Navigating Uncertainty

TACOMA POWER

TACOMA PUBLIC UTILITIES

INTEGRATED RESOURCE PLAN
2017 UPDATE

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Letter from the Power Manager

The electric grid (and perhaps even electric utilities) of the future may be drastically different than the one we rely on today. Recent advances in technology – in particular distributed energy resources, improved electric device efficiency, electric vehicles – have already spurred change in the electric industry.

Regionalization of wholesale markets, extended renewable energy incentives, and persistent efforts to tax or cap carbon are creating complex uncertainties.

The role of Power Management is to navigate this uncertainty and to provide the best value possible to our customers. This requires being vigilant of disruptive changes and adapting as needed.

Load growth and **carbon policy** are two important changes discussed in the 2017 IRP.

Load growth has been in decline for quite some time; however, the 2017 IRP update marks the first planning cycle in which Tacoma Power's load is actually projected to be lower in 20 years than it is today.

While some would argue this phenomenon is a precursor to the "utility death spiral," we might also view declining load as an opportunity to innovate. Washington State is among a host of states, cities and nations committed to mitigating the impacts of climate change.

While it isn't known what policy path the state will pursue, meeting our state greenhouse gas emission targets will require steep carbon reductions- also known as "Deep Decarbonization." Washington State has identified three potential deep decarbonization pathways, including electrification.

Electrification of end uses, particularly transportation, has the potential to not only advance deep decarbonization efforts but also to reverse the decline in load growth observed in recent years. Moving forward, it is important that we maintain a position that allows us to adapt to changes and take advantage of new opportunities as they arise. This is accomplished through careful and thoughtful planning.

An integrated resource plan (IRP) ensures the utility provides reliable power at lowest reasonable cost and risk. Historically, the questions we have asked in the IRP have been whether, when and which new resources are needed to meet future demand.

However, the IRP may soon require asking new questions: Does the traditional utility business model need to change? How do we evolve in an increasingly constrained environment?

For an industry that has been built on and supported by growth in demand for decades, sluggish or declining load growth will require innovative thinking and planning. These are uncertain times indeed, but they are also ripe with opportunity.

The electric utility industry has undergone periods of significant technological, economic, and regulatory transformations over the past century.
As we look ahead to the next two decades, there is good reason to believe that more disruptive changes are on the horizon.

The decision at hand is how we choose to plan for that change. ■

Clay Norris, Section Manager
Power Management

RESOLUTION NO. U-10971

A RESOLUTION relating to the approval and adoption of the Tacoma Power 2017 Integrated Resource Plan Update.

WHEREAS Washington State law (Chapter 19.280 RCW) requires the Department of Public Utilities, Light Division (d.b.a. "Tacoma Power"), to prepare and submit an integrated resource plan or update ("2017 IRP") to the State Department of Commerce by September 1, 2018. Tacoma Power has completed an IRP Update for compliance with its 2018 submission, and

WHEREAS the 2017 IRP Update, on file with the Clerk of the Board, incorporates new estimates for retail customer demand, a review of the output of existing energy resources, calculated the amount of available conservation deemed cost-effective, and an update on renewable energy requirements to comply with I-937. An overview of the 2017 IRP Update was presented to the Board on October 25, 2017, and

WHEREAS RCW 19.280.050 requires the governing body of the electric utility to approve such plan after public notice and hearing, and

WHEREAS the Board conducted a public hearing on the plan on November 15, 2017, and

WHEREAS Tacoma Power requests approval and adoption of the 2017 IRP Update by the Board; Now, therefore,

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BE IT RESOLVED BY THE PUBLIC UTILITY BOARD OF THE CITY OF TACOMA:

Tacoma Power's 2017 Integrated Resource Plan Update is approved, and the appropriate officers of the City are directed to file such plan with the state of Washington in accordance with Chapter 19.280 RCW.

Approved as to form and legality:

William Fosbre
Chief Deputy City Attorney

Monique Trudnowski
Chair

Secretary

Marlean Jacobs
Clerk

Adopted 11-15-17

Section One

Executive Summary
2017 IRP Update
Progress Report

Executive Summary

The 2017 Integrated Resource Plan identifies several action items for follow-up during the next several years, including:

1. Acquire 6.4 aMW of conservation as directed by the Conservation Potential Assessment
2. Investigate the value of flexible capacity provided by our hydro resources as well as demand side resources.
3. Explore distributed energy resource (DER) planning methodologies and impacts
4. Improve resource planning analytical capabilities to enable analysis of additional resources and expanded opportunities

The results of the 2017 Integrated Resource Plan (IRP) Update indicate that Tacoma Power can adequately meet customer demand for electricity for the next 20 years with our existing resource portfolio and planned conservation acquisition.

Tacoma will also not need a new resource to meet renewable energy portfolio requirements. These results confirm the findings of the 2015 IRP.

The most important change between the current and previous IRPs is that Tacoma is now projecting a declining retail load forecast. This means that for even a critical water year, we are not expected to reach our contract high water mark (the maximum amount of power we are entitled to recieve from Bonneville Power Administration (BPA). As a result, we expect to take decreasing amounts of power from BPA over the remainder of the contract period.

Decreasing retail load also implies a reduced need for renewable energy credits to comply with the Energy Independence Act of 2006.

Under average water conditions, Tacoma Power can expect to be over 200 aMW surplus. Although this puts Tacoma in a comfortable position in terms of resource acquisition, there is quite a bit of uncertainty that plagues the current and future planning environment. In particular, a rapidly evolving regional energy market, steadily declining wholesale market prices as well as falling prices of distributed energy resources can potentially align in ways that change our position.

Recognizing both Tacoma's current resource situation as well as the potential for conditions to change, the action items of the 2015 IRP instructed the utility to continue to acquire all cost-effective conservation and to stay abreast of disruptive changes in the industry. Similarly, the 2017 IRP's action plan calls for Tacoma Power to acquire all cost-effective conservation and to explore ways in which the utility can extract more value for its resources. The purpose of this document is to provide both an update to the 2015 IRP as well as a sneak peek at some of the issues we are likely to investigate during the 2019 IRP.

Section one of this document includes:

- An updated load resource balance and resource adequacy assessment
- A progress report on the action items laid out in the 2015 update

Section two introduces topics to be addressed in our next full IRP including:

- An overview of major regulatory, policy, technology and customer trends with potential to impact resource planning
- A discussion of the impending expiration of power contracts which make up over 50% of Tacoma's resource portfolio. ■

2017 IRP Update

Tacoma Power completes a full integrated resource plan (IRP), or an IRP update every two years.

This process includes an assessment of current and projected loads and resources to produce a load resource balance (LRB). A load resource balance calculation helps Tacoma determine whether we expect to have enough resources to meet projected customer needs. For planning purposes, the load resource balance is determined for a critical water year. A critical water year is a historic year in which record low levels of water were observed resulting, in extremely limited hydroelectric generation.

The 2015 IRP provided justification for switching from a 1941 water year to the use of the 2001 water year as its representative for critical water planning. Since the 2015 IRP, there have been a number of changes impacting the calculation of our load resource balance including our projected retail load as well as our projected conservation and hydro resources.

Retail Demand

Although customer count is expected to increase noticeably over time, driven by increased population in Tacoma Power's service territory, usage per customer is expected to continue to decline. The retail load forecast used in the 2015 IRP represented a significant reduction from that used in the 2013 IRP. Similarly, in the 2017 IRP update, retail demand is expected to continue to decline compared to previous forecasts.

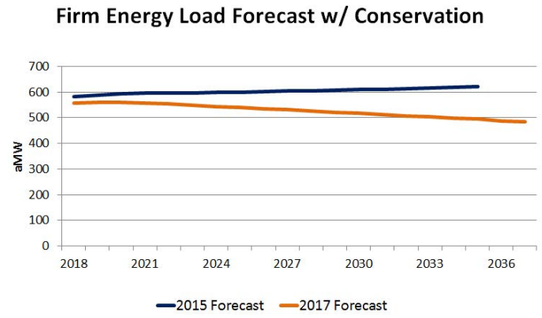
This steady decline is driven by a number of factors including:

- Adoption of energy efficient technologies as well as conservation: Total employment and retail sales in Pierce County are expected to increase over time, reflecting the aforementioned population growth, but continued customer adoption of energy-saving technologies such as LED lighting and the success of Tacoma Power's energy efficiency programs will likely offset potential load growth. While the forecast of cumulative conservation savings over the next twenty years is lower than the forecast used in the 2015 IRP, the impact of conservation measures on retail load is still quite robust.

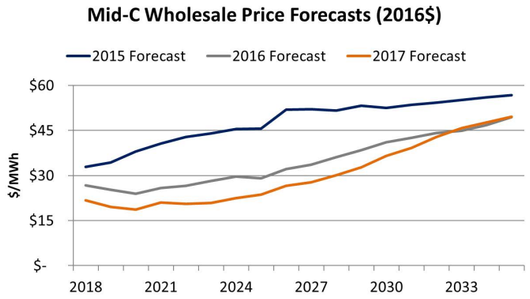
- Efficiency codes and standards: The 2017 IRP forecast also accounts for recent changes in codes and standards that are expected to reduce the typical energy use of new buildings in Tacoma.

- Adjusted large load assumptions: Overall expectations for new large loads have been reduced from previous estimates, both in terms of customers and energy demand. Only projects that have been sited and have begun construction were included in the forecast. Existing industrial loads are projected to be generally flat given the mitigating effect of conservation on any increased energy demand resulting from these industrial customers' own operations and sales.

Firm energy load in Tacoma Power's service territory is projected to decline by an average of 0.8% per year, falling from 558 average megawatts in 2018 to 484 average megawatts in 2037. This is a total decrease in retail load of 13.3% over the next twenty years. Peak loads are also expected to decline over time to a somewhat smaller degree, from an annual peak of 973 megawatts in 2018 to an annual peak of 919 megawatts in 2037.



In the 2015 IRP, while loads were indeed projected to be lower than previously expected, they were still expected to slightly increase over time. As such, this forecast represents a fundamental shift in planning for the utility.



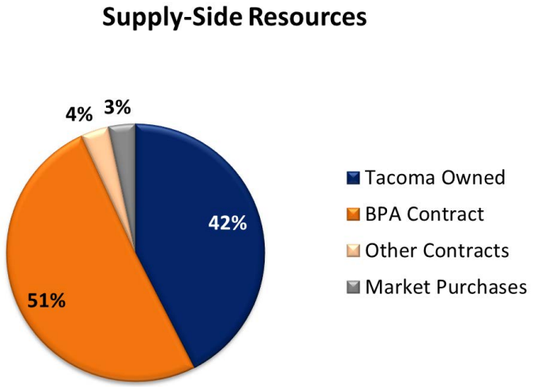
Supply Portfolio

Tacoma meets customer loads with both supply side and demand side resources.

