2022 INTEGRATED RESOURCE PLAN

Seattle City Light

EXECUTIVE SUMMARY

Seattle City Light and partner City of Seattle departments are at an important crossroads along the path to create Seattle's energy future on behalf of the customers and communities we serve. The 2022 Integrated Resource Plan (IRP) is a long-term strategy to meet anticipated customer energy needs over the next 20 years. The IRP also outlines a 10-year clean energy action plan that allows City Light to meet its goals around reliability, affordability, and environmental responsiveness, while also complying with regulatory requirements and ensuring service equity.

The IRP is not meant to prescribe or implement resource-related decisions, but directionally it represents City Light's current view of resource adequacy, Washington state policy requirements, transmission constraints, and available resource technology. As such, it recommends a portfolio composition that would be best positioned to meet those needs.

The recommended 2022 IRP portfolio was selected due to its resource diversity, high customer optionality, low transmission reliance, and reasonable cost. This portfolio of energy resources includes more wind and solar energy serving customer load as well as new customer participation in demand response and energy efficiency. It also paves the way for transportation and building electrification efforts that will shift our communities away from fossil fuels. It recommends that over the next 10 years (2022-2031), City Light will look to add approximately 175 megawatts (MW) of solar and 225 MW of wind to its energy portfolio. In addition, the utility will work with customers to identify around 85 MW of energy efficiency and tailor a demand response shift of up to 47 MW during the summer and around 79 MW for winter. Finally, City Light anticipates around 24 MW of customer-owned solar installations positively impacting our portfolio in the same time frame. The following decade (2032-2041) has similar goals, which are reflected in the Portfolio Analysis discussed later in this document.

The recommendations for the next two years within this biennial IRP update include:

- Continued customer engagement and education about energy efficiency and demand response programs.
- Participation in regional energy programs and markets to reduce load peaks and resource generation fluctuations from localized weather.
- Work with regional partners and planning organizations to identify and start transmission project development processes that expand access to affordable clean power supplies, engaging all stakeholders early in the process.
- Implementation of clean energy supply procurement processes with operational dates as early as the start of 2026 and 2027 for delivery to Seattle.
- Continued climate change and electrification research that will help us refine our resource strategies and timelines.

INTRODUCTION

City Light has provided its customers with reliable, affordable, and environmentally responsive clean energy since 1910. As the utility continues this tradition and plans for the future, it must account for growing power supply demands from its customers, while prioritizing emission reductions. This will ensure an equitable clean energy transition for all customers served.

With shared environmental values, City Light and the residents of Seattle continue to promote balancing power supply demands with environmentally friendly power supply resources required to meet those needs. City Light is a consistent voice for generating electricity with renewable or non-emitting resources and promoting energy efficiency with its customers. It strives to limit negative impacts on the environment and reduce the need for costly new power generation. Since 2005, City Light has operated as greenhouse gas neutral – the first electric utility in the nation to achieve that distinction.

City Light's 2022 Integrated Resource Plan (IRP) outlines how the utility will meet anticipated customer needs under changing market dynamics, evolving policies, and future uncertainties over the next 20 years. The IRP requires a constant review of conditions that affect its power supply needs, costs, and risks. These considerations range from the evaluation of energy efficiency potential and new resource opportunities to ensure reliability, environmental stewardship and compliance with Washington state-mandated clean and renewable resource requirements.

The IRP is created as part of good utility practice and is developed with guidance from the Mayor, City Council, and Washington state law, including the Energy Independence Act (I-937) and the Clean Energy Transformation Act.

The primary goals in developing an integrated resource plan are to:

- Forecast the energy and capacity needed to meet customer demand.
- Determine the utility's capability to supply those needs and ensure flexibility during fluctuation.
- Define the capability and cost of current and prospective resources.
- Evaluate potential future City Light portfolios based on reliability, cost, risk, and environmental impact.
- Recommend a plan of action.

PUBLIC INVOLVEMENT

Over the next 20 years, City Light will track its power supply needs from both new and traditional resources. These power supply choices require investing hundreds of millions of dollars of customer funds and affect future operating costs, reliability, and the City's environmental footprint for decades to come. As a publicly owned utility, customer input on the IRP is essential.

Since fall 2021, City Light has conducted eight external IRP advisory panel meetings that included customers, environmental organizations, regional energy-related governmental organizations, and academic specialists. Presentations included topics such as energy conservation, climate change, load forecasts, resource adequacy, IRP modeling assumptions, and many other energy-related issues. Advisory panel feedback helped to shape the IRP process, findings, and recommendations.

In summarizing the views of the IRP advisory panel and public participants, their commitment to the environment is clear:

- There is broad support for immediate actions to address greenhouse gas emissions that contribute to climate change.
- The focus of a clean energy transformation needs to be equitable, with a priority on helping communities that have been historically impacted by fossil fuel use.
- Planning for more electrification of buildings and transportation in our communities, in conjunction with a changing climate and uncertainty in future transmission availability, remains a top priority.

