ATTACHMENT A - 2016 INTEGRATED RESOURCE PLAN EXECUTIVE SUMMARY

Overview

Seattle prides itself on environmental responsibility, with adopted policy priorities that directly influence energy demand and resource decisions. The Integrated Resource Plan (IRP) is Seattle City Light's 20-year study which determines when City Light has power supply needs and how to meet those needs in the most reliable, cost-effective, and environmentally responsible manner. This IRP reflects the results of the past two years' research and modeling. It culminates with a two-year action plan and sets direction for the next Integrated Resource Plan.

The primary conclusion of the study is that the customer energy demand will continue to grow at a moderate pace and that City Light will not require any new energy resources for more than a decade. The study shows a high probability that this moderate demand growth can be met most cost-effectively with new energy efficiency programs without other new resource investment.

Key Findings and Conclusions

- **Seattle City Light expects to experience continued modest load growth.**

  Over the course of the Integrated Resource Plan's 20-year study, City Light expects to experience modest average annual load growth of about 0.4% under conditions of normal weather. This growth is absent new City Light sponsored energy efficiency programs. These programs are commonly referred to as programmatic energy efficiency and considered as a resource in the development of the utility's long-term resource planning. Continued economic and related population growth of the region are key contributors of demand within the service area. Some of the factors experienced throughout the region and the country resulting in demand growth slower than experienced in years past include ever-improving technological efficiencies, stringent building codes, and ratepayer preferences towards reduced electricity usage among others.

- **The utility is well positioned to meet its power supply needs.**

  For the next decade, City Light expects to be able to meet its resource needs with its existing resources portfolio, new programmatic energy efficiency, use of hydro generation flexibility in existing hydro resources, and short-term wholesale market purchases as deemed reliable and necessary. This includes meeting seasonal power supply needs of the utility in the winter (when highest demand occurs). The significant increase in power supply resources in 2028 compared to the 2012 Integrated Resource Plan (IRP) comes from including an assessment of the expiration of City Light's power purchase contract with the Bonneville Power Administration (BPA). The IRP analysis shows, to meet its obligations to be a reliable, environmentally responsible, and cost-effective utility, that a new BPA hydro dominated resource is part of the preferred resource portfolio.

- **Seattle City Light should continue on a path of acquiring programmatic energy efficiency.**

  Energy efficiency through new programmatic energy efficiency is considered to be the resource of choice. The Energy Independence Act of 2006 codified in the revised code of Washington (RCW) 19.285 requires utilities to acquire cost-effective energy efficiency and renewable resources to meet a portion of load. In the 2016 IRP energy efficiency is lower cost than renewable resources and as such, the recommended portfolio in the 2016 IRP continues a high achievement of energy efficiency strategy as directed by the City Council. As a consequence of reducing load, energy efficiency also reduces the amount of renewable resources and renewable energy credits (RECs) the utility must acquire to comply with RCW 19.285.

- **Seattle City Light should continue to acquire renewable energy credits (RECs) and renewable resources as necessary to meet renewable portfolio standard (RPS) requirements mandated by RCW 19.285**

  In 2020, City Light's RPS requirement jumps to 15% of annual load from its current level of 9%. Based on the existing renewable mix in City Light's resources portfolio and previously acquired RECs, the utility will meet its RPS obligations through 2023. Because City Light does not have power supply needs before 2028, RECs are expected to be the lowest cost way to satisfy RCW 19.285 until City Light needs energy resources.

Integrated Resource Planning Process

Seattle City Light's 2016 Integrated Resource Plan (IRP)

- identifies how much reliable winter seasonal power supply the utility needs (when highest demand occurs)
- demonstrates how the utility plans to meet growing resource demand and comply with RCW 19.285 within a policy context
- evaluates candidate resource portfolios against four criteria - reliability, cost, environmental impact, and risk - balancing these criteria with public input from a wide range of perspectives

The two-year planning process that culminated in City Light's preferred portfolio includes these steps:

- public involvement of citizens and stakeholders with diverse perspectives
- reviewing existing portfolio and reflecting changes since the 2014 IRP Update including hydro efficiency upgrades and new contracts
- forecasting customer demand for power each month through 2035
- evaluating the resource adequacy measure, crucial for defining the timing and amount of future need

- considerations of policy direction from Washington State and Seattle City Council
- developing costs and characteristics of alternative resources to be included in the candidate resource portfolios
- designing and modeling candidate resource portfolios for evaluation against four criteria: reliability, cost, risk, and environmental impacts
- recommending a long-term resource strategy and near-term resource action plan

Public Involvement

The IRP stakeholder committee represents residential, commercial, and industrial customers, environmental organizations, and academics located in the City Light service territory, as well as, energy-related government agencies. This committee guided the resource planning efforts during a series of meetings with comments, questions, and suggestions throughout the process. Members of the public also attended IRP public meetings and offered feedback that helped shape the recommendation made for a preferred portfolio and will be used in planning for future IRPs.

