres repetitively flood.

REFERENCES

• A 2008 Organization for Economic Cooperation and Development (OECD) examination of 136 port cities worldwide found that Tampa and St. Petersburg together are one of the most vulnerable regions in the world, among the 10 regions with the most property at risk to wind damage and coastal flooding from storm surge.

• A 2013 report led by the World Bank listed the cities most at risk from flooding, due to rising sea-levels. In terms of overall cost of damage, Tampa- St. Petersburg was the 7th most at risk globally, 4th in the United States.

ST. PETERSBURG, FL INITIATIVES TO DATE

• In 2015, the city, in partnership with the community, committed to the 2020 Plan – a collective impact initiative with the following goals:

- > Reduce poverty in South St. Petersburg by 30% by 2020.
- > Increase employment by 5,000 by 2019 by intensively applying efforts to create jobs (via business & commercial development) and increase employment through high school career academies & other skills gap closing initiatives.
- > Support 500 businesses (including micro & small businesses) to accelerate growth and job creation for South St. Petersburg workers.
- > Focus on men and boys 16+, especially ex-offender fathers, equipping them to work, placing them into jobs and helping them become proactive in their children's lives.
- On June 11, 2015, the South St. Petersburg Community Redevelopment Area (CRA) was established with the purpose of creating a sustainable and durable source of financing to assist private enterprise in remedying blight and poverty in South St. Petersburg.

BUILDING EQUITY BRIDGING DIVIDES

The adverse effects from environmental threats often impact low income communities (coastal <u>and</u> inland) the hardest, as they can have the most difficulty bouncing back from shocks and stresses.

In the face of climate change and increasing environmental threats, the city's low income communities have a limited capability to move or rebuild following intense storm events. Across the country, low-income communities have, historically, failed to benefit from the "green" investments that aim to reduce the risk of climate change. Many climate policies have often overlooked the magnitude of environmental, economic, and social vulnerabilities that these communities face.

A significant number of St. Petersburg's citizens, predominantly in South St. Petersburg (Southside Community Redevelopment Area or CRA) have disproportionate poverty and unemployment levels. The Southside CRA and other lowincome communities have been working diligently for several years to transform into healthy, vibrant communities by empowering businesses, neighborhoods, and citizens through targeted grant funding, education and outreach, workforce readiness, community policing and more. Considering vulnerable populations in resiliency work will help minimize disproportionate effects of climate change that could counter that progress.

The City of St. Petersburg has demonstrated a commitment to addressing the physical, economic and social challenges of climate change in a comprehensive and integrated way – one that leads to equity and opportunity for all citizens.

MAPPING SOCIAL VULNERABILITY OF SEA LEVEL RISE

The map to the right illustrates the social vulnerability of a 6 foot sea level rise scenario, depicting the ability of communities in these areas to prepare and respond to hazards like flooding. Sourced from the US Census Bureau, the Hazards and Vulnerability Research Institute Social Vulnerability Index considers the follow-ing population characteristics: socioeconomic status, gender, race and ethnicity, employ-ment loss, residential property (value, quality, density), renter population, occupation, family structure, education, availability of medical services, social service dependence & special-needs population.

Note: This map has not been regionally corrected to the St. Petersburg tide gauge data. The data does not consider the economic vulnerability of low income populations outside of the floodzone.



Mayor Rick Kriseman of the City of St. Petersburg, State of the City Address January 14, 2017:

It is important for the whole community to be resilient not just before and after acute weather events, but during the more gradual changes in our environment, as well. This is not some far-off hypothetical. This is real... The resiliency planning we're doing is a cross-departmental effort - no more silos and is being done in collaboration with the many storm and sewer analyses and projects inderway. We understand that our city is a connected and dynamic living system where cause and effect are considered, and projects that offer multiple benefits will be prioritized."



RECOMMENDATIONS RESILIENT CITY

As St. Petersburg works towards becoming a more resilient place, the city has an opportunity to implement strategies that can simultaneously address the increasing environmental risks and bridge many of the existing social, cultural and economic divides. Being a resilient city is not just about preparing for the physical inevitabilities of sea level rise and the increasing threat of storms. It is preparing citizens, neighborhoods, businesses and government for whatever shocks the future holds by providing communities with the resources to withstand, respond and thrive in the face of pressures.

Resiliency is defined by the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. These adverse events can include shocks, such as hurricanes or floods, as well as chronic stresses, such as unemployment, poverty or lack of food access.

The city has already taken a number of steps that serve as an important foundation for improving resiliency. This includes waterfront master planning, fostering partnerships with the county, focusing on emergency management and targeting investment through the creation of a community redevelopment area (CRA) in south St. Petersburg. Going forward, it is important to stay focused on supporting, connecting and growing these initiatives to remain proactive.

The next section outlines recommendations on steps the City of St. Petersburg can take to enhance its resilience.



WHAT WE HEARD FROM STAKEHOLDERS

• St. Pete has the opportunity to lead the region on resiliency issues.

• The cost of inaction should be quantified and understood.

• A new way of thinking is needed. We are in the wrong mindset about solving problems.

• We need to make good land use decisions based on vulnerabilities and the existing capacity of infrastructure, especially those that are being planned and funded now.

• Mitigating and adapting to sea level rise will require local level commitment.

• We need to bridge the economic and physical gaps between downtown and the rest of the city.

• Leadership and communication is critical on this issue.

• Partnership and collaboration across and between jurisdictions is important.

LEAD BY EXAMPLE

RESILIENT CITY DECISION MAKING

The City of St Petersburg can promote positive economic returns and enhanced quality of life for all residents by connecting resilience to opportunity with city wide investments and holistic decision-making. This proactive approach will allow St. Petersburg to lead the Tampa Bay region by example, reinforcing resilience into the bottom line.

While the city has already demonstrated a commitment to these issues, the following strategies would further integrate resilience as a core value in the city's decision-making:

+ Align the city's capital budget around resilience priorities and goals that enhance or produce greater resilience. This does not necessarily mean having to spend additional dollars – it can mean ensuring that existing money is oriented towards or reflective of the city's resilience goals.

+ Integrate resilience goals and decision-making

through all functions of city government and across all agencies. By crafting policies and programs based on their potential to create multiple benefits, the city can make itself safer, healthier, and more economically stable using existing resources.

• Consider renaming Office of Sustainability to the Office of Resilience and Sustainability.

• Elevate responsibilities of the head of this office, creating a cabinet-level Chief Resilience Officer role, to ensure the ability to implement change across departments and be involved in budget allocation decision-making.

+ Create and implement the Integrated Sustainability

Action Plan and other city resilience planning efforts

within a framework of creating economic opportunity, bridging social and physical divides, and improving climate resilience. Prioritize projects in which multiple benefits can be realized.

+ Invest wisely with a data driven approach and gain a full understanding of the costs associated with inaction vs. investment.

- Pinellas County's Vulnerability Assessment will help identify exposures and the associated costs of disasters in various scenarios to the city's infrastructure.
- Consider partnering with a reinsurance company to take advantage of sophisticated resource based risk mapping tools to make the most fiscally appropriate decisions between hardening assets and risk transfer.
- Partner with the Trust for Public Land to create a digital map and tool that can be used to determine areas of investment based on multiple variables.

+ Implement a 'Resilient project review' at the municipal level for city funded projects and/or those that have stormwater management and green infrastructure components.

+ Target critical city infrastructure/buildings that could benefit from building hardening, emergency planning and other improvements using resilience features as a case-study for learning and future roll out.

+ Invest in city sponsored, neighborhood scale demonstration projects using innovative technology and solutions to improve energy efficiency and resilience – promoting the city as a leader and resulting in cost savings.

+ Leverage opportunities for private sector investment in projects and strategies that improve resilience.

• Incentivize private investment in local resilience building in select areas to catalyze local economic development.
• Explore public private partnerships to improve climate resilience efforts and create business and employment opportunities.

+ Stakeholder engagement, partnerships, and decisionmaking in resilience planning should include "cost of doing nothing" discussions. See page 14 for detailed strategies.

CLIMATE SMART CITIES TOOL

The Trust for Public Land applies its expertise in climate research, computer-assisted mapping, and urban design to help cities "connect, cool, absorb, and protect"—the four pillars of TPL's climate strategy.

The Trust for Public Land (TPL) in partnership with the City of Boston, Greenovate, and Boston Harbor Now is preparing Boston for the many impacts of a changing climate through the development of data-driven planning strategies and green infrastructure solutions that will advance equity and make the city more resilient.

In addition, ULI Boston is partnering with the Trust for Public Land to add an additional layer of data points to the Climate-Smart Cities tool, to allow the real estate industry ability to analyze points of interest at the parcel level.