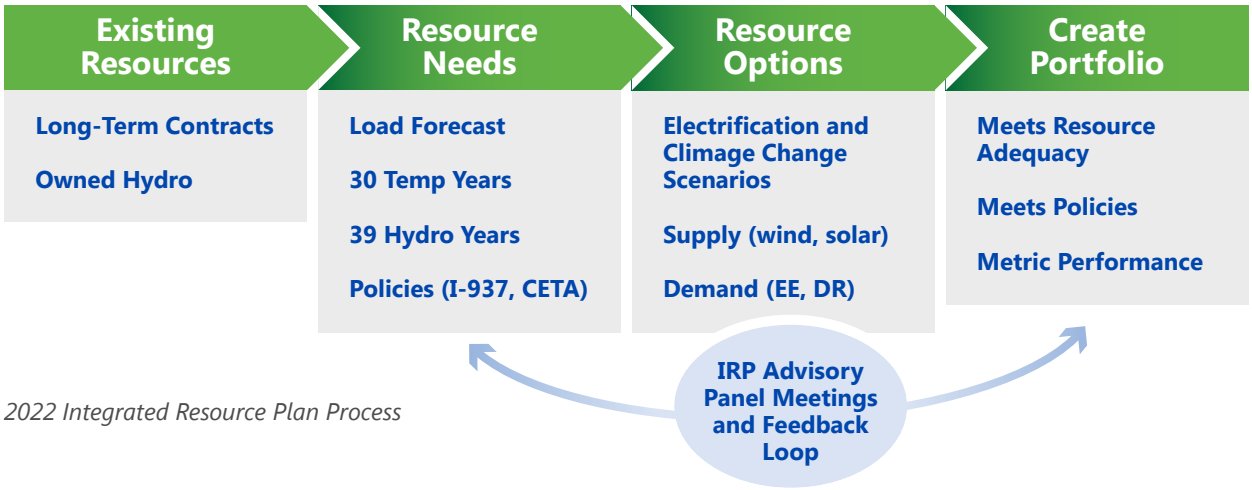
INTEGRATED RESOURCE PLAN PROCESS

The IRP is a long-term decision support tool designed to educate and support stakeholder participation in achieving City Light's energy future. It is also a Washington Utilities and Transportation Commission requirement to develop and update integrated resource plans, make them available to the public every two years, and provide a summary of estimated future resource needs at least 10 years into the future. Consistent with City Light values, the IRP recommendations are balanced to consider how our choices support a healthy environment, stop and reverse inequity, and create a vibrant future for our customers and community. The IRP is one of many important planning processes synchronized into City Light's Strategic Plan.

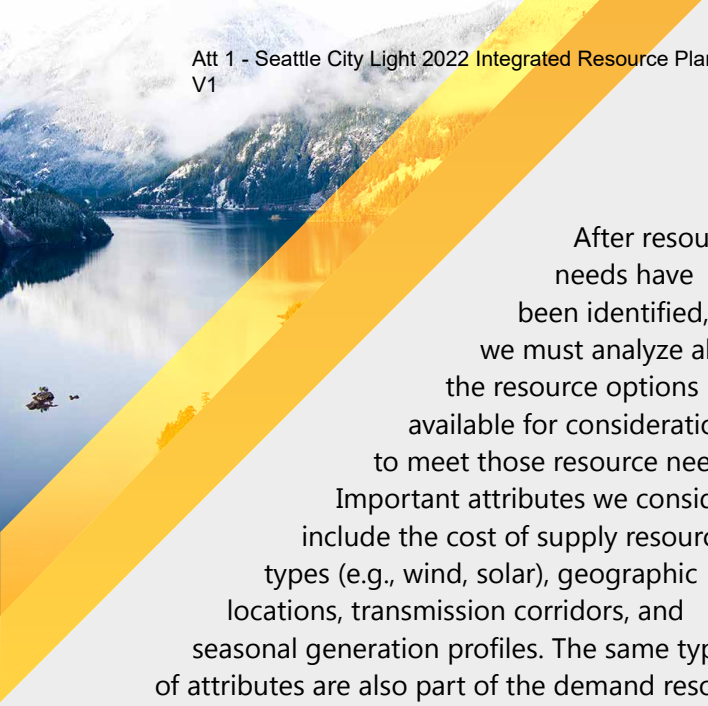
City Light's IRP process evaluates how robust our choices are at meeting the utility's goals and the range of conditions we expect to experience over the next 20 years. We must consider many different subject areas such as electricity demand forecasting, regional transmission outlooks, supply side renewable resource options and their costs, customer side energy options and their costs, and clean energy policies that City Light must comply with. The utility relies on input from an informed IRP advisory panel composed of external industry experts, individuals advancing equitable and clean energy policies, and City Light experts and leaders from across the utility, as well as City Light's customer outreach processes conducted to support our Strategic Plan and Transportation Electrification Strategic Investment Plan. Guided by this information and Seattle City Council and Mayoral directives, an IRP plan is developed.

As shown below, the 2022 IRP process starts with City Light's current portfolio of energy contracts and generation and finishes with recommendations needed to meet electricity demands over the next 20 years.

The first stage of the framework, and the IRP starting point, considers City Light's base load forecast, existing resource mix of contracts, and owned generation. The second stage of the framework determines if our existing resource-mix of contracts and generation is on track to meet not only our resource adequacy metric, but also our I-937 and Clean Energy Transformation Act compliance needs. The resource adequacy metric is tested using 39 different water supply conditions, as well as 30 different temperature conditions affecting electricity demand.



2022 Integrated Resource Plan Process



After resource needs have been identified, we must analyze all the resource options available for consideration to meet those resource needs. Important attributes we consider include the cost of supply resources, types (e.g., wind, solar), geographic locations, transmission corridors, and seasonal generation profiles. The same types of attributes are also part of the demand resource options, such as energy efficiency, demand response, and customer solar. In the end, the IRP portfolio selection framework will feature a mix of supply and demand resources that best fit City Light's resource needs.

