

2014

# Seattle City Light Integrated Resource Plan

Update and Progress Report



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# 2014 INTEGRATED RESOURCE PLAN UPDATE AND PROGRESS REPORT

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## EXECUTIVE SUMMARY

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Our ability to predict the future is imperfect by nature, which is why utility planners do their Integrated Resource Plans (IRPs) over again every two to four years. While Seattle City Light's 2012 IRP did not perfectly predict the future, its forecasts were reasonably accurate. As a result, the 2012 IRP resource strategy remains robust. In the last two years, Seattle has continued its emphasis on the acquisition of energy efficiency, small acquisitions of renewable resources, and improvements in hydro generation efficiency. When combined with broader national trends of slower economic growth and improvement in the energy efficiency of lighting, appliances and motors, the time that Seattle will need to make major resource investments has been pushed back by a minimum of two years from the 2022 date anticipated in the 2012 IRP.

Seattle City Light's 2013 Conservation Potential Assessment (CPA) indicates that new energy efficient technologies have become more widely-available and the costs for existing technologies have fallen. Avoided costs of conservation fell with declining wholesale power market prices. Yet, the 2013 CPA found that an estimated 44 megawatts of additional new conservation potential will be cost-effective over the 20-year forecast period. More than half of future conservation potential is expected to come from lighting efficiencies.

Consistent with greater energy efficiency and slower economic growth, Seattle City Light's demand for electricity is growing more slowly than forecasted in the 2012 IRP. Seattle City Light's 20-year average annual demand growth is forecast at 0.5 percent, or about half the national average, despite local economic growth above the national average. One factor in a lower demand outlook in 2014 is the deep bore tunneling machine known as "Bertha." Its load alone was expected to roughly equal a total of two years of service-area wide demand growth in the 2012 IRP forecast. However, Bertha, the world's largest tunneling machine, has had ongoing mechanical problems and operates at lower electricity demand than was anticipated.

Two technologies that may significantly impact future demand are electric vehicles and solar PV panels. Electric vehicles, if widely-adopted, hold the potential to consume most of Seattle City Light's surplus generation position. Having the opposite effect, solar PV panels reduce customer demand for electricity. Today, electric vehicles are estimated to use about 3 megawatts of electricity demand in King County, or 0.3 percent of total demand, while solar panels are estimated to offset about 1 megawatt of demand or about 0.1 percent of total City Light demand. The solar panels face a more challenging business environment in Seattle than in many

parts of the U.S., with a cloudy marine climate and the potential for state subsidies to be reduced. Although very small in percentage of total load and generation respectively, both electric vehicles and solar panels are growing quite rapidly.

Since 2012, Seattle City Light has acquired several small, new resources. An expansion of 6.4 megawatts at the Columbia Ridge plant began generating in 2014, using landfill gas. A similar fuel is in use by the West Point Waste Water Treatment plant, where methane gas generates 2.5 megawatts of energy, starting in 2014. Hydro efficiencies from rebuilding a turbine and replacing a transformer are expected to increase generating capability at the Boundary plant by up to 40 megawatts by 2017.

Long term, climate change creates questions about the future of Seattle City Light's approximately 92 percent hydroelectric generation, especially for the three Skagit River plants. As warming continues, river flows and generation are gradually increasing during the winter months and declining in the summer months; as snowpack gradually declines, decreasing this natural storage of water between winter and spring. Skagit River basin glaciers have been clearly shrinking with warmer temperatures, giving a boost to the Skagit River's glacier-fed side-stream flows. How long that boost in glacier-fed flows will last is unknown. The University of Washington has estimated that melting glaciers provide more than 40 percent of the flows below Ross reservoir during the summer. As part of its climate change research, Seattle City Light is working with the National Park Service and the University of Washington to inventory and forecast future flows from the glaciers.

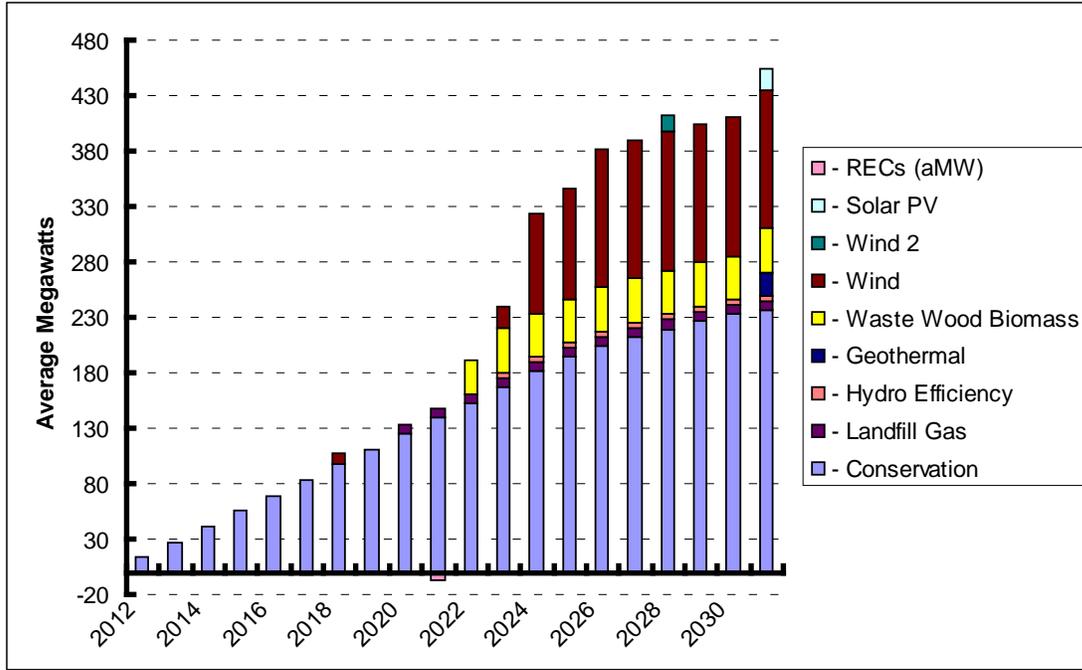
## BACKGROUND

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The 2014 Integrated Resource Plan Update and Progress Report is a retrospective look at the Seattle City Light 2012 Integrated Resource Plan (IRP). Under Washington state law RCW 19.280, utilities are required to complete IRPs or IRP Progress Reports every two years. A Progress Report may be filed every other 2-year period, or a complete IRP every four years. Seattle City Light, with the Mayor's and City Council's approval, selected the Progress Report option for 2014 because it did not expect to see material changes from the 2012 IRP that would cause it to change the City's resource strategy. A fixture of the City's resource strategy is to meet load growth with conservation and renewable resources, to the extent possible.

The 2012 IRP Preferred Portfolio was selected from eight alternative plans after carefully considering the costs, risk, and environmental performance. Further information on City Light's IRPs can be found online at: <http://www.seattle.gov/light/news/issues/irp/>

## 2012 IRP Preferred Portfolio



This report provides an update on key issues and forecasts contained within the 2012 IRP, as well as providing a progress report on the 2012 IRP Action Plan. With a letter of support from the 2014 Integrated Resource Plan Stakeholders to the City Council, the 2014 IRP Update and Progress Report was approved by the City Council with Resolution 31537, on July 28, 2014. Filing an approved 2014 Integrated Resource Plan Update and Progress Report by September 1, 2014 with the State of Washington fulfills the City of Seattle’s responsibility under RCW 19.280 from September 2014 through August 2016.

## CHANGES IN THE REGULATORY ENVIRONMENT

### CARBON DIOXIDE (CO<sub>2</sub>)

Some national energy forecasting firms are now projecting that federal regulation of carbon dioxide emissions will not occur before 2020. With a cost for CO<sub>2</sub> emissions not beginning before 2018 in the 2012 IRP, the 2012 outlook may still be a reasonable forecast. However, it is more likely that state regulation would precede federal regulation. A successful CO<sub>2</sub> market in California increases the likelihood that states in the Pacific Northwest could join an expanded California market, or create their own state-level markets, ahead of federal climate policy.

