

Accessing and Applying District-Scale Energy Utility Data

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ABSTRACT

Since 2009, the City of Portland Bureau of Planning and Sustainability has provided technical assistance for two emerging self-governed EcoDistricts to assess their environmental performance, set targets and prioritize the implementation of future projects. For energy performance, the City coordinated with three utilities to access monthly and 15-minute interval consumption histories at a neighborhood scale. In one EcoDistrict, the aggregated energy performance of eight key property owners was analyzed to inform a district energy feasibility study, and potential collaborative building energy retrofit projects. In another EcoDistrict, geographic information system technology was utilized by the City, an electric utility and the US Department of Energy's National Renewable Energy Laboratory to compare the district-wide commercial and residential electric consumption pattern to potential solar photovoltaic energy production. This process also assisted the EcoDistrict's major educational institution in collecting individual building data to benchmark energy performance with the US Environmental Protection Agency's Energy Star Portfolio Manager. Working with the EcoDistricts and energy utilities, the City identified innovative methods to access and apply district-wide energy data.

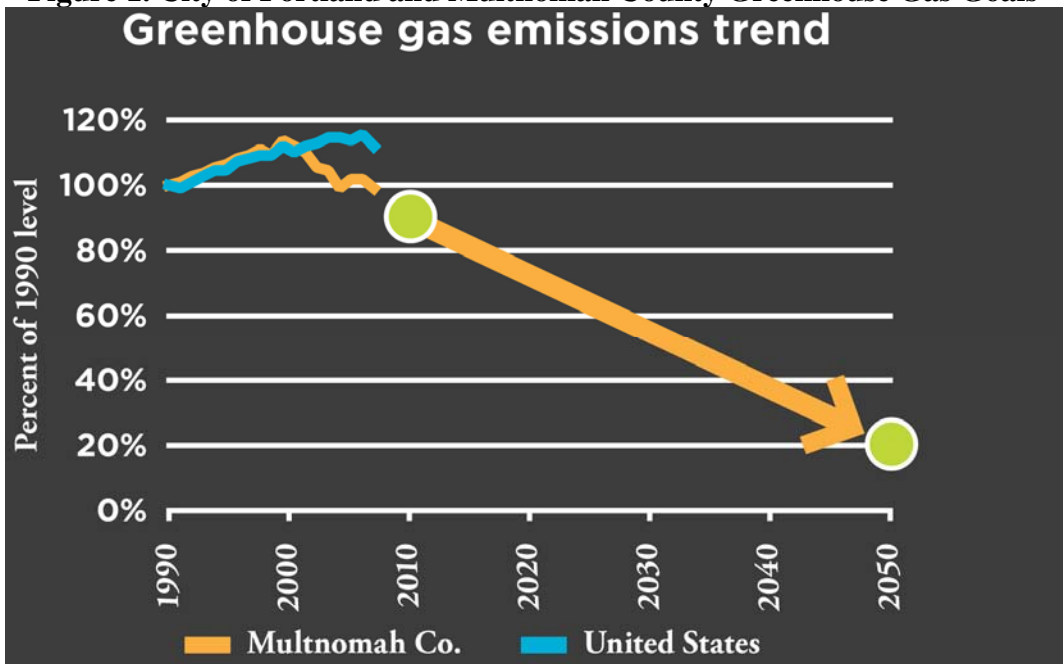
Introduction

In October 2009, the City of Portland and Multnomah County released a Climate Action Plan (CAP) with goals to reduce greenhouse gas emissions 40% below 1990 levels by 2030 and 80% by 2050 (City of Portland and Multnomah County, 2009). As shown on Figures 1 and 2, significant reductions in greenhouse gases will be necessary to achieve these goals, particularly in the building sector that emits nearly half of the City's carbon dioxide (CO₂e).

Specific to existing buildings in Portland, the CAP includes a long-term 2030 objective to reduce total energy use by 25 percent. However, measuring progress toward this target has not been possible because the three privately-owned energy utilities serving Portland (Northwest Natural Gas, Pacific Power and Portland General Electric) only share consumption data on an aggregated City-wide, annual basis. To enable assessment of building performance targets, the CAP includes a short-term 2012 action to require benchmarking of all existing commercial and multifamily residential buildings.

