Hillsboro
OREGON

Energy Management Plan

City Operations

HILLSBORO SUSTAINABILITY GUIDING STATEMENT

The City of Hillsboro envisions a sustainable future, in which the City responsibly satisfies the needs of its residents, provides a healthy and satisfying work environment for its employees and minimizes its impact on the physical environment of the community.

TABLE OF CONTENTS

Introduction

Energy is a critical component of our community and in the delivery of City services. Energy heats and cools our buildings, powers our vehicles and provides light for safety throughout the community. Most of the City's energy is generated from sources that are fueled by non-renewable[1,2] natural resources, or fossil fuels. With global human population growth and increasing consumption, nonrenewable resources will continue to be depleted, the cost of energy will continue to rise, and greenhouse gas emissions[3] will continue to affect global climate change, which threatens our long term future. It is imperative that energy use become more efficient and that more energy be produced from renewable resources.

Recognizing this, in 2010 City of Hillsboro leaders adopted aggressive long term goals to reduce non-renewable energy consumed by City facilities. City staff have focused efforts on meeting those goals and have requested funds annually over the past 10 years to make investments in energy efficiency. With an annual energy expenditure of $3,300,000[4] (2017), effective energy management and conservation has delivered significant energy as well as cost savings.

The City has already met or is on track to meet four of seven energy and greenhouse gas emissions-related goals, and it has cut energy use by over 26% in that time. How the City obtains energy for its facilities and how employees use that energy will continue to determine how the City will meet its long term goals. More efficient use of energy benefits the City's financial bottom line as well as the indoor comfort of building occupants. It also increases the value of buildings and infrastructure and reduces emissions of pollutants. The City focuses on optimizing energy efficiency by using an integrated approach to energy management, one that considers how buildings and infrastructure are designed and built, operated and maintained.

1 Primary non-renewable resources are coal, natural gas and petroleum.
2 In 2017, approximately 11% of total U.S. energy came from renewable energy sources such as hydro, wind, solar and geothermal (source: U.S. Energy Information Administration).
3 Electricity alone accounts for ~33% of total U.S. greenhouse gas emissions (U.S. Environmental Protection Agency).
4 Includes electricity, natural gas, water and fuels. Does not include electricity for water treatment (Joint Water Commission).

Introduction Continued

The City of Hillsboro's Energy Management Plan (EMP) defines the City's energy-using facilities and infrastructure, summarizes energy use and cost data, and describes the means, including policies, to reduce energy use across City operations. It is intended to be a living document based on continual improvement and a robust cycle of measuring, monitoring, reporting, analyzing, adjusting and reviewing.

The EMP encompasses City facilities and City utility infrastructure located in the public right of way and easements, including heating and cooling of buildings and lighting of roadways and parking lots. The EMP encompasses both existing and future facilities and defines policies and processes to ensure the most efficient use of energy and water. The EMP includes practices and policies to drive continued progress toward the established long term goals. Some of the key policies include:

- **Required energy modeling for all new major facilities and renovations**
- **Required City building temperature set points and related protocols as stated herein**
- **Required 3rd party commissioning for all new major facilities and renovations**
- **Recommended occupant energy conserving practices**
- **Regular outreach and engagement to communicate energy saving practices and policies to employees**
- **Required City exterior dark sky compliant lighting**
- **Required energy metering and management systems on all new City facilities, renovations, and retrofits so that all City facilities are managed with the energy metering and the most advanced energy saving HVAC and lighting systems**
- **Requires employees to limit the use of all personal energy-consuming devices at City workstations and facilities, including computers and computer equipment**

CITY ORGANIZATIONAL GOALS - 2030

Materials Management

- Achieve a rate of construction material consumption that meets internal standards for sustainability
- 100% of all inputs purchased by the City are sourced from sustainable sources or meet internally established criteria (e.g., zero waste, zero toxins) where technologically and financially feasible
- Zero construction and maintenance waste (no waste from construction and maintenance activities is sent to landfill). May be accomplished via public/private partnerships

Energy Management

- 20% reduced energy intensity by 2020 (goal achieved); In 2018, a new goal was established to achieve an additional 20% energy savings by 2025
- 60% reduced City facility energy consumption per square foot (2007 baseline)
- 100% of electricity and natural gas sourced from renewable sources for City facilities and exterior lighting infrastructure
- 80% reduction in greenhouse gas emissions; 100% of remaining emissions offset (2007 baseline)
- 80% production of energy for City facilities from renewable sources
- 100% fossil fuel-free staff vehicles and 40% reduction for other exempt vehicles (non-passenger emergency response, etc.) [Based on available technologies and cost effectiveness] (2007 baseline)
- All City facilities zero net energy consumption, if feasible based on Return on Investment (ROI) or cost/benefit analysis

Policy

- 100% of City development investments meet a standard set for sustainable development, and City promotes and encourages sustainable development by others
- 100% of applicable City policies incorporate the principles of sustainability
- All city facilities constructed or renovated shall meet equivalent of Leadership in Energy and Environmental Design (LEED) standards or better, unless cost prohibitive based on Return on Investment (ROI) or cost/benefit analysis

Natural Resources

- 25% reduction in water consumption by City facilities against established baseline (including re-use and other measures) (2007 baseline)

CITY ENERGY GOALS

Seven of the City's fifteen sustainability goals for the year 2030 that were set in the City's sustainability plan and adopted by the City Council in 2010 relate to energy, water, and fuels. In addition, in 2012 the City adopted an interim goal to reduce the energy use intensity of City facilities 20% by 2020 as part of the U.S. Department of Energy Better Buildings Challenge. With that goal achieved, a new goal has been established to further reduce energy use intensity an additional 20% by 2025. For this EMP, the goals related to energy and water are considered and listed on page 5. These goals are reviewed at least every five years along with all sustainability goals as defined in the Sustainability Plan.

The fundamental objective of providing facilities that maximize occupant comfort is also critical and should not be understated. This Plan seeks to define parameters for managing facilities that maximize both energy efficiency and occupant comfort, recognizing that comfortable occupants are healthier, happier, and more productive.

Table 1: City Energy and Water 2030 Goals (City Operations Only)

Goal		Status
1	Better Buildings Challenge: 20% reduced City facility energy intensity by 2020* (2009 baseline)	
	Includes all facilities in the Better Buildings Challenge. Data compiled in Portfolio Manager.	
	2009: EUI 268, Improvement 0% 2017: EUI 200, Improvement 26%	*Goal achieved (based on 2009 baseline)
2	Better Buildings Challenge: 20% reduced City facility energy intensity by 2025 (2015 baseline)	
	Includes all facilities in the Better Buildings Challenge. Data compiled in Portfolio Manager.	
	2015: EUI 208, Improvement 0% 2017: EUI 200, Improvement 4%	In progress
3	60% reduced City facility energy consumption per square foot (2007 baseline)	
	Includes all City facilities currently tracked in Portfolio Manager.	
	2007 Average EUI: 122.71 Improvement 0% 2017 Average EUI: 88.09, Improvement 28%	In progress
4	100% of electricity and natural gas from renewable sources for City facilities and exterior lighting infrastructure	
	Total electricity and natural gas use for all City facilities, street lighting, parks, traffic signals, etc. Data taken from Green Power Community annual data reports and includes clean wind purchases.	
	2009: Electricity 12.61%; Natural Gas 0% 2017: Electricity 31.97%; Natural Gas 0%	In progress; *Note: Budget Committee voted to increase to 100% wind power for City electricity use*
5	80% reduction in Greenhouse Gas (GHG) emissions (MT CO2e)	
	Scopes 1 & 2 greenhouse gas emissions only. Scope 3 emissions are only recorded every five years. Does not include JWC. Data compiled in greenhouse gas calculator.	
	2007: Scopes 1 & 2: 8,900 2016: Scopes 1 & 2: 8,995 2007-2016 change: emissions increased about 1%	In progress
6	80% production of energy for City facilities from renewable sources	
	Onsite energy (such as solar) production only. See "EMP Goal 5" spreadsheet in appendix for data methodology.	
	2009: 0% 2017: 1%	In progress
7	100% fossil-fuel free staff vehicles and 40% reduction for other exempt vehicles (based on available technologies & cost effectiveness).	
	Fossil-fuel free vehicles – electric, solar, hydrogen, etc.	
	2009: 1 2017: 3	In progress
8	All City facilities zero net energy[5] consumption, if feasible based on Return of Investment (ROI) or cost/benefit analysis	
	All City facilities will produce enough onsite energy to satisfy all facility energy needs without needing to purchase power from additional sources.	
	2009: Zero facilities 2017: Zero facilities	In progress; *Note: 53rd Avenue community center is enrolled in ETO Path to Net Zero Program*
9	25% reduction in water consumption by City facilities against established baseline (including re-use and other measures)	
	Includes all City facilities that are part of the Better Buildings Challenge. Data compiled in Portfolio Manager.	
	2012: 70 WUI 2017: 63 WUI 2012-2017 change: 11% improvement (BBC)	In progress