On the demand side, conservation is our primary resource. The conservation target in a biennium is set through a calculation of avoided cost, as required under the Washington State Energy Independence Act (2006).

On the supply side, Tacoma Power's portfolio consists of owned resources, contracted resources, and the wholesale energy market. Because the vast majority of this resource portfolio is hydroelectric, the amount of power generated varies from year to year depending upon the timing and quantity of inflows. Various operational constraints also have an impact on how much power our resources can extract from available water.

We project reductions in both Tacoma's demand-side conservation and supply-side portfolios. Conservation reductions are due to a combination of unit savings and cost assumptions which reduced economic potential. As for our supply portfolio, new safety requirements at Riffe Lake has forced operational changes and effectively reduced output.



Riffe Lake Operation

The United States Geological Survey (USGS) recently revised its earthquake predictions for the Cowlitz River Basin. To protect public safety, Tacoma Power has proposed to hold Riffe Lake's maximum elevation down approximately 30 feet lower than full. This change is expected to be in effect at least into the next decade. Approval by the Federal Energy Regulatory Commission is pending.

The lower level will keep the lake water below the spillway gates. These gates might be rendered useless in the event of certain seismic activity which could cause significant downstream flooding if the reservoir were full. It should be noted that Mossyrock Dam's concrete structure is not expected to fail during an earthquake.

The reduction in lake level reduces the amount of electricity that is available because of lower generator efficiency and capacity. Riffe Lake is Tacoma Power's largest storage reservoir and supplies water to the utility's largest generators. It is estimated that the energy loss will average 46,300 MWh/year or 5.3 aMW.

Conservation: Avoided Cost Calculation

In 2017, the cost of the Block product under our purchase power contract with the Bonneville Power Administration (BPA) became the basis of the avoided wholesale energy cost to determine economic conservation potential project conservation acquisitions over the planning period.

In prior years, the wholesale market price forecast was used as the avoided cost of conservation. The justification for using the market price as conservation's avoided cost was that energy saved from conservation efforts would avoid wholesale market purchases. However, our load forecast now indicates we will not reach our contract high water mark (the maximum we are entitled to take from BPA) during the planning horizon. This means that conservation reduces our take of power from BPA.

Under the new approach, we recognize that energy saved through conservation reduces our annual net requirement (the amount of power Tacoma buys from Bonneville). This means that when the market price is below the cost of the Block product, the avoided cost of conservation is actually the cost of the Block product.

That said, the Block product changes annually based upon our annual energy load forecast, and comes in a prescribed shape. However, reductions in the Block power we receive almost never coincide perfectly with the timing of load reductions from conservation (i.e. the Block shape is different from the shape of conservation savings).

Because we buy and sell energy on the market, we derive more value from measures that provide us extra savings when prices are high and less value from measures that save more when price are low. We capture this incremental value by scaling up our market price forecast to the cost of the Block product and using that as our calculation of avoided cost. Switching to this alternative avoided cost calculation resulted in a higher quantity of conservation measures deemed cost-effective than would be under an avoided cost based on current wholesale market prices.

Wholesale Market: Mid-C Price Forecast

The overwhelming majority of Tacoma Power's wholesale market transactions (in terms of volume traded) are sales.

During an average water year, roughly 60% of our resources are used to meet our retail load and about 40% is sold in the wholesale market. Long range wholesale price forecasts have been declining over the past decade because of oversupply of natural gas and oversupply of power generation.

A comparison of Tacoma Power's 2015, 2016, and 2017 wholesale price forecasts indicates that the price outlook is steadily falling.

Differences between the current and previous wholesale price forecasts are due to a combination of changes in assumptions which include; lower natural gas prices, lower demand, early coal plant retirements, increased buildout of renewables, as well as an assumed Northwest carbon tax beginning in 2028.

Resource Adequacy

Adequacy standards for Tacoma Power and the region have changed over the years largely because of the availability of better computational models. The shift has been from deterministic load resource balance models to probabilistic models which test the impact of multiple operating variables. Future adequacy standards will likely evolve due to changes in generation mix within the region, technology, and policy.

Tacoma Power measures the adequacy of its electric supply as part of the planning process to ensure that reliable and cost effective service is available to meet retail customer demand. The utility plans how it is going to match customer demand with available electric supply during each hour of the day for the next 20 years into the future.

It is crucial for a hydroelectric utility to have adequate energy supply in addition to the capacity that is necessary to meet peak hourly demands. Tacoma Power's energy supply was evaluated over both annual and monthly time horizons. Peaking capacity was evaluated over a 72 hour high load period.

Tacoma Power considers itself to have adequate resources when it meets the following three criteria:

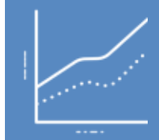
1. Annual Adequacy: When simulated annual energy supply under "critical water" conditions exceeds "baseline" annual forecasted demand

2. Monthly Adequacy: When simulated monthly energy supply exceeds "baseline" forecasted monthly demand at least 19 times out of 20

3. Peak Adequacy: Adequate supply during 72-hour peak load periods for 19 out 20 simulations. Load period is the year which has the highest expected loads. That year is simulated with the water years from 1950-2015

Definitions

"Critical water" | A scenario of river flows that reflects the lowest levels of water supply for both Tacoma Power hydropower projects and volume dependent supply contracts.



"Baseline" | A scenario of retail load forecast that assumes average temperature, average customer growth, and predicted customer behavior over the long term.

These metrics are consistent with methods commonly used by other Pacific Northwest utilities and the Northwest Power and Conservation Council, and reflect the specific characteristics of Tacoma Power's portfolio of resources.

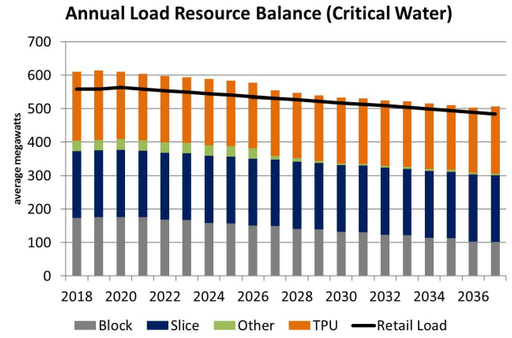
Tacoma Power's current adequacy metrics only measure the risk of shortfall which is sufficient for a utility which is not short of capacity. If it is determined in the future that capacity expansion is needed, then additional metrics will be necessary to assess magnitude, duration, frequency, and timing of potential shortages. Also, in the future Tacoma Power may need to measure the adequacy of its balancing reserves if a decision is made to add renewable or intermittent generation to the supply portfolio.

Annual Adequacy

Does simulated energy supply under critical water conditions exceed forecasted customer loads over a year? This metric ensures we have enough energy to meet retail demand based on reasonable expectations of customer need.

The amount of our expected annual supply is sufficient to meet load during a critical water year. Because load is projected to decline, Tacoma is not expected to reach its contract high water mark (the maximum amount of power Tacoma has a right to take from BPA). It should be noted that Tacoma Power's BPA contract will terminate in 2028 and so the analysis through 2037 assumes that the contract will be renewed or replaced with a similar product, which may or may not be the case. Also, during a normal water year (not critical water year), the utility can expect to be just over 200 aMW surplus.

Annual forecasted energy supply at critical water (water year 2001) exceeds annual forecast average retail energy demand in all study years (2018-2037).

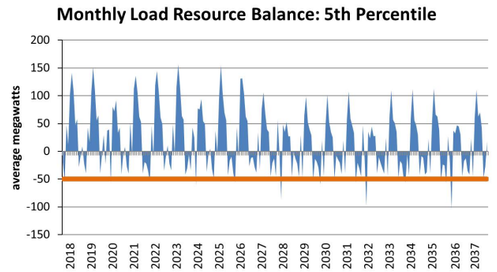


Monthly Adequacy

Does simulated energy supply exceed forecasted customer loads in every month 90% of the time? This metric ensures we have the capacity to meet customer need as it varies by season and month.

The simulated monthly energy supply, plus 50 aMW of allowable market purchases, exceeds the simulated monthly retail demand at least 19 times out of 20. It should be noted that monthly deficits can be caused because water is stored during one month and then used to capture higher wholesale market value. The rare occasions of simulated deficits are partially due to changes in maximum elevation at Riffe Lake.

Simulated monthly energy supply plus 50 aMW of allowable market purchases exceeds simulated monthly retail energy demand in at least 19 out of every 20 months.

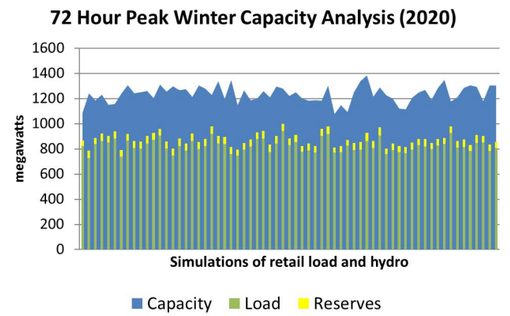


Peak Adequacy

Does simulated capacity exceed the highest 72-hour average peak ("highest") customer load in 19 out of 20 years? This metric ensures we have the capacity to meet the most pressing peak demand. This IRP ran 66 simulations.

An extreme weather event was tested by measuring supply during the 3-day period with the highest simulated hourly loads. The PLEXOS model simulated that the utility would purchase for some hours during a cold snap but this mirrors how we would typically operate. The simulation did show that we were net surplus during the 3-day period and that we had enough machine capacity to ride out an extreme cold snap.

Simulated capacity exceeds the highest 72 hour peak retail energy demand in 19 at least 19 out of 20 annual simulations.