In New Orleans, the Trust for Public Land's Climate-Smart Cities team is working with public agencies, neighborhoods, funders, and researchers to help the city develop green infrastructure where it's needed most. They are developing a GIS-driven tool that combines geographic data about climate-related threats like flooding with data on public health, income, and neighborhood access to green space to help planners prioritize projects.





MIAMI-DADE COUNTY'S BUDGET IS FOCUSED ON RESILIENCE

In 2016. Miami-Dade County adopted a budget focused on allocating resources to enhance the resilience of the county and the residents' quality of life. The county defined four dimensions of resilience that serve as pillars of their framework: 1) health & wellbeing 2) economy & society *3) infrastructure & environment and 4) leadership & strategy. By analyzing the* services the county provides to residents through a new prism, the county focused on making community a safe place to live with employment opportunities, cultural and recreational options, social services and communications channels within a government committed to protecting and maintaining our natural and man-made assets. One example of the positive impact of this strategy is that the Miami-Dade Parks Department is now factoring sea level rise into park designs.

"A local government budget is one of the most important tools available." James Murley, Miami-Dade's Chief Resilience Officer



WHAT WE HEARD FROM STAKEHOLDERS

• It is difficult for small businesses to shift their focus and resources from their immediate needs toward long-term emergency planning.

• Money talks. Businesses need to see tangible financial risks and rewards before they will act.

• Affordability is an issue from both a retail leasing and workforce housing perspective.

• Having a high percentage of renters makes post-disaster small business recovery especially vulnerable. Most renters do not return, creating employee and customer shortages for local businesses.

• St. Pete has a large number of jobs in the hospitality and service industries. These jobs are hard to recover quickly post-disaster.



Marine research boat docked in St. Pete's Bayboro Marine Research Cluster area

ADAPT TO THRIVE

SHIFTING FROM BUSINESS AS USUAL

In order to respond to the economic imperative to prepare for the challenges of sea level rise, the city's economic development and resilience initiatives should work in lockstep to realize the co-benefits of resilience investments and ensure they are experienced equitably throughout the city. Businesses, large and small, being prepared, empowered and invested in the resilience efforts of the city is a critical component.

Currently, training is offered to businesses through the St. Pete Greenhouse and the city's emergency management staff, particularly as new businesses ask for assistance. The current city initiatives can be expanded into a long-term plan to offer assistance and facilitate collaboration among the business community for resiliency.

+ Lean on experts to help communicate risk and mitigation strategies to the business community.

• Engage the reinsurance industry, which has some of the best climate change risk modeling in the world and a vested interest in making businesses more resilient.

- Partner with a reinsurance representative to present to business leaders, the chamber, downtown partnership, etc. "In Miami, when we brought in the insurance industry, we started capturing the attention of businesses." James Murley, CRO for Miami-Dade County
- Use business groups, such as the Chambers of Commerce and providers of business services, as conduits to raise awareness and encourage action.

+ Focus on small business resilience. Work to ensure

small businesses are able to get back online postdisaster to ensure individual and neighborhood recovery, particularly in south St. Petersburg.

Steps can include:

- Provide outreach, education and technical assistance to small businesses to create disaster preparedness and business continuity plans.
- Work with the county, the St. Pete Greenhouse and/ or the Tampa Bay Regional Planning Council to combine existing resources and create a simple, customizable disaster preparedness planning blueprint for small businesses.
- Use existing neighborhood networks to inventory which small-businesses have/do not have plans and communicate opportunities for technical assistance.

+ Position the city as a pioneer in resilience and create value out of the opportunity.

- Mitigation and adaptation can be leveraged as an economic development tool. The city's investment in resilience, efficiency and lowered risk can help attract new businesses and investment.
- Home to the largest marine and environmental sciences community in the Southeast, St. Petersburg has the shared interest and opportunity to collaborate and co-brand its resilience work with one of the city's largest business sectors.
- Incorporate a strong resilience component and potential demonstration project in the development of the Innovation District.

+ Forge partnerships with local entities. In concert with the 2020 Plan, forge a partnership between the city, local colleges, job training organizations and anchor institutions to anticipate opportunities, provide skills training and create pathways to jobs related to the city's upcoming infrastructure and resilience investments.

+ Expand on existing city and partner initiatives to identify the sector-specific job training efforts locally that could benefit from a focus on resiliency or identify

NEW ORLEANS ASSET ANALYSIS

The City of New Orleans is undergoing an analysis of all of the sewage and water assets around the city with the help of global reinsurer Swiss RE and Veolia, a resource management company. This effort will connect sea level rise projections and hurricane models to understand what the investment will be overtime to harden or move vulnerable assets, while simultaneously managing the billions of dollars in spending on upgrading sewage and water systems.



Career fair at Pinellas Technical College



St. Pete's 'Not My Son' community outreach campaign

"Of necessity, most business people are focused on the immediate and not on the long term. The challenge is to raise climate change to a front of mind issue and the goal is get businesses to harden themselves so they can bounce back faster." Lex Kelso, Principal Green Coast Enterprises, LLC





NOLA NETWORK FOR ECONOMIC OPPORTUNITY

The City of New Orleans Network for Economic Opportunity (the Network) focuses on connecting disadvantaged job seekers and businesses to opportunities. Since launching in 2014, the Network's key initiatives have included:

- Policy improvements, such as strengthening enforcement and compliance with the disadvantaged business enterprise (DBE) program and executing a local hiring initiative to employ residents.
- Opportunity centers, where workforce development organizations provide foundational skill development.
- Case management and supportive services .
- Sector-specific job training to increase opportunities through partnerships with large employers and projects including the new airport terminal, new hospitals, and the Sewerage & Water Board of New Orleans (SWBNO).

WHAT WE HEARD FROM STAKEHOLDERS

• St. Petersburg has 6,159 acres of parkland.

• Connections are lacking between the Southside CRA & downtown.

• The city should explore and embrace the opportunities that may come with the challenges of sea level rise and climate change.

- The city's aging infrastructure needs to be made more resilient.
- When it comes to climate change, the problems we have are local.
- We need to be evidence based and solution oriented.
- The city should celebrate the leadership of current green building projects.



HARNESS OPPORTUNITY

ADAPTING TO THE CHANGING ENVIRONMENT

Through innovative demonstration projects, policies and programs, the city can encourage physical and cultural shifts to more resilient design and thinking.

By adapting the City of St. Petersburg to the natural environment and the increasing risks of climate change, opportunities can be created for all residents to thrive. Successful adaptation will mean creating resilient systems and a culture of environmental awareness among all.

+ Take advantage of existing assets and redevelopment opportunities to lead the way.

• Investigate opportunities to utilize the existing extensive park system in all areas of the city to create multi-functional green spaces for retention, absorption and distribution of water integrated into recreation features. Choose projects where multiple benefits can be gained, including raising awareness among vulnerable populations.

• Plan and design for a future where city green space and parks can serve as a first defense against the vulnerabilities of climate change and storm surge.

- Explore code changes that may be required and work with parks and recreation to consider parks in a green infrastructure context.
- Seize the opportunity of significant signature projects, including the pier and the Tropicana Field site to mandate, create and integrate resilience features and outcomes that are physical, economic and social in nature.

+ Plan for and design city infrastructure for a longer life to ensure long term resilience. Actively advocate for

amendments to state and federal policies that would allow infrastructure repair/replacement funds/grants to be used not just to rebuild the way things were, but to be stronger and more resilient.

+ Actively encourage and pursue new funding sources for the design and installation of green infrastructure.

+ Rethink FEMA repetitive loss areas. Consider investing funds into community-wide green infrastructure projects that reduce risk and provide benefits for more residents. The City of New Orleans has implemented this strategy and can provide helpful guidance.

+ Continue to strive towards and invest in the city's 100% renewable energy goal.

- Provide incentives for projects with features that are energy efficient and resilient.
- Reducing energy use and water use at a building by building level helps to relieve stress on existing and future infrastructure.
- Improve energy efficient codes and standards to make commitment to renewable energy more impactful, and realized faster.

+ Integrate resilient policies into the city legislative framework.

