2021 Electric Integrated Resource Plan

Technical Advisory Committee Meeting No. 3 Agenda

Tuesday, September 29, 2020
Virtual Meeting

Topic	**Time**	**Staff**
Introductions	9:00	Lyons
IRP Transmission Planning Studies	9:15	Spratt
Break	10:15	
Distribution Planning within the IRP	10:30	Fisher
Lunch	11:30	
Demand Response Potential Assessment	12:30	AEG
Break	1:30	
Conservation Potential Assessment	1:45	AEG
Electric Market Forecasts	2:45	Gall
Portfolio Scenarios	3:30	Lyons
Adjourn	4:00	

→ Join Skype Meeting

Trouble Joining? Try Skype Web App

Join by phone

509-495-7222 (Spokane) English (United States)

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Conference ID: 67816

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2021 Electric IRP
TAC Introductions and IRP Process Updates

John Lyons, Ph.D.

Third Technical Advisory Committee Meeting
September 29, 2020

Updated Meeting Guidelines

- Electric IRP team still working remotely, available by email and phone for questions and comments
- Some processes are taking longer remotely
- Virtual IRP meetings until back in the office and able to hold large group meetings
- Joint Avista IRP page for gas and electric: https://www.myavista.com/about-us/integrated-resource-planning

Virtual TAC Meeting Reminders

- Please mute mics unless speaking or asking a question
- Use the Skype chat box to write questions or comments or let us know you would like to say something
- Respect the pause
- Please try not to speak over the presenter or a speaker who is voicing a question or thought
- Remember to state your name before speaking for the note taker
- This is a public advisory meeting – presentations and comments will be recorded and documented

Integrated Resource Planning

- Required by Idaho and Washington* every other year
- Guides resource strategy over the next twenty + years
- Current and projected load & resource position
- Resource strategies under different future policies
  - Resource choices
  - Conservation measures and programs
  - Transmission and distribution integration for electric
  - Gas distribution planning
  - Gas and electric market price forecasts
- Scenarios for uncertain future events and issues
- Key dates for modeling and IRP development are available in the Work Plans

Technical Advisory Committee

- The public process piece of the IRP – input on what to study, how to study, and review of assumptions and results
- Wide range of participants involved in all or parts of the process
  - Ask questions
  - Help with soliciting new members
- Open forum while balancing need to get through all of the topics
- Welcome requests for studies or different assumptions.
  - Time or resources may limit the number or type of studies
  - Earlier study requests allow us to be more accommodating
  - **August 1, 2020** was the electric study request deadline
- Planning teams are available by email or phone for questions or comments between the TAC meetings

2021 Electric IRP TAC Schedule

- TAC 1: Thursday, June 18, 2020
- TAC 2: Thursday, August 6, 2020 (Joint with Natural Gas TAC)
- TAC 2.5: Tuesday, August 18, 2020 Economic and Load Forecast
- **TAC 3: Tuesday, September 29, 2020**
- TAC 4: Tuesday, November 17, 2020
- TAC 5: Thursday, January 21, 2021
- Public Outreach Meeting: February 2021
- TAC agendas, presentations, meeting minutes and IRP files available at:

  https://myavista.com/about-us/integrated-resource-planning

Process Updates

IRP data available on the web site:

- Avista Resource Emissions Summary
- Load Forecast
- CPA Measures
- Avista 2020 Electric CPA – Summary and IRP Inputs
- Home Electrification Conversions
- Named Populations
- Natural Gas Prices
- Social Cost of Carbon

Today's TAC Agenda

9:00	Introductions, Lyons
9:15	IRP Transmission Planning Studies, Spratt
10:15	Break
10:30	Distribution Planning within the IRP, Fisher
11:30	Lunch
12:30	Demand Response Potential Assessment, AEG
1:30	Break
1:45	Conservation Potential Assessment, AEG
2:45	Electric Market Forecasts, Gall
3:30	Portfolio Scenarios, Lyons
4:00	Adjourn

Integrated Resource Plan (IRP) Transmission Planning Studies

Dean Spratt, Transmission Planning

Third Technical Advisory Committee Meeting

September 29, 2020

FERC Standards of Conduct

Non-public transmission information can not be shared with Avista Merchant Function employees

There are Avista Merchant Function employees attending today

We will not be sharing any non-public transmission information. Avista's OASIS is where this information is made public

Agenda

- Introduction to Avista System Planning
  - Useful information about Transmission Planning
  - Recent Avista projects

- Generation Interconnection Study Process
  - Integrated Resource Plan (IRP) Requests
  - Large Generation Interconnection Queue

Introduction to Avista System Planning

Avista's System Planning Group includes:

- Asset Performance and Management
- Distribution Planning
- Transmission Planning
  - Focus on reliable electric service
    - Federal, regional, and state compliance
    - Regional system coordination
  - Provide transmission service and system analysis
    - Planned load growth and changing generation dispatch
    - Interconnection of any type of generation or load
      - We are ambivalent about type (must perform though)

Information About Transmission Planning

- We care about the Bulk Electric System (BES)
  - Our 115 kV and 230 kV facilities (>100 kV)
- We identify issues where the Avista BES won't reliably deliver power to our customers
- Then put together plans to fix it
  - "Corrective Action Plans"
  - Mandated and described in NERC TPL-001-4
- We live in the world of NERC Mandatory Standards
  - Energy Policy Act of 2005

TPL-001-4

- Describes outage conditions we must study
  - P0: everything online and working
  - P1: single facility outages, like a transformer
  - P2, P4, P5 & P7: multiple facility outages
  - P3 & P6: overlapping combination of two facilities

Standard TPL-001-4 — Transmission System Planning Performance Requirements

Table 1 – Steady State & Stability Performance Planning Events

Steady State & Stability:

a. The System shall remain stable. Cascading and uncontrolled islanding shall not occur.
b. Consequential Load Loss as well as generation loss is acceptable as a consequence of any event excluding P0.
c. Simulate the removal of all elements that Protection Systems and other controls are expected to automatically disconnect for each event.
d. Simulate Normal Clearing unless otherwise specified.
e. Planned System adjustments such as Transmission configuration changes and re-dispatch of generation are allowed if such adjustments are executable within the time duration applicable to the Facility Ratings.

Steady State Only:

f. Applicable Facility Ratings shall not be exceeded.
g. System steady state voltages and post-Contingency voltage deviations shall be within acceptable limits as established by the Planning Coordinator and the Transmission Planner.
h. Planning event P0 is applicable to steady state only.
i. The response of voltage sensitive Load that is disconnected from the System by end-user equipment associated with an event shall not be used to meet steady state performance requirements.

Stability Only:

j. Transient voltage response shall be within acceptable limits established by the Planning Coordinator and the Transmission Planner.

Category	Initial Condition	Event [1]	Fault Type [2]	BES Level [3]	Interruption of Firm Transmission Service Allowed [4]	Non-Consequential Load Loss Allowed
P0 No Contingency	Normal System	None	N/A	EHV, HV	No	No
P1 Single Contingency	Normal System	Loss of one of the following: 1. Generator 2. Transmission Circuit 3. Transformer [5] 4. Shunt Device [6]	3Ø	EHV, HV	No[9]	No[12]
		5. Single Pole of a DC line	SLG			
P2 Single Contingency	Normal System	1. Opening of a line section w/o a fault [7]	N/A	EHV, HV	No[9]	No[12]
		2. Bus Section Fault	SLG	EHV	No[9]	No
				HV	Yes	Yes
		3. Internal Breaker Fault [8] (non-Bus-tie Breaker)	SLG	EHV	No[9]	No
				HV	Yes	Yes
		4. Internal Breaker Fault (Bus-tie Breaker) [8]	SLG	EHV, HV	Yes	Yes

Standard TPL-001-4 — Transmission System Planning Performance Requirements

Category	Initial Condition	Event [1]	Fault Type [2]	BES Level [3]	Interruption of Firm Transmission Service Allowed [4]
P3 Multiple Contingency	Loss of generator unit followed by System adjustments[9]	Loss of one of the following: 1. Generator 2. Transmission Circuit 3. Transformer [5] 4. Shunt Device [6]	3Ø	EHV, HV	No[9]
		5. Single pole of a DC line	SLG		
P4 Multiple Contingency *(Fault plus stuck breaker[10])*	Normal System	Loss of multiple elements caused by a stuck breaker [10](non-Bus-tie Breaker) attempting to clear a Fault on one of the following: 1. Generator 2. Transmission Circuit 3. Transformer [5] 4. Shunt Device [6] 5. Bus Section	SLG	EHV	No[9]
				HV	Yes
		6. Loss of multiple elements caused by a stuck breaker[10] (Bus-tie Breaker) attempting to clear a Fault on the associated bus	SLG	EHV, HV	Yes
P5 Multiple Contingency *(Fault plus relay failure to operate)*	Normal System	Delayed Fault Clearing due to the failure of a non-redundant relay[13] protecting the Faulted element to operate as designed, for one of the following: 1. Generator 2. Transmission Circuit 3. Transformer [5] 4. Shunt Device [6] 5. Bus Section	SLG	EHV	No[9]
				HV	Yes
P6 Multiple Contingency *(Two overlapping singles)*	Loss of one of the following followed by System adjustments.[9] 1. Transmission Circuit 2. Transformer [5] 3. Shunt Device[6] 4. Single pole of a DC line	Loss of one of the following: 1. Transmission Circuit 2. Transformer [5] 3. Shunt Device [6]	3Ø	EHV, HV	Yes
		4. Single pole of a DC line	SLG	EHV, HV	Yes

TPL-001-4, cont.

- A couple of NERC directives for the above faults
  - "The System shall remain stable"
    - Cascading and uncontrolled islanding shall not occur
  - "Applicable Facility Ratings shall not be exceeded"
    - Equipment ratings, voltage, fault duty, etc
  - "An objective of the planning process is to minimize the likelihood and magnitude of Non-Consequential Load Loss following planning events"

Two Approaches to Reliability Issues

- Transmission Operations (TO) are guided by *significantly* different standards than Transmission Planning (TP).
- TO standards provide *flexibility* that TP standards do not allow
  - Operators can push system limits to ***SAVE*** the interconnected system
    - Shed load, overload equipment, etc – all short term
    - The planned system should give them the tools to do this
    - Standards continue to define this balance

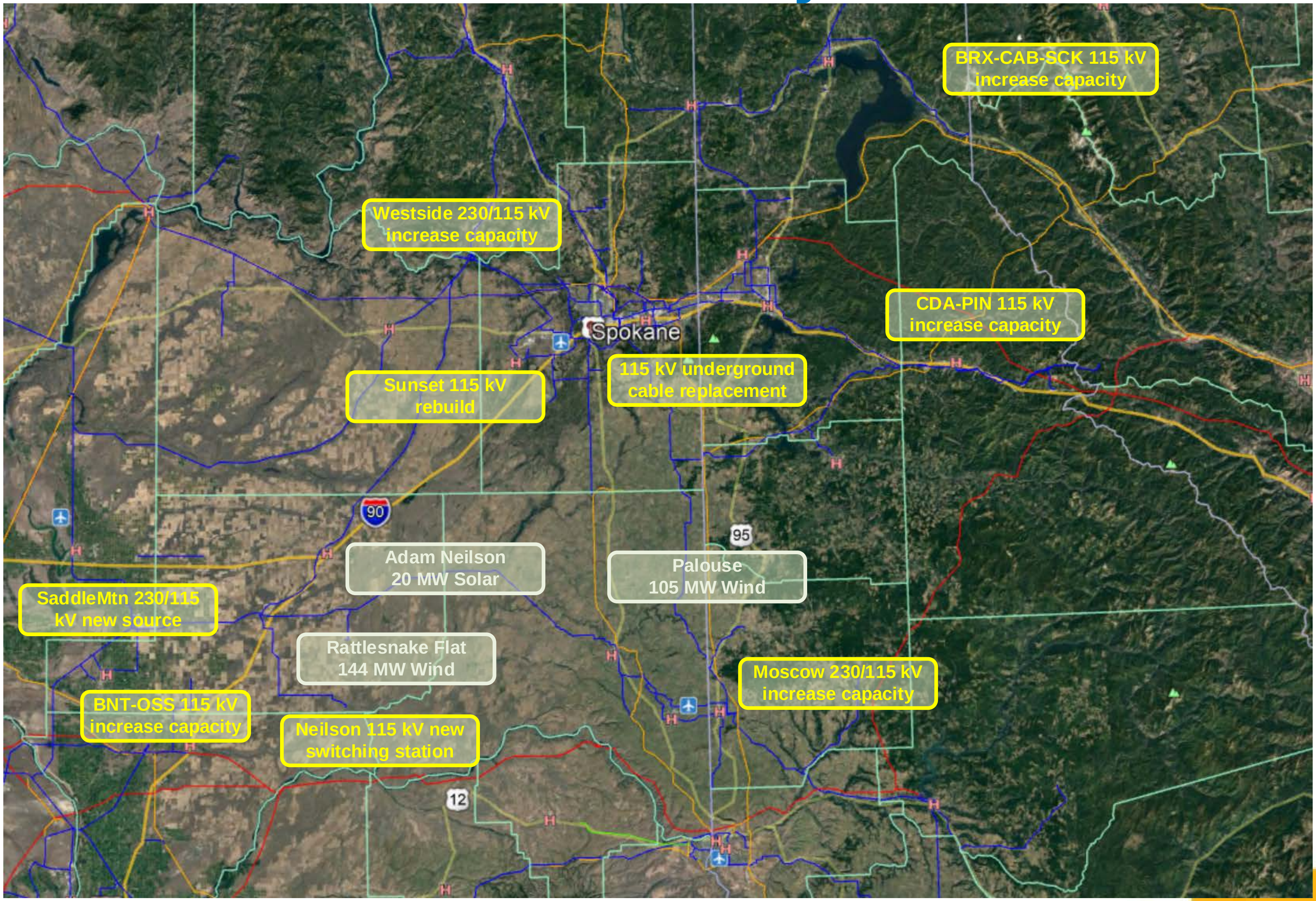
Standards are a Roadmap

Changes in equipment, analysis tools, experience, and expectations impact Avista's study process and results