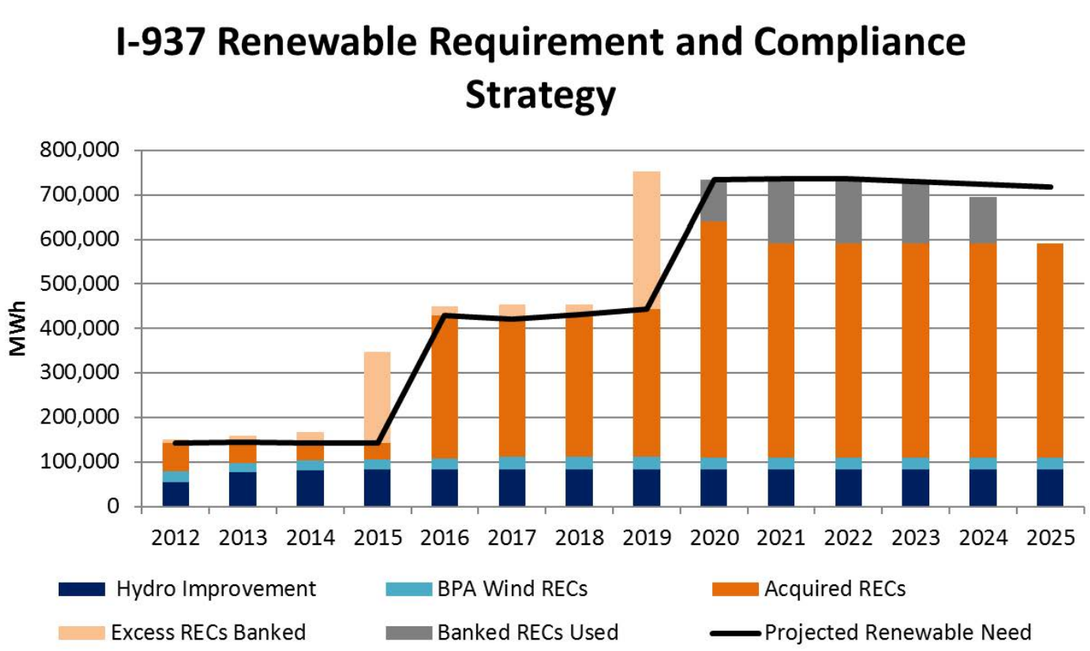
Renewable Compliance Update

Utilities serving 25,000 customers or more are subject to the renewable portfolio standard (RPS) established by the 2006 Washington State Energy Independence Act (I-937).

I-937 establishes a renewable portfolio standard (RPS) with renewable energy targets as a percentage of customer load. These targets increase over time, from 3 percent by 2012, to 9 percent by 2016, to 15 percent by 2020.

Although Tacoma Power's existing hydroelectric power is a renewable resource, it is not eligible for I-937 compliance. Eligible resources include incremental hydro, wind, solar, geothermal, landfill gas, wave, ocean or tidal power, gas for sewage treatment plants and biodiesel fuel and biomass energy.
Utilities can comply with the RPS requirement using utility-owned eligible resources or by purchasing renewable energy credits (RECs). Since Tacoma Power does not need additional energy, our compliance strategy has largely been to purchase RECs.

In prior years, we have acquired more RECs than required to meet annual requirements. That excess is banked for use in future years. Currently, Tacoma Power has purchased and banked enough RECs to meet our I-937 requirements through 2024. ■



2017 IRP Update Action Plan

The landscape in which we plan is constantly changing. Between IRP cycles, a short term plan helps us to better navigate this uncertainty. Historically, Tacoma Power's short term plans have called for regular assessment of changes in the industry and continuous development of ways to better position the utility for a number of potential futures. Similarly, the action items of the 2017 IRP Update include the following:

1. Acquire 6.4 aMW of conservation in the 2018-2019 biennium
Conservation continues to be Tacoma Power's preferred resource. This is because conservation slows load growth and delays the need to invest in a new generation resources. Tacoma Power's 2018 Conservation Potential Assessment (CPA) identified a ten-year conservation potential of 31.7 aMW. The two-year pro rata share of that potential is 6.4 aMW and sets the conservation target for the 2018-2019 biennium.

2. Investigate the future value of flexible capacity
Because our resources are hydroelectric, they provide both firm and flexible capacity. Historically, Tacoma (and the region in general) has not been short on capacity and therefore, the value of flexible capacity has often been considered insignificant. However, changes in the industry –increased penetration of variable energy resources (like wind and solar) and opportunities to participate in the California Energy Imbalance Market – may increase the need for and value of flexible resources. Developing a clear understanding of the current and future value of flexible capacity is important for evaluating new programs and resources. With this understanding, Tacoma Power will be better prepared to assess new opportunities over the coming years.

3. Explore expansion of the IRP to include Distributed Energy Resource Planning
The WUTC is currently considering a position to require investor owned utilities to conduct and publish a distributed energy resources plan at periodic intervals. The proposal would require the utility to consider, at a sub-area level, the costs and benefits of DER deployment. The likelihood of legislative action to extend this process to customer owned utilities is possible. Resource planners should engage in this process, participate in the discussion and understand how this requirement may impact distribution and resource planning.

4. Investigate resource planning tools and analysis methodologies
As the industry changes, it is important that we invest in appropriate analytical tools and make changes to our planning scope and methods as necessary.

Progress Report

The results of the 2015 IRP's load resource balance indicated that there would be no need for a new resource other than conservation. Given that fact and the uncertainty surrounding our future planning landscape, Tacoma developed a short term action plan requiring the utility to:

1. **Acquire** 9.4 average megawatts of energy conservation in the 2016-2017 biennium.
2. **Continue evaluation** of BPA products as more information becomes available.
3. **Learn** from small-scale resource pilot programs at Tacoma Power and elsewhere to inform future IRP's.
4. **Monitor and report** on emerging technologies that may significantly impact retail demand.
5. **Explore** methodologies to incorporate estimated climate change impacts into the official long-term load forecast.

For each of these 2015 action items, Tacoma Power has either met or is well on its way to meeting the specified objectives.

Methodologies to Incorporate Climate Change Impacts into Load Forecast

Staff explored potential methodologies by which our current load forecast could be "adjusted" to account for climate change.

One method we have implemented is an adjustment to the estimated relationship between temperatures and load. Climate change is represented in our adjustment as an increase to normal temperatures that escalates over time. These increased temperatures increase the number of days in a year where load is higher due to cooling buildings, but decrease the number of days in a year where load is higher due to heating buildings.

To determine the annual temperature adjustments, we used the average monthly future temperatures estimated by the University of Washington's Climate Impacts Group in 2015. Those future temperatures correspond to a future period beyond the timeframe of our current load forecast, so the temperatures used in our climate change adjustment are scaled back to align with the load forecast timeframe. The temperature adjustments range from an annual average of +0.15 degrees Fahrenheit in 2018 to 1.59 degrees Fahrenheit in 2037. Individual months have temperature adjustments that differ from these averages based on the shape of expected temperature changes across a given year.

Ultimately, the impacts estimated using this approach are de minimis. Tacoma has a mild maritime climate that is not susceptible to large swings in load for heating or cooling. Temperature increases over time serve to reduce this winter peak. These same increases in temperature also increase summer load. These effects counteract each other on an annual basis, as total load in 2037 is only reduced by 0.03%.

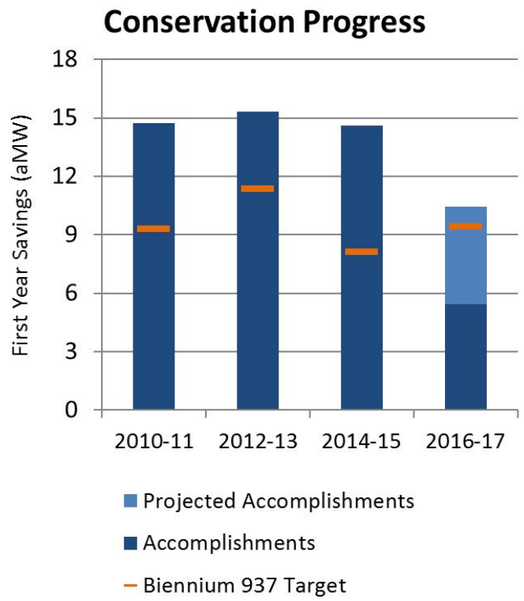
While the impacts are small, it is useful for the utility to begin to estimate the impacts of climate change on load. Future IRPs will look to improve upon this methodology and examine the impact of climate change on both load and generation.

Acquire 9.4 a MW of Conservation

Since 2006, WA state utilities have been required to acquire all cost effective conservation. Tacoma has historically done well in this regard and exceeds conservation targets every biennium.

In 2016, Tacoma acquired 5.45aMW of conservation - over half of the 9.4 required for the biennium. We are well on our way to meeting the target.

Also, because we have exceeded our targets in past years, Washington State law provisions that allow utilities to bank excess conservation for use in later years place us in an even more comfortable position to meet or exceed the 9.4aMW conservation target for the biennium.



Evaluation of BPA Products

Tacoma Power is a preference power customer of the Bonneville Power Administration (BPA). Tacoma purchases the "Slice/Block" product from BPA via a long-term power supply contract, which is active through 2028.

The "block" portion is a guaranteed and certain quantity of energy every month that does not vary with streamflow conditions. The "slice" portion of the contract is a percentage share of the total output of BPA's generation resources, meaning it varies by hydrologic conditions. As such, there is bounded uncertainty about the amount of power Tacoma will receive from BPA in a given year.

In 2016, Tacoma Power had an option to switch products from the current "Slice/Block" product to a "Shaped Block" product, and the two alternatives were carefully considered in the 2015 IRP.

At the time, forecasts of natural gas fundamentals suggested oversupply conditions from the expansion of hydraulic fracturing (i.e. "fracking") technologies would be short-lived and that wholesale power prices would return to pre-2010 levels. This has not been the case. Based on analysis done in the 2015 IRP, the utility elected to retain our current BPA product selection, the "Slice/Block" product.

This will be the power product Tacoma purchases from BPA through the remainder of the contract. The focus of our BPA power product evaluation is shifting to long-term decisions.

Small Scale Pilot Programs

Tacoma is currently in the early stages of acquiring and installing advanced metering infrastructure (AMI). This technology will allow Tacoma to develop a host of new and innovative programs to bring more value to our customers.