• Explore implementation of an Adaptation Action Area(s), an optional comprehensive plan designation, as a redevelopment tool to improve both resilience and equity. Identify areas that experience flooding and/ or are vulnerable to the related impacts of rising sea levels for prioritizing funding for infrastructure needs and adaptation planning. See Miami's Arch Creek Basin and the ULI Advisory Services panel, as a framework for putting social equity at the forefront of the climate action agenda. http://uli.org/advisory-service-panels/ miami-florida-advisory-services-panel/ "There are opportunities for small, fundable demonstration projects that address both resiliency and community building at the same time. This is a great way to try new things without having to change all the rules yet." Katharine Burgess, Director of Resilience, Urban Land Institute

"There is a higher cost to reactive planning than proactive planning and being proactive can actually pay off". Arlen Stawasz, Resiliency Strategist, Perkins+Will



• Mandate that climate change and sea level rise be considered for new and redevelopment projects above a certain size threshold for public and private projects.

+ Implement innovative programs to spur investment in resilience.

• Ensure city stormwater management projects are highly visible and also serve to elevate awareness and provide public education.

• Consider a resilient retrofit program to incentivize property owners to incorporate resilience measures such as hardening and weatherization on their own property.

• Encourage land stewardship by introducing a 'greening' vacant lot program that can help reduce stormwater runoff, provide opportunities for food growing, act as a demonstration project and encourage community cohesion and reinvestment while beautifying an area.

• Introduce a resilient city design competition to motivate talent from across Tampa Bay and the country to tackle local resilience challenges in innovative ways.

RESILIENT BUILDING TOOLKIT

- Fast Track Permitting
- Refund of permit fees (up to a certain \$\$ threshold)
- Impact fee reductions
- Require LEED for buildings over a certain square footage
- Require developers to complete a "Climate Change Preparedness and Resiliency Checklist" as a prerequisite to development of new buildings over a certain size (See Boston, MA)
- Density bonuses to encourage development in the right areas, or areas that need economic development
- Parking reduction for projects that locate near mass transit, and/or provide increased pedestrian opportunities
- Explore future micro-grid opportunities

NOLA TAKES ACTION ON URBAN WATER MANAGEMENT

The City of New Orleans is building a series of green infrastructure demonstration projects to show the public how underutilized spaces can be developed to retain stormwater and designed to make neighborhoods more attractive. This includes transforming vacant lots into rain gardens that draw runoff from the street, store it temporarily, and capture many of the pollutants it carries. Innovative green infrastructure solutions such as green roofs, bioswales, and pervious pavement are being funded.

Revisions to the Comprehensive Zoning Ordinance now require the mitigation of runoff associated with new development or reconstruction at certain targets, using on-site water catchment techniques to slow surface flow and, in turn, reduce subsidence rates throughout the city.



Demonstration raingarden in New Orleans

WHAT WE HEARD FROM STAKEHOLDERS

• Neighborhoods need to be more walkable to improve community connectivity.

• There needs to be more communication about programs available for low income residents to encourage homeownership.

• There is a high number of renters in flood prone areas.

Cost of homeownership is rising.

• There is a need to start seeing City of St. Petersburg as a cohesive whole.

• There is a perception that downtown is not for everyone.

• The cost of complying and/cost of insurance could be incentives to proactively prepare for resilience.

• There will be a tension between preservation and preparation.

Programs are needed to help with existing housing stock.

RESILIENT LIVING CREATING CONNECTED & STRONG NEIGHBORHOODS

As the city makes decisions to adapt to the changing environment, investments with multiple benefits that serve to improve the stability, health and housing of all residents, – particularly those that are most vulnerable–should be prioritized.

Investments that create opportunities for all community members are investments in resilience.

+ Integrate decision-making on city resources and investments in resilience with efforts to improve social equity outcomes in the south St. Petersburg CRA, including the 2020 taskforce and plan. Leverage the existing strong partnerships such as between the city, Urban League and the Chamber of Commerce. The STAR Communities framework can serve as a facilitation tool for achieving this goal. (See sidebar on pg. 18)

+ Strengthen multi-modal connections between and within low-income neighborhoods and downtown St. Petersburg.

+ Make streetscape improvements with resilient design features to help catalyze growth and increase connectivity in redevelopment areas.

+ Engage and collaborate with the City of St. Petersburg Housing Authority, a large landowner in the city, to become a partner with the city on investing in resilience measures that improve equity outcomes.

+ Invest in household stability to ensure individuals, neighborhoods and communities can 'bounce back' from the stressors of climate change and storms. • Promote homeownership and make home retrofits more feasible for low-income communities.

• Promote social enterprise endeavors such as home and cooperative gardening, education and agricultural assistance programs.

• Continue to use HOME, CDBG, neighborhood stabilization resources and CRA resources to close the gap in making home retrofits.

• Partner with organizations in the private sector to develop an emergency savings account program to help individuals and families save.

• Consider a Citywide rental registry that connects landowners with positive economic opportunities (low interest financing, renovation money).

+ Ensure information on programs are readily available, integrated into other existing programs/tools and widely promoted in order to cultivate a culture of awareness about resilience.



A rendering from FARROC Design Competition, Queens, NY

There is going to be a tension between wanting to incentivize people to move to less vulnerable areas and protecting the less vulnerable areas from gentrification and displacing current populations that are there. Hard choices and policy decisions are going to have to be made considering social equity concerns alongside the vulnerabilities." Leigh Fletcher, Partner, Fletcher & Fischer

"There is a real need to focus on homeownership in flood prone areas in a way that ensures investments in the home result in houses more resilient to storm events. To do this, there needs to be some type of affordable way to enable homeowners to make improvements to their properties." Leroy Moore, Chief Operating Officer, Tampa Housing Authority



ENCORE!® is a public-private partnership between the Tampa Housing Authority, Bank of America, and City of Tampa. This \$425 million 40-acre sustainable master-planned, mixed-use redevelopment community just north of Downtown Tampa's urban core will be home to professionals, families and active seniors – a multigenerational mix of 2,500 people and will create 1,000 permanent jobs.

certified LEED Gold or Silver. ENCORE! also foot vault, which holds up to to 35,000 cubic

Read more at <u>http://casestudies.uli.org/encore/</u>





Encore!, Tampa, FL

Encore!, Tampa, FL

MANDATING CLIMATE TRAININGS FOR ALL STAFF IN BROWARD COUNTY

Broward County, Florida has mandatory climate trainings for all county staff, in recognition of the need for all employees to work together and apply their skills and knowledge to address the environmental challenges faced by the County. With the help of representatives from the CLEO Institute and staff experts in the field, county staff learn how global climate change translates to local challenges and opportunities, how to apply tools and resources, and engage in activities to connect their role at the county with the county's overall goals for adaptation and mitigation.

Trainings are specific to different divisions/ departments, including: Libraries, Cultural Division, Parks & Recreation, Public Works, Water & Wastewater Services, Airport, Port Everglades, Human Services, Transportation, Environmental Protection and Growth Management.

IDENTIFY MESSENGERS ESTABLISHING BOLD AND STRATEGIC COMMUNICATIONS

Often an afterthought from a resources perspective, the importance of a robust communications strategy, at the center of a resilience action plan, cannot be understated.

The city, with the support of a diverse coalition of partners, will need an agile and comprehensive communications strategy to:

> Build consensus and stakeholder acknowledgment that St. Petersburg's waterfront is both a risk factor and the city's competitive edge.

> Create an inclusive call to action, and empower St. Petersburg's diverse citizenry with educational outreach, tools for adaptation and mitigation, and access to economic indicators that help illustrate return on investment.

> Demonstrate that St. Petersburg is a thriving, modern city up to the challenge of living with water.

> Ensure all citizens and businesses are prepared to respond and have the capacity to help each other during emergencies.

+ Boldly brand the city's resilience initiative and invest in a highly visible public outreach campaign.

• Consider engaging a strategic communications firm to help communicate risks, change behaviors and celebrate the city's investment in resilience. A professional firm has the talent and resources to expertly target messaging, raise the profile of the initiative, position the city as a resilience leader, quantify communication goals and track progress across a mix of mediums. Seek funding through foundation funding resources such as the Tampa Bay Community Foundation, Kresge Foundation, etc. • Translate complicated climate science and infrastructure improvement plans into language and mediums that are easily understood by the diverse set of stakeholders.

+ Promote transparency and allow the community to easily track the city's progress.

• Utilize the framework and metrics of the STAR community rating system, particular around equity, to communicate performance to the public.

+ Break down silos at the city level, and conduct crossdepartmental communications training to promote climate resilience fluency among the city staff.

+ Ensure every 'weather' event becomes an opportunity for public education and the rallying of support for the city's initiatives and the need for action. "Sometimes you aren't your own best messenger" --Jeffrey Hebert, Deputy Mayor & Chief Resilience Officer, City of New Orleans "It is important to bridge the divides and develop communication strategies that make the whole of the community feel included in this process while also communicating about what resiliency planning can do to improve lives. It's not just a defense mechanism. It can also be a prosperity mechanism." Taylor Ralph, REAL Building Consultants





A student of Catalyst Miami holds up a solar bug he created



Local St. Petersburg children learn how to cook healthy meals for the whole family at Childs Park Test Kitchen

ST PETERSBURG, FL STAR COMMUNITIES

The STAR Community Rating System® (STAR) provides a clear, data-driven approach to assessing social, economic and environmental progress. Built by and for local governments, STAR is a catalyst for local action and is transforming the way that communities address their social, economic and environmental progress.