**WSCC DISTURBANCE-PERFORMANCE TABLE
OF ALLOWABLE EFFECT ON OTHER SYSTEMS[1]**

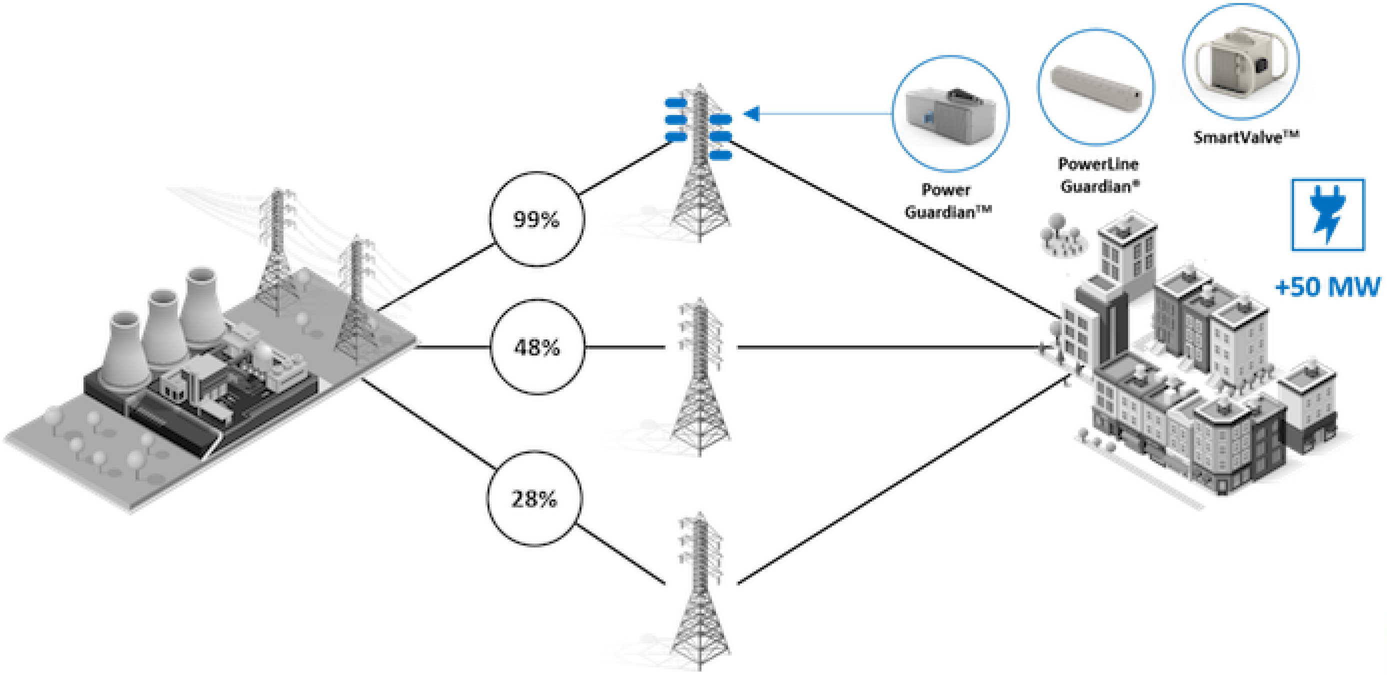
Performance Level	Disturbance(2) Initiated By: No Fault 3 Ø Fault With Normal Clearing SLG Fault With Delayed Clearing DC Disturbance (3)	Transient Voltage Dip Criteria (4)(5)(6)	Minimum Transient Frequency (4)(5)	Post Transient Voltage Deviation (4)(5)(6)(7)	Loading Within Emergency Ratings	Damping
A	Generator One Circuit One Transformer DC Monopole (8)	Max V Dip - 25% Max Duration of V Dip Exceeding 20% - 20 cycles	59.6 hz Duration of f Below 59.6 hz - 6 cycles	5%	Yes	>0
B	Bus Section	Max V Dip - 30% Max Duration of V Dip Exceeding 20% - 20 cycles	59.4 hz Duration of f Below 59.4 hz - 6 cycles	5%	Yes	>0
C	Two Generators Two Circuits DC Bipole (8)	Max V Dip - 30% Max Duration of V Dip Exceeding 20% - 40 cycles	59.0 hz Duration of f Below 59.0 hz - 6 cycles	10%	Yes	>0
D	Three or More circuits on ROW Entire Substation Entire Plant Including Switchyard	Max V Dip - 30% Max Duration of V Dip Exceeding 20% - 60 cycles	58.1 hz Duration of f Below 58.1 hz - 6 cycles	10%	No	≥0

Recent Transmission Projects



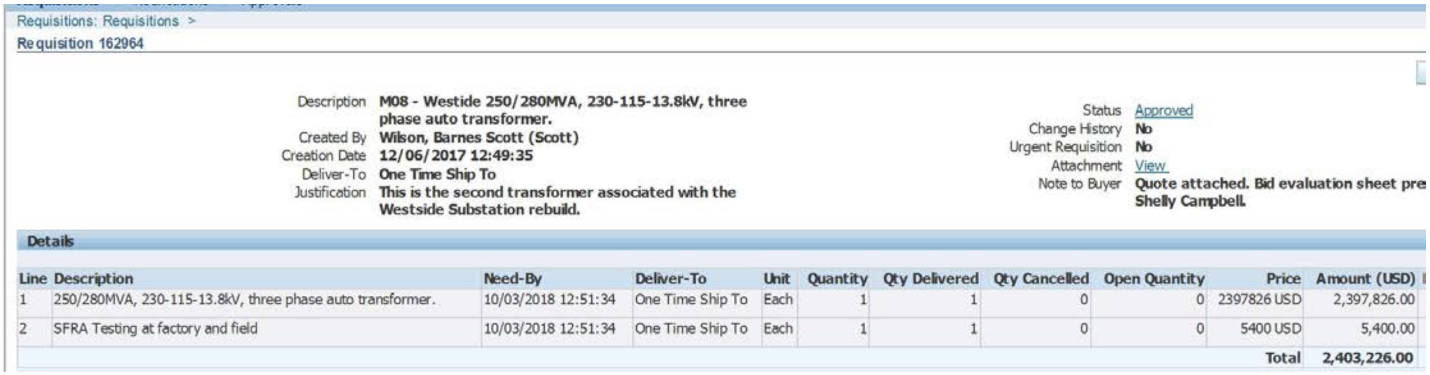
Non Wire Solutions are Evaluated

- We are documenting this with more clarity
- Non-wire options require robust wires to perform
  - Avista is working on the transmission fundamentals



Evaluated Batteries for T-1-1

- TPL-001-4 ~ T-1-1 for long lead equipment
  - Double transformer outages
    - Shawnee 230/115 kV outage followed by a:
      - Concurrent outage of Moscow 230/115 kV
  - Could we mitigate performance issues with storage?
    - Yes…but…
      - We would need a 125 MW battery
        - » Charge is 8 hours, discharge for 12 to 16 hours (outage is weeks to months)
      - A third transformer is a better solution
        - » Robust performance and much less $$$$



Requisitions: Requisitions >

Requisition 162964

Description: M08 - Westide 250/280MVA, 230-115-13.8kV, three phase auto transformer.
Created By: Wilson, Barnes Scott (Scott)
Creation Date: 12/06/2017 12:49:35
Deliver-To: One Time Ship To
Justification: This is the second transformer associated with the Westside Substation rebuild.

Status: Approved
Change History: No
Urgent Requisition: No
Attachment: View
Note to Buyer: Quote attached. Bid evaluation sheet pre Shelly Campbell.

Details

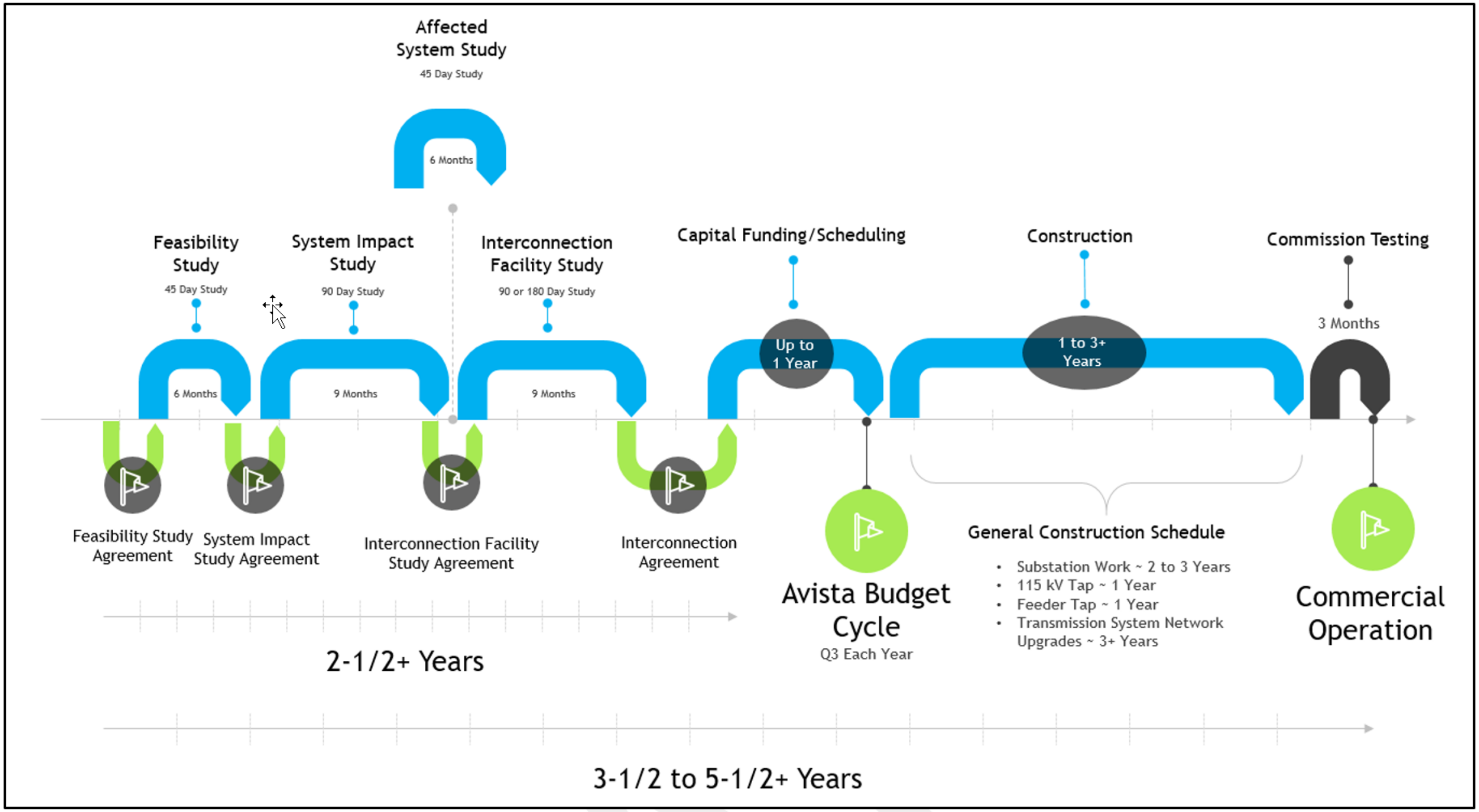
Line	Description	Need-By	Deliver-To	Unit	Quantity	Qty Delivered	Qty Cancelled	Open Quantity	Price	Amount (USD)
1	250/280MVA, 230-115-13.8kV, three phase auto transformer.	10/03/2018 12:51:34	One Time Ship To	Each	1	1	0	0	2397826 USD	2,397,826.00
2	SFRA Testing at factory and field	10/03/2018 12:51:34	One Time Ship To	Each	1	1	0	0	5400 USD	5,400.00
									Total	2,403,226.00

Generation Interconnection Study Process

Process for Generation Requests

- Two sources:
  - External developers
    - Enter via the OATT
  - Internal IRP requests
    - Feasibility Lite Study…then OATT
      - AVA Merchant MUST follow the OATT just like external parties
- Typical process:
  - Hold a scoping meeting to discuss particulars
  - Outline a study plan
  - Augment WECC approved cases for our studies
  - Analyze the system against the standards
  - Publish our findings and recommendations