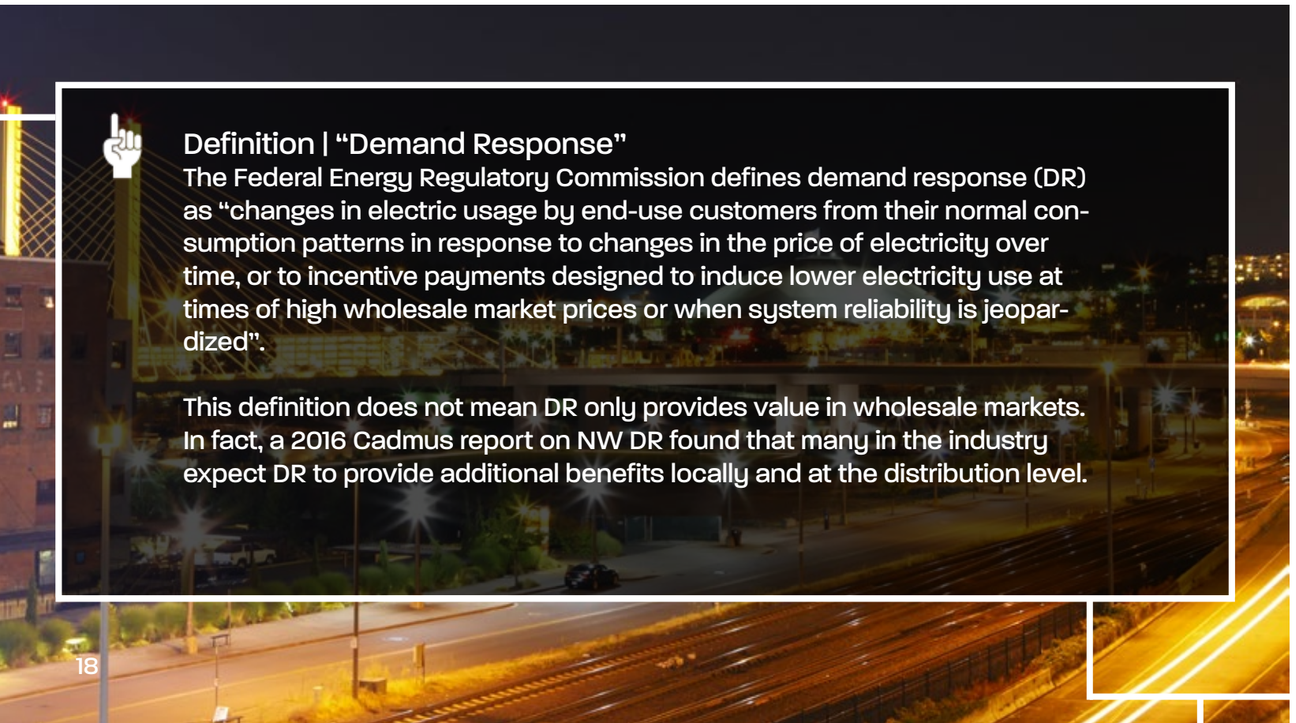
In preparation for our Advanced Metering Infrastructure (AMI) roll-out, staff is working to develop programs to make use of new opportunities enabled through AMI- in particular, demand response and other advanced billing opportunities.
Tacoma is also currently participating in a smart water heater demand response pilot with BPA. Through this pilot, over 80 Tacoma residential customers have volunteered to have their water heaters connected to devices that allows the utility to send electronic signals to the water heater.

Definition | "Smart Water Heater"

Smart water heaters are water heaters that have a communication interface, are able to participate in two-way communication. According to BPA's technology innovation program, the stated goals include minimizing residential customers' perceptions of inconvenience or discomfort due to DR as well as demonstrating:

- ability of low-cost communication technologies to enable broad scale DR
- continuous load control for both arbitrage and renewable integration
- **value of intelligent, grid-integrated water heaters**

During times of operational need, the utility can temporarily override thermostat control and reduce demand, providing Tacoma Power with more flexibility. The project kicked off in 2017 and is scheduled to be completed in late summer of 2018. A main deliverable from this project will be a report detailing customer acceptance of the program, a business case for market transformation in which all PNW water heaters are DR-ready, as well as a market transformation plan.



Definition | "Demand Response"

The Federal Energy Regulatory Commission defines demand response (DR) as "changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized".

This definition does not mean DR only provides value in wholesale markets. In fact, a 2016 Cadmus report on NW DR found that many in the industry expect DR to provide additional benefits locally and at the distribution level.

Report on Emerging Technologies

Tacoma keeps track of innovations and improvements in emerging technologies such as electric vehicles and new types of energy storage. We also monitor more mature technologies, such as rooftop solar and demand response, which while prevalent in other regions are only slowly gaining traction locally.

Demand Response (DR)

Although it has existed for decades, demand response has not been a traditionally sought out resource in the Northwest. Demand response tends to be most valuable when market prices are high or during events that jeopardize reliability. However, as the penetration of variable energy resources such as wind and solar grows, new value streams of DR are emerging and there is a growing potential for this resource even in the pacific northwest – where energy prices are generally low and extreme weather events or capacity shortages have been less of a concern.

The Northwest Power and Conservation Council (NWPCC) recently identified demand response as a cost effective resource that can help replace retiring capacity and assist in the integration of renewable generation.

A demand response potential study commissioned by the Council in 2015 identified over 3000 MW of "technically achievable potential" DR in the form of peak load reduction and about 300 MW of DR in form of balancing services by 2030.
In the 7th power plan, the Council modeled only the peak load reduction portion of this potential DR and identified at least 600 MW as cost-effective for the northwest region.

However, a recent Demand Response Potential study commissioned by the California Public Utility Commission found that the value of fast acting DR for variable energy resource (VER) integration and balancing is significantly higher than the value of DR for peak reduction. Given this fact and the current development and growing expansion of the CAISO market, there could be other opportunities for economic DR in the region- above and beyond the amount identified by the Council for peak load reduction.

Tacoma Power's Demand Response Strategy

Given the growing regional interest in DR as well as its success across the country, there is interest in the utility toward investigating suitable DR programs for pilot studies. Initial efforts should focus on the development of robust, cost effective program designs. To that end, Tacoma will need to conduct a detailed study that:

- Quantifies the costs and benefits of various potential DR programs under existing conditions as well as future policy and market conditions.
- Identifies ways to co-optimize DR with conservation, grid modernization and other demand side efforts to improve cost effectiveness
- Establishes a roadmap for DR implementation in conjunction with AMI rollout

Electric Vehicles

Electric vehicle (EV) sales continue to grow at a steady pace as improved models gain interest among mass market consumers despite the low cost of petroleum. Among US states, Washington State EV sales (2% of all new vehicle sales) ranks only second to California. Tacoma Power's service territory has registered a 70% increase (approximately 300) in new EVs since the 2015 IRP (425 EVs) but lags the state average adoption with a new car sales proportion of only 0.8%.

"The Collaborative"

Tacoma Power has joined with other Washington electric utilities to form the Pacific Northwest Transportation Electrification Collaborative to help clarify the role of the electric utility in transportation electrification. Members of "the collaborative" include Puget Sound Energy, Seattle City Light, Chelan County PUD, Snohomish County PUD, and Avista. Together these utilities commissioned a study by Energy and Environmental Economics, LLC (i.e. E3), a noted expert in the field, to estimate the benefits and costs of transportation electrification. The study concluded the likelihood of significant societal benefits (enjoyed mostly by EV drivers) but benefits to utility ratepayers are less certain and depend on individual utility circumstances.

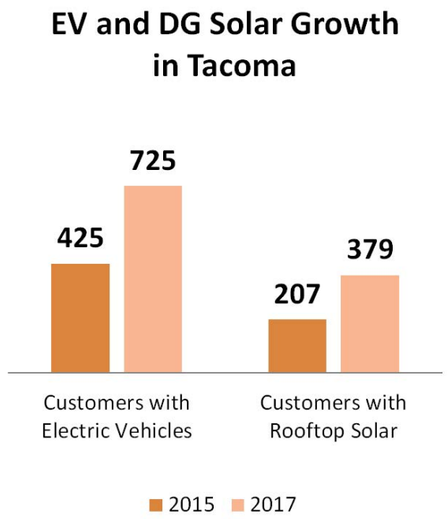
Based on a series of assumptions and estimates, the case study for Tacoma Power's service territory estimated that by the mid-2030s, if Tacoma Power saw 17,000 EVs within its service territory, the retail load impact would likely be 7-8 aMW and would result in an additional $6M of gross revenues per year (1.6% of 2017 budgeted revenue). The estimated costs to accommodate additional EV energy demand is less certain and could range from $5M- $7M per year. Because EV charging is expected to coincide with evening peak demand, programs that delay EV charging to early morning hours could reduce the costs to the utility by a considerable amount.

Tacoma Power's EV Strategy

Tacoma Power has long been a supporter of EV technology since its first fleet purchase in 2003. Currently, Tacoma Power has 56 hybrid and electric vehicles and has installed ten public charging stations. Tacoma Power continues to work with utilities in "the Collaborative" and with state legislators to clarify utility authority in relation to the promotion of electrified transport and to create conditions that help utilities make smart investments that benefit ratepayers.
In an effort to increase opportunities for education, outreach, and grant funding, Tacoma Power is the first electric utility in Washington State to join "Forth" a leading EV industry advocacy group.

In partnership with Forth, Tacoma Power was successful in securing funding for a new public charging station to be located just off interstate 5 in downtown Tacoma.

Tacoma Power seeks to partner with others to find opportunities under the VW Settlement Trust proceedings by exploring opportunities to electrify transit and other commercial diesel fleets, the installation of more public charging stations, the electrification of cargo handling equipment at the Port of Tacoma and by extending shore-to-ship power supply services.



Distributed Solar Generation

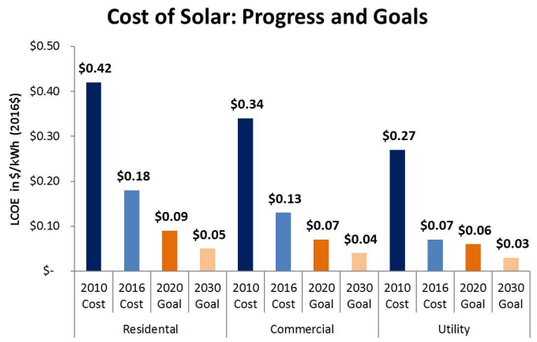
The number of solar panels deployed across the country has expanded rapidly over the past decade. The amount of solar capacity installed in the U.S. each year has risen from 79 MW in 2005 to nearly 15 GW in 2016, and total US solar capacity has increased from 2.5 GW in 2010 to nearly 40 GW by early 2016.

While projections vary, all agree that despite the reductions in incentive programs, overall growth in solar generation will continue over the next several decades. Total U.S. solar capacity is projected to nearly triple, reaching between 120 and 140 GW, by 2022. Conservative projections from the Energy Information Administration (EIA) suggest that solar capacity will be nearly 250 GW by 2040 (330 GW if carbon policies become more stringent in the future).

California has led the country in solar installations.

Just under half of all US solar capacity (nearly 20 GW by the end of 2016) is located in California, and it became the first state to have at least 5% of its electric power production from grid-scale solar in 2014. Two other Western states—Nevada and Arizona—are also among the 10 states with the most solar capacity in the US.

Solar is expanding more slowly in the Northwest, but it is still growing quickly. Idaho and Montana have around 359 and 26 MW of capacity currently installed, respectively. As of mid-2017, Oregon had about 272 MW of solar capacity, while Washington had 96 MW of capacity installed. Oregon and Washington are projected to install an additional 2.2 GW and 277 MW, respectively, more over the next five years. Solar growth in Tacoma has been relatively modest but steady. The number of residential Tacoma Power customers with rooftop solar jumped from 207 to 389 (80% increase) between 2015 and 2017. In 2016, Tacoma Power launched its first community solar project and over 1,000 customers participated to make the project fully subscribed. ■



TACOMA POWER'S DISTRIBUTED SOLAR STRATEGY

The 2015 IRP evaluated and ranked various potential utility-scale generation resources for Tacoma Power should we ever need a new resource. Of the six resources evaluated, solar ranked last due to its high cost, low flexibility, and poor fit to timing of peak load requirements. However, Tacoma Power remains committed to customers who choose to invest in rooftop solar.

In April 2017, Tacoma City Council adopted resolution #39699 requesting the Tacoma Public Utility Board to "develop a plan to increase the use of residential solar in the City of Tacoma" and requiring such plan to "address economic inequality and ensure an equitable increase in the number of residential solar users from all income levels." In response, Tacoma Power staff presented a two-part plan to the City Council and Public Utility Board members.

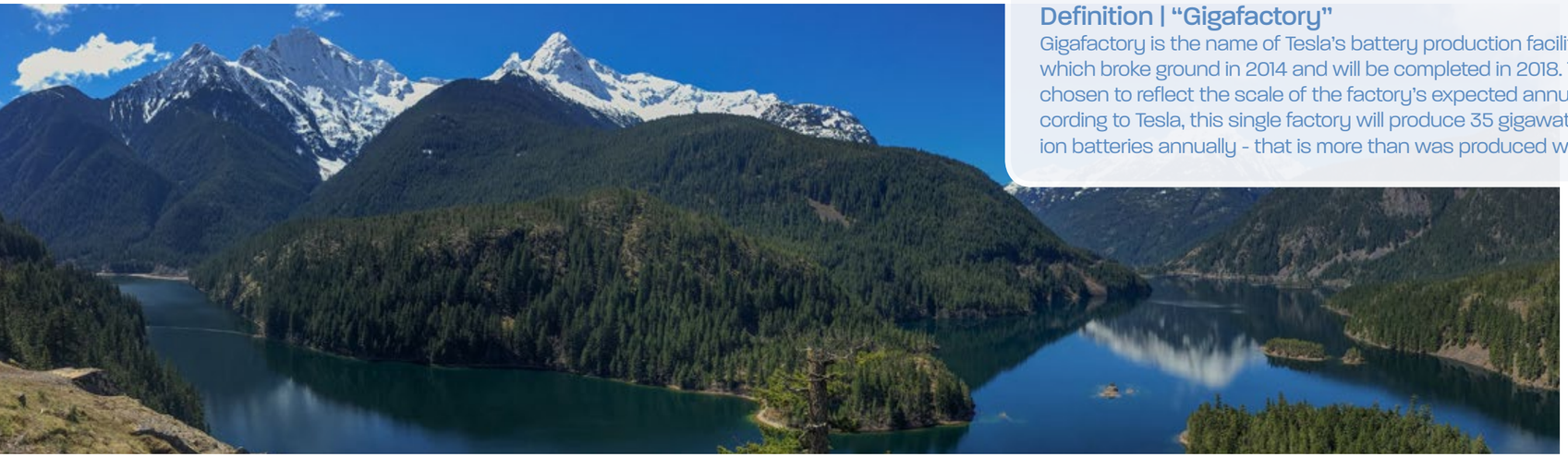
Part one of the plan aims to increase residential solar adoption overall through participation in the Renewable Energy System Incentive Program and expanding marketing, customer outreach and education. Part two of the plan specifically aims to increase access to solar among customers with low incomes.

To achieve this goal, Tacoma Power plans to offer customers with low incomes a special incentive package to reduce upfront costs, pursue multi-family pilot projects, include bonus scoring for low-income housing project through evergreen options, and advocate for legislation to increase state support for low-income and community solar.

Resolution #39699

BE IT RESOLVED BY THE COUNCIL OF THE CITY OF TACOMA

Section 1. That the City Council hereby requests the Tacoma Public Utility Board ("Board") to develop a plan to increase the use of residential solar in the City of Tacoma, which plan will address economic inequality and ensure an equitable increase in the number of residential solar users from all income levels.



Definition | "Gigafactory"

Gigafactory is the name of Tesla's battery production facility in Nevada which broke ground in 2014 and will be completed in 2018. The name was chosen to reflect the scale of the factory's expected annual production. According to Tesla, this single factory will produce 35 gigawatt hours of lithium ion batteries annually - that is more than was produced worldwide in 2013.

Energy Storage

The Pacific Northwest has long enjoyed the flexibility and certainty that energy storage can bring from its wealth in hydro reservoirs.

In recent years, massive investment in variable energy generation has led to an increasing number of overgeneration events that is likely to worsen with further deployments of renewable generators. The uncertainty and instability that comes with renewable generators has spurred increased global interest in the development of energy storage technologies.

While there are several promising energy storage technologies in development, the most exciting developments are in chemical batteries.

The World Needs Energy Storage

The market demand for energy storage as a solution to renewable energy overgeneration events and grid instability remains high.

Since the 2015 IRP was released, California and Oregon have expanded their Renewable Portfolio Standards to 50% and California lawmakers are seeking to further extend their standards to 100%. At the same time, efforts to reduce carbon emissions have led to retirements and reduced production from dispatchable fossil fuel generators that use natural gas and coal. For example, Navajo 2 & 3, Valmy 1, and Jim Bridger 1 & 2 have experienced accelerated retirements to further meet carbon reduction goals in the Western United States.

State governments and regulators recognize that energy storage is a solution to filling the gap, so they are providing utility mandates and incentives to spur demand for energy storage.

California was the first to adopt an energy storage mandate, requiring three major power companies to have storage capacity that can output 1,325 MW by the end of 2020.

This large-scale energy storage effort has the capacity equivalent of two average sized coal-fired power plants.

Nevada, California, New Jersey, and Maryland are a few of the states that have created specific incentives for investment in energy storage technologies. Nevada's recent bill created a 30% tax credit for energy storage devices, and the state of Maryland has $750,000 a year available for energy storage tax credits for behind-the-meter systems.

Hawaii's consumer energy storage incentive is in process, and would be a rebate program to incentivize energy storage that is installed concurrently with solar panels.

Lower Battery Production Costs, Increasing Demand

Funding for utility energy storage research has been supported by a complementary demand for batteries by electric vehicle manufacturers. Companies like BYD, Tesla, and Panasonic are designing and promoting the use of batteries for both purposes. As a result, lithium-ion battery production costs have decreased an average of 14% annually between 2007 ($1,000/kWh) and 2014 ($410/kWh). Since 2015, production costs have declined further to $285/kWh in 2016, a further 30% decrease.

Risks to Energy Storage Development

It is uncertain if battery production costs are likely to continue this rate of decline for long.

Some analysts suggest that the energy density limits of lithium-ion have nearly been reached and that further improvements in battery performance will be difficult. Other analysts suggest that a shortfall of essential elements could result in constraints on future battery production, but presently, there is little evidence of this scarcity.

The U.S. Geological Survey in 2015 estimates that the world has enough reserves for about 365 years at the current production rate. However, if EV and stationary storage revolutions take off, and Tesla's vision of 100 Gigafactories of battery production comes true, then that 365-year supply will turn into less than a 17-year supply.

Continued Research May Yield Further Benefits

The success of lithium-ion batteries has led to a competitive environment focused on research and development. Researchers are searching for ways to enhance certain performance characteristics by changing the battery design or chemistry.

These alternate battery designs offer a growing array of battery choices that will allow the consumer to apply the optimal battery design to more efficiently meet a growing number of applications.

Sodium based, nickel based, metal air, lithium-ion, and flow batteries all offer promising solutions to the challenges faced by a world transitioning from the fossil fuel era to the renewable energy era. ■

Section Two
Looking Ahead to 2019

Factors Impacting Planning
Issues to Consider

Factors Impacting Planning

Tacoma Power's primary objective is to meet the needs of our customers while minimizing cost and risk.

We strive to achieve that goal, in part, by staying vigilant of change in the industry, engaging our customers, and through insightful strategic planning. Years of sound investment decisions have put Tacoma Power in a strong financial position and with an environmental record to be proud of.

Our abundant hydropower resources supply Tacoma Power customers with 97% carbon free electricity. Our fiscal prudency has provided a stable AA bond rating which enables the utility to borrow money at low interest rates and allows Tacoma Power to make important investments to keep our power supply reliable and inexpensive.

In 2017, the average monthly residential bill for a Tacoma customer was $77- That's 15%-20% lower than the average bill for customers of the region's other large utilities. Maintaining affordability for our customers is a driving force behind Tacoma Power's strategic plan and drives us to continuously assess and monitor technology, policy and regulatory trends.

Customer Expectations

Tacoma Power serves over 157,000 residential customers and over 18,000 commercial and industrial customers.

Through conservation programs, our customers play an important role in the resource planning process. In 2017, our customers are expected to save an estimated 45 million kWh- delaying the future need for investment in a more expensive generation resources.

Understanding customer attitudes and preferences towards various technologies, products and services is critical to both successful conservation programs as well as overall customer satisfaction.

Tacoma has conducted a number of customer surveys and market studies to gauge customer awareness, interest and satisfaction in various conservation programs.

In 2016, Tacoma completed its first ever survey of residential customers' power products and services preferences. This survey explored customers' interest in new Advanced Meter Infrastructure (AMI)-enabled products as well as their attitudes and preferences regarding renewables and distributed energy resources.

"Survey Says!"

Of the Customers Surveyed

85% expressed interest in **web or mobile app tools for consumption and billing information.** This interest was equally strong across all income and education levels.

69% expressed interest in **web or mobile apps to remotely control devices in the home**

43% expressed interest in an **electric water heater that could be automatically controlled by Tacoma Power when demand is high**

15% indicated they probably would purchase **rooftop solar in the next 12 months**

3% indicated they probably would purchase an **EV in the next 12 months**

Our survey results indicate that Tacoma's customers show a strong interest in AMI-enabled technology that provides information, convenience and energy management. There is much lower, but not insignificant, interest in owning rooftop solar and electric vehicles.