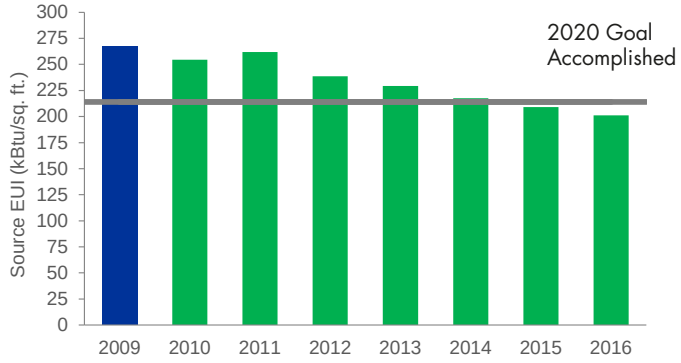
5 See definition of net zero energy in the appended Glossary.

BETTER BUILDINGS CHALLENGE
CITY FACILITIES ENERGY USE INTENSITY (EUI)

The baseline year for the Better Buildings Challenge energy data tracking is 2009. Goal 1 was achieved in 2016, four years ahead of the target of 2020. A new goal has been set with a baseline of 2015, to further reduce energy use intensity 20% by 2025. To date, City facilities are 4% below the 2015 level. In 2018, the City was recognized by the U.S. Department of Energy as the #1 local government in the U.S. for reducing energy use.

The Better Buildings Challenge Portfolio represents about 51% of the City's total facility square footage. Facilities such as water treatment plants, park restrooms, maintenance storage sheds, mixed use facilities, and others are not included in the Challenge because some building types are not comparable for baselining and tracking, some facilities have shared ownership, which makes tracking difficult, and some buildings are not metered separately. While the goals and energy savings achieved in the Better Building Challenge do contribute toward the City's 2030 goals, they represent a portion of City's building inventory and the overall energy profile.

EUI & % Improvement vs. 2009 Baseline



State and Local Government

Challenge Partners with Greatest Energy Savings

Savings Since Baseline Year

Hillsboro, OR*	26%
State of Maryland*	23%
State of Delaware*	22%
State of North Carolina*	21%
Atlanta, GA	19%
Boston, MA	18%
King County, WA*	18%
Common Wealth of Massachusetts	15%
Margate, FL	15%
Cook County, IL	14%

*Goal achiever

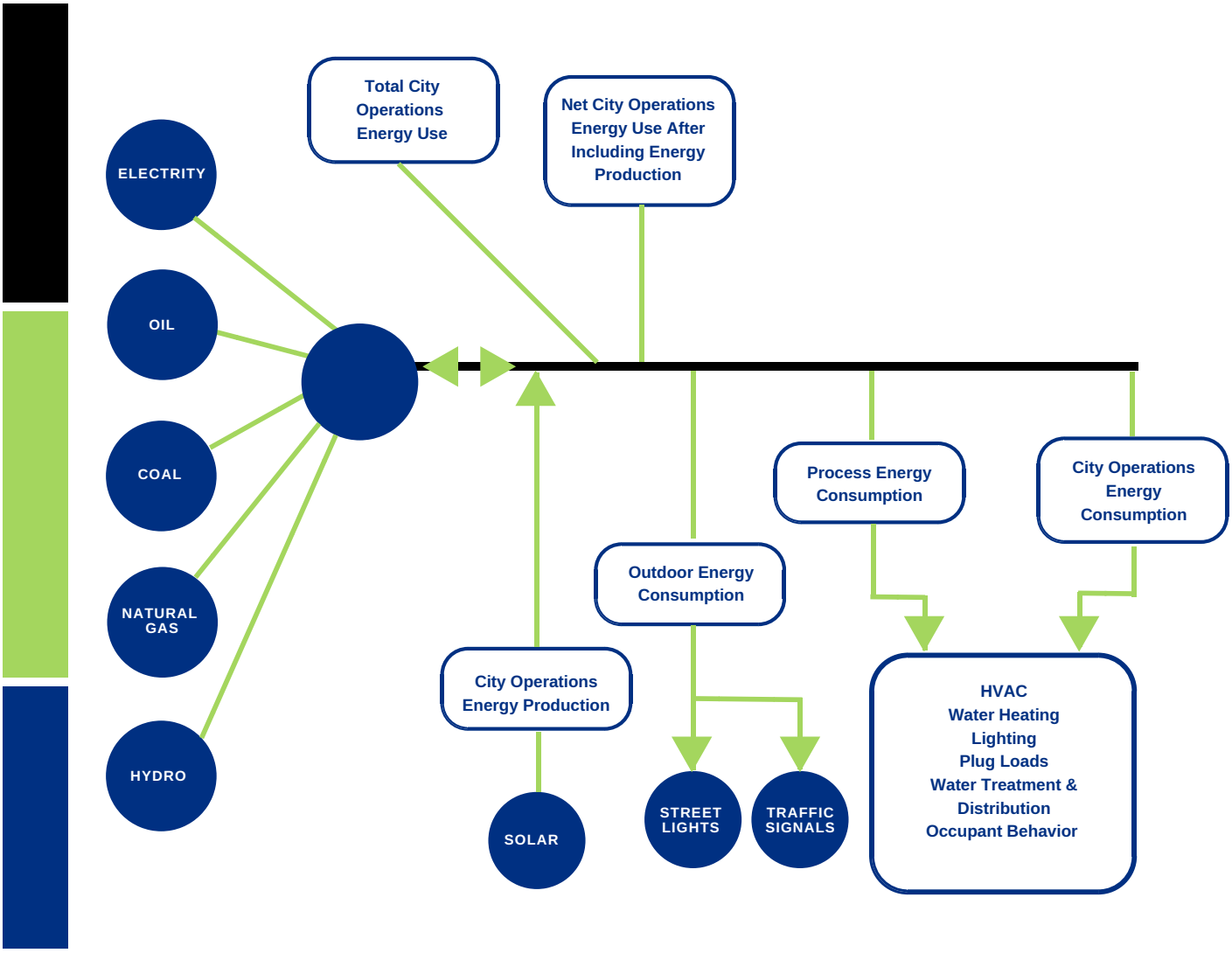
*Data reflects BBC facilities only

THE ENERGY CYCLE

"If you cannot measure it, you cannot improve it" – Lord Kelvin (William Thomson)
"What gets measured gets managed" – Peter Drucker

The Energy Flow diagram shown below provides a visual of the energy cycle – including generation[6] , production[7], and consumption. The diagram helps set the context for how energy is produced and used. The objective of the EMP is to meet the City's goals by reducing consumption of energy derived from non-renewable resources and by increasing the percentage of energy derived from renewable resources.