The IRP was developed in two phases. In the first phase, we identified initial assumptions, including projected peak demand, forecasts of future energy prices, availability of spot market purchases, resources to consider, resource costs, performance measures, and a wide range of potential resource portfolios that could meet the projected demand.

These assumptions were adjusted in response to IRP Stakeholder input. The operations of the alternative resource portfolios were then simulated using a computer model of the electric system in the West. The results of the computer modeling of power operations were evaluated for performance, using the four criteria of reliability, cost, risk, and environmental impact.

In the second phase of the IRP process, performance measures were used to narrow down the set of resource portfolios, based upon their performance on the four evaluation criteria. After this analysis and consulting with the IRP Stakeholders, a recommended resource portfolio was identified.

Existing Resource Portfolio

City Light's existing portfolio includes past investments in programmatic energy efficiency, generation resources and contracts, and wholesale market purchases. City Light's policy makers have been committed to energy efficiency as the resource of first choice for over 30 years. Generation resources include low cost City Light-owned hydroelectric projects, power purchased at preference rates from Bonneville Power Administration, and contract purchases from other entities. City Light's own hydroelectric facilities are located mainly in Washington State. In 2002, City Light added wind power to its portfolio when it signed a 20-year contract to purchase output from the Stateline Wind Project in eastern Washington and Oregon. City Light has a 20-year power purchase agreement with Waste Management Renewable Energy, to purchase approximately 12 average megawatts of output from the Columbia Ridge Landfill Gas project in Arlington, Oregon. As needed, the utility supplements the aforementioned resources with

purchases made in the wholesale power market. The location of the key facilities in City Light's resource portfolio excluding the BPA resources are shown in the map below.

Figure 1. City Light's generation resources

Characteristics of the existing resource portfolio influence the choice of resource additions. The existing resource portfolio is dominated by large hydroelectric projects, leaving the utility exposed to high levels of precipitation and snow pack risk. The two dominant characteristics, of the portfolio, are hydro monthly shape and variability. The monthly shape of generation from the existing portfolio is not synchronized with service area load a shown in Figure 2. Load is highest in winter, but generation is highest in late spring. This suggests the use of strategies that in effect *reshape* generation to meet winter load. Surplus energy from the 2nd quarter spring runoff can be sold ahead and the proceeds used to buy energy ahead for the 4th and 1st quarters, in effect reshaping the energy from the spring to the winter.