The City Light IRP portfolio modeling framework develops a mathematically optimized (i.e., minimum cost) portfolio of resources, as shown below.

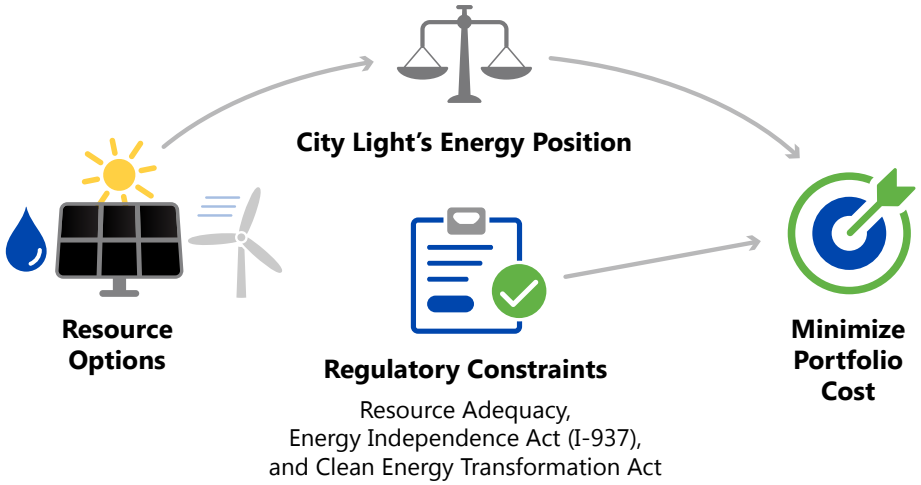
City Light and its stakeholders recognize there are other metrics to consider besides cost when determining the best mix of resources. For the 2022 IRP, City Light ranked and evaluated more than 20 resource strategies to develop a robust plan against six performance metrics:

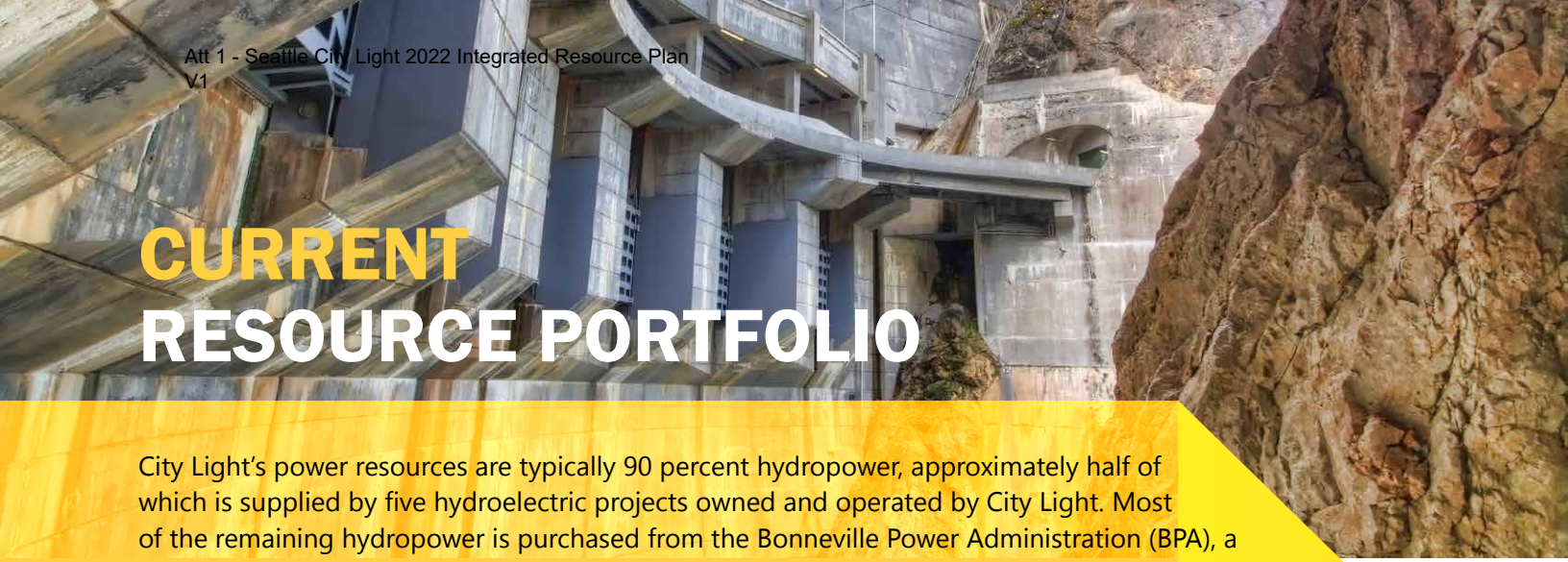
- Cost
- Greenhouse gas emissions
- Expanded customer programs opportunity
- Transmission risk
- Climate change preparedness
- Electrification preparedness

Each proposed portfolio receives a score and a ranking based on the measured performance, and by process of elimination, a recommended portfolio emerges. The IRP is not meant to prescribe or implement resource-related decisions but is designed to inform long-term and directional plans to best meet City Light's resource needs. City Light will continue to evaluate its IRP resource recommendations at least every two years.