Figure 8: Energy Flow Diagram



6 Generation refers to the process of producing electricity by transforming other forms of energy, or the amount of electricity produced.

7 Production refers to the creation of energy from the various non-renewable and renewable sources, such as coal, natural gas, wind, solar and others.

MEASURABLE ASPECTS

Buildings
- New buildings
- Improvements and renovations to existing buildings

Non-Buildings
- Water treatment and storage facilities and pump stations
- Traffic signals
- Street lighting and parking lot lighting
- Electric vehicle charging stations
- Irrigation water

On Site Energy Generation
- E.g., Solar, micro-hydro

Fuel Consumption
- Fleet vehicles
- Generators

Voluntary Green Power Purchases

Water Consumption

Table 3: Energy Projects/Actions

Energy/GHG Project	Status	Proposed Action	Considerations
Consider City-wide policy to require the purchase of only Energy Star-certified devices wherever possible	New	Include policy in Purchasing rules that requires the purchase of Energy Star certified devices where they are available, and only exempt in certain circumstances.	Need to form policy with Purchasing and with input from stakeholders.
Assess opportunities for interior lighting upgrades	New	Identify opportunities for interior lighting efficiency upgrades and implement where possible.	New lighting technology makes interior efficiency upgrades possible, typically with very short financial returns on the investment, and reduced energy costs.
Create Community Revolving Loan Fund	Started	Convert internal Revolving Loan Fund to have a community-facing resource, and include funds from energy savings from street light conversion.	Streetlight conversion is in process; need to determine actual savings and portion to be allocated to fund. Also need to create construct with input from Sustainability Task Force.
Develop minimum standards for all City building construction or renovation	Started	Revise existing goal that is tied to LEED adopted policies that require energy modeling for the design of new major[8] facilities or renovations and 3rd party commissioning of new major facilities and renovations[9] will be included in new facility Design and Construction Standards, which are under development.	As part of the design of the new 53rd Ave community center, Owner's Project Requirements are being developed. These requirements will document the building's system, material, and operational needs, and will inform development of comprehensive facility Design and Construction Standards. The Standards will define, among other elements, green building design, construction and operations.
Develop criteria for tree plantings as offset for greenhouse gas emissions	Started	Continue project.	The City applied for and received Tree City USA designation in March 2019.

8 "Major" facilities in this context are occupied buildings with a significant energy demand.
9 "Renovations" relative to these requirements are defined as 'any change to an existing building or facility that substantially affects the mechanical, lighting or other systems resulting in a significant change to the building's energy performance.'

Energy/GHG Project	Status	Proposed Action	Considerations
Implement fleet utilization study relative to fuel efficiency	Started	Establish fleet fuel efficiency baseline, measures, best management practices (BMP).	Efforts to increase fleet efficiency include: • Update to fleet fuel efficiency goal • Draft potential vehicle purchasing policy, based on overall estimated fleet fuel efficiency average • Implement fleet telematics on additional City fleets • Draft potential no-idle City fleet policy
Limit the use of personal energy-consuming devices at work stations and at City facilities.	Started	Encourage employees to limit the use of personal energy consuming devices in workstations and at City facilities. High-energy using devices such as personal space heaters should only be used when necessary and must be approved by the Fire Department and Public Works Facilities Maintenance Division. High energy using devices are those that use greater than 150 watts of energy.	"Plug load[11]" refers to the energy needed to power devices plugged into electrical outlets. Personal energy-consuming devices add a significant cumulative load and their use should be minimized. Devices consume energy even when off or in 'sleep' mode.[12] High-energy using devices personal space heaters are high-energy consumers that also can negatively affect a building's central HVAC system, which further exacerbates energy use and occupant comfort issues. Safety is also a concern with space heaters, as more than 6,000 hospital emergency room visits for burns and 25,000 residential fires[13] are attributable to heaters each year.
Develop and implement City facility water conservation project	✓ Completed and ongoing	Install low-flow or waterless devices in new facilities and renovations; look for opportunities to retrofit existing features and irrigation where appropriate.	Opportunities to reduce water consumption are identified through EMP process.

10 See the US Department of Energy for further information: http://energy.gov/energysaver/articles/energy-efficient-computer-use
11 See definitition of plug load in the appended glossary
12 Appendix B lists several commonly used plug in devices and their estimated energy use and costs
13 Source: U.S. Consumer Product Safety Commission

Energy/GHG Project	Status	Proposed Action	Considerations
Require inclusion of energy metering and management system and dashboard on new buildings and renovations, and retrofit into existing facilities	✓ Completed and ongoing	Include energy metering and management system compatible with existing software/hardware on all new buildings and renovations. Retrofit existing facilities to be compatible with energy management system.	The adopted energy metering and management system has been deployed on several City facilities and allows facility managers to: - Track energy performance in real time - Control and adjust systems to maximize efficiency Investment in this system has demonstrated the value of focused energy management controls; this is a key tool for energy management of City buildings.
Assess renewable energy generation opportunities	✓ Completed and ongoing	New opportunities consistently identified.	As of 2018, City offsets 1.5% of electricity use with solar power. New opportunities for increased solar and in-line hydro generation are in process.
Optimize traffic signal timing on key City thoroughfares	✓ Completed and ongoing	Implement on additional facilities where possible.	Timing on all City intersections as well as parts of NE Cornell and 185th & Baseline done, new facilities include timing systems.
Conduct streetlight inventory and lighting evaluation and implement efficiency measures	✓ Completed and ongoing	Comprehensive acquisition and conversion program is underway.	The remaining 4,770 City streetlights that have not been converted to high efficiency LED are in process of being converted. This represents 65% of the 7,300 total City streetlights. Also, 'smart' nodes will be added to the lights to allow for light level and other controllability, including light dimming during low traffic periods.
Implement building temperature set point, operational hours and lighting systems to balance energy efficiency and occupant comfort	✓ Completed and ongoing	Create more clearly defined protocol for setting building heating and cooling control set points, lighting levels and times, and process for adjustments.	More detailed policy is provided in the sections below.

Energy/GHG Project	Status	Proposed Action	Considerations
Implement ongoing employee outreach and education program to communicate energy saving practices and policies and benefits of energy efficiency behaviors	✓ Completed and ongoing	Continue and expand outreach efforts through existing and new channels, conduct special campaigns such as the Power Down Challenge.	Occupant behavior plays a key role in energy efficiency; in addition to educational outreach, new policies will set heating and cooling limits and will provide recommendations to employees regarding personal temperature related comfort in City facilities.
Require exterior lighting on City facilities to comply with the City dark sky requirements and to maximize energy efficiency	✓ Completed and ongoing	Develop dark sky requirements for Community Development Code, Municipal Code and other relevant guiding documents. Direct all lighting to be dark sky compliant.	New lighting technology, such as LED provides a great opportunity for exterior lighting to be directed only where it is intended and not beyond, thereby preserving the night sky. New technology also has a major beneficial impact on energy consumption.
Identify and assess market mechanisms to offset greenhouse gas emissions (e.g., green credits)	✓ Completed and ongoing	Increase the City investment to offset through renewable energy credits (REC).	City currently offsets 35% of electricity use, and will increase the offset to 100% in 2018 through the purchase of additional RECs.
Implement City wide centralized PC power management	Not started	Consider power management with available incentives.	Compatibility with City IS system/ procedures. Ensure cost/benefit justification.