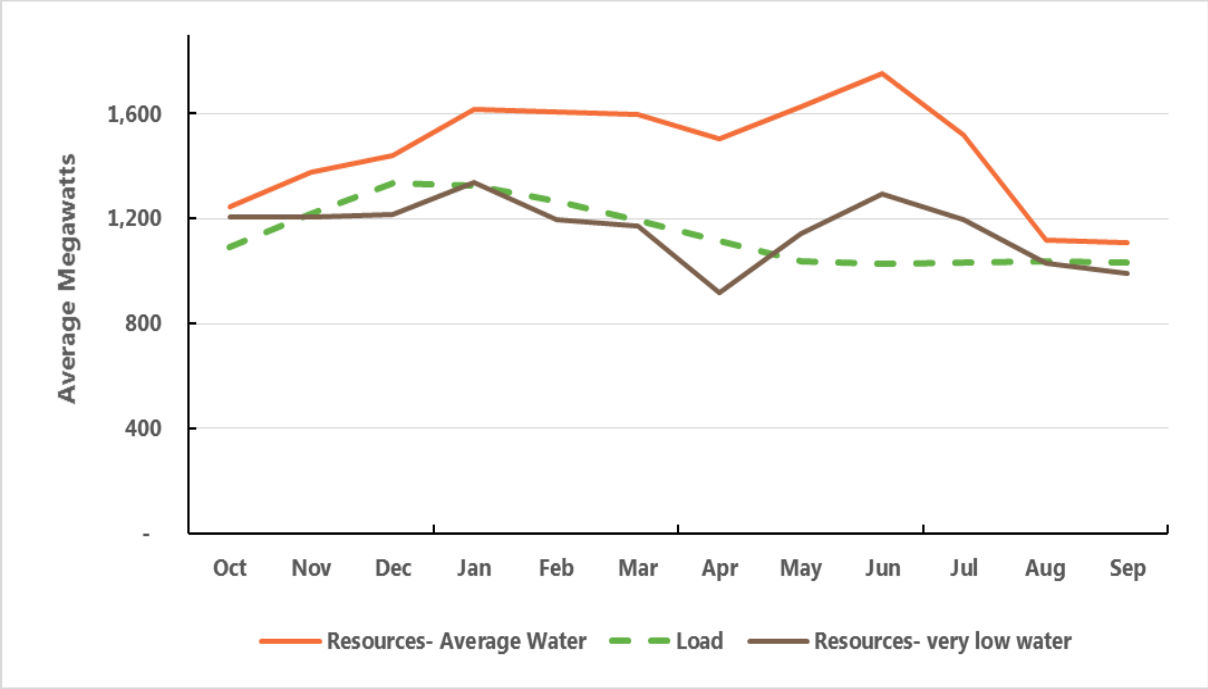

Figure 2. City Light's monthly load and resources

Hydro variability refers to the very broad range of seasonal and annual generation capability determined by precipitation and can be very challenging to manage. Figure 3 below shows how annual and monthly hydro generation for City Light's primary supply resources can vary significantly from year to year. It shows the range of what would be generated by the Skagit Project, Boundary Dam and BPA Slice product combined (City Light's three largest resources) if the 80 years of historic water conditions shown occurred given current river regulation.

City Light must ensure that sufficient winter resources are available to provide the power needed by its customers under the high stress scenario of low water conditions and low winter temperatures. At the same time, the utility must also make the effort not to acquire too much surplus power, in order to avoid the risk of not being able to sell surplus power at favorable prices.