In 2017, Tacoma began a multi-year project to install Advanced Metering Infrastructure (AMI). AMI is a sophisticated metering technology that allows for two-way communication between a utility and its customers. This is an important investment because of the improved accuracy in billing and the opportunities that are possible for designing programs to better suit evolving customer needs.

During this process, staff is designing and developing various AMI-enabled products. Moving forward, Tacoma will need to continuously assess and monitor changing customer attitudes towards technology (in particular distributed energy resources) and to develop AMI-enabled products and programs that are aligned with these evolving customer needs and interests as well as Tacoma's resource needs.

Factors Impacting Planning

Distributed Energy Resources

Over the years, the electric industry has seen major transformations driven by technology, policy and customer need.

Today, one of the more potentially disruptive forces facing electric utilities is the rise of distributed energy resources (DERs). There are many types of DERs, including distributed generation (such as rooftop solar), electric vehicles, distributed energy storage (such as the Tesla Powerwall), programmable devices (such as thermostats and home appliances) as well as various forms of demand response.

These resources are located on the distribution network and are most often owned and operated by consumers – not the utility. When present in concentrated quantities, DERs represent a technical challenge in terms of grid-integration as well as an economic challenge to the utility at times of falling demand and increasing costs.

These challenges are exacerbated by rate designs that distort the economic benefit of customer-owned resources.

The increased adoption of these resources can be attributed to a number of factors including improvements in technology driving down costs while increasing accessibility, supportive policies creating incentives for customers to invest in DERs, as well as the natural evolution of customer desires and expectations.

At present, there are few locations across the US where DERs have reached a high enough penetration to represent a near-term disruption to utility business as usual. However, as costs continue to fall for these resources and as customer expectations evolve, it is very likely that DERs will become ubiquitous and play a greater and important role in the electric grid of the future.

The Department of Energy recently commissioned a series of nine reports on issues surrounding the future of electric utilities to inform on-going discussions and decisions by various public stakeholders, including regulators, policy makers and the electric industry.

The first four of these nine reports specifically focus on DER-driven changes and impacts. The sixth report in this series deals with the future of electric resource planning.

What this means to Tacoma Power is an open question for our 2019 IRP.

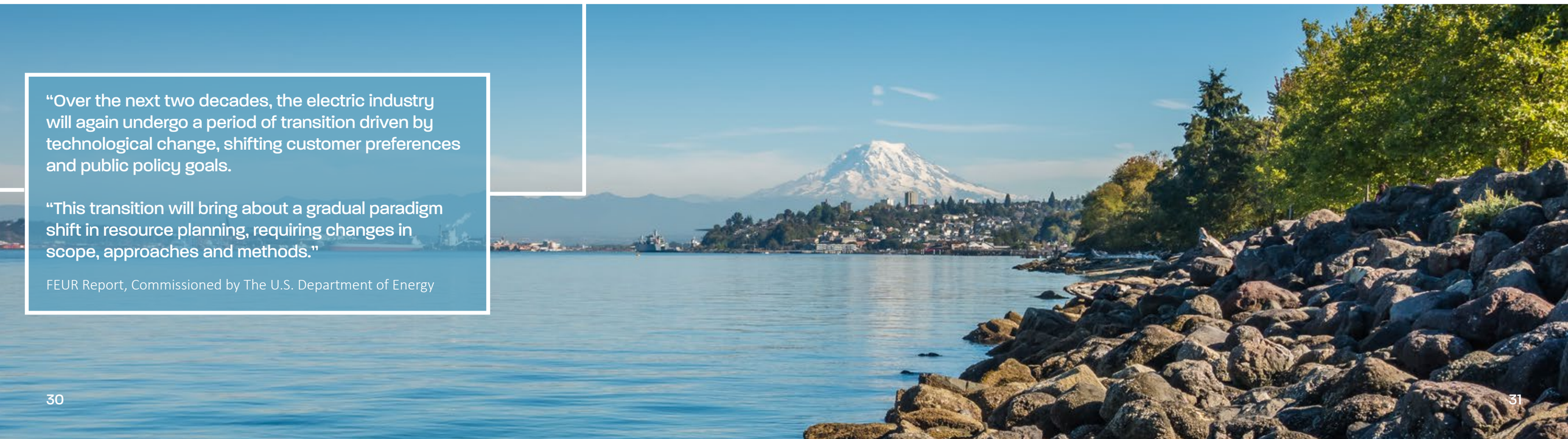
It is unlikely that there will be a one size fits all strategy for utilities in terms of future resource planning - particularly, with respect to DER integration. Tacoma has not yet seen adoption of DERs such as solar and electric vehicles at a scale similar to that of California, Hawaii or New York.

This means that we have the fortune of being able to incorporate DERs into our resource planning process and optimize their integration- ideally, before grid challenges and economic, regulatory or political pressures require us to do so. Still, Washington regulators and legislators have already begun to explore the possibility of mandatory DER planning.

Recommendations for Future Resource Planning

1. Ensure consistent methods to evaluate a wide array of DERs in addition to conservation and utility scale generation.
2. Consider new investment drivers in addition to traditional resource adequacy, such as, risk management, value-added services, or cost reduction.
3. Develop enhanced models to systematically integrate rate design, customer behavior, and distribution networks into the resource planning process.

> "Over the next two decades, the electric industry will again undergo a period of transition driven by technological change, shifting customer preferences and public policy goals.
>
> "This transition will bring about a gradual paradigm shift in resource planning, requiring changes in scope, approaches and methods."
>
> FEUR Report, Commissioned by The U.S. Department of Energy



Local and Regional Carbon Policy

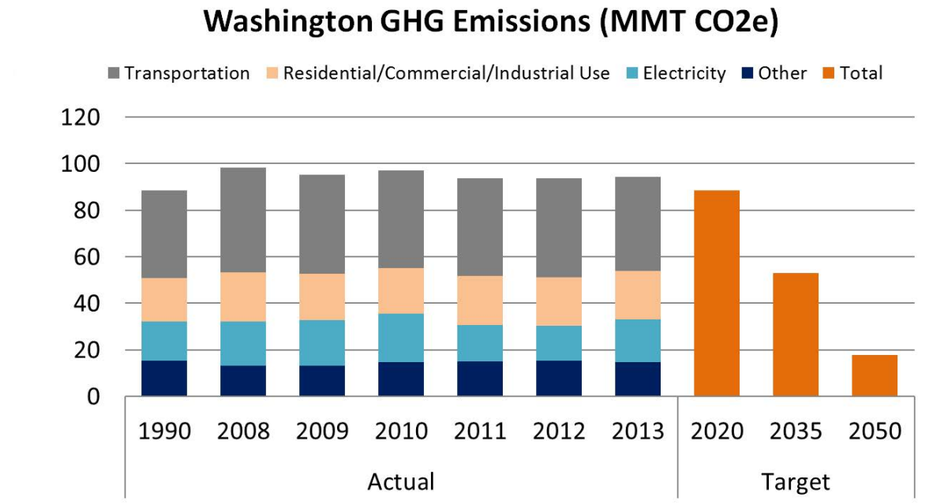
Legislative policies to deal with carbon emissions and climate change are stalled at the national level. Congress has shown little enthusiasm for the topic since the failed Waxman-Markey bill in 2009, which would have capped carbon emissions and created a national market for trading carbon credits. In 2013 the Obama Administration rolled out its Climate Action Plan, which tentatively established the first national regulations to reduce emissions from power plants under the Clean Air Act.

Those regulations were stayed in the Supreme Court. On March 28, 2017, President Donald Trump signed an Executive Order on Energy Independence, which calls for a review of the Clean Power Plan. This, coupled with the recent announcement of intent to withdraw from the Paris Climate Agreement, implies there will not be a national carbon policy in the near future. Climate change policy advocates are looking to individual states to take action on carbon reduction.

The Washington State Legislature has considered legislation to create a market-based carbon reduction policy. In 2015, Governor Inslee directed the Department of Ecology, under the authority of the Washington Clean Air Act, to develop rules for a greenhouse gas cap and reduce program.

On September 12, 2016, the Washington State Department of Ecology adopted the Clean Air Rule (CAR) to cap and reduce carbon emissions from significant in-state stationary sources, such as petroleum product producers, importers, and distributors and natural gas distributors operating within Washington State. Compliance is phased in over time, with the first compliance period established for January 1, 2017 through December 2020. The Clean Air Rule is currently being litigated.

Carbon Washington, a grass-roots based climate advocacy group, collected enough signatures to get its carbon tax proposal, Initiative 732, on the November 2016 ballot. This "revenue neutral" proposal was intended to balance the revenue generated by the carbon tax with reductions in the Business and Occupation tax. I-732 did not have the support of many of the mainstream environmental organizations, who preferred a carbon tax that would raise money for clean energy efforts, water quality improvement, and help disadvantaged communities. Voters ultimately rejected I-732. Had it passed, Washington State would have been the first state to place a tax on carbon emissions.



Numerous carbon tax proposals were introduced during the 2017 Washington State legislative session, but were not acted on. The most prominent carbon tax proposals covered all sectors and all fossil fuels, some provided exemptions or phased in the tax for energy intensive trade exposed industries, aviation, maritime, agriculture and public transportation fuels. Initial tax rates ranged from $15 per metric ton (MT) of carbon dioxide with caps ranging from $30/MT to $106/MT. Proceeds from the tax were used differently in the various proposals, with funding put toward clean energy, education, water and forests investments, low-income assistance and disadvantaged communities.

There has also been significant carbon-related policy activity in California and Oregon. On May 1, 2017, California Senate President pro Tempore Kevin de Leon introduced Senate Bill 100, The California Clean Energy Act of 2017.
If approved, SB 100 would put California on the path to 100 percent renewable energy by 2045. In July 2017, the California Legislature amended and extended its Cap and Trade program through 2030.

Meanwhile, the Oregon State Legislature is considering a bill (Senate Bill 557/HB 2135) that, if enacted, would create a carbon cap and trade market in Oregon beginning in 2021, with a declining cap on emissions through 2050. The cap covers major sources of climate pollution, including transportation, utilities, natural gas, and industrial emissions.

Carbon policy advocates in many states are now exploring potential ballot measures. In Washington, we expect they will be reaching out to civic, environmental, business and social justice leaders to develop an initiative. If the Washington State Legislature does not adopt carbon reduction policy next session, there is a strong likelihood of further attempts at adopting a policy via a ballot measure.