Building Temperatures

A one degree change of the heating or cooling temperature can affect the energy used by that system by 1%. Standard thermostat settings for City work environments shall be 69° for heating and 76° for cooling. Sites such as SHARC and Community Center may have operational requirements which would allow setting outside of these settings. See details below.

Unoccupied Temperatures

Unoccupied building temperatures have a large impact on energy use, since many buildings are unoccupied up to two-thirds of the time. Therefore, standard unoccupied temperatures shall be 55° for heating and 80° for cooling. Buildings with marginal capacity for reheat may be run at an unoccupied winter maximum of 60°. Summer unoccupied temperatures in buildings with night flush ventilation capability will vary depending on the outside temperature, but will adhere to the standard if no outside cooling is available. In buildings with temporary override capability, staff should consider the energy impacts if invoking normal daytime temperatures when working outside of normal hours.

Occupied Summer Temperatures

Temperatures shall be set to provide a minimum 76° temperature in the work area in the summer. Workgroups may choose to have the temperature set higher than this minimum in the summer, if all those affected by the change are in agreement and the temperature does not rise above 80° in the work area.

Some buildings may be "pre-cooled" using off-peak energy or cool night air. Heat should not be used if the building is cool in the morning due to pre-cooling.

Employees should take a problem-solving approach to any comfort issues that may arise. The following are some suggestions to maximize comfort during the summer cooling season:

a. Expect that it may take a few days to adjust to slightly warmer temperatures.
b. Expect that temperatures at the end of the day may drift upward since cooling will be turned off one hour before the building closes.
c. Dress in lightweight, work-appropriate clothing.
d. Bring layers for possible cooler morning temperatures, especially in buildings that use pre-cooling.
e. Adjust blinds to block direct sunlight and reduce heat gain.
f. Do not let hot air in by opening windows when it is hotter outside than in.
g. If possible, work areas should be shifted away from windows. Areas adjacent to windows are hotter in the summer and colder in the winter.
h. Drink plenty of cool, non-alcoholic beverages. Staying hydrated helps the body stay cool.
i. Use of a small personal fan can make a person feel up to up to 5° cooler. A fan may be used if it is less than 8" diameter and does not cause noise or draft problems for co-workers. Staff are expected to be diligent about turning the fan off when not in use.

If a work space is consistently above 76° and this is causing discomfort, employees may request that the Department Manager contact the Facilities Maintenance Division at 503-615-3440.

If the temperature in the work space is determined by the Facility Maintenance Division to be within the expected range, staff should direct any comments or complaints to their Department Manager.

Occupied Winter Temperatures

Office temperatures shall be set to provide a maximum 69° temperature in the work area in the winter. Work groups may choose to have the temperature set lower than this maximum in the winter, if all those affected by the change are in agreement and the temperature does not fall below 65° in the work area.

Employees should take a problem-solving approach to any comfort issues that may arise. The following are some suggestions to maximize comfort during the winter heating season:

- Computer and work patterns should be rearranged, if possible, away from windows, drafts or heating air supply.
- Dress in warmer clothing, with layers.
- Keep your feet dry. Cold or damp feet can increase the sensation of being chilled.
- On a break, a short, brisk walk can create warmth.
- Request a 100/150 watt heating panel from Facilities Maintenance. Staff are expected to be diligent about turning the heating panel off when not in use.

If a work space is consistently below 69° and this is causing discomfort, employees may request that the supervisor contact the Facilities Maintenance Division at 503-615-3440 for assistance with the problem.

If the temperature in the workspace is determined by the Facilities Maintenance Division to be within the expected range, staff should direct any comments or complaints to their Department Manager.

High wattage (above 150 watt) personal space heaters are not permitted in City facilities. In addition to using large amounts of energy, they can cause circuits to overload and trip frequently, cause power quality problems for computer equipment and can be a safety hazard. A radiant heat panel, foot warmer or heating pad should be used instead. Devices that would affect temperature shall not be placed near thermostats.

Windows and Doors

Doors and operable windows may be opened for additional ventilation only when the temperature according to the thermostat for that area (not a personal thermometer) reads between 70 and 75 degrees. Thermostat readings in this range indicate that no heating or cooling is taking place.

Hot Water

Hot water shall be stored at a temperature of 120°. Areas with special needs such as cafeterias, laundering room, and shower facilities may use higher temperature settings as recommended by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

Maintenance and Continuous Improvements

All buildings, systems, and equipment shall be maintained in a manner to promote energy conservation. Energy usage shall be closely tracked and monitored and the sustainability/facilities team shall be responsible for continuously identifying and implementing efficiencies to reduce energy consumption and costs.

Monitoring and Reporting

Within the structure of the Sustainability Plan, the EMP defines who, how and when for energy measuring and monitoring. Within the City Manager's Office, the Sustainability Team leads the maintenance and tracking of data for electricity, natural gas and water utilities. The primary tool used for energy and water data tracking is the U.S. Environmental Protection Agency (EPA) Portfolio Manager (PM) online database, a part of the EPA Energy Star program. This free tool provides a comprehensive portal for much of the facility energy data. Additionally the Sustainability Team separately tracks data not captured in PM.

The sustainability team leads development of the annual Local Government Operations greenhouse gas (GHG) inventory report. The report satisfies the requirement of the U.S. Conference of Mayors Climate Protection Agreement, to which the City is a signatory. It requires the collection of data for aspects beyond energy and water, such as employee travel and commuting, vehicle and equipment fuel, purchasing and other aspects.

The sustainability team works closely with the Public Works Facilities Maintenance and Engineering divisions in order to comprehensively manage energy activities and priorities and to provide data that informs decisions on those priorities. This includes building energy (maintenance) and street lights and traffic signals (engineering). Regular monthly meetings are held with Facilities Maintenance and additionally as needed.

Reporting on facility and non-facility energy and water consumption is done at least annually as a part of sustainability reporting, with additional reporting as needed. This reporting includes a high level summary of energy performance year-to-year, expressed in energy use, cost and intensity[14]. Reporting also includes an annual accounting of revenues and expenditures of the Sustainability Revolving Fund (SRF), originally seeded with savings from energy efficiency projects (see more on the SRF on page 22).

Selecting and Prioritizing Projects

The energy data that is collected, tracked and maintained informs decisions on project priorities. Those projects are identified within the Sustainability Plan by cross-departmental staff. Proposed projects are assessed for their potential simple payback, return on investment, as well as their potential to contribute to the City's goals and to enhance the comfort and value of City facilities. Key partners that may help support energy projects financially and otherwise include the Energy Trust of Oregon, State Department of Energy, U.S. Department of Energy, Portland General Electric, and Northwest Natural Gas.

14 Energy use intensity is a normalized expression of facility energy efficiency.

City Buildings

City facilities are listed in Table 4 and include all energy-consuming buildings for which the City is able to track data. This list does not include non-energy consuming buildings such as park restrooms or small storage buildings. Currently the City portfolio includes 36 buildings that consume energy and are tracked within this EMP.