California began trading CO<sub>2</sub> allowances in late 2012, with the market clearing price at the minimum possible bid. Following the dismissal of several lawsuits testing state regulatory authority over CO<sub>2</sub> in 2013, auction prices rose in 2014. In February of 2014, the California Air

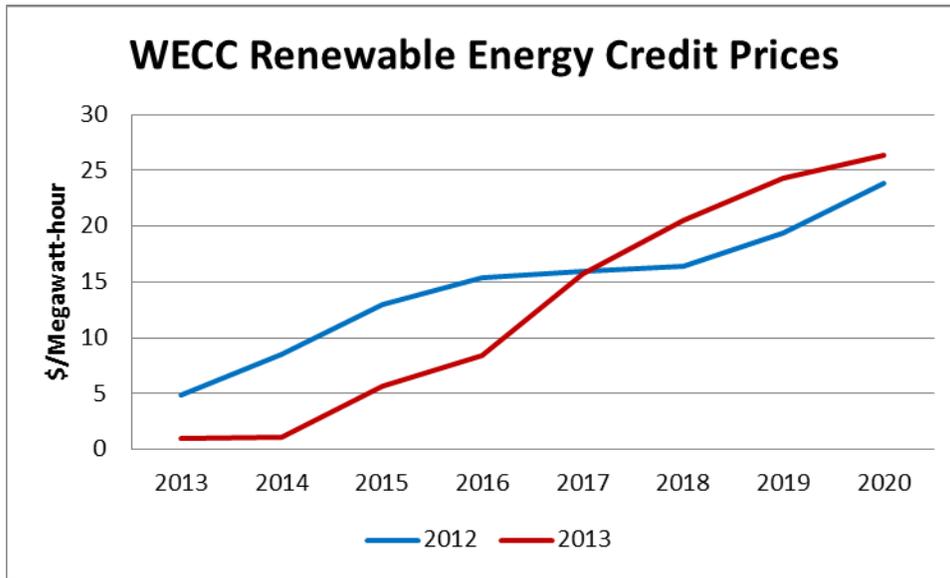
Resources Board sold 19.5 million allowances for \$11.48 each. Each allowance permits the release of one metric ton of carbon dioxide. Electric utilities were important customers of the 2014 auction, as more fossil-fuel generation than usual was needed to meet electricity demand during a poor hydro year in California.

In April of 2014, Washington Governor Jay Inslee appointed a 21-member task force to help design a “market-based” carbon-reduction plan, such as a cap-and-trade system or carbon tax, to take to the Washington Legislature in 2015.

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## RENEWABLE ENERGY CREDITS (RECS)

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Renewable energy credits (RECs) are certificates representing the environmental attributes of renewable energy for one megawatt-hour. RECs can be used as a substitute for actual renewable generation with the renewable portfolio standards that exist in many states, including Washington.

The two REC price outlooks for the Western Electric Coordinating Council depicted above are from the same third-party forecaster, a little over a year apart. The graph clearly underscores the challenges in forecasting REC prices. The 2012 REC price forecast used in the 2012 IRP turned out to be significantly higher than actual 2012-2013 prices. During the same period, the REC market collapsed as California regulators severely limited out-of-state REC purchases by California utilities. Many wind developers in the Pacific Northwest had targeted the growing California market to sell RECs and wind power. Following the decision to cap out-of-state REC purchases by the California Public Utilities Commission, REC prices in the Pacific Northwest

dropped significantly, as the size of the market for RECs instantly became much smaller and the Pacific Northwest became largely oversupplied.

REC prices rose slightly in 2014 with the expiration of a 2013 one-year extension of the production tax credit for wind. The prospects for extension of the production tax credit directly affect future REC prices, as the sale of production tax credits have been key to supporting continued expansion of wind generation, where the majority of tradable RECs have been created.

City Light purchased qualifying RECs for compliance with I-937, the Washington Energy Independence Act, meeting requirements into the 2020s. Because of its existing REC inventory, changes in REC prices and availability have no material impact upon the 2012 IRP results. The IRP preferred portfolio is conservation and renewable resources. The future acquisition of renewables indicates that RECs in the middle of the 2020s may be supplied by City Light's own resource acquisitions. In the interim, City Light has a sufficient REC inventory to meet state regulatory requirements.

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## 2014 CONSERVATION POTENTIAL ASSESSMENT (CPA)

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### OVERVIEW

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Despite over 35 years of City Light conservation programs, substantial conservation potential remains in Seattle. Much of the remaining opportunity is in conservation measures for end-uses that have long been targeted. In particular, lighting continues to hold much conservation potential, as customers migrate across technologies from incandescent, to compact fluorescent lights (CFLs), to light emitting diodes (LEDs).

City Light uses two measures of the avoided cost of conservation. One measure is to meet the requirements of the Energy Independence Act, known as I-937. The second is the avoided cost of the renewable resources in the preferred portfolio from the 2012 IRP. Both measures of the avoided cost of conservation have fallen since the 2012 IRP, indicating that conservation became less cost-effective as the cost of wholesale power fell.

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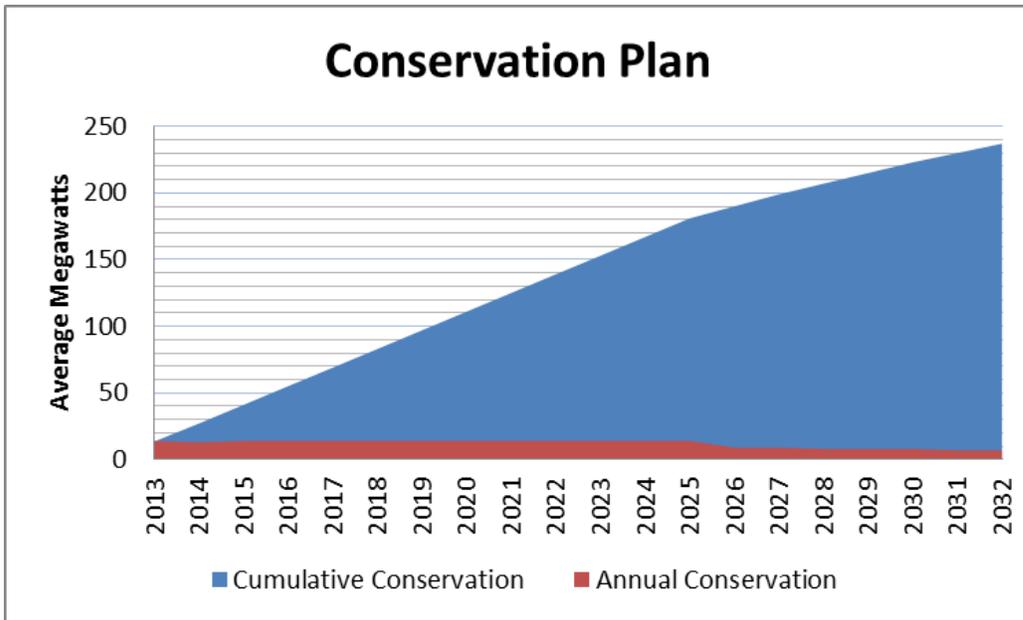
### ACHIEVABLE POTENTIAL IN THE 2013 ASSESSMENT

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Achievable potential is the amount of conservation potential expected after accounting for program participation, customer preferences, and budget constraints. Achievable potential across the residential, commercial, industrial, and street lighting combined is 22.6 aMW in 2015. Cumulative achievable potential grows to 118.4 aMW by 2023. This level of potential savings is consistent with other studies of conservation potential for utilities with mature conservation programs. As compared to the 2012 Conservation Potential Assessment, total technical (before considering constraints) potential is very similar. Yet, in the 2013 CPA, both the economic

(cost-effective) potential and achievable potential increased by more than 40 MW during the 20-year forecast period.