IRP Portfolio Modeling Framework

Goal: Design best mix of resources to meet City Light's needs over next 20 years

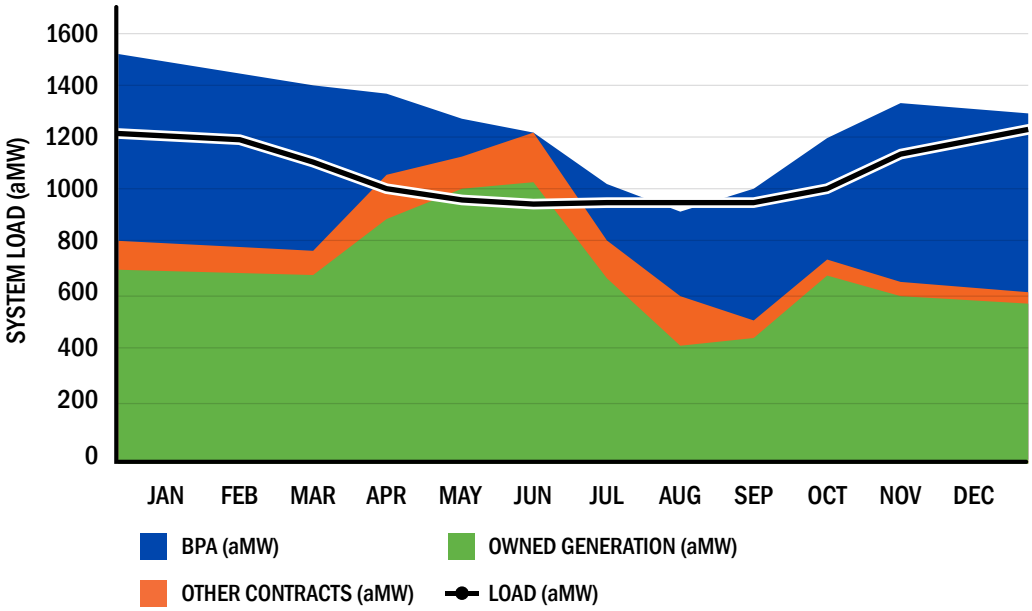




CURRENT RESOURCE PORTFOLIO

City Light's power resources are typically 90 percent hydropower, approximately half of which is supplied by five hydroelectric projects owned and operated by City Light. Most of the remaining hydropower is purchased from the Bonneville Power Administration (BPA), a nonprofit federal power marketing agency. Beyond generating hydropower, City Light is charged with the responsibility to operate its hydroelectric projects for flood control, fish management, and recreation. City Light's load-resource balance during the calendar year 2022 is shown below.

2022 City Light Load-Resource Balance



Three impactful processes shaping the composition of our future energy portfolio are underway:

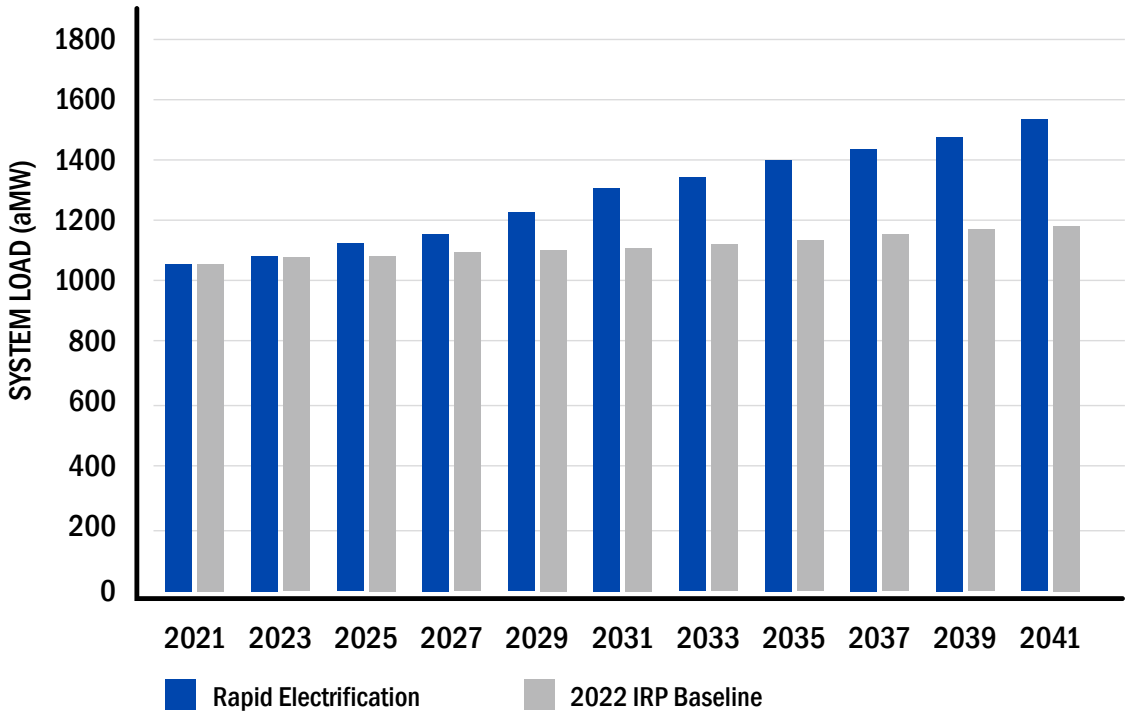
- By 2026, three power purchase contracts/exchanges are set to expire.
- In 2026, City Light hopes to begin operating under a new long-term license for the three dams on the Skagit River.
- In 2028, City Light will begin a new long-term contract with BPA to purchase energy from the federal hydroelectric system. As part of the new contract negotiations, City Light will seek opportunities to improve the timing and magnitude of power deliveries from BPA to best fit our load and resource balance.