Table 4: Building List

Map	Building	Address	Square Feet
	Civic Center		
1	Civic Center Complex	150 E Main Street	125,097
	Fire		
2	Main - Station 1	240 S 1st Avenue	15,245
3	Brookwood - Station 2	5045 SE Drake Street	4,375
4	Ronler Acres - Station 3	4455 NW 229th Avenue	14,531
5	Jones Farm - Station 5	2850 NE 25th Avenue	13,458
6	Cherry Lane - Station 6	21880 NW Cherry Lane	15,995
7	Parkwood Fire Logistics	275 NE 25th Avenue	3,248
8	Wood Street Training Facility	620 SW Wood Street	22,200
	Intermodal Transit Facility (ITF)[15]		
9	Hillsboro ITF Bike Park	8th Avenue and Baseline	1,474
9	Parking Garage	8th Avenue and Baseline	247,485
9	Portland Community College	8th Avenue and Baseline	9,522
9	Pacific University	8th Avenue and Baseline	7,541
	Library		
10	Brookwood Library	2850 NE Brookwood Parkway	77,352
11	Shute Park Library	775 SE 10th Avenue	16,000
	Parks & Recreation		
12	Gordon Faber Recreation Complex	4450 NW 229th Avenue	44,360
12	Ron Tonkin Field	4460 NW 229th Avenue	22,727
13	Walters Cultural Arts Center	527 E Main Street	15,664
14	Parks Maintenance	5500 NE Moore Court	15,000
15	Jackson Bottom Wetlands Preserve	2600 SW Hillsboro Highway	12,000
16	River House	4000 SE Rood Bridge Road	2,845
16	River House Annex	4000 SE Rood Bridge Road	1,000
17	Parks Administration	4400 NW 229th Avenue	10,500
18	Community Senior Center	750 SE 8th Avenue	11,175
19	SHARC	953 SE Maple Street	43,480
19	SHARC Bathhouse	626 SE 9th Avenue	3,540
20	Tyson Recreation Center	1880 NE Griffin Oaks Street	4,256
21	McDonald House	22180 NW Birch Street	8,758
22	Master's House	20350 SW Kinnaman Road (Aloha)	2,100
23	Patterson House	5207 SE Patterson Street	1,894

Table 4: Building List Continued

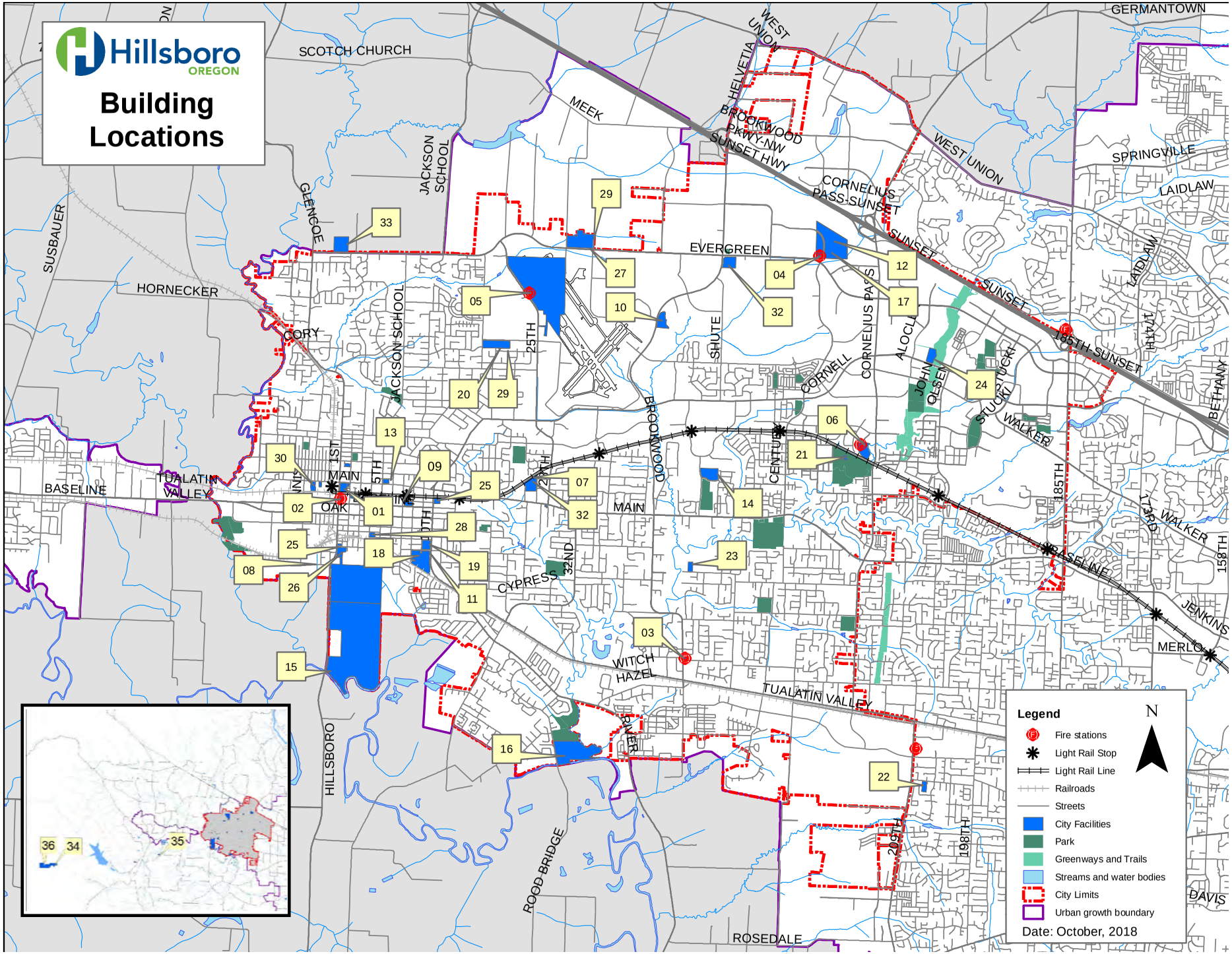
Map	Building	Address	Square Feet
	Police		
24	East Precinct[16]	20795 NW Cornell, Suites 100 & 200	15,719
24	West Precinct	250 SE 10th Avenue	35,500
25	Evidence Storage	145 SE Maple Street	6,300
26	Maple Street Training Center	142 SE Maple Street	23,024
26	Warehouse #1	142 SE Maple Street	7,000
26	Warehouse #2	142 SE Maple Street	7,200
26	Warehouse #3	142 SE Maple Street	1,224
	Public Works		
27	Main Building	4415 NE 30th Avenue	26,000
27	Operations Shop	4415 NE 30th Avenue	14,800
27	Operations Covered Storage	4415 NE 30th Avenue	15,300
28	Fleet Shop	4437 NE 30th Avenue	8,500
29	Facilities Maintenance	1890 Griffin Oaks	7,320
	Hillsboro Water/Joint Water Commission (JWC)		
30	Water Distribution & Operations	390 W Main Street	13,054
31	Evergreen Reservoir	5540 NW Evergreen Parkway	1,646
32	24th Avenue Reservoir	250 NE 24th Avenue	1,646
33	Crandall Reservoir	30575 NW Evergreen Road	3,467
34	Cherry Grove Pump Station	End Lee Falls Roads 2.8 Miles	1,491
35	Joint Water Treatment Plant	4745 Winters Road	9,974
36	Slow Sand Filter Plant	End Lee Falls Road 2.8 Miles	960
TOTAL SQUARE FOOTAGE			972,947

Building Details

Non-building connected energy and water meters are tracked separately. These meters include street and traffic signal lighting, parks buildings and features, irrigation and fountain water meters, electric vehicle charging stations, and renewable energy systems.

The key factors influencing energy consumption are vital in order to understand the potential for reducing energy use. These factors begin with the individual building characteristics. These include age, location, design, size, occupancy, mechanical and lighting systems.