Cumulative Savings (aMW)	2014	2015	2018	2023	2028	2033
Technical Potential	43	74.9	142	249.4	366.4	449.6
Economic Potential	32.6	57.5	104.1	179.8	267.5	330.3
Achievable Potential	11.4	22.6	49.5	118.4	194	250.6



## MAJOR SOURCES OF SAVINGS OPPORTUNITIES

For both the residential and commercial sectors, interior and exterior lighting represent more than half of total achievable potential, consistent with lighting’s preponderance in technical and economic potential. Given that these are mature technologies, they have relatively high market acceptance. Compact fluorescent light technology has been widely adopted and is no longer a qualifying I-937 conservation measure after 2013, despite some continued use of incandescent lighting by customers.

For the residential sector, new national appliance efficiency codes are expected to gradually reduce appliance electricity consumption. For example, the new codes for refrigerators in 2014 are expected to reduce average electricity consumption by 25 percent. This means the average refrigerator will soon use one-fifth the energy that a similar-sized refrigerator would have used in the 1970s (source ACEEE). Also, the growing share of new multi-family housing in Seattle

brings into play stronger building codes for energy efficiency, reducing per customer consumption for the long-term.

In the industrial sector, motors and system controls for industrial processes make up almost two-thirds of the total industrial savings potential.

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## CONSERVATION AVOIDED COST AND THE I-937 TARGET

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The amount of conservation that Seattle City Light pursues is in part determined by the “avoided cost” of conservation. The avoided cost is a measure of the costs that Seattle would have incurred, absent the conservation activities that City Light funds. The calculation of this measure is required for the Energy Independence Act that was passed as Initiative 937 in 2006 (I-937). I-937 requires City Light to capture one-fifth of cost-effective conservation every two years.

For planning purposes at City Light, conservation has two avoided costs. One avoided cost is required for Initiative 937, the Energy Independence Act. By state statute and rule-making, this is the avoided cost of energy as priced by the wholesale power market and other factors, using a market price forecast.

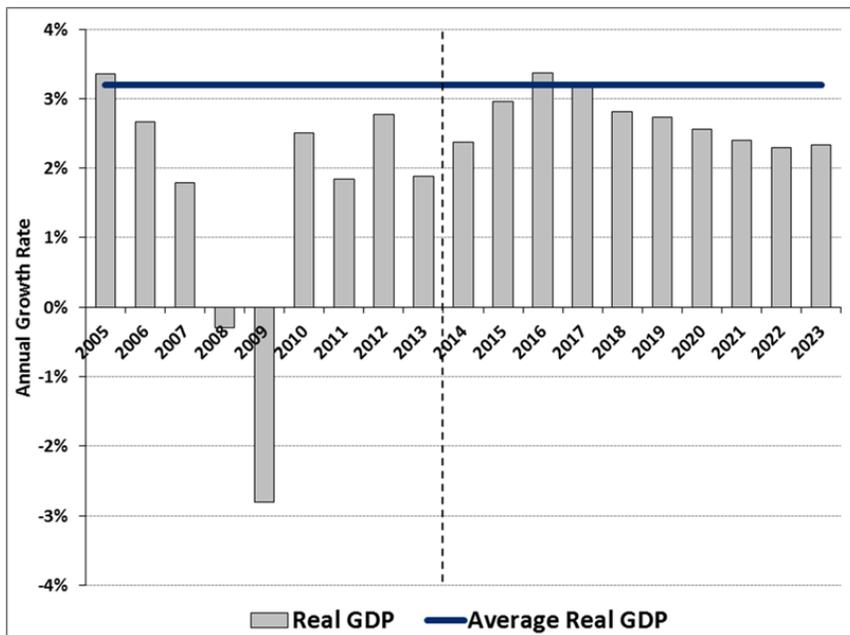
A second avoided cost is calculated as the levelized cost of the marginal resources in the preferred portfolio from the most recent IRP (2012 IRP). The second avoided cost method is the one used by City Light, as a result of the City of Seattle’s long-term policy to use only renewable resources for power generation. The avoided cost of the IRP preferred portfolio is higher than the I-937 market price-driven avoided cost because it is calculated using the cost of renewable resources instead of purchased power from the wholesale market.

Both measures of avoided cost have fallen since the 2012 IRP. Mid-Columbia wholesale power market prices have fallen since 2012, affecting the avoided cost measure for I-937. The avoided cost measure using renewable resource costs has fallen primarily because of a delayed need for new resources. The measure uses levelized costs, which discounts the onset of costs by the utility’s cost of capital. Delaying the need to acquire new renewable resources results in a lower levelized, avoided cost of conservation.

## ELECTRICITY DEMAND FORECAST

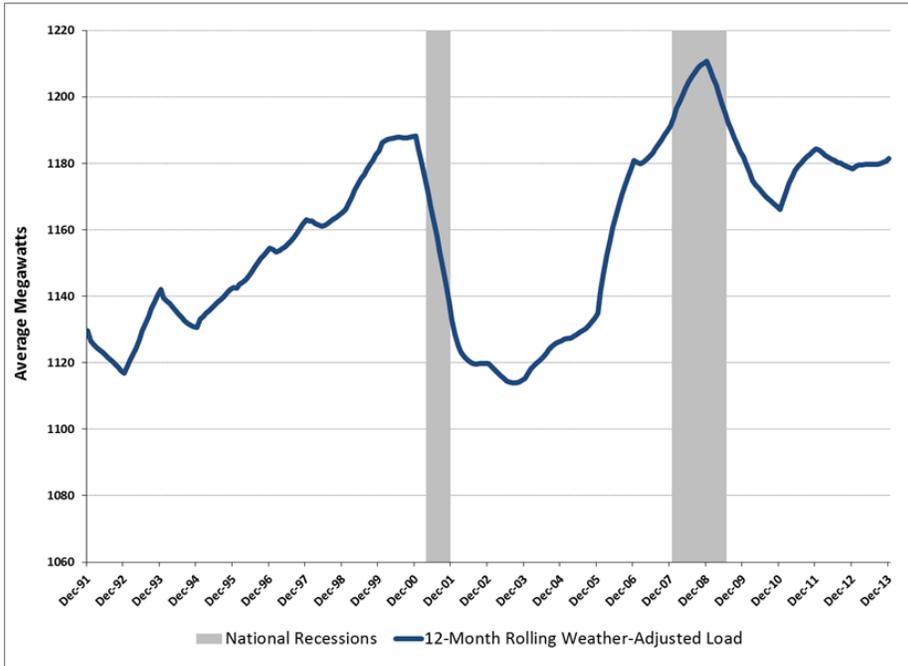
City Light is currently forecasting slower load growth than was forecasted in the 2012 IRP. A slower than expected economic recovery, continuing increases in the efficiency of end-uses of electricity, and increasing prices for electricity are driving lower long-term electricity demand.

From 2012 to 2014, the major changes to national economic outlooks were consecutively lower expectations for growth in GDP. The lower expectations for GDP growth are the result of many factors, including the general aging of the workforce, the sovereign debt crisis, higher oil prices, economic slowdown in Asia, ending the payroll tax holiday, and monetary policy uncertainty impeding investment. GDP forecasts are now consistently lower than the long-term average. The most recent GDP growth forecast from IHS Global Insight is seen below, in relation to the line representing the long-term average in real GDP growth.