As of December 2016 St. Petersburg is recognized as a 3-STAR community and is currently using STAR to document existing and planned community-wide sustainability efforts. The results will guide the City's sustainability planning efforts through revisions of existing plans and codes as well as highlight needed planning efforts including Climate Action and Resiliency Planning. STAR assessment benefits community by:

- Demonstrating commitment to data-driven approach
- Strengthening local metrics
- Increasing transparency through reporting
- Establishing a baseline and identifying gaps & priorities
- Building a brand and culture of local sustainability
- Begin incorporating sustainable practices within the DNA of city operations and practices

WHAT WE HEARD FROM STAKEHOLDERS

- There is a feeling of community distrust and old wounds in the southside.
- People feel like they are being told, and not included in decision making.
- In every stakeholder meeting, (science to social equity) people expressed communication as the number one issue.
- It's hard to make the threat feel real with no recent environmental disaster as a call to action. However, the sewage issue could be repositioned as a rallying point.
- We are currently preaching to the choir. We need to establish ways to communicate opportunities and risks to the larger population.



EVACUTEER - THE POWER OF US In New Orleans, a sculpture on the street corner doubles as a designated evacuation meeting place in case of emergency. The program is called Evacuteer.

COLLABORATION FORGING NEW PARTNERSHIPS

A resilient planning solution must not only protect the city's built and natural environment but also ensure that vulnerable communities can access resources and strengthen the social networks that both enrich life every day and offer lifelines during extreme events. This can only be accomplished through partnerships that build trust and social cohesion, identify and create champions, increase climate literacy and encourage collaboration.

+ Use existing social/community group networks and meeting schedules to connect with constituents.

- Before asking for buy-in on resilience work:
 - Attend meetings outside of City Hall
 - Listen, listen, listen!

Be prepared to address old wounds and mistrust, particularly in vulnerable communities.

+ Build social cohesion and expand reach by cultivating a new network of unexpected climate resilience champions.

• Spread the message beyond the science, planning, resilience-minded community groups.

- Articulate the linkages of resilience work with the missions of organizations not typically drawn to the topic of resilience (such as: leadership classes, anti-poverty, social, economic/ business development, neighborhood, arts, tech, food, and health organizations).
- Highlight mutual benefits and empower these existing networks and organizations to become community advocates for resilience programs.

+ Continue to collaborate with and leverage the expertise of a diverse ecosystem of national and local partner organizations. • Involve these community partners and their resources in the city's strategic communications planning efforts

+ Place extra emphasis on harnessing and utilizing the relationship between local universities and the city.

• Consider collaborating on projects such as a "Knowledge, Attitudes and Practices" (KAP) Survey of the community as it relates to climate change and community resilience.

• Continue to partner on energy goals.

+ Attract the support and interest of the private sector to be involved in high visibility, high profile activities.

- Partner with the reinsurance industry and banks to communicate financial risks.
- Partner with businesses that have significant experience in product distribution and logistics to access those existing networks in a catastrophic event.

+ Brainstorm creative outreach opportunities to promote emergency preparedness, strengthen the social fabric and raise awareness of climate threats and opportunities. Some examples include:

- Block parties with music and food to encourage neighbors to meet one another and learn about emergency preparedness (weather related and otherwise). The community will identify neighborhood leaders or "block captains" who volunteer to be trained in emergency response strategies.
- Partner with local artists to visualize risks and build awareness in unique ways, such as temporary exhibits on the waterfront, artistic demonstration of sea level rise projections, and collaboration with the mural arts program.
- Consider partnering with tech incubators and schools like the Iron Yard to create an emergency preparedness/ resilience app.

"You can use your existing community organizations to become environmental champions. This is great way and great model to increase collaboration between community partners throughout St. Petersburg". Zelalem Adefris, Climate Resilience Program Manager, Catalyst Miami

"Create an ecosystem of partnerships between existing groups to work towards becoming a resilient city." Leigh Fletcher, Partner, Fletcher & Fischer





Waterlicht consists of wavy lines of light made with the latest LED technology, software and lenses. As a virtual flood, it shows how high the water could reach without human intervention.

CATALYST MIAMI'S: CLEAR PROGRAM

Catalyst Miami is an anti-poverty nonprofit organization with a mission to develop and support individual leaders and strong organizations that work together to improve health, economic opportunity, and civic engagement in the Miami-Dade community.

In response to the challenges that Miami-Dade County's 2.7 million residents are likely to face as a consequence of climate change and sea level rise, Catalyst established the CLEAR Miami (Community Leadership on the Environment, Advocacy, and Resilience) program. CLEAR Miami is a 12-week training program focused on climate resilience education and leadership, which provides graduates with a groundwork to become climate resilience educators, leaders, and innovators in their own communities and beyond. By the end of the program the graduates have taken on community projects that include: incorporating environmental concerns in neighborhood coalitions, cleaning up garbage and promoting recycling in their neighborhoods, and promoting emergency preparedness.



Future resilience leaders attend CLEAR Miami



The Urban Land Institute is a 501(c)(3) nonprofit research and education organization supported by its members. Founded in 1936, the institute now has more than 40,000 members worldwide, representing the entire spectrum of land use and real estate development disciplines, working in private enterprise and public service, including developers, architects, planners, engineers, lawyers, bankers, economic development professionals, among others. As the preeminent, multidisciplinary real estate forum, ULI facilitates the open exchange of ideas, information, and experience among local, national, and international industry leaders and policy makers dedicated to creating better places.

The mission of the Urban Land Institute is to provide leadership in the responsible use of land and to help sustain and create thriving communities. The Tampa Bay District Council serves seven counties in this region and has over 400 members.



Appendix D.2: Vulnerability Assessment Workshop (June 22, 2018)



| | Transportation | | | | | |
|--|--|--|--|---|--|---|
| | Roads, highways, and bridges | Public Transportation | Bike/pedestrian network | Port/Marina | Airport | F |
| Increase in temperature- Days 95°F or higher (and localized drought) | Loss of pavement integrity and/or decreased utility of pavement due to prolonged heat exposure. Thermal expansion of metal structures (e.g., bridge expansion joints). | Weathering and/or damage to fleet (tires, mechanical equipment, etc.). Inadequate bus/public transit shelters to help shade/cool people while waiting for public transportation increased risk of heat exposure and heat-related illness for passengers. Increased costs for cooling of facilities (stations, bus depots, maintenance facilities, etc.) Overheated electrical equipment and communications systems. | Increased risk of heat exposure and/or heat-related illness for pedestrians and bicyclists. Loss of pavement integrity and/or decreased utility of pavement due to prolonged heat exposure. | Increasing risk of heat exposure and/or heat-related illness for port workers and marina visitors. Increasing cost for cooling port facilities. | Loss of runway pavement integrity and/or decreased utility of pavement due to prolonged heat exposure. Overheated electrical equipment and communications systems (disrupted airfield operations). Length of runways becomes inadequate due to decreasing air density (reduced aircraft performance). Increased costs for cooling facilities. | Expansion an tracks and joi Overheated tr and commun Regional brow delay to servi Increased cos |
| Sensitivity | <u>S3</u> | S4 | S4 | S4 | S2 | S3 |
| Adaptive Capacity | AC1 | AC1 | AC1 | AC1 | AC3 | AC1 |
| Vulnerability Ranking | | | | | | |
| Changing precipitation (increased volume/frequency of extreme rainfall events) | Reduced roadway visibility. More frequent or severe flooding of roads and the potential for road washout. Weaken soil and culverts (that support roads, tunnels, bridges) during flash floods. Roadway closures. | Reduced roadway visibility. More frequent or severe flooding of roads and the potential for road washout. Service disruptions or roadway closures. | More frequent or severe flooding of roads and the potential for road washout Erosion, scouring and undermining of pavement on sidewalks and bike paths. | Reduced navigability | Travel disruptions due to heavy rain and/or runway closure due to flooding. Damage to airport runways and disrupted airfield operations due to flooding. Erosion, scouring and undermining of runway pavement. Weaken soil and culverts (that support runways, roadway to terminals, etc.) during flash flood | Reduced visib signaling, swi Erosion, scour of railroad inf bed supports, |
| Sensitivity | S4 | S2 | S4 | S2 | S3 | S 3 |
| Adaptive Capacity | AC2 | AC4 | AC1 | AC3 | AC2 | AC2 |
| Vulnerability Ranking Increase in hurricanes/extreme storm events | Damages to roadways and bridges due to fallen trees, debris, making roads & bridges impassible or inaccessible. Safety risk to drivers. Closure of facilities due to debris from storm surge and damage to roadway infrastructure (clogging of drainage | Damages to public transportation fleet, facilities, and bus stations/shelters. Disruptions or delays in services. Safety risks to workers | , Damages to bike/ped paths due to fallen trees and debris, making bike/pedestrian path impassible or inaccessible. | Disruption to port operations and navigation aids. Debris and foreign object damages to port facilities, marina, boats, etc. Delay in services due to power outages. Safety risk to port workers. | Debris and foreign object damages to aircraft, airfield, and ramps/gates. Disruption to airport operations and navigation aids. Delay of cargo shipments. Delay in services due to power | Delays in serv outages. Flooding of ra Debris and fo to rail tracks, communicati |
| Constituit : | systems, etc.) | C1 | | | outages/damages/flooding. Safety risk to workers. | |
| Adaptive Capacity | 462 | | AC2 | | | AC2 |
| Auuptive Capacity | | AC4 | | | | AC2 |
| Sea Level Rise | Salt water intrusion and inundation of shoreline assets. Quicker deterioration or erosion of exposed equipment, structures, and roadway infrastructure. Flooding due to high tide or storm- surge, resulting in service disruptions or limited access/roadway closure in low- lying areas. Permanent inundation of roads. Increased costs for maintenance, recovery, and/or relocations. | Permanent inundation of roads/ transit routes Increased nuisance flooding | Permanent indundation of roads/paths Increased nuisance flooding | Limited access or closure due to rising sea levels. Increased nuisance flooding Permanent inundation of port infrastructure. Limiting boat access or less bridge clearance due to higher water level. | Salt water intrusion/corrosion, inundation, increasing risk of runway erosion. Permanent inundation of airport infrastructure. Closure of facilities due to debris from storm surge, and damage to port infrastructure (clogging of drainage systems, etc.). | Inundation of Saltwater com |
| Adaptive Capacity | AC2 | AC4 | AC2 | AC2 | AC2 | AC3 |
| Vulnerability Ranking | | | | | | |