15 Joint ownership of ITF by City, Tuality Healthcare and Pacific University
16 Leased facility


Hillsboro
OREGON
Building Locations
SCOTCH CHURCH
MEEK
WEST UNION
HELVETIA
BROOKWOOD PKWY-NW
SUNSET HWY
GERMANTOWN
SPRINGVILLE
LAIDLAW
CORNELIUS PASS-SUNSET
SUNSET
185TH-SUNSET
JACKSON SCHOOL
GLENCOE
SUSBAUER
HORNECKER
CORY
EVERGREEN
SHUTE
CORNELL
CORNELIUS PASS
ALOCLEK
JOHN OLSEN
STUCKI
WALKER
BETHANY
TUALATIN VALLEY
BASELINE
MAIN
OAK
1ST
5TH
10TH
25TH
32ND
BROOKWOOD
CENTURY
CYPRESS
WITCH HAZEL
HILLSBORO
ROOD BRIDGE
ROSEDALE
DAVIS
JENKINS
MERLO
158TH
185TH
198TH
209TH
Legend
Fire stations
Light Rail Stop
Light Rail Line
Railroads
Streets
City Facilities
Park
Greenways and Trails
Streams and water bodies
City Limits
Urban growth boundary
Date: October, 2018
N

Building Energy Consumption

The sustainability team has developed tools to track and graph energy performance. In addition, Portfolio Manager has recently been improved to better generate reports on building energy consumption. This will be a primary tool for a regular performance assessment and communication to leadership and stakeholders. For buildings and infrastructure not trackable in Portfolio Manager, separate tracking tools have been or will be developed. Detailed information for occupied buildings is captured in the web-based Portfolio Manager tool. Table 5 below lists the location of key energy information. In some cases details are limited due their availability.

Table 5: Locations of Key Energy Information

Facility	Details Maintained By	Format
Buildings	Public Works Facilities and Sustainability Team	Online XML
Water Meters (City facilities)	Water and Sustainability Team	Online XML
Water Meters (irrigation)	Water, Parks Maintenance and Sustainability Team	Online XML
Non-Building Aspects		
Water Treatment, Reservoirs and Pump Stations (electricity)	Sustainability Team	Online
Traffic Signals and Crossing Beacons	Public Works Transportation and Sustainability Team	Online XML
Street Lights	Public Works Transportation and Sustainability Team	Online XML
Electric Vehicle Charing Stations	Sustainability Team	Online (those that are submetered) XML (usage)
Irrigation Water Meters (parks)	Water, Parks Maintenance and Sustainability Team	Online XML
Onsite Generation		
Solar Arrays	Sustainability Team	Online XML
Micro-hydro Generators	Water	Water Dept. SCADA
Fuels		
Fleet Vehicles	Public Works Facilities and Fleet	XML
Backup Power Generators	Sustainability Team	XML
Voluntary Green Power Purchases	Sustainability Team	XML

NON-BUILDING ASPECTS

Electric Vehicle Charging Stations

The City has installed 37 electric vehicle charging stations with nine designated for City fleet use, seven designated for use by Pacific University and Tuality Healthcare at the downtown Intermodal Transit Facility, and 21 available for public use. Public chargers are located at the Hillsboro Civic Center (4 units), Jackson Bottom North Viewing Area (2 units), Gordon Faber Recreation Complex (3 units), Walters Cultural Arts Center (2 units), Intermodal Transit Facility (6 units), and the Brookwood Library (4 units).

Street Lighting

The City recently finalized the purchase of all Option A street lights which were owned and maintained by Portland General Electric (PGE). Option A street lights will be converted to Option C (City owned and maintained) by the end of January 2019. The City's Option B lights (owned by the City and maintained by PGE) have been converted to Option C. As of fall 2017, the City has about 7,359 public roadway lights. Data on the power consumption of the City's streetlights is maintained by the Public Works Department and the sustainability team.

An LED conversion project to replace the City's high pressure sodium streetlights to energy efficient, low color temperature LED lights is currently underway. Color temperature is measured in degrees Kelvin (K) on a scale from 1,000 to 10,000. High pressure sodium lights measure around 2,200K and are a yellow color. The first section of LED lights the City installed are around 4,000K and are a blue-white light, and much closer to daylight color levels. Blue light has been linked to disruptions in circadian rhythms for humans and also disrupts wildlife reproduction which can lead to reduced populations. The remaining high pressure sodium streetlights will be converted to 3,000K which is the highest recommended by the American Medical Association at present to prevent impacts to humans. The 4,000K LED's that were installed previously will be replaced as they fail with the lower K temperature bulbs. All LED lights, 3,000K and 4,000K, will eventually be dimmed during off-peak periods to further limit disruptions to humans and wildlife.

Traffic Signals

The City maintains 31 traffic signals. The balance of the intersections in the City are maintained by Washington County or the Oregon Department of Transportation (ODOT). In 1996 the City began to convert the City traffic signal bulbs from incandescent to more efficient LED bulbs. To date, all City green and red traffic signal bulbs have been converted to LED. Some of the yellow bulbs have been converted, as well as some of the pedestrian crossing signal bulbs. The City is in the process of retrofitting all remaining bulbs to LEDs.

Street Crossing Flashing Beacons

The City maintains a total of 10 solar flashing beacons which are located in five different school zones. In addition, the City maintains six pedestrian activated solar flashing beacons at mid-block crosswalks.

Fuels

The Public Works Facilities and Fleet Division maintains more than 400 vehicles, pieces of equipment and generators. Fleet fuel consumption data is maintained by the sustainability team. Other fleet equipment data is maintained by Public Works Facilities and Fleet Division.

Renewable Energy Generation

A growing portion of the City's electricity is generated by on-site, distributed renewable sources, primarily solar. Over 258kWh of solar photovoltaic energy capacity is installed on City facilities (approximately 100kW is part of a 3rd party power purchase agreement for which the City does not 'own' the renewable energy credits (RECs)). Each of the City's solar arrays is tied to an inverter that is connected to the internet, and the production for each system is accessible online. The links and access information for each of the arrays is located on the City website.

SUSTAINABILITY REVOLVING FUND (SRF)

Funding for energy and other sustainability projects may come from existing departmental budgets. Through savings from energy efficiency projects a dedicated funding source and a means to capture project savings has been created with the Sustainability Revolving Fund (SRF).

Revolving funds have been used through the years in many areas, such as economic development, resource conservation, and energy efficiency. A revolving fund is established for a specific purpose and is replenished by requiring a return on the grant or loan, such as through a defined percentage of the grant/loan, or a portion of funds saved through use of the funds. This maintains the fund over time after the initial "seed" investment.