Interconnection Study Timeline



Current Interconnection Queue

Generator Interconnection Applications								
Proj #	Date of Request	Status of Request	Service Type	Max Summer output	Max Winter output	Total (MW)	Projected In-Service Date	Type of facility
17	3/6/2009	Operational	ER	100	100	100.00	6/1/2011	Wind
46	10/6/2015	LGIA	NR	126	126	126.00		Wind
52	2/8/2017	LGIA	NR	100	100	100.00		Solar
53	4/11/2017	Operational	NR	19.2	19.2	19.2	12/15/2018	Solar
59	5/23/2018	SIS	NR/ER	116	116	116.00	6/1/2021	Solar & Storage
60	6/4/2018	IFS	ER	150	150	150.00	12/15/2022	Solar & Storage
61	6/4/2018	Withdrawn	NR	20	20	20.00	11/15/2019	Solar
62	6/8/2018	FS	NR/ER	123.2	123.2	123.20	11/30/2021	Wind
63	6/8/2018	FS	NR/ER	26	26	26.00	2/28/2023	Hydro
66	7/10/2018	FS	NR	71	71	71.00	7/1/2023	Wood Waste
67	8/27/2018	FS	NR/ER	80	80	80.00	6/30/2023	Solar
68	9/20/2018	FS	ER	750	750	750.00		Wind
69	9/20/2018	FS	ER	750	750	750.00		Wind
70	8/31/2018	SIS	NR	2.5	2.5	2.50	1/1/2019	Energy Storage - Battery
71	10/4/2018	FS	NR	7	7	7.00	8/15/2020	Solar
72	10/9/2018	FS	NR/ER	80	80	80.00	6/30/2021	Solar
73	10/12/2018	FS	NR/ER	100	100	100.00	6/30/2020	Solar
74	11/16/2018	SIS	NR/ER	0.1	0.1	0.10	1/15/2019	Energy Storage - Battery
76	11/27/2018	FS	NR/ER	200	200	200.00	12/31/2020	Solar
77	12/4/2018	FS	NR/ER	5	5	5.00	12/31/2020	Solar
79	12/4/2018	FS	NR/ER	5	5	5.00	6/30/2020	Solar

Current Queue, continued

Generator Interconnection Applications								
Proj #	Date of Request	Status of Request	Service Type	Max Summer output	Max Winter output	Total (MW)	Projected In-Service Date	Type of facility
80	12/17/2018	FS	NR/ER	19	19	19.00	6/30/2020	Solar
81	12/18/2018	FS	NR/ER	94	94	94.00	6/30/2020	Solar
82	2/20/2019	FS	ER	600	600	600.00	12/31/2021	Wind
83	3/27/2019	FS	ER	300	300	300.15	10/31/2022	Wind
84	4/17/2019	FS	NR/ER	5	5	5.00	8/31/2020	Solar
85	4/17/2019	FS	NR/ER	5	5	5.00	8/31/2020	Solar
86	5/29/2019	New	NR/ER	20	20	20.00	12/31/2022	Solar
87	6/17/2019	New	NR	5	5	5.00	8/31/2021	Solar
88	6/17/2019	New	NR	5	5	5.00	8/31/2021	Solar
89	6/17/2019	New	NR	5	5	5.00	8/31/2021	Solar
90	6/17/2019	New	NR	5	5	5.00	8/31/2021	Solar
91	6/17/2019	New	NR	5	5	5.00	8/31/2021	Solar
92	6/17/2019	New	NR	5	5	5.00	8/31/2021	Solar
93	6/17/2019	New	NR	5	5	5.00	8/31/2021	Solar
94	6/17/2019	New	NR	5	5	5.00	8/31/2021	Solar
95	6/20/2019	New	NR/ER	600	600	600.00	12/1/2022	Wind
96	6/20/2019	New	NR/ER	400	400	400.00	12/1/2022	Wind
97	6/24/2019	FS	NR/ER	150	150	150.00	12/31/2021	Solar & Storage
98	8/29/2019	New	NR/ER	80	80	80.00	12/1/2023	Solar & Storage
99	9/6/2019	New	NR	200	200	200.00	12/31/2021	Solar & Storage
100	9/27/2019	New	NR/ER	100	100	100.00	12/31/2021	Solar & Storage
101	10/22/2019	FS	NR/ER	500	500	500.00	9/1/2024	Wind & Storage
102	11/5/2019	New	NR/ER	200	200	200.00	11/30/2022	Solar & Storage
103	12/10/2019	New	NR	19.25	19.25	19.25	3/31/2021	Solar
104	3/2/2020	New	NR/ER	120	120	120.00	12/31/2023	Wind

2021 IRP *Transmission* Cost Estimates

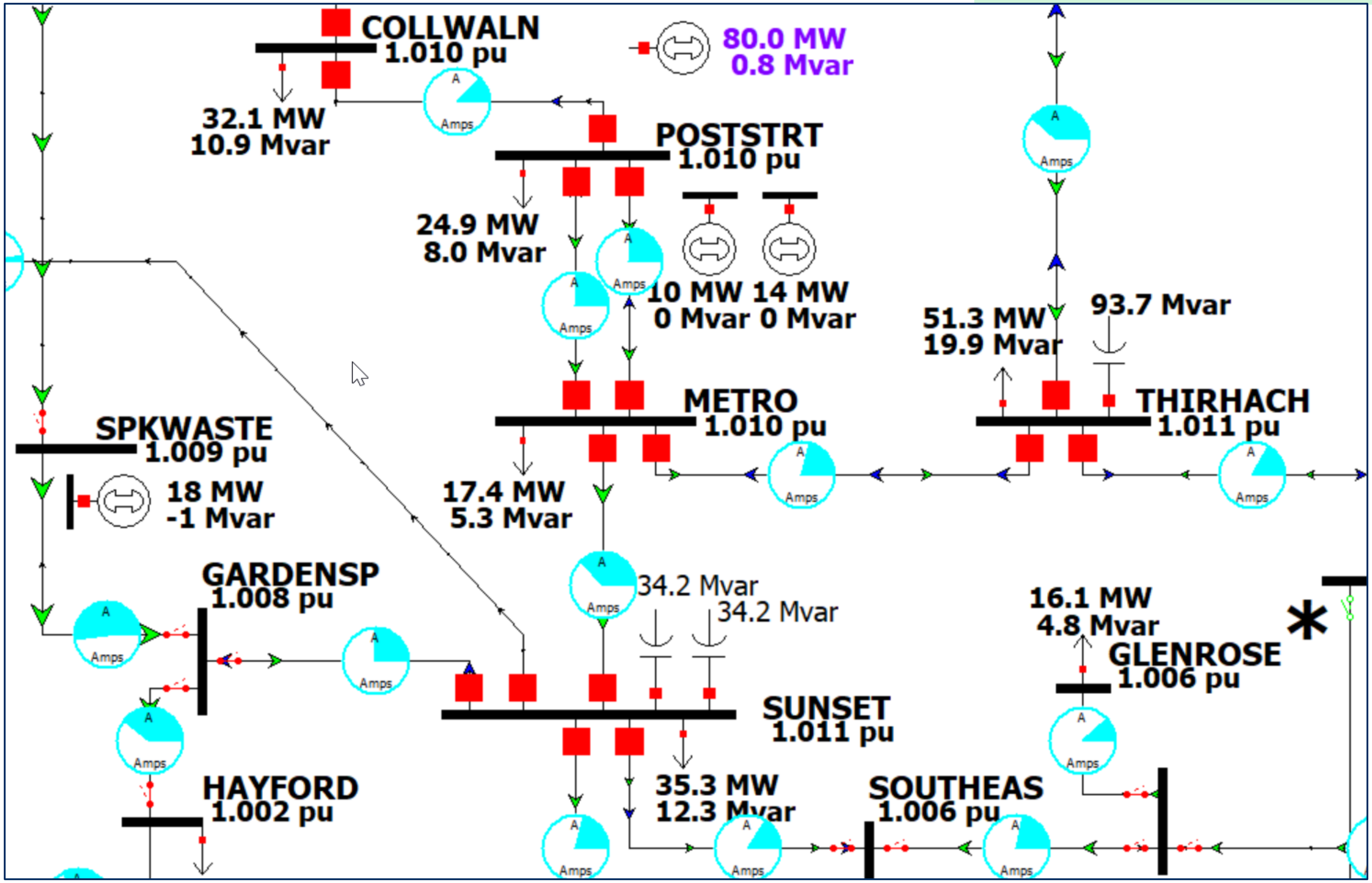
Assume anti-islanding scheme, but no RAS

Station	Request (MW)	POI Voltage	Cost Estimate ($ million)
Kootenai County (GF)	100	230 kV	4
Kootenai County (GF)	200/300	230 kV	80-100
Rathdrum	25/50/100	115 kV	<1
Rathdrum	200	115 kV	55
Rathdrum	50/100	230 kV	<1
Rathdrum	200	230 kV	60
Benewah	100/200	230 kV	<1
Tokio	50/100	115	<1, 20
Othello/Lind	50/100/200	115 kV	Queue Issues
Lewiston/Clarkston	100/200	230 kV	<1
Northeast	10	115 kV	<1
Kettle Falls	12	115 kV	<1
Kettle Falls	24/100/124	115 kV	<20
Long Lake	68	115 kV	33
Monroe Street	80	115 kV	2
Post Falls	10	115 kV	<1
Cabinet Gorge	110	230 kV	<14

[1] Preliminary estimates are given as -25% to +75%

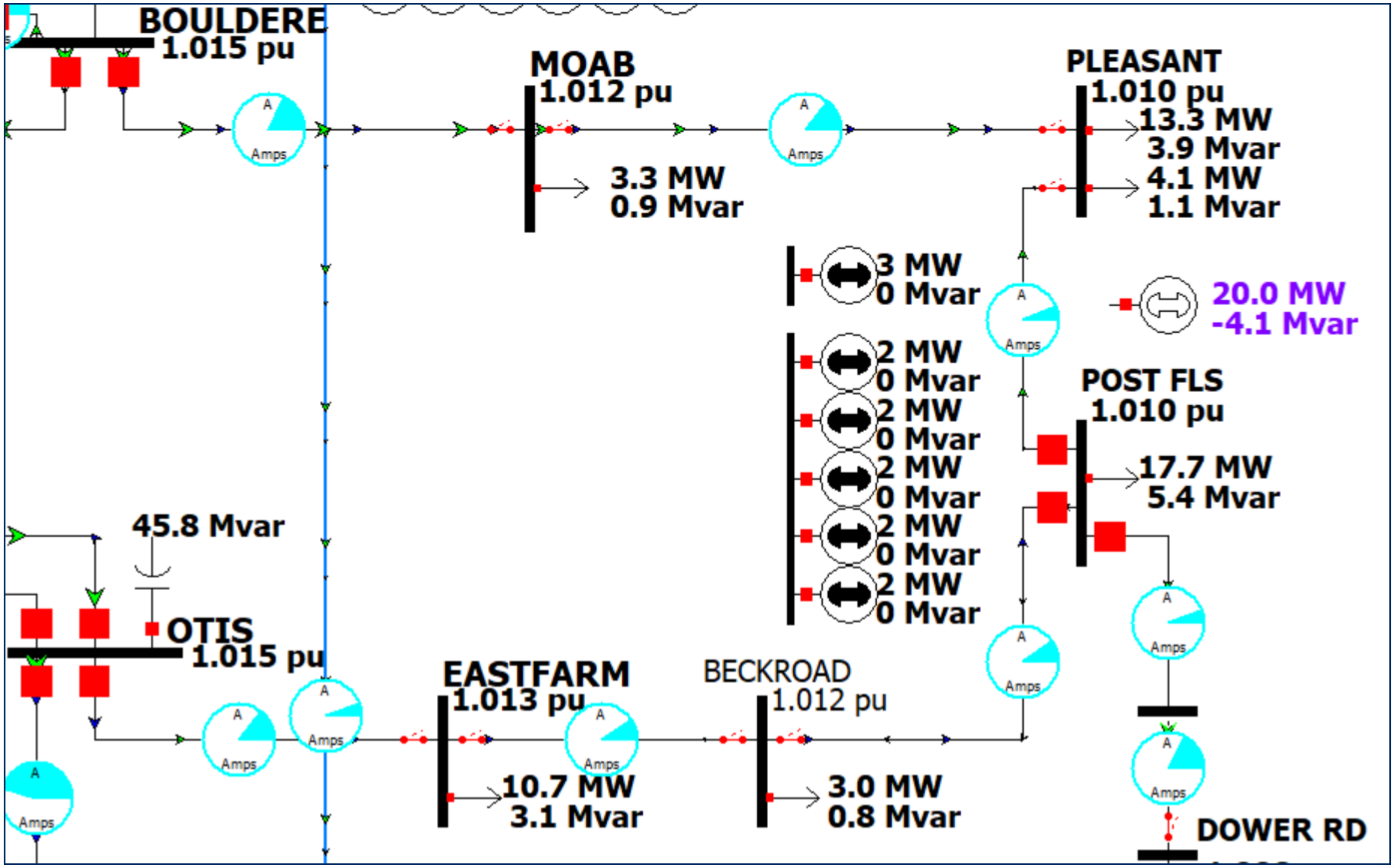
Monroe Street: 80 MW

Requires the Metro Rebuild Project be completed



Post Falls: 10 MW to 20 MW

Interconnection only



Questions?