LOAD FORECAST

The 2022 IRP baseline scenario anticipated modest load growth of 0.5% per year over the next 10 years. Under the baseline scenario, economic growth and electrification of transportation and buildings contribute to load growth, while market driven energy efficiency and distributed solar generation help mitigate load growth. The baseline load scenario also included variability from a range of different weather conditions to simulate extreme peaking requirements.

In addition to the baseline scenario, the 2022 IRP process also considered separate scenarios that addressed potential load impacts of climate change and more rapid electrification. The rapid electrification scenario was based on City Light and the Electric Power Research Institute's (EPRI) January 2022 Electrification Assessment and served as a "book end" scenario for higher levels of load growth. Under the rapid electrification scenario, City Light's load would increase by 32% compared to the baseline scenario shown below. Impacts to load from climate change were less pronounced. They generally pointed to lower loads in the winter and higher loads in the summer; however, more research is still needed to better model extreme weather conditions and peaking requirements under climate change. Importantly, 2021 featured a new all-time high peak load for June of 1,533 MW, and a near record December peak load of 1,896 MW.

2022 IRP Baseline Load Forecast vs EPRI's Rapid Market Electrification scenarios



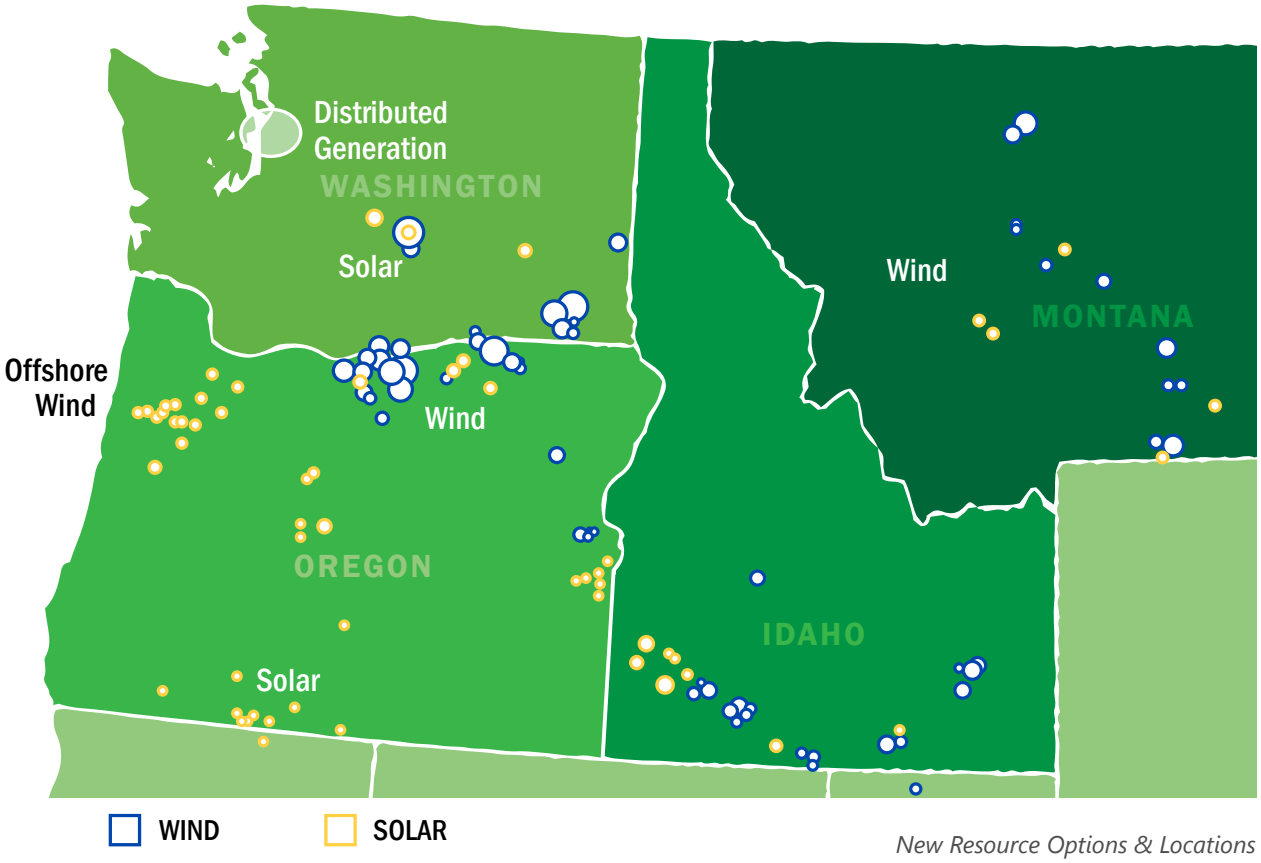
RESOURCE NEEDS

The 2022 IRP features two key conclusions compared to the 2020 IRP Progress Report in terms of City Light's resource needs:

- There are no significant changes in base-scenario summer resource needs compared to the 2020 Progress Report. But the 2022 IRP climate change scenario, which incorporates climate change impacts to weather and local hydrology, clearly shows increasing summer energy shortfalls going forward.
- Winter needs, especially December, are higher than the 2020 IRP progress report indicated, due to the updated load forecast that now features new building electrification codes and additional electric vehicle growth. The Rapid Market Electrification Scenario demonstrates additional significant growth in winter electricity demand.