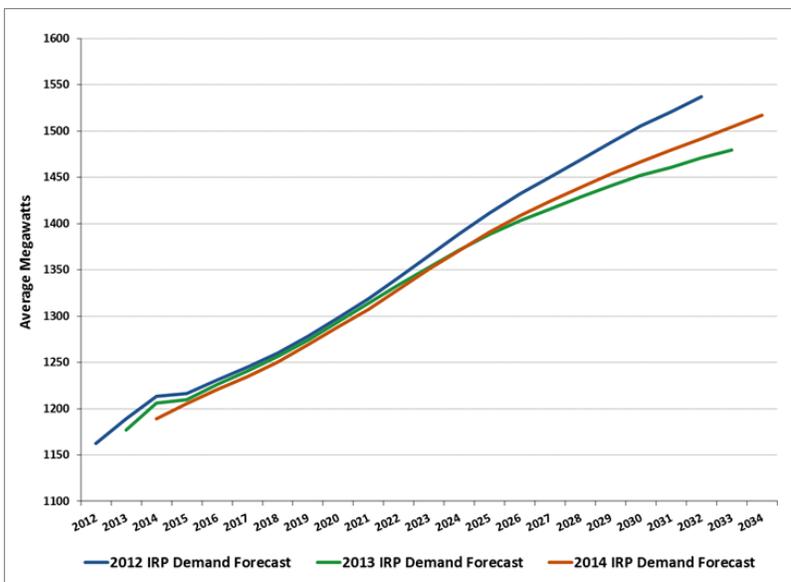
Typically when recovering from a recession, there is a period of relatively rapid national economic expansion. City Light electricity demand often lags the national economic recovery, as can be seen below. The shaded areas represent economic recessions in the 1990s and 2000s, while the line represents City Light electricity demand. After the “Great Recession of 2008,” electricity demand growth began a typical recovery pattern of lagging GDP growth, with electricity demand bottoming out in 2010. However, breaking from a typical pattern, it leveled off even as the economic recovery continued. Since 2011, City Light electricity demand forecasts have been consistently lowered. In part, forecasted increases in the price of electricity act to slow electricity demand growth.

## Electricity Demand and Recessions



The first ten years of the 2014 System Load Forecast are lower than the 2012 forecast, but have nearly the same trend. By 2022 the forecasts begin to diverge more, with slightly higher growth than in the 2013 forecast, but still lower than the 2012 IRP forecast. The forecasts depicted below are after conservation and assume normal weather.

## City Light Electricity Demand Forecasts 2012-2014

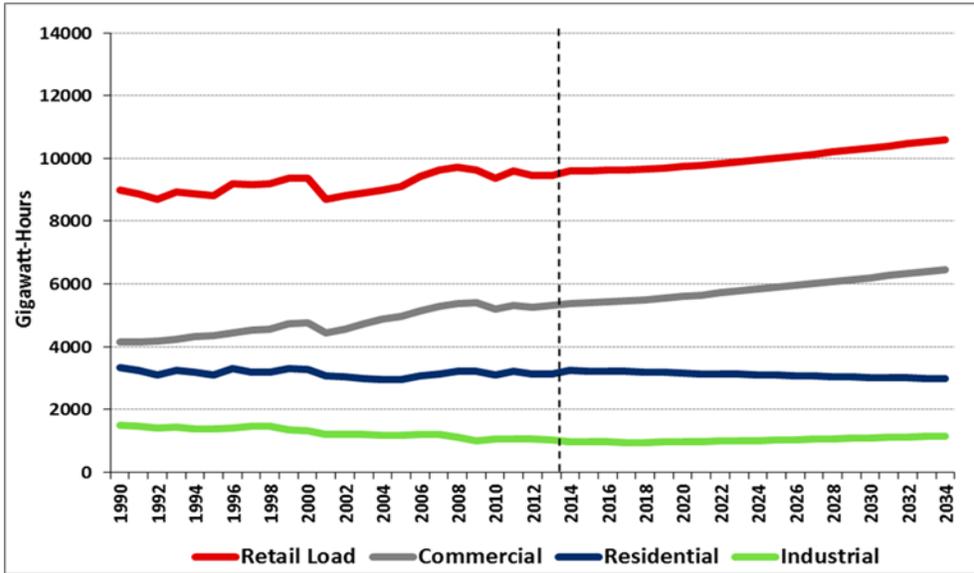


In the first part of the 2012 and 2013 forecasts, a pronounced “bump” in electricity demand can be seen. One change from the 2012 IRP electricity demand forecast is to reduce the projected electricity demand of the tunnel-boring machine, known as “Bertha.” Bertha is the largest tunnel-boring machine in the world. Early in the project, planners and engineers overestimated the load for the large tunnel-boring machine, including its consistency of operation. Bertha presently is not operating due to mechanical problems, but is estimated to restart operations in March of 2015. In the most recent system load forecast, City Light has significantly lowered its estimate of Bertha’s future power consumption.



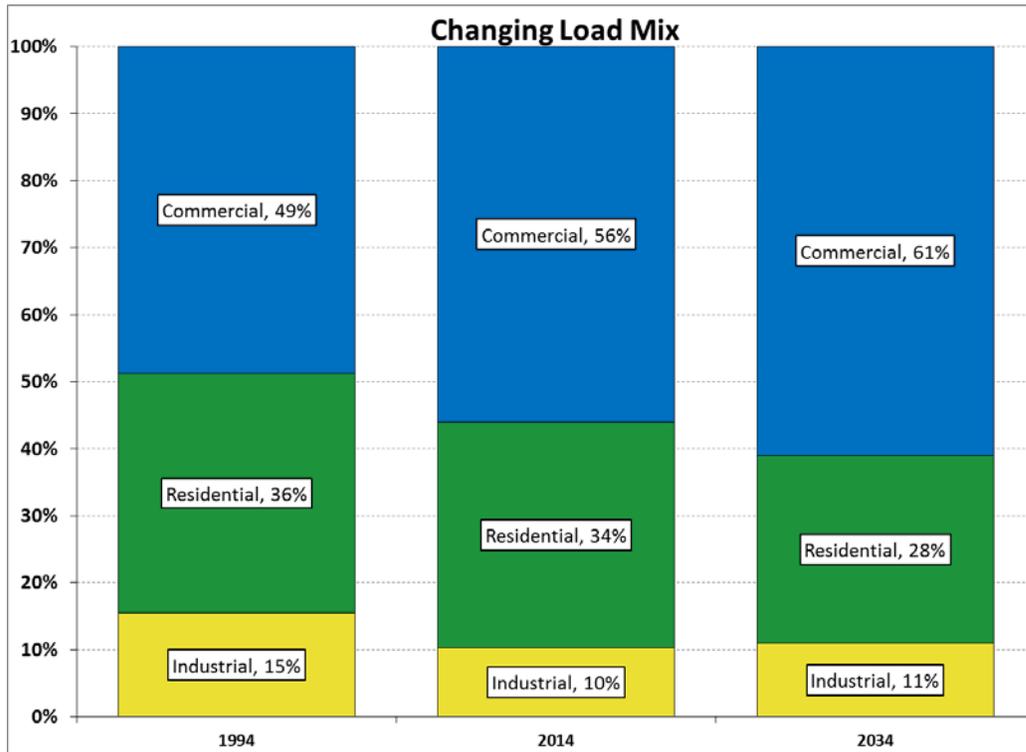
While the forecast of total demand shows a consistent trend in electricity demand growth, a different picture emerges when the forecast is disaggregated by sector in the graph below. Most of the growth in Seattle’s electricity demand forecast is coming from the commercial sector. The commercial sector includes retail stores, finance, insurance, real estate, other services, international trade, and government. Seattle is a commercial center for the Pacific Northwest and thus has higher than average employment in this sector. The industrial sector forecast of electricity demand shows slow demand growth, while electricity demand in the residential sector has been on a long, slow decline.

