Seattle City Light

Seattle's municipal electric utility

2010 Integrated Resource Plan

“That Man May Use It Freely as the Air He Breathes, the Waters of the Rivers, the Winds of Heaven”

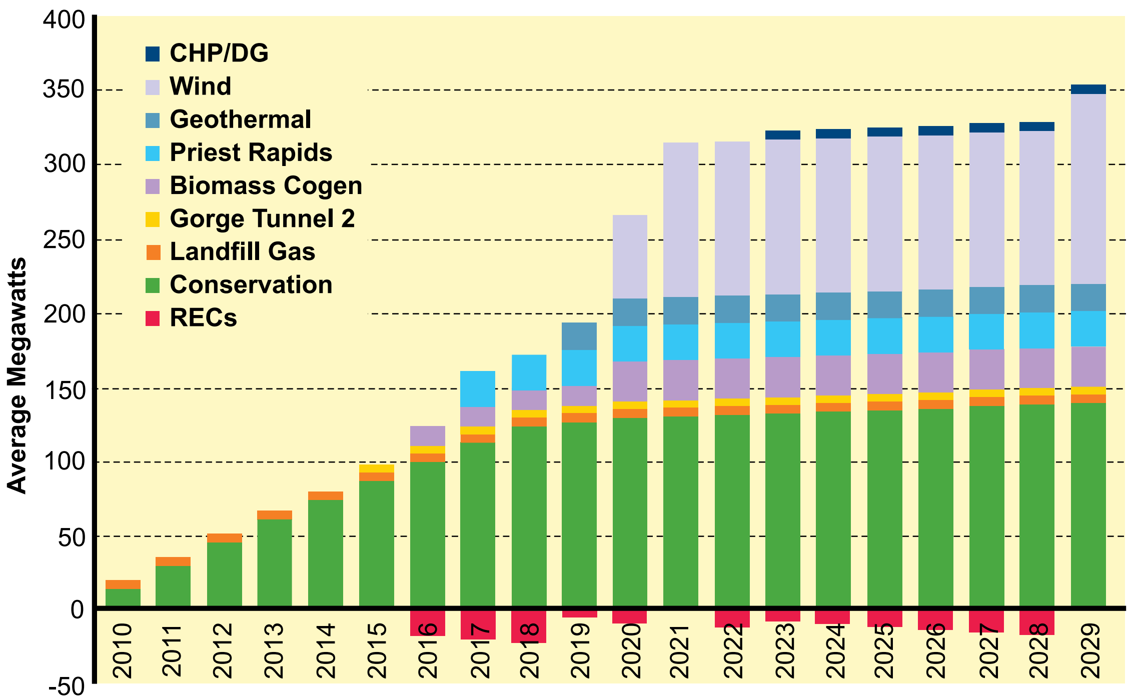
1958, Seattle City Light Glass Mosaic by Jean Cory Beall, d. 1978. This photograph shows part of the mural that adorned the former City Light building on Third Avenue until 1996. Another detail is shown on page 33. The mural is now housed at the Museum of History & Industry. Photographs courtesy of Carolyn Marr, Librarian, Museum of History & Industry.

Summary

In 2009 and 2010, City Light worked with stakeholders and the public to develop a plan for future energy resources. The plan identifies how much power and conservation is needed, and when. City Light analyzed a number of potential resources to add to its existing resource portfolio over the next twenty years. Combinations of generation and conservation resources were evaluated for reliability, cost, risk, and environmental impact. Public and stakeholder input was solicited along the way, and the portfolio shown below was identified as the one best able to reliably meet customer demand at the lowest cost.

Figure 1

Preferred Portfolio for Meeting Winter Resource and I-937 Needs*



*Also includes from 50-200 MW short-term exchanges, reshaping transactions, and short-term market purchases in the winter heating season.

Key Points

- Conservation is the resource of choice and, as recommended in the 2008 IRP, it should be acquired in the near term to gain the greatest benefit.
- The utility can meet its energy needs through 2020 without acquiring new year-round generating resources, through a combination of conservation, efficiency improvements, flexibility of current power contracts, and market purchases.
- City Light plans to begin acquiring renewable resources and/or renewable energy credits (RECs) now, as necessary to meet I-937 requirements by 2016.
- The IRP analysis demonstrates that a mix of renewable energy credits and renewable resources throughout the planning period performs best.

Conservation is the resource of choice…

Acknowledgements

2010 IRP Stakeholders

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Danielle Dixon	Northwest Energy Coalition
Tom Eckman	Northwest Power & Conservation Council
Mike Hansen	Sabey Corporation
Hamilton Hazelhurst	Vulcan Development, Inc
Pam Jorgensen	Harborview Medical Center
Steve LaFond	Boeing Company
Henry Louie, PhD	Seattle University
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Mike Ruby	Envirometrics, Inc.
Scott Rusch	Fred Hutchinson
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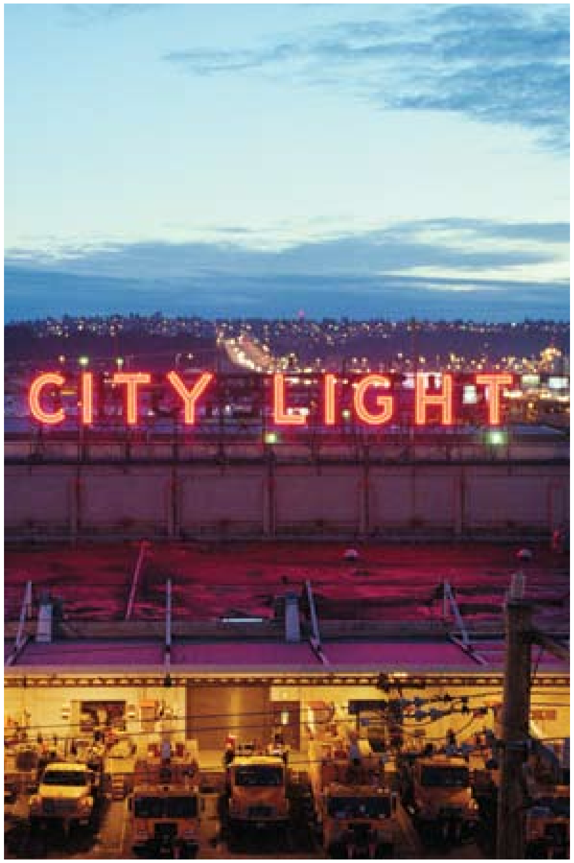


Seattle City Light is the first carbon-neutral utility in the nation. It offers some of the lowest rates in the nation and the Northwest.

Organization

On the cover:
Ross Dam on the Skagit River
Columbia Ridge Landfill Gas
Stateline Wind
Burlington Biomass
Sockeye salmon
Bald eagles
Compact fluorescent light bulbs
City Light South Service Center

Part I – Introduction

City Light operates in an environment shaped by regulation, city, state, and federal policies, and Western wholesale power market dynamics. The utility's resource plan must comply with Washington state legislative requirements for Integrated Resource Plans and the acquisition of renewable resources. As a municipal utility, City Light seeks public involvement in making resource decisions.

Legislation

ESHB 1010 (Chapter 195, Laws of 2006, Revised Code of Washington (RCW), Chapter 19.280) was passed by the Legislature in 2006, and requires certain Washington utilities, including City Light, to regularly prepare Integrated Resource Plans (IRPs). Under this law, IRPs must describe the mix of energy supply resources and conservation 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 conservation and a wide range of commercially available generation technologies, including renewable technologies.

The Energy Independence Act (RCW, Chapter 19.285) requires utilities in Washington with more than 25,000 customers to acquire all cost-effective conservation at a prescribed pace and to acquire eligible renewable resources at a rate of a) 3% of retail load by 2012; b) 9% of retail load by 2016; and c) 15% of retail load by 2020. Eligible renewable energy must either be sourced from within the Pacific Northwest, or be purchased outside the Pacific Northwest but delivered into Washington on a firm transmission path, in real-time, without integration services. Hydroelectric power is not qualifying renewable energy, unless it is the direct result of qualifying hydro efficiency improvements made after March 31, 1999. The requirement for qualifying renewables can be met with renewable energy credits (RECs), which represent the environmental attributes of qualifying renewable resources at the rate of one REC per megawatt-hour. (See Appendix A – Regulatory Requirements for Planning, and Appendix B – The Planning Environment.)

Washington state Initiative 937 requires acquisition of renewable resources, such as wind.

Initiative 937 (I-937): The Energy Independence Act

I-937 passed by ballot measure in the State of Washington in 2006. I-937 established a statewide renewable portfolio standard, setting targets for the percentage of retail demand that must be met with renewable power and setting a conservation target for each qualifying electric utility, including City Light. The renewable power target is 3% in 2012, 9% in 2016, and 15% in 2020. For the conservation target, each qualifying utility must achieve no less than 20% of its cost-effective conservation every two years. The 2012 renewable power target has already been met by City Light's Stateline wind contract. However, since hydroelectric power does not count as renewable in I-937, City Light must acquire renewable resources or renewable energy credits to meet its 2016 and 2020 targets. Acquisitions of resources and/or renewable energy credits in the plan during the first decade are designed to meet City Light's I-937 requirements.

Public Involvement

Over the next 10 years, City Light will make resource and I-937 compliance choices. These choices may require investing hundreds of millions of dollars of customer funds, affecting future operating costs, reliability, and the City's environmental footprint for decades to come. As a publicly-owned utility, customer input on the integrated resource plan is essential. City Light conducted six IRP stakeholder meetings with representatives of customers, power suppliers, environmental organizations, governmental policy-makers, and universities. In addition, City Light held three public meetings and maintained a website to collect comments on the IRP.

To summarize the views of the stakeholder and public participants, there was broad support for both the recommended resource portfolio over alternative portfolios and continued aggressive pursuit of conservation; strong interest in solar and other distributed resources; and concern over the potential environmental impacts of alternative resource choices – particularly in the extraction of natural gas from shale formations. City Light was urged to acquire renewable energy credits and renewable resources earlier instead of later, based upon the possibility that future costs could be higher. They also recommended that City Light acquire both renewable resources and renewable energy credits (RECs) for compliance with I-937 because of uncertainty about the future supplies and costs of both. The IRP stakeholder group made more specific recommendations about future areas of investigation and analyses, which are reflected in the IRP Action Plan. (Additional details are provided in Appendix C – Public Involvement.)

As a publicly-owned utility, customer input on the integrated resource plan is essential.

Landfill gas generation was one of the resources recommended for acquisition in the 2008 IRP. City Light began receiving output from the new Columbia Ridge facility in late 2009.

Part II – Load Growth

The utility is obligated to serve customer load under all conditions, including the combination of severe cold and drought when the system is most stressed. New resources will be needed in order to meet service-area load growth and/or to comply with I-937. The timing of resource acquisition depends on the rate of load growth, together with the I-937 schedule for acquiring renewable resources and/ renewable energy credits. The amount of resources acquired depends on the level of reliability desired, as well as the mandates of I-937.

Commercial load growth is concentrated in Seattle's downtown core.

Plug-In Hybrid and Electric Vehicles

As promised, the Nissan Leaf electric vehicle will be available by the end of this year, and the Chevrolet Volt in 2011. Other automakers are also coming out with electric and plug-in hybrid vehicles over the next couple of years. Nine advanced automotive battery plants are being built in the US (four in Michigan).

Subsidies, tax credits, and other incentives are designed to overcome obstacles to establishing an electric transportation system. The two main obstacles are the battery technology and charging infrastructure. The batteries are expensive, thus the subsidies that make them price competitive; mass production may bring down the cost. The batteries also take a lot more time to charge than does refueling a hybrid or a gas-powered vehicle. The second obstacle, lack of charging infrastructure, contributes to what has been dubbed as "range anxiety," the fear of being stranded. There is, too, the cost of a home charging station, with a current unit cost of about $2,000, in addition to a subsidized vehicle cost of about $25,000.

In the 2008 IRP, the impact of the adoption of plug-in hybrids and all electric vehicles on system load was evaluated. The effect on peak load depended on assumptions about market penetration and charging patterns for a vehicle with a 40-mile range. Although it was conceivable that load during the peak period could increase by about 20 average megawatts, such an increase could easily dealt with because of the storage capacity of the utility's hydro system. Efforts to overcome the inconvenience of the long charging periods have lead to the development of quick charging devices. This potential for increasing the level vehicle-charging load is examined in Appendix D – The Impact of Electric Vehicles on System Load.

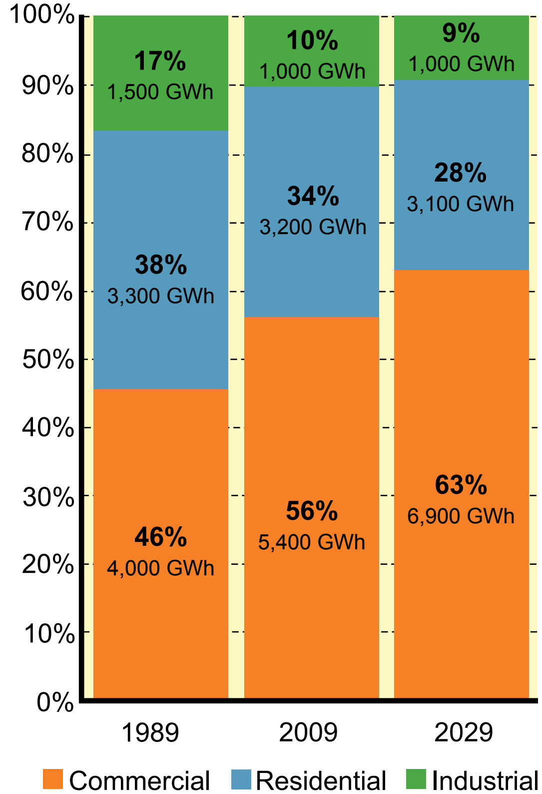
Load Forecast

City Light's load has declined from a pre-recession high of 1,160 annual aMW in September 2008 down to 1,130 annual aMW in mid-2010 – a level first seen in early 1999. System load is expected to return to its pre-recession level by mid-2013 and to continue to grow at an average annual rate of 1.4% over the 20-year planning period, if there is no new programmatic conservation. Programmatic conservation will be acquired in the early years of the planning period, with the cumulative amount reaching 113 aMW by 2018, and 134 aMW by 2029. This level of programmatic conservation reduces the average growth rate to 0.8%.

Load growth is driven by economic activity, and the forecast of system load is based on forecasts of several economic and demographic variables. Variables with the greatest predictive capability are employment and the number of households. The Seattle area enjoys a resilient economy, and the city of Seattle is a growing commercial and financial center. Long-term load growth is expected to be strongest in the commercial sector. Because each of the customer classes is growing at a different rate, the customer mix will change over time, with commercial load becoming an ever larger portion of total load, as shown in Figure 2.

Figure 2

Change in Load Mix at 20-Year Intervals



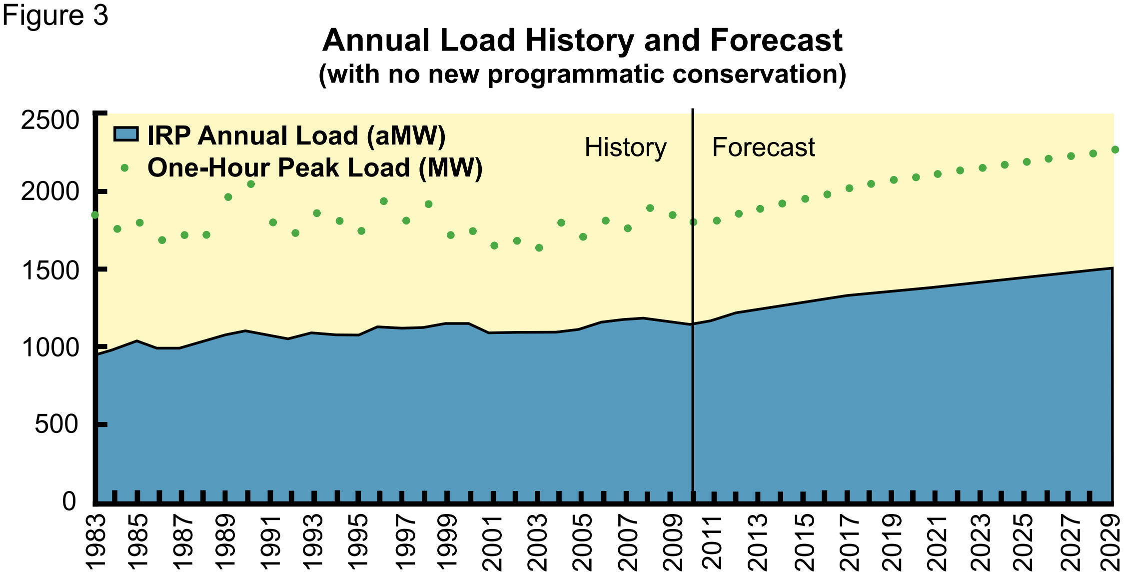
Long-term load growth is expected to be strongest in the commercial sector.

Will Seattle Lead the Way?

There are several pilot programs for electric and plug-in hybrids throughout the nation. Seattle is participating in a $100 million U.S. Department of Energy project to deploy 11,000 charging stations and 4,700 Nissan Leaf vehicles in ten cities in five states. Three of the other participating cities are in the Pacific Northwest: Portland, Corvallis, and Eugene, Oregon. Nissan is already fully subscribed; purchasers receive a federal tax credit that brings the sticker price of $32,780 down to about $25,000. Nearly half of the 11,000 charging stations will be home-charging packages, with Nissan handling the permitting and installation. King County is also installing charging stations at some of its public facilities, such as park-and-ride lots. A recent City Light survey of residential customers found that about 6% of households already have a hybrid, plug-in hybrid, or electric-powered vehicle.

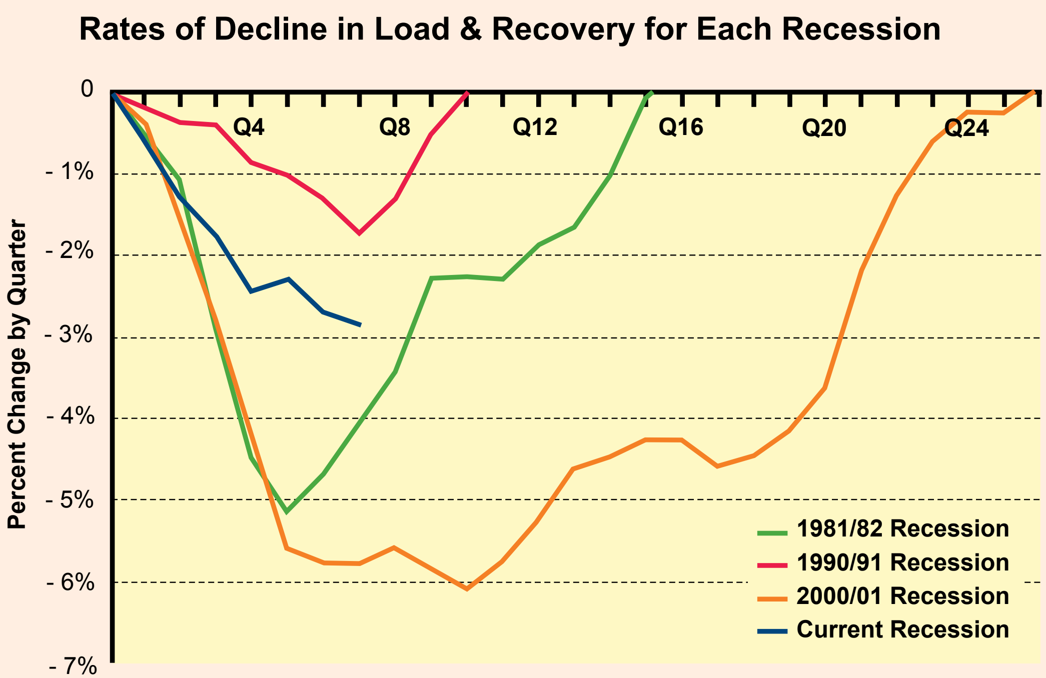
City of Seattle, Port of Seattle, King County and Puget Sound Clean Air Agency are testing the performance of PHEVs.

Figure 3



For the purposes of the IRP analysis, the assumption of no new programmatic conservation is necessary so that additional new conservation can be evaluated in the same way as new generation resources. The load forecast displayed in Figure 3 is, therefore, higher than the forecast of load that is used for determining the amount of generation needed to serve load. (More information on load and the load forecast are presented in Appendix E – Load Forecast for the Integrated Resource Plan.)

Figure 4



The Recession & System Load

From peak to trough, system load (adjusted for weather) has dropped by nearly 3% due to the current recession, less than half the 6% decline experienced in the early 2000s when the Seattle economy suffered the double impact of the dot.com bust and the West Coast energy crisis. The utility expects to regain load lost during the current recession by mid-2013. The accompanying graph compares the effect on load of the current recession with the most recent three.

Part III – Current Portfolio, Resource Adequacy and I-937

Although City Light's current portfolio is sufficient on an annual basis to meet load growth over the next decade, the utility must also have enough power to serve its customers during short-term periods when loads are high and resources may be stressed. Resource adequacy studies help determine the level of need for additional resource availability at such times. Beyond acquiring resources to serve load, the utility is also required to meet the mandates of Washington State Initiative 937 by acquiring renewable resources or renewable resource credits (RECs).

Current Portfolio

City Light's current resource portfolio is predominantly hydropower, both owned and contracted, as shown in Figure 5. Boundary Dam, located on the Pend Oreille River in northeastern Washington, produces the most power, but has only modest storage capability. The Skagit Project in northwestern Washington has generous storage capability that provides valuable operational flexibility for the portfolio. As one of its "preference customers," the utility is entitled to low-cost power from the Bonneville Power Administration (BPA). Additional hydro comes from smaller projects, both owned and contracted.

Figure 5

City Light's Owned and Contracted Resources

	Nameplate Capability MW	Annual Energy Critical Water aMW	Annual Energy Average Water aMW
Owned Resources			
Boundary Project	1022	267	394
Gorge	173	80	109
Diablo	169	66	94
Ross	460	63	100
Small Hydro	48	18	23
Total	1872	494	720
Contracted Resources			
Bonneville	970	567	610
Priest Rapids	14	14	18
GCPHA	64	27	27
High Ross	72	36	36
Lucky Peak	113	28	33
Stateline Wind Project	175	n/a	47
Total	1408	672	771

Source: *Bond Issue Official Statement, 2010*

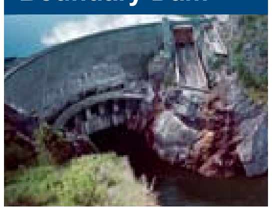
(In addition, SCL has recently acquired small amounts of landfill gas and biomass.)

The current portfolio also features non-hydro resources that qualify under I-937 and fulfill its requirements through 2015. The largest is Stateline Wind, plus small amounts of biomass and landfill gas. Power is also purchased in the wholesale market to supplement owned and contracted resources. (See Appendix F – Current Resource Portfolio for more information.)

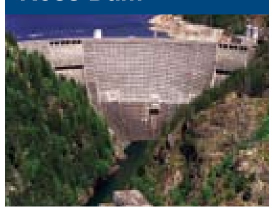
Figure 6

Energy Resources

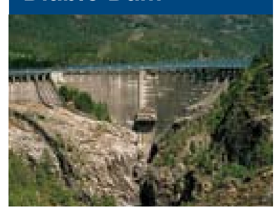
Boundary Dam



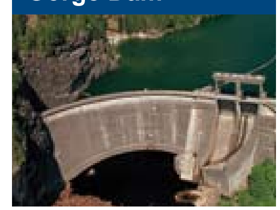
Ross Dam



Diablo Dam



Gorge Dam



Stateline Wind

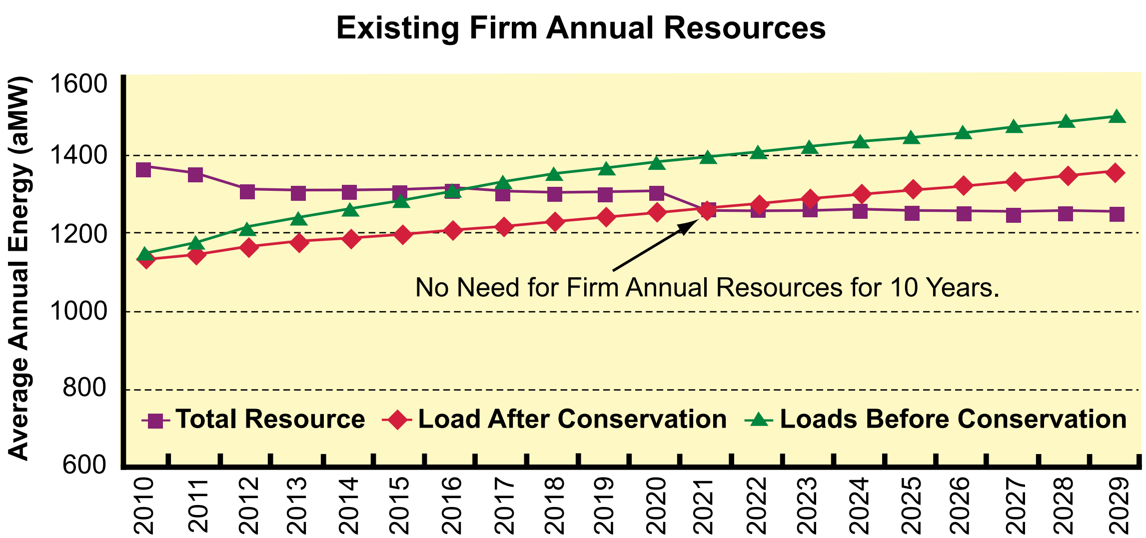
City Light's current resource portfolio is predominantly hydropower, both owned and contracted.

Low water at Tolt reservoir

Snowmelt in the North Cascades feeds streams and lakes at the Skagit project.

City Light provides a high level of resource reliability. On an average annual basis, City Light's current portfolio of firm resources can carry it through until about 2021. In an average water year and with normal temperatures, City Light often has substantial surplus power available to sell in the wholesale power market, even during the winter when load is highest. Under very low water conditions and average demand, however, City Light could be short of firm resources on an annual average basis by 2021. Figure 7 shows annual firm energy available under low water conditions (1977) from existing resources compared to load projections, with and without new programmatic conservation.

Figure 7



City Light often has substantial surplus power available to sell in the wholesale power market, even during the winter when load is highest.

Figure 8

Need for Annual Firm Resources (Annual aMW)			
	Existing Annual Resources	Load after New Programmatic Conservation	Annual Need for New Generation Resources
2010	1,367	1,132	
2011	1,354	1,144	
2012	1,312	1,164	
2013	1,308	1,176	
2014	1,308	1,186	
2015	1,308	1,194	
2016	1,312	1,204	
2017	1,305	1,215	
2018	1,303	1,225	
2019	1,303	1,236	
2020	1,307	1,248	
2021	1,256	1,260	4
2022	1,256	1,273	17
2023	1,256	1,285	29
2024	1,260	1,296	36
2025	1,256	1,307	51
2026	1,256	1,318	62
2027	1,253	1,331	77
2028	1,256	1,343	87
2029	1,252	1,355	104

Renewable Energy Credits (RECs)

RECs represent the technology and environmental attributes of electricity generated from renewable energy resources. A REC is a tradable certificate that is proof of at least one hour of generation from a renewable generation facility. It can be sold separately from the generic energy it is associated with. As used in the IRP, RECs are compliant with Washington's Energy Independence Act of 2006 (I-937). This law specifies that RECs must be from a qualifying renewable generation facility that is not powered by fresh water, the generation facility is located in the Pacific Northwest, and are verified by a renewable energy credit tracking system selected by the Washington Department of Commerce.

Nearly 400,000 customers depend on City Light for electric power.

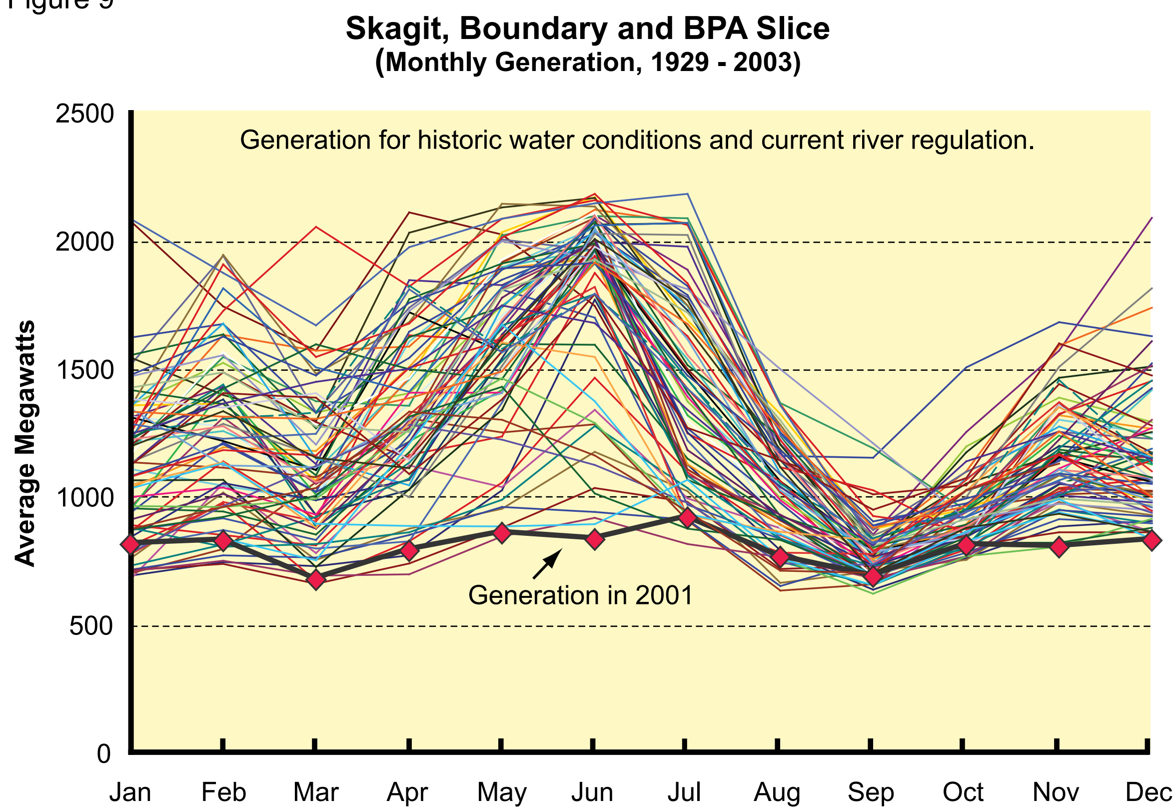
Hydropower Generation Variability

Over 90 percent of City Light's power comes from hydroelectric power plants. Hydro is an excellent resource, but highly variable, both across seasons within a year (Figure 9) and from year-to-year (Figure 10). Historically, hydropower generation for City Light has sometimes varied by more than 50 percent from year-to-year. This high degree of variability makes long-term operational planning difficult, as does providing for sufficient reserves. City Light uses statistical measures of generation variability, in combination with the variability of demand, to estimate future resource needs.

Diablo Switchyard.

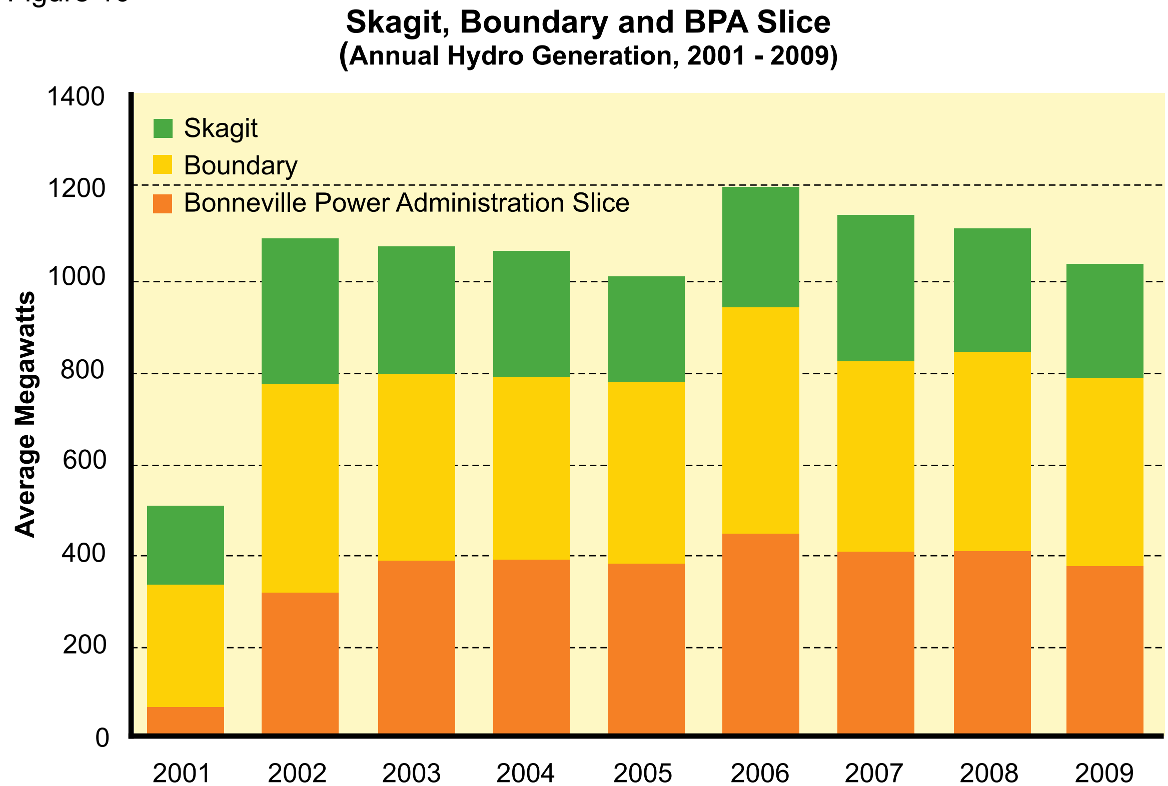
Gorge Powerhouse.

Figure 9



Ross Dam in the North Cascades

Figure 10



Over 90 percent of City Light's power comes from hydroelectric power plants. Hydro is an excellent resource, but highly variable.

Diablo Dam

Resource Adequacy Needs

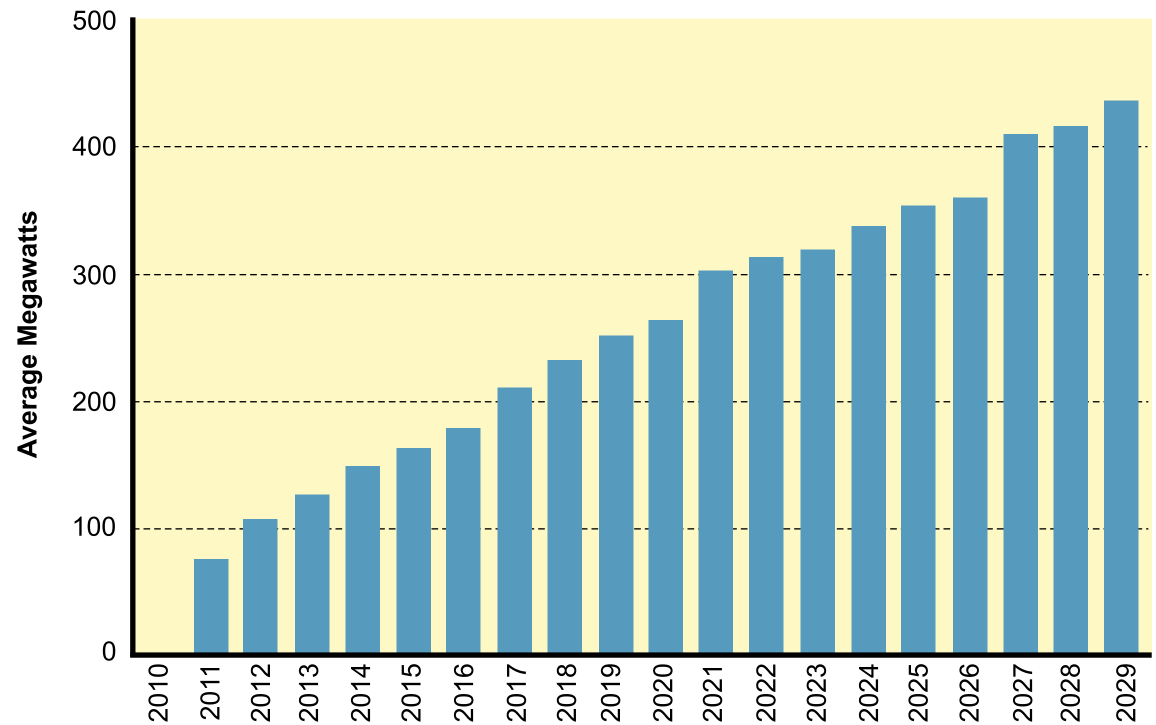
Challenges to the reliability of City Light's power supplies can arise from variability in hydro generation capability, volatility in customer demand, and unplanned generation and/or transmission outages. Having sufficient resources to overcome these challenges and meet customers' energy requirements at all times is called "resource adequacy." IRP stakeholders have recommended a target resource adequacy measure equaling a 95% probability that City Light will have sufficient resources to meet customer demand. A probabilistic measure has advantages over many previous measures because it is dynamic, considers the variability of both demand and generation simultaneously, and provides a better understanding of how much risk is being taken. As a winter-peaking utility, City Light measures this target as a 95% probability of meeting customer's highest hourly peak demand in the month of December. Although peak demand most frequently occurs in January, historically, cold fronts have driven the highest peak demand periods in December. In this analysis, demand variability, hydro variability, unplanned generation outages, and operating reserves are considered.

As customer demand increases, so does the amount of resources needed. The targeted amount of additional energy resources needed each year to ensure the 95% level of power supply reliability is calculated within the IRP. This amount has been adjusted to reflect anticipated near-term actions by City Light including wintertime wholesale market purchases, seasonal exchanges, and reshaping of current contract hydro resources. The remaining resources needed each year become planned new winter resource additions, or planned energy conservation, in each of the prospective resource portfolios evaluated in the IRP. The same resource adequacy target is maintained for each prospective resource portfolio.

The resource adequacy analysis results in targeted resources that grow at an annual average rate of 0.9% per year. This is slightly faster than the expected average rate of demand growth alone (after conservation), but also covers the expiration of resource contracts, hydro variability, unplanned outages, and operating reserves. Figure 11 depicts the new conservation and generating resource targets used in the 2010 IRP. (Appendix G – Resource Adequacy provides additional detail on how resource adequacy is determined.)

Figure 11

Winter Heating Season Resource Targets for 95% Coverage



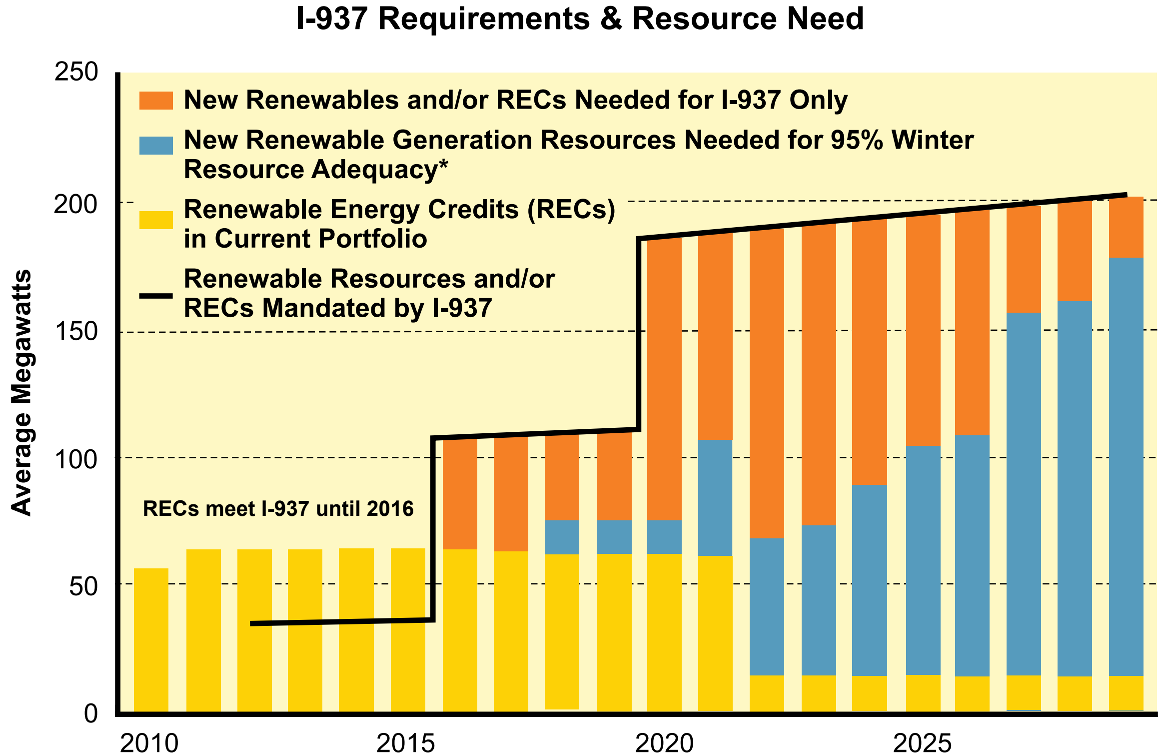
Initiative 937 (I-937) Needs

In 2006, I-937, also known as the Energy Independence Act, was passed by ballot measure in the state of Washington. This law establishes requirements for large Washington utilities, like City Light, that they must meet an escalating percentage of their demand (3% in 2012, 9% in 2016, and 15% in 2020) with qualifying renewable energy or renewable energy credits. Renewable energy credits, as defined in the Act, represent only the environmental attributes of renewable energy – and can be purchased from qualifying renewable energy producers.

Although hydropower does not count, from 2012 to 2016 City Light meets the I-937 requirements because of its existing qualifying renewable resources, which include wind, landfill gas, and biomass. The dark yellow bars in Figure 12 represent the amount of qualifying renewable resources or RECs that City Light currently has, or expects to have, available. The amount decreases in 2022 when the Stateline Wind contract expires.

For the 2016 through 2019 requirements, the utility is currently estimated to need about 40 average megawatts (aMW) more. Failing to meet the I-937 requirements can result in a fine. The fine escalates with inflation and is estimated at $64 for each megawatt-hour (MWh) a utility falls short in 2016. For example, if City Light had a 10 aMW shortfall for its estimated 113 aMW target for the year 2016, it could expect a $5.6 million fine. This is why it is very important for the utility to plan for and acquire sufficient RECs and resources ahead of the 2016 requirement. Acquiring RECs and renewable resources to meet the I-937 requirements is part of the 2010 IRP Action Plan.

Figure 12



*These renewable resources will count for I-937. To the extent that any new resources acquired to meet resource adequacy are not renewable, a like amount of renewables and/or RECs would be needed to meet I-937.

All the resource portfolios in the 2010 IRP are designed to contain sufficient renewable resources and/or renewable energy credits to meet future I-937 requirements, as well as the resource adequacy targets described above. Each candidate IRP resource portfolio is tailored to meet both of these important objectives. Because of this, candidate resource portfolios are similar in size and in the timing of new conservation and resource additions.

Part IV – Resource Options, Candidate Portfolios and Scenarios

Resources considered for acquisition were primarily conservation, efficiency improvements, and renewable resources. Conservation is featured in all candidate portfolios, as are currently planned efficiency improvements. Candidate portfolios comprising various combinations of resources were analyzed in the Round 1, with the more promising portfolios moving on to Round 2 analysis, which included scenarios testing.

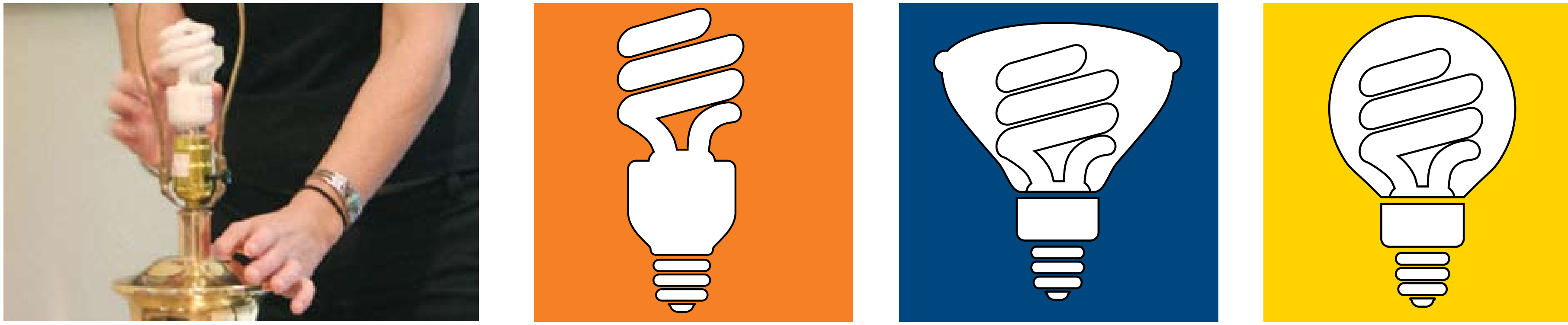
Resource Options

While the market offers a variety of resource technologies, technologies considered for the 2010 IRP were limited to those that are commercially available, have low environmental impact, and have the lowest reasonable cost. The three main categories of resources are conservation, generation and the wholesale power market. Generation resources can be further categorized as renewable and nonrenewable. The resource options that were considered are described in Appendix H – Resource Options.

Fuel Cell Breakthrough?

Fuel cells promise the benefits of distributed generation: the avoidance of transmission and distribution costs and lower emissions. Fuel cell technology, which uses an electro-chemical process rather than combustion to produce power, is not new. It has been considerably more costly than grid-delivered power. A recent breakthrough in reducing costs has been publicized by the inventors of the "Bloom Box," a solid oxide fuel cell. With federal tax credits and California state subsidies, the cost of the power produced by the Bloom Box is currently competitive in the San Francisco Bay area, where commercial rates average 17 to 18 cents per kilowatt-hour. Several large companies – FedEx, Google, Wal-Mart, and eBay – already serve parts of their loads with Bloom Boxes, at an upfront net cost of about $150,000 (after grants and tax credits) for each refrigerator sized unit that can generate 100 kW. Brick-sized units are predicted by the company to be ready for residential use in 5-10 years at an estimated cost of $6,000 per household. An in-depth analysis of Bloom Box costs is available in Appendix I – The Bloom Box: A Solid Oxide Fuel Cell.

Gorge Tunnel 2, which is already underway, is a generation efficiency measure that counts for I-937.



Through its Twist & Save program, City Light provides discounts on compact fluorescent lights (CFLs) to help customers save energy and money.

Conservation

Energy conservation continues to be the first choice resource. I-937 requires the acquisition of all cost-effective conservation. All candidate portfolios comply with I-937, featuring accelerated programmatic conservation to gain the greatest benefit.

Generator Efficiency Improvements

Efficiency improvements to existing generation resources can be cost effective, with significantly less impact on the environment than new projects. A second tunnel at Gorge Dam at the Skagit Project is one such improvement. Based on the most recent schedule, this efficiency improvement is on track to deliver five average megawatts of power by 2015.

Conservation Falling Off?

Not really. City Light has been pursuing conservation at an accelerated rate since its 2008 IRP. This means that we are acquiring it faster than before, at a pace that exhausts known cost-effective conservation opportunities within a decade. The 2010 IRP shows conservation tapering off abruptly after that. Then the plan has only opportunities coming from new construction, which occurs at much slower rate. The reason is that we do not yet know what new technologies will enable even more cost-effective conservation that far into the future. Historically, new technologies have always added to the “pool” of cost-effective conservation opportunities, so that City Light has been able to continuously implement new conservation programs for over 30 years. Lighting provides a good example. Replacing incandescent light bulbs with compact fluorescent light bulbs is providing substantial energy savings to Seattle. Now, it appears that LED light bulbs will bring the next generation of energy savings in lighting. Once they are ready to be commercialized, they are expected to surpass even the compact fluorescent bulbs in energy efficiency.

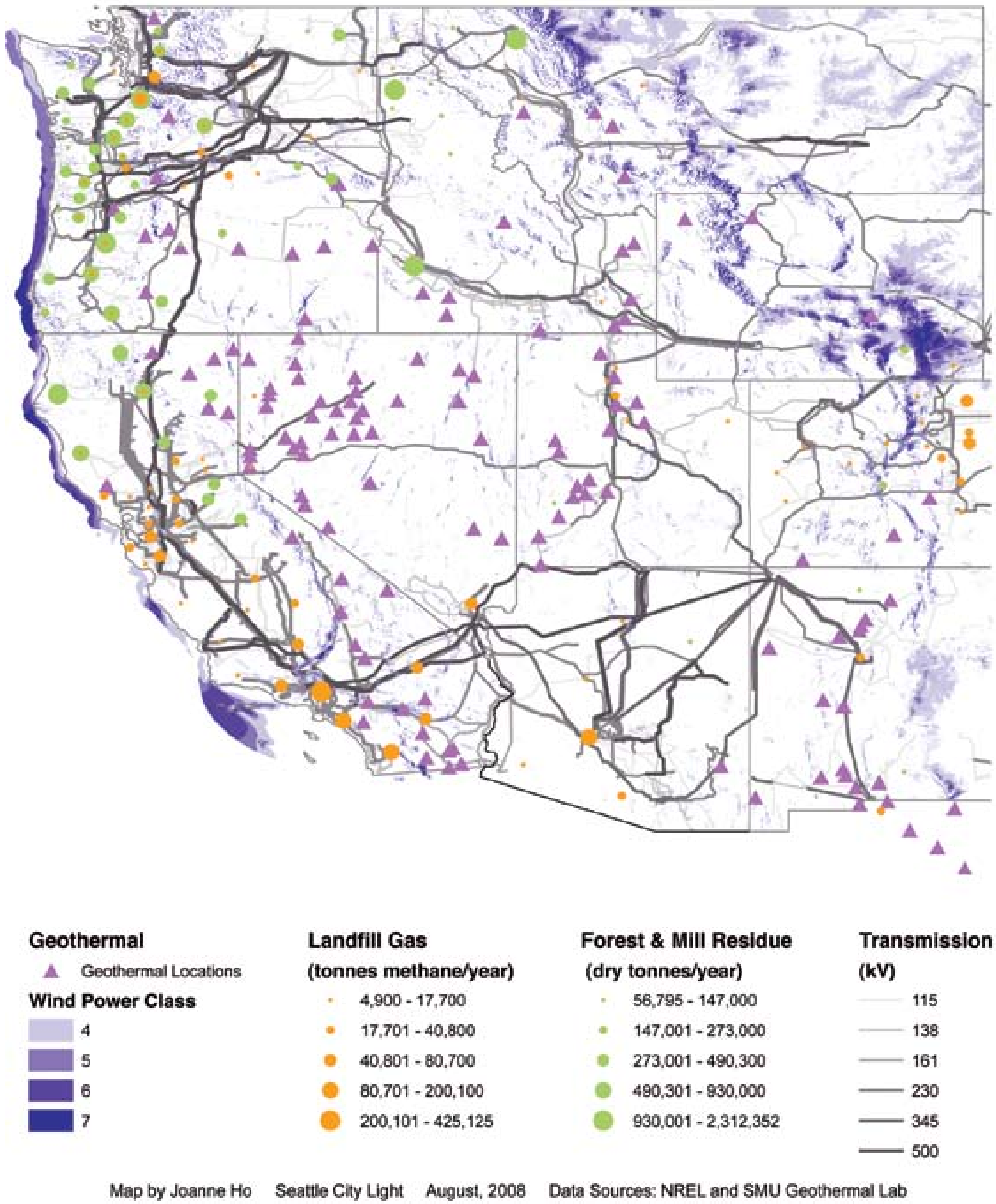
The three main categories of resources are conservation, generation and the wholesale power market.