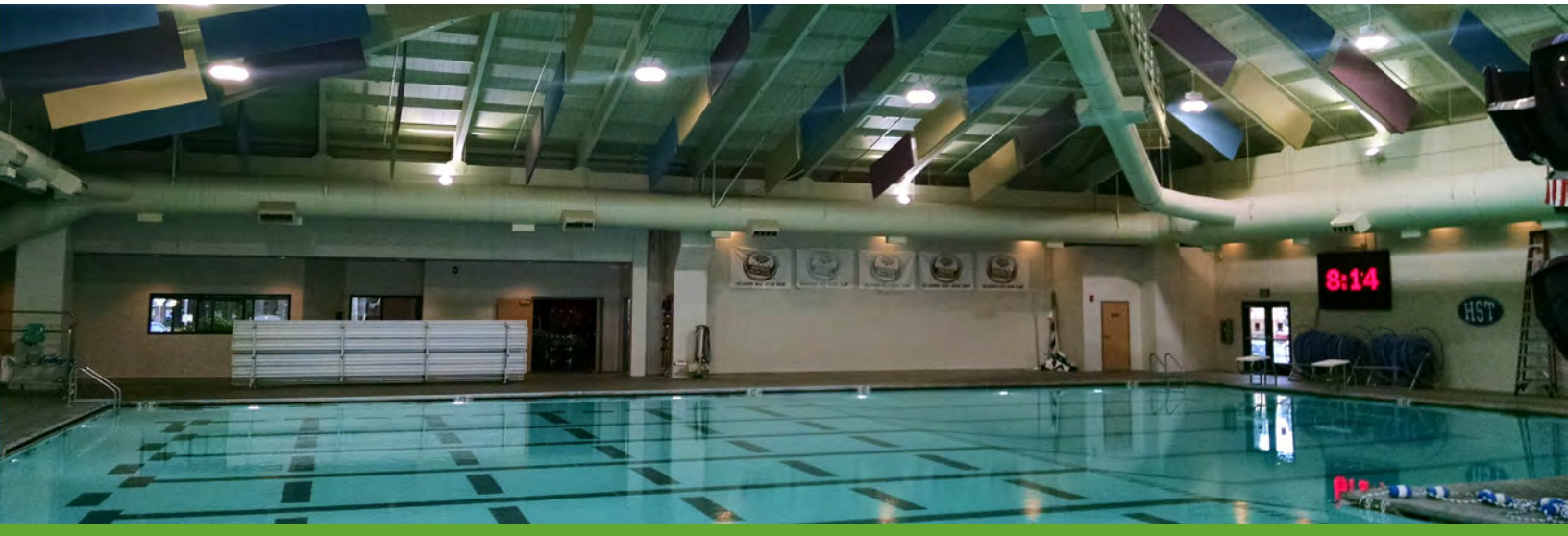
The purpose of the SRF is to capture and track savings from sustainability projects and to utilize some of those savings for subsequent projects. The fund provides a resource for employees for internal sustainability projects, and a structure for use, replenishment and management of those funds.

Since the fund was created in 2011 with $51,000 ($30,000 which came from energy savings from two projects), the fund has allocated over $70,000 to sustainability projects and it has been reimbursed with over $64,000 from the percentage saved from those projects.

Some of the projects funded since the inception of the SRF in 2010 include:

- Parks vehicle logistics optimization tracking
- Griffin Oaks lighting retrofit
- Energy management controls for Shute Park Library
- SHARC pools underwater LED lighting retrofit

Information and the application process for the SRF is located on the City intranet page.



APPENDIX A – GLOSSARY

Specific terms used in the EMP are defined below. The definitions represent the terminology contained in the EMP, as well as common industry standards or department-specific terms.

3rd Party Commissioning
Commissioning verifies and ensures that a building is constructed and calibrated to operate as it is designed. 3rd party commissioning is an enhanced form of commissioning by an agend other than the design or construction team that increases objectivity and enhances results. Key benefits include:

- Reduced energy use and costs
- Lower operating costs
- Reduced contractor call backs, and
- Better building documentation.

Baseline Energy Use
The energy consumed in the base year as a reference point for determining increases or reductions in future consumption.

Btu
A unit of energy consumed by or delivered to a building. Btu is an acronym for British thermal unit and is defined as the amount of energy required to increase the temperature of 1 pound of water by 1 degree Fahrenheit, at normal atmospheric pressure. Energy consumption is expressed in Btu to allow for consumption comparisons among fuels that are measured in different units.

Ccf
100 cubic feet, an American standard measurement of water or natural gas volume.

Conversion Factors
1 kWh = 3412 Btu
1 Therm = 100,000 Btu
1 Ccf Natural Gas = 1000 Btu
1 Gallon #2 Oil = 140,000 Btu
1 Gallon #4 Oil = 144,000 Btu
1 Gallon #6 Oil = 152,000 Btu
1 Gallon of Propane = 91,600 Btu
1 Ton of Coal = 28,000,000 Btu
1 Boiler of Horsepower = 33,475 Btu/h (9.811 kW)
1 Horsepower = 746 kW
1 Ton of Refrigeration = 12,000 Btu/hr
1 ccf water = 748 gallons

Energy
There are many different contexts for the term energy. In the context of this EMP, energy refers to the output needed for heating and cooling buildings, powering vehicles and interior and exterior lighting, and the resources needed to create that output.

Energy Assessment
Energy assessment is an analysis and investigation of a site's energy use that identifies opportunities for improvement which are of sufficient detail to enable investment decisions to be made. The outcome typically includes a business case, such as simple payback or return on investment.

Energy Conservation

The avoidance of energy use and the reduction in demand for energy related services. Conservation is typically associated with behavior, whereas efficiency is associated with technology and systems.

Energy Efficiency

The reduction in consumption of energy for current operations. Efficiency typically involves a reduction in energy consumption without a reduction in the services delivered.

Energy Intensity

Energy intensity is a ratio of energy consumption to another metric, typically national gross domestic product (GDP). Sector-specific or other specific energy intensity is calculated with specific metrics. A higher intensity indicates a higher cost for energy.

Energy Intensity as defined here is not to be confused with Energy Use Intensity (EUI), a measure of building energy use per unit area.

Energy Management Plan (EMP)

An EMP is a plan that defines a process to reduce energy consumption and maintain an optimized energy use.

Energy Modeling

Energy modeling focuses during the design phase on the energy systems and predicted efficiency of a building and seeks to maximize potential for energy efficiency by:

- Identifying potential problems with mehcanical and lighting systems
- identifying new energy efficient technologies
- Providing a holistic assessment of cost and benefit of options over the life of the building
- Ensuring that efficiency measures also address occumpant comfort.

The cost of energy modeling is typically recouped through lower operational costs over the life of the building.

Energy Saving Project

A project that will reduce energy consumption including:

- Projects that reduce energy use – such as kWh of electricity or therms of natural gas.
- Projects that reduce the peak consumption of energy – such as kW or kVA of electrical demand.

Energy Use Intensity (EUI)

EUI is a measure of a building's energy use. EUI represents the energy consumed by a building relative to its size. EUI is calculated by dividing the total energy consumed in one year (typically measured in kBtu) by the total floor space (either source or site) of the building. For example, if a 50,000 square foot school consumes 7,500,000 kBtu of energy per year, the EUI would be 150. A similarly sized school that consumes 9,000,000 kBtu of energy per year has a higher EUI (180). HVAC (heating, ventilation and air conditioning)
HVAC refers to the mechanical heating, cooling and ventilation systems in a building.

High Energy Devices

High energy using devices are those that use greater than 150 watts of energy.

Internal Rate of Return (IRR)

IRR is the rate of return anticipated from an investment project. It is often referred to simply as yield on project. The IRR is calculates the discount rate that equates the present value of a project's cash out flow with the present value of its cash inflow. In other words, the IRR is that discount rate that will cause the net present value of a project to be equal to zero.

Generally speaking, the higher a project's IRR, the more desirable it is to undertake the project. IRR can be used to prioritize potential projects. The formula or equation is as follows: [Factor of internal rate of return = investment required / net annual cash inflow] (1).

Light Emitting Diode (LED)

LED is a semiconductor light source. LEDs have many advantages over incandescent and other traditional lighting technologies, including lower power consumption, longer lifetime, better lighting quality (for some applications), and faster switching.

Net Present Value (NPV)

The NPV of a project is the difference between the project's cash inflows and the cash outflows. It can help determine whether the project is an acceptable investment.

Each cash inflow/outflow is discounted back to its present value (PV), then they are summed. Therefore NPV is the sum of all terms, where:

t = the time of the cash flow;
i = the discount rate (rate of return that could be earned on an investment in financial markets with similar risk);
Rt = the net cash flow (i.e., cash inflow – cash outflow, at time t).

With a particular project, if Rt is a positive value, the project is in the status of positive cash inflow in the time of t. If Rt is a negative value, the project is in the status of discounted cash outflow in the time of t. Appropriately risked projects with a positive NPV could be accepted. This does not necessarily mean that they should be undertaken since NPV at the cost of capital may not account for opportunity cost (i.e., comparison with other available investments). In financial theory, if there is a choice between two mutually exclusive alternatives, the one yielding the higher NPV should be selected.