Avista OASIS link:

http://www.oasis.oati.com/avat/index.html

Distribution Resource Planning

Damon Fisher, System Planning
Third Technical Advisory Committee Meeting
September 29, 2020

Goals of Electric Distribution Planning

- Ensure electric distribution infrastructure to serve customers now and in the future with a focus on:
  - Safety
  - Reliability
  - Capacity
  - Efficiency
  - Level of service
  - Operational flexibility
  - Corporate/Regulatory goals
  - Affordability

AVISTA

Distribution Resource Planning

- Washington House Bill 1126 (passed 2019)
  - https://app.leg.wa.gov/RCW/default.aspx?cite=19.280.100
  - 10-Year Plan
  - DER's and Non-Wire Alternatives
  - IRP Resource Needs
  - Temporal and spatial planning
  - Temporal and spatial value
  - Probabilistic analysis (Pessimistic, Optimistic)
  - Open Planning

Primary Goal of Distribution Resource Plan

- Where possible, solve distribution grid deficiencies using distributed energy resources (DER) that also contribute to system resource needs as identified in the Integrated Resource Plan.

Can IRP resource needs and distribution “fixes” be aligned? Certainly.

- Not without challenges.
  - Temporal need
  - Grid operation and flexibility
  - Resource adequacy- a new distribution definition?
  - System Protection

Typical Distribution System Deficiencies

- Low Voltage
- Capacity (Substation/Feeder)
- Asset Condition
- Contingency Switching Limits

What are DER’s? – Distribution’s Perspective

- Anything that can reduce demand or support voltage

Real

Targeted Energy Efficiency

Targeted Demand Response

Apparent

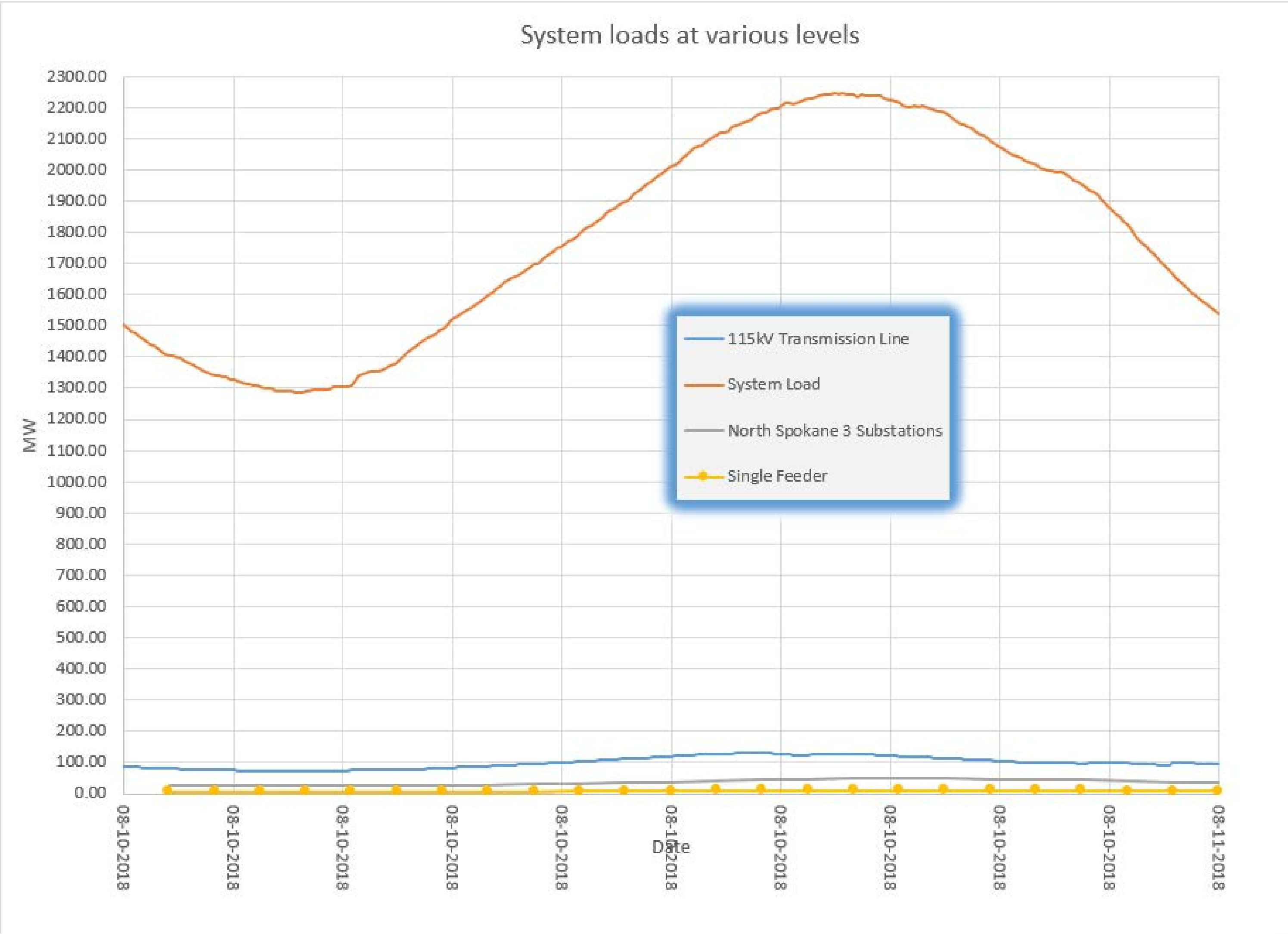
Storage (Load shifting)

Generation (Load service)

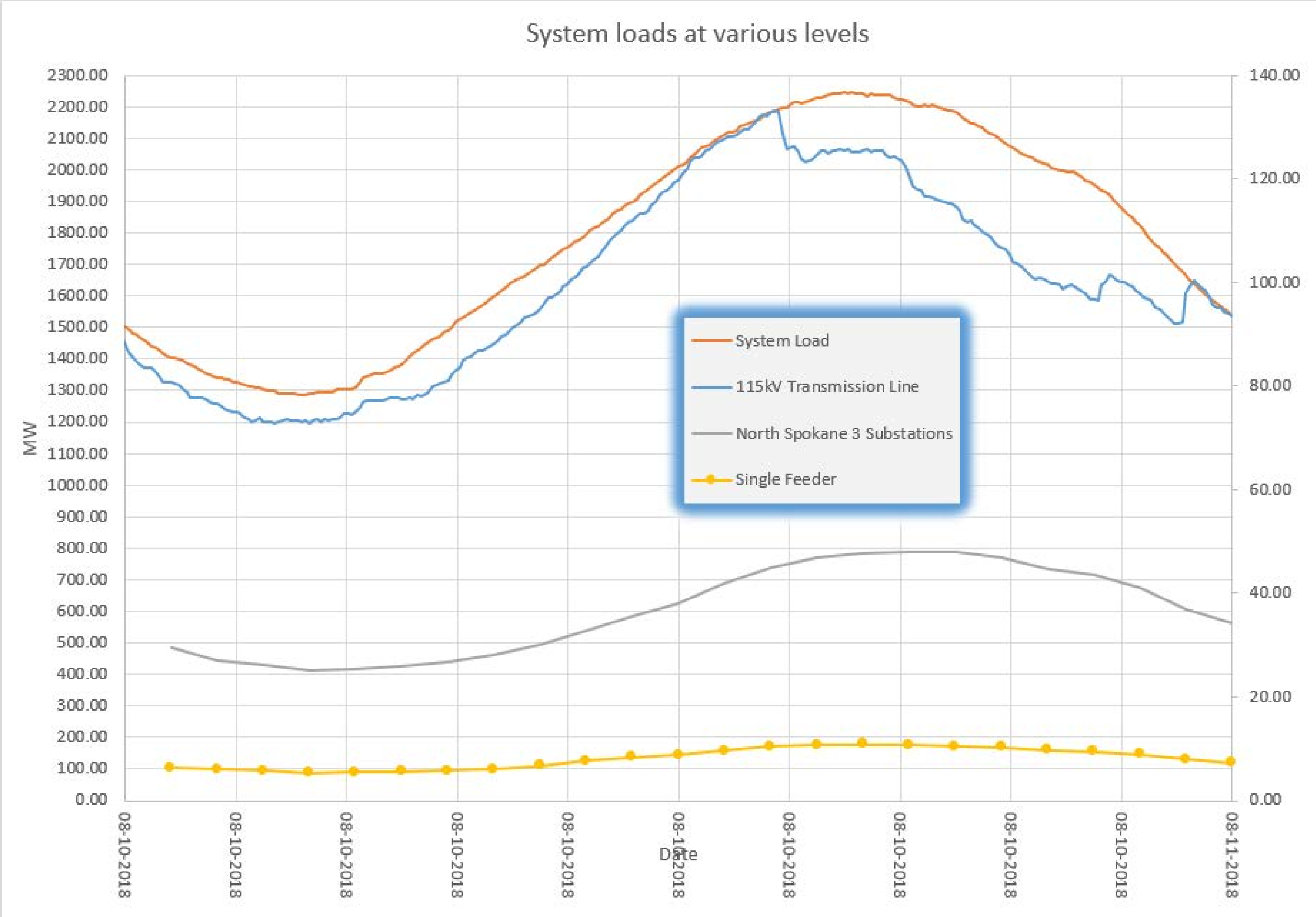
How Do DER's Get Implemented?

- Three Paths-
  1. Retail/Commercial Customer driven. Customers install DER's on their side of the meter for unknown reasons.
  2. The second way would be 3rd party grid connections (utility scale). We have a few requests in the queue and a 20MW installation in Lind Washington. These can cause grid challenges.
  3. The third way is utility-driven targeted DER's to solve grid issues on either side of the meter. Incentivized #1 and #2 above.