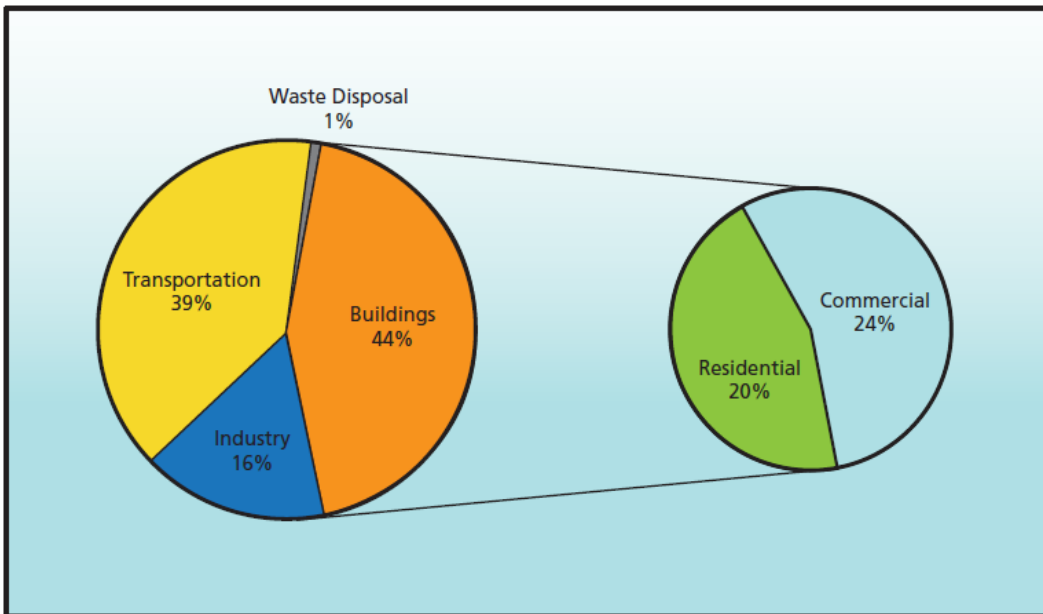
The City of Portland Bureau of Planning and Sustainability (BPS) has been considering a commercial building energy benchmarking and disclosure policy over the past four years. A draft High Performance Green Building Policy (BPS, 2008) was released for public comment in December 2008 that proposed a requirement for building owners to estimate and publicly disclose their energy performance. If approved by City Council, this new requirement would enable the City to 1) identify buildings that have the greatest potential to improve performance, 2) help prospective buyers and tenants make informed decisions, and 3) measure and evaluate progress toward the CAP 2030 objective for buildings. However soon after its release, the proposal was placed on hold as the makeup of Portland's City Council changed.

Figure 1. City of Portland and Multnomah County Greenhouse Gas Goals
Greenhouse gas emissions trend



Source: City of Portland and Multnomah County, 2009

Figure 2. Annual CO₂e Emission by Sector



Source: BPS, 2008

At the beginning of 2010, BPS revisited the High Performance Green Building Policy proposal and explored a key question regarding legal protection of utility account data privacy. Contrary to information provided during the policy’s stakeholder process, Portland’s three energy utilities revealed that accountholder privacy is determined by individual company rules rather than local, state or federal laws. This revelation led to utility conversations regarding the possibility of aggregating building energy consumption data and opened the door for two