## History and Forecast Electricity Demand by Sector



Overall demand growth is forecast to average 0.5% annually from 2014 to 2034. Nationally, the Energy Information Administration forecasts electricity demand to average about 1.0% growth per year. Seattle electricity demand is expected to grow at half the national rate. This much slower growth in electricity demand is attributable to several factors, including over 35 years of utility conservation programs, some of the most stringent building codes in the nation for energy efficiency, and a geographically-constrained urban footprint, whose urban center has bodies of water on three sides. Many utilities serve geographic areas that expand into rural areas that formerly had low population density, building completely new residential sub-divisions and commercial zones. Seattle City Light’s customer growth is coming mostly from infill and greater population density, which tends to be much more energy-efficient. The chart below more clearly shows the changing historical and forecast mix of load by customer class from 1994 to 2034.

## Seattle City Light's Forecast of Changing Load by Customer Class



## POWER RESOURCES

### CHANGES IN CITY LIGHT RESOURCES

Changes in three resources since the 2012 IRP are expected to have the greatest impact on Seattle's future power supply.

- Turbine rebuilds will result in up to 40 MW of new hydro generating capacity from 2014-2016. The expanded turbine capacity is presently constrained by the capacity of the transformers, but this situation is expected to be remedied in 2016. Hydro efficiencies will be the largest source of new generation.
- Seattle City Light contracted with Columbia Ridge landfill gas for another 6.4 aMW of generation. The expanded generation began in 2014.
- The output of Lucky Peak was exchanged on a two-year basis, moving the receipt of power from mostly the summer to the winter, when the annual peak demand for electricity in Seattle occurs. It is anticipated that this type of exchange will continue for the next few years.

Other changes in resources have lesser impacts, but are worth noting:

- West Point waste water treatment plant began operation with methane-fueled turbines in 2014, generating approximately 2.4 megawatts on average. This amount of generation is an offset to the larger electricity demand of the wastewater treatment plant, with no net generation interchange into City Light's system expected.
- Nucor Steel Seattle waste-heat recovery process began testing in 2014 and is scheduled to begin operation in 2015. It will offset existing load and no net interchange with City Light will occur.
- Rooftop solar PV installations are growing in Seattle. They are not a City Light resource, but do produce energy to serve City Light customers. Absent an increase in subsidies or improved solar technology, it is uncertain how much solar generation in the service area will continue to grow.

No other material changes or expirations in major contracts are expected that would change the resources identified in the 2012 IRP.

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## NATURAL GAS PRICES

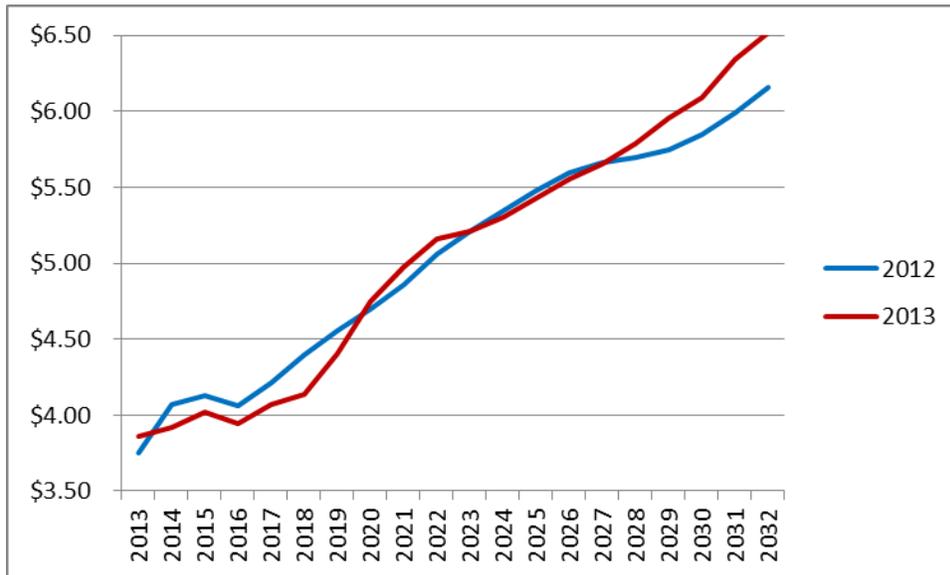
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Natural gas prices are important in the 2012 IRP in two ways. First, they are the cost of fuel for natural gas generation in some of the 2012 IRP resource portfolios. Second, natural gas drives the power pricing that helps to determine the cost-effectiveness of each of the IRP resource portfolios. The power prices determine the cost of market purchases and the revenue from market sales for each resource portfolio.

While shale gas was discussed in the 2012 IRP, it was not yet clear the extent to which shale gas would revolutionize the U.S. natural gas industry. Since 2012, additional productive shale reserves were identified in the Southeastern U.S. and Western Canada, further increasing an already large North American shale gas resource base.

In general, natural gas prices remained below the forecast used in the 2012 IRP. Natural gas prices were below \$4.50 per MMBTU for much of 2012 and 2013, reflecting strong shale gas production and inventories. However, for the winter of 2013-2014, one of the coldest on record for much of the Eastern U.S., natural gas prices temporarily jumped to over \$7.00 per MMBTU. The forecasts below were completed a year apart, both indicating the expectation that in the Pacific Northwest, natural gas prices will not again reach an average of \$5.00 per MMBTU until after 2020. Before 2022, the 2013 natural gas price forecast is consistently lower than the forecast used in the 2012 IRP.

## Natural Gas Price Forecasts, 2012 and 2013



Lower natural gas prices than forecasted in 2012 lead to larger differences in 2012 IRP portfolio costs, but are not expected to change the rankings in portfolio performance, since the portfolios with natural gas already had the lowest costs. This suggests portfolios with natural gas generation may be even more cost-effective in the 2016 IRP.

## FUTURE LOADS AND RESOURCES

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On an average annual basis, Seattle City Light expects to continue to have surplus energy for more than a decade. Comparing average generation with average demand is one of the commonly used measures in the industry. However, the wide variability in year-to-year hydro conditions means this measure is not very useful for evaluating the adequacy of hydro resources to serve load. Average hydro conditions and average demand tell us little about what happens in a very dry year. While these years are infrequent, they do occur and are quite unpredictable.

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### PROBABILISTIC RESOURCE PLANNING

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Some hydro utilities plan their resources to meet a “critical water” year, or the year with the lowest recorded water conditions. While this has the benefit of low risk, the range from the lowest water conditions to average water conditions is very wide, making this planning approach very conservative. It can cause unnecessary expense for customers to acquire and maintain rarely-needed resources and create a persistent, large energy surplus. Instead, City Light does probabilistic analyses of load and hydro conditions to assess the risk of having insufficient power supply. In the 2012 IRP, it established a target measure of 10% Loss of Load Probability (LOLP). LOLP is a measure of the likelihood that the utility cannot self-supply under the most adverse operating conditions – high demand, low supply, or a combination of both. If City Light were temporarily short on power it would still have the option to purchase and import power on the regional electric transmission system, as it did in 2001, one of the lowest water years on record. Planning to occasionally serve load with forward purchases is not new to Seattle City Light. In many years, the utility readjusts its power supply by selling surplus in the spring and buying forward for the summer and fall. This practice depends upon continuing to have a well-supplied and competitive regional power market.

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### THE REGIONAL POWER MARKET

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The state of the regional power market (Pacific Northwest and West-wide) is routinely studied by both the Western Electricity Coordinating Council (WECC) and the Northwest Power and Conservation Council (NPCC). Using very different study methodologies, their results are not always completely aligned, but typically agree on major conclusions.

One measure of the adequacy of supply of a regional power market is the reserve margin. The Pacific Northwest has a healthy reserve margin under WECC standards, as indicated by their 2013 Power Supply Assessment. Both the summer and winter reserve margins are above the North American Reliability Corporation (NERC) reference margin. In the NERC 2013 Long Term Reliability Assessment, WECC margins remain above the NERC reference margin through 2023. Reference margins are established by the corresponding public utility commission, NERC Region, ISO/RTO, or provincial authority. Absent a provided reserve requirement, NERC assigns a 15-percent margin for predominately thermal systems and a 10-percent margin for predominately hydro systems.

2013 WECC Regional Target Margins				
Subregion	Zones	Balancing Authorities in the Subregion	Summer Margin	Winter Margin
Northwest	Montana, Pacific Northwest	Avista Corporation, Bonneville Power Administration - Transmission, Tacoma Power, NaturEner Glacier Wind Energy, NaturEner West Wind, Northwestern Energy, PacifiCorp - West, Portland General Electric Company, PUD No. 1 of Chelan County, PUD No. 2 of Grant County, PUD No. 1 of Douglas County, Puget Sound Energy, Seattle Department of Lighting, Western Area Power Administration - Upper Great Plains West, Constellation Energy Control and Dispatch	17.5%	19.2%

The Northwest Power & Conservation Council uses a probabilistic measure when assessing resource adequacy in the Pacific Northwest. Their most recent study shows a Loss of Load Probability of 6 percent by 2019. This LOLP measures the probability that the region is unable to self-supply its electricity demand in all hours. The 6 percent is slightly higher than the regional target of a 5 percent LOLP, but is not considered cause for concern. Further, the 5 percent LOLP is a policy target that could easily be reached by constructing new power plants, or by achieving greater energy efficiency than used in the estimate. The same study shows that two years later, the LOLP climbs to 11 percent, with the retirement of half the capacity at the Centralia coal-fired power plant in 2020 and the closure of the entire Boardman coal-fired power plant in 2021. If construction of new power plants does not replace the retiring coal-fired generation, the resulting 11 percent LOLP would be a cause for concern for the region.

An important risk to both assessments is that more coal-fired generation capacity retires sooner than currently anticipated. For example, a state or national carbon cap-and-trade or carbon tax policy could be implemented, or the EPA rule, section 111d could prove more costly for Northwest coal plants than expected. Neither WECC nor the Northwest Power & Conservation Council speculates on future public policy when doing their assessments.

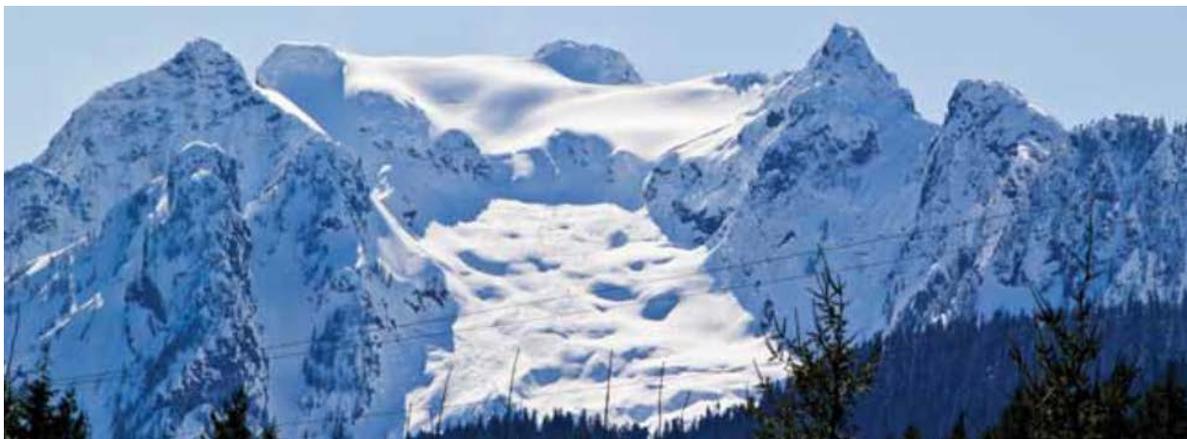
In the 2016 IRP, information on new construction and retirements of regional generating plants will be updated within the modeling, helping City Light to keep abreast of the expected future status of the regional power market. Scenarios of public policy on carbon dioxide emissions will be prepared.

For the IRP Update and Progress Report, City Light analyzed its current resource portfolio. Expected changes in City Light’s resources and a projected long-term average annual demand growth rate of 0.5% suggests that the onset of new energy resource needs may be delayed by at least two years in the upcoming 2016 IRP resource adequacy analyses as compared to 2012. The 2016 IRP will use rigorous analytical methods and the most current data and forecasts available at that time.

## THE ENVIRONMENT

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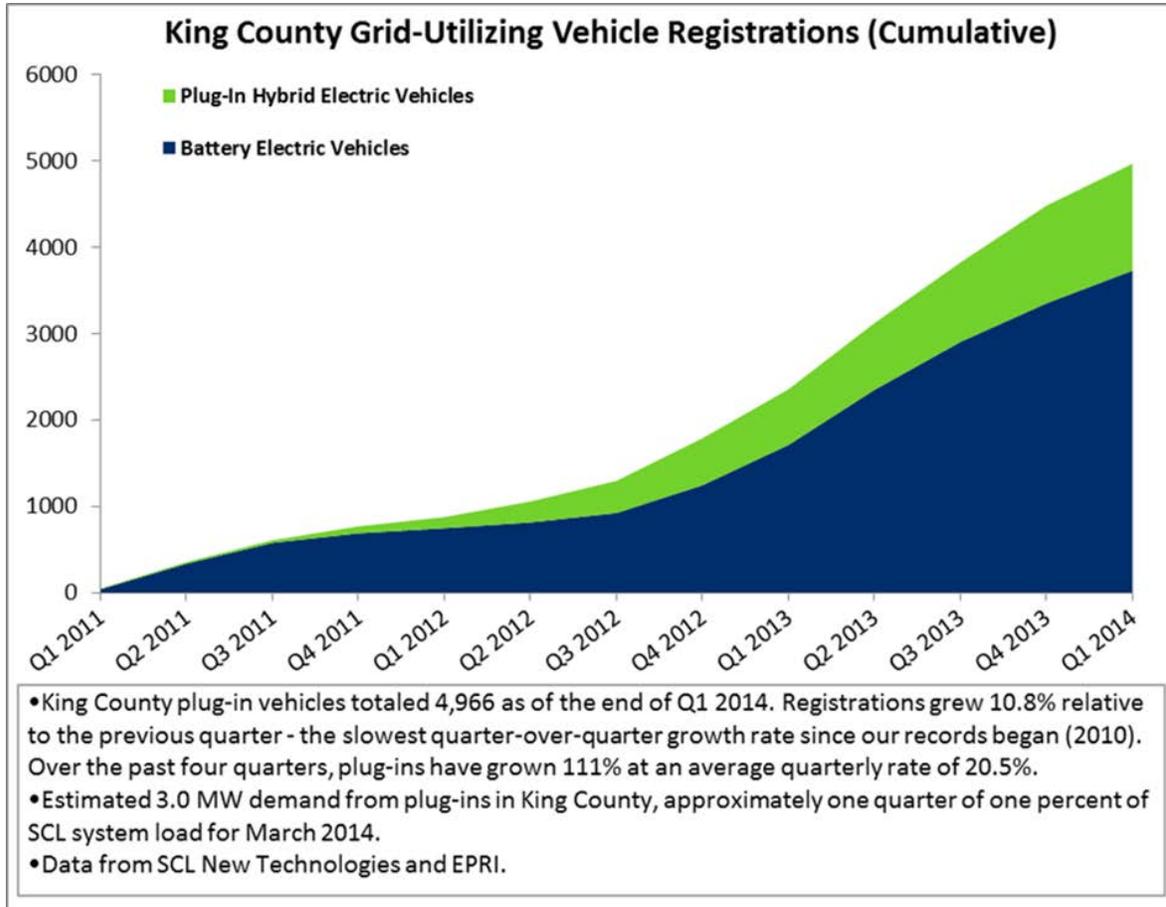
Being a good steward of the environment is a core value of Seattle City Light. As such, analysis of environmental impacts permeates the Integrated Resource Planning process. This is demonstrated in preparing an environmental impact statement (EIS) for the IRP and in extensive quantitative analysis of environmental impacts. For electric generation emissions, this includes modeling emissions rates and mitigation costs for carbon dioxide, sulfur dioxide, nitrogen oxide, mercury, and particulate for any market purchases made by City Light in the IRP portfolio simulations and analyses. Renewable energy credits and carbon dioxide emissions allowance costs are forecasted and included in resource portfolio costs. Constraints on river operations and reservoir management are modeled to protect and preserve four fisheries in the Skagit River (Chinook, Sockeye, Pink, and Steelhead). Avoided environmental costs are included in the analysis of the avoided cost of conservation.



City Light has modeled potential climate change impacts for river and reservoir operations. Part of the 2012 IRP Action Plan is to continue modeling climate change impacts on hydro operations. In the 2012 IRP, a key risk was identified as the impact of climate change on North Cascade glaciers. It is estimated that up to 44 percent of Skagit River flow below the Ross reservoir during the summer is made up of glacial runoff. Despite this, relatively little is known about the long-term impacts of climate change on the glaciers, other than that they have been clearly receding for many years. City Light has begun working collaboratively with the National Park Service to conduct an improved inventory of Skagit basin glaciers and glacial recession. With the National Park Service and the University of Washington, it is working to model present-day glacier contributions to stream flow. Lastly, City Light is working with the University of Washington to model and forecast future glacial runoff and contributions to stream flow.

## ELECTRIC VEHICLES AND SOLAR PV

### ELECTRIC VEHICLES



Seattle City Light has been assisting its customers with information and advice for electric vehicles and rechargers for years. From a planning perspective, City Light first forecasted electric vehicle electricity demand in its 2010 IRP. In that study, customer's purchases of electric vehicles were expected to grow slowly because of significant obstacles to rapid, widespread adoption. Those obstacles included range anxiety due to battery limitations, higher costs than conventional vehicles, slow sales because of a slow recovery from the great recession, and the fact that in 2010, the average U.S. vehicle was replaced only about every 10 years.

However, as the chart above shows, there was a change by the end of 2012. By 2013, electric vehicle sales, especially all-electric, were growing at a faster rate. The economy improved and the relative all-in cost differential for electric versus gasoline-fueled vehicles was declining.

In 2013, Toyota Motor Company alone sold over 1 million electric vehicles worldwide, with the Prius accounting for about half of total electric vehicle sales. By 2014, electric vehicle sales growth was still relatively fast in King County, but showing signs of slowing, following an

international trend. The international trend of slowing electric vehicle sales growth reflects the previous high sales growth rate and getting closer to saturation of the current market. Toyota recently announced plans to move away from all-electric cars to vehicles powered by a hydrogen fuel cell, which it believes will better meet consumer needs. Their new vehicle, to be launched in 2015, is expected to be called the “Mirai,” which means “the future” in Japanese.

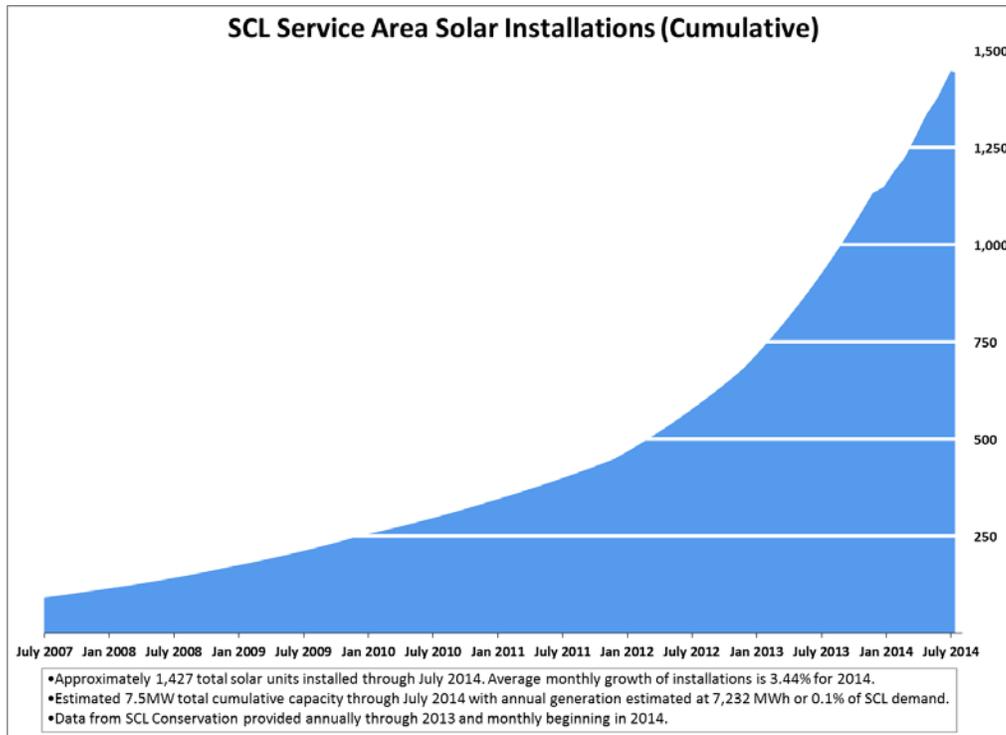
Also on the horizon is the promise of lower cost, longer-range, all-electric vehicles. Tesla currently produces the Model S, but the all-electric vehicle has a base price of about \$70,000. Tesla intends to produce an all-electric vehicle to retail around \$40,000 in 2017, putting it much closer to the cost of a gasoline-fueled vehicle. On June 12, 2014, Tesla’s CEO, Elon Musk, announced that Tesla will share all its technology patents with its competitors, with the hope of spurring a mass market for electric vehicles.

### Toyota “Mirai” Fuel Cell Vehicle



### Tesla Model S

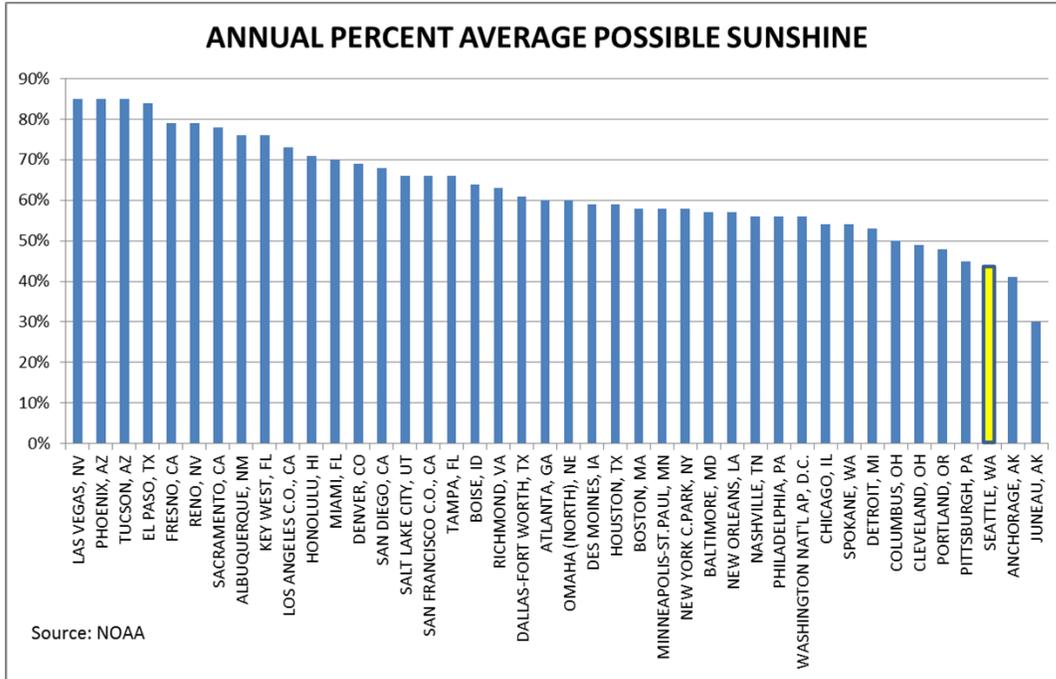




Like electric vehicles, solar photovoltaic (PV) panel installations in Seattle City Light service area are growing rapidly, but are still a very small percentage of total supply. Solar PV is attractive to some customers because of its low environmental impacts and the ability to self-generate power. This is a national trend, with solar power costs reaching parity with electricity prices in some U.S. metropolitan areas. Prices for solar PV panels have fallen considerably in the past few years, as increased production has created economies of scale and increased competition between solar panel producers. Rapid growth in solar installations has led industry observers to forecast the end of the electric utility business as we know it. If the majority of customers self-supply large amounts of their power, what happens to electric utilities, with their central-station generation and distribution business model?

In Seattle, however, the situation is somewhat different. Seattle has a cloudy marine climate that yields about half the solar electricity production that an identical system would produce in the desert Southwest. Seattle has some of the lowest electricity prices for a major metropolitan area in the United States. Peak solar PV electricity production occurs in the summer, yet peak electricity demand in Seattle occurs in the winter. With low winter production and no production at night, nearly all local installations of solar PV systems are not the primary

electricity supply for most of the year. The combination of limited sunshine and competing low cost power make Seattle one of the most challenging locations for solar power economics in the country. Continued federal tax credits and a sizable Washington state subsidy are needed to make projects cost-effective for consumers.



Solar PV electricity production does not produce carbon dioxide or other emissions, but neither do hydroelectric plants, the source of about 90 percent of Seattle’s power. City Light’s power has had net zero greenhouse gas emissions since 2005.

At present, solar-generated power serves about one-tenth of one percent (0.1%) of Seattle’s electricity demand. Nevertheless, even in Seattle this is an important trend to watch, as new technology, new production cost improvements, or increased subsidies could spur faster growth and portend future changes to City Light’s operations and business model.

## PROGRESS ON THE 2012 IRP ACTION PLAN

<b>Summary of 2012 IRP Action Plan Progress</b>			
<b>Action</b>	<b>2012</b>	<b>2013</b>	<b>Progress</b>
Pursue accelerated conservation in the amounts targeted in the renewables: base conservation portfolio, as budget allows:	14 aMW by end of 4th Quarter	14 aMW more by end of 4 <sup>th</sup> Quarter	Achieved 2012 and 2013 targets of 14 aMW, exceeding I-937 requirements in both years.
Continue to acquire RECs, per the resource acquisition strategy, in order to meet I-937 requirement	Acquire an annual average of 7.3 aMW	Acquire an annual average of 7.3 aMW	Pursuant to City Light's resource acquisition strategy we acquired RECs as a rate greater than 7.3 aMW per year and exceeded the 2012 and 2013 targets well in advance. City Light is in compliance with I-937 on a forecast basis through the 2020 target year and beyond.
Work to ensure sufficient transmission transfer capability for City Light to support serving peak customer demand	Ongoing	Ongoing	City Light's current transmission transfer capacity is sufficient to meet current peak customer demand. City Light continues to work with the relevant transmission providers to obtain long-term, firm transmission for new, renewable resources acquired to meet I-937 requirements.
Serve retail load with market purchases, short-term exchanges, and transactions to reshape seasonal energy as needed	Ongoing	Ongoing	Entered into an exchange agreement for Lucky Peak hydro generation.
Complete a new conservation resource potential assessment for use in integrated resource planning and I-937 compliance	Complete project design and contracting	Complete study and report results for use in 2014 IRP, I-937	2013 Conservation Potential Assessment completed in Spring 2013, finding an additional 44 aMW of conservation potential in 2014-2015
Engage BPA to limit the cost drivers in the FY 2013-14 rate case	Ongoing	Ongoing	Pursuant to City Light's Strategic Plan, City Light has continued to engage with the BPA on a wide range of issues to limit the rate at which our BPA power and transmission rates have been increasing. The utility continues to have some success in limiting the percentage by which these rates have been increasing.
<b>Future Resource Costs</b>			
Investigate the development status, costs, and commercial availability of resources	Ongoing	Ongoing	Conducted Requests for Proposals and evaluated new renewable resources. Participating in the generation resource advisory committee of the Northwest Power & Conservation Council.
Continue to refine forecasts, modeling, and assumptions	Ongoing	Ongoing	Initiated long-term outage plans in IRP, helping define variations in resource needs through 2031. Adjusted normal temperatures for warming in Seattle climate, calibrating seasonal demand forecasts.
Continue participation in and evaluation of climate change research for impacts to hydro operations and fish populations	Ongoing	Ongoing	Conducted a review of recent research on climate change and updated expected impacts of climate change on future City Light electricity demand. Working with the National Park Service to study the impacts of Climate Change on North Cascades glaciers feeding the Skagit River.

## RECOMMENDATIONS FOR THE 2016 IRP

### 2014 IRP Stakeholders

John Chapman, University of Washington Tom Eckman, Northwest Power & Conservation Council Nancy Hirsh, Northwest Energy Coalition Steve LaFond, Formerly WECC Board of Directors Mike Locke, McKinstry Paul Munz, Bonneville Power Administration Mike Ruby, Envirometrics, Inc.	Cameron Cossette, Nucor Steel Seattle Steve Gelb, Emerald Cities Tony Kilduff, Ph.D., Seattle City Council Staff Henry Louie, Ph.D., Seattle University Megan Owen, McKinstry Chris Roe, The Boeing Company Jennifer Sorensen, Ph.D., Seattle University
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As part of the process for updating the 2012 IRP, Seattle City Light engaged the 2014 IRP Stakeholders to review the assumptions and methodologies used in the IRP and make recommendations about potential improvements. These recommendations will be used in the design of the 2016 IRP, which will begin in early 2015. The recommendations included:

1. Continue to research long-term impacts of climate change on Seattle City Light’s hydro resources.

Seattle City has made a good start on climate change research. The results of research in the 2010 and 2012 IRPs suggest that climate change will reduce Seattle’s hydro resource availability in the summer, while at the same time warmer temperatures are increasing electricity demand for air-conditioning.

2. Evaluate the impacts that EPA’s rule on carbon dioxide emission might have on Seattle City Light.

On June 2, 2014, the Environmental Protection Agency issued “Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units.” The final EPA ruling is expected to result in closure of some coal-fired generation plants in the Western United States. This could impact the supply and cost of electricity in western power markets.

3. Assess opportunities to increase the value of Seattle City Light’s Conservation efforts.

Seattle City Light has long worked to ensure conservation programs serve all types of customers. However, there may be opportunities to further increase the value of conservation efforts by targeting locations with fast growing load to reduce capacity limitations of distribution lines or substations. Alternatively, targeting conservation to more directly reduce winter or summer peak loads.

4. Assess the impacts of growth in solar photovoltaic installations, electric vehicles, and the installation of a smart grid in Seattle in 2017.

While in early stages of development, each of these three technologies holds the potential to significantly impact electricity demand and long-term resource planning at Seattle City Light.

Other Recommendations:

- Look for opportunities to present to community groups as part of other City meetings to improve public engagement.
- Ensure the 2016 IRP is aligned with Seattle's Climate Action Plan.
- Work to better understand the declining growth rate in electricity demand.
- Evaluate the cost and risk tradeoffs in the 10 percent LOLP resource adequacy standard.
- Investigate the potential impacts of liquified natural gas exports from British Columbia.
- Monitor the regional power market for signs of shortage or excessive costs.