System Resources vs. Feeder Demand

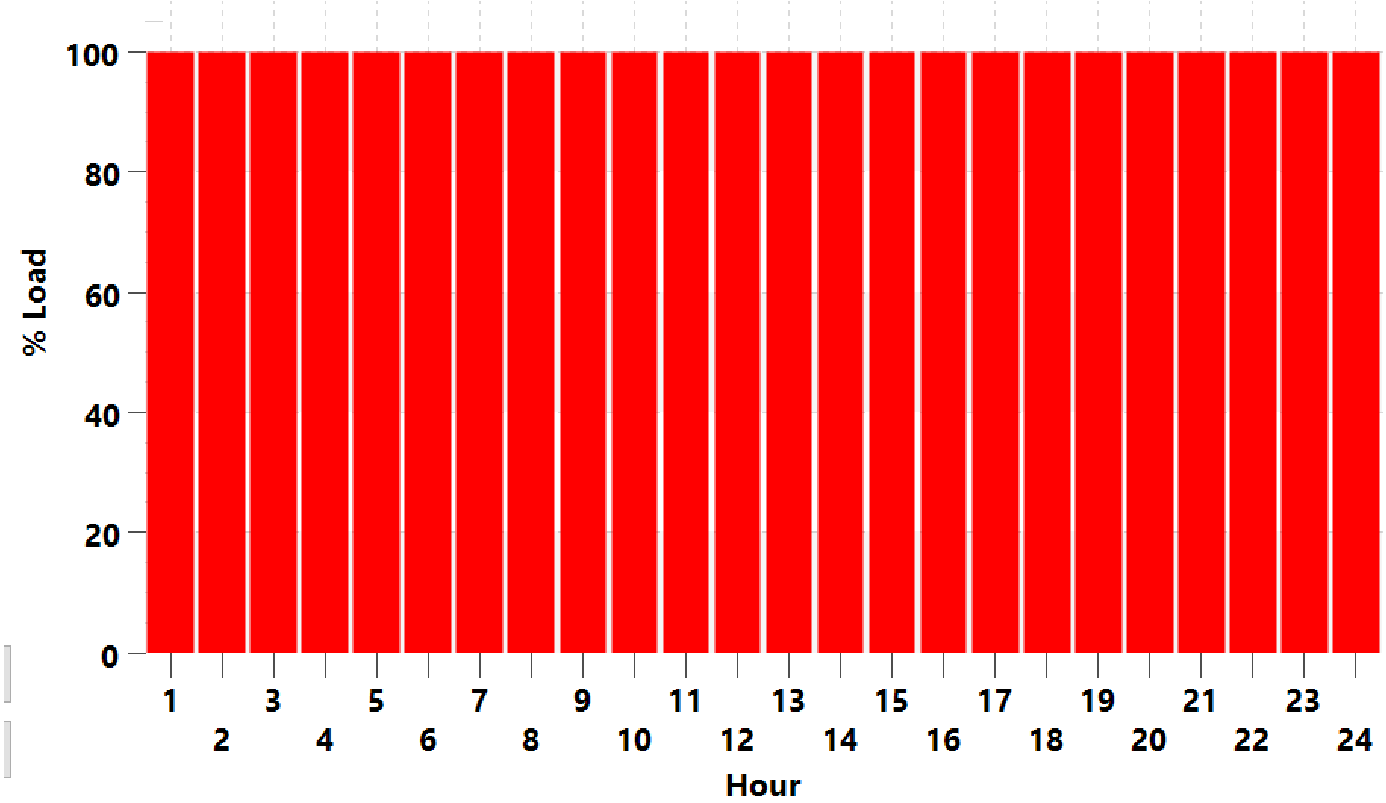


System Resources vs. Feeder Demand



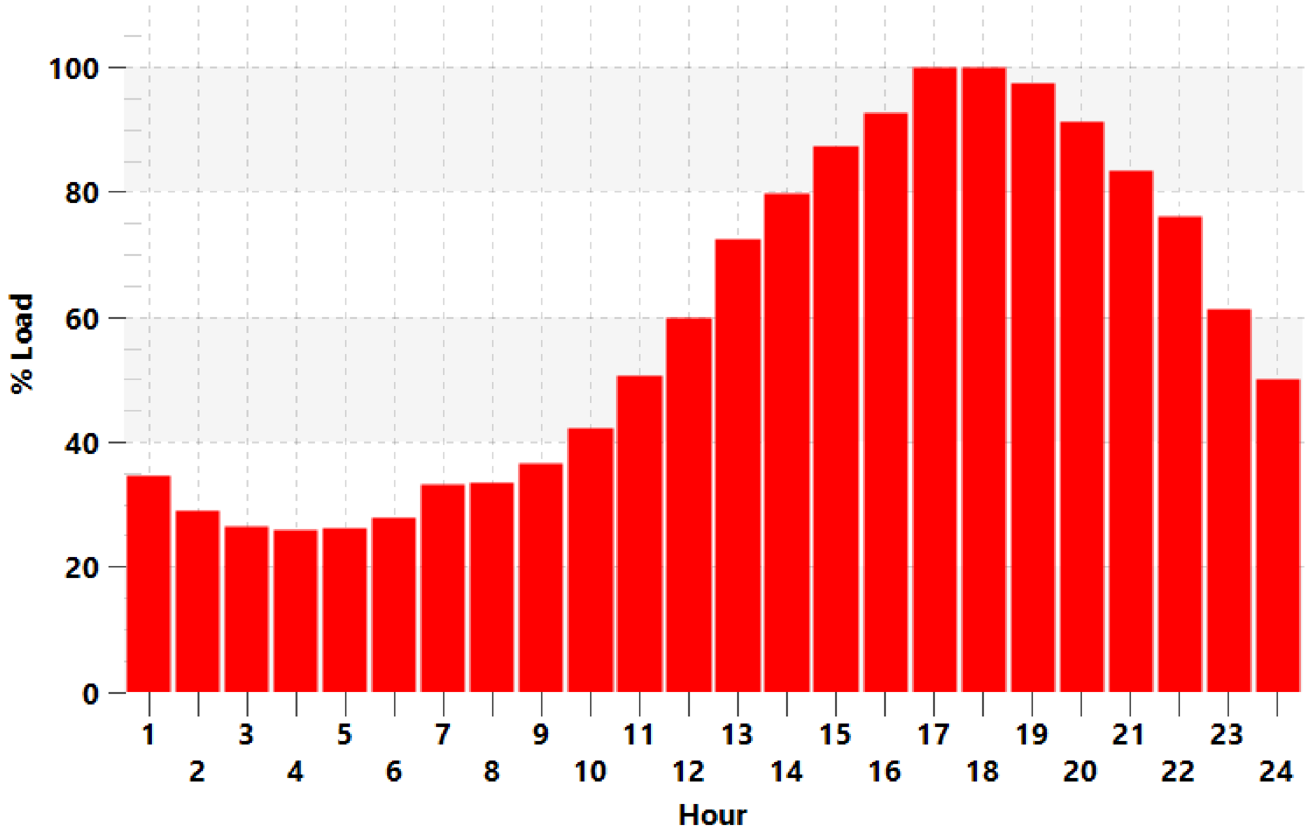
It Is All About Curves

- The ideal curve-

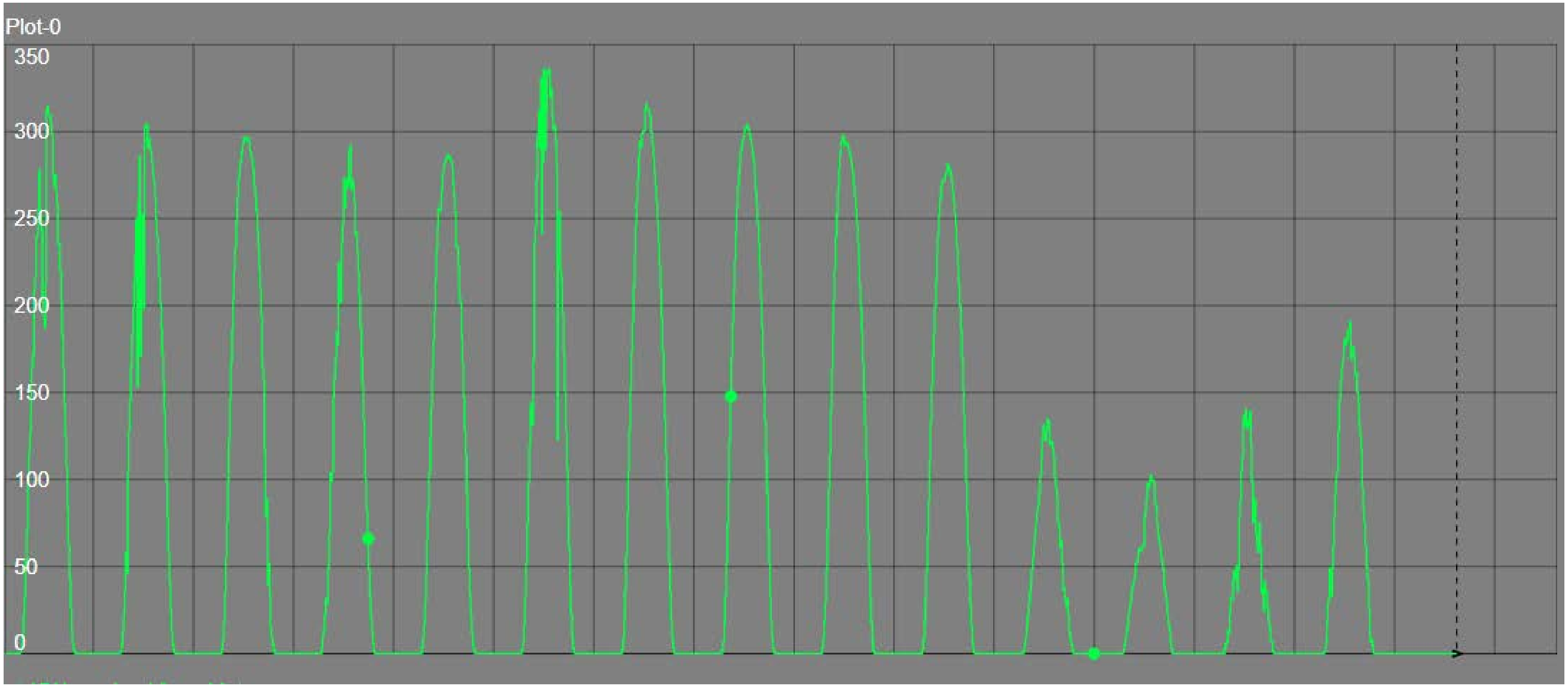


It is all about curves

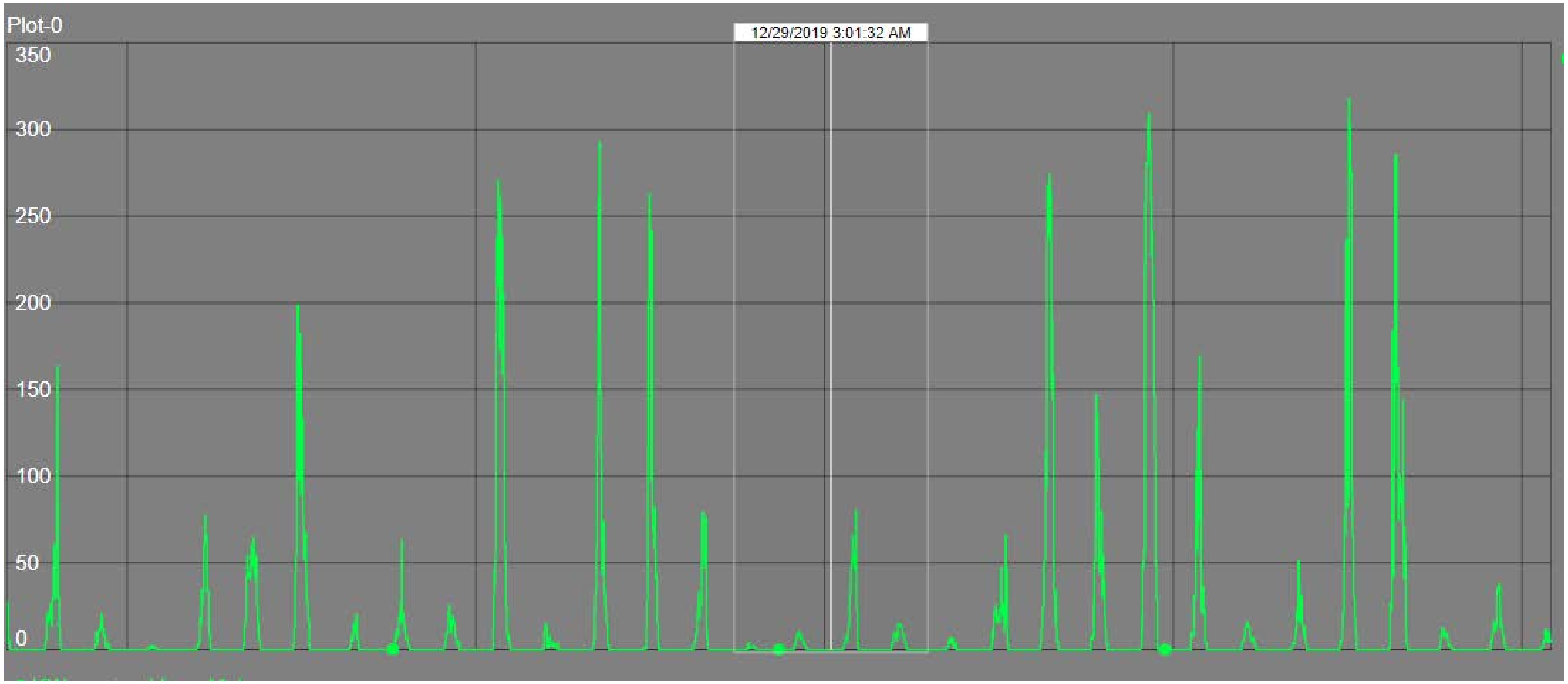
- A real curve (not ideal)-



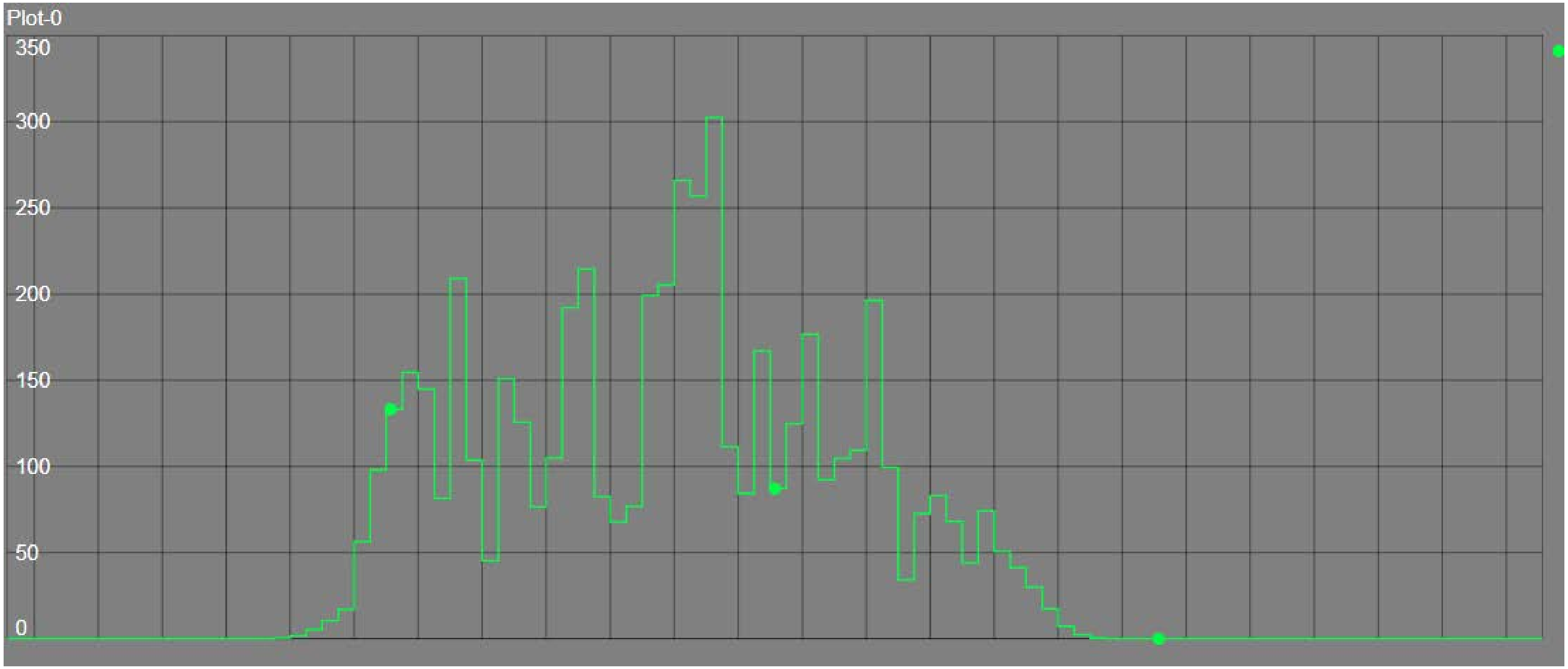
Can We Fix Curves with PV? Community Solar – Summer