Renewable Energy Incentives

In an effort to support the adoption of renewable energy technologies by retail and utility customers, incentives have been provided by all levels of government. As demand increases, the scale of production will increase and unit costs will decline. In practice, the incentives provided over the last two decades have been very successful. In the case of wind turbines, the American Wind Energy Association reported that levelized cost of production has decreased by two-thirds over the last decade.

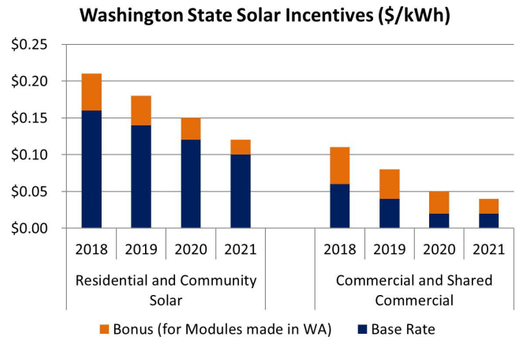
There is a growing sense among policymakers at the national and state level that as wind and solar generation costs decline farther and farther, the need for continued incentives is declining, and that reduced incentives are in order.

Federal Incentives

Since the 2015 IRP, the federal Production Tax Credit (PTC) was renewed for extended new wind projects but not geothermal and biomass. For wind systems commencing construction after 2017, the PTC is $0.0184/kWh. However, if wind, geothermal, closed-loop biomass and solar systems are not claiming the ITC, then they will receive $0.023/kWh for projects commencing prior to January of 2017.
Unlike previous versions of the PTC, this extension of benefits declines quickly for wind systems and is set to fall by 40% in 2018, 60% in 2019 and finally expire by 2020.

The Investment Tax Credit (ITC) has also been renewed and extended since 2015. Originally set to ramp down to 10% in 2017, the ITC has maintained its 30% subsidy for solar, wind, and fuel cell systems. For geothermal, microturbines and combined heat & power systems (CHP), the rebate amount is 10%. There will be a gradual step down of the credits between 2019 and 2022, but the rate of decline is unknown. There has been no information released on when the ITC will expire.

The Residential Renewable Energy Tax Credit was extended for PV and solar thermal technologies, but not for other renewable energy technologies. Systems placed in service before 2019 will receive a 30% rebate, and will phase down by 4% each year after until ultimately ending in 2022. Fuel cell, wind, and geothermal credits are not eligible for the tax credit if installed in 2017.



State Incentives

Washington has recently revised the Production Incentive Program to extend the program until the end of 2029. The rates are much lower and step down annually, but the program guarantees the customer's rates for up to 8 years or until the owner has earned back 50% of the paid installation cost.

The incentives caps are also much higher per owner for commercial and utility-scale systems. The residential (1-12 kW) annual payment cap is $5,000 per year and the commercial (>12 kW) annual payment cap is $25,000 per year.

Solar systems also qualify for tax exemption in Washington State. Solar systems 10 kW or less are exempt for sales tax, and will expire on June 30, 2018. In Washington, renewable energy produced by solar, wind, small hydroelectric, animal-waste biogas, and CHP technologies up to 100 kW in size also qualify for net metering. This benefit, which credits the customer's bill at the retail rate, will end when the qualifying installed capacity in the utility's service area reaches the statutory cap. Under the law, Tacoma Power has a cap of 5.235 MW. As of July 2017 there was 2.010 MW of installed residential and commercial net metered projects.

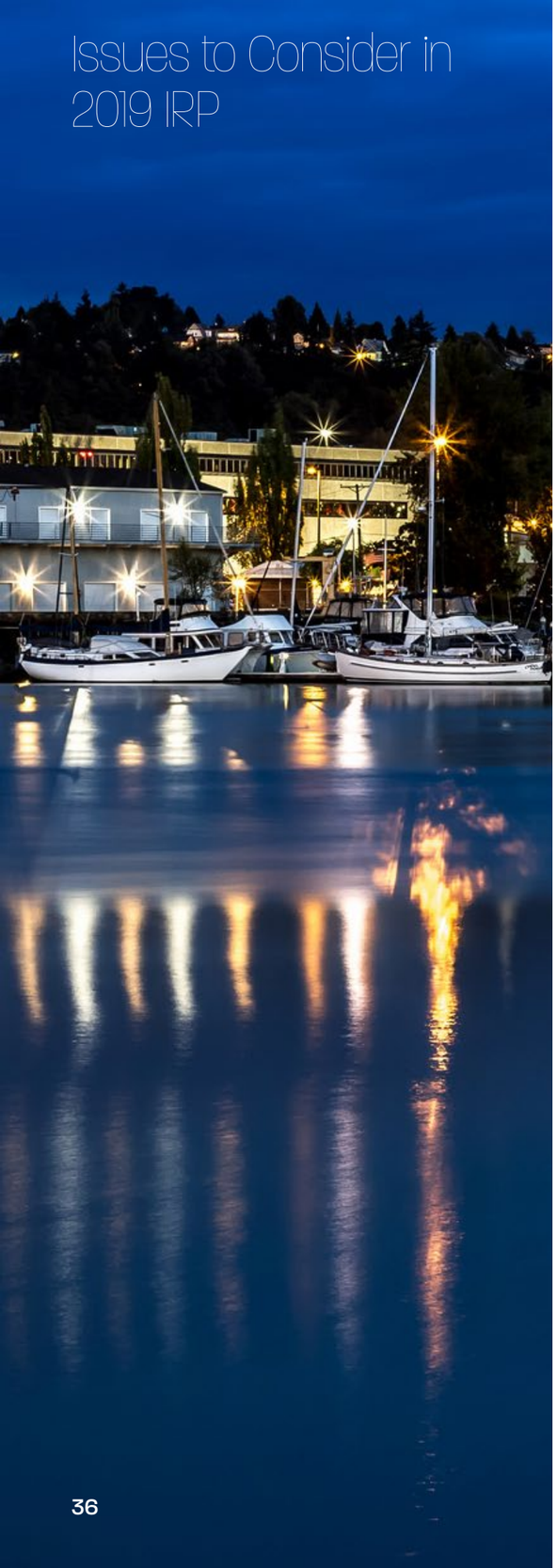
Electric Vehicles

Electric vehicle adoption has accelerated in the past few years, and incentives have played a big part in driving that adoption by supplementing consumer interest while the technology is developing. Between 2013 and 2016, the number of EVs registered in Pierce County rose from just 409 electric vehicles to 1,290. This growth was made possible by the application of customer incentives. The federal tax rebate incentive is worth $7,500 and applies to all-electric and plug-in hybrid vehicles depending on auto manufacturer sales. The Washington Alternative Fuel Vehicle (AFV) Tax Exemption was updated in 2015, increasing the selling price cap of the lowest base model price from $35,000 to $42,500. If the vehicle sale or lease is exempt from sales tax, it is also exempt from the Motor Vehicle Sales/Use Tax of 0.3%. The AFV will expire when the total number of qualifying vehicles titled in Washington on or after July 15, 2015 reaches 7,500 vehicles, or on July 1, 2019.

Future

As renewable energy technologies achieve cost competitiveness with other incumbent technologies, the need for government incentives to spur demand diminishes. Expect that successful technologies, like wind and solar generation, will have incentives extended at reduced levels or simply be terminated. This funding may be funneled to support new emerging technologies, such as utility scale or home energy storage, instead. ■

Issues to Consider in 2019 IRP



Of the aforementioned factors impacting resource planning, carbon policy is a key driving force behind the issues to be addressed in the 2019 IRP.

This is because local and regional carbon policies will ultimately have impacts on several planning variables including regional resource development, wholesale market prices, and even load growth. Carbon policy also impacts the value of hydropower. And that value is a key variable in determining the value of our long term power contracts.

Deep Decarbonization

In 2013, a global coalition of researchers formed what is known as the Deep Decarbonization Pathways Project (DDPP). The goal of this group is to chart practical pathways for countries to deeply reduce their greenhouse gases (GHG). Deep decarbonization aims to limit the global rise in temperature due to global warming to 2 degrees Celsius.

Although any number of policies may have short term or incremental impacts on carbon, deep decarbonization methodology considers comprehensive pathways that lead to complete or near complete decarbonization.

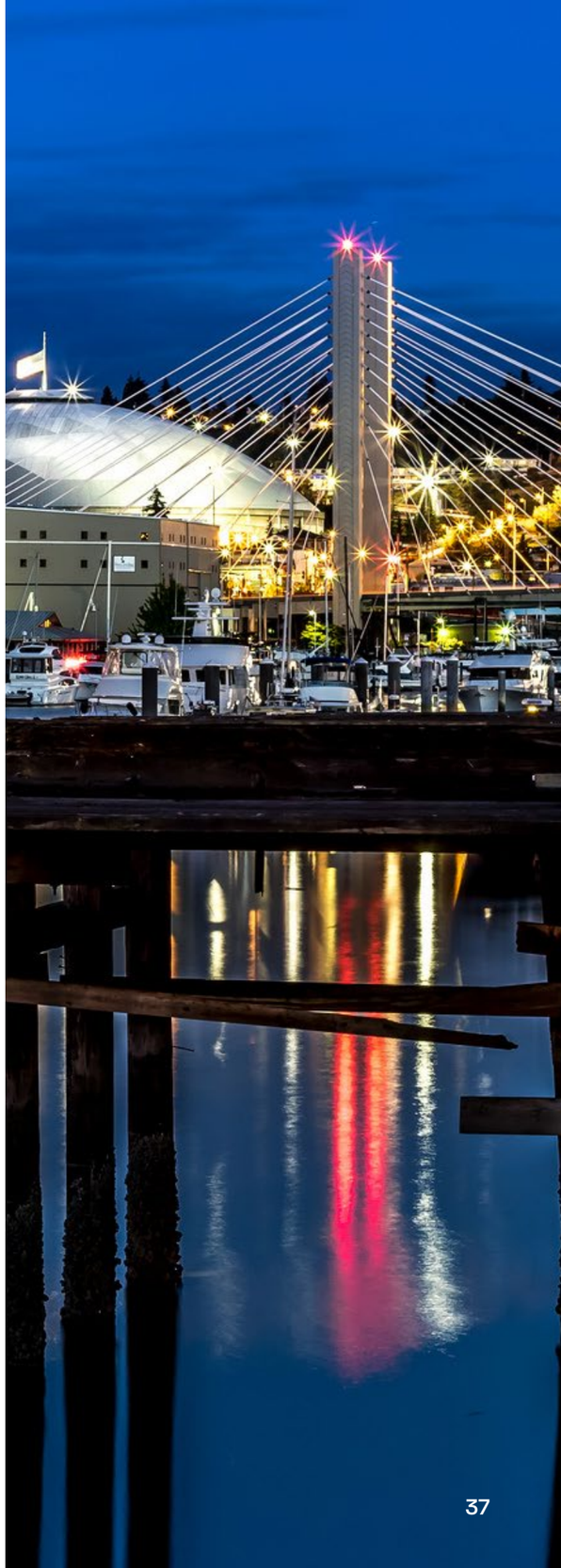
In 2008, Washington State legislature mandated a reduction in the State's GHG emissions and set emission limits to be achieved by 2020, 2035, and 2050. These limits were initially signed into law in 2008 with a final carbon reduction target of 50% below 1990 levels by 2050. However, in 2014, the Intergovernmental Panel on Climate Change issued its 5th Assessment Report (AR5), which updated current global climate change impacts as well as future projections. Based on those updated findings, the department of Ecology further strengthened its recommended GHG emission limits to 80% below 1990 levels by 2050. Unfortunately, Washington State is not currently on track to reach these targets.

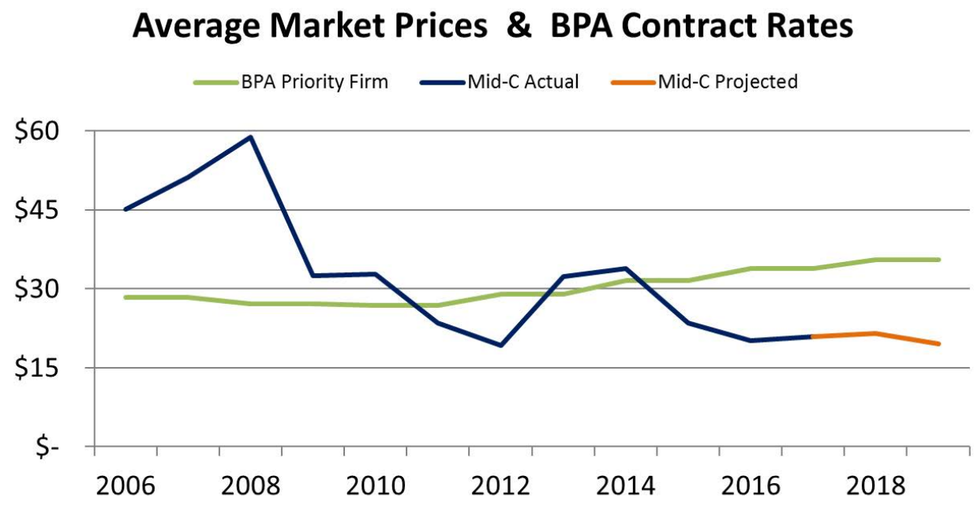
In 2016, Washington State partnered with DDPP and experts at Evolved Energy to develop three pathways that the state can pursue to reach the new carbon limits recommended by the Washington Department of Ecology.

The potential pathways identified were:

1. **Electrification:** Reduce GHG emissions in the electric industry then power as much of the economy as possible with clean electricity.
2. **Renewable Pipeline:** Replace natural gas with low carbon fuels (such as biogas) for use in heating and industrial processes.
3. **Innovation:** Incorporate technological breakthroughs in storage and electric transportation.

Ultimately, this deep decarbonization analysis resulted in two important conclusions. First, the state can in fact achieve its reduction targets with appropriate investment in energy-efficient and low-carbon technologies. And second, electricity generated from clean resources (such as hydropower) will grow increasingly important over time- regardless of which of the three pathways is chosen.





Expiration of Long Term Contracts
Between 2022 and 2028, long-term contracts representing over 50% of Tacoma's resource portfolio will expire. Historically, our integrated resource plans have assumed that the bulk of these contracts would be renewed. Before moving forward, however, this assumption must be tested.

The 2019 IRP will involve a thorough examination of the value of long term power contracts as well as the risk and the uncertainty associated with various alternatives. If existing power supply contracts are not renewed, how much firm power supply should Tacoma Power acquire, and what are the likely candidates for generation alternatives or market purchases?

Columbia Basin Hydro Contracts (approximately 32 aMW)
During the 1980's, the cities of Seattle and Tacoma entered into five 40-year power purchase agreements with three Columbia Basin Irrigation Districts. From these contracts, Tacoma receives 50% of the output of five low-head hydroelectric projects located along irrigation canals in Eastern Washington. The power delivered from these projects to Tacoma (about 130 aMW) is seasonal, occurring primarily during the summer.

Because Tacoma is a winter peaking utility, this power comes at a time when the utility is surplus and selling into the wholesale market. At the time these contracts were drawn up, both load and power prices were expected to increase indefinitely. This expectation is no longer true.

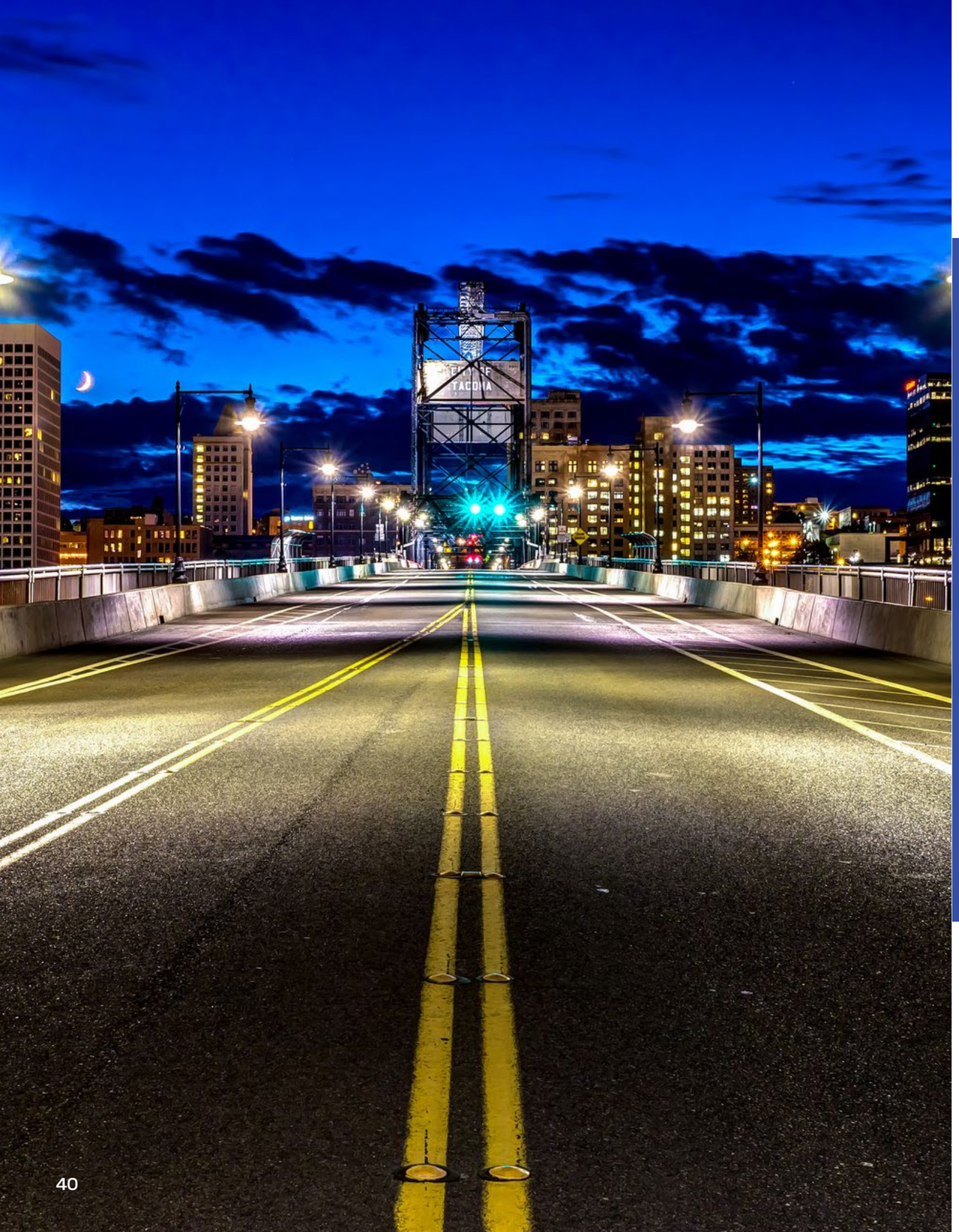
With wholesale power prices continuing to fall, power from the CBH contracts now costs more than the price for which it can be sold into the market. Assessing the value of these contracts- whether renewed under current contract terms or negotiated new terms- will be a major component of the 2019 IRP.

Bonneville Power Administration Contracts (approximately 400 aMW)
BPA has been the provider of choice for Northwest public utilities for decades. The federal Columbia River hydropower system has provided a robust, low-cost resource that meets the full requirements of numerous distribution utilities and augments the resources of larger public utilities like Tacoma Power. Historically, BPA has relied on the wholesale market to offset the costs of operating the federal system borne by its preference power ratepayers. The stark decline in wholesale power prices over the last few years has made it harder for BPA to offset these costs. While short-term hourly purchases of wholesale power are not equivalent to a long-term firm product such as BPA power, the comparison does illustrate the challenge BPA faces. Lower wholesale market prices cause upward pressure on BPA's rates, all else equal.

BPA power rates have increased by over 30% since 2009- more than double the rate of inflation. In the next two years, Tacoma Power will pay about 6% more for the power it receives from BPA than it did in the previous biennium, as per the results of the most recent BPA power rate proceeding. These rate increases have become common in the last decade.

Tacoma Power's robust hydroelectric portfolio positions the utility well to make resource decisions now and in the future, given the stability of our owned generating resources. Strategically speaking, utilities that own their own resources have an advantage. Resources such as Tacoma Power's hydroelectric facilities provide a flexible and reliable power source that could be paired with less firm resources in the future.

The decision to either build a new resource, increase reliance on short-term wholesale purchases or enter into a long-term power purchase agreement with an independent power producer (such as a wind or solar farm) depends on an individual utility's planning context and resource needs. Our 2019 IRP will begin the work to evaluate Tacoma Power's alternatives for additional resources. ■



Technical Appendix

The appendix is available online at mytpu.org/IRP.

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Questions and Comments

Thank you for reviewing Tacoma Power's 2017 Integrated Resource Plan Update. If you have questions or comments, please contact Ahmahz Negash at (253) 502-8093 or anegash@cityoftacoma.org.


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