The 2022 IRP features many of the same utility-scale resource options as the 2020 IRP Progress Report: eastern Washington solar, southeast Oregon solar, and Columbia River Gorge wind. However, the additional electrification and climate change studies informing the 2022 IRP indicate City Light will likely need to pursue acquisition of additional resources, such as:

- Local commercial or community solar projects that will diversify sources of weather-dependent generation and transmission uncertainty, and therefore help mitigate associated risks.
- Offshore and Montana wind in the 2030s with winter peaking generation profiles to help meet expected increases in seasonal demand.
- Demand response programs, which will help the utility manage short-term peaks in electricity demand.



New Resource Options & Locations

REGULATORY REQUIREMENTS

The Clean Energy Transformation (CETA) Act of 2019 recognizes existing hydroelectric projects and nuclear plants as non-emitting greenhouse gas energy generation resources. The three major milestones of CETA are:

1. Utilities must remove coal-fired generation from Washington's allocation of electricity by 2026.
2. Washington retail sales must be greenhouse gas neutral, with at least 80% renewable or non-emitting by 2030.
3. Washington retail sales must be 100% renewable or non-emitting by 2045.

With an existing energy portfolio typically more than 90% renewable or non-emitting, City Light is well positioned for meeting the second CETA milestone listed above.

City Light must comply with the Climate Commitment Act (CCA) of 2021 that requires reductions in greenhouse gas emissions from most sectors of the economy, including the electric utility sector, with milestones beginning in 2023. Entities impacted by these legislative requirements will receive allowances based on their individual emissions from 2015 to 2019; allowances specify the percentage of load that can be served by generation resources that are not provably greenhouse gas free. As of May 2022, the allowance amount is unknown.

The first compliance period is 2023 to 2026. The CCA requires reductions in greenhouse gas emissions to 45% below 1990 levels by 2030 and further reductions to 95% below 1990 levels by 2050. City Light will continue to track rulemaking activities to understand potential impacts to the utility's business and understand how it can manage its future reporting and compliance obligations and the associated costs.

The Energy Independence Act, also known as I-937, requires electric utilities serving at least 25,000 retail customers to use renewable energy and energy conservation. I-937 annual compliance can be met in three ways:

- If a utility has "load growth," each utility shall use eligible renewable resources and/or renewable energy credits (RECs) to meet 15% of its load.
- If a utility has "no load growth," each utility shall use eligible renewable resources and/or RECs to meet 1% of its retail revenue requirement.
- If a utility spends at least 4% of its retail revenue requirement on the incremental cost of renewable energy and/or RECs.

To comply with I-937 requirements, City Light has been using the "no load growth" compliance option since 2019. If City Light has increasing load over four consecutive years, it must meet 15% of sales with eligible resources, RECs, or a combination. Load increased in 2021 compared to 2020, and if load growth continues, City Light will need to take additional actions to ensure compliance with I-937 as early as 2024. With new wind and solar additions potentially starting in 2026, as well as the RECs already committed, City Light is well positioned for meeting I-937 requirements for renewable energy well into the future. After 2030, if City Light has a greenhouse gas free energy portfolio for four years in a row for CETA, then City Light does not have to take any additional actions for I-937.

In 2018, the Mayor and Seattle City Council updated the Seattle Climate Action Plan unveiling the goal to make Seattle carbon neutral (zero net emissions of greenhouse gases) by 2050. Most of the strategic initiatives of this plan involved transportation electrification, building electrification, and energy efficiency.

PORTFOLIO ANALYSIS

As part of the 2022 IRP analysis, three scenarios were considered:

1. Base load (i.e., 2020 corporate load forecast) with historical hydro and historical temperature.
2. Climate change with simulated future hydro and simulated temperature-affected load.
3. EPRI's Rapid Market Electrification with historical hydro and simulated electrification loads.

For planning purposes, the base load and historical hydro scenario were used as the baseline to plan energy portfolios in the 2022 IRP. However, climate change and electrification scenarios were used to better understand if different portfolios had attributes that could help manage uncertain climate change or electrification futures.

City Light developed more than 20 different portfolios of potential additional energy resources and narrowed that to a top seven. These top portfolios aligned with the latest regional transmission assumptions, state and local clean energy policies, resource options, and City Light's resource adequacy metrics.