| | | Utilities | | |
|--|--|---|--|--|
| eight Rail | Telecommunication | Electricity | Water Supply | Wastewater |
| buckling of railway ts. ains, electrical systems cations equipment. nouts, interruption or es. for cooling facilities. for cooling facilities. lity (risk for track ching, etc.) ng and undermining astructure (e.g., rail- rail lines, etc.). | Overheating of data centers, exchanges, base stations, etc. Decreased range of wireless signal transmission. Increased air-conditioning requirements and cost to maintain communications systems and equipment. S1 AC4 Changes in requirements to maintain internal environments of system devices due to changes in humidity. | Increased stress on power grid due to higher cooling demand. Increasing risk for more brownouts and blackouts due to increasing electric demand. Reduced generation efficiency due to increased temperature of cooling water. Increased heat exposure, heat-related illness, and safety risks for maintenance workers. Increased energy costs. S3 AC2 Increased flooding in low-lying/underground infrastructure and access points. | Lower water availability due to increased evaporative losses from lakes and resevoirs; more concentrated pollutant loads (less water, same amount of pollutant). Increase in algal blooms that could threaten water supply quality. Increase water demand for irrigation, cooling, and other consumptive uses. Reduced capacity of existing infrastructure (pumps, pipes, storage, and treatment facilities) to meet increased demond S2 AC4 Runoff implications for water quality? | Higher temperature of treated wastewater causing thermal impacts on receiving water. Higher water temperature may affect biological wastewater treatment processes. Overheated equipment, disruption to operations of wastewater plant. |
| | | | | |
| | S1 ACA | \$7 AC3 | SU ACA | 54 AC1 |
| | | | | |
| ces due to power l lines. eign object damages ail signals, n equipment, etc. | Damage to telecommunications towers, data centers, stations, etc. from high wind or fallen trees. Delay in services due to power outages. | Disruption of operations (temporary shutdown of plants, facilities, equipment.). Debris and foreign object damages to power plant infrastructure and facilities. Safety risks to workers. Increased demand of worker time (longer shifts/more workers for restoration efforts) | Increased turbidity loading in reservoirs due to increased runoff. Damage to or inundation of facilities, infrastructure, and distribution network (pipes, etc.). Disruption to water treatment operations due to power outage. | Increased risk of combined sewer overflows due to stormwater exceeding conveyance and treatment capacity. Risk of power outages interrupting treatment plant and remote lift/pump station operations. |
| | S3 AC1 | S4 AC2 | S3 AC3 | S4 AC1 |
| 1111 2 | | | | |
| rail lines? usion | 51 | Inundation of low-lying/underground infrastructure and access points. | Saltwater intrusion and inundataion, contaminating potential fresh water supplies. Salt water corosion of water conveyance infrastructure. | Inundation of low-lying treatment facilities and wells. Inundation of outfalls causing discharge to back-up. |
| | AC4 | AC2 | AC2 | AC1 |
| | | | | |

| | Natural Resources | | | | | |
|--|---|---|---|--|---|---|
| | Waterbodies & Waterways | Wetlands | Habitat | Urban Trees | Beaches | Open space, public parks & facilities |
| Increase in temperature- Days 95°F or higher | Increase in algal blooms in inland and coastal waters due to warmer temperatures, which may lead to water quality issues and fishkills. More concentrated pollutant loads due to evaporative losses (less water, same amount of pollutant). | Shifts in local species composition, introduction of new and/or invasive species. | Inability to thrive in warmer conditions New/invasive species competing for resources | Potentially change in species growth rates. Increased tree stress, shifting phenology, and altered insect and pathogen lifecycles. | Algal blooms - beach closures, health impacts, coastal species impacts | Increased use of water and utility sources at publicly owned and operated parks and recreation facilities due to high temperatures. Increasing cost for cooling facilities. |
| Sensitivity | S3 | 53 | 53 | 53 | S2 | S3 |
| Adaptive Capacity | AC2 | AC2 | AC2 | AC2 | AC0 | AC1 |
| Vulnerability Ranking | | | | | | |
| Changing precipitation (increased volume/frequency of extreme rainfall events) | Increased turbidity to waterbodies and reservoirs due to increased runoff. | Increased runoff leads to increased nutrient loading to wetlands and potential decrease in groundwater recharge. | New or increased presence of damaging pests Washout, contamination, or other stress to habitat | Moisture stress for certain species can lead to increased mortality. | | Risks of flooding and water damage at park facilities. |
| Sensitivity | S4 | S4 | S1 | S3 | S1 | \$3 |
| Adaptive Capacity | AC3 | AC3 | AC4 | AC2 | AC4 | AC1 |
| Vulnerability Ranking | | | | | | |
| Increase in hurricanes/extreme storm events | Shoreline erosion. | Erosion to wetland areas. | Loss of habitat due to erosion, wind damage, and/or flooding | Increased tree damage from storm events- damage to older forests- potential to create clearings and open habitats. | | Potential for damage to park facilities and equipment due to severe storm events. |
| Sensitivity | <u>S3</u> | S1 | S1 | <u>S3</u> | S1 | <u>S3</u> |
| Adaptive Capacity | AC3 | AC3 | AC3 | AC1 | AC4 | AC1 |
| Vulnerability Ranking | | | | | | |
| Sea Level Rise | Changes in salinity and water level due to potential land subsidence, availability of sediment, and/or sea level rise. Salt water intrusion impacts to freshwater habitat and species | Salt water intrusion and inundation, potentially reducing coastal wetland areas and resulting in potential losses of certain fishery habitat. Inundation of coastal wetland, resulting in loss of tidal wetland and less protection for coastal lands against storm surge. | Loss of habitat due to erosion and/or salt water intrusion | | Coastal erosion Beachfront property damage | Inundation of low-lying/coastal parks and open spaces |
| Sensitivity | S4 | 53 | S4 | 51 | S4 | S4 |
| Adaptive Capacity | AC1 | AC1 | AC1 | AC4 | AC1 | AC1 |
| Vulnerability Ranking | | | | | | |