Net Zero Energy

Also known as zero net energy (ZNE), a building with net zero energy consumption and zero carbon emissions annually. For the Living Building Challenge (LBC), the standard for net zero energy buildings is to consume only the energy generated on site by renewable sources, with the balance of energy demand mitigated with aggressive energy efficient design measures.

NMI – National Meter Identifier

Each electricity meter on the national electricity market is uniquely identified by an alphanumeric identifier known as a "NMI". The NMI identifies the metering at a given premise and ensures that billing is done accurately.

Non-renewable Energy

A non-renewable resource is a natural resource which is not reproduced, grown, generated, or used on a scale which can sustain the rate of its consumption. Fossil fuels such as coal, petroleum and natural gas are examples of non-renewable energy sources. By contrast, resources such as timber (when harvested sustainably) and wind (used to power energy conversion systems) are considered renewable resources.

Phantom Load

Also known as "vampire" load, phantom load refers to energy consumed by devices while plugged in while they are turned off or in 'sleep' mode.

Plug Load

Energy used by an energy consuming device that is powered by an electrical outlet in a facility. Broadly refers to the energy demand overall from devices plugged into outlets throughout a facility.

Portland General Electric (PGE)

Portland General Electric is the electric utility company serving most of Washington County and Hillsboro.

Potable Water

Potable water meets or exceeds EPA's drinking water quality standards and is approved for human consumption by state or local authorities having jurisdiction; it may be supplied from wells or municipal water systems.

Project Cost Saving

Project cost savings includes savings in direct energy costs (such as energy consumption and/or energy demand charges) and indirect costs (such as chemical and water costs, labor and maintenance, and operating costs) associated with an energy saving project.

Project Payback

Project payback is the length of time required to recover the initial project capital investment. If the cash inflow occurs at a uniform rate, it is the ratio of the amount of initial investment over expected annual cash inflow, or: Project Payback = Initial Investment/Annual Cash Inflows.

Renewable Energy

Renewable energy is derived from sources which are continually replenished such as sunlight, wind, rain, tides, waves, geothermal heat and other sources.

Renewable Energy Certificates (RECs)

Also known as renewable energy credits, RECs represent the environmental attributes of the power produced from renewable energy sources and are sold separate from commodity electricity. Customers can often purchase RECs through their local utility or a competitive electricity marketer.

Return on Investment (ROI)

ROI is a performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. ROI is calculated by dividing the benefit (return or profit) of an investment by the cost. The result is expressed as a percentage or ratio.

For a single-period review:

ROI % = Net profit ($) / Investment ($) × 100; or, ROI = (gain from investment - cost of investment)/cost of investment.

Simple Payback

Simple payback is the amount to be invested divided by the estimated annual net cash flow. For example: $10,000/$5000 = 2 Years.

Sustainability

As defined by the Brundtland Commission, Sustainability is "Meeting the needs of the present without compromising the ability of future generations to meet their own needs."

Therm

Natural gas meters measure volume and not energy, therefore a therm factor converts the volume of gas to its heat equivalent in order to measure energy consumption. The therm factor is usually in the units Therms/Ccf.

1 Therm = 100,000 Btu (approximately the energy equivalent of burning 100 cubic feet, often referred to as 1 Ccf of natural gas).

APPENDIX B
ENERGY USE AND COSTS FROM COMMON PLUG-IN DEVICES AND COMPUTERS

Electricity-consuming devices are routinely plugged in to workstation and other plugs in City facilities. The following tables provide some estimates and comparisons for many common plug-in devices. The first table shows power consumption and energy cost estimates for some devices. The second table shows a calculation of energy and cost use and savings potential for City computer equipment if it is routinely fully shut down. This information is provided to give a sense and order of magnitude for how devices use energy and those costs.

Reducing the time plugged in or eliminating them altogether can have a substantial impact on energy consumption in buildings. Overall, according to the U.S. Energy Information Agency, use of office equipment and other plug-in devices account for up to 30% of the building's energy use in a typical office building, and as much as 50% in a building that has optimized mechanical and lighting systems.

Table 6: Electrical Devices Power Consumption

Appliance	Power Draw On (W)	Power Draw Standby/Off (W)	Annual Energy Consumption (kWh)	Operating Cost ($/yr)
Personal space heater	1,000	3	329	$29.61
Personal fan, 8 to 16- inch	50	1	62	$5.58
Clock radio	10	3	30	$2.70
Small stereo with remote	24	6	55	$5.00
Phone charger	0.8-2	1	7.2	$0.70
Digital photo frame, 7-inch	0.25-1	0.25-1	6.57	$1.00
Refrigerated vending machine	1,000	3	2,500-4,400	$225 - $400
Coffee maker, large commercial	1,100	70/1	1,349	$121.41

*Assumes $0.09/Kwh

Electricity cost calculation: (device wattage x hours used per day) / 1000 = daily kilowatt hour (kWh) consumption.

Table 7: City Computer Energy Use and Costs

Equipment	Power Draw On (W)	Power Draw Screen Saver (W)	Power Draw Sleep/Off (W)	Power Draw Locked/ Logged Off	Power Draw Standby/ Shut Down	Operating Cost* ($/yr) On** / Operating Cost* ($/yr) Off**
Personal computer	85	–	–	78	5	$30,804 / $7,234
Flat panel monitor	45	41	4	–	–	Included w/PC / Included w/PC
Laptop	30	–	4	30	5	$3,510 / $895
					TOTAL	**$34,314 / $8,129**

*Assumes $0.09/Kwh, totals are for full fleet of City equipment annually
**Assumes machine is fully shut down when possible during work hours and outside of work hours

APPENDIX C
COMPLETED AND ONGOING ENERGY PROJECTS

Energy/GHG Project	Status	Proposed Action	Considerations
Create an internal sustainability revolving grant fund	✓ Completed and ongoing	N/A	As of 2018, nine projects have been funded with additional savings placed back in to the Fund.
Document 2007 City facility baseline and conduct facility energy audits	✓ Completed and ongoing	Energy Management Plan.	Plan defines processes timeline and reporting.
Monitor energy use at SHARC and maximize boiler performance	✓ Completed and ongoing	Continually monitor usage and adapt as necessary. Deploy monitoring at other facilities.	Success of energy monitoring has resulted in large savings at this major energy consumer.
Develop City-owned and/or third party developer owned solar installations where cost effective	✓ Completed and ongoing	Look for addtional solar installation opportunities.	New solar array is planned for 53rd Avenue facility, will be owned and maintained by City.
Assess and implement replacement of rooftop HVAC units with high efficiency units or heat pumps	✓ Completed and ongoing	Many facilities have been upgraded; additional opportunities will be identified through EMP process.	Continual process by Facilities Maintenance team.
Establish water consumption rate	✓ Completed	N/A	Baseline water consumption for City facilities is established.
Require employees to fully shut down computers and monitors when not in use for over four hours[14] (also see related P17 above)	✓ Completed and ongoing	Periodic communications on this policy are delivered via email and new hire orientations.	Computers and monitors consume energy even while in "sleep" mode; roughly 1,000 Pcs (250 mobile, 750 stationary), 1,000 monitors and 50 thin client computers City- wide consume over 600 kWh of electricity costing upwards of $30,000 per year. Shutting PCs and monitors down fully when possible has the potential to save 75% on utility costs.

14 See the US Department of Energy guidance for further information: http://energy.gov/energysaver/articles/energy-efficient-computers-use

Hillsboro
OREGON