The 2022 IRP portfolios were evaluated according to six different metrics. These metrics were developed as part of the 2022 IRP process to account for costs (Net Present Value), the climate change scenarios studied (Climate Change impacts), portfolio unspecified purchases (Greenhouse gas emissions), diversity of customer options (Expanded customer programs opportunity), the Rapid Market Electrification scenario studied (Electrification preparedness), and transmission cost and uncertainty (Transmission risk). All these metrics were equally weighted. The top-performing portfolio had the following attributes:

NEW RESOURCE ADDITIONS BY TIME PERIOD	2022–2031	2032–2041	TOTAL
Solar (MW)	175	0	175
Wind (MW)	225	50	275
Energy Efficiency (aMW)	85	31	116
Customer Solar Programs (MW)	24	28	52
Summer Demand Response (MW)	47	31	78
Winter Demand Response (MW)	79	43	122

2022 IRP Recommended Top Portfolio Plan

Columbia River Gorge

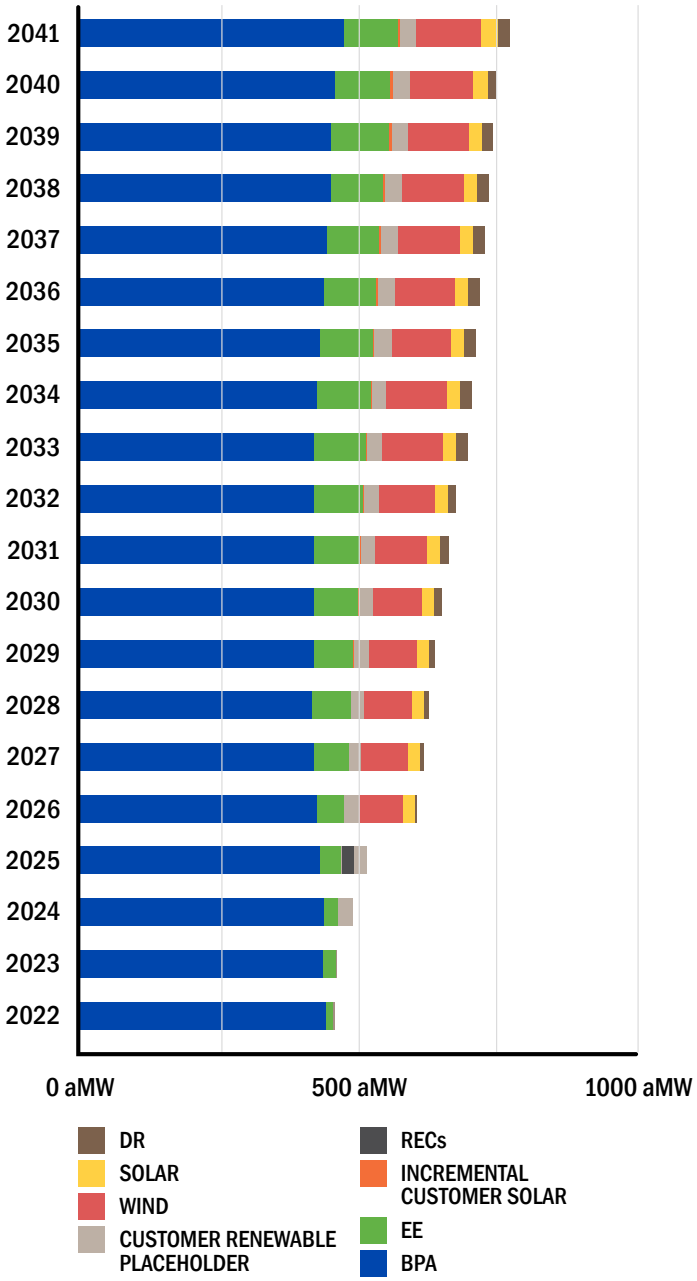
While each successive City Light IRP has its own set of assumptions such as load forecasts, contracted energy, price of new resources, and state policies influencing resource decisions, the 2022 IRP top portfolio contains the largest proportion of solar compared to previous IRPs. Decreasing materials costs and improvements in hardware efficiencies has led to significant decreases in the cost of solar energy over the last several years. However, during spring 2022, prices jumped upward due to supply chain troubles, as well as the U.S. Department of Commerce's review of alleged circumvention of solar panel tariffs in some countries. This investigation could pause manufacturing and shipping of solar panels, and hence delay development of new solar energy projects. Long term, solar energy from eastern Washington or Oregon can provide City Light affordable summer power when the hydroelectric resources run low. Local customer solar can provide non-wired energy solutions with the additional benefit of being strategically deployed to areas of greatest need.

The risk of summer forest fires and heavy smoke in the PNW as our climate changes make wind resources, a continuous theme in City Light's IRP recommended portfolios since 2016, a valuable energy hedge with solar. Wind has also seen price decreases and efficiency increases the last several years. Like solar, wind resources in the Columbia River Gorge also tend to experience peak production during the summer months. Montana wind and offshore wind, both of which can see up to 50% capacity factors, are winter peaking, which will benefit City Light particularly as electrification is expected to increase winter demand. The 2022 IRP recommended portfolio mix (page 13) anticipates all of City Light's wind resources prior to 2030 will be from the Columbia River Gorge area, while after 2030 it is possible that new transmission infrastructure would allow for City Light to benefit from a Montana wind resource. Development of offshore wind technology, such as floating turbines, may also make offshore wind resources off the coast of Washington or Oregon feasible for inclusion in future portfolios.

> *Decreasing materials costs and improvements in hardware efficiencies has led to significant decreases in the cost of solar energy over the last several years.*

Comparing energy efficiency forecasts between the past few IRPs is much more difficult due to quantifying voluntary technology adoption rates over time, outside of the programmatic adoption rates. The 2022 IRP recommended portfolio includes about 40 average MW (aMW) of energy conservation measures by 2026, which is about 4 aMW higher than the 2022 Conservation Potential Assessment (CPA). The 2022 IRP is the first to recommend a portfolio that endorses demand response programs, as they not only manage climate- or electrification-related extremes, but also generally reduce customers' energy burden. The 2022 IRP top portfolio's resource mix is shown below.