| | Health and Human Services | | | Food Systems | Businesses | | | | |
|--|--|--|--|--|--|--|---|---|---|
| | Hospital | Public safety & Emergency services | At-risk service providers (shelters, community health centers) | Schools | - | Hospitality and service industry | Small Businesses | Large employers | Single-family |
| Increase in temperature- Days 95°F or higher (and localized drought) | Risk of heat exposure and heat- related illness. Health and safety concerns for vulnerable populations (children, elderly, low-income, individuals with pre-existing illness). Potential increase in hospitalization rates; health care providers' infrastructure and capacity to provide services (efficiently) due to increasing demand for treatment. | Potential increase in hospitalization rates; Emergency service providers' infrastructure and capacity to provide services (efficiently) due to increasing demand for treatment. Increased risk of vector-borne and zoonotic dieases from pests and mosquitoes (such as malaria, yellow and dengue fevers, zika virus, West Nile, etc.) Increase growth of bacteria in warmer coastal waters, increase risk of bacteria infections in humans (via eating shellfish or exposure to water). | Increased demand for services Facility cooling demands Insufficient resources to manage new or increasing health impacts. | Health/safety of students in schools if inadequately air conditioned? Loss of school days due to respiratory illness. | Warmer temperature/drought may increase stress on crops and farm animals (sepecially for dairy production), therefore reducing yields (indirect implications) Changing suitability for Florida/Southeast native crops. Crop damage due to invasive species. Increase risk of food-borne illness due to increase in algal blooms or other disease-causing agents that travel by water. Increased spoiling/ demand for | Limitation to outdoor operations and maintenance services. Safety concerns (heat exposure, heat- related illness) for outdoor workers. Reduced tourism | Impact of cooling demand on energy costs Health risks to employees | Decrease in productivity from brownouts, blackouts Decrease in productivity if facilities cannot adequately keep up with cooling demand. Water shortage implications for large water users? | Increased cooling |
| Sensitivity | S4 | S4 | S4 | S3 | 53 | S3 | S3 | S2 | S3 S3 |
| Adaptive Capacity | AC2 | AC2 | AC2 | AC2 | AC2 | AC2 | AC2 | AC2 | AC3 AC |
| Vulnerability Ranking | | | | | | | | | |
| Changing precipitation (increased volume/frequency of extreme rainfall events) | Respiratory illness from mold and flood residue in homes. | Access routes experience washouts | Flooding of facilites/access to facilities Ability to recover from damages | Flooding of facilities/access to facilities | Shortage of fruit and vegetable supplies due to late harvest and reduced yields. Moisture-reliant pathogens could thrive. Increased risk of pollutant runoff which could also mean increased risk of pesticides entering the food chain or evolution of pesticide resistance (implications for the safety, distribution, and consumption of | Impacts to tourism Damages to buildings and infrastructure Flooding of facilities/access to facilities Disrupted transportation and delivery of goods/resources. | Damages to buildings and infrastructure Flooding of facilities/access to facilities Worker access to facilities Disrupted transportation and delivery of goods/resources. | Damages to buildings and infrastructure Flooding of facilities/access to facilities Worker access to facilities Disrupted transportation and delivery of goods/resources. | |
| Sensitivity | 53 | 53 | 51 | <u>52</u> | 53 | <u>S3</u> | 53 | 52 | S3 S3 |
| Adaptive Capacity | AC2 | AC3 | AC3 | AC3 | AC2 | AC2 | AC2 | AC2 | AC3 AC |
| Vulnerability Ranking | | | | | | | | | |
| Increase in hurricanes/extreme storm events | Power outages, delays and disruptions to health care services. Evacuations may be complicated by the need for concurrent transfer of medical records, medications, and medical equipment. | Power outages, delays and disruptions to critical health care equipment and services. Potential increase in hospitalization rates; Emergency service providers' infrastructure and capacity to provide services (efficiently) due to increasing demand for treatment. Severe weather impacts may cause disruptions for emergency care services, and the ability to reach critical care facilities. | Increased demand for services Power outages (and maintanence of cooling needs) Increased refugee population (indirect) | School closures Building damages and repair costs Influx of refugees (indirect) | Storm damage prevent distribution/access to food | Reduced tourism - economic impact to businesses, reduced jobs for service workers Demand on hotels for emergency shelter Disruption to outdoor operations and/or maintenance services. Increase demand for maintenance/construction workers depending on the magnitude of damgage. | Damages to buildings and facilities Increased insurance premiums/costs Power outages Extended recovery time from damages/power outages | Decrease in productivity if employees cannot get to work and/or if facilities need to be shut down. Disrupted transportation and delivery services. | Some individuals with disabilities or lang understanding or re |
| Adaptive Capacity | 4C1 | 462 | 462 | 4C2 | 55 AC2 | AC1 | 34 AC1 | 54 AC2 | 35 462 |
| Augure Cupucity | ACT | ACS | AC2 | AC2 | AC2 | ACT | | ACZ | AC |
| Sea Level Rise | | Flooding to facilities/ access | routes for certain locations | | Decreased freshwater availaibility for irrigation, limiting crop production. | Impacts to tourism and coastal tourism related facilities | Flooding of businesses in low- lying/coastal locations | Flooding of businesses in low- lying/coastal locations | Housing or |
| Sensitivity | 54 | S4 | 54 | S4 | S1 | 54 | 54 | 54 | 54 54 |
| Adaptive Capacity | AC1 | AC1 | AC2 | AC1 | AC2 | AC1 | AC1 | AC1 | AC1 ACI |
| Vulnerability Ranking | | | | | | | | | |





Appendix D.3: Vulnerability Assessment Summary Report





St. Petersburg Vulnerability Assessment Summary Report

Introduction

As part of recent and ongoing efforts to understand and respond to the implications of climate change, the City of St. Petersburg ("the City" or "St. Petersburg") has conducted a **climate vulnerability assessment**.

The goal of this assessment is to evaluate the overall vulnerability of St. Petersburg's infrastructure as well as socioeconomic systems to anticipate and adapt to the impacts of an already changing climate.



Surrounded by water on three sides, St. Petersburg is particularly vulnerable to climate change impacts such as sea level rise.

Source: City of St. Petersburg

The assessment supports St. Petersburg in **prioritizing strategies that address its vulnerabilities and leverage its strengths**.

The City will continue collaborating with Pinellas County and other agencies throughout the region, including the recently formed Tampa Bay Regional Resiliency Coalition,¹ to establish consistent approaches to understanding and addressing climate change vulnerabilities.

¹ http://www.tbrpc.org/one-bay-resilient-communities-working-group/





Overview

The sections below summarize the vulnerability assessment by discussing planning tools, key areas of vulnerability, and current and future efforts that will enable St. Petersburg to successfully adapt. Sections include:

- STAR Communities and Resiliency in St. Petersburg Intersections between STAR Communities goal areas and vulnerability assessment
- > **Changing Conditions** Descriptions of changing climate conditions due to:
 - Sea Level Rise
 - Extreme storms and hurricanes
 - Precipitation patterns
 - Temperature increase
- > Evaluating Vulnerability Methods for assessing vulnerability
- > **Understanding Vulnerability** What does climate vulnerability look like in St. Petersburg?
- > What's Next? Next steps for addressing St. Petersburg's vulnerabilities





Star Communities and Resiliency in St. Petersburg

This vulnerability assessment incorporates guidance from the **Sustainability Tools for Assessing and Rating Communities (STAR Communities) system**. STAR Communities provides a flexible framework and evaluation metrics to understand and improve upon existing conditions and resources across seven sustainability goal areas.

Figure D.3-1 : Seven STAR Sustainability Goal Areas



Source: STAR Communities 2018

- > Several STAR Communities objectives are related to resiliency and support the assessment of vulnerabilities and resiliency strategy development, including:
- > Hazard Mitigation
- > Climate Adaptation
- > Housing Affordability
- > Community Health and Health Systems
- > Local Economy
- > Community Cohesion
- > Human Services
- > Civic Engagement
- > Community Water Systems
- > Green Infrastructure
- > Natural Resource Protection



Changing Conditions

Climate conditions are changing and in the coming decades, St. Petersburg will continue to feel the impacts of a changing climate. Key climate change trends include sea level rise, changing precipitation patterns, increased temperature, and increases in intensity of extreme storms, hurricanes, and associated storm surge.

Sea level is rising

Local water levels have **increased by 0.89 feet** over the past century. By mid-century, St. Petersburg will experience the effects of **two to three feet in sea level rise**.² Impacts from sea level rise (SLR) include:

- > Flooding of public and private shoreline assets, water and stormwater systems during high tide, "king tide"³, and storms, including "sunny day/nuisance" flooding
- > Coastal erosion, island breach, wetland and habitat impacts
- > Contamination of water supply caused by seepage, flooding, and failed backflow prevention
- > Saltwater intrusion and inundation:
 - Increasing rate of deterioration/erosion of exposed equipment, structures, and roadways
 - Impacts to freshwater resources/habitat

² NOAA Sea Level Trends Online. Retrieved from: <u>https://tidesandcurrents.noaa.gov/sltrends</u>; USGCRP. 2017. Climate Science Special Report: Fourth National Climate Assessment, Volume I.