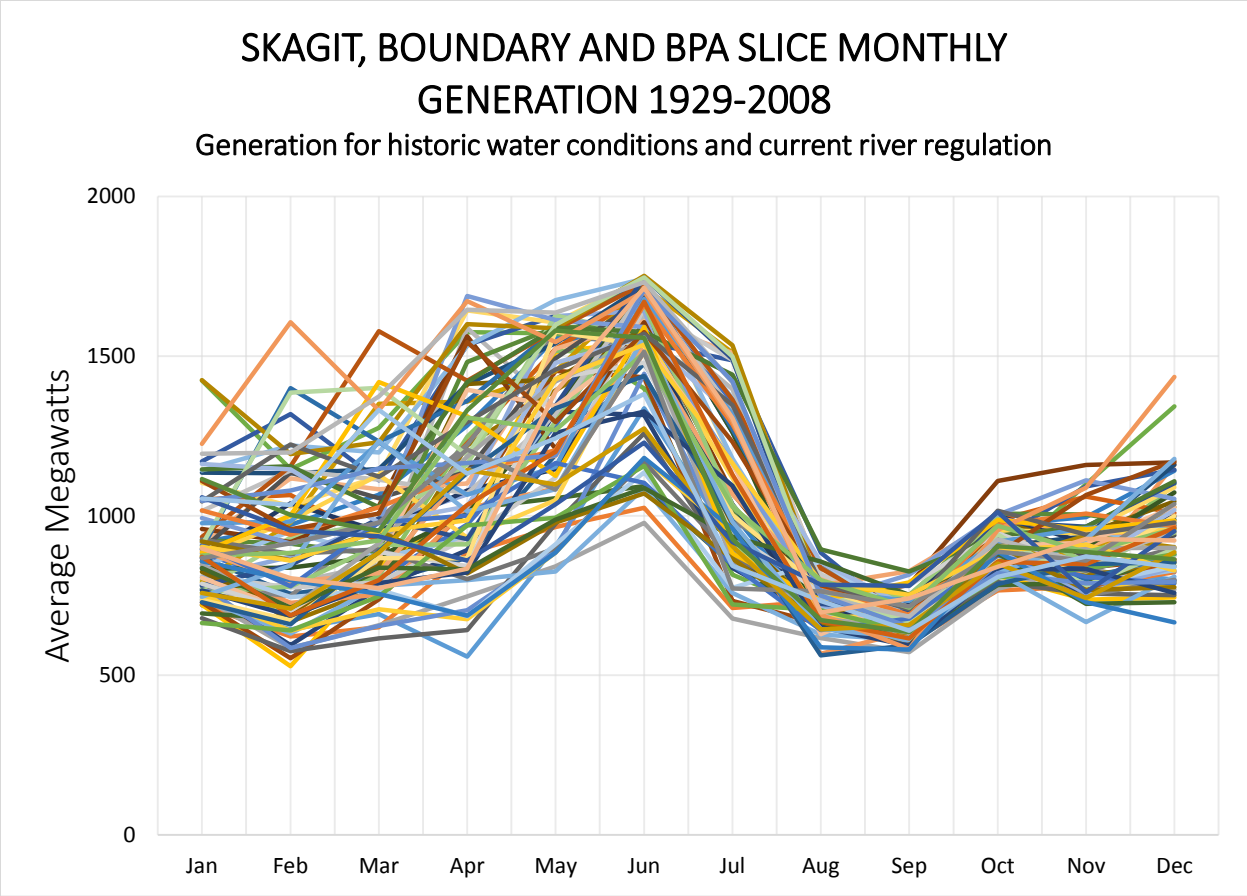

Figure 3. Seasonal and Annual Variability in City Light Hydro Resources

Load Forecast

The first step in assessing the need for additional resources is a forecast of Seattle's future electricity demand and establishing a target for the desired level of resource adequacy. The utility's Integrated Resource Plan long-range forecast projects continued long-term load growth trends in electricity demand for the service area. This growth is primarily driven by projected economic and population growth for the region. Relative to prior IRP studies, and as evident in recent years throughout the region and the nation, load growth is forecasted to continue to slow due in part to changing regulations, building codes, and customer behaviors. It should be noted that the IRP treats energy efficiency as a resource and evaluates it in the same way as it evaluates other resources. As such, the graph below in Figure 4 shows the load forecast without the impacts of new programmatic energy efficiency.

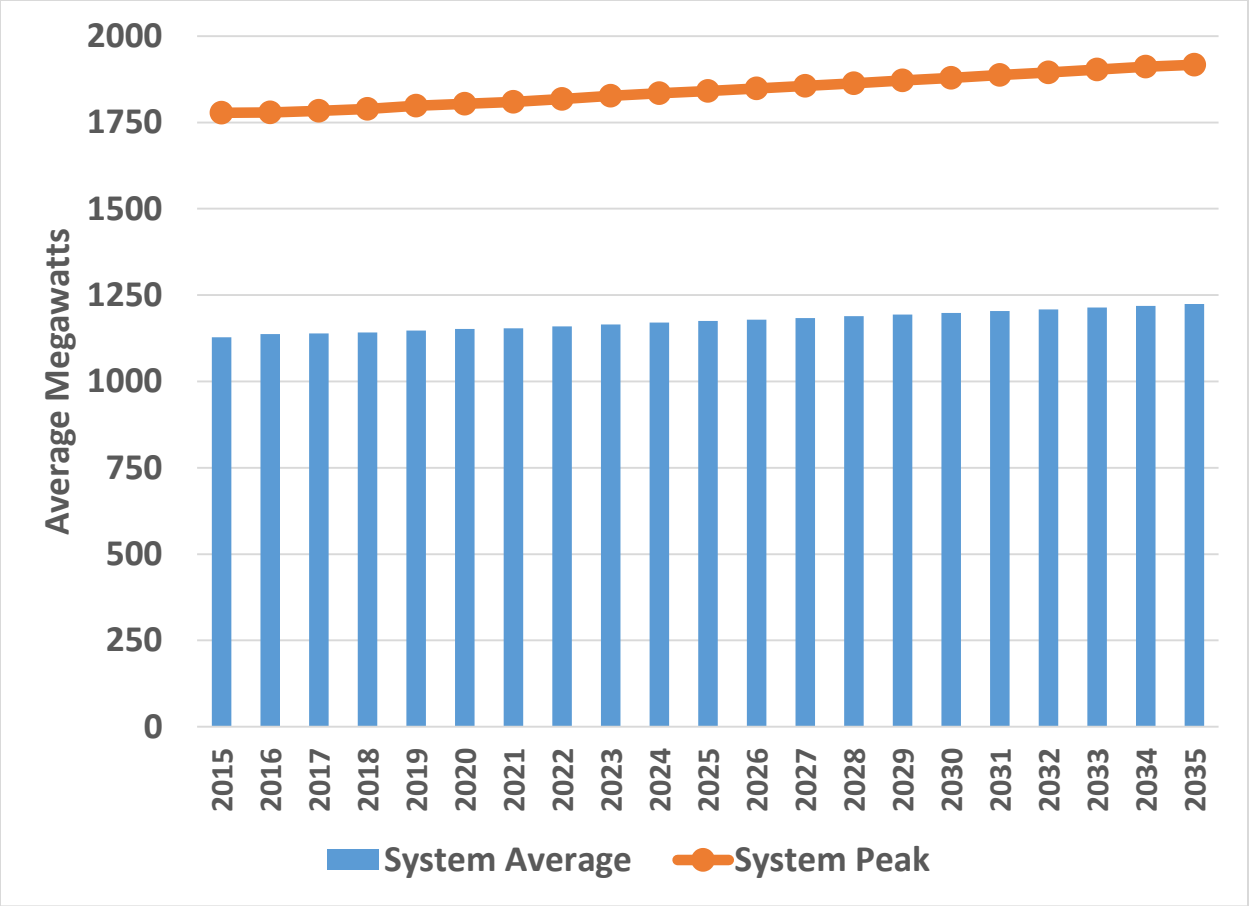

Figure 4. 2016 IRP peak and average energy load forecast (before new programmatic energy efficiency)