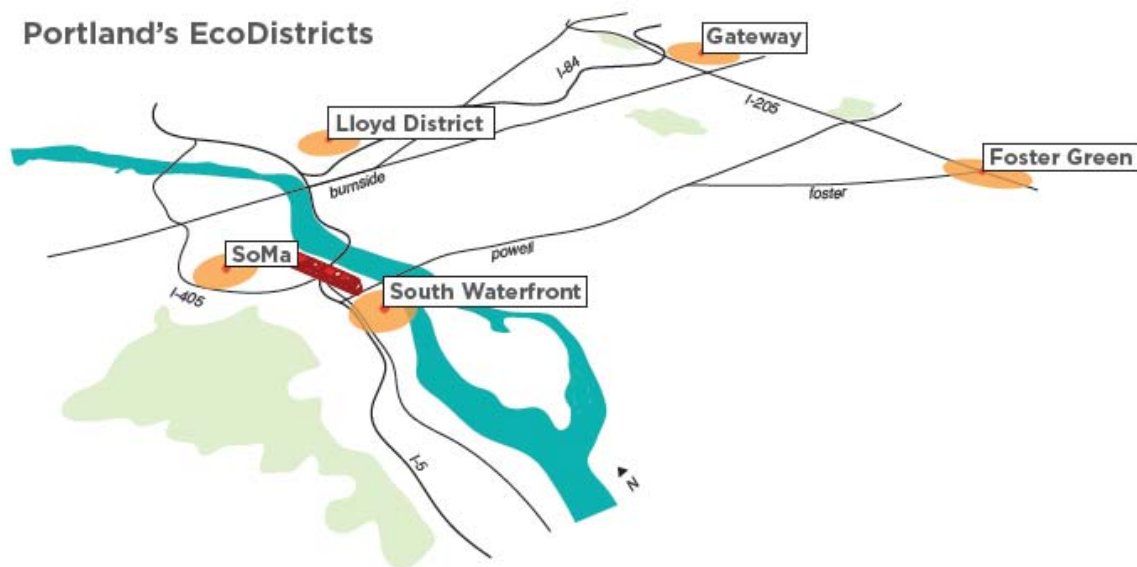
alternatives to the original policy proposal: 1) provide owners and managers access to their whole building energy consumption data and enable performance benchmarking, and 2) provide the City with aggregate building energy consumption data by neighborhoods and building types. Both of these alternative paths would significantly refine the process for acquiring and sharing building energy utility data.

As commercial building energy policy alternatives continued to be considered, BPS found new opportunities to evaluate building energy performance through its technical assistance for emerging EcoDistricts™. As described by the Portland Sustainability Institute (PoSI),

EcoDistricts™ are a comprehensive strategy to accelerate sustainable development at the neighborhood scale by integrating building and infrastructure projects with community and individual action (PoSI, 2011).

The City of Portland partnered with PoSI in 2009 to launch five pilot EcoDistricts™, each with a vision to achieve net-zero energy use annually and performance beyond carbon neutrality. For two of these pilot areas, Lloyd and South of Market (SoMa) shown on Figure 3, BPS worked with the local energy utilities to access aggregate building energy consumption and set performance targets aligned with the CAP greenhouse gas goals.

Figure 3. Portland's Pilot EcoDistricts



Source: PoSI, 2011

Lloyd EcoDistrict Energy Performance Assessment

Background

The Lloyd EcoDistrict is a 400-acre neighborhood in Portland's Central City, mostly used for commercial activity including a mix of office buildings, major event complexes, hotels and retail. Although the district was primarily single-family homes in 1910, less than 10% of the current building floor area is occupied by residents. A map of existing building uses is shown on

Figure 4. Because of many existing surface parking lots, vacant parcels, and under-utilized properties, the Lloyd EcoDistrict offers substantial redevelopment potential.

Figure 4. Lloyd EcoDistrict Existing Building Uses



Source: City of Portland, 2010

In 2004, the Portland Development Commission (PDC) sponsored a 35-block study within the Lloyd District (PDC, 2004) that would maximize development potential while achieving environmental goals,

The Lloyd Crossing Sustainable Design Plan looks at an urban ecosystem in which individual properties and the neighborhood public realm function together as an environmentally low-Impact unit with high economic potential.

The plan provides the vision, goals and strategies to establish a sustainable framework and neighborhood identity.

The energy vision of the plan is to create a neighborhood in which the carbon balance and the use of incident solar energy match as closely as possible to (and ultimately improve upon) pre-development conditions, dramatically reducing environmental impact.

Building upon this framework, a Lloyd Green District Projects Work Group was formed in 2009 by owners, managers and tenants throughout the district. The City of Portland BPS provided staff resources to develop a performance baseline designed to inform this work group of potential opportunities and project ideas that improve the environmental performance of the district. In 2011, the Lloyd EcoDistrict pilot formed to build upon the Lloyd Green District process and begin implementation of specific projects.

Lloyd EcoDistrict Energy Data

The Lloyd Green District performance baseline established a benchmark for tracking progress toward eight sustainable performance categories: Energy, Transportation, Stormwater, Water, Habitat, Waste, Economy, and Social. Available 2008 baseline data was obtained for seven participating property owners who manage 20 of the largest properties in the Lloyd District.

- Ashforth Pacific (7 properties)
- Doubletree Hotel
- Metro Regional Government
- Oregon Convention Center
- Portland Development Commission (8 properties)
- Portland Trailblazers
- State of Oregon

Benchmarking and tracking building energy costs and consumption informed the potential for building energy efficiency improvements and onsite renewable energy generation as well as progress toward achieving fossil-free, carbon-neutral goals. Energy baseline metrics and 2008 measures are listed on Table 1.

Table 1. Building Energy Baseline Metrics and 2008 Measures

Baseline Metric	2008 Measure
Electricity Consumption	59.1 million kWh
	\$3,374,642.14
Natural Gas Consumption	1,348,622 Therms
	\$874,837.86
Renewable Capacity	0 kW
Renewable Energy Credits	0 kW
Carbon Dioxide Emissions	120.4 million lbs CO ₂
Fossil Fuel Energy Consumption	308,000 MMBtu

For 2008, aggregated electricity and natural gas billing data was obtained from PacifiCorp and NW Natural Gas, respectively. Although the City of Portland and State of Oregon do not have laws protecting utility account holder privacy, each of these utilities maintains company-specific rules. Permission to access utility data was coordinated using an authorization form prepared by BPS and completed by each participating property owner. To protect competitive utility data privacy from public record requests, BPS received monthly consumption and cost data from each utility without identifying specific account holders or buildings. In addition 15-minute interval load data was provided by PacifiCorp. Examples of monthly data formats are shown on Tables 2 and 3 for electricity and natural gas, respectively.

Table 2. Example of January 2008 Aggregate Building Electricity Consumption Data

Meter #	On Kw Usage	Off Kw Usage	On Kwh Usage	Off Kwh Usage	Invoice Amount
35540365	707	358	192400	91600	\$16,264.18
35540291	1096	1112	260000	204000	\$23,066.79
81162124	2770	2658	568000	397200	\$53,865.02
35540283	768	672	224000	160000	\$18,517.52
81162123	1835	1745	396900	185700	\$32,233.47
81162117	1446	1084	398000	266000	\$31,298.19
81162137	1890	1582	530800	282400	\$41,652.67
35540390	2107	2040	381600	208800	\$35,183.62
21427812	1295	1150	248400	126000	\$21,144.84
Total	13914	12401	3200100	1921700	\$273,226.30
Average	1546	1378	355567	213522	\$30,358.48

Table 3. Example of January 2008 Aggregate Building Natural Gas Consumption Data

Meter #	January 2008	
	Usage (therms)	Billed
232091-9 (boiler)	28711	27416.95
232088-5 (show gas)	101	123.74
232089-3 (kitchen)	1236	1396.29
Building Total	30048	\$28936.98
2008 Total	223211	\$224076.92

BPS estimated building carbon CO₂ emissions by combining utility data with emission factors for the combustion of natural gas (11.3 lbs of CO₂ per therm as reported by the United States Department of Energy, Energy Information Administration (DOE EIA, 2007)) and consumption of electricity (1.78 lbs of CO₂ per kWh based on the 2007 Pacific Power electricity generation mix as delivered (City of Portland and Multnomah County, 2009)). Similarly, building fossil fuel consumption in millions of British Thermal Units (MMBtu) was estimated by BPS using these same references.

In addition to benchmarking the energy and carbon performance for participating property owners in the Lloyd Green District, the 2008 baseline utility data has proven useful in the assessment of future district energy services. In 2010, PoSI and Compass Resource Management completed a background report and screening of district-scale infrastructure opportunities within three pilot EcoDistricts™ (PoSI, 2010). This report identifies the Lloyd District's Rose Quarter as a good candidate for district energy based on several factors: 1) three existing major event centers could serve as large anchors (Veterans Memorial Coliseum, Oregon Convention Center and Rose Garden Arena shown on Figure 5), 2) these three event centers currently operate central mechanical systems compatible with district energy, and 3) a major renovation of the Veterans Memorial Coliseum is underway.

Figure 5. Major Event Centers in the Lloyd EcoDistrict



Source: City of Portland

In 2011, the City of Portland worked with PoSI and PDC to further explore district energy potential in the Rose Quarter and issued a Request for Qualifications to develop a thermal energy system shared by the three major event centers as part of the Veterans Memorial Coliseum renovation project (PDC, 2011). Corix Utilities was selected as a development partner and completed a technical feasibility study that established the business case for district heating and cooling services. Throughout this process, the aggregated Lloyd Green District baseline energy utility data provided key information on monthly energy consumption patterns and peak load demand. Building energy data will continue to be useful to establish the business case for district energy expansion in the Lloyd EcoDistrict as a strategy to meet carbon-neutral, net-zero energy targets.

The Lloyd EcoDistrict partners have identified five ambitious projects that showcase their commitment to deep sustainability on a district-scale: 1) existing building retrofit program, 2) district-scale food waste compost program, 3) district green streets strategy, 4) district mode-split strategy, and 5) Lloyd EcoDistrict brand. The existing building retrofit program will leverage the opportunity for the whole district to take advantage of district energy opportunities underway in the Rose Quarter. BPS is currently coordinating with the Lloyd EcoDistrict to update the 2008 energy performance baseline measures and committed to district energy expansion. BPS is also working with NW Natural Gas and PacifiCorp to aggregate annual residential, commercial and industrial energy consumption by zip code. This data will help inform the Lloyd EcoDistrict's energy and carbon goals.

SoMa EcoDistrict Energy Performance Assessment

Background

The South of Market (SoMa) EcoDistrict is a 100-acre neighborhood in Portland's Central City, mostly used for institutional purposes related to Portland State University (PSU). However, outside the core campus area, a mix of other uses exists including high-rise residence halls, office towers, and parking structures, as mapped on Figure 6.

Figure 6. SoMa EcoDistrict Existing Building Uses



Source: City of Portland, 2010

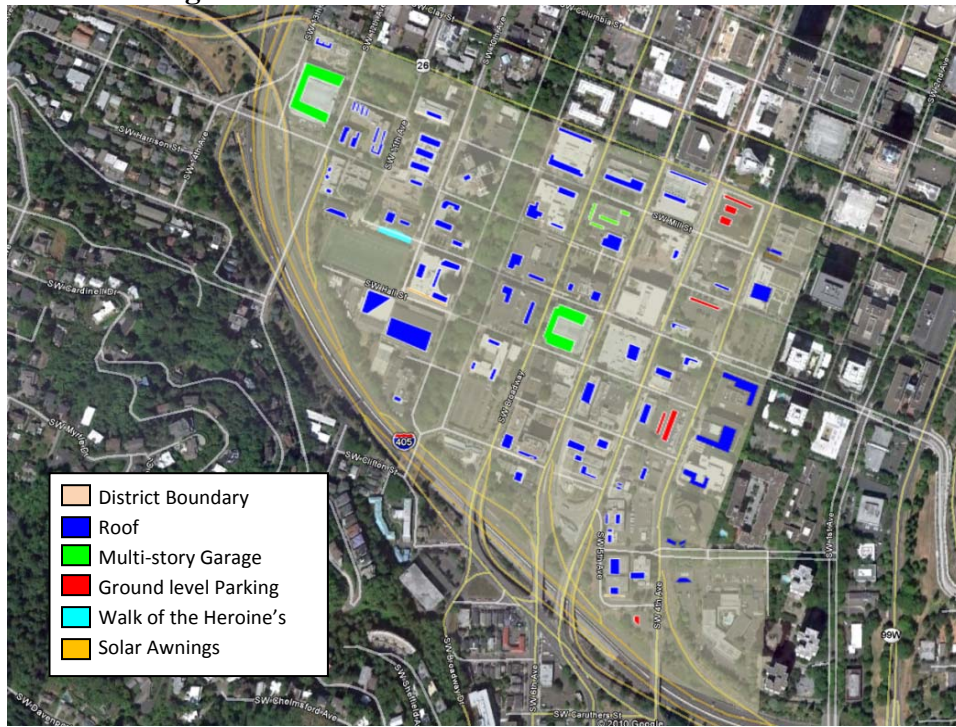
Seven major development projects were completed in the SoMa EcoDistrict over the past ten years, and as enrollment at PSU continues to grow, more residential and commercial development is expected in the area. The proposed Oregon Sustainability Center is one such project that will bring new focus to PSU, Portland and Oregon for the project's goal to achieve the net-zero energy goals of the Living Building Challenge (International Living Building Institute, 2010).

SoMa EcoDistrict Energy Data

As part of a U.S. Department of Energy Solar America Cities grant, the National Renewable Energy Laboratory (DOE NREL) provided technical assistance to the City of Portland from August 2010 through March 2011 to assess the implementation of solar technologies in five pilot EcoDistrict areas including the SoMA EcoDistrict. The purpose of this project was to determine solar hot water (SHW) and photovoltaic (PV) energy potential based on

a site visit and Google Earth analysis. As shown on Figure 7, a mixture of rooftop, carport, garage and awning sites exist in the SoMa EcoDistrict..

Figure 7. SoMA EcoDistrict Solar Site Potential



Source: DOE NREL, 2011

NREL determined that very little rooftop space exists on the district’s high rise buildings, however there is some potential for solar awnings on building southern sides (DOE NREL, 2011). Also, a number of high-rise buildings diminish the potential for ground-level carport PV, however there are several parking garages with solar access. Potential renewable energy generation was broken down into PSU-owned areas and non-PSU areas as shown on Table 4 and 5, respectively.

Table 4. Potential Solar Energy Generation of PSU-Owned Properties

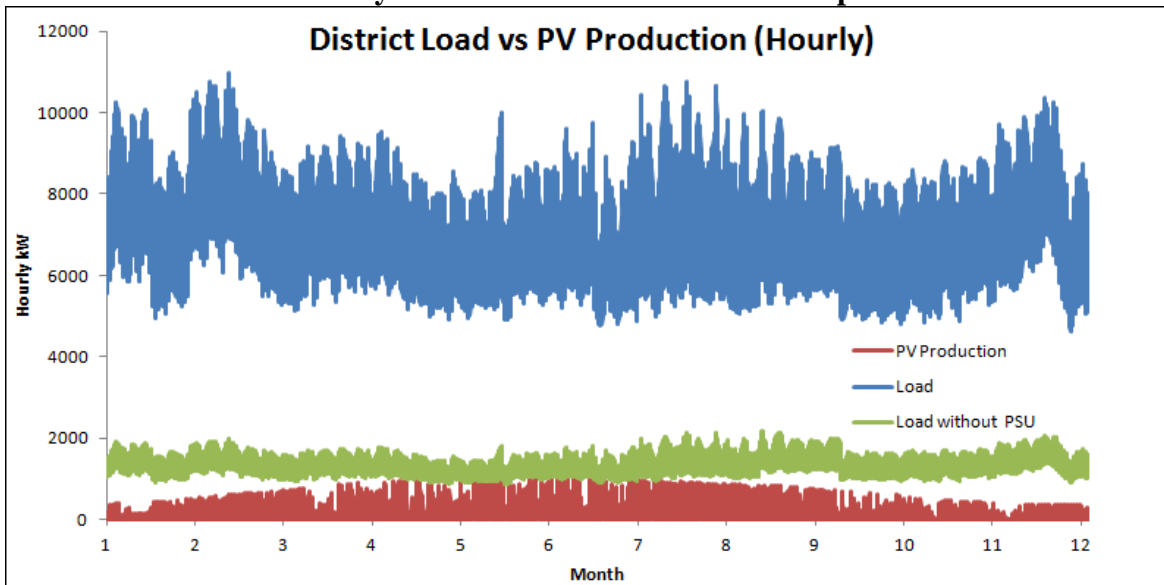
Location	Useable Area (ft2)	PV System Size (kW)	Standard efficiency (kWh)	PV	20° Mount (therm)	Tilt SHW
Rooftop (50% PV, 50% SHW)	151,826	547	545,283		55,815	
Awning	6,577	53	52,491			
Carport	3,027	30	26,902			
Multi-story Parking	44,510	445	395,633			
Walk of the Heroine’s Walkway	5,469	55	43,647			
Total	211,408	1,130	1,063,956		55,815	

Table 5. Potential Solar Energy Generation of non-PSU Properties

Location	Mounting Type	Useable Area (ft ²)	PV System Size (kW)	Standard efficiency PV (kWh)	20° Mount (therm)	Tilt SHW
Rooftop (50% PV, 50% SHW)	Tilt	35,126	126	126,156		12,913
Awning	Tilt	452	4	3,610		
Carport	Flat	11,654	117	103,585		
Total		47,232	247	233,351		12,913