³ A king tide is a non-scientific term used to describe exceptionally high tides. Higher than normal tides typically occur during a new or full moon and when the Moon is at its perigee, or closest to Earth.



Figure D.3-1: Map of 2.1-2.4 feet of sea level rise in St. Petersburg for 2060

- > Increased costs for maintenance, recovery, relocations
- > Limited access to low-lying area roads
- > Limited boat access less bridge clearance

The impacts from SLR place hundreds of homes and individuals in St. Petersburg

High-risk region: Tampa-St Pete is ranked #7 globally (4th in U.S.) among regions most at risk from sea level rise in terms of overall cost from damages. *Source: Hallegatte et al. (2013). Future*

at risk by 2035, and tens of thousands at risk by the end of the century. Even in an intermediate SLR scenario, these figures correspond to nearly \$5 billion dollars in property value at risk by 2100. In Figure 3, the **intermediate scenario** refers to global average SLR of approximately 4.0 feet above 1992 levels by 2100, while the **high scenario** refers to global average SLR of average SLR of approximately 6.6 feet above 1992 levels.⁴

⁴ Union of Concerned Scientists. (2018). Underwater: Rising Seas and the Implications for US Coastal Real Estate, Technical Backgrounder. https://www.ucsusa.org/sites/default/files/attach/2018/06/underwater-analysis-technical-backgrounder.pdf.





Figure D.3-3: Sea level rise implications in St. Petersburg, Florida

Source: Union of Concerned Scientists. 2018. Underwater – Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate

Precipitation patterns are changing

Historically, the St. Petersburg area has experienced a trend of **increased instances and intensity of extreme rainfall events**.⁵

Long-term precipitation records (1892-2008) indicate a **delay in the onset of the wet season** and an overall **decrease in summer precipitation**. Projections indicate these trends will continue.⁶

Figure D.3-4: Predicted extreme rainfall events in Tampa/St. Petersburg

| | Rainfall Totals (in) | | | | | |
|----------------|--------------------------------|------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Design Storm | Current Typical St. Pete | Updated Historical* | 2040 RCP 6.0* | 2040 RCP 8.5* | 2070 RCP 6.0* | 2070 RCP 8.5* |
| 100-yr 24-hr | 12 | 12.26 | 13 | 13.5 | 14.03 | 14.59 |
| 25-yr 24-hr | 9 | 9.56 | 10.3 | 10.2 | 10.34 | 10.85 |
| 10-yr 1-hr | 3.2 | 2.84 | 2.94 | 2.98 | 3.11 | 3.01 |

Source: CH2M HILL Engineers, Inc. 2016; Wet Weather Overflow Mitigation Program – Phase I. Notes: 100-yr./24-hr. based on 7-station median around Tampa/St. Petersburg area 25-yr./24-hr. and 10-yr./1-hr. are based on KSPG (St. Petersburg rainfall gauge) historic data

⁶ Mahjabin, T. (2015). Long-term Trends in Magnitude and Frequency of Extreme Rainfall Events in Florida.



⁵ CH2M HILL Engineers, Inc. (2016). Wet Weather Overflow Mitigation Program – Phase I.

Flood zones, defined

Special Flood Hazard Area (SFHA): area that will be flooded by an event with a 1% chance of occurring or being exceeded in each year, also known as a 100-year flood.

Coastal High Hazard Area (CHHA): area located along an open coast with high vulnerability to powerful waves resulting from storm surges or seismic events.

Federal Emergency Management Agency (FEMA) Flood Zones: areas categorized by FEMA according to their level of risk from flooding, which may inform, but are distinct from, local evacuation zone designations.

Pinellas County Evacuation Zone: areas in Pinellas County designated A-E by level of vulnerability to hurricane-related storm surge, based on elevation (except mobile homes).

Impacts from changing precipitation patterns include:

- Flooding and weakening of soil and culverts that support roadways and bridges due to overwhelmed stormwater/drainage systems
- Damages to building envelopes and/or mold exposure due to driving rain
- Damages to facilities, disruption of operations and services due to flooding and standing water
- > Increased risk of contamination due to increased run-off
- Travel delays and disruption of operations due to reduced visibility
- New or increased presence of disease vectors (e.g., mosquitos in wetter conditions)



Hurricane Irma was the most recent Category 4 storm to make landfall in southwest Florida (Category 2 upon reaching Tampa Bay).

Source: City of St. Petersburg

In the flood zone: Nearly half (47%) of St. Petersburg's population lives in a home located in the Special Flood Hazard Area (SFHA).



Severe hurricanes and extreme storms are more frequent and intense

Since the early 1980s, the intensity, frequency, and duration of Atlantic hurricanes has increased. Between 1900 and 2015, 63 tropical systems made landfall in the Tampa Bay area.⁷

Although projections indicate a decrease in the overall number of storms in Florida by the end of the century, climate scientists expect that **severe storms (Category 4 or 5) will increase in frequency**.⁸

- > Impacts of more intense storms include:
- > Damage to residential and commercial property
- > Damage and/or obstruction to roadways, ports, and airport runways:
 - Wind damage to infrastructure, facilities, and equipment
 - Fallen trees, debris, and foreign object damage to infrastructure, facilities, and equipment
- > Power failure
- Limited access to/delays in delivery of resources/supplies
- > Public health/safety risk for workers and residents
- Increased maintenance and repair costs due to more frequent flooding
- Increased insurance costs associated with increased risks
- > Reduced mobility



Extreme storm events can severely damage natural and built environments.

Source: City of St. Petersburg.

⁸ Bell, G. D. et al. (2011). [*Tropical cyclones*] Atlantic basin [in "State of the Climate in 2011"]; Melillo, Richmond, and Yohe. (2014). Climate Change Impacts in the United States: The Third National Climate Assessment.



⁷ Summary of the Hazard Analysis for the Tampa Bay Area, Florida Technical Support Document. (2015). Prepared for the U.S. Department of Homeland Security to inform the Tampa Bay area workshop.

Temperatures are increasing

St. Petersburg's annual average **temperatures are increasing** and at a faster rate than historical trends.



Figure D.3-5 Temperature increase in Pinellas County

Source: U.S. Climate Resilience Toolkit Climate Explorer. Higher emissions scenario = RCP 8.5, lower emissions scenario = RCP 4.5.





Source: U.S. Climate Resilience Toolkit Climate Explorer. Higher emissions scenario = RCP 8.5, lower emissions scenario = RCP 4.5.



St. Petersburg currently has an annual average of nine days above 95°F. By mid-century, that number will be between 30-50 days. By the end of this century, the average number of days above 95°F will be between 50-130.

Impacts of increasing temperatures and hotter days include:

- > Poor air quality
- > Stress on energy system due to increased cooling demand
- > Stress on bridge/road infrastructure (such as thermal expansion of metal structures, pavement integrity, etc.)
- Heat-related illness, worker heat exposure, limitations on outdoor operations and maintenance services
- Changes in disease vectors
- Loss or damage of wetland resources due to extended and/or more frequent droughts
- Shifts in natural systems, leading to species migration or failure and loss of ecosystem services



Algae bloom in Old Tampa Bay, north of Howard Frankland Bridge, August 2011.

Source: Dorian Aerial & Architectural Photographics





Evaluating Vulnerability

Based on an investigation of climate impacts, the City evaluated critical systems and assets, assessed their sensitivity and adaptive capacity through a stakeholder workshop, and completed a preliminary ranking of system and asset vulnerabilities.



Twelve systems within three planning areas provide a framework for assessing St. Petersburg's climate vulnerability. While evaluating vulnerability of these systems, the City also considered their intersections with the seven STAR Communities sustainability goal areas.





Planning Areas

| | | | 1 | | |
|----------------|--|--|---|----------------------------|---|
| Infrastructure | | Natural Resources | | Socioeconomic Resources | |
| System | STAR Goal Area(s) | System | STAR Goal Area(s) | System | STAR Goal Area(s) |
| Transportation | Built Environment | Wetlands & Habitat | Natural Systems | Businesses | • Economy & Jobs |
| Utilities | Climate & Energy Built Environment | Urban Trees | • Natural Systems | Health & Human Services | Health & Safety Equity & Empowerment |
| | | Waterbodies | • Natural Systems | Food Systems | • Health & Safety • Natural Systems |
| | | Beaches | Natural Systems | Housing | Built Environment Equity & |
| | | Open Space & Recreational Facilities | Natural Systems Built Environment Education Arts & Community | | Empowerment |

St. Petersburg understands that low-income and minority populations, refugees, children, elderly, and disabled, among others, already face limited access to resources and/or discrimination. These communities are therefore more vulnerable to climate change impacts and face disproportionate difficulty recovering from those impacts.