Resource Adequacy

The 2016 IRP relies on a measure of resource adequacy that targets a 90 percent confidence level of meeting loads in all hours during the winter season. It considers historical load variability, hydro generation variability, and the collective plans for maintenance and turbine overhauls, and appropriately adjusts its resource adequacy studies to account for them.

City Light provides a high level of resource reliability, including the ability to serve load even when hydro generation capability is low. In an average water year and with normal temperatures, City Light has substantial surplus power available to sell in the wholesale power market, even during the winter.

In addition to serving system load on an annual average basis, City Light must also have sufficient resources on a monthly, weekly and hourly basis. The greatest threat to City Light's resource reliability is the combination of low water and high customer demand for power. Low generation capability is usually due to drought conditions in the Pacific Northwest. High customer demand is usually due to extremely low temperatures in the winter. City Light's annual peak demand most often occurs in December or January.

Using the 90 percent resource adequacy measure and considering 200 MW of short-term market purchases, the Plan shows that, by relying on new programmatic energy efficiency and reshaping energy with hydro flexibility, the utility does not need winter seasonal resources until 2028 when the Bonneville Power Contract expires. The winter seasonal resource need (after energy efficiency) in 2028 increases through time as loads grow and additional existing contracts expire. Figure 5 shows the megawatts of supply additions needed to meet resource adequacy with and without new programmatic energy efficiency.