Can We Fix Curves with PV?
Community Solar – Winter



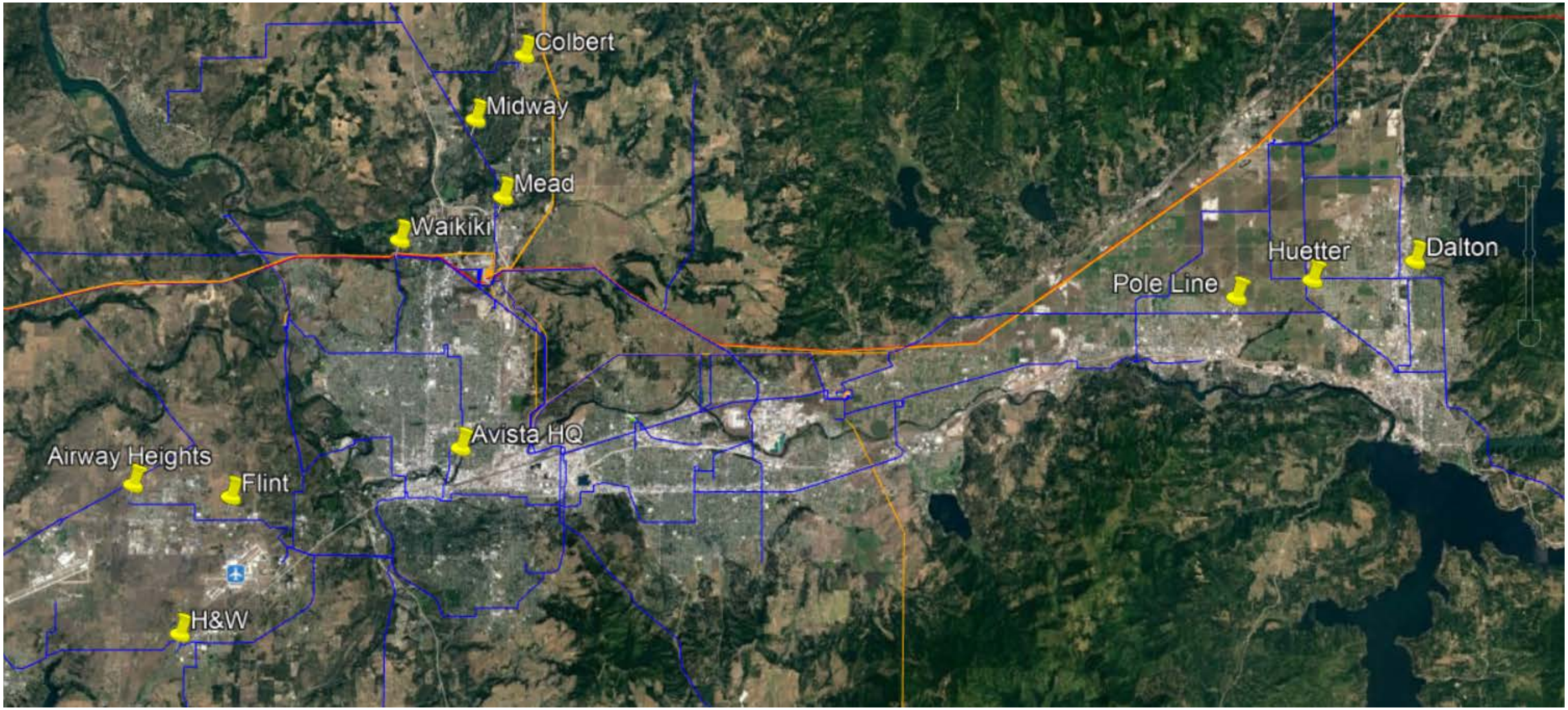
Can We Fix Curves with Just PV? Community Solar – Cloudy Day, Battery



Capacity Projects

53	Flint Road Station	Scope not complete. New distribution station located north of Spokane along the Airway Heights - Sunset 115 kV Transmission Line.	Q3 2022	Budgeted Not Scoped	
98	Midway Station	Scope not complete. New distribution station located north of Spokane along the Bell – Addy 115 kV Transmission Line.	Q1 2023	Budgeted Not Scoped	
80	Huetter Station Expansion	Scope not complete. Rebuild existing distribution station to two 30MVA transformers, 6 feeders, and looped through transmission with circuit breakers.	Q1 2025	Budgeted Not Scoped	

Locations



Colbert
Midway
Mead
Waikiki
Avista HQ
Airway Heights
Flint
H&W
Pole Line
Huetter
Dalton

DRP Implementation Gaps

- Spatial Load Forecasting
- Spatial DER Forecasting
- System Performance Criteria
- DER Acquisition and Implementation Processes
- Engineering/Operational Expertise

Interesting Distribution Efforts

- AMI data load disaggregation
- Hosting Capacity Maps
  - Example Hosting Capacity map: https://www.arcgis.com/apps/webappviewer/index.html?id=84de299296d649808f5a149e16f2d87c
- Northwest Utility DER Technical Discussion

Questions?

Applied Energy Group

AVISTA DR POTENTIAL STUDY

Preliminary Results Slide Deck – Sep 28, 2020

Energy solutions. Delivered.

AGENDA

- Methodology
- Program Characterization
- Preliminary Impacts
- Next Steps

Methodology

APPROACH TO THE STUDY

AEG Applied Energy Group

Data Collection
- Align with EE Potential study
  - Market Profiles
- Secondary Sources
  - Industry or regional reports & previous studies

→ Analysis Inputs

Characterize the Market
- Segmentation by Customer Class
  - Residential and C&I (General Service, Large General Service and Extra Large General Service)

→ Baseline Forecast

Develop list of DR Options
- DLC
- Third Party
- Storage
- Rates
- Ancillary Services

→ Program List

Characterize the Options
- Develop Program Assumptions
  - Impacts, Participation, Technology, Costs, Incentives

→ Potential Inputs

Estimate Potential
- Technical Achievable Potential
  - Potential for all programs regardless of cost and without consideration of dual participation
- Realistic Achievable Potential
  - Integrated case of cost-effective programs

→ Final Results

CALCULATION OF IMPACT (MW)

$$\mathit{Program\ Impact}_{year,program}$$

$$= \mathit{Per\ Customer\ Peak\ Impact} * \mathit{Eligible\ Participants}$$

$$* \mathit{Participation\ Rate} * \mathit{Equipment\ Saturation\ Rate}$$

where:

Year= Forecasted year between 2022 and 2045

Program Characterization

DR PROGRAM OPTIONS

Program Type	Program Option	Mechanism
Curtailable / Controllable DR	DLC with two-way communicating or Smart T-stats	Internet-enabled control of thermostat set points, can be coupled with any dynamic pricing rate
	DLC Central AC	DLC switch installed on customer's Central AC
	CTA-2045 Water Heaters (WA)	Modular communications interface for water heaters that will become the new technology standard
	DLC Water Heating (ID)	DLC switch installed on customer's Water Heater
	DR providing ancillary services (Fast DR)	Automated, fast-responding curtailment strategies with advanced telemetry capabilities suitable for load balancing, frequency regulation, etc. Equipment considered for this option includes: **Battery Storage, Thermostats (heating/cooling), Electric Vehicles, Third Party Contracts, and Water Heaters**
	Smart Appliance DLC	Internet-enabled control of operational cycles of white goods appliances
	DLC Electric Vehicle Charging	DLC switch installed on customer's equipment
	Third Party Contracts-	Includes the following three measure options
	Capacity Bidding	Customers volunteer a specified amount of capacity during a predefined "economic event" called by the utility in return for a financial incentive.
	Emergency Curtailment Agreements	Customers enact their customized, mandatory curtailment plan. May use stand-by generation. Penalties apply for non-performance.
	Demand Buyback	Customers enact their customized, voluntary curtailment plan. May use stand-by generation. No penalties for non-performance. Requires AMI technology.
	Battery Energy Storage	Peak shifting of loads using stored electrochemical energy
	Behavioral DR	Voluntary DR reductions in response to behavioral messaging. Example programs exist in CA and other states. Requires AMI technology.
	Thermal Energy Storage	Peak shifting of primarily space cooling or heating loads using a thermal storage medium such as water or ice
Rates	Time-of-use Rates	Higher rate for a particular block of hours that occurs every day. Requires either on/off peak meters or AMI technology.
	Variable Peak Pricing	Much higher rate for a particular block of hours that occurs only on event days. Requires AMI technology.

AMI ASSUMPTIONS

Some of the options require AMI

- DLC Options- No AMI Metering Required
- Dynamic Rates- require AMI for billing
- Ancillary Options- require two way communicating controls

Washington currently has 93% AMI saturation

- Assume 100% saturation by 2022

Idaho will start AMI rollout in 2022 and will take 18 months to fully deploy

- Assume 33% saturation in 2022 and 100% by 2024

PARTICIPATION RATES
DLC PROGRAM OPTIONS

Program Option	Residential	General Service	Large General Service	Extra Large General Service
DLC Central AC	10%	10%		
DLC Smart Thermostats - Cooling	20%	20%		
DLC Smart Thermostats - Heating	5%	3%		
CTA-2045 WH	50%	50%		
DLC Water Heating	15%	5%		
DLC Electric Vehicle Charging	25%			
DLC Smart Appliances	5%	5%		

Sources:

- **DLC Central AC**– NWPCC DLC Switch cooling assumption- 5 yr ramp rate
- **DLC Smart Thermostats (Cooling)** – NWPCC Smart Thermostat cooling assumption- 5 yr ramp rate
- **DLC Smart Thermostats (Heating)** – Agreed upon estimate with Avista. NWPC participation estimate was too high.
- **CTA – 2045 WH** - NWPCC Grid interactive WH assumptions.
- **DLC Water Heating** – Best estimate based on industry experience – in line with other DLC programs
- **DLC Electric Vehicle Charging** – NWPC Electric Resistance Grid-Ready Summer/Winter Participation- 10 yr ramp rate
- **DLC Smart Appliances** - 2015 ISACA IT Risk Reward Barometer - US Consumer Results. October 2015. http://www.isaca.org/SiteCollectionDocuments/2015-risk-reward-survey/2015-isaca-risk-reward-consumer-summary-us_res_eng_1015.pdf

PARTICIPATION RATES
RATES AND STORAGE

Program Option	Residential	General Service	Large General Service	Extra Large General Service
Third Party Contracts		15%	20%	20%
Thermal Energy Storage		0.5%	1.5%	1.5%
Battery Energy Storage	0.5%	0.5%	0.5%	0.5%
Behavioral	20%			
Time-of-Use Opt-in	13%	13%	13%	13%
Time-of-Use Opt-out	74%	74%	74%	74%
Variable Peak Pricing Rates	25%	25%	25%	25%

Sources:

- Third Party Contracts – Best estimate based on industry experience
- Thermal Energy Storage – Best estimate based on industry experience
- Battery Energy Storage – Best estimate based on industry experience
- Behavioral - PG&E rollout with six waves http://www.calmac.org/publications/DNVGL_PGE_HERs_2015_final_to_calmac.pdf
- Time-of-Use Rates – Best estimate based on industry experience; Brattle Analysis and Estimate; Winter impacts ½ of summer impacts
- Variable Peak Pricing Rates - OG&E 2017 Smart Hours Study
- Real Time Pricing - Best estimate based on industry experience

PEAK IMPACTS

DLC PROGRAMS

Season	Program Option	Residential	General Service	Large General Service	Extra Large General Service
Summer only	DLC Central AC	0.5 kW	1.25 kW		
Summer only	DLC Smart Thermostats - Cooling	0.5 kW	1.25 kW		
Winter only	DLC Smart Thermostats - Heating	1.09 kW	1.35 kW		
Annual	CTA-2045 WH	0.5 kW	1.26 kW		
Annual	DLC Water Heating	0.5 kW	1.26 kW		
Annual	DLC Electric Vehicle Charging	0.5 kW			
Annual	DLC Smart Appliances	0.14 kW	0.14 kW		

Sources:

- **DLC Central AC and Smart Thermostats (Cooling)** –NWPC DLC Switch cooling assumption was close to 1.0 kW reduced to adjust for Avista proposed cycling strategy, Thermostats equal to switch
- **DLC Smart Thermostats (Heating)** – NWPC Smart thermostat heating assumption (east)
- **CTA-2045 Water Heating** - NWPC Electric Resistance Grid-Ready Summer/Winter Impact, Gen Service is 2.52x that of res based on DLC Central AC Res to C&I ratio
- **DLC Water Heating**- NWPC Electric Resistance Switch Summer Impact, Gen Service is 2.52x that of res based on DLC Central AC Res to C&I ratio
- **DLC Electric Vehicle Charging** – Based on Avista Research
- **DLC Smart Appliances** - Ghatikar, Rish. Demand Response Automation in Appliance and Equipment. Lawrence Berkley National Laboratory, 2015. Web. http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-05/TN205072_20150618T110004_Demand_Response_Automation_in_Appliances_and_Equipment.pptx