This mural by J & S Signs is part of St. Petersburg's Art in Public Places program, which funds art works that strive to foster a sense of community identity.

Source: City of St. Petersburg.

Throughout the assessment, the City was attentive to the Equity and Empowerment STAR Communities sustainability goal area, and to the way that the twelve identified systems intersect with the overarching ideas of equity, accessibility, and public health.

Climate equity concerns. In 2015, 22% of St. Petersburg's population lived below the poverty line. Lowincome populations have a harder time bouncing back from climate impacts due to limited financial resources. *Source: Urban Land Institute. (2017). Realizing Resilience.*





Understanding Vulnerability

The following section provides an overview of select examples of system vulnerabilities within each planning area. These examples represent only some of the vulnerabilities identified within the broader assessment.

Infrastructure

Storms, flooding, and heat events can compromise the integrity of the physical, electrical, and logistical networks that enable St. Petersburg to function, which poses major safety risks for people navigating, living, and working in the city.

Affected infrastructure subsystems and assets include St. Petersburg's roads, highways, and bridges, public transportation, bike/pedestrian network, port/marinas, airport, and freight rail, as well as St. Petersburg's

telecommunications, electricity, water supply, and wastewater system.



Residents rely on St. Petersburg's roadways and other infrastructure to access and navigate the City's downtown.

Source: City of St. Petersburg



| | Vulnerability Examples |
|-----------------------------|---|
| Sea level rise | Temporary/permanent inundation of coastal assets, low-lying areas, and roads |
| | Increased costs for maintenance, recovery, and/or relocations |
| Changing precipitation | Higher volume of stormwater increases risk for sanitary sewer overflows, |
| (increased volume/frequency | contamination of water bodies, decreased efficiency of wastewater treatment |
| of extreme rainfall events) | plant |
| | More frequent or severe flooding of roads and the potential for road washout |
| Increase in | Damages to/inaccessibility of roadways and bridges due to fallen trees and |
| hurricanes/extreme storm | debris |
| ovents | Safety risk to drivers, passengers, workers |
| events | Delay in services due to power outages/damages/flooding |
| Increased in extreme | Increased costs and stress on power grid due to higher demand for cooling of |
| temperature—days over 95°F | facilities |
| (and localized drought) | Increased heat exposure, heat-related illness, and safety risks for maintenance |
| (and localized drought) | workers, residents, visitors |

Natural Resources

Climate impacts will cause significant disruptions to the natural systems that provide home, refuge, and recreational opportunities for St. Petersburg's human and non-human inhabitants. Waterbodies and waterways, wetlands, coastal habitats, urban trees, beaches,

and open space, public parks and facilities are highly sensitive to climate change impacts.

However, many of these assets have some adaptive capacity or are naturally adaptive to these impacts, suggesting that greater overall flexibility could be attained through the integration of these systems.



St. Petersburg's Dell Holmes Park provides recreational opportunities for residents as well as natural habitat for local wildlife.

Source: City of St. Petersburg

| | vulnerability Examples |
|--|--|
| Sea level rise | Inundation of coastal wetland, resulting in loss of tidal wetland and less protection for coastal lands against storm surge Inundation of low-lying/coastal parks and open spaces Loss of habitat due to erosion and/or salt water intrusion Habitat changes, including replacement of emergent wetlands by subtidal seagrasses |
| Changing precipitation (increased volume/frequency of extreme rainfall events) | Increased runoff leads to increased nutrient loading to wetlands and potential decrease in groundwater recharge Increased turbidity of waterbodies and reservoirs, which reduces water quality |
| Increase in hurricanes/ extreme storm events | Increased tree damage from storm events, disrupting older forest habitats Potential for damage to park facilities and equipment due to severe storm events |
| Increased in extreme temperature—days over 95°F (and localized drought) | Algal blooms: water quality issues, health impacts, coastal species impacts, fishkills, beach closures, health impacts, coastal species impacts Shifts in local species composition, introduction of new and/or invasive species |

Vulnerability Examples

Socioeconomic Resources

Impacts from climate change weaken many of the social and human services and economic, physical, and human assets that sustain St. Petersburg's communities.

These resources—often those most needed to respond to, adapt to, or prevent the most negative impacts of changes—include hospitals, public safety and emergency services, atrisk service providers (e.g., shelters, community health centers), schools, food systems, businesses, and housing.



The 2017 Shine Mural Festival featured artwork by locals such as Herbert Scott Davis.

Source: City of St. Petersburg

| | Vulnerability Examples |
|-----------------------------|---|
| Sea level rise | Decreased freshwater availability for irrigation, limiting crop production |
| | Flooding of businesses and homes in low-lying/coastal locations |
| | Limited access to healthcare facilities |
| | Increased insurance costs |
| Changing precipitation | Respiratory illness from mold and flood residue in homes |
| (increased volume/frequency | Disrupted transportation and delivery of goods/resources |
| of extreme rainfall events) | Damage to homes/buildings and supporting infrastructure |
| Increase in hurricanes/ | Damage from wind, flooding, driving rain; power outages |
| extreme storm events | Delays and disruptions to health care and emergency services |
| | Disruption of food distribution or limited access to food |
| | Inability or limited ability of individuals with disabilities or language barriers to |
| | access evacuation routes, understand or receive warnings of impending danger, |
| | or communicate their needs |
| | Reduced tourism—economic impact to businesses, fewer jobs |
| Increased in extreme | Risk of heat exposure and heat-related illness |
| temperature—days over 95°F | Health and safety concerns for vulnerable populations (children, elderly, low- |
| (and localized draught) | income, individuals with pre-existing illness) |
| (and localized drought) | Increased risk of vector-borne and zoonotic diseases from pests and |
| | mosquitoes (such as malaria, yellow and dengue fevers, zika virus, West Nile) |
| | Increased stress on crops and farm animals due to warmer |
| | temperatures/drought, which impacts food systems |





What's Next?

St. Petersburg will incorporate this vulnerability summary report into the Integrated Sustainability Action Plan (ISAP) and continue to consider its vulnerabilities in adaptive infrastructure, facility, and other city planning work moving forward.

Additionally, the City will continue collaborating with Pinellas County and other agencies throughout the region, including the recently formed Tampa Bay Regional Resiliency Coalition,⁹ to



St. Petersburg youth participate in the Minor League Baseball "Play Ball" program.

Source: City of St. Petersburg

establish consistent approaches to understanding and addressing climate change vulnerabilities.

⁹ http://www.tbrpc.org/one-bay-resilient-communities-working-group/



Existing Policies, Ongoing Resiliency Efforts, and Action Items

The following table illustrates several of the City's existing efforts and collaborations toward a more resilient St. Petersburg, as well as examples of actions that will enhance its current work by addressing key vulnerabilities.

Existing Policies, Programs, and Strategies

- O Elevation certificates for buildings in Special Flood Hazard Area (SFHA)
- O Freeboard update Ordinance No 191-H (Aug 2015)
- O Repetitive Loss Area Analysis (RLAA)
- O Local Mitigation Strategy (LMS) Plan
- O StormREADY Community
- O Emergency Management & Disaster Operations Plan (includes County, State, etc.)
- O Development of Watershed Master Plan
- Development of a Sustainability & Resiliency City Facility Building Ordinance

Recent and Ongoing Resilience Efforts

- O Tampa Bay Climate Science Advisory Panel (CSAP)
- O Pinellas County Vulnerability Assessment – coordinated effort among cities including St. Pete
- O ULI Realizing Resilience social equity and economic opportunity
- O Integrated Water Resources Master Plan
- O Stormwater Management Master Plan
- O Wastewater Wet Weather Overflow Mitigation Study
- Integrated Sustainability
 Action Plan (ISAP)
- Integration of climate projections into project design

Ways to Address Existing Vulnerabilities

- Develop Energy Roadmap that explores mechanisms to incentivize clean and distributed energy and protect utilities/energy infrastructure
- Promote existing resources for vulnerable populations, such as Energy Neighbor
 Fund to help pay energy bills
- Explore additional resources to support financial burden of elevating/ storm-proofing buildings or installing back-up generators
- Develop a plan to creatively disseminate Integrated Sustainability Action Plan (ISAP) to diversify its readership