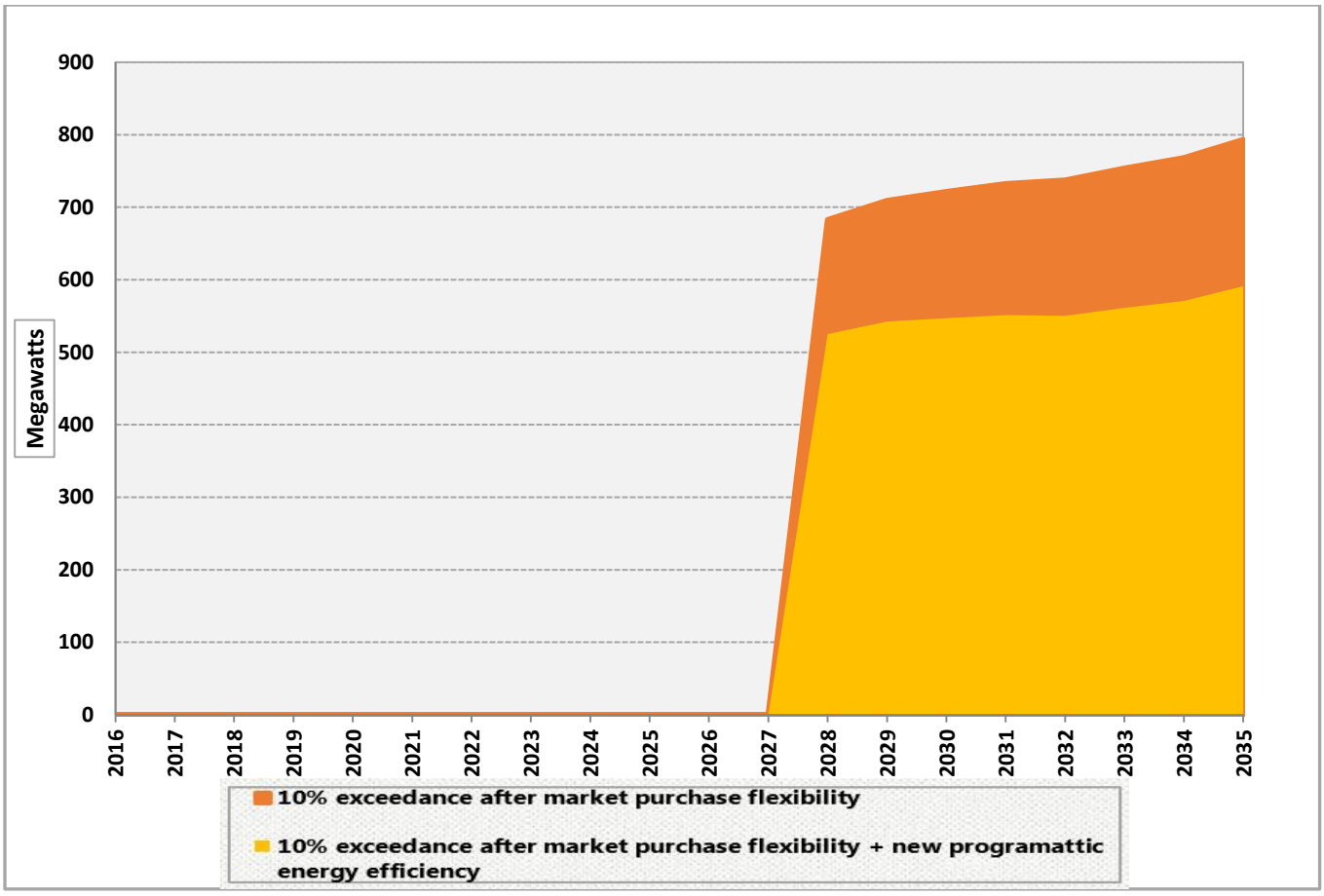

Figure 5. Resource adequacy targets 90% confidence levels after 200 MW of market purchase flexibility

Policy Direction

Policies that directly affect City Light's Integrated Resource Plan are State of Washington laws, RCW 19.280 and RCW 19.285 (Energy Independence Act), and the Seattle City Council Resolutions 30144, 30359, and 31667.

RCW 19.280 passed by the Washington legislature in 2006, requires certain Washington utilities, including City Light, to regularly prepare IRPs. Under statute, IRPs must describe the mix of energy supply resources and energy efficiency needed to meet current and future needs at the lowest reasonable cost to the utility and its ratepayers, using available technologies. Utilities must also consider and include in their planning cost-effective energy efficiency and a wide range of commercially-available generation technologies, including renewable technologies.

The Energy Independence Act (RCW 19.285) requires utilities in Washington with more than 25,000 customers to acquire all cost-effective energy efficiency at a prescribed pace and to acquire "qualifying" renewable resources at a rate of:

- 3 percent of retail load by 2012;
- 9 percent of retail load by 2016; and
- 15 percent of retail load by 2020

RCW 19.285 has an impact on both the timing and the amount of energy efficiency and renewable resources (or RECs) that the utility must acquire.

Resolution 30144 (2000) gives policy direction to the utility to meet load growth with energy efficiency and renewable resources to the extent possible. Resolution 30144 also gives policy direction to City Light to mitigate greenhouse gas emissions from any fossil fuel use, and sets a long-term goal of "Net Zero" annual greenhouse gas emissions. City Light first achieved Net Zero in 2005 and has remained Net Zero.

The Greenhouse Gas Mitigation Strategy Resolution 30359 (2001) establishes standards for calculating greenhouse gas emissions and mitigation projects. The climate change policy does not prohibit City Light from acquiring electricity from resources that produce greenhouse gas, but does require the utility to fully offset those emissions.

Resolution 31667 (2016) also guides resource strategies to support clean and safe electricity production, opposing the use of fossil fuels and new nuclear energy in the generation of electricity.

Resource Choices

The three main categories of resources are energy efficiency, electric generation, and the wholesale power market. Generation resources can be further categorized as renewable and nonrenewable.

Energy Efficiency City policy guidance and RCW 19.285 require the acquisition of cost-effective energy efficiency. Certain energy efficiency measures can improve load shape because their greatest effect is in the winter when the weather is colder and nights longer, requiring greater electricity use. Energy efficiency was the mainstay in both rounds of portfolio analysis, which examined base and high levels of achievement as shown in Figure 6.

Figure 6. Base and High achievement of Energy Efficiency (2015 Conservation Potential Assessment)

Market Near term purchases in the wholesale power market are used to supplement the utility's own generation and long-term contracts, as needed in order to serve retail load.

Renewable Generation Renewable resources satisfy the need for power and avoid air and water pollution that endangers the environment and human health. Renewable resources could become even more advantageous with the imposition of a carbon tax or a cap-and trade scheme. Approximately 90% of City Light's power is generated by hydropower, including its own hydroelectric facilities in Washington State. However, for meeting the RPS electricity generation from freshwater is excluded unless it results from qualifying hydro generation efficiency improvements. In the 2016 IRP, renewal of the BPA hydro generation resource was considered as a resource choice. Another type of renewable resource is RECs. RECs represent only the environmental attributes of renewable generation and can be purchased from qualifying renewable energy producers.