PEAK IMPACTS

RATES AND OTHER OPTIONS

Season	Program Option	Residential	General Service	Large General Service	Extra Large General Service
Annual	Third Party Contracts		10%	21%	21%
Annual	Thermal Energy Storage		1.7 kW	8.4 kW	8.4 kW
Annual	Battery Energy Storage	2 kW	2 kW	15 kW	15 kW
Annual	Behavioral	2%			
Annual	Time-of-Use Rate Opt-in	5.7%	0.2%	2.6%	3.1%
Annual	Time-of-Use Rate Opt-out	3.4%	0.2%	2.6%	3.1%
Annual	Variable Peak Pricing Rates	10%	4%	4%	4%

Sources:

- **Third Party Contracts** - Weighted average impacts from report: Impact Estimates from Aggregator Programs in California (Source: 2019 Statewide Load Impact Evaluation of California Aggregator Demand Response Programs)
- **Thermal Energy Storage** - Ice Bear Tech Specifications, https://www.ice-energy.com/wp-content/uploads/2016/03/ICE-BEAR-30-Product-Sheet.pdf
- **Battery Energy Storage** – Typical Battery size per segment
- **Behavioral** - Opower documentation for BDR with Consumers and DTE
- **Time-of-Use Rates** –Brattle Analysis and Estimate - PacifiCorp 2019 opt-in and opt-out scenarios. Summer Impacts Shown (Winter impacts ½ summer)
- **Variable Peak Pricing Rates** - OG&E 2018 Smart Hours Study, Summer Impacts Shown (Winter impacts ¾ summer)

AVERAGE EVENT DURATION FOR DLC OPTIONS

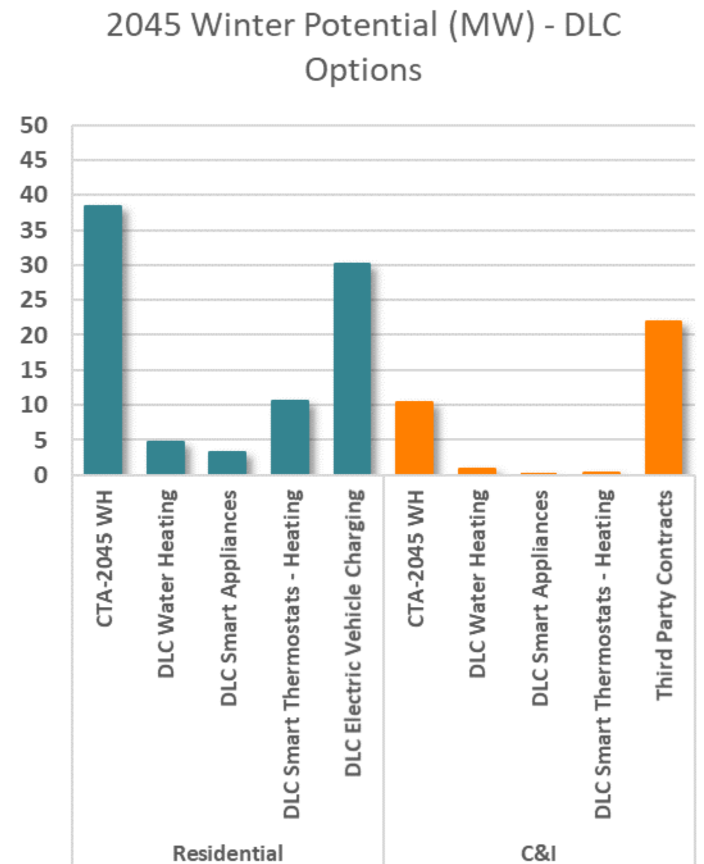
Option	Annual Event Hours	Average Duration per Event	Max Event Duration
Central AC	50	3 hrs	6 hrs
Smart Thermostats - Cooling	36	3 hrs	6 hrs
Smart Thermostats - Heating	36	3 hrs	6 hrs
Water Heating	100	3 hrs	6 hrs
Electric Vehicle Charging	528	6 hrs	8 hrs
Smart Appliances	528	6 hrs	8 hrs
Third Party Contracts	30	4 hrs	8 hrs

Technical Achievable Potential

DLC Options

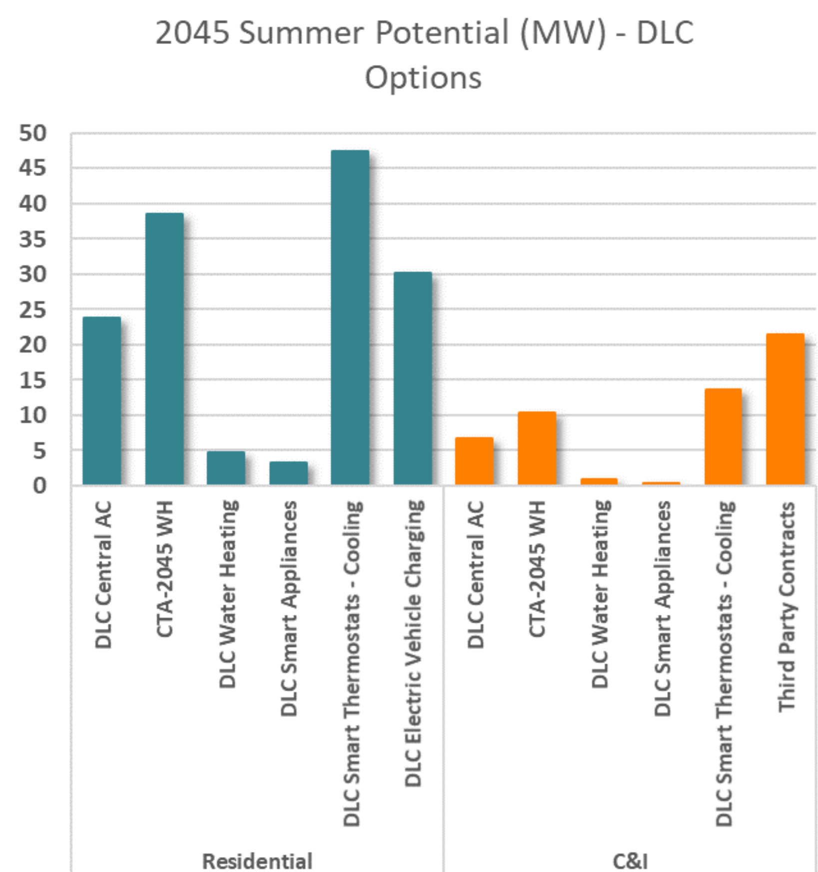
TECHNICAL ACHIEVABLE POTENTIAL
WINTER - DLC OPTIONS

Sector	Option	2022	2025	2035	2045
Residential	DLC Central AC	-	-	-	-
	CTA-2045 WH	0.0	1.3	21.1	38.5
	DLC Water Heating	0.5	4.3	4.7	4.6
	DLC Smart Appliances	0.3	2.4	3.0	3.3
	DLC Smart Thermostats - Cooling	-	-	-	-
	DLC Smart Thermostats - Heating	0.8	7.8	9.5	10.5
	DLC Electric Vehicle Charging	-	0.3	5.6	30.2
C&I	DLC Central AC	-	-	-	-
	CTA-2045 WH	0.0	0.3	5.2	10.4
	DLC Water Heating	0.1	0.6	0.8	0.9
	DLC Smart Appliances	0.0	0.3	0.3	0.4
	DLC Smart Thermostats - Cooling	-	-	-	-
	DLC Smart Thermostats - Heating	0.0	0.2	0.3	0.3
	Third Party Contracts	4.6	21.9	21.8	21.9



TECHNICAL ACHIEVABLE POTENTIAL
SUMMER - DLC OPTIONS

Sector	Option	2022	2025	2035	2045
Residential	DLC Central AC	0.6	6.8	14.5	23.7
	CTA-2045 WH	0.0	1.3	21.1	38.5
	DLC Water Heating	0.5	4.3	4.7	4.6
	DLC Smart Appliances	0.3	2.4	3.0	3.3
	DLC Smart Thermostats - Cooling	1.2	13.5	29.1	47.4
	DLC Smart Thermostats - Heating	-	-	-	-
	DLC Electric Vehicle Charging	-	0.3	5.6	30.2
C&I	DLC Central AC	0.2	1.9	4.1	6.8
	CTA-2045 WH	0.0	0.3	5.2	10.4
	DLC Water Heating	0.1	0.6	0.8	0.9
	DLC Smart Appliances	0.0	0.3	0.3	0.4
	DLC Smart Thermostats - Cooling	0.3	3.8	8.3	13.5
	DLC Smart Thermostats - Heating	-	-	-	-
	Third Party Contracts	4.5	21.4	21.3	21.4

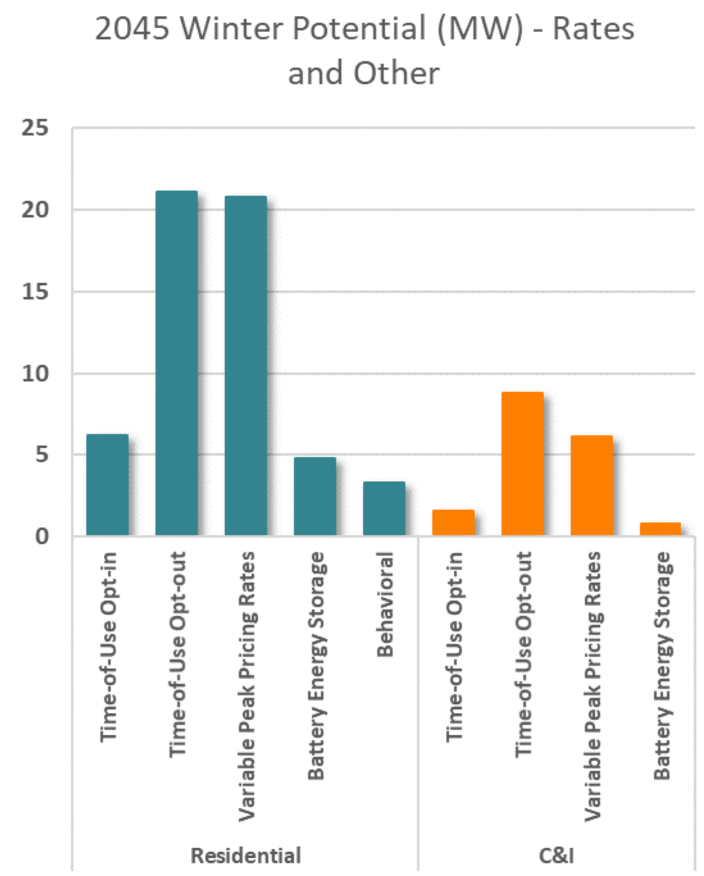


Technical Achievable Potential

Rates and Other Options

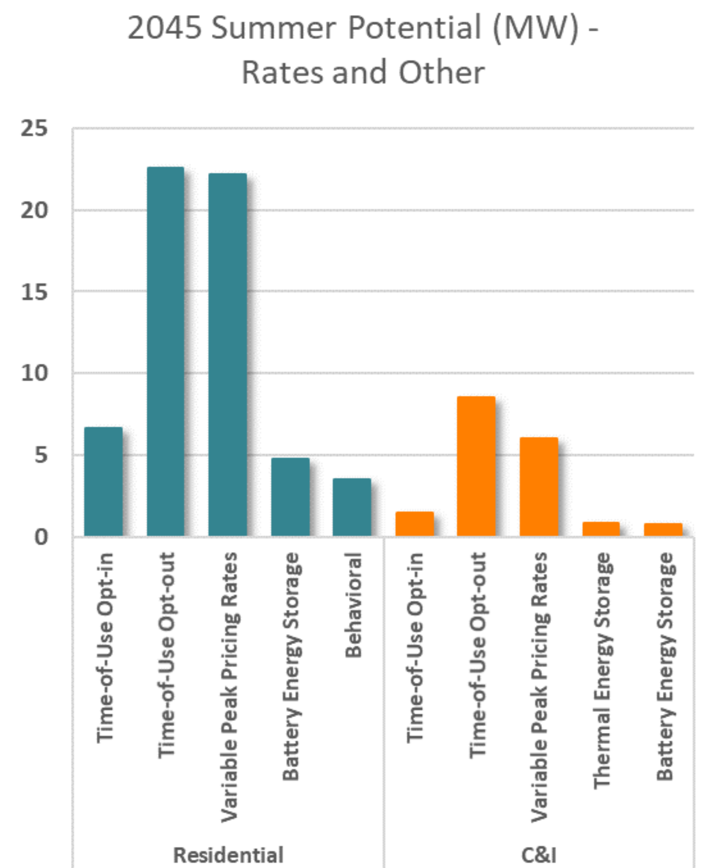
TECHNICAL ACHIEVABLE POTENTIAL
WINTER - RATES AND OTHER OPTIONS

Sector	Option	2022	2025	2035	2045
Residential	Time-of-Use Opt-in	0.4	5.0	5.9	6.2
	Time-of-Use Opt-out	19.6	19.4	20.0	21.1
	Variable Peak Pricing Rates	1.4	16.8	19.7	20.8
	Battery Energy Storage	0.1	0.6	4.3	4.8
	Behavioral	0.6	3.0	3.1	3.3
C&I	Time-of-Use Opt-in	0.1	1.4	1.6	1.5
	Time-of-Use Opt-out	10.4	9.2	8.9	8.8
	Variable Peak Pricing Rates	0.5	5.3	6.0	6.1
	Thermal Energy Storage	-	-	-	-
	Battery Energy Storage	0.0	0.1	0.7	0.8