Renewable Resources

Renewable resources offer an alternative to the combustion of fossil fuels whose by-products can pollute air and water. Wind, landfill gas, and biomass are available in varying amounts in the near term; geothermal is expected to become more widely available in the future. In addition to their production costs, new renewable resource projects can impose significantly more transmission costs if they are not located near existing transmission lines. Even when located near existing transmission, wind does not use transmission efficiently because of its high degree of variability, pushing up unit costs of transmission. Figure 13 shows locations for renewable resources throughout the West, along with transmission lines. Most existing transmission paths are at or near their rated limits, further constraining the delivery of renewable resources to load.

Burlington Biomass plant

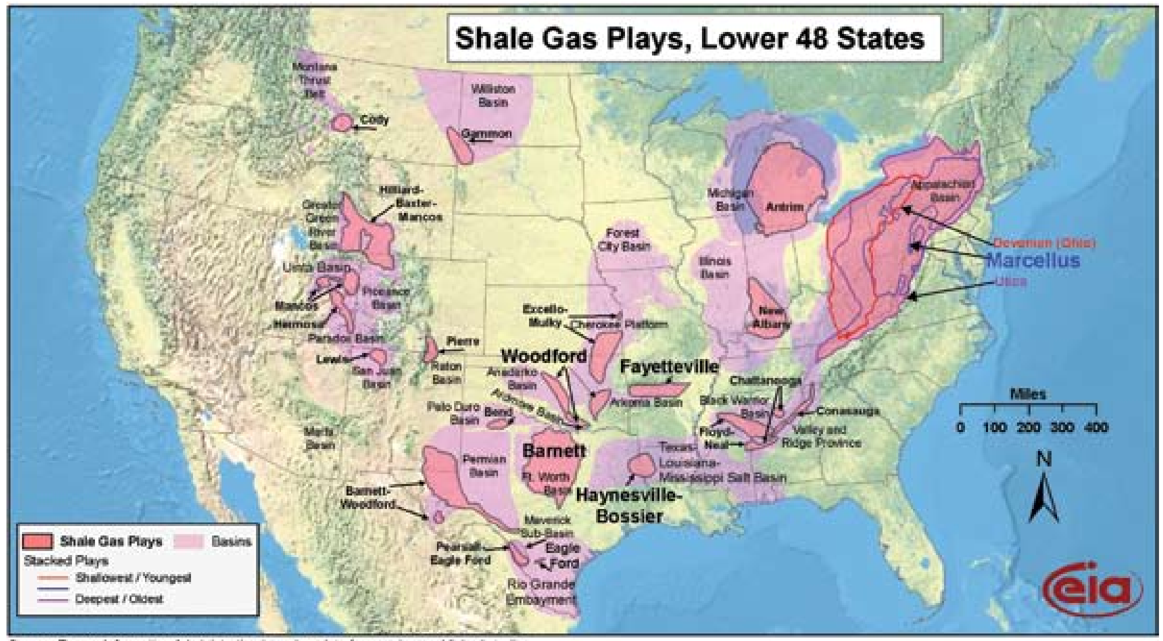
Figure 13 **Renewable Resource Locations**



Cap-and-Trade

Cap-and-trade is a market-based approach to curbing carbon dioxide emissions that is an alternative to a direct carbon tax or to the imposition of limits. Cap-and-trade would make burning coal, or other fossil fuels, to generate electricity more expensive, and thus less competitive than other types of generation, especially generation from renewable resources. Proponents argue that cap-and-trade would encourage investment in renewable resource technologies; opponents argue that capping such emissions will raise prices to consumers and will disadvantage U.S. industries in the global market. Federal legislators have sought to create a market in tradable permits to pollute as part of a broad energy bill, but such legislation has yet to pass. Early versions of cap-and-trade included a wide range of emitters, such as the transportation and oil refining sectors, as well as electric companies. Under the most recent proposal, the level of emissions produced by electric power companies only would be capped, and utilities would be granted permits that they could trade. A similar scheme was instituted in 1995 for power plants that emit sulfur dioxide, which is responsible for acid rain. New rules that rely on limits have led to the collapse of sulfur dioxide markets. Carbon cap-and-trade has already been implemented by the European Union.

Figure 14



Source: Energy Information Administration based on data from various published studies.
Updated: March 10, 2010

Nonrenewable Resources

If Federal legislation to enact cap-and-trade for energy utilities is eventually passed, the price of electric power produced by the combustion of fossil fuels will increase. Cleaner burning natural gas will supplant coal, if and when a cost is imposed on the production of carbon dioxide. Technology for extracting natural gas from shale oil fields has increased supply vastly (Figure 14) and has driven down natural gas prices. The possibility that a natural gas combustion turbine might make sense was explored in the first round of portfolio analysis. A simple cycle turbine, used mainly for peak loads, was tested in one portfolio. In another portfolio, a combined cycle turbine for baseload power generation was tested.

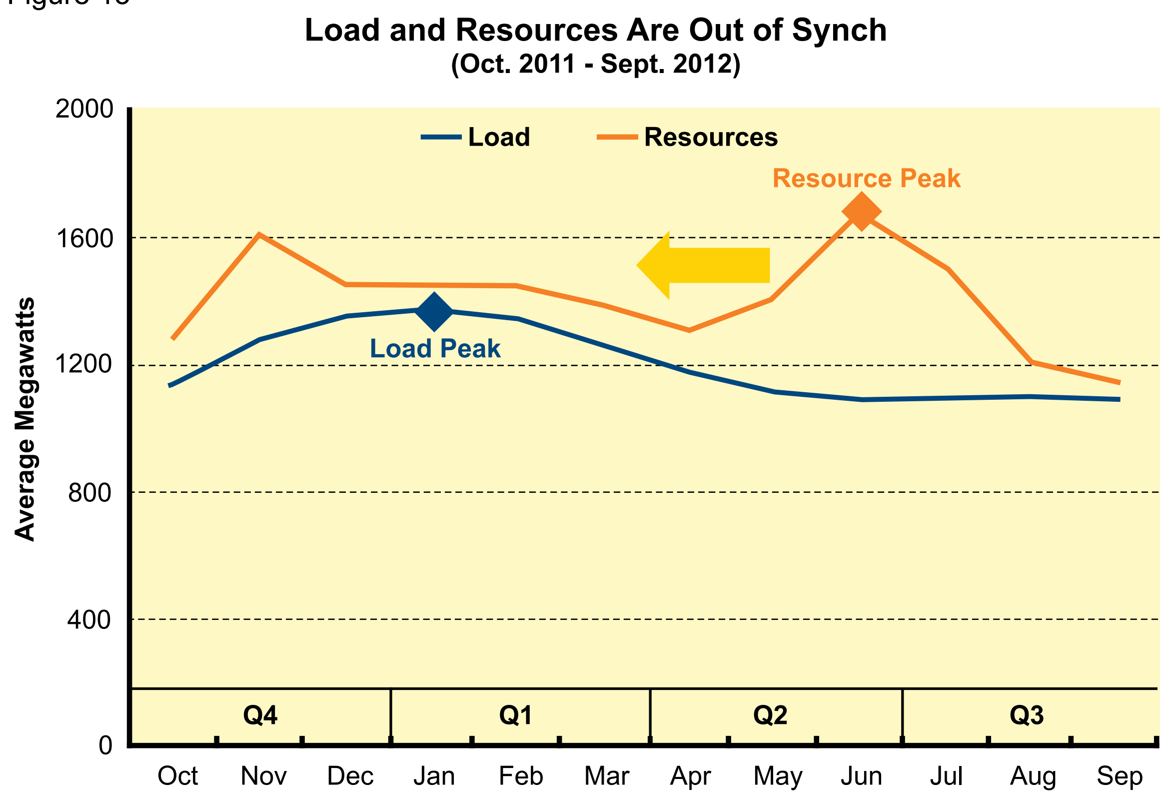
The possibility that a natural gas combustion turbine might make sense was explored in the first round of portfolio analysis.

Wholesale Energy Market

As indicated earlier, City Light has sufficient firm resources to fulfill its customers' needs through 2020 on an annual basis. However, the utility does face short term/seasonal shortages induced primarily by low precipitation and below normal streamflow events. Wholesale market purchases, including seasonal exchanges, can be a cost effective way to serve load during these types of events and help forestall the acquisition of more expensive generation resources. Figure 15 illustrates the mismatch between load and resources. Exchanges and purchases can help reshape the utilities annual surplus to better meet the firm requirements of its customers.

High-voltage lines carry power into City Light's service area.

Figure 15

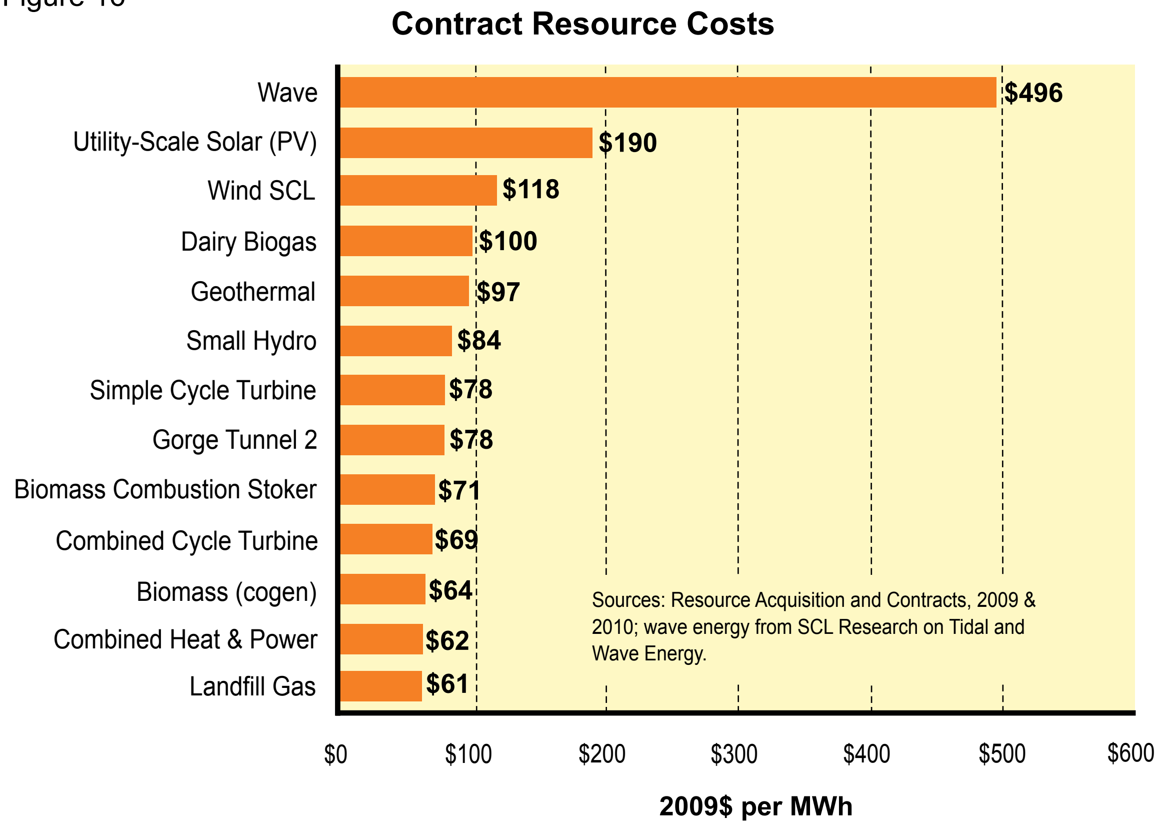


Exchanges and purchases can help reshape the utilities annual surplus to better meet the firm requirements of its customers.

Other Resource Types

The utility continues to monitor developments in other resource technologies for both their cost and commercial availability, taking into account the policy direction from the City's elected officials and from state and federal government. These resources, and their estimated contract costs per megawatt-hour, are listed in Figure 16. (These are not levelized costs.) Another unit of measure for power costs is cents per kilowatt-hour, where for example, utility-scale solar's $190/MWh equals 19 cents per kilowatt-hour. All costs for new renewable resources are considerably higher than City Light's embedded costs of existing hydro resources, which are less than 3.5 cents per kilowatt-hour.

Figure 16



Demand Response Pilot

The term demand response, or DR, refers to strategies for reducing system peak demand through prior arrangements with customers who are willing to drop some portion of their load on short notice. Customers are compensated for their participation. Demand response programs are most successful for utilities that must acquire expensive generation resources in order to serve peak demand. Fortunately for City Light, the operational flexibility of its hydroelectric dams allows it to meet its peak load inexpensively, without demand response.

Demand response (DR) electronics were installed in a few commercial buildings in order to observe the effect of partial load reductions during selected hours in March and October 2009. The Bonneville Power Administration was a partner in the pilot. Experience was gained with both DR equipment and customer participation, though the cost of DR at this time outweighs any benefit to the utility and its customers. The utility continues to monitor developments in DR through its participation in the Pacific Northwest Demand Response Project sponsored by the Northwest Power and Conservation Council. The Council's sixth plan finds that demand response will not be cost effective before 2020. More information on the Demand Response Pilot is available in Appendix J – Demand Response Pilot.

Candidate Portfolios

Once the targets for resource adequacy (reliability) and I-937 have been established, candidate resource portfolios are prepared. Each candidate portfolio is carefully designed to meet both the resource adequacy (reliability) and I-937 (regulatory) requirements for renewable resources and conservation. These criteria differ in amounts and timing throughout the 20-year planning horizon. The candidate portfolios are also structured to test a range of potential strategies to meet these important reliability and regulatory objectives. The strategies tested vary significantly in reliance upon renewable energy credits, amounts of conservation, amounts of generating resources, and the types of resources (Figure 17). Three levels of conservation were evaluated in the portfolios. In total, nine candidate resource portfolios were tested. All amounts listed in Figure 17 are for incremental generation and RECs beyond what exists today. A more complete description of the candidate portfolios can be found in Appendix L – Analysis of Candidate Resource Portfolios.

Figure 17

Candidate Resource Portfolios

	Candidate Portfolio	2020 New Renewables (aMW)	2020 RECs (MWh)	Resource Strategy
1	RECs-Only	5	981,120	Rely on the market for power and RECs
2	Lo-RECs	119	35,040	Meets targets with mostly resources
3	Med-RECs	30	420,480	Blend of RECs and resources
4	Hi-RECs	75	814,680	RECs for I-937, resources for reliability
5	Gas & Max RECs	5	981,120	Natural gas (CCT) and maximum RECs
6	Wind & Gas	105	157,680	Lots of wind, natural gas (SCT)
7	Hi-Cons.	112	78,840	Higher conservation (5-year plan targets)
8	Max Exchange	88	306,600	Highest level of exchanges
9	Cons.: Load Growth	29	823,440	Less conservation, at pace of load growth

Railcars carry garbage from Seattle and Portland to the Columbia Ridge Landfill facility.

Portfolio Performance Measures

Candidate resource portfolios are measured on cost, risk, reliability, and environmental performance. In keeping with guidance from the City Light IRP Stakeholders, no performance measure is treated as more important than another; all portfolios meet the reliability criterion. The performance measures are defined as follows:

Figure 18

Performance Measures for Candidate Resource Portfolios

Measure	Definition
Cost	20-year net present value of the resource portfolio costs
Risk	Volatility in resource portfolio costs
Reliability	Frequency of insufficient City Light energy to meet demand
Environmental Performance	Air emissions of CO_2, SO_2, NO_x, mercury, and particulate*

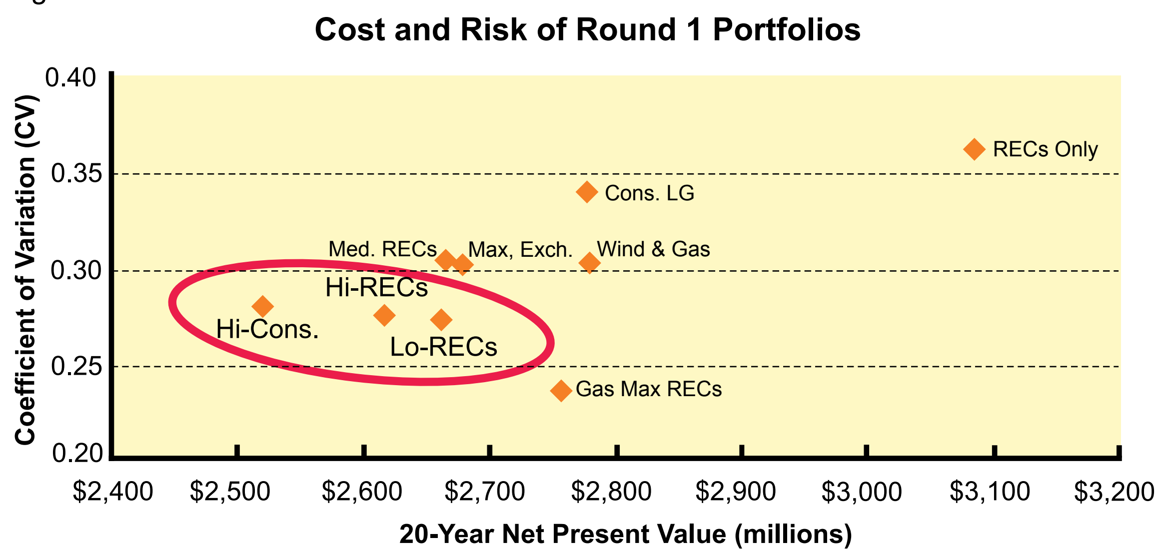
*Other environmental impacts to land, air, water, soil, geology, plants, animals, employment, aesthetics, recreation, and culture are evaluated in the Environmental Impact Statement (EIS).

Round 1 Portfolio Analysis

An initial evaluation of the resource portfolios was completed using the AURORAxmp model. This detailed economic dispatch model simulates operations of City Light's candidate portfolios within the Pacific Northwest for 20 years, considering factors including generation costs, revenues, air emissions, transmission, market purchases, and market sales. The data collected during the simulation of each resource portfolio allows calculating the performance measures described above. (The Aurora Model is described in detail in Appendix K – Aurora Model.)

For the first round of analysis, the coefficient of variation (CV) in costs is used to represent portfolio risk. It measures the dispersion of a distribution, suggesting how much the costs of a resource portfolio can vary. It is much less labor intensive to develop than the stochastic risk analysis used for the top three portfolios in Round 2. Based upon the first round portfolio analysis, the six lowest ranking candidate portfolios (not circled) were eliminated from further consideration. The results for cost and risk are depicted in Figure 19.

Figure 19



Based upon low NPV of costs and a low coefficient of variation, three candidate portfolios (circled) were carried forward to Round 2 for further analysis. These were Hi-Cons (high conservation), Lo-RECs (low renewable energy credits), and Hi-RECs (high renewable energy credits).

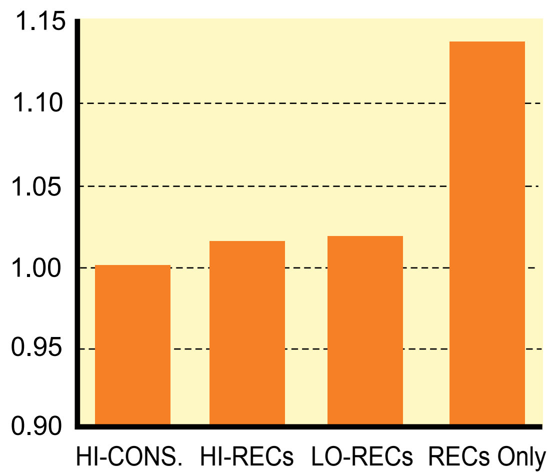
Round 2 Portfolio Analysis

The focus of Round 2 was on selecting the preferred portfolio from the top three candidate resource portfolios. For input, these candidate portfolios were presented to the Seattle City Council's Energy, Technology, and Civil Rights Committee, the 2010 IRP Stakeholder Committee, and to City Light customers in three public meetings. The additional analysis completed in Round 2 included a stochastic risk analysis and testing of the portfolios against eight scenarios.

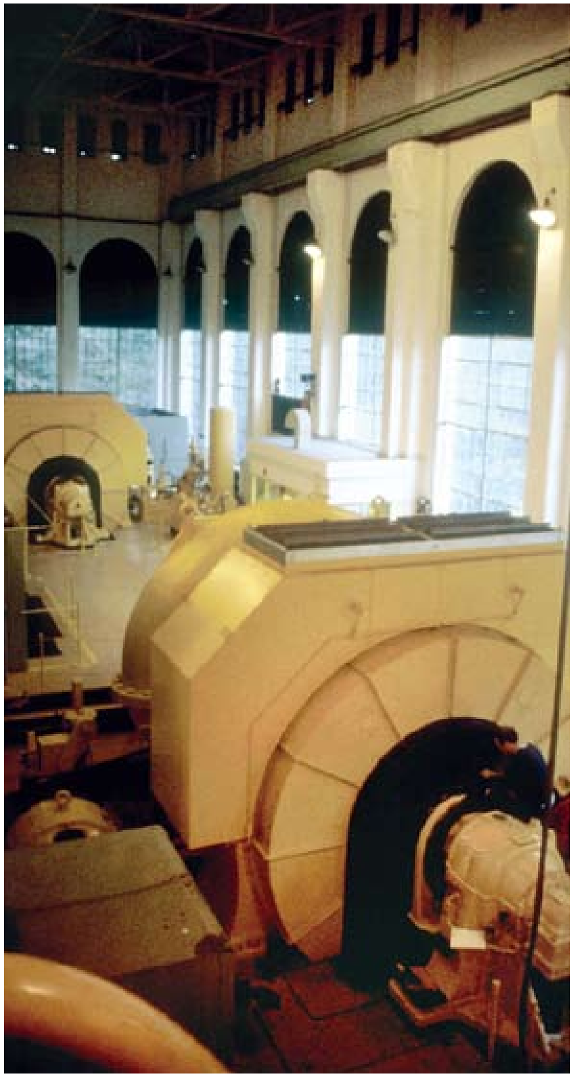
The stochastic risk analysis evaluated the potential variability of each of the top three candidate portfolios' costs, while incorporating historical volatilities of hydro generation, demand, and natural gas prices, independently from one another. Latin Hypercube sampling , a technique similar to Monte Carlo simulation, was used. Each portfolio was "shocked" with independent draws, each draw having different quantities of hydro generation, demand, and natural gas prices. The 20-year net present value of costs was derived for each portfolio, with a 5% chance of exceedance (95% chance of costs being less than or equal to the derived amount). The risk index in Figure 20 represents the total potential change in costs for the top three candidate portfolios, including both existing and new resources, shown relative to each other. The Hi-Cons Portfolio had the lowest risk. The risk impacts appear significantly larger when comparing across portfolios of new resources only. However, new resources make up less than 20% of the total energy in the combined existing and new resources, so the change in risk profile shown in Figure 20 is diluted by the much larger existing resources. (See Appendix M – Risk Measure for more about the risk index.)

Figure 20

Risk Index for 95% Coverage



The focus of Round 2 was on selecting the preferred portfolio from the top three candidate resource portfolios.



New resources will eventually be needed to supplement existing generation from plants like Cedar Falls.

Scenarios

Scenario analysis can provide insight into how a candidate portfolio performs when key variables are significantly different than the base forecast. For the 2010 IRP, electricity demand, natural gas prices, carbon dioxide emissions allowance costs, and REC costs have been used to test the performance of the top three resource portfolios.

Electricity Demand Scenarios

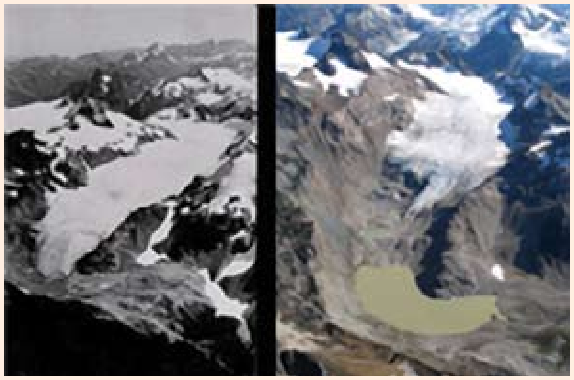
These scenarios consider impacts to total portfolio costs and resource needs arising from higher and lower than expected demand growth. City Light examined historical periods and selected demand growth rates at the high and low ends of their historical range. There is a 95% probability that demand growth will be between the high-load growth scenario and the low-load growth scenario (Figure 21).

Historical load data for Seattle indicates that following a recession, it can take as long as seven to eight years for demand growth to return to its long-term trend. Load growth tends to lag the economic recovery. In the low-demand scenario, it is expected that sales of surplus resources would increase during a prolonged period of reduced demand. Very little purchasing of power from the wholesale market occurs.

In the high-demand scenario, the clear implication is that City Light would have no choice but to acquire substantial power supplies from the wholesale power market, resulting in much higher net power costs than either the base-case or the low-demand scenarios in the long run.

Climate Change

Climate change impacts on the city's hydroelectric resources and power generation were examined in the 2008 IRP. Warming is expected to alter the timing of hydroelectric generation both on the federal Columbia River power system and on the City Light hydroelectric system. Increasingly through time, more precipitation will fall as rain instead of snow. Snow and glacier melt patterns will shift stream flows earlier in the year. More water for generation will be available in the winter and less for the summer. Greater variability in weather and increased frequency of storms is also expected, which can affect water management practices and resource needs. For the 2010 IRP, City Light worked with climate researchers at the University of Washington's Climate Impacts Group to evaluate more specific impacts to the Skagit and Pend Oreille river systems, which host most of City Light's hydroelectric facilities. Much of the information was developed using statistical downscaling methods for global climate models, calibrated with actual stream flow histories from the Skagit and Pend Oreille Rivers and their tributaries. The focus of the 2010 study was on expected flow impacts for specific tributaries and dams, extreme weather events, and the likely impacts of the extreme weather events for the Skagit and Pend Oreille Rivers and their respective fisheries. The potential impacts of warming on cold water species, including salmon, steelhead, and bull trout are of concern to City Light. More information can be found in the 2010 IRP Appendix N – Climate Change.



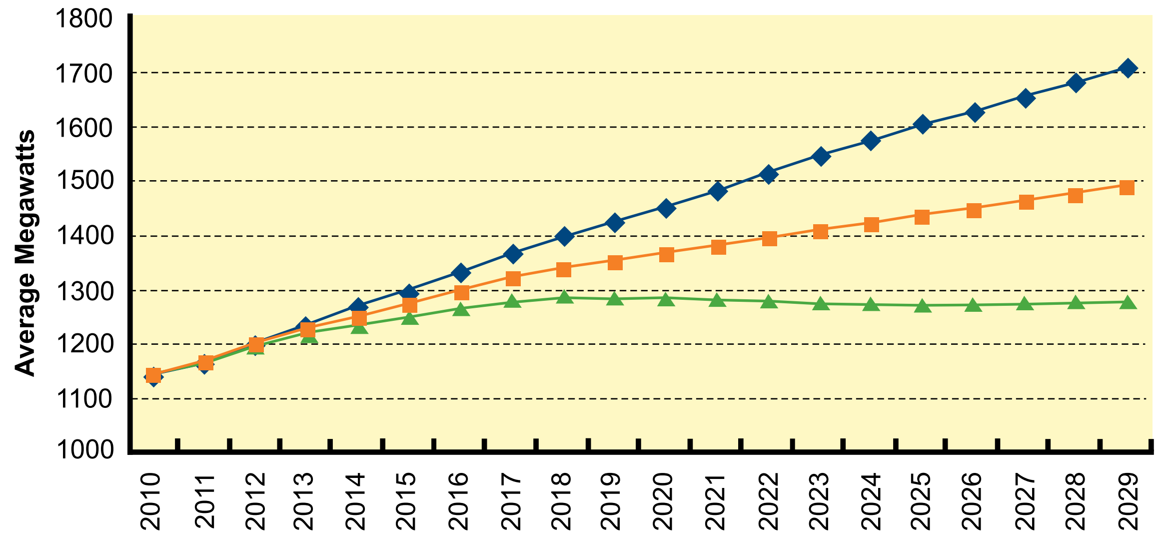
Glaciers in the Skagit River watershed are receding and thinning. As they shrink in size, their contribution to summer flows into tributaries that feed Diablo Lake and the Skagit River decreases. Source: USGS

The impacts of both the high- and low-demand growth scenarios are so large that they tend to overwhelm the differences in the candidate new resource portfolios. However, the Hi-Cons portfolio performs best of the three in both the high-demand and low-demand scenarios. In the high-demand scenario, the Hi-Cons portfolio beats the Lo-RECs portfolio by $41 million (in net present value), and it beats the Hi-RECs portfolio by $30 million. In the low-demand scenario, Hi-Cons beats Lo-RECs by $41 million and Hi-RECs by $37 million.

City Light began receiving power from the Stateline Wind project in 2002, under a 20-year contract.

Figure 21

Demand Scenarios: Base, High and Low Forecasts
(no new programmatic conservation)



Managing the Wind Resource

Even before the passage of I-937, wind farms were being built in the northwest. Tax credits offered by the federal government, together with the prospect of renewable portfolio standards requiring RECs at the state level, helped make this resource competitive with other generation. City Light started receiving power from Stateline Wind in 2002. Even though the "fuel" is free, its supply is not controllable. When there is no wind, there is no generation, letting stand idle expensive transmission capacity reserved to carry wind power to consumption centers. Such idle capacity is costly, and it drives up the total cost of wind generation. Because wind is also unpredictable, to meet customer demand in real-time, grid operators must have other controllable resources available which can be called upon to either ramp up or ramp down as the amount of wind generation rises and falls. This capability also contributes to the total cost of wind. The Sixth Northwest Conservation and Electric Power Plan, issued by the Northwest Power and Conservation Council, identifies regional wind development potential of 13,535 MW (or 4,810 aMW, assuming an average capacity factor of 36%). At some point, the current ability to accommodate wind variability within the region may be exhausted without substantial new investment for wind integration.

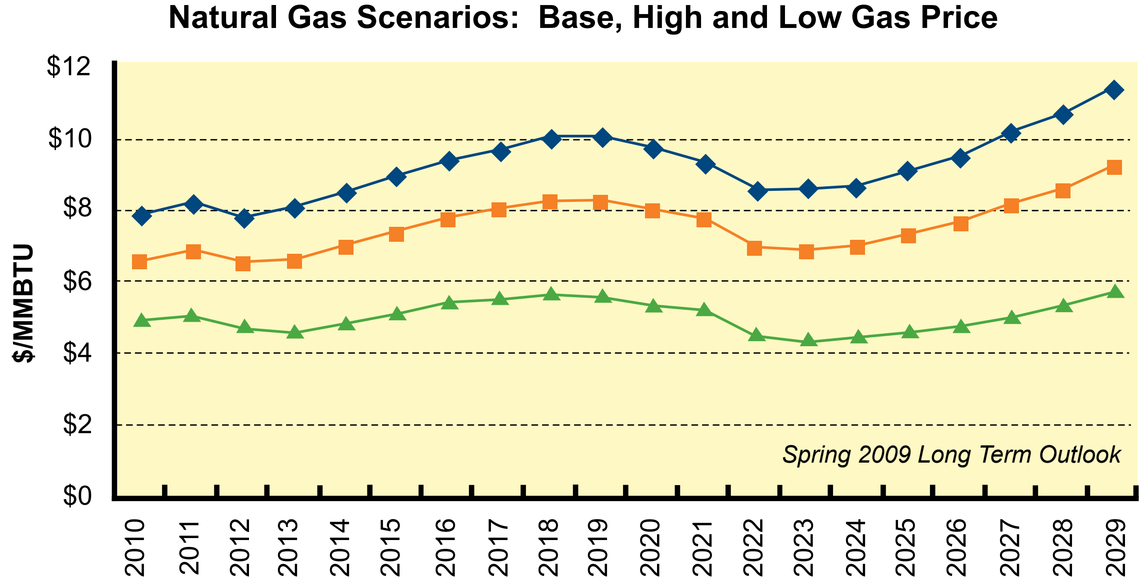
Natural Gas Price Scenarios

Indirectly, natural gas prices have a large impact on City Light finances. With natural gas-fired generation as the price-setter for most hours in Western power markets, power market prices and City Light's wholesale revenues tend to move up and down with natural-gas prices. Natural gas prices are notoriously difficult to predict, often leaving even the most expert forecasters with embarrassingly large errors. In 2008, natural gas prices reached $12 per MMBTU, but the recession and improved technology for recovery of shale gas have combined to drive prices once again into the $3 to $6 per MMBTU range. In the high natural gas price outlook, natural-gas prices do not reach the 2008 highs for another 20 years. In the base forecast, natural gas prices stay well below 2008 prices in real terms.

The 2009 long-term forecast used for the 2010 IRP has higher prices than currently observed. Nevertheless, even a modest economic recovery would push natural gas prices up. The forecasts seen in Figure 22 show rising (real) prices this decade, followed by a pronounced decline. The decline starting in 2020 is the result of an expectation of increased natural gas supplies from a new Alaska pipeline and expanded Canadian gas production.

The results of the two natural gas scenarios produce the largest differences in performance of the candidate portfolios of all the scenarios.

Figure 22



The Hi-RECs portfolio has fewer resources and therefore sees less of a financial loss on the sale of surplus resources in a low power price market. Hi-Cons beats the other two portfolios handily in the high gas price scenario.

Natural gas prices are notoriously difficult to predict, often leaving even the most expert forecasters with embarrassingly large errors.

Skagit morning.

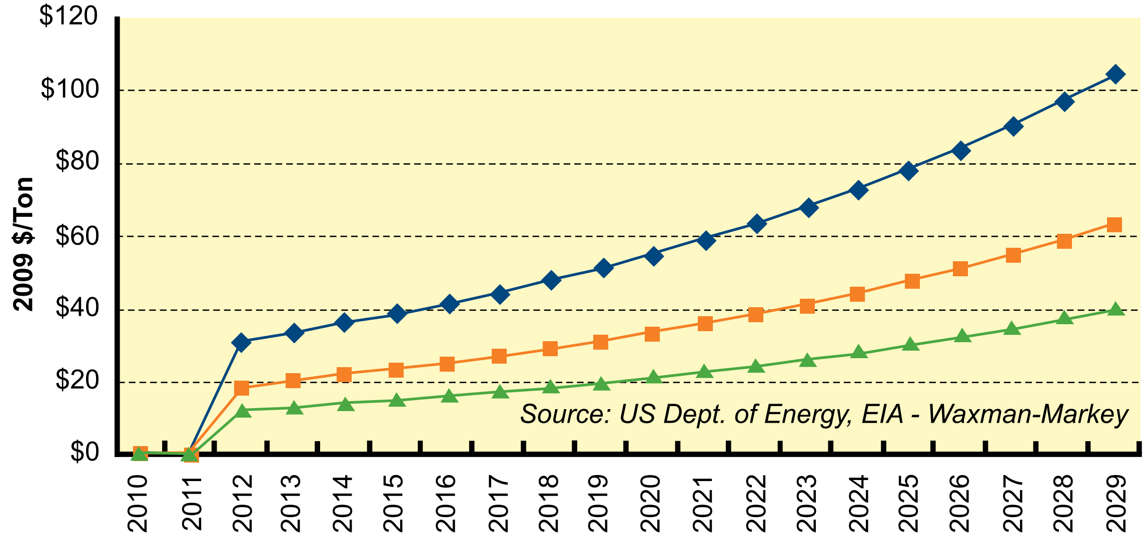
Carbon Dioxide Emissions Cost Scenarios

With mounting scientific evidence on the impacts of climate change and a new administration in Washington DC, the prospects for new regulations for utility CO_2 emissions have grown. The base case for the 2010 IRP includes a cost for CO_2 emissions. For the scenario analysis, a U.S. Department of Energy study of CO_2 emission allowance costs for the Waxman-Markey bill was used (Figure 23). With City Light's "low carbon" resource portfolio, the impacts of CO_2 emissions allowance costs are mostly indirect, but still quite important. If a cost for emitting CO_2 is imposed by law, wholesale power market prices will reflect the added costs for large amounts of electricity generation in the West, making City Light's hydro and renewable resource portfolio more cost competitive. With little or no costs for CO_2 emissions, City Light faces increased risk that energy from new renewable resource acquisitions for I-937, when unneeded, may not fetch a high enough price in the wholesale power market to prevent net financial losses.

This risk is borne out in the CO_2 scenarios, which show that the Hi-RECs portfolio beats Hi-Cons by \$28 million and Lo-RECs by \$69 million in the low CO_2 cost scenario. However, the Hi-Cons portfolio beats Hi-RECs by \$150 million and Lo-RECs by \$40 million in the High CO_2 emissions cost scenario. (More about the cost of emissions can be found in Appendix O – Air Emissions Rates and Costs.)

Figure 23

Carbon Dioxide Emissions Allowance: Base, High and Low Cost



Is Biomass Carbon Neutral?

The Environmental Protection Agency's 2010 final rule determining which sources will be subject to greenhouse gas permitting requirements did not exempt biomass power, setting off a controversy. Washington State's I-937 classifies as a qualifying renewable resource "biomass energy based on animal waste or solid organic fuels from wood, forest, or field residues, or dedicated energy crops." By convention, biomass has been widely classified as carbon-neutral, since trees regrow and absorb the carbon dioxide released by their combustion. Some scientists claim that re-absorbtion of carbon dioxide may take up to 200 years, whereas combustion releases CO2 very quickly. The Environmental Protection Agency is currently taking public input on how its climate regulations should treat carbon dioxide emissions from biomass, The biomass in the City Light IRP is cogeneration from wood waste, a form of wood biomass generation that is more likely to receive credit for carbon neutrality than other forms. Wood biomass continues to be a qualifying renewable resource under Washington state law. City Light will carefully monitor the "carbon neutral" status of wood biomass.

Renewable Energy Credit (REC) Price Scenarios

REC prices are as challenging as natural gas prices to forecast. There is no relevant price history for Washington and the Pacific Northwest, since the renewable portfolio standards in Washington and Oregon have not yet taken hold. History in other states shows that REC prices are low until RECs are required by law. REC prices were forecast for the 2010 IRP as the difference between natural gas-fired generation costs and renewable energy costs, as represented by wind. The difference in their costs is seen as equivalent to the environmental attributes that RECs represent. This approach produces a base case forecast that soon goes into the $30 range, similar to the costs observed in California today, where a renewable portfolio standard has already taken effect. On a levelized basis over twenty years, the base REC price outlook equals $38/MWh. A ceiling price of $55/MWh in 2012 is expected, since it equals the penalty for failure to comply plus inflation from 2006, when I-937 was passed. For all the analyses, a cap equal to 4% of the utility's revenue requirement was placed on each portfolio's total costs associated with I-937 compliance, consistent with Washington state law. This revenue requirement cap mutes the impacts of the REC prices on the candidate resource portfolios for the base and high cases. Due to the level of uncertainty for future REC prices, a wide range of prices is tested within the REC price scenarios. The levelized REC prices used in these scenarios were $60/MWh for the high case, $38/MWh for the base case, and $18/MWh for the low case.

The Hi-Cons portfolio performs the best in the base-case and low-priced RECs scenarios. However, in the high-priced RECs scenario, the Lo-RECs portfolio performs the best. This is because it purchases the least amount of RECs of any of the original nine candidate resource portfolios.

History in other states shows that REC prices are low until RECs are required by law.

Renewable Energy Credits represent the cost of environmental attributes, such as wildlife habitat protection.

Portfolio Rankings by Scenario

The high conservation portfolio displays a robust performance, ranking first in the cost and risk measures and in five of eight scenarios.

Figure 24

Round 2 Portfolios			
Scenarios	**Hi-Cons.**	**Lo-RECs**	**Hi-RECs**
Low Customer Demand	1	2	3
High Customer Demand	1	2	3
Low CO_2 Emissions Cost	1	2	3
High CO_2 Emissions Cost	2	1	3
Low Natural Gas Price	2	1	3
High Natural Gas Price	1	2	3
Low REC Price	1	2	3
High REC Price	2	1	3
Scenario Average Rank	**1**	**2**	**3**
Risk	**1**	**3**	**2**
Base Case 20-Year NPV	**1**	**2**	**3**

While overall the Hi-Cons portfolio ranks best in the scenarios (Figure 24), for three of the eight scenarios (high CO_2 costs, low natural gas prices, and high REC prices), it was not the best performing of the three portfolios. In the high CO_2 cost scenario, the Lo-RECs portfolio performs the best because it has the least purchases from the wholesale power market. This is because of the high proportion of coal and natural gas-fired generation making up the Western wholesale power market, which incurs higher CO_2 emissions allowance costs.

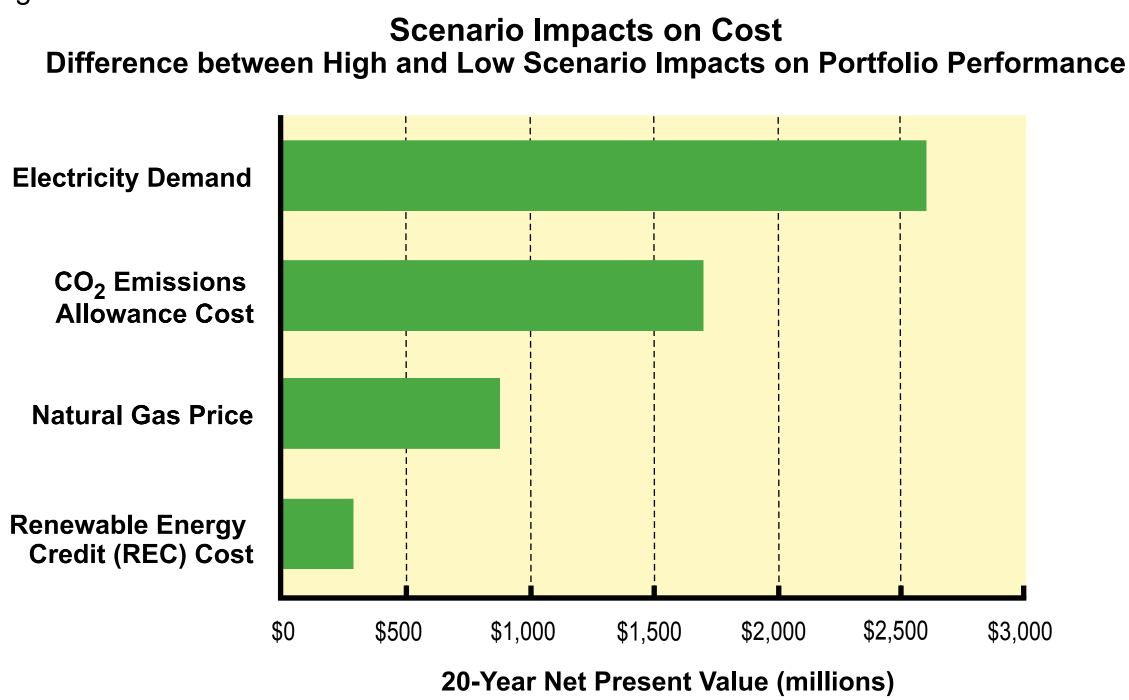
In the low natural gas price scenario, low natural gas prices lead to low wholesale power market prices. Wholesale power prices in this scenario are sufficiently depressed that City Light's wholesale sales yield much lower revenues, causing higher net costs for each resource portfolio. The only scenario with higher net costs is the high-demand scenario, where the resource portfolios soon become inadequate to serve customers. In the low natural gas price scenario, the Lo-RECs portfolio performs the best, but only by a small margin above the Hi-Cons portfolio. Intuitively, it might be expected that the Hi-RECs portfolio would be the most successful, since it has fewer resources and should allow for purchasing more low-priced power in the wholesale market. However, there are two reasons this did not happen. First, lower wholesale revenues from surplus power sales outweigh the savings from lower purchased power costs. Second, the cost of RECs is high for this portfolio, tipping it in favor of the Hi-Cons portfolio. For the Hi-RECs strategy to be successful over the long-term, it requires an ongoing alignment of the relative costs of three separate factors: the future costs of CO_2 emissions allowances, the future cost of RECs, and future wholesale power prices. Each of the three factors has its own independent variability (risk). The Hi-RECs portfolio is not the best performer on the risk measure.

Relative Scenario Impacts

Comparison of the scenarios can provide useful information for resource strategy and management efforts. Although imprecise compared to the risk measure, the range of the cost impacts from a high scenario to a low scenario for a particular factor also helps to convey a sense of what is "at risk." An important question is: How well is the resource portfolio scaled and designed to meet the full range of potential futures that can occur? When a portfolio is either too large or too small in new resources, or designed with an inappropriate mix of resources, it will result in higher net costs and risks. As seen in Figure 25, demand could potentially have a very large impact on the costs of a candidate resource portfolio. If the portfolios are not quickly adjusted to the level of demand in the high growth and low growth scenarios, they can incur substantial unnecessary costs. The range of potential impacts of CO_2 emissions allowances are also quite large, followed by natural gas (and wholesale power) prices – and lastly, REC costs.

City Light is unlikely to have significant influence on the national policy for CO_2 emissions allowance costs, and none on natural gas prices. However, it can have influence on demand, its own resource portfolio size and design, and its total REC costs. It can understand which market and/or regulatory outcomes pose the most risk for its resource portfolios. It can also carefully monitor, forecast, and adjust its resources for the impacts of all these factors.

Figure 25



Spawning salmon.

The Preferred Portfolio

The high conservation portfolio is the best performing of the top three candidate portfolios. It performs best on cost and risk, and it is the leading portfolio when "stress tested" with eight scenarios over the 20-year forecast period. The high conservation portfolio is the preferred portfolio and is recommended to City of Seattle policy makers.

The preferred portfolio continues a core resource strategy of advancing conservation as the least cost and lowest risk resource available. It strives to make the most of our existing generating resources and power contracts, as exemplified by City Light's Gorge Tunnel 2 hydro efficiency project. It minimizes the costs of new resources by making increased use of flexibility in existing power contracts, yet it is designed to fully comply with I-937, Washington's renewable portfolio standard. This portfolio minimizes future emissions of greenhouse gases. It is designed to manage future risks to reliability from adverse hydro and extreme winter temperatures. It reshapes our winter energy capability by moving surplus energy from the spring to winter. The high conservation portfolio balances multiple objectives for low costs, low risk, regulatory compliance, and strong environmental performance.

Figure 26

Preferred Portfolio*
Cummulative Resources (aMW)

Year	Conservation	Gorge Tunnel 2	Biomass Cogen.	Priest Rapids	Geothermal	Wind	CHP/DG	RECs	Total RECs & Resources
2010	14								14
2011	30								30
2012	46								46
2013	61								61
2014	74								74
2015	87	5							92
2016	100	5	14					17	136
2017	113	5	14	24				19	175
2018	124	5	14	24				22	189
2019	127	5	14	24	18			4	192
2020	130	5	28	24	18	56		9	270
2021	131	5	28	24	18	104			310
2022	132	5	28	24	18	104		11	322
2023	133	5	28	24	18	104	6	7	325
2024	134	5	28	24	18	104	6	9	328
2025	135	5	28	24	18	104	6	11	331
2026	136	5	28	24	18	104	6	13	334
2027	138	5	28	24	18	104	6	15	338
2028	139	5	28	24	18	104	6	17	341
2029	140	5	28	24	18	128	6		349

*Also includes from 50-200 MW short-term exchanges, reshaping transactions, and short-term market purchases in the winter heating season.

Part V – Two-Year Action Plan

The recommended resource strategy is a continuation of the utility's policy of obtaining low-cost power with low environmental impacts for its ratepayers/owners while making the most of its existing resources. Conservation is the first choice resource. In order to comply with I-937 requirements in 2016, the utility plans to acquire gradually a combination of new renewable resources and renewable energy credits (RECs) in the intervening years, depending on cost and availability. After 2016 the utility plans to continue to acquire a combination of renewable resources and renewable energy credits sufficient to meet both I-937 and resource adequacy (the ability to serve customers' electrical demand and energy requirements at all times). Power will be purchased from the wholesale market when resource need exists and acquiring new resources is not justified. When needed, new resources will be acquired in the most cost-effective manner for our customers, taking into account the full cost of the resource and the total value of any associated renewable energy credits and power.

The Integrated Resource Plan will be revisited over the next two years, culminating in the 2012 IRP. In the meantime, steps will be taken to follow through on the findings of the 2010 effort. The action plan for this year and next is outlined in the table below.

Glass Mosaic by Jean Cory Beall

IRP Action Plan, 2010-2011

Actions	2010	2011
Conservation Resources		
Pursue accelerated conservation in the amounts targeted in the Hi-Cons. portfolio	14 aMW by end of 4th Qtr	16 aMW more by end of 4th Qtr
Complete a new conservation resource potential assessment for use in resource planning and I-937 compliance	Complete project design and contracting	Begin incorporating study results into IRP
Generation Resources		
Pursue full BPA contract rights	Analyze contract and provide input	Finalize the contract in 2011
Market Resources		
Serve retail load with market purchases, short-term exchanges, and transactions to reshape seasonal energy as needed	Ongoing	Ongoing
Other New Resources		
Continue to acquire RECS and/or renewable resources, in keeping with the resource acquisition strategy, in order to meet I-937 requirement for 2016	As budget allows	Acquire an annual average of 7.3 aMW of renewables and/or RECs
Monitor and investigate evolving technologies having potentially large impacts on electric service (e.g., electric vehicles, fuel cells, solar)	Ongoing	Ongoing
Transmission		
Work to ensure sufficient transmission transfer capability for City Light to support serving peak customer demand	Ongoing	Ongoing
Future IRPs		
Review long term resource adequacy planning standards and metrics for City Light and assess impacts to reliability	Analyze winter resource adequacy metrics and strategy	Implement any changes within the 2012 IRP
Continue participation in and evaluation of climate change research for impacts to hydro operations and fish populations, as budget allows	Focus research on Cascade glaciers and impacts to river temperatures as budget allows	Begin evaluating findings in 2012 IRP as budget allows
Evaluate prospects for renewable energy credits, including future availability and cost	Ongoing	Input new assumptions into 2012 IRP forecasts

Appendices

A. Regulatory Requirements for Planning
B. The Planning Environment
C. Public Involvement
D. The Impact of Electric Vehicles on System Load
E. Load Forecast for the Integrated Resource Plan
F. Current Resource Portfolio
G. Resource Adequacy
H. Resource Options
I. The Bloom Box: A Solid Oxide Fuel Cell
J. Demand Response Pilot
K. Aurora Model
L. Analysis of Candidate Resource Portfolios
M. Risk Measure
N. Climate Change
O. Air Emissions Rates and Costs
P. Retail Rate Analysis

Appendices available at :
http://www.seattle.gov/light/news/issues/irp/

Columbia Ridge Landfill Gas

Burlington Biomass

Stateline Wind