Non-Renewable Generation Non-renewable resources are generally fossil fuels such as coal, oil and natural gas. City Light is required by RCW 19.280.030 to evaluate non-renewable generation as well as renewable generation. Most fossil fuel resources have reliability advantages in their generation profile that allows them to meet utility customers' base energy requirements and frees up the hydroelectric resources to follow load. The most effective fossil fuel resource that can follow load is the natural gas simple-cycle combustion turbine that can be used to meet

peak load requirements or to operate during the hours near the peak hour, thus saving hydro power to meet the peak requirements. Natural gas-fired turbines can also provide necessary integration services to intermittent renewable generation, improving reliability of electric service. Three of the nine resource portfolios studied contained natural gas generation. City Light's analysis includes emission costs for these resources.

Portfolio Analysis

Nine optimized candidate portfolios were constructed based on load forecast, resource adequacy requirements, RPS requirements, characteristic of supply resources and their environmental attributes and emissions, Seattle City Council policies, Conservation Potential Assessment (CPA), and market purchase flexibility. Candidate portfolios were simulated within the AURORAxmp® Electric Market Model developed by EPIS, Inc., under different scenarios (stress testing). The scenarios that have been considered for stress testing in addition to expected conditions were high and low demand conditions, high and low water conditions, high and low natural gas prices, and high, base and low carbon dioxide prices. AURORAxmp® produces City Light's total resource cost and net wholesale revenues. The sum of these is net portfolio cost.

The portfolios were then evaluated using the following criteria:

- **Cost.** The net present value (NPV) of cash flows of Net Portfolio Costs over 20 years
- **Risk.** The volatility of Net Portfolio Costs over 20 years

Selection of the 2016 Integrated Resource Plan Strategy

In 2008, the Seattle City Council requested that City Light's IRP forward three candidate resource portfolios (plans) for evaluation instead of one. The purpose was to enable policy issues to be more fully considered within a process that was strongly quantitative in nature.

The 2016 IRP candidate portfolios were ranked based on costs and risks and the top three performing portfolios were selected for further evaluation. The top three portfolios were subjected to probabilistic risk analysis that varied key assumptions: the level of system load, the price of natural gas, and hydro conditions. Figure 6 is a representation of supply and demand risk area.