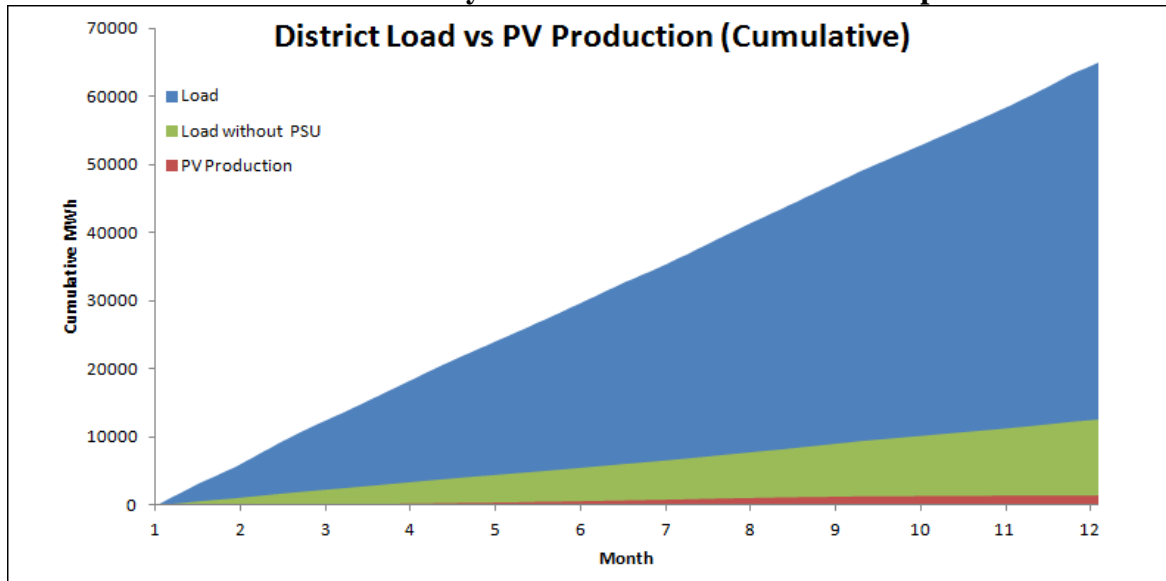
In 2011, Portland General Electric (PGE) provided monthly electricity consumption data for the SoMa EcoDistrict, at the request of BPS to compare the potential district-wide solar electricity production. Similar to Portland's other two privately-owned energy utilities, PGE maintains company-specific rules regarding account holder privacy. To protect the privacy of PSU, PGE required signed authorization to aggregate 2010 district-wide electricity consumption by commercial and residential customers within PSU's campus and outside of PSU. Aggregation of data was made much simpler by PGE and BPS geographic information system capability that is not shared by the other two utilities. Given signed authorization from PSU, PGE also provided 2010 monthly billing histories for all of PSU's meters. PSU later used this data to evaluate whole building energy benchmarking. As shown on Figures 8 and 9, NREL compared the actual 2010 SoMa EcoDistrict electricity consumption to their analysis of potential solar PV.

Figure 8. Comparison of Potential Hourly Solar PV Production to 2010 SoMa EcoDistrict Electricity Load with and without PSU Properties.



Source: DOE NREL, 2011

Figure 9. Comparison of Potential Cumulative Solar PV Production to 2010 SoMa EcoDistrict Electricity Load with and without PSU Properties



Source: DOE NREL, 2011

Although NREL estimated an annual solar energy production of 1.3 million kWh in the SoMa EcoDistrict, this full potential would only meet 2% of the district's annual load. Moreover, PV power output would never exceed peak loads during summer months. As an academic research institution, PSU's energy use intensity is much higher than other areas of Portland, however PSU could partner on a community solar initiative to offset the non-PSU building electricity consumption in the SoMa EcoDistrict. The City of Portland is currently evaluating potential community solar sites to help neighborhoods achieve net-zero energy goals.

Conclusion

Despite the absence of policy to obtain building energy utility data, the City of Portland worked with privately-owned utilities to access aggregate neighborhood-scale energy consumption data. This information has provided key data to help emerging, self-governed EcoDistricts to assess their environmental performance, set targets and prioritize the implementation of future projects. These projects include district energy feasibility in the Lloyd EcoDistrict and potential solar production in the SoMa EcoDistrict. EcoDistrict performance assessment has also presented new opportunities to evaluate progress toward the City' Climate Action Plan goals.

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