TECHNICAL ACHIEVABLE POTENTIAL
SUMMER - RATES AND OTHER OPTIONS

Sector	Option	2022	2025	2035	2045
Residential	Time-of-Use Opt-in	0.5	5.4	6.3	6.6
	Time-of-Use Opt-out	21.1	20.7	21.4	22.5
	Variable Peak Pricing Rates	1.5	17.9	21.0	22.2
	Battery Energy Storage	0.1	0.6	4.3	4.8
	Behavioral	0.6	3.2	3.4	3.5
C&I	Time-of-Use Opt-in	0.1	1.4	1.5	1.5
	Time-of-Use Opt-out	10.1	8.9	8.6	8.5
	Variable Peak Pricing Rates	0.5	5.2	5.9	6.0
	Thermal Energy Storage	0.1	0.7	0.8	0.8
	Battery Energy Storage	0.0	0.1	0.7	0.8



Ancillary Services

By Option

ANCILLARY SERVICE ASSUMPTIONS

Ancillary Option
Battery Energy Storage
Electric Vehicle Charging
DLC Smart Thermostats- Cooling
DLC Smart Thermostats- Heating
DLC Water Heaters
CTA-2045 Water Heaters
Third Party Contracts

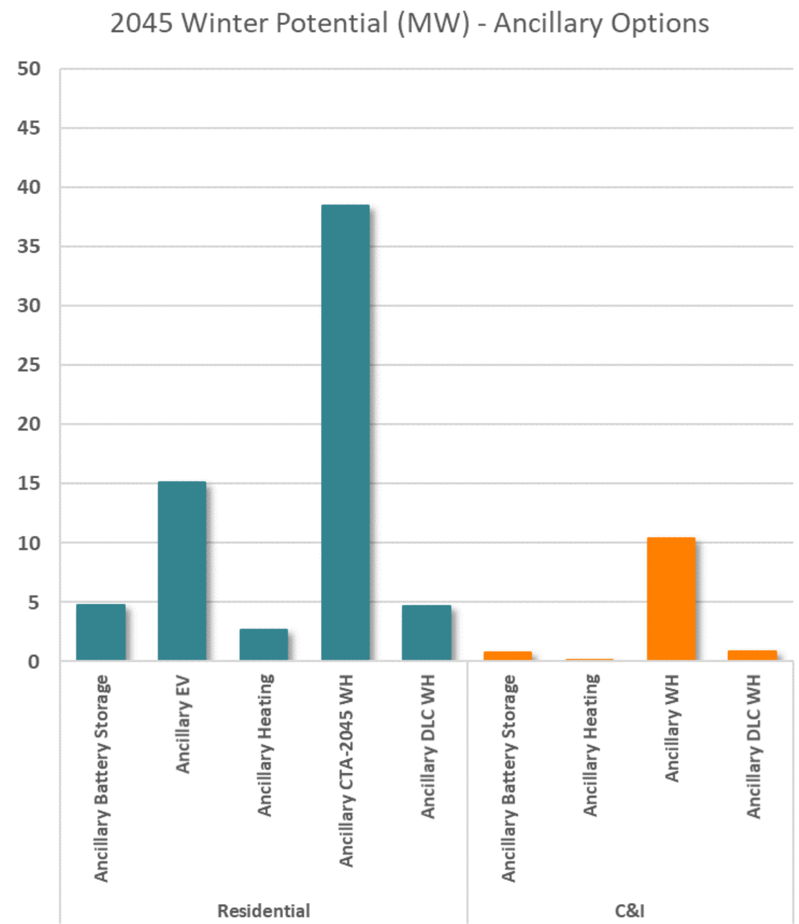
Participation Assumptions

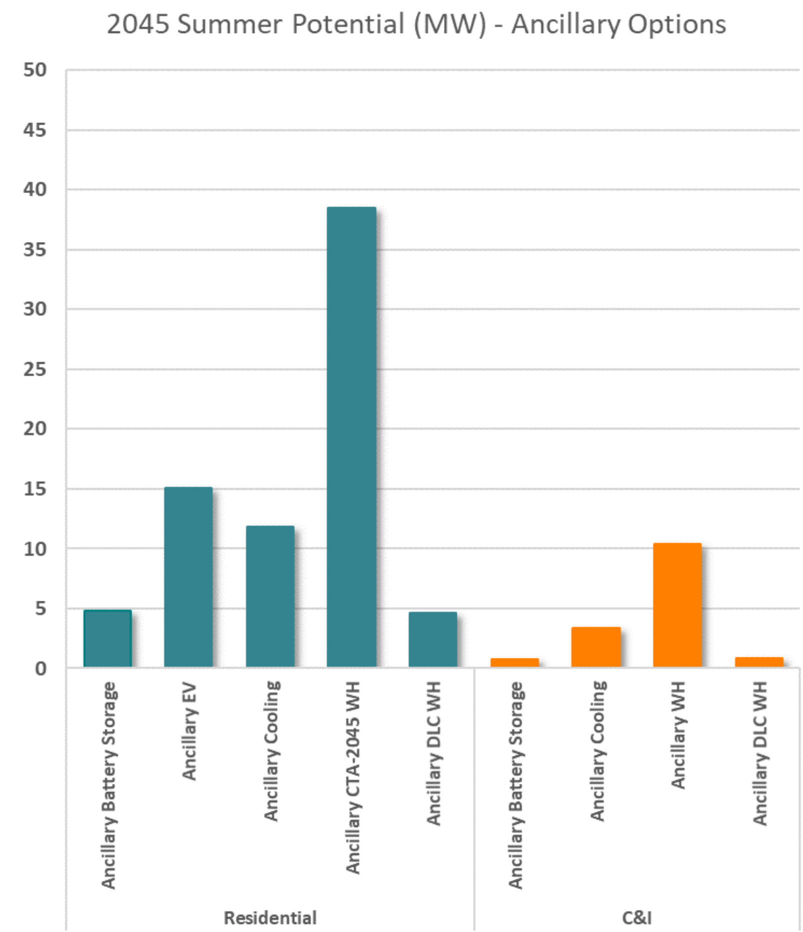
- Full for Battery/EV/WH
- Half for Heating/Cooling
- Third Party based on saturations of EMS systems for PAC C&I

Impact Assumptions

- Full for Battery/WH
- 75% for Third Party
- Half for Heating/Cooling/EV

ANCILLARY SERVICES
TECHNICAL ACHIEVABLE POTENTIAL





DR Event Shapes

Load Shifting Assumptions

SHIFT OR SAVE

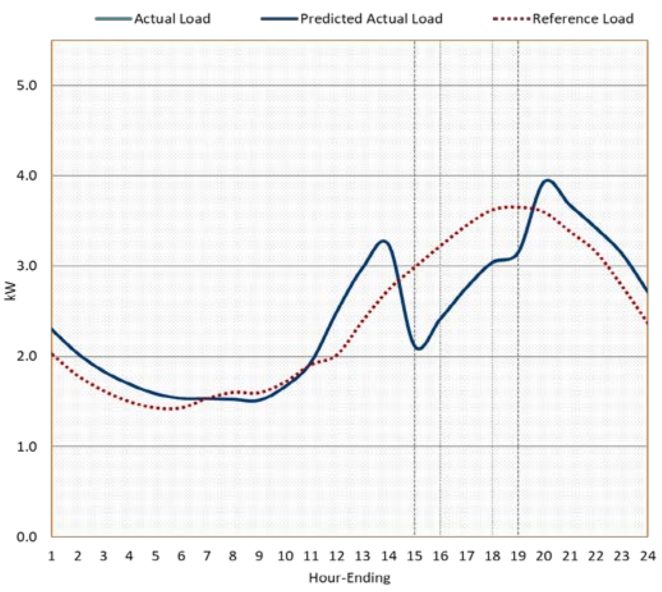
In order to incorporate the impacts into the IRP we need to understand how an even effects overall consumption

Depending on the program type, calling an event can have different effects

- Save energy (0% shift)
- Shift energy (100% shift)
- Partial shift

The next slide will show specific examples of each

Graph shows typical event shape for a Residential Variable Peak Pricing program



EVENT LOAD SHAPES

	Partial Shift				Full Shift				Full Save				Full Shift spread out before/after event			
Program	**DLC Central AC**				**CTA-2045 Water Heating**				**Time-Of-Use Opt-In**				**Variable Peak Pricing**			
State	**WA**		**ID**		**WA**		**ID**		**WA**		**ID**		**WA**		**ID**	
Season	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**
Pre-Event Shift Ratio	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	35%	35%	35%	35%
Post-Event Shift Ratio	65%	65%	65%	65%	100%	100%	100%	100%	0%	0%	0%	0%	65%	65%	65%	65%
Impact at Peak (kW)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50								
Peak Impact Percentage	24.9%	23.1%	26.7%	25.5%	24.9%	23.1%	26.7%	25.5%	2.9%	5.7%	2.9%	5.7%	7.5%	10.0%	7.5%	10.0%
Hour Ending																
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	(0.08)	(0.11)	(0.07)	(0.10)
16	-	-	-	-	-	-	-	-	-	-	-	-	(0.08)	(0.11)	(0.07)	(0.10)
17	0.43	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.05	0.11	0.05	0.10	0.14	0.20	0.13	0.18
18	0.46	0.49	0.50	0.49	0.50	0.49	0.50	0.49	0.06	0.12	0.05	0.11	0.15	0.21	0.14	0.19
19	0.46	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.06	0.12	0.05	0.11	0.15	0.22	0.14	0.20
20	(0.29)	(0.31)	(0.32)	(0.31)	(0.37)	(0.36)	(0.37)	(0.36)	-	-	-	-	(0.10)	(0.14)	(0.09)	(0.12)
21	(0.29)	(0.31)	(0.32)	(0.31)	(0.37)	(0.36)	(0.37)	(0.36)	-	-	-	-	(0.10)	(0.14)	(0.09)	(0.12)
22	(0.29)	(0.31)	(0.32)	(0.31)	(0.37)	(0.36)	(0.37)	(0.36)	-	-	-	-	(0.10)	(0.14)	(0.09)	(0.12)
23	-	-	-	-	(0.37)	(0.36)	(0.37)	(0.36)	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Next Steps

NEXT STEPS

Finalize Technical Achievable Potential

Characterize Program Costs

Estimate Achievable Potential

- Integrated case
- Calculate levelized costs

Finalize Results

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2020 CONSERVATION POTENTIAL ASSESSMENT – UPDATE

Prepared for the Avista Technical Advisory Commitee

AGENDA

Topics

- AEG Introduction
- AEG's CPA Methodology
- Electric CPA Summary
- DR Analysis Summary
- Natural Gas CPA Summary

ABOUT AEG

AEG Applied Energy Group

Planning	EM&V	Implementation & Technical Services	Market Research
Baseline studies	EE portfolio & targeted programs	Engineering review, due-diligence, QA/QC	Program / service pricing optimization
Market assessment studies	Demand response programs & dynamic pricing	M&V, modeling & simulation, onsite assessments	Process evaluations
Program design & action plans	Pilot design & experimental design	Technology R&D and data tools (DEEM)	Market assessment / saturation surveys
End-use forecasting	Behavioral programs	Program admin, marketing, implementation, application processing	Market segmentation
			Customer satisfaction / customer engagement

VISION DSM™ Platform

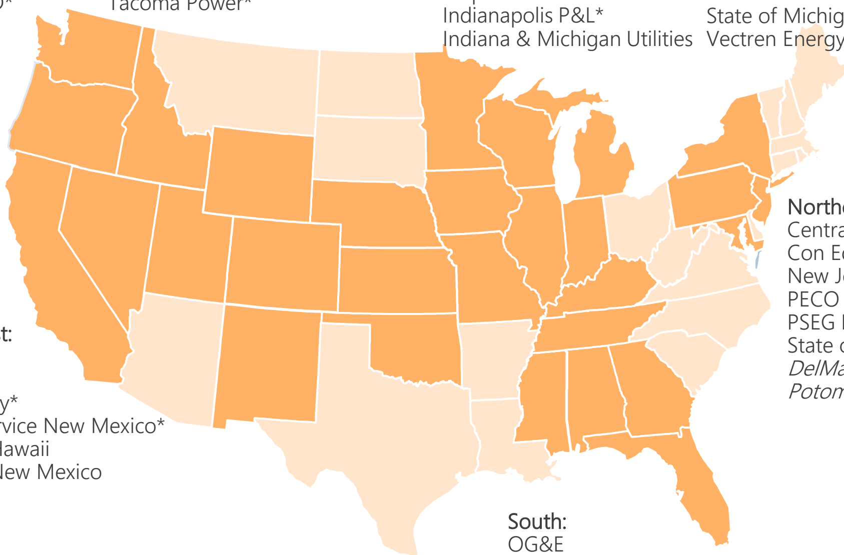
Full DSM lifecycle tracking & reporting

AEG EXPERIENCE IN PLANNING

Including Potential Studies and End-Use Forecasting

Northwest & Mountain:
Avista*
BPA*
Cascade Natural Gas
Chelan PUD
Cheyenne LFP
Colorado Electric*
Cