Serving our customers

Integrated Resource Plan Public Workshop 2

Key Inputs & Assumptions

March 11, 2020

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WELCOME!

Thanks for coming back for Round 2.

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Outline

1. Portfolio Selection Metrics
2. Tacoma Power's Current Portfolio
3. Conservation Potential Assessment
4. Base Case Load Forecast
5. Base Case WECC Build & Prices
6. Scenarios
7. Next Steps and Action Items

Portfolio Selection Metrics

How will we evaluate different portfolios?

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Reminder of IRP Process

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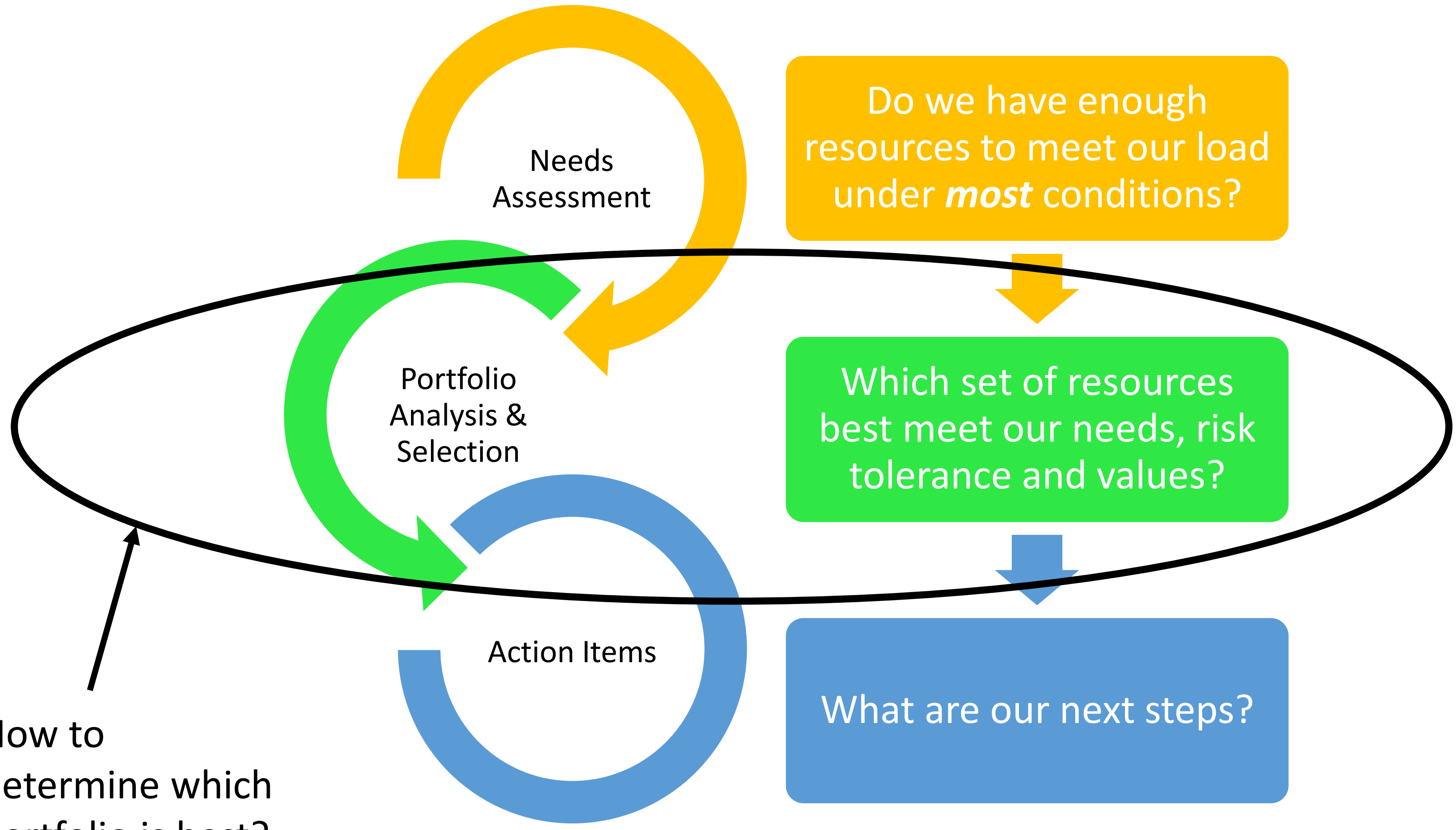

How to determine which portfolio is best?

Portfolio Selection Process

Step 1: Create set of potential portfolios

Add resources to existing portfolio to fill gaps

↓

Step 2: Rule out portfolios that don’t meet minimum standards

Resource Adequacy	CETA compliance

↓

Resource Adequacy (RA) Standard

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What is Resource Adequacy?

✓ Having enough resource to serve loads

What is a Resource Adequacy Standard?

✓ Metric + Maximum Threshold

Example

Number of hours per year when we're short can be no more than 2.4

Metric

Threshold

PORTFOLIO SELECTION METRICS

Principles for a RA Standard

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Principles Used to Select a Standard

- ✓ Probabilistic (evaluates outcomes over all simulations)
- ✓ Choose from common standards used elsewhere
- ✓ Address three key dimensions of inadequacy events
  - Duration
  - Magnitude
  - Frequency
- ✓ Balance high reliability standards with costs

Draft Adequacy Standard

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DURATION

No more than 2.4 hours per year when we're short on average

Loss of Load Hours (LOLH) of 2.4 per year

MAGNITUDE

Shortage of no more than 0.001% of total load across the year on average

Normalized Expected Unserved Energy (NEUE) of 0.001% per year

FREQUENCY

No more than 2 days when we're short over 10 years (0.2 days per year) on average

Loss of Load Expectation (LOLE) of 0.2 days per year

ADEQUATE if all three standards are met

INADEQUATE if any of the three are not met

CETA Compliance

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CETA Rule

✓ 100% of load met by non-emitting resources or alternative compliance 2030-2044 (up to 20% from alternative compliance)

COMPLIANT if 80% or more of load is served by carbon-free power

NON-COMPLIANT if less than 80% of load is served by carbon-free power

PORTFOLIO SELECTION METRICS

Portfolio Selection Process

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Step 1: Create set of potential portfolios

Add resources to existing portfolio to fill gaps

Step 2: Rule out portfolios that don't meet minimum standards

Resource Adequacy	CETA compliance

Step 3: Compare remaining portfolios using objective criteria

Expected costs	Financial risk	Ability to change course

What goes into portfolio costs?

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Calculate net present value (NPV) of costs for each simulation

Costs

- Capital Expenditure
- Operation & Maintenance
- Purchased Power
- Transmission
- Renewable Energy Certificates (RECs) to comply with I-937 & CETA
- Social Cost of Carbon Emissions

Offsets to Costs

- Power Market Sales less GET

Social Cost of Carbon Emissions

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Values determined by Department of Commerce rulemaking

Year in which emissions occur or are avoided	Social Cost of Carbon Dioxide (in 2018 dollars per metric ton)
2020	$74
2025	$81
2030	$87
2035	$93
2040	$100
2045	$106
2050	$113

Applications

- ✓ Direct emissions from generation + leakage
- ✓ Emissions in market purchases

How do we calculate expected cost?

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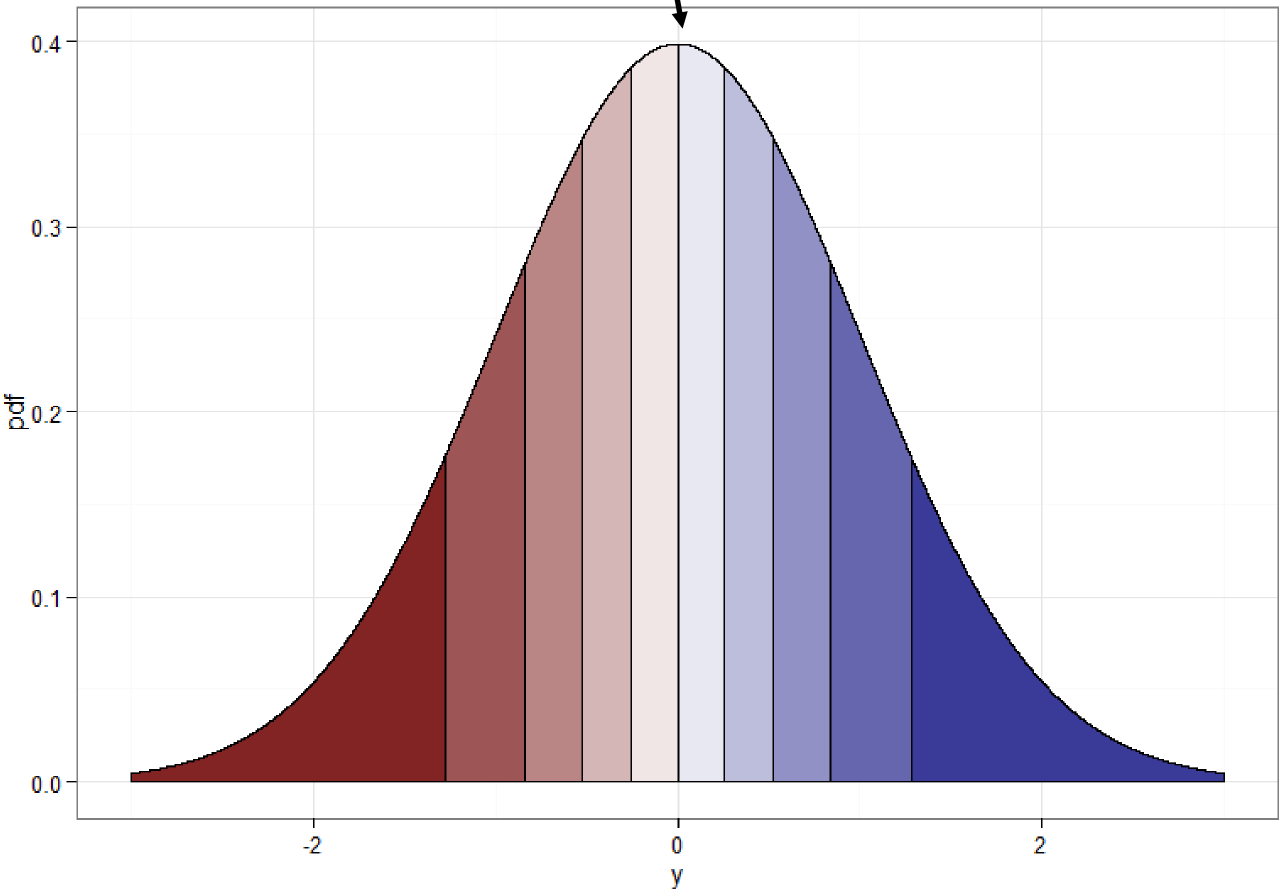
EXPECTED COST
= average across all simulations



PORTFOLIO SELECTION METRICS

How do we evaluate financial risk?

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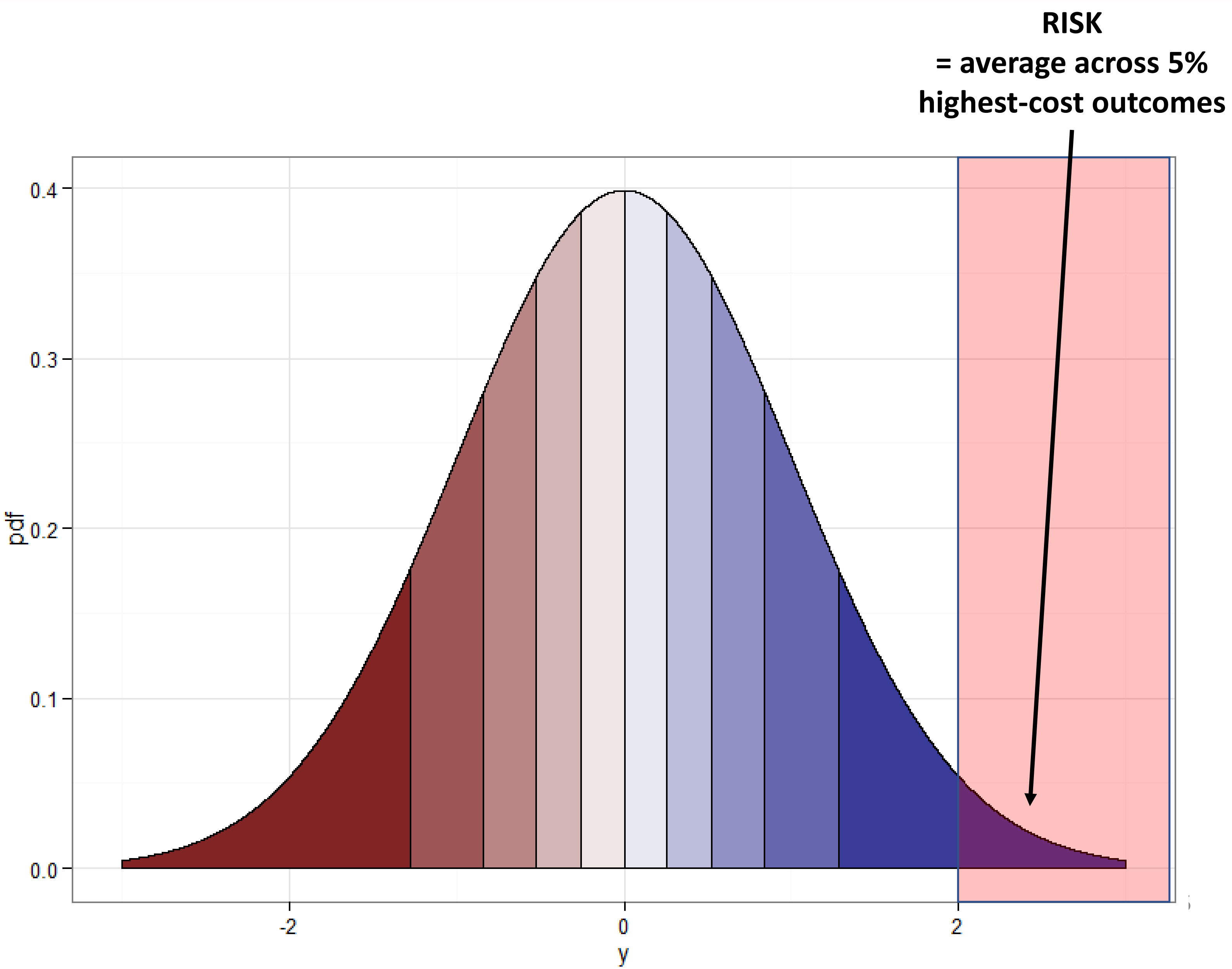
PORTFOLIO SELECTION METRICS



What do we do with the information?

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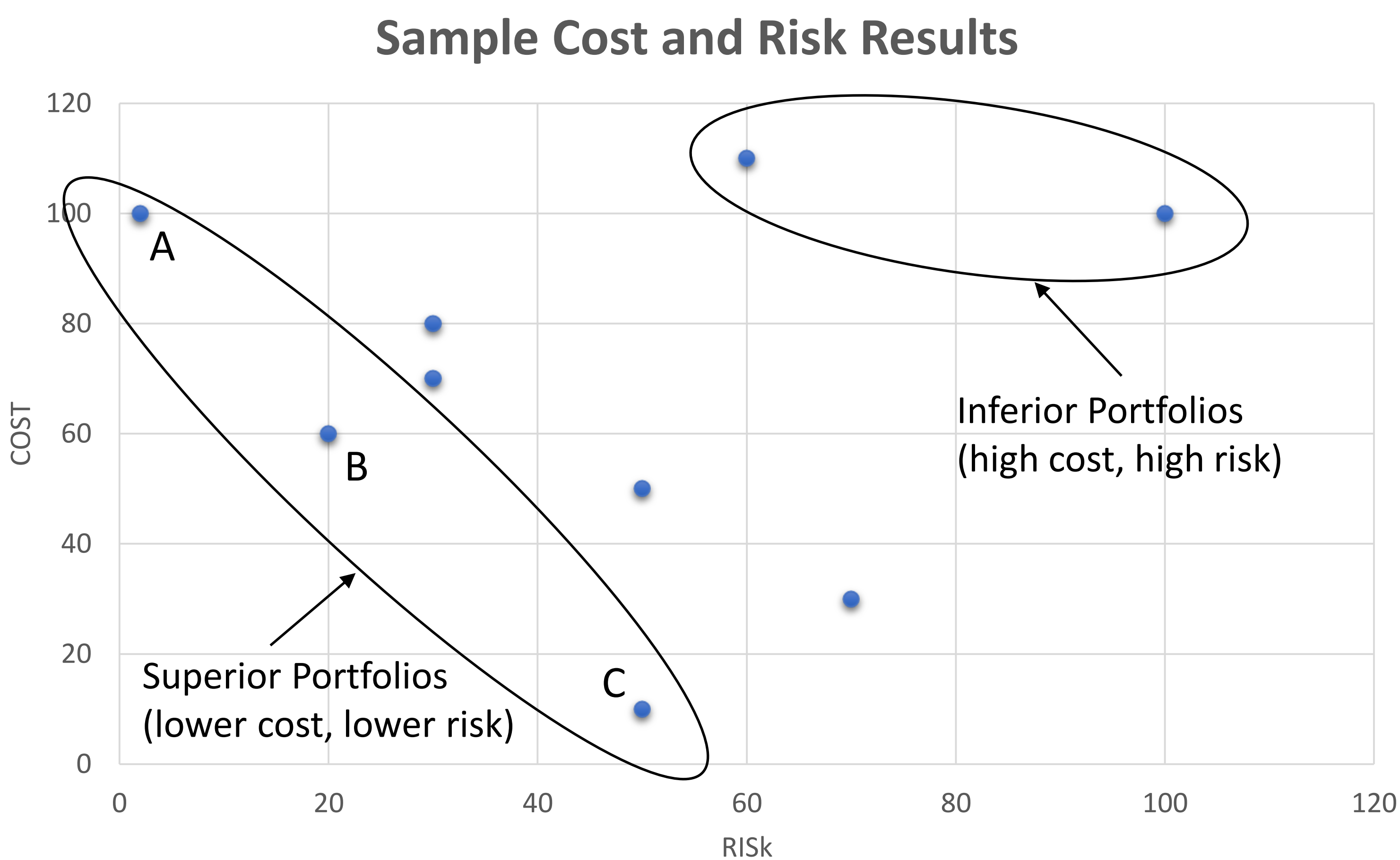

PORTFOLIO SELECTION METRICS

Ability to Change Course

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Five-point scale to qualitatively reflect the value of having flexibility to adjust to a changing world.

5
- Demand-side resources (conservation, demand response) that can be invested in piecemeal rather than all at once.

4
- Short-term contracts (<10 years)

3
- Medium-term contracts (10 to 15 years) with output that cannot be adjusted
- Long-term contracts with output that adjusts based on need (e.g. BPA)

2
- Long-term contracts (>15 years) with output that cannot be adjusted

1
- Any large resources that we build or acquire

Tacoma Power's Current Portfolio

What resources do we have today?

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Our Resources Today

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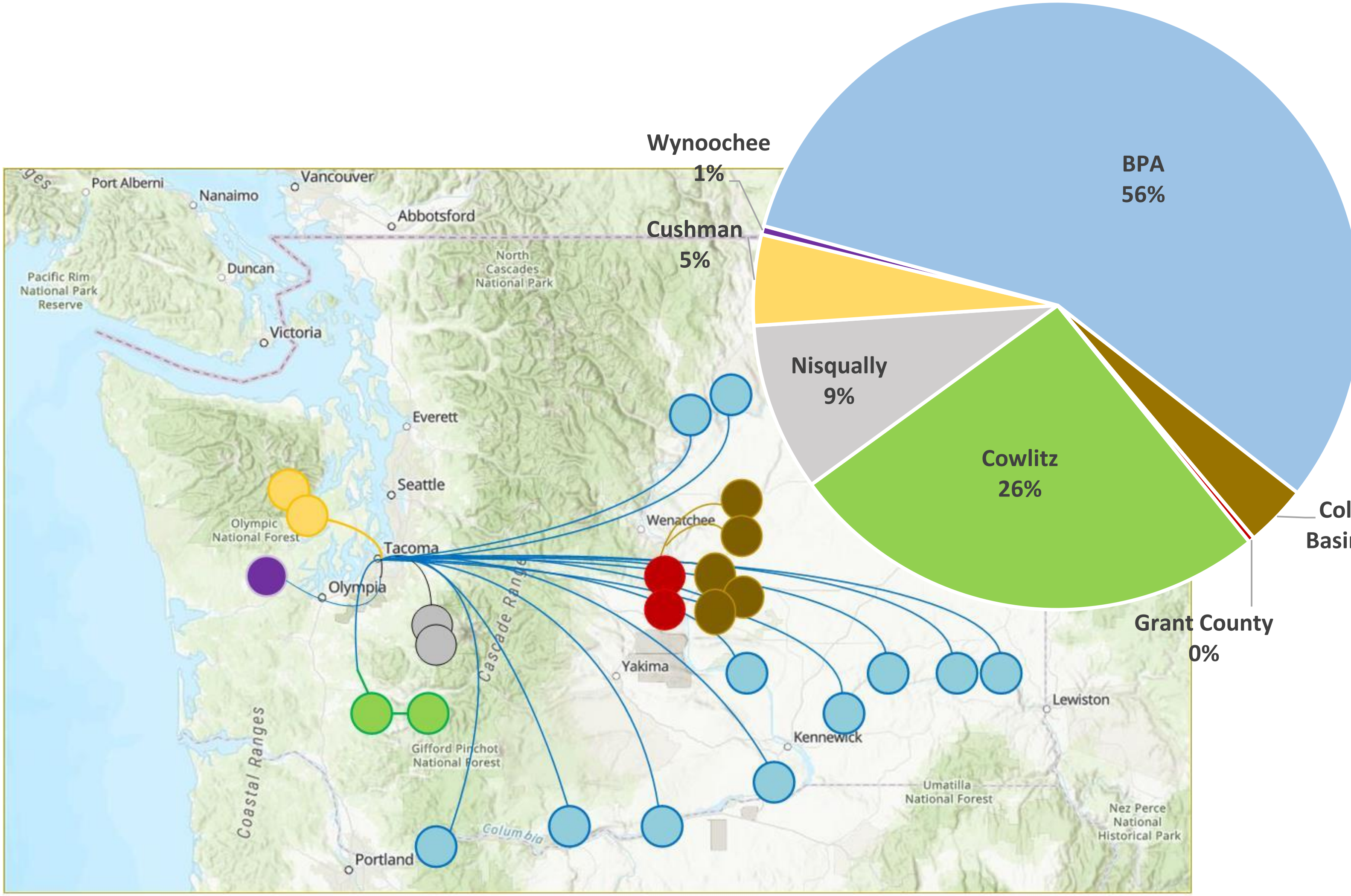
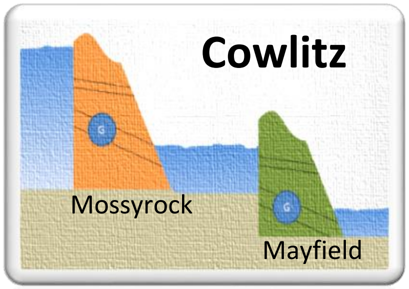


Generation Resource

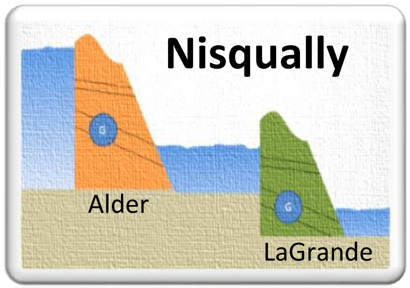
Transmission
Capacity

CURRENT PORTFOLIO

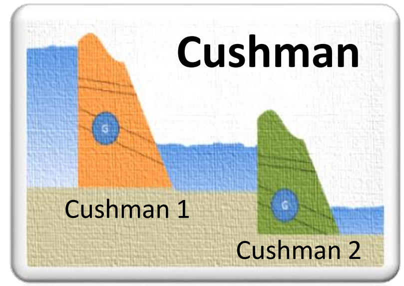
Our Hydro Projects



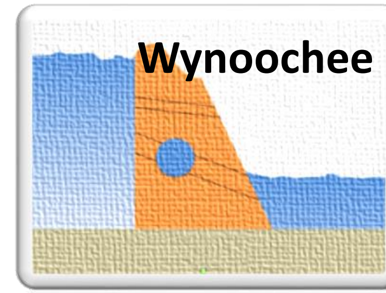
- **63%** of Tacoma's average generation
- Total generating capacity = 466MW
- Significant storage and flexibility at Mossyrock
- Continuous outflow at Mayfield
- Diminished storage at Cowlitz due to Riffe Lake upper seismic operating limit



- **22%** of Tacoma's average generation
- Total generating capacity = 116MW
- Limited storage and some shaping flexibility at Alder
- Continuous outflow at LaGrande



- **12%** of Tacoma's average generation
- Total generating capacity = 135MW
- Flexible when there are sufficient flows



- **2%** of Tacoma's average generation
- Total generating capacity = 13MW
- Run-of-river operations

BPA Purchased Power

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Overview

- BPA is a Federal Power Marketing Agency
  - ✓ 21 US Army Corp of Engineer Dams (14,650 MW)
  - ✓ 10 Bureau of Reclamation Dams (7,800 MW)
  - ✓ Columbia Generating Station (Nuclear, 1,100 MW)
  - ✓ Several Wind Generation contracts (58 aMW)
- Power is sold at cost (Currently ~ $32/MWh)
- Tacoma Power has been a BPA customer since 1940
- Tacoma Power is BPA's 4th largest customer (~$120M/year, ~5.5% of BPA's total load)
- Current Contract Expires September 2028

BONNEVILLE
POWER ADMINISTRATION

BPA Slice/Block Product

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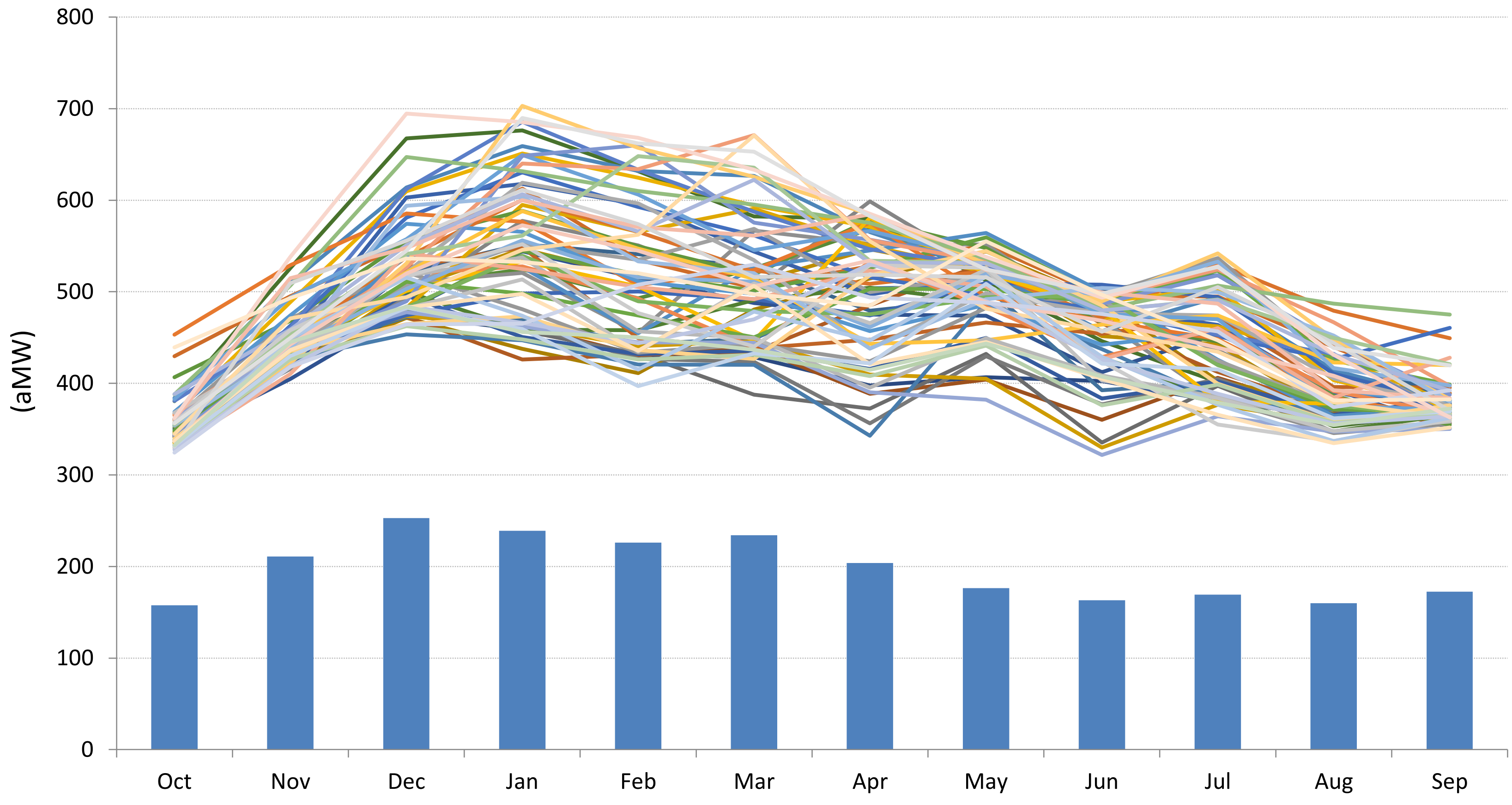

CURRENT PORTFOLIO

BPA "Preference" Power Products

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BPA's statutes require it to:

- Provide power to public utilities (or "preference customers") upon request
- Amount of power is based upon the requesting utility's Total Retail Load less its own resources under "critical water" conditions ("Net Requirement")
- Net Requirement (NR) is determined annually based upon our load forecasts (Example to right):

	aMW
Total Retail Load	580
Less: Tacoma Resources (Critical Water)	185
BPA "Net Requirement"	**395**
Critical "Slice" @ 2.96%	**200**
Block (Net Requirement less Slice)	**195**

Key Challenge: BPA has discretion over whether to allow any new resource we acquire to count against our net requirement

CURRENT PORTFOLIO

Columbia Basin Hydro & Grant County

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CURRENT PORTFOLIO

Columbia Basin Hydropower

Columbia Basin Hydro

- 5 Irrigation Canals (Staggered Terms 2022-2026)
- ~27 aMW in months of March through October
- Pricing (~$29/MWh) = Cost (~$12/MWh) + Incentive Payment (~$17/MWh)

Grant PUD

Grant County Contract

- .29% "slice" share of Priest Rapids and Wanapum Dams (expires 2052)
- ~2.5 aMW Similar in shape to the BPA Slice product
- Pricing (~$11/MWh) = Cost + Share of proceeds from auction of excess energy

Conservation

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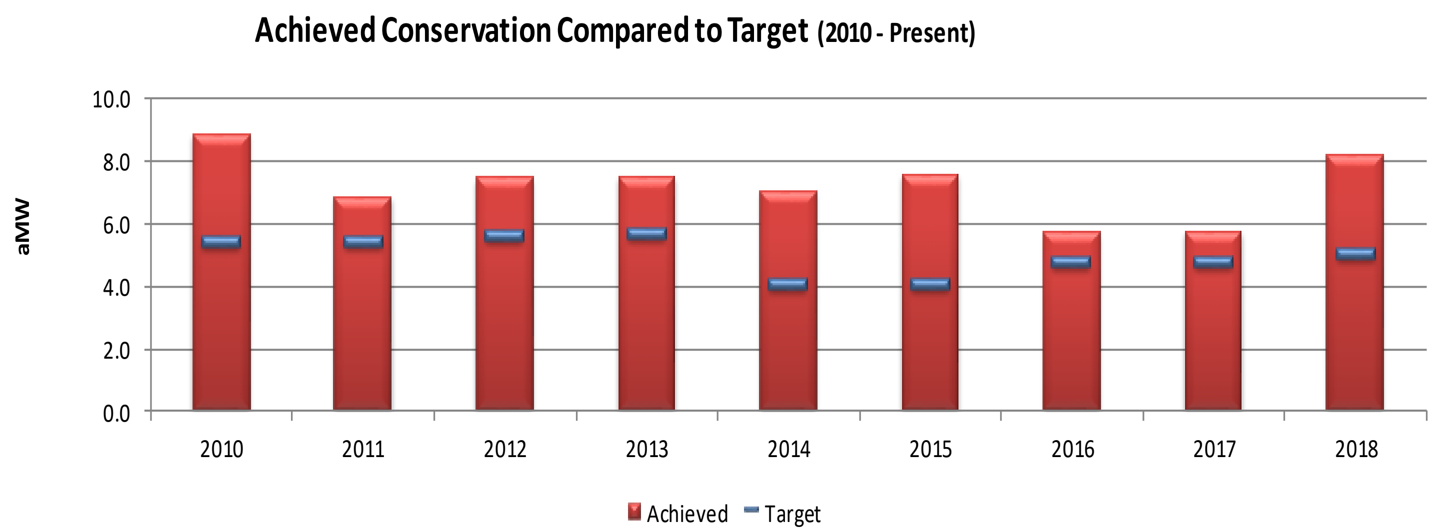

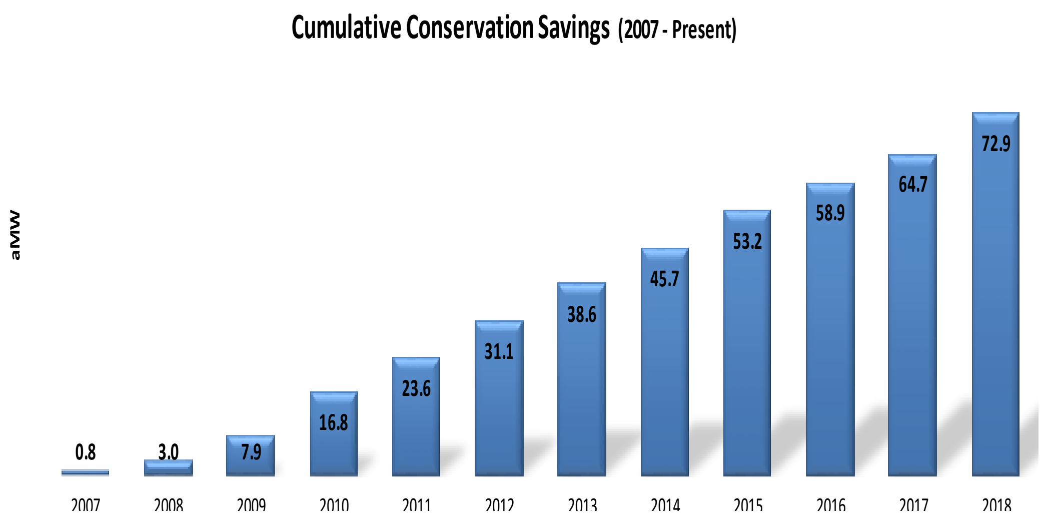

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CURRENT PORTFOLIO

Conservation Potential Assessment

How much conservation can we acquire?

How much should we acquire?

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Outline

1. Role of CPA in Planning
2. Types of Potential
3. Conservation History
4. Conservation Plans
5. Factors Impacting CPA Results
6. Recent CPA Results

Role of CPA in Planning

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Conservation Potential Assessment (CPA) data output used in IRP to model conservation impacts on load forecast

Identify measures

- With net benefit to the service area
- With utility costs lower than generation
- That improve the load-resource balance
- For development in conservation acquisition plan

Energy Conservation – State Law

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The Energy Independence Act requires qualifying utilities to determine their conservation potential using "methodologies consistent with those used by the Pacific Northwest Electric Power and conservation planning council" (19.285.040(1)(a) RCW)

The Energy Independence Act is codified in WAC 194-37 which requires qualifying utilities to establish a:

- 10-year conservation resource potential every two-years
- Biennial conservation target that is "no less than its pro rata share of its ten-year potential."

Definitions of Potential

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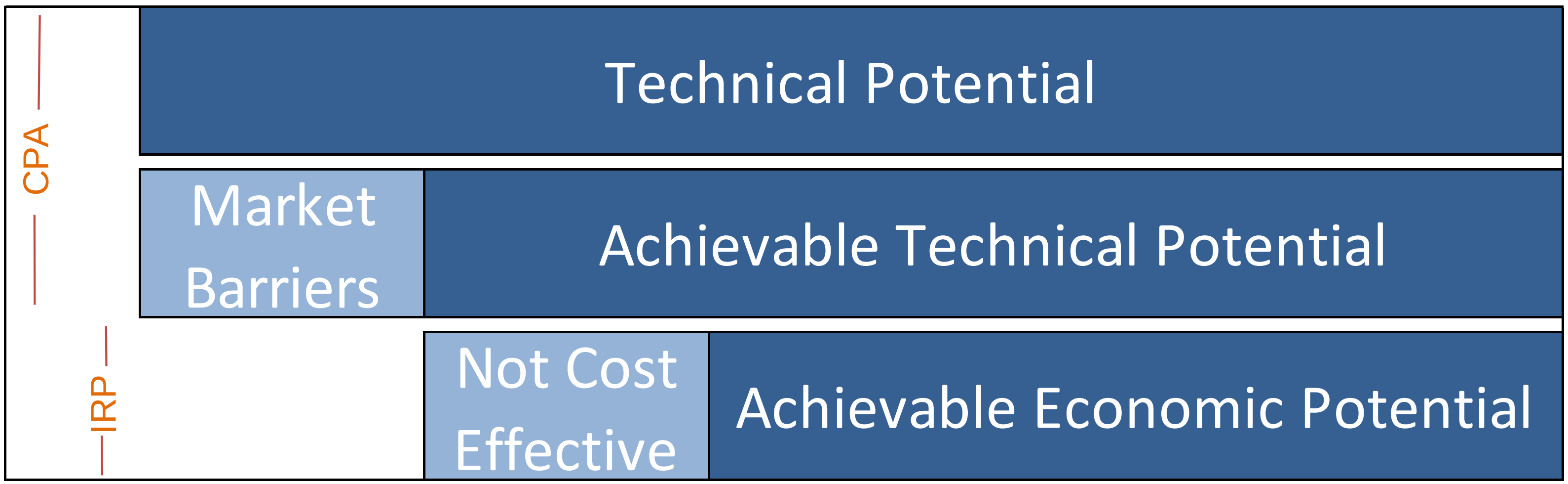

Achievable economic potential simplified here. Due to BPA contract requirements, conservation results in purchase of less BPA resource.

Conservation Accomplishments

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Consistently achieve beyond our target

Getting harder to acquire savings

2019 By sector

- 29% Residential
- 71%Commercial/Industrial

Major Factors Affecting Potential

End-use saturation and efficiency levels

Baselines – codes, standards, markets

Recent accomplishments

Measure assumptions

New technology

Avoided price forecasts

TRC Forecast Avoided Costs

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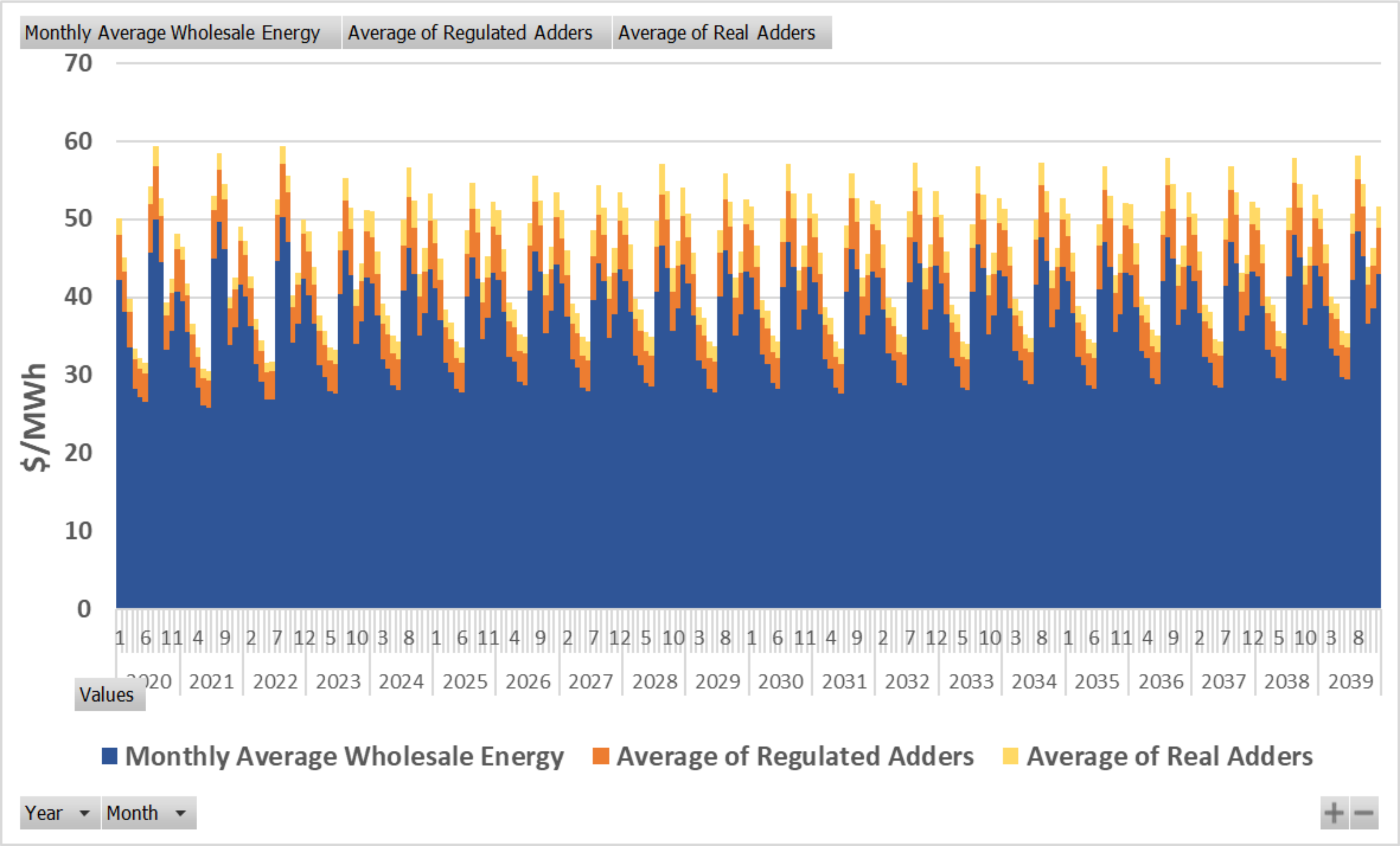

Active Programs

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CONSERVATION POTENTIAL ASSESSMENT

Residential

Weatherization

Heating Systems

Consumer Products

New Construction & Custom Projects

Quick Energy Savers

Hard to Reach

-Owner Occupied

-Rentals/Apartments

-Agency Partnerships

Commercial/Industrial

Bright Rebates

Custom Retrofit

Equipment Rebates

New Construction

Strategic Energy Management

Other

NEEA

Distribution Efficiency

20-Year Conservation Potential

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	Achievable Technical Potential (GWh)	Economic Achievable Potential (GWh)	Percent 2039 Baseline
Residential	355	84	4.0%
Commercial	248	171	13.6%
Industrial	115	94	5.9%
JBLM Residential	7	2	5.0%
JBLM Commercial	31	22	7.5%
Street Lighting	6	6	31.2%
Distribution Efficiency	14	11	0.2%
Total	775	389	8.0%

Residential Potential: 84,029 MWh

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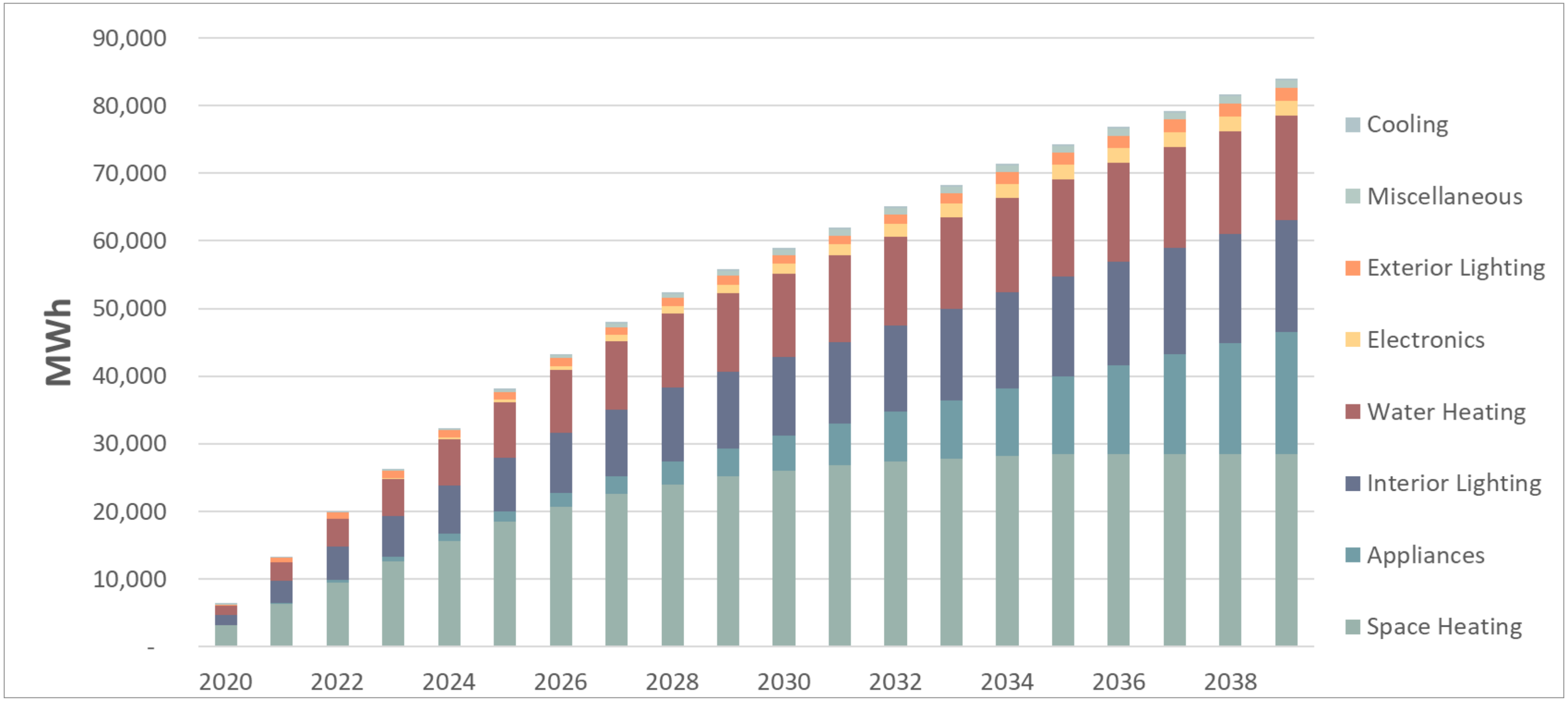

Lighting accomplishments and federal standards impact remaining potential

Fewer economic weatherization measures make it more difficult to implement the program

A combination of Energy Star appliances will eventually become a significant opportunity

CONSERVATION POTENTIAL ASSESSMENT

Commercial Potential: 171,549 MWh

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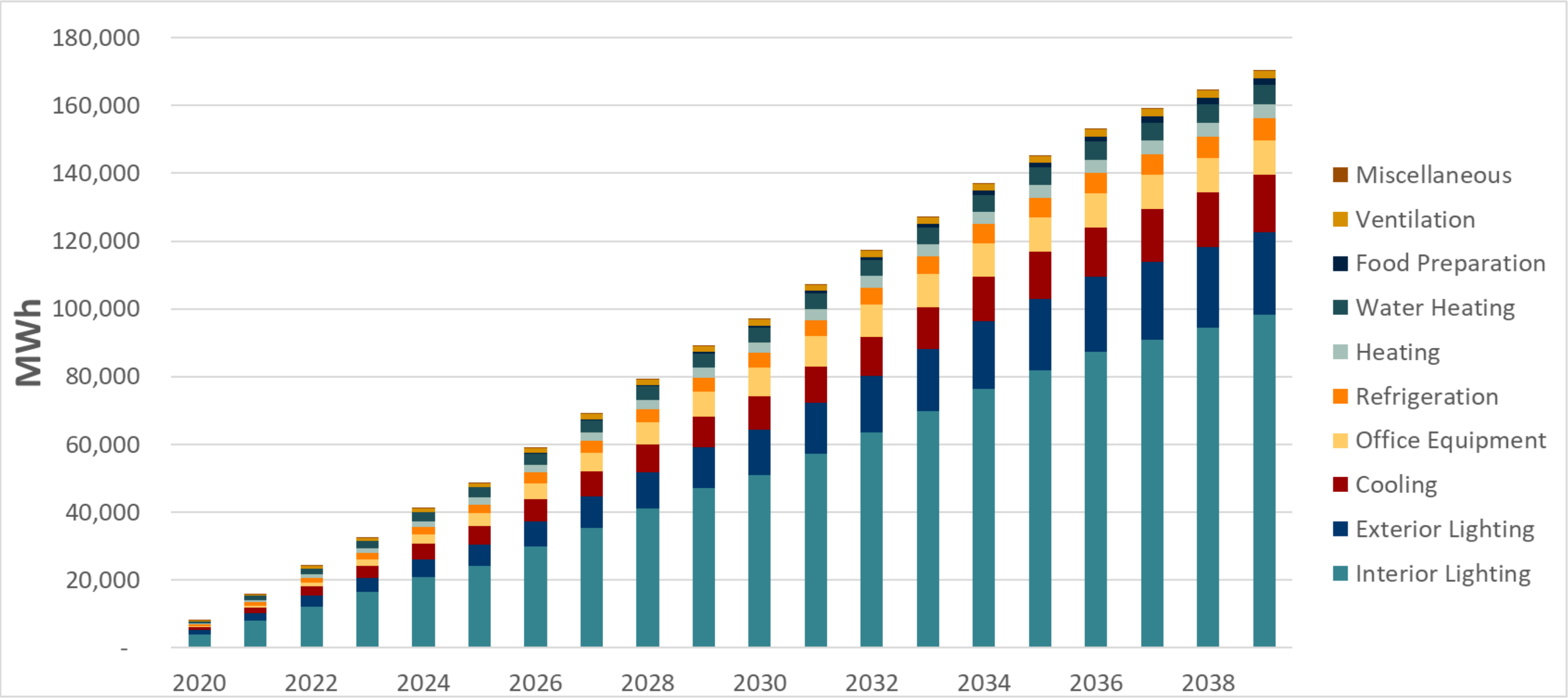

Lighting is nearly 30% of commercial consumption and 72% this sector's conservation potential

Existing buildings account for 65% of the sector potential

62% of sector potential is from office, retail, school, hospital and misc. segments

CONSERVATION POTENTIAL ASSESSMENT

Industrial Potential: 94,397 MWh

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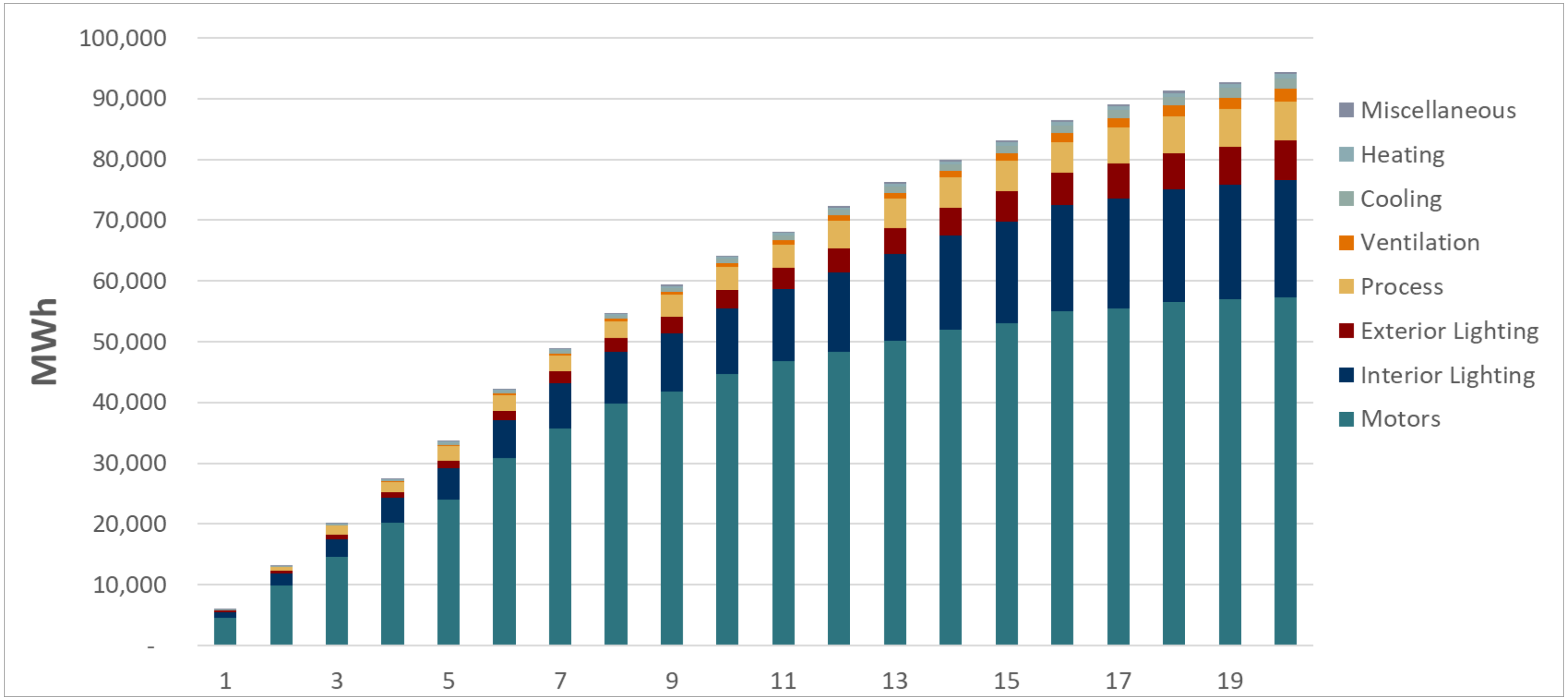

Like previous results, motors continue to dominate industrial potential, about 60% of sector potential

Lighting is a strong 27% of the sector potential

JBLM Commercial: 21,569 MWh

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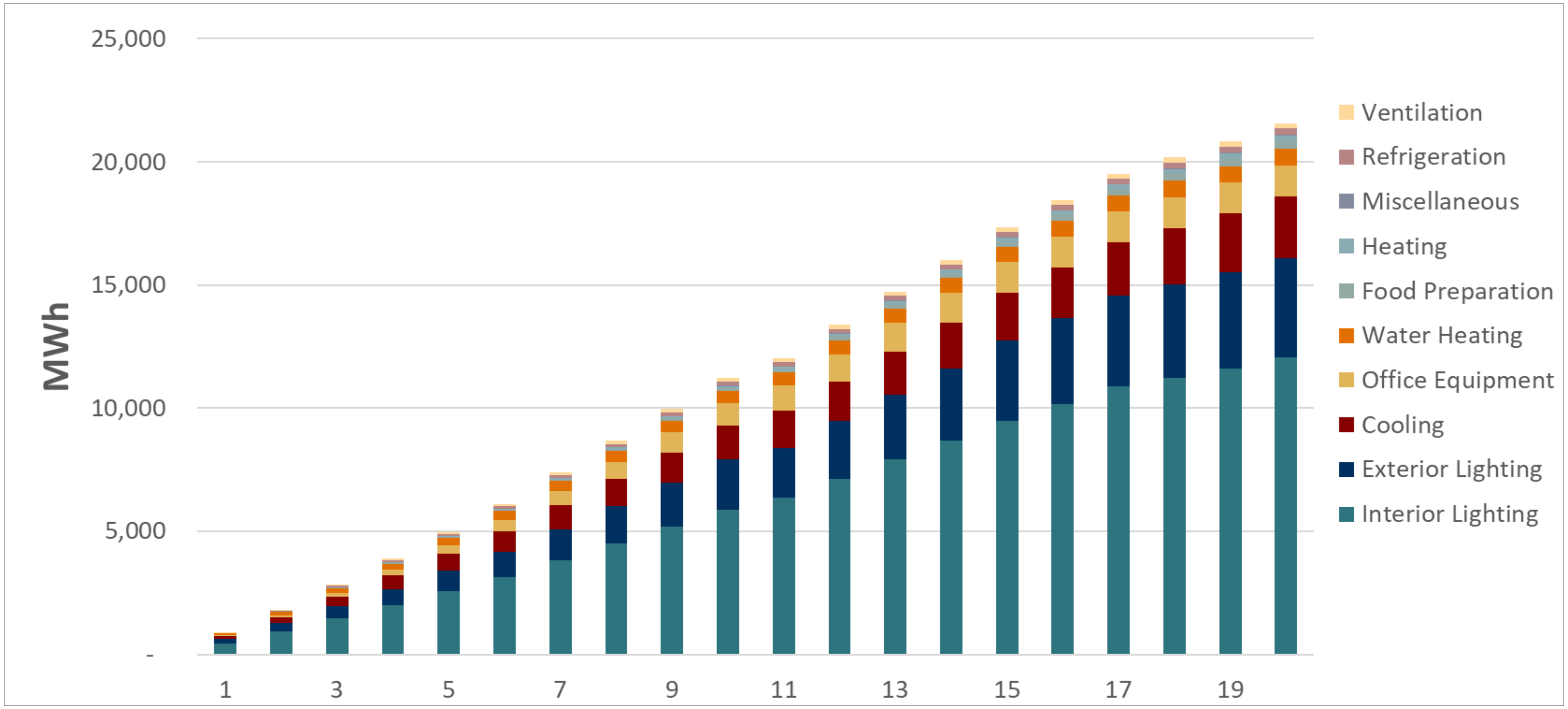

Like civilian commercial, lighting dominates at 74% of potential

Combined HVAC potential contributes 14%

JBLM potential assumes a slower implementation

On/Off Street Lighting: 5,649 MWh

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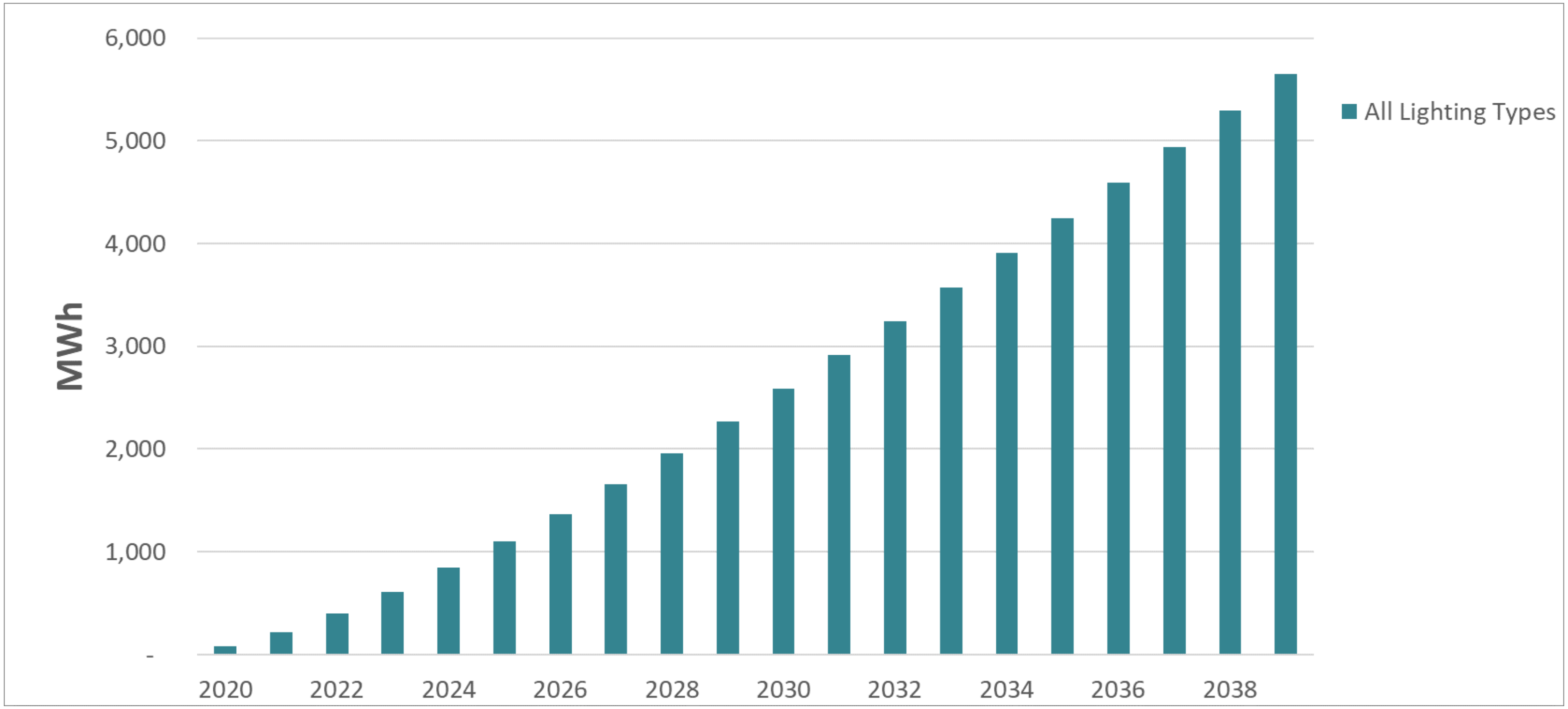

Spread among many different wattage and fixtures types

About 50% in the 100 and 400 watt equivalent

Codes and Standards

By the year 2039, existing state building codes and federal energy standards on equipment are projected to reduce overall load by 122,119 MWh (built into the forecast)

Sector	Impact (MWh)	% of Baseline Load
Residential	44,678	~2.1%
Commercial	60,067	~4.5%
Industrial	5,727	~0.1%
JBLM	11,647	~1.0%

Base Case Load Forecast

How much load do we expect in our base case?

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Load Forecast Outline

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1. Introduction to Load Forecasting
2. National Trends in Electricity Use
3. Critical Drivers
4. Forecasting Methodology
5. Forecast Products

This is where we answer the question "what is a load forecast?"

Introduction to Load Forecasting

Introduction to Load Forecasting

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Tacoma Power is an electric power service provider.

As an electric power provider, Tacoma Power energizes everything from street lights to large industrial operations.

We call the collection of all our retail services our system. The electric power that's consumed on our system is called system load.

Introduction to Load Forecasting

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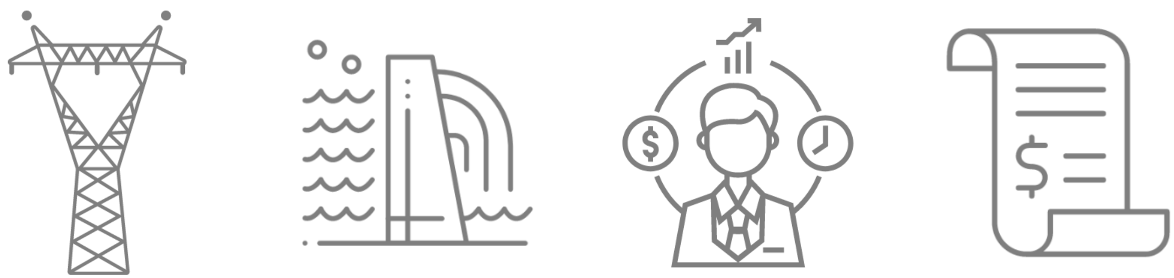
Tacoma Power stands ready to serve every customer's need at every moment.

Tacoma Power does this by securing adequate infrastructure and resources.



Transmission & Distribution

Owned Hydroelectric Generation

Wholesale Transactions

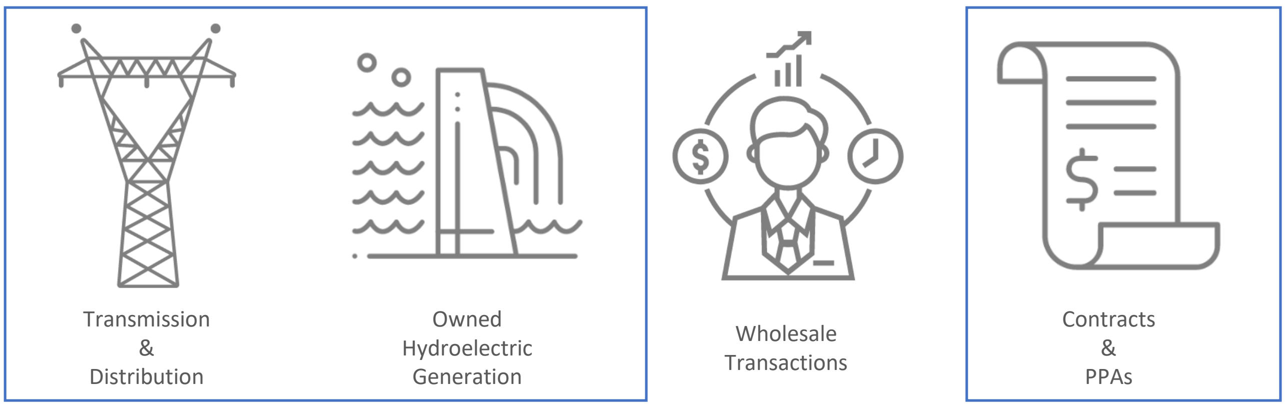
Contracts & PPAs

Tacoma Power relies on real-time, short-term, and long-term forecasts to know how much infrastructure and resource will be adequate at every moment.

Introduction to Load Forecasting

Tacoma Power's long term load forecast is the subject of this presentation.

Generally speaking, long-term load forecasts inform long-term infrastructure and resource planning.



Utilities need long-term load forecasts because it usually takes a long time to build things like power plants, substations, and transmission infrastructure.

Introduction to Load Forecasting

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The long term load forecast is a projection of Tacoma Power's service requirements.

- Tacoma Power's long-term load forecast spans the next twenty years.
- The objective of the long-term load forecast is to provide a "business-as-usual case". No assumptions about new policies or technologies are included.
- The long-term load forecast is developed using a set of models that consider economic, demographic, weather, and service area trends.
- Long term load forecasts are not a prediction of what will happen, but a modeled projection of what may happen given certain assumptions and methodologies.

This is where we take a step back.

National Trends in Electricity Use

National Trends

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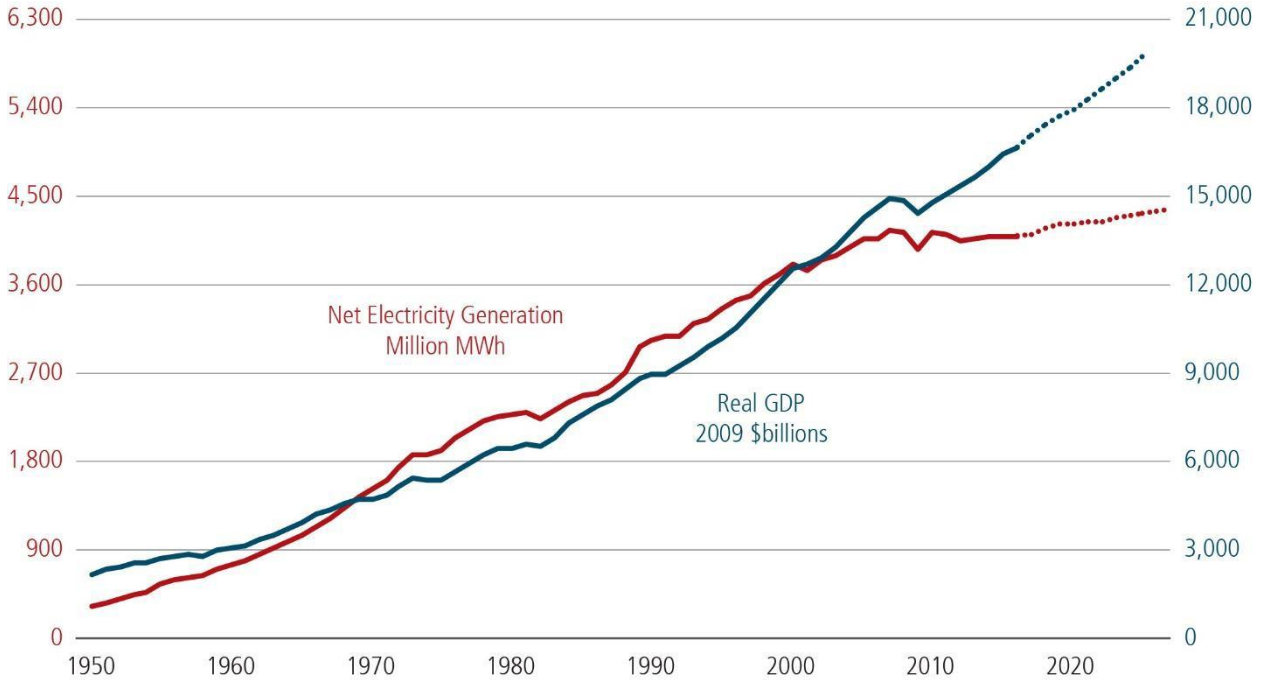
Historically, electricity demand was coupled with economic growth. Around 2000, this relationship changed.

Gross Domestic Product and Net Electricity Production
Historical (1950-2016) and Projected (2017-2027)



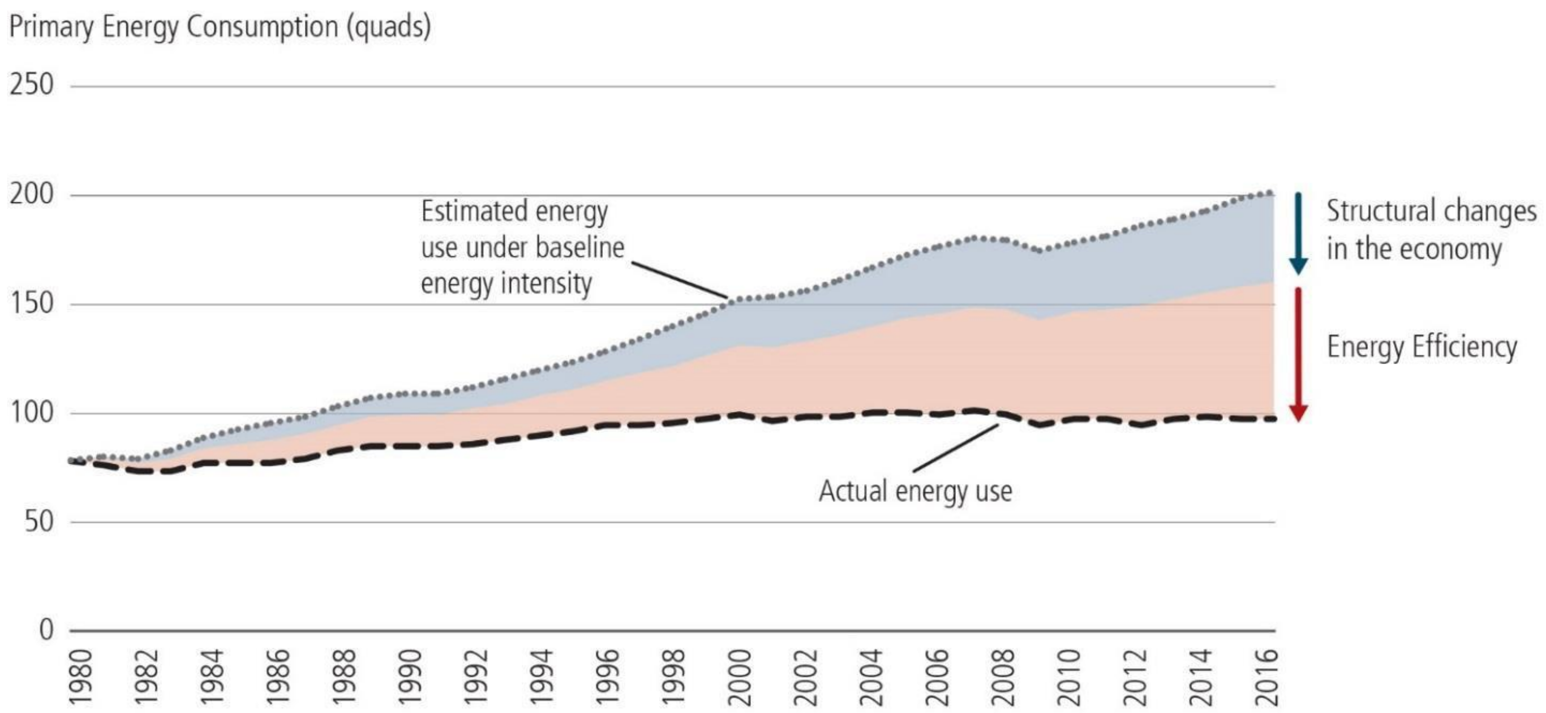
U.S. Department of Energy | Staff Report on Electricity Markets and Reliability, August 2017

LOAD FORECAST

National Trends

The decline in the demand growth rate can be attributed to a variety of factors.

Estimated U.S. Energy Savings from Structural Changes in the Economy and Energy Efficiency
1980-2016



U.S. Department of Energy | Staff Report on Electricity Markets and Reliability, August 2017

National Trends

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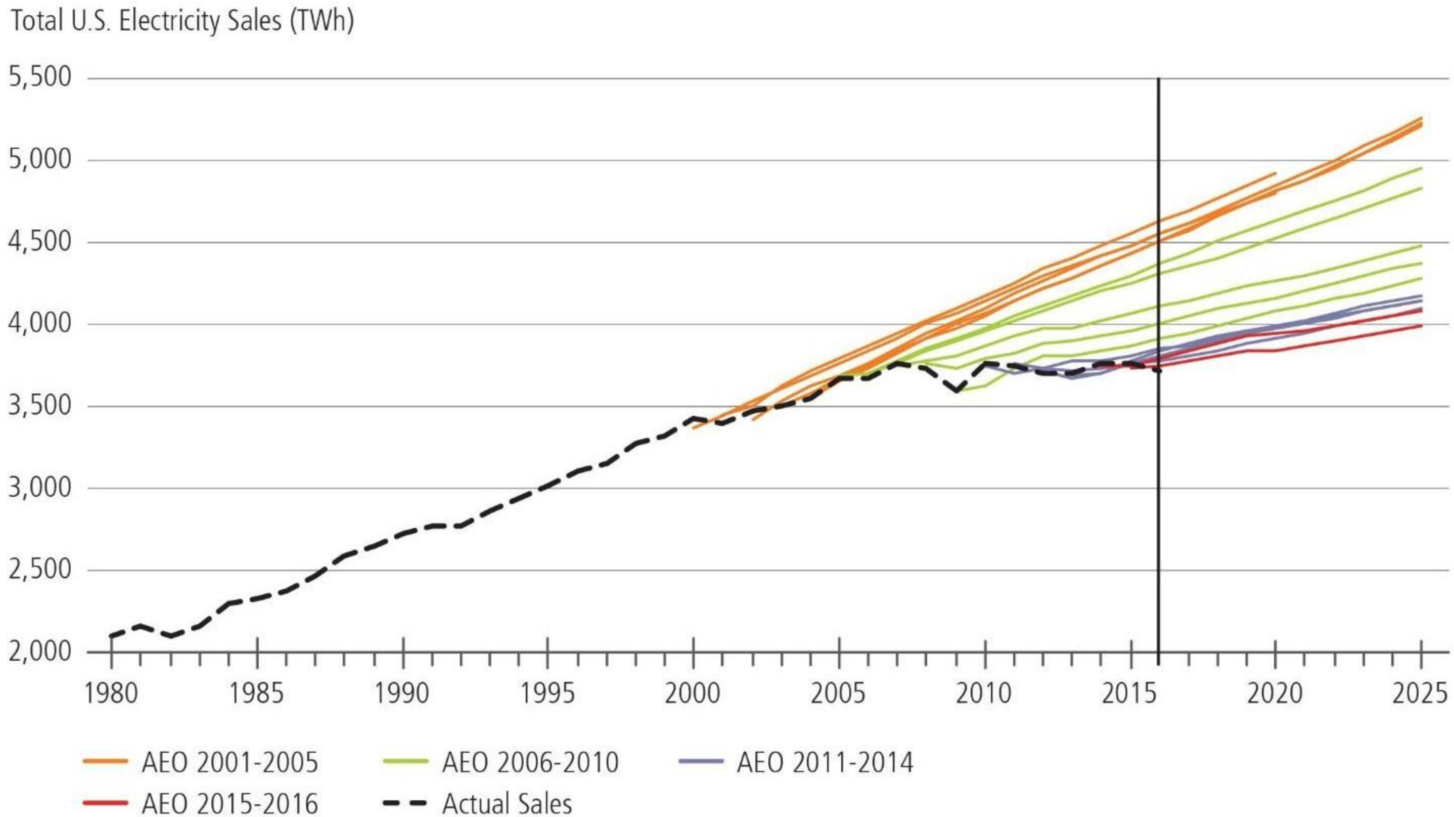
A changing policy and market environment has made it difficult to accurately forecast national electric load.

U.S. Energy Information Administration Annual Energy Outlook Reference Case Projections
2017-2030



U.S. Department of Energy | Staff Report on Electricity Markets and Reliability, August 2017

National Trends

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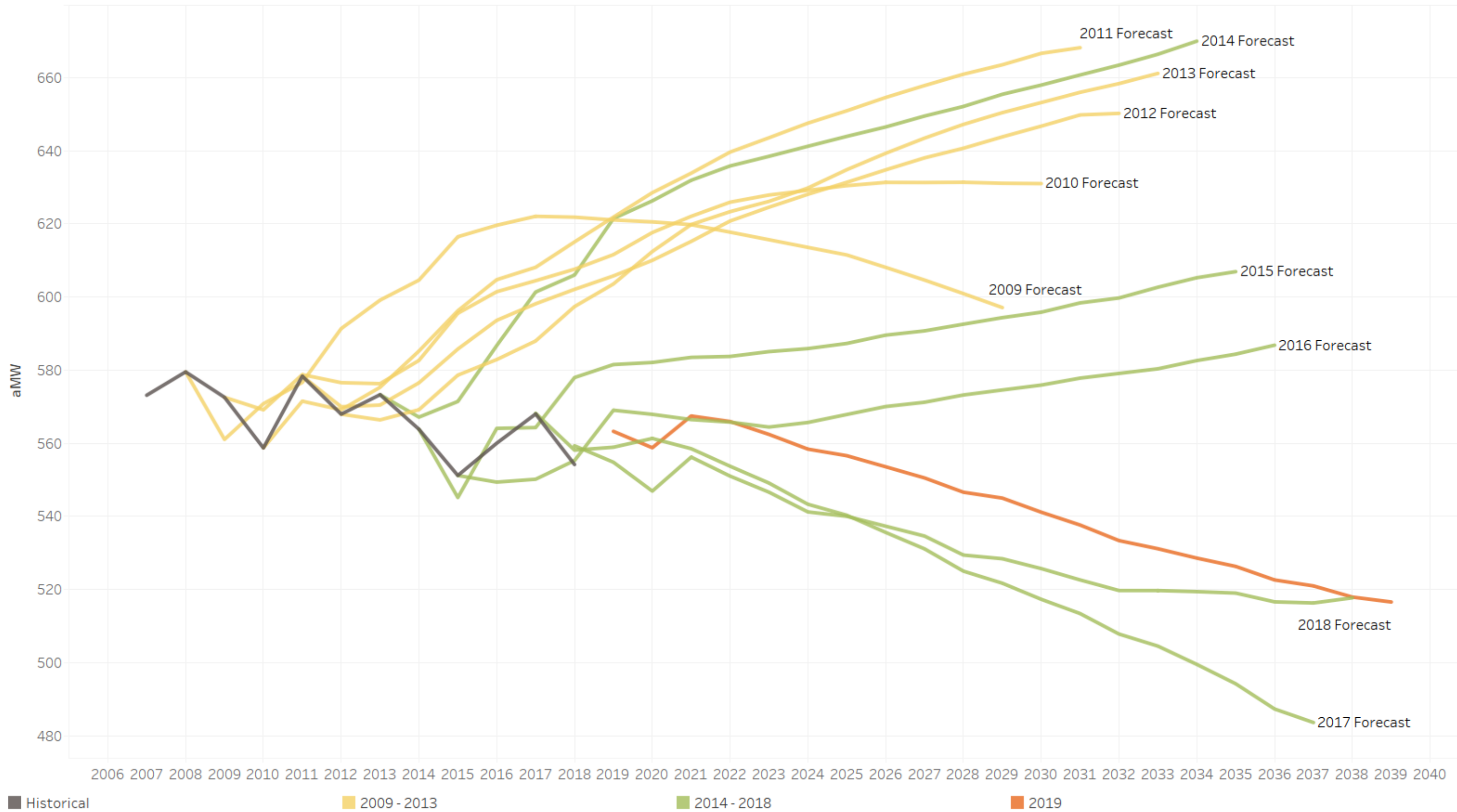
The same environment has made it difficult to accurately forecast Tacoma Power's electric load.

Tacoma Power Annual Load Projections
2019-2039



National Trends

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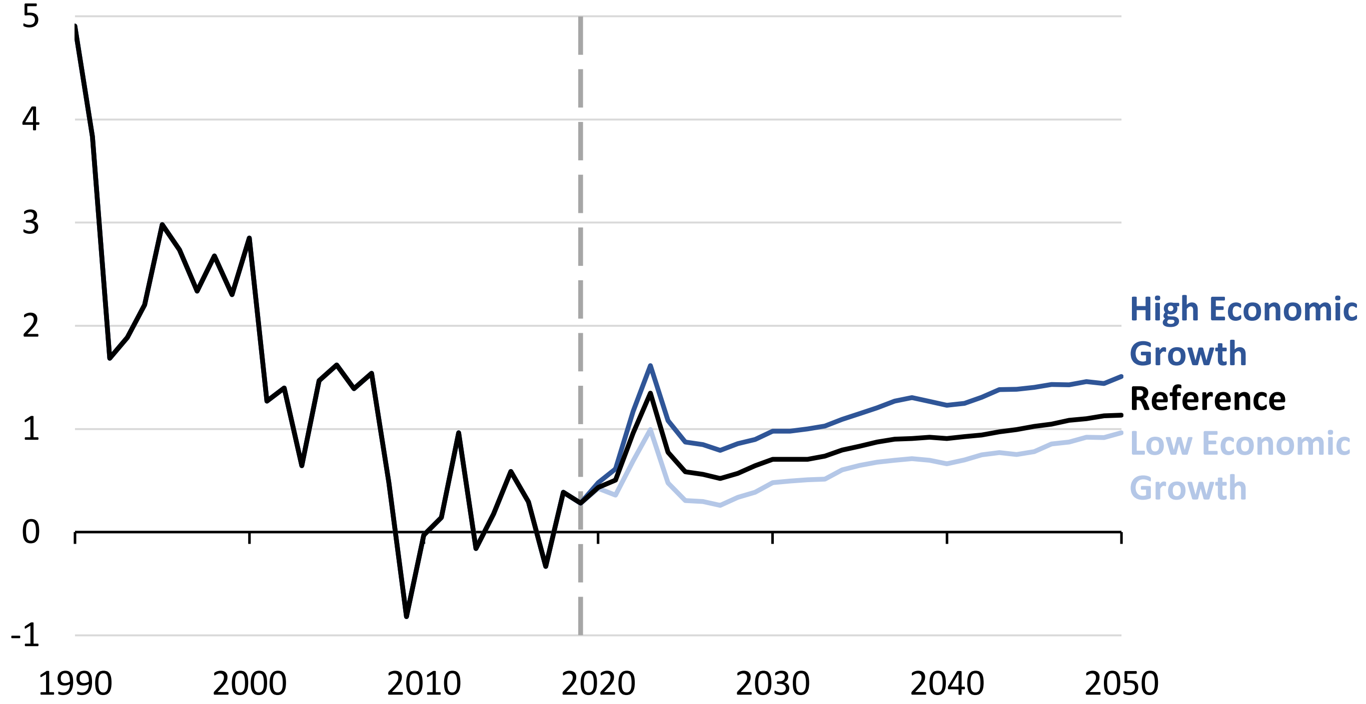
The most recent Annual Energy Outlook projects electricity demand to grow slowly through 2050.

AEO2020 Electricity use growth rate
percentage growth (three-year rolling average)



U.S. Energy Information Administration | Annual Energy Outlook 2019

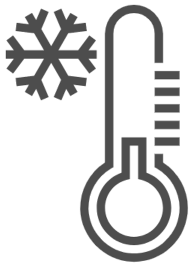
This is where we answer the question "what affects load?"

Critical Drivers

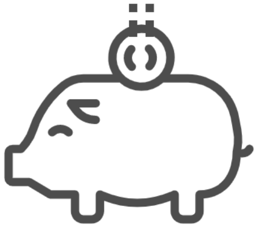
Critical Drivers

Many factors affect electric load and our forecast assumes specific values for these factors throughout the forecast horizon.

Load is most notably driven by the weather, the economy, and the demography of a service territory.



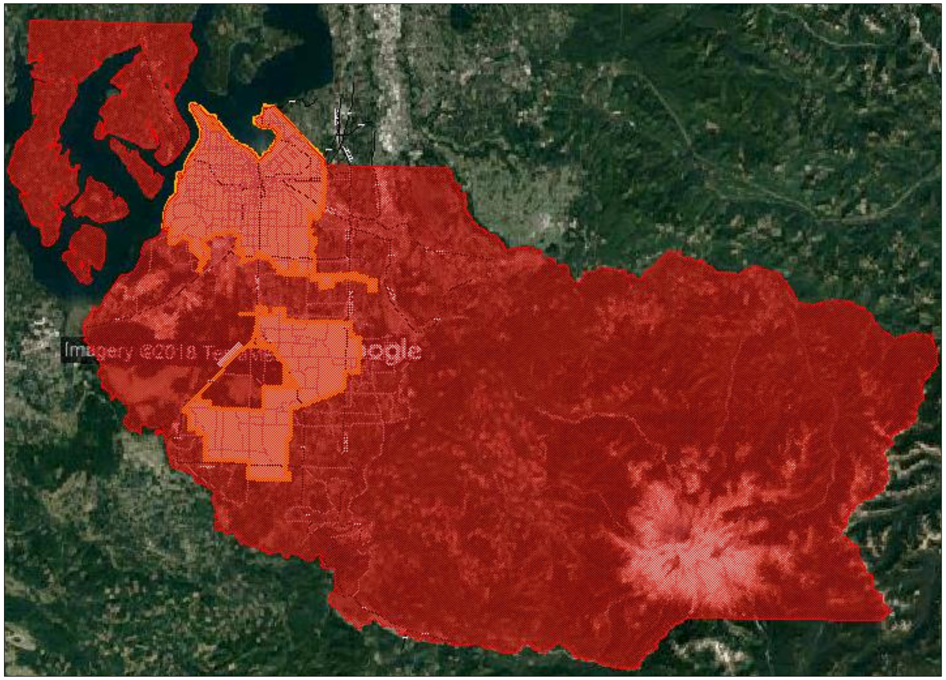
We purchase weather data from an independent firm that specializes in weather and environmental information.



We purchase economic and demographic data from an independent firm that specializes in long-term county-level economic and demographic data series.

Critical Drivers

The economic and demographic inputs considered by our models are specific to Pierce County.



Tacoma Power's service territory is contained within Pierce County.

LOAD FORECAST

Critical Drivers

Over the historical period, the economy has experienced change. Over the forecast horizon, the economy will continue to change.

	Compound Annual Growth Rate
	Forecast Horizon
Residence Adjustment	1.69%
Non-Industrial Retail Rates	4.20%
Non-Industrial Energy Efficiency Acquisitions	1.92%

Critical Drivers

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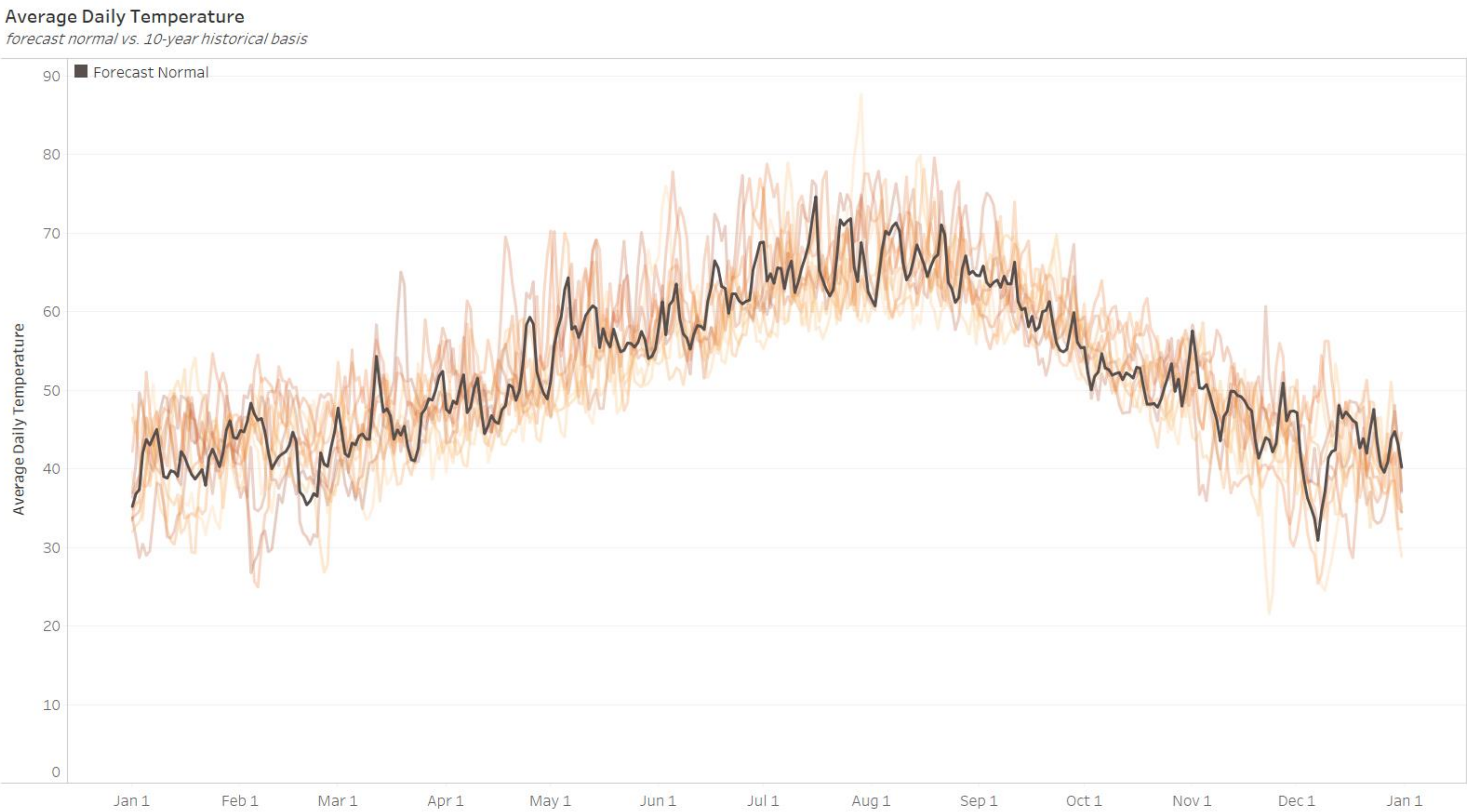
The 2019 Forecast Weather Normal is based on 10 years of historical weather.



LOAD FORECAST

This is where we answer the question "how is the forecast derived?"

Forecasting Methodology

Forecasting Methodology

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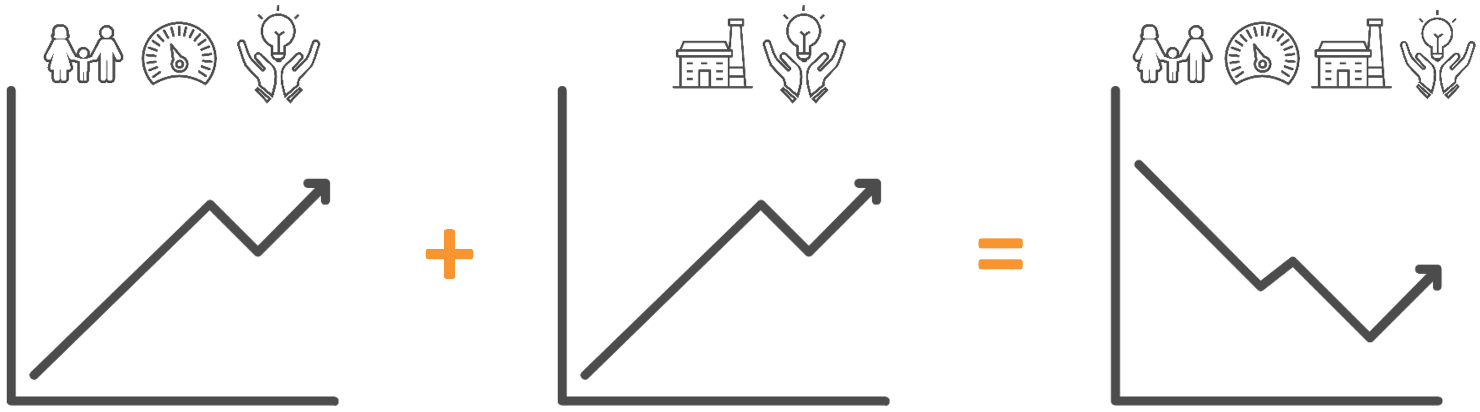
Tacoma Power's System Energy Load Forecast is the sum of a non-industrial forecast and an industrial forecast.



Non-Industrial Load Forecast

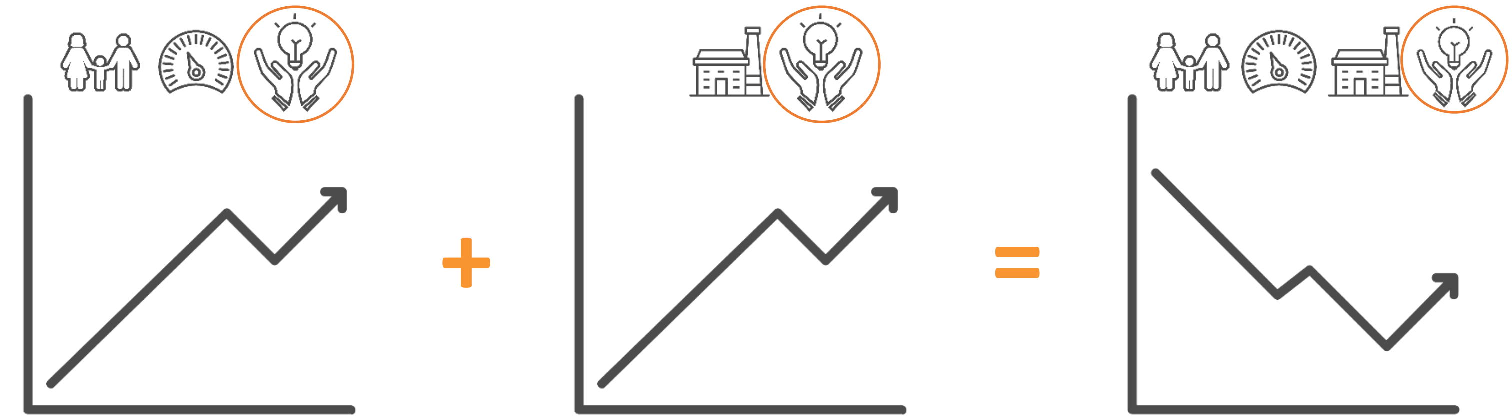
Industrial Load Forecast

System Load Forecast

Forecasting Methodology

TACOMA POWER
TACOMA PUBLIC UTILITIES

Within the non-industrial and industrial load forecasts, we account for conservation and codes & standards



Non-Industrial Load Forecast

Industrial Load Forecast

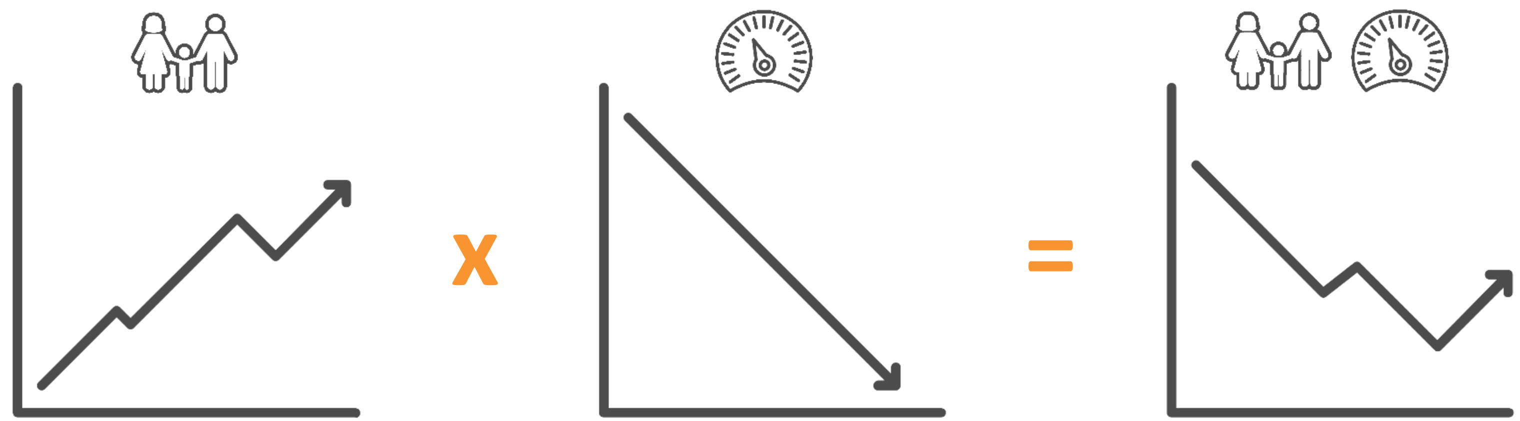
System Load Forecast

The forecasts of conservation and codes & standards are provided by Tacoma Power's Conservation Potential Assessment.

Forecasting Methodology

TACOMA POWER
TACOMA PUBLIC UTILITIES

The non-industrial load forecast is the product of two separate forecasts.

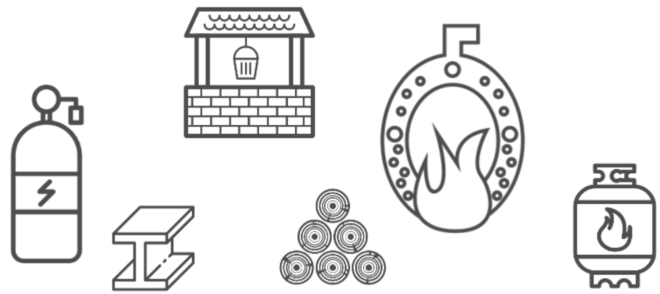


Non-Industrial Customer Forecast	Non-Industrial Use-per-Customer Forecast	Non-Industrial Forecast

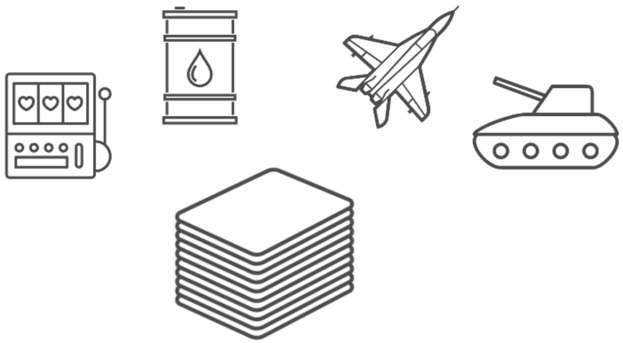
Non-Industrial loads are relatively weather-sensitive. Variability in weather can distort underlying trends in consumption. We adjust for weather-driven variability through a process called 'Weather Normalization'.

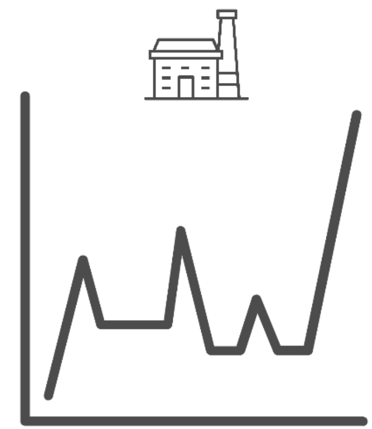
Forecasting Methodology

The industrial forecast is the sum of 11 forecasts.



$$\sum_{k=0}^{11} \text{Individual Industrial Load Forecasts} =$$



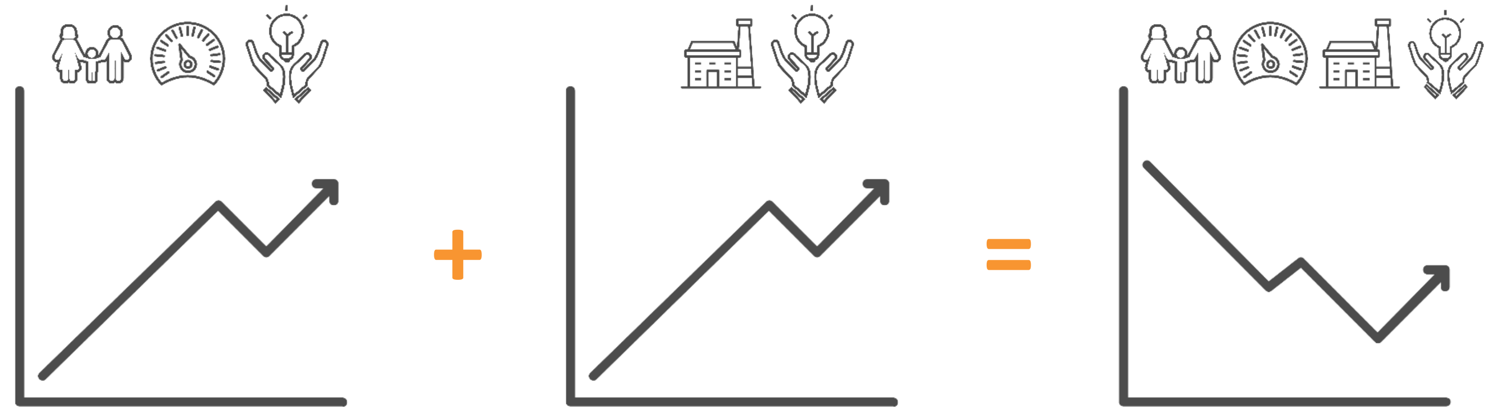


Pre-Conservation Industrial Forecast

We create individual load forecasts for each of the industrial loads existing or expected within our service territory. Forecasts are based on historical records of consumption and account executive knowledge of customer expectations.

Forecasting Methodology

Tacoma Power's System Energy Load Forecast is the sum of a non-industrial forecast and an industrial forecast.



Non-Industrial Load Forecast

Industrial Load Forecast

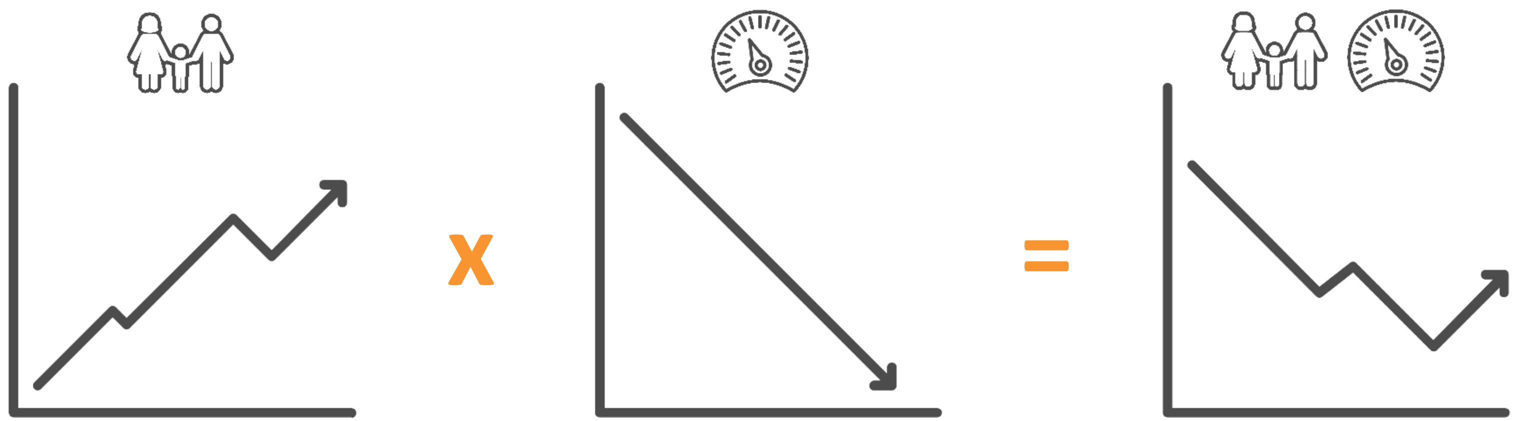
System Load Forecast

This is where we discuss the results of the forecasting process.

Forecast Products

Forecast Products

Let's begin with the non-industrial load forecast.



Non-Industrial Customer Forecast

Non-Industrial Use-per-Customer Forecast

Non-Industrial Forecast

The non-industrial load forecast is the product of two separate forecasts.

Forecast Products

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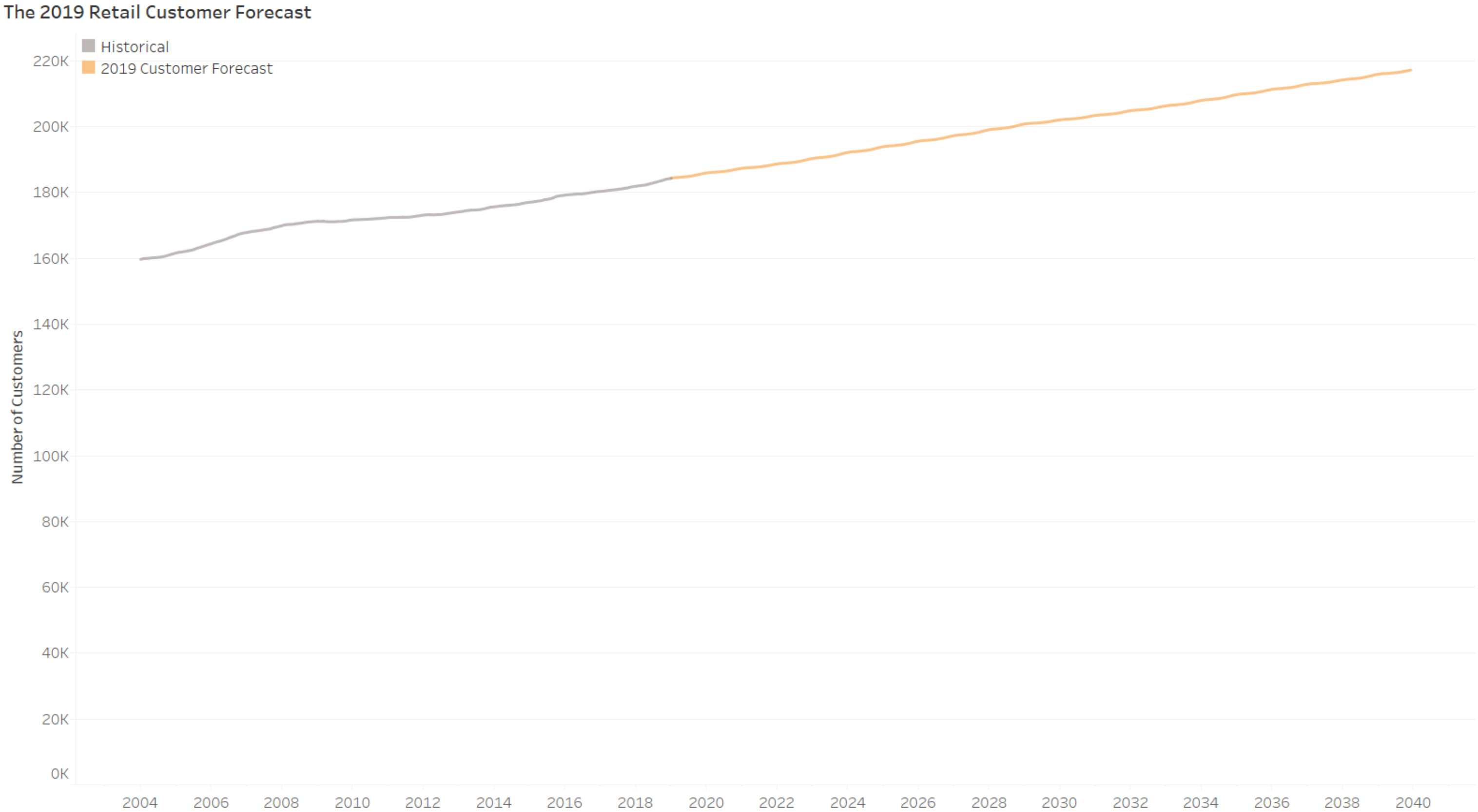
Tacoma Power's retail customer base is projected to grow over the forecast horizon.



LOAD FORECAST

Forecast Products

TACOMA POWER
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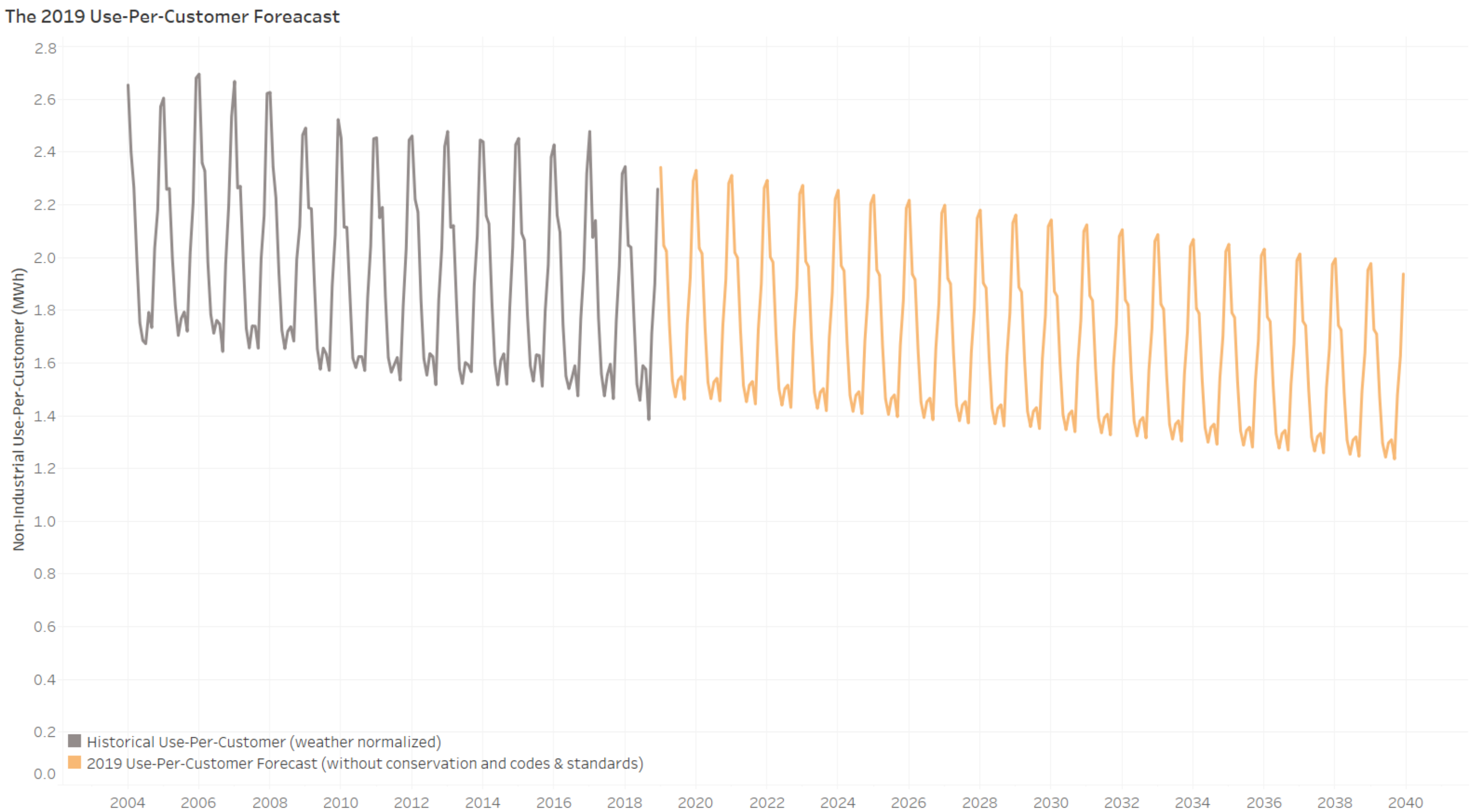
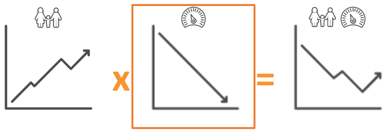
Use-Per-Customer is projected to decline over the forecast horizon.





LOAD FORECAST

Forecast Products

TACOMA POWER
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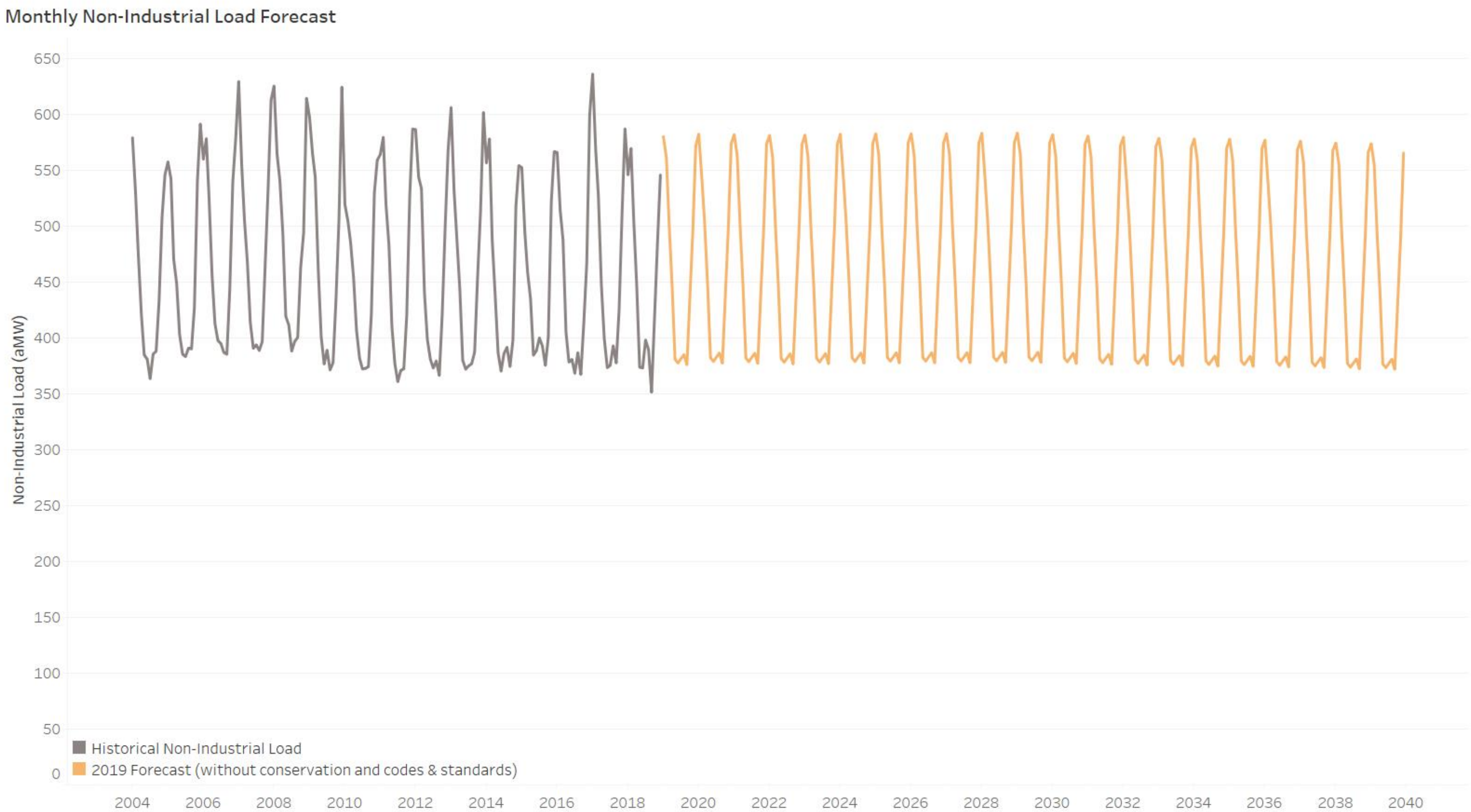
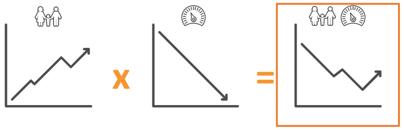
With the customer and use-per-customer forecasts, non-industrial load is projected to decline over the forecast horizon.





Forecast Products

Recall, we account for conservation and codes & standards within the non-industrial and industrial forecasts.

Non-Industrial Load Forecast + Industrial Load Forecast = System Load Forecast

The forecasts of conservation and codes & standards are provided by Tacoma Power's Conservation Potential Assessment.

Forecast Products

TACOMA POWER
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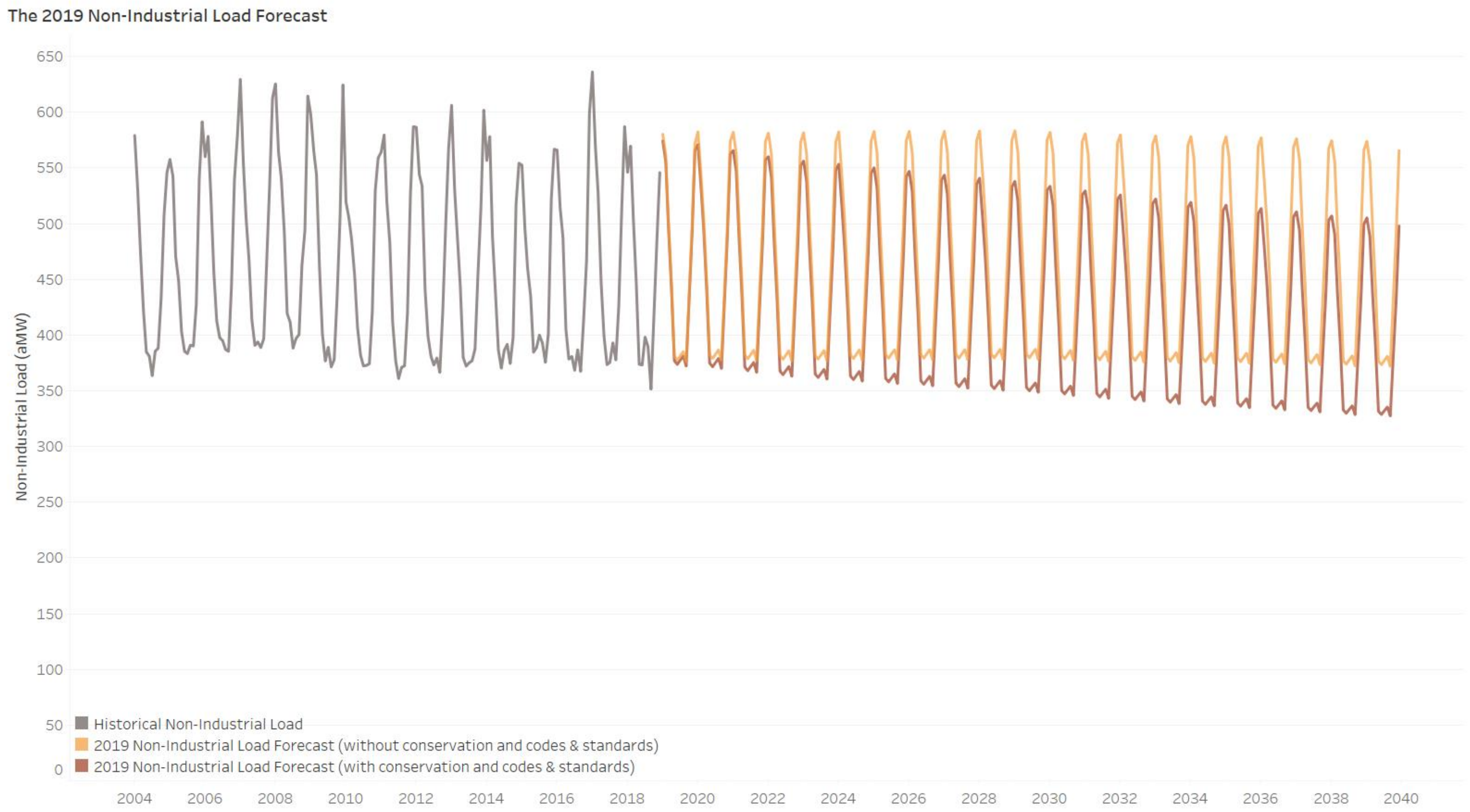
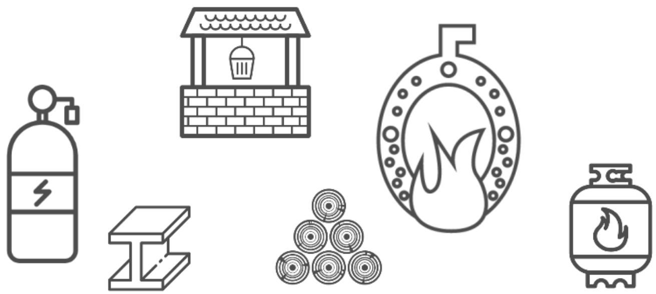
LOAD FORECAST

Conservation and Codes & Standards accelerate the projected decline in non-industrial load.

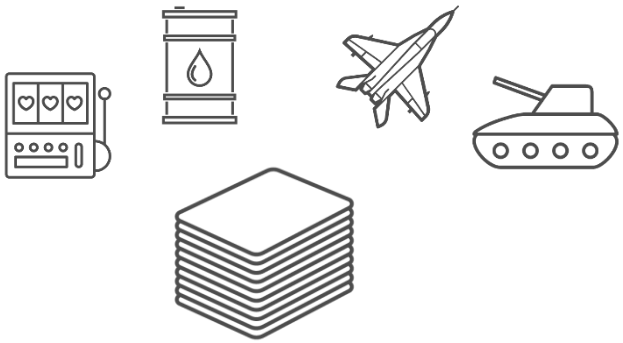


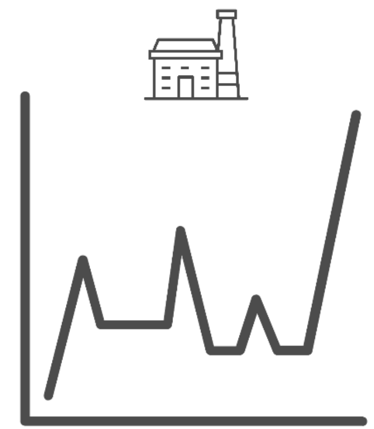
Forecast Products

Let’s now discuss the industrial load forecast.



$\sum_{k=0}^{11}$ Individual Industrial Load Forecasts =





Pre-Conservation Industrial Forecast

The industrial forecast is the sum of 11 forecasts.

Forecast Products

TACOMA POWER
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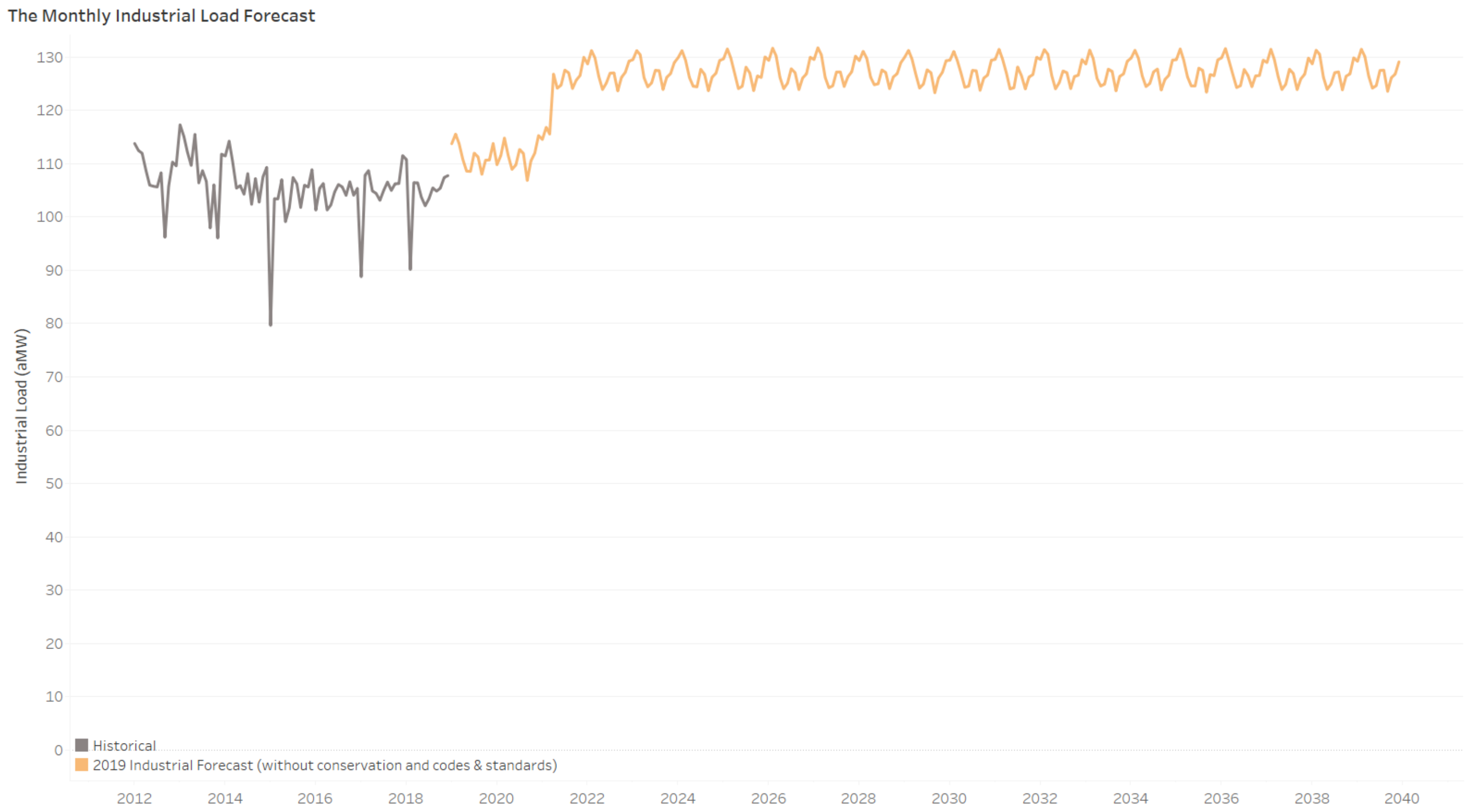
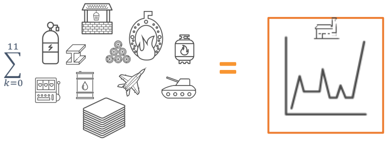
LOAD FORECAST

Industrial load is expected to grow within the forecast horizon.





Forecast Products

Again, we account for conservation and codes & standards within the non-industrial and industrial forecasts.

Non-Industrial Load Forecast

Industrial Load Forecast

System Load Forecast

The forecasts of conservation and codes & standards are provided by Tacoma Power's Conservation Potential Assessment.

Forecast Products

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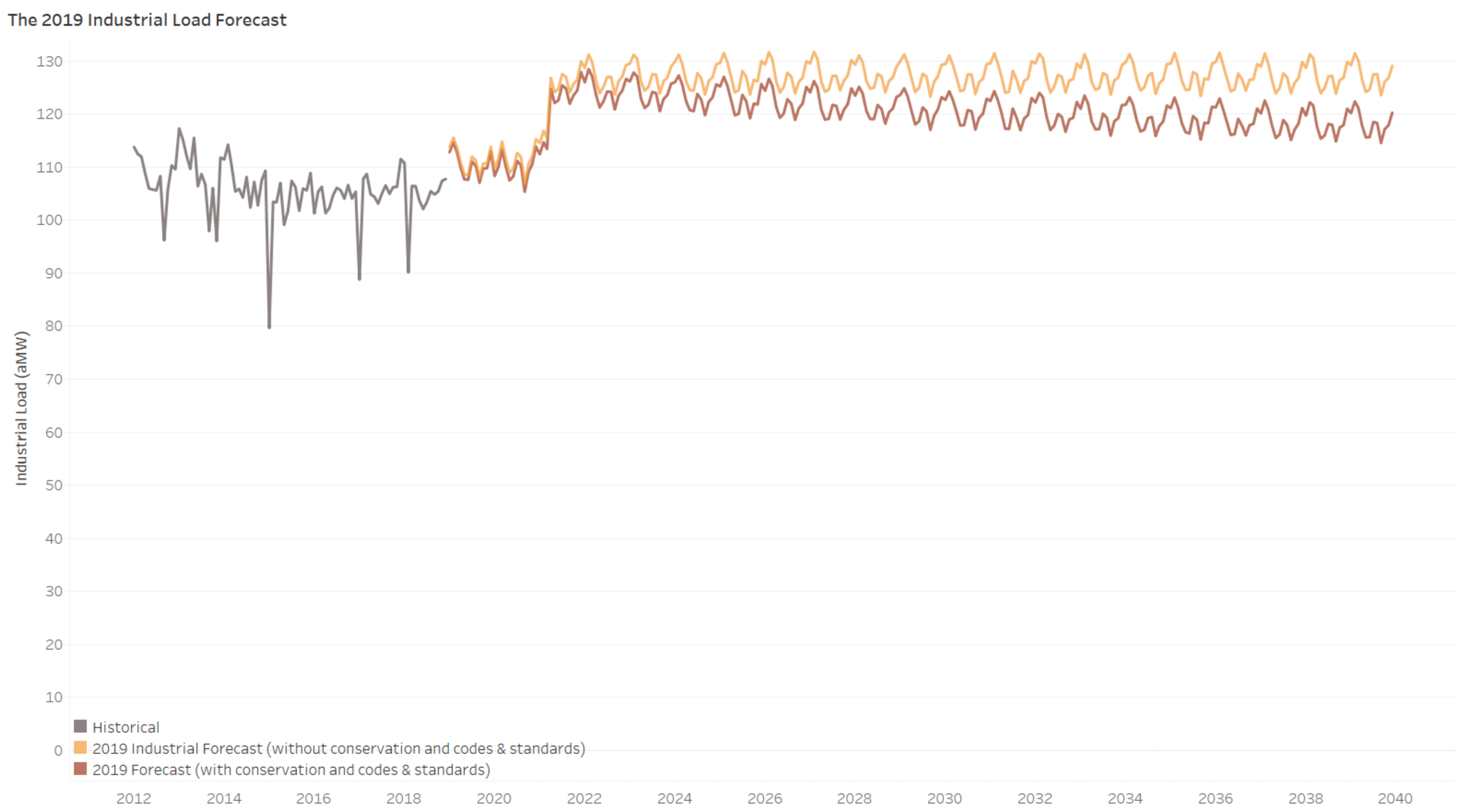
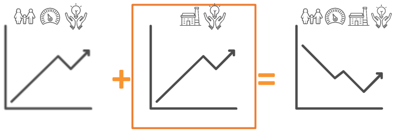
After accounting for conservation and codes & standards, the projected growth in industrial load is reduced.

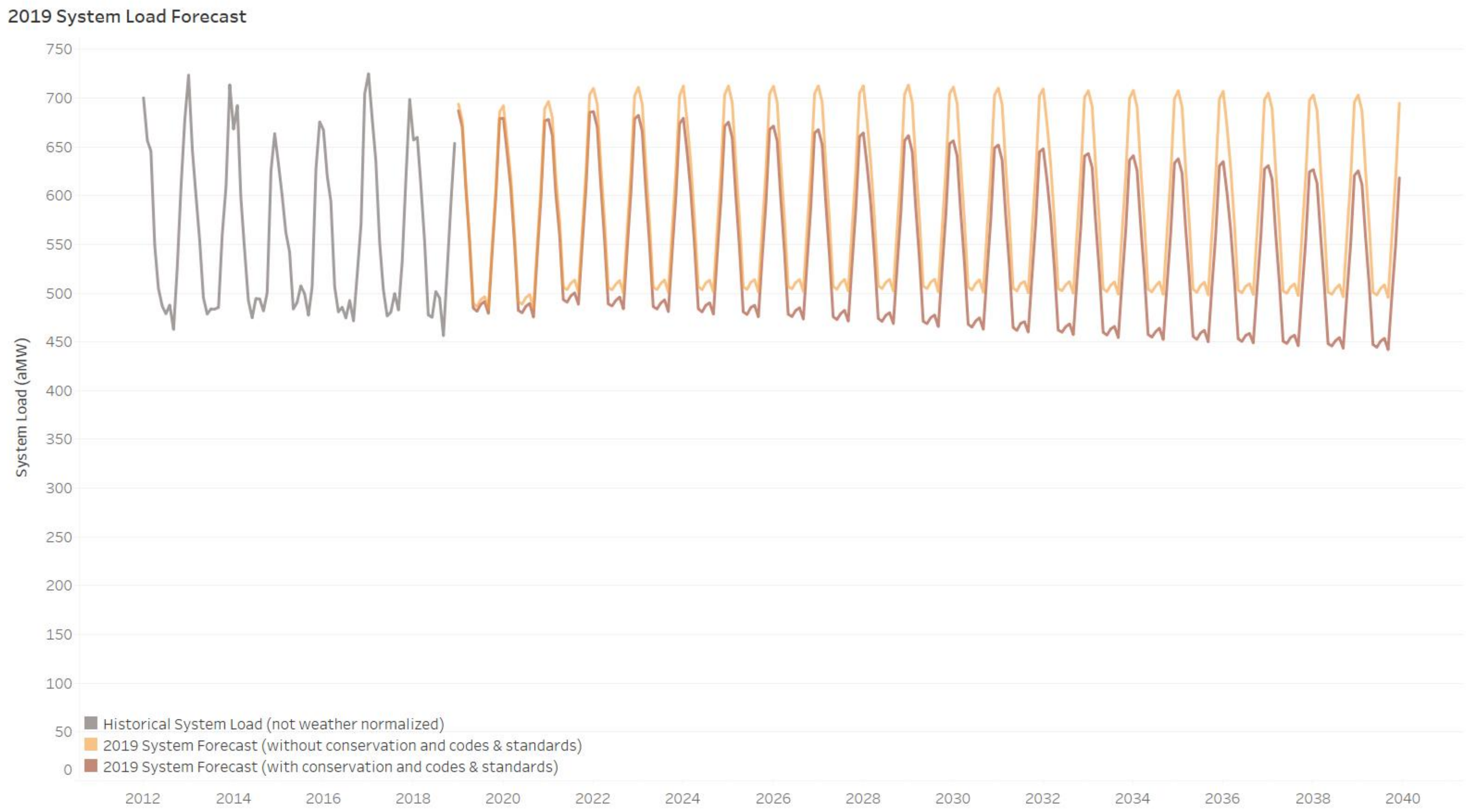




LOAD FORECAST

Forecast Products

After we account for conservation and codes & standards, system load is projected to decline.



Base Case WECC Buildout & Prices

How many resources will be built in our base case scenario?

What will prices look like in our base case scenario?

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Forecasting Caveat!

"All models are wrong,
but some are useful."

~George E.P. Box (1919 - 2013)

The AURORA model is useful when:

- its inputs reflect actual or plausible realities
- its outputs are directionally accurate

The “WECC”

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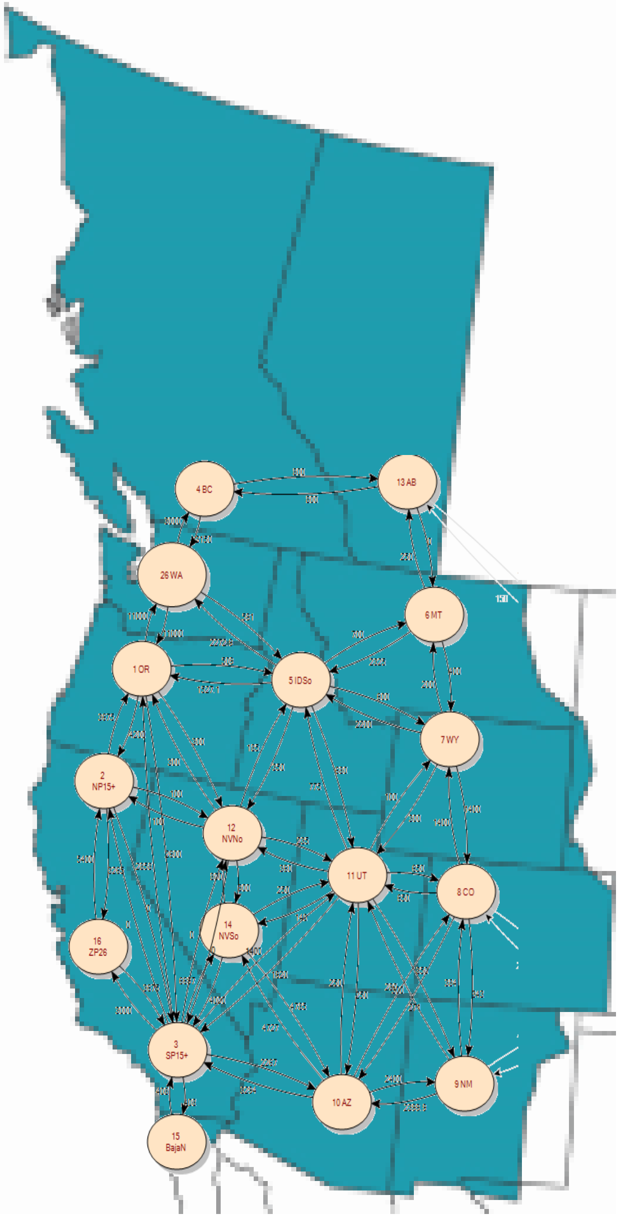
Western Electric Coordinating Council:

- 2 Canadian Provinces
- 11 Western States
- Northern Baja Mexico

WECC-US Utility Fun Facts:

- 147 Investor-Owned (~75% of load)
- 241 Non-Investor-Owned (~25% of load)



Current WECC Generation & Load

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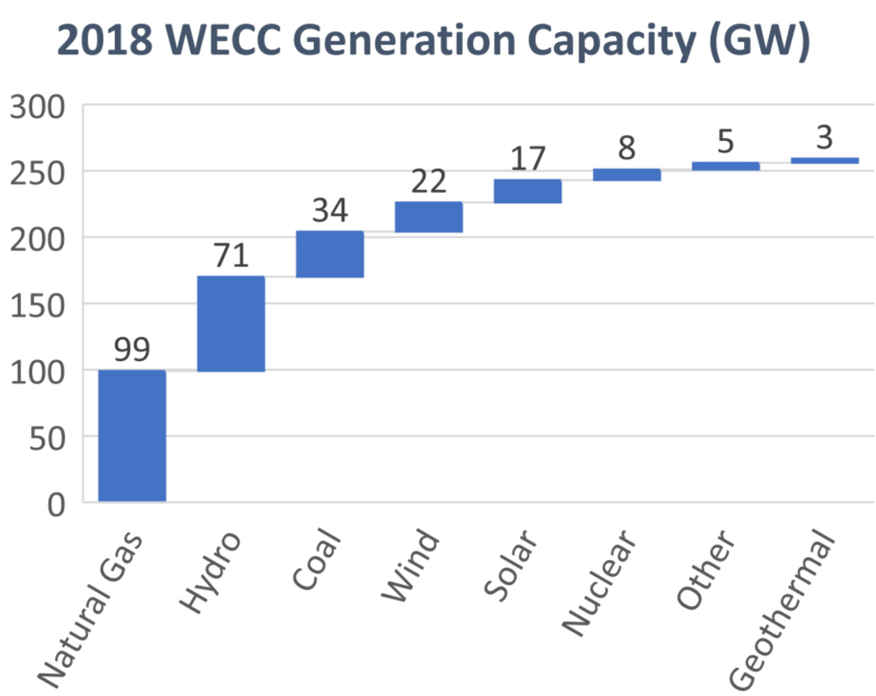
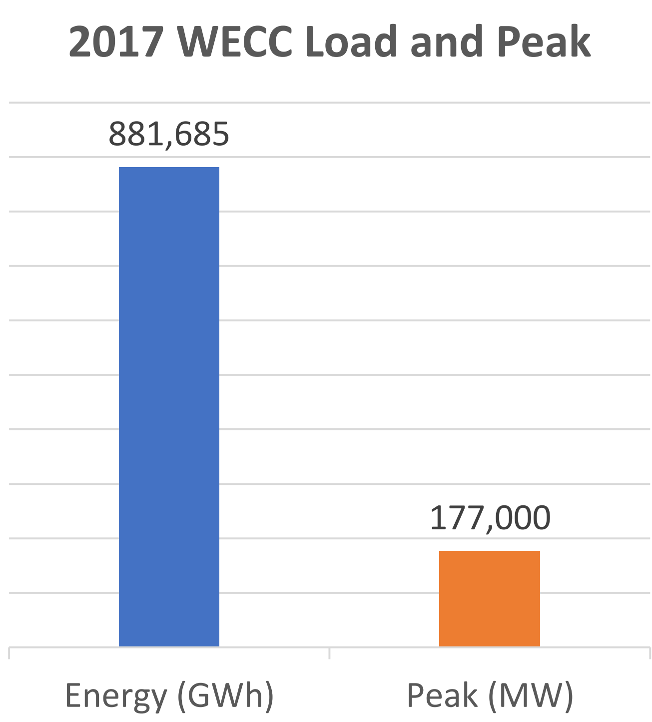
In 2018, the combined nameplate capacity of all utility-scale resources in the WECC was 258 GW.

Approximately 1,300 MW of wind and solar capacity were added and natural gas capacity increased by 900 MW.





WECC Load Forecast

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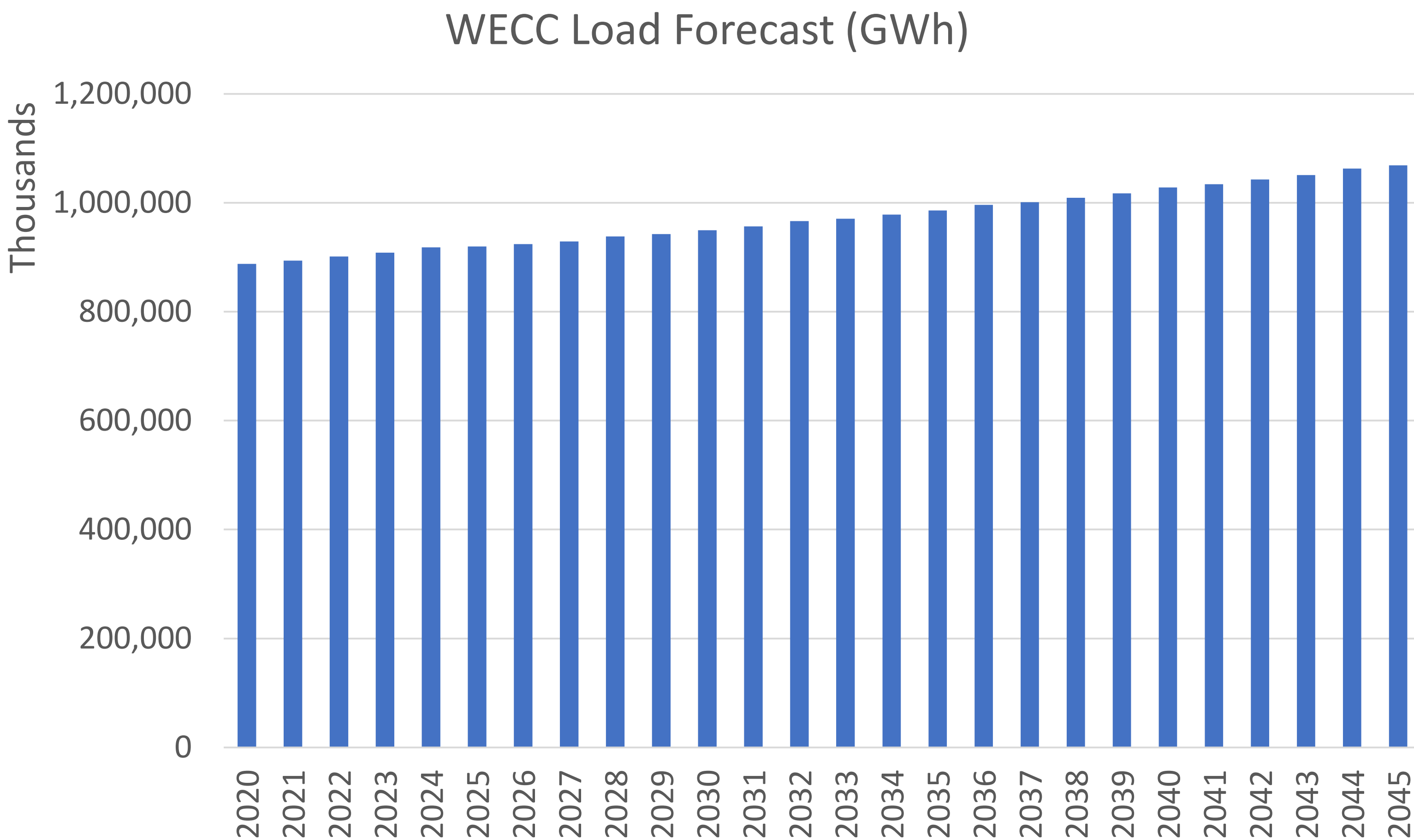

*Average annual load growth of 0.7%

WECC 2045 Resource Buildout

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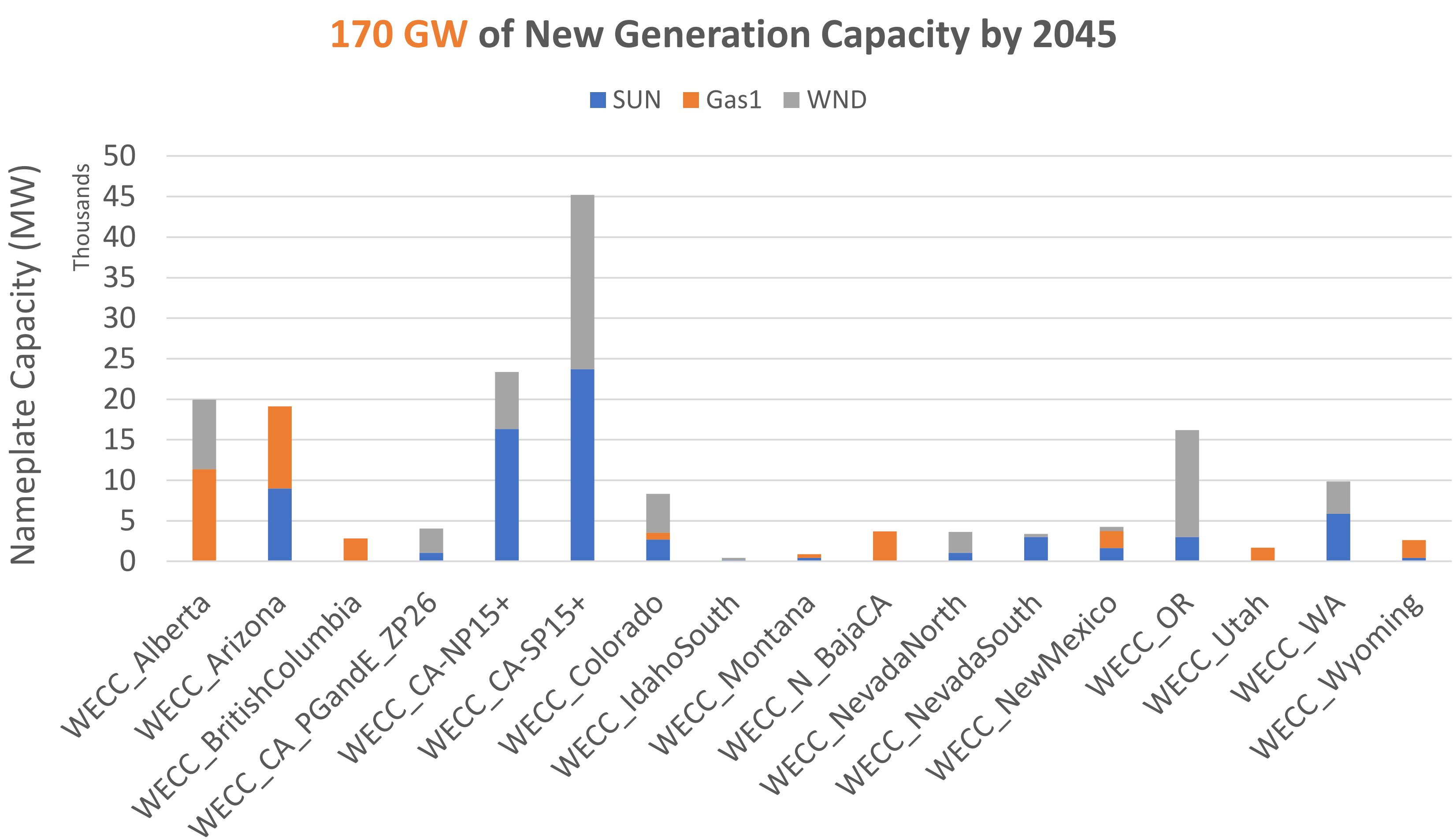

135 GW Renewables

35 GW Gas

*1.3 GW of Battery Energy Storage Assumed (CA mandate)

WECC 2045 Economic Retirement

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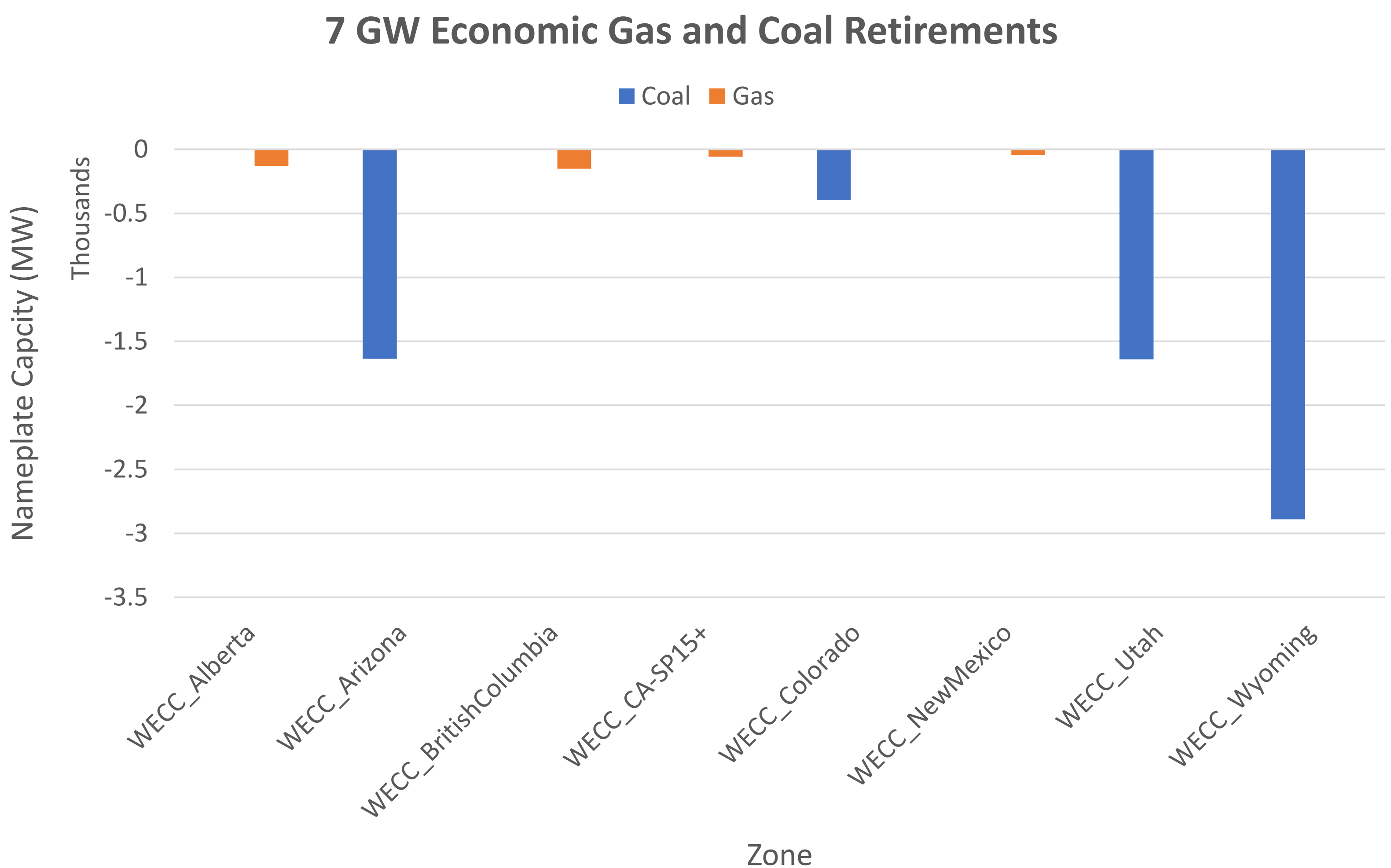

6600 MW Coal (not including 7GW of announced early retirements)
400 MW Gas

WECC BUILDOUT

WECC Emissions

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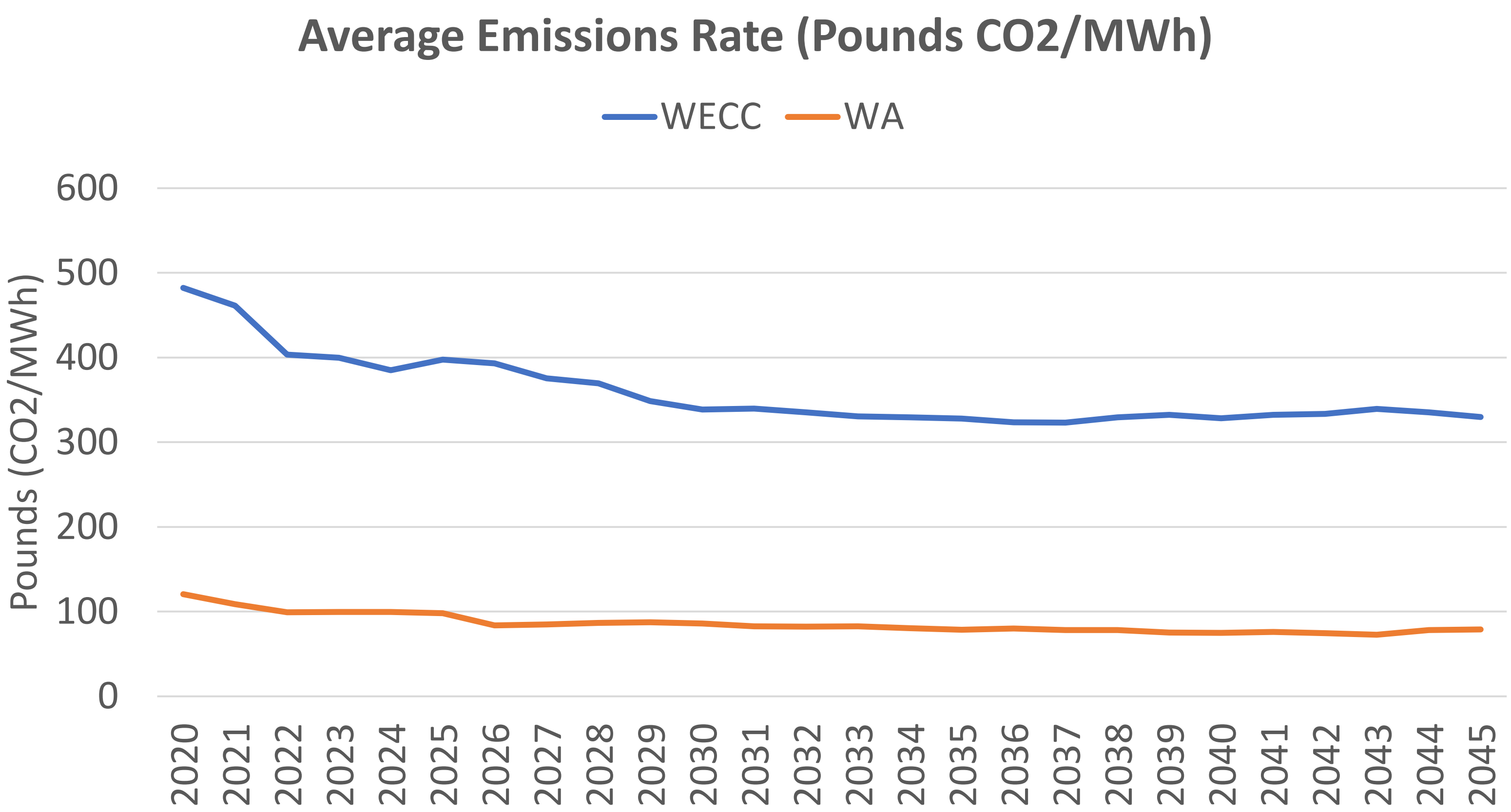

32% reduction in WECC emissions rate by 2045
35% reduction in WA emissions rate by 2045

WECC BUILDOUT

What does the Aurora model say?

Price Forecast

Average Annual Price Forecast

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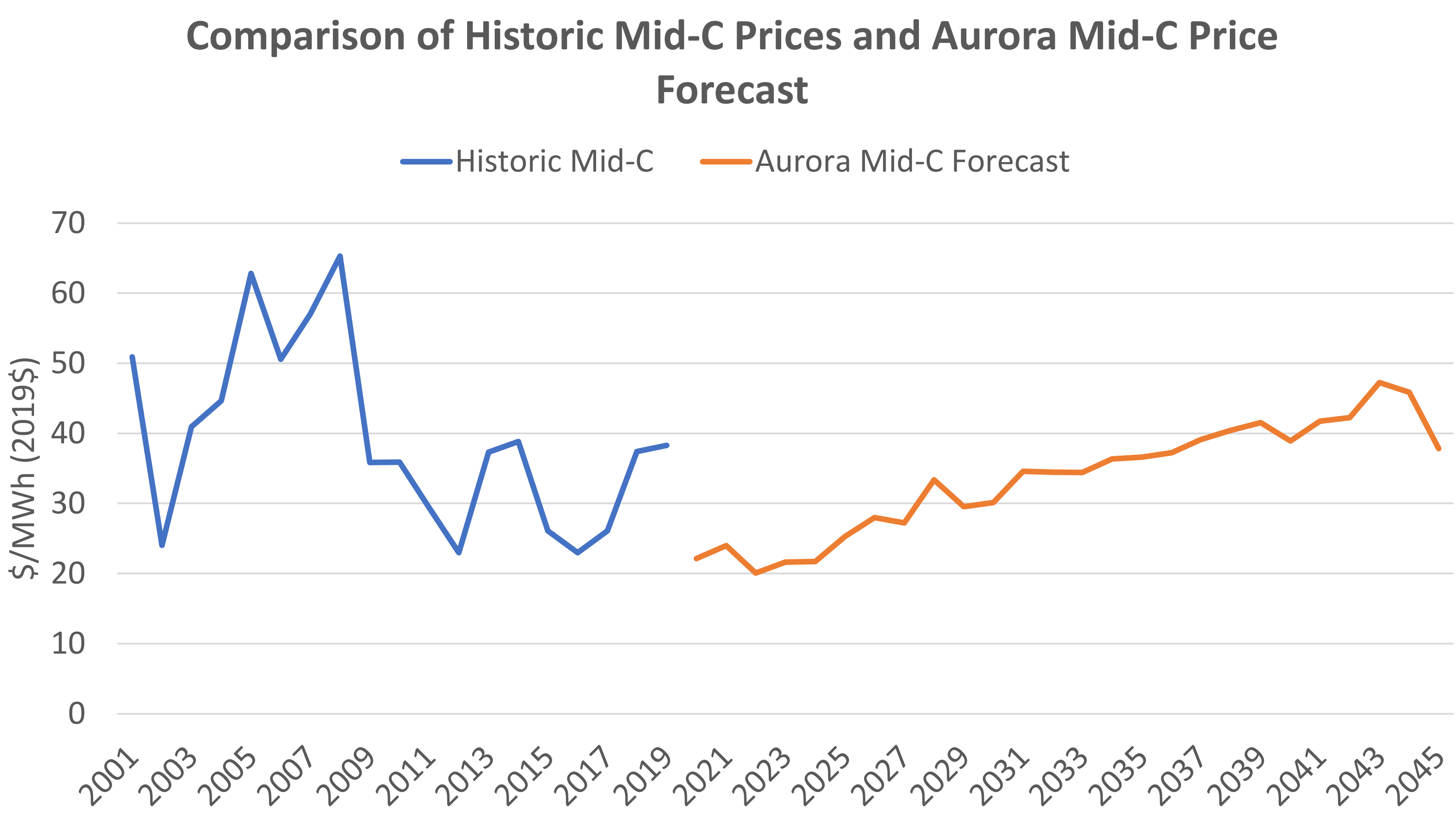

Hourly Price Forecast Volatility

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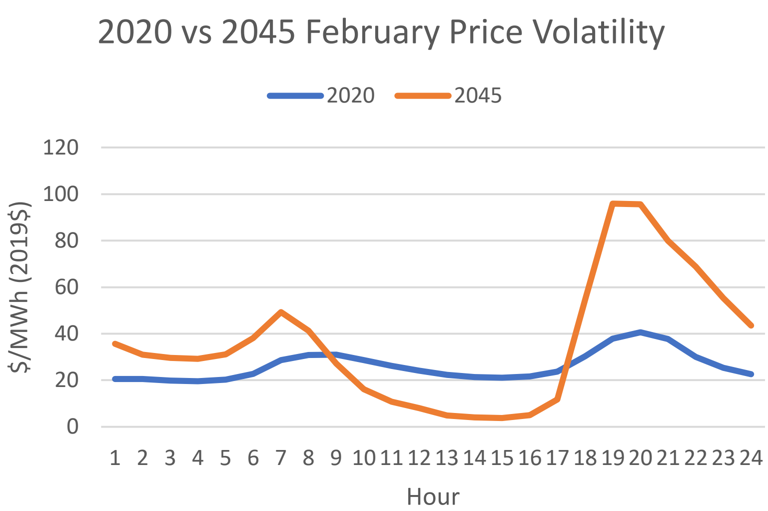

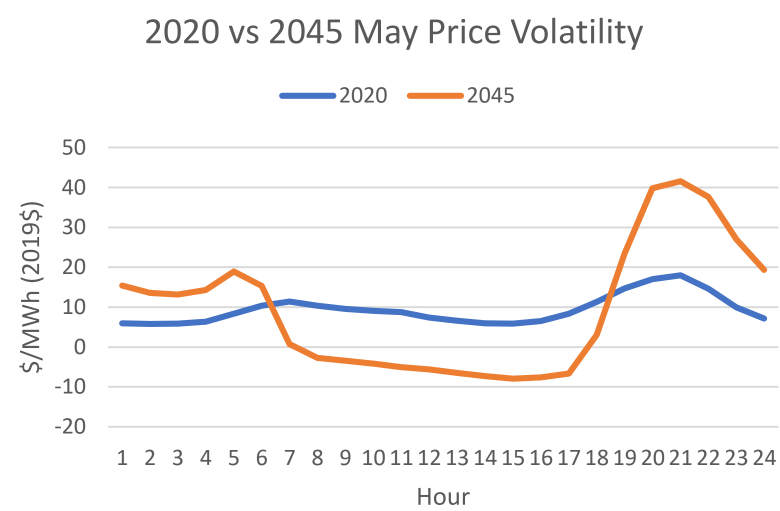

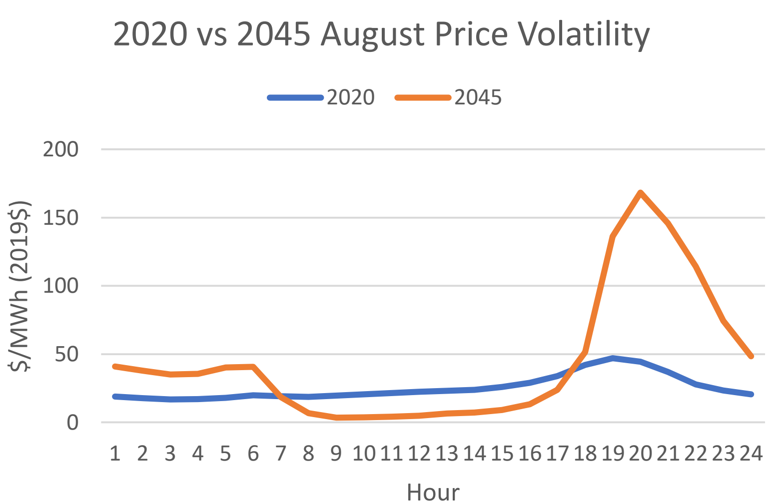

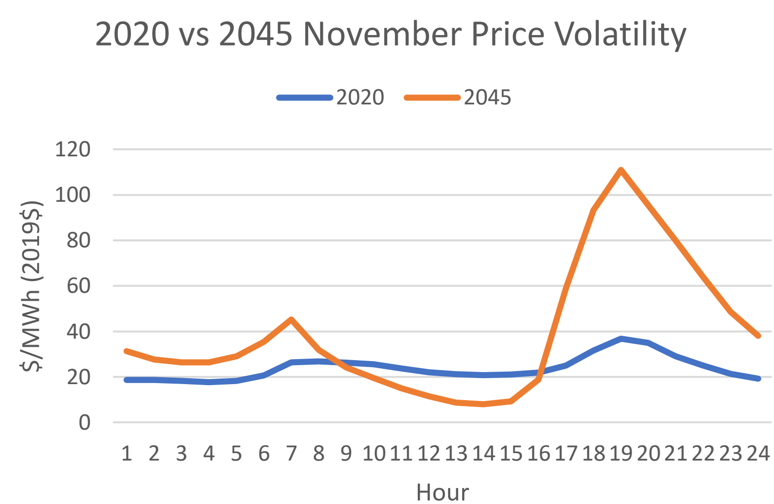

PRICE FORECAST

Preliminary Scenarios

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Reminder from Last Time

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Scenarios	Random Variability
Base Case • Business-as-usual load forecast • Existing laws and trends	Run many simulations with different weather & prices
Alternative Scenario 1 • Alternative set of assumptions 1	Run many simulations with different weather & prices
Alternative Scenario 2 • Another alternative set of assumptions 2	Run many simulations with different weather & prices

PRELIMINARY SCENARIOS

Survey Results

Changes to Tacoma Power Service Area

LOCAL CHANGES	Employees	%	Working Group	%
Population growth	17	77%	5	71%
Acceleration of electric vehicle adoption	13	59%	4	57%
Changing energy usage patterns due to climate change	11	50%	4	57%
Economic growth	8	36%	3	43%
Economic decline	2	9%	2	29%
Even more efficient energy-using equipment	10	45%	1	14%
Addition of new large load(s)	7	32%	1	14%
Loss of large load(s)	5	23%	1	14%
Increased use of natural gas for heating	2	9%	1	14%
Increased adoption of rooftop solar	2	9%	1	14%
Infrastructure inadequacies (water & sewer)		0%	1	14%
Increased use of electricity for heating	6	27%	0	0%
Population decline	0	0%	0	0%
Policy changes forcing electrification	1	5%		0%
Continued gentrification and housing issues	1	5%		0%
Economic uncertainty	1	5%		0%
Utilities becoming more energy integrators than power suppliers	1	5%		0%
Figuring out how to use lots of power between 10AM and 2PM	1	5%		0%

General agreement that growth is likely

PRELIMINARY SCENARIOS

Survey Results

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Policy Changes

City, County or Statewide Law	Employee Survey	%	Stakeholder Survey	%
All new buildings must be built with EV chargers	14	64%	6	86%
All new buildings must be "solar-ready"	3	14%	4	57%
Adoption of a national or statewide tax on carbon	14	64%	3	43%
City, county or statewide requirement that all ships docked at Port of Tacoma run on electricity rather than diesel while docked	13	59%	3	43%
Adoption of a national or statewide cap and trade program for carbon	11	50%	3	43%
City, county or statewide ban on natural gas in new homes	8	36%	2	29%
Clean Fuel Standard		0%	1	14%
Moratorium on fracking	1	5%		0%
IOUs become public and controlled by the federal government	1	5%		0%
RA compliance laws	1	5%		0%
Early retirement of CGS	1	5%		0%

Some agreement that vehicle/port electrification policies and a price on carbon are likely.

Employee Survey Results

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What are the biggest changes that we will see in the power industry over the next 20 years?

Types of Change	Number of Responses
Technological solutions to integrating renewables	8
Changing markets	6
Electrification	5
Acceleration of green policies/laws	5
DERs (Rooftop Solar, Home Batteries, etc.)	3
Climate change impacts on our hydro projects	3
Policies outside of WA that are bad for Tacoma Power	3
Reductions in consumption	3
Reliability challenges due to more renewables	3
More renewables	2
Changing customer expectations for information & products	2
Cybersecurity	1
Transmission constraints for Tacoma Power	1
Increased AC	1
Natural gas price increases	1

Write-in Scenarios

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Employee Survey

Large solar projects/PURPA puts (1MW+)
Would be good to see climate goals & Tacoma EAP considered in resource planning
Power industry is nationalized
Massive electrification
No transmission into & out of Tacoma due to BPA changes to OATT practices & policies
Cybersecurity costs become high
Increased drought events (frequency & duration)
Transmission constraints in Puget Sound as portfolios become more varied
Increased expectation that Tacoma Power lead the way on citywide GHG reduction
Reduced liquidity due to EIM participation

Working Group Survey

Energy storage, intelligent controls & utility process/controls that easily integrate renewables
Infrastructure inadequacies (water & sewer)

Critical Uncertainties

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Resource Adequacy

- Loads
- Water supply
- Energy supply from contracted resources (BPA, etc.)

Portfolio Costs

- Market price levels
- Market price volatility
- Generation costs
- Contract costs

Drivers of Scenarios

Carbon Emissions/ CETA compliance

- Market emissions rate
- CETA rules for spot market purchases

Employee Survey Results

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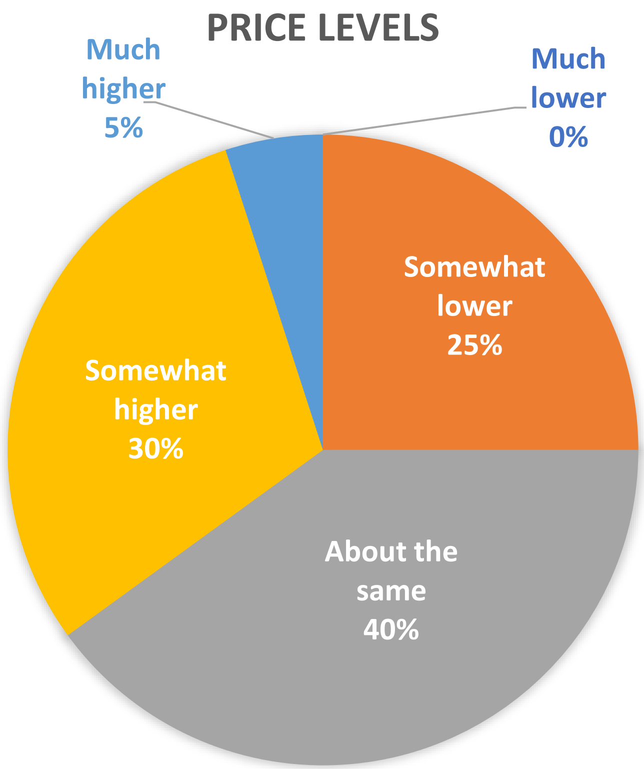
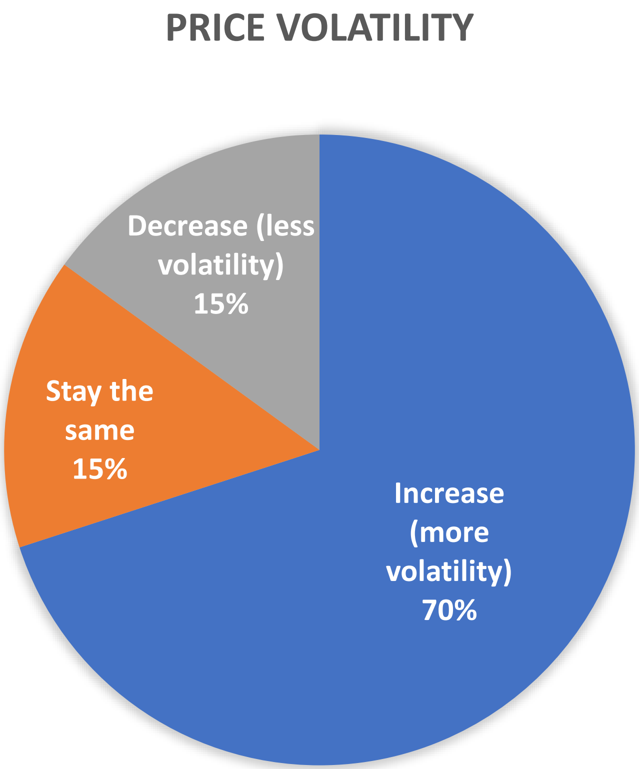
How will prices change by 2040?





PRELIMINARY SCENARIOS

Creating Scenarios

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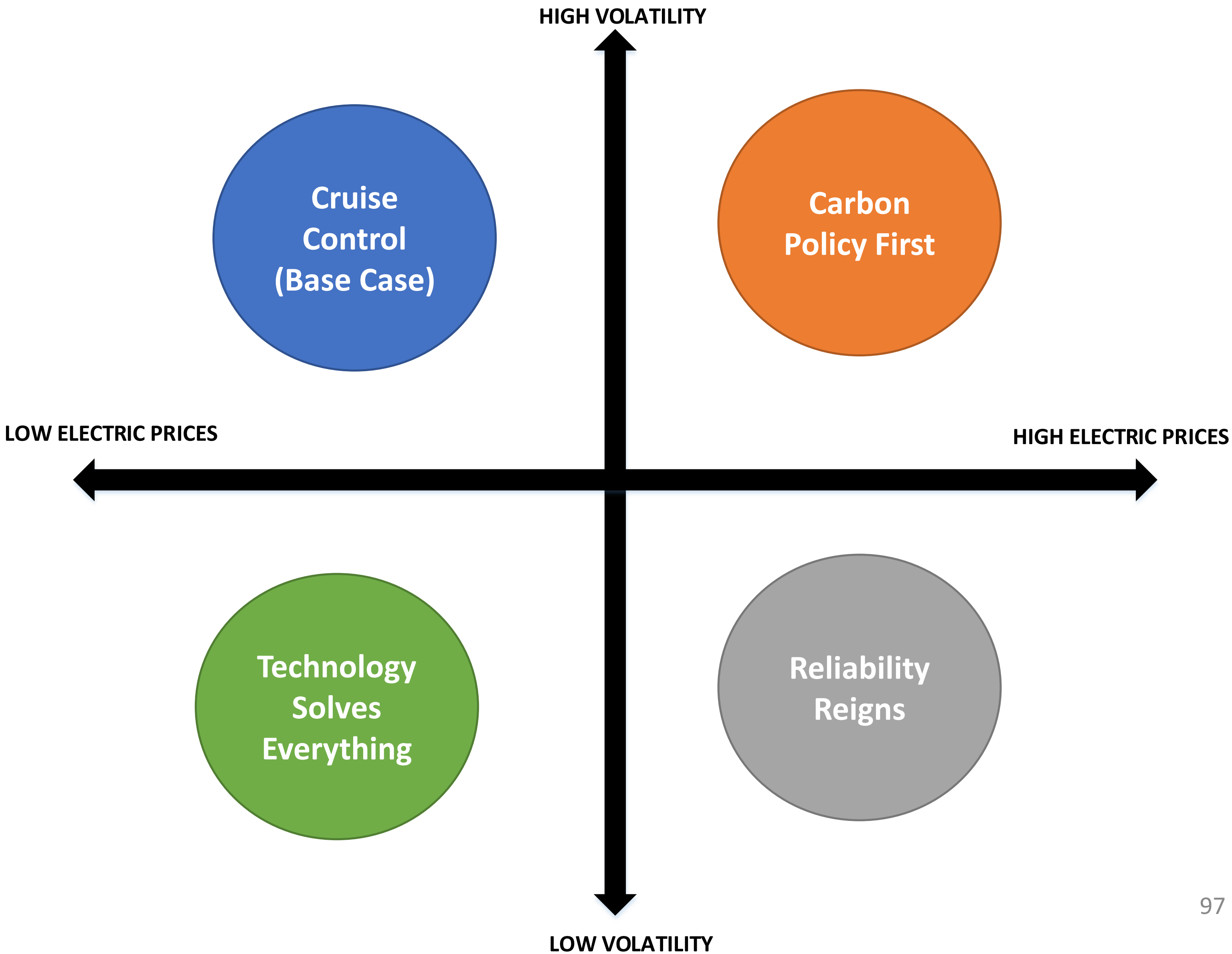
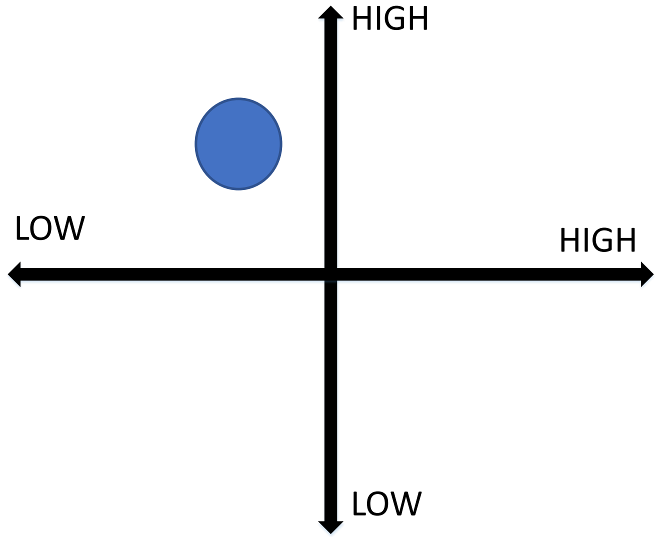


PRELIMINARY SCENARIOS

“Cruise Control” (Base Case)

What does the world look like?

Business as usual. Policies as they exist today with no additional changes. Standard forecasts of loads, storage and renewables costs.



DEMAND

Utility load forecasts

RENEWABLES

Prices similar to current forecasts

STORAGE

Prices similar to current forecasts

CARBON POLICY

Existing policies

NATURAL GAS

Prices similar to current forecasts

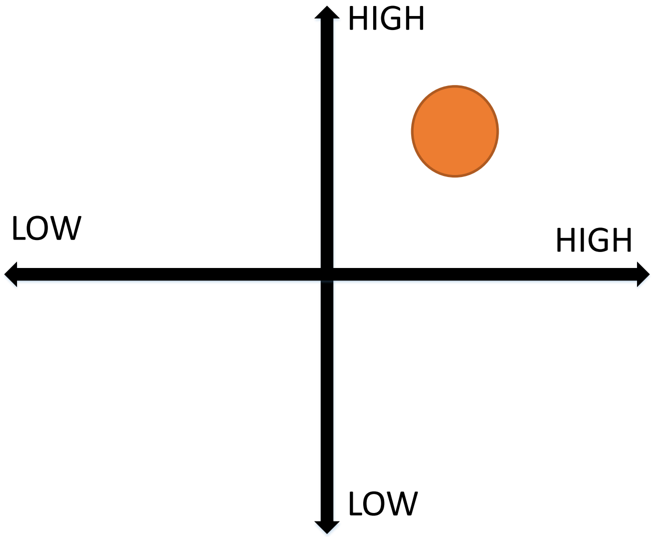
COAL RETIREMENTS

Announced retirements + economic retirements

"Carbon Policy First"

What does the world look like?

Carbon reduction policies are extremely strong and spread to almost every state in the WECC. Policies are numerous, fast approaching, costly to implement, and there is a very limited opportunity for new thermal generation buildout. In fact, carbon taxes force existing thermal generation to economically retire. International carbon reduction policies have resulted in substantial increases in liquefied natural gas (LNG) exports, which cause natural gas prices to rise and expose markets to more volatility.



DEMAND

Electrification without widespread demand management

RENEWABLES

Prices similar to current forecasts

STORAGE

Costs remain high

CARBON POLICY

Carbon taxes in NW

NATURAL GAS

High prices due to international competition for supply

COAL RETIREMENTS

Accelerated

PRELIMINARY SCENARIOS

“Reliability Reigns”

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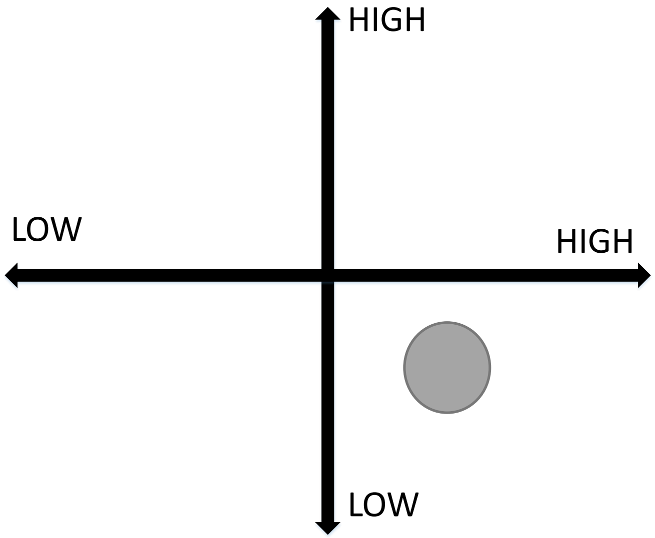
What does the world look like?

Poor planning and a series of unfortunate gas events lead to power shortages/outages and price extremes. Low income customers' access to power becomes a fundamental equity issue. With storage technology still expensive, policy makers decide to roll back clean energy policies (including RPS and Carbon Tax rules) in favor of more inexpensive and reliable resources.



DEMAND Electrification without widespread demand management	**RENEWABLES** Prices similar to current forecasts	**STORAGE** Costs remain high
CARBON POLICY Roll back of carbon policies around 2030	**NATURAL GAS** Prices similar to current forecasts	**COAL RETIREMENTS** Announced & economic retirements until 2030 only

PRELIMINARY SCENARIOS

“Technology Solves Everything”

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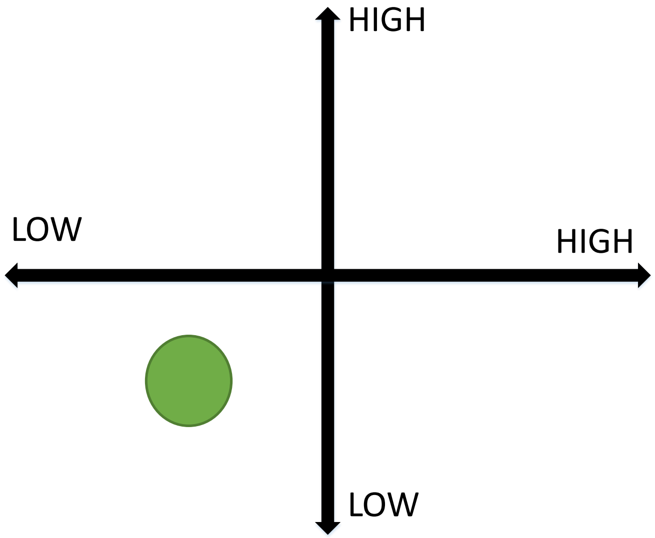
What does the world look like?

Low-cost solutions allow utilities to efficiently and cost-effectively integrate large quantities of renewable resources. This includes demand-side resources optimized for grid integration (electric vehicles, demand response, large flexible loads, etc.) and supply-side resources like storage. Because of the diversity of demand-side resources and significant investments in renewables, energy market prices are both stable and low.



DEMAND	**RENEWABLES**	**STORAGE**
Strong reliance on demand-side resources	Accelerated decline in costs	Low cost Substantial buildout

CARBON POLICY	**NATURAL GAS**	**COAL RETIREMENTS**
Existing policies	Low gas prices due to low demand for natural gas	Announced & economic retirements

PRELIMINARY SCENARIOS

Next Steps and Action Items

What are we covering next?

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Workshop Plan

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Background Information → Key Inputs & Assumptions → Current Resources and Future Options → Preferred Alternative and Action Items

Workshop 1

IRP Overview

Workshop 2

Present key inputs

Present and discuss metrics

Present and discuss scenarios

Workshop 3

Review current situation

Present and discuss resource alternatives

Workshop 4

Present analysis results

Present and discuss preferred portfolio

Discuss action items

Workshop 3

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Current Resource Performance and Future Options

Scenarios
- Buildout & Prices in Alternative Scenarios

Resources
- Performance of Current Portfolio
- Resource Options