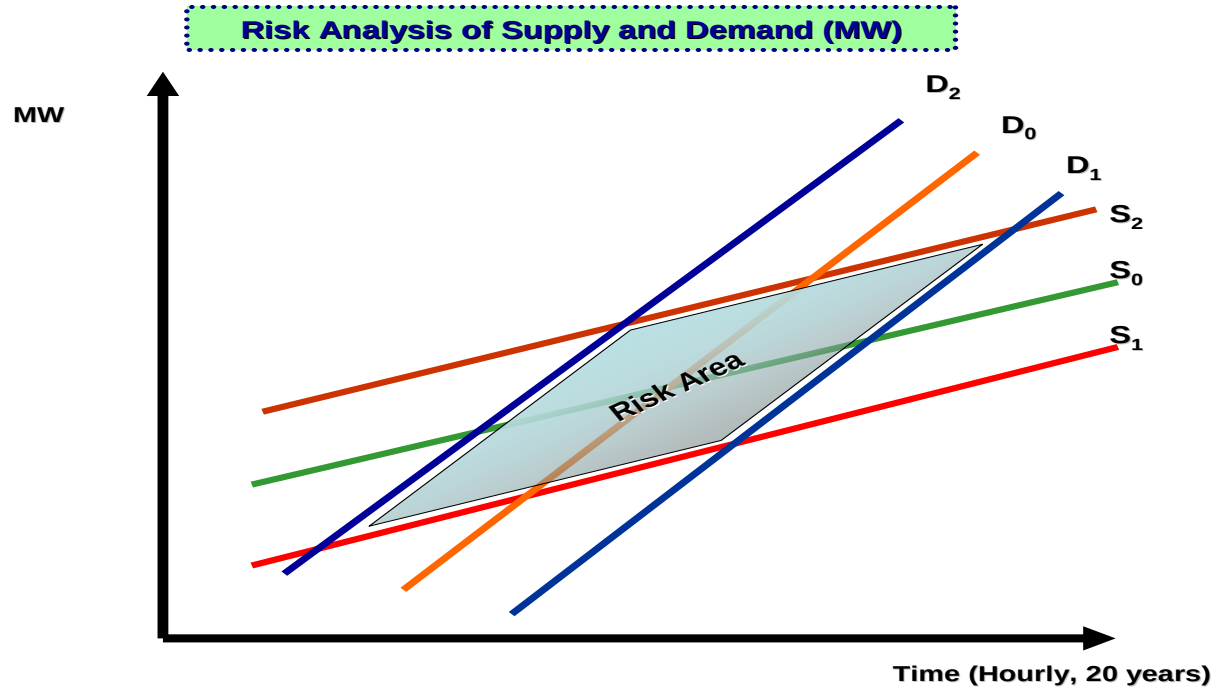

Figure 7. Risk analysis of supply and demand

The top three performing portfolios are "High achievement of Energy Efficiency, Hydro, and Wind", "Base Energy Efficiency, Hydro, and Gas", and "Base Energy Efficiency, Hydro, and Wind". These three portfolios include similar levels of programmatic energy efficiency over the duration of the planning horizon. High achievement of energy efficiency has higher levels of achievement representative of the current pace of achievement. All three top portfolios have similar amounts of market purchase flexibility as deemed reliable and cost-effective. The "High achievement of Energy Efficiency, Hydro and Wind" portfolio includes the addition of hydro resources and wind resources to go along with a high achievement level of programmatic energy efficiency. The "Base Energy Efficiency, Hydro and Gas" portfolio includes the addition of hydro resources, renewable energy credits, and a combined-cycle turbine (with carbon emission costs included) to go along with a base level of programmatic energy efficiency. The third portfolio, "Base Energy efficiency, Hydro and Wind", includes the addition of hydro resources and wind resources to go along with a base level of programmatic energy efficiency.

The results in order of lowest cost and risk are:

1. Base Energy Efficiency, Hydro and Gas with Market Purchase Flexibility
2. High achievement of Energy Efficiency, Hydro and Wind with Market Purchase Flexibility
3. Base Energy Efficiency, Hydro and Wind with Market Purchase Flexibility

The 2016 IRP analysis finds that the "Base Energy Efficiency, Hydro and Gas" portfolio performed marginally better from a cost and risk perspective. However, this portfolio is incompatible with Resolution 30144 and Resolution 31667. The former established a preference

for cost-effective energy efficiency and renewable resources, and the basis for City Light to offset all of its greenhouse gas emissions from fossil fuels. The latter opposes the use of fossil fuels. The "Base Energy Efficiency, Hydro and Wind" portfolio and the preferred "High achievement of Energy Efficiency, Hydro and Wind" portfolio both meet the objectives of the resolutions. The preferred portfolio performs better from a cost and risk perspective. Based on the recommendation from stakeholders, its consistency with Seattle City Council policies, and its reasonable cost and risk, City Light identifies the "High achievement of Energy Efficiency, Hydro, and Wind" portfolio as the preferred portfolio for planning purposes. The following table shows the recommended portfolio additions from 2016 IRP preferred portfolio.

Recommended Portfolio Additions from 2016 IRP

(Average Megawatts)

Cumulative Resource Additions	High achievement of Energy efficiency	New BPA Hydro	Wind	RECs (annual additions)
2016	14	0	0	0
2017	29	0	0	0
2018	46	0	0	0
2019	61	0	0	0
2020	78	0	0	0
2021	94	0	0	0
2022	108	0	0	0
2023	121	0	0	0
2024	133	0	0	2
2025	143	0	0	12
2026	152	0	0	11
2027	160	0	0	56
2028	167	492	56	0
2029	175	500	60	0
2030	182	500	60	8
2031	188	500	60	14
2032	193	500	60	15
2033	197	500	60	15
2034	201	500	66	27
2035	205	500	83	10

Two-year Action Plan

To meet winter resource needs, City Light's 2016 IRP recommends a long-term energy efficiency and power resource strategy and a short-term action plan. The recommended 2016 IRP action plan entails these steps:

- continue high achievement of cost-effective energy efficiency
- update the Conservation Potential Assessment as needed for use in resource planning and for RCW 19.285 as required by year-end 2017
- continue to assess modeling inputs, assumptions, and methodologies related to all work central to the IRP including load forecast and how customer energy use is changing
- continue to engage BPA to limit cost drivers for the BPA contract to ensure the contract remains affordable into the future
- serve retail load with existing resources portfolio, short-term market purchases, and other transactions to reshape seasonal energy as needed
- maintain an adept and active power marketing operation that is very active in the wholesale power markets
- provide regional leadership to ensure the availability of efficient wholesale markets and reliable transmission capacity for serving City Light customers
- continue environmental stewardship
- provide leadership in the research of climate change and climate adaptation practices
- continue participation in and evaluation of factors impacting City Light's hydro operations, and fish populations