2022 IRP Recommend Top Portfolio Resource Mix



In summary, the new resources outlined in the 2022 integrated resource plan are due to:

- Certain power purchase contracts and exchanges gradually expiring by 2026.
    - o Stateline Wind, Columbia Basin Hydro, Lucky Peak Exchange.
- Clean energy policies forcing coal plant retirements.
    - o 2,150MW coal retirements by 2027 in the Northwest.
    - o Increases regional resource adequacy concerns.
    - o Results in less certainty that City Light can buy affordable and reliable energy in markets.
- Pace of climate change and electrification.
- Increasing customer push for greenhouse gas free portfolio.

There is always the risk of the wind not blowing, the sun not shining, and energy conservation or demand response reaching its limits on helping with resource adequacy. As City Light's electrification loads begin to materialize and we see an increasing frequency of weather extremes associated with climate change, other base load dispatchable resources such as batteries, hydrogen, geothermal, small modular/advanced nuclear, etc., should be part of the discussion to maintain current levels of grid reliability. Given these uncertainties, it is crucial to develop plans in partnership with our customers, community groups and other stakeholders that have the right degree of flexibility to be consistent with their needs and expectations.

CONCLUSIONS

The 2022 IRP helps City Light develop a plan for providing customers with reliable, safe, and affordable clean energy for decades to come. Its core findings are:

- City Light expects modest load growth due to continued electrification of transportation and certain heating and cooling applications in buildings.
- City Light should continue to engage and educate customers about energy efficiency and demand response programs.
- City Light should continue to participate in regional energy programs and markets to increase our ability to meet peaks and ensure uninterrupted service.
- Improvements in the transmission system will be critical to meet clean energy requirements established by city and state legislation. Together with its stakeholders, City Light should continue working with regional partners and planning organizations to identify transmission need and implement transmission development projects. City Light should initiate clean energy supply procurement processes with operational dates as early as 2026 and 2027 for delivery to Seattle.
- City Light should continue climate change and electrification research to refine its resource strategies and timelines.

> *Over the next 10 years, City Light will look to bring many new resources into its portfolio, as well as new licenses and power contracts.*

Over the next 10 years, City Light will look to bring many new resources into its portfolio, as well as new licenses and power contracts. In general, resources will be added proportionally, according to the 2022 IRP Recommended Top Portfolio Plan. Some key milestones over the next 10 years are shown below.

2022 IRP Ten Year Important Milestones

2022	2024	2026	2028	2030	2032
Demand Response Pilot Programs Start (2023) **Time of Use Rates Pilot** **CEIP***	**Climate Commitment Act 2023** **Opt-in Time of Use Rates Begin** **New ~100 MW Resource for Customer R+** **IRP Progress Report, CPA** and Strategic Plan Update** **CEIP Update**	**~400 MW New Supply Resources Online** **~50 aMW Energy Efficiency** **New Skagit License Start** **~10 MW Demand Response** **Full IRP, CPA, Full Strategic Plan and CEIP**	**New BPA Contract Start** **IRP Progress Report, CPA and Strategic Plan Update** **CEIP Update**	**CETA Greenhouse Gas Neutral** **Full IRP, CPA, Strategic Plan Update and CEIP**	**Long-Lead Resource Additions MT and Offshore Wind** **~90 aMW Energy Efficiency** **IRP Progress Report, CPA and Full Strategic Plan Update** **~90 MW Demand Response** **CEIP Update**

**CEIP – Clean Energy Implementation Plan a requirement of the Clean Energy Transformation Act.*
***CPA – Conservation Potential Assessment.*

FUTURE WORK

As negotiations with BPA for the Western Resource Adequacy Program are ongoing, City Light will explore whether its contract could allow for different energy allocation. In other words, the utility should try to structure more energy in December and/or August even as other utilities reach for the same resources. These months will be important as electrification and climate change begin to influence City Light's load and resource balance. Also, the next BPA contract might have options for 100% clean block products. The increasing calls from City Light's customers, as well as the Climate Commitment Act requirements taking effect in 2023, put reductions in resource emissions at a higher priority.

City Light will further study energy efficiency, distributed resources, storage, and customer solar potential under climate change and electrification loads. This will help inform program design to account for future IRP modeling. Future resource options should also consider new, potentially large 24/7 loads such as hydrogen production facilities (200MW-500MW), existing steam plant to electric conversions, or other large base loads. Additional resources and flexibility resulting from grid modernization programs will be important to incorporate into future IRPs as well.

City Light will continue to develop relevant social equity metrics and include these metrics in future IRP analyses and decision processes. Baseline levels for social equity metrics can be established from City Light's current energy portfolio to help identify and prioritize areas for improvement, such as developing energy efficiency, demand response, and community solar programs to ease the energy burden for environmental justice communities and vulnerable populations. Social equity metrics could also be incorporated into IRP portfolios to quantify improvement or detriment to these customers to better inform IRP recommendations.

Incorporation of additional climate change scenarios in IRP analyses will also help to create a more thorough understanding of climate change-induced resource need. BPA recently proposed changes to its regional analysis that now aim to incorporate current and anticipated impacts of climate change on the region. City Light should continue to stay engaged and actively participate in BPA planning activities to help ensure robust and equitable regional energy policy.

Seattle City Light

700 5th Avenue
P.O. Box 34023
Seattle, WA 98124-4023

seattle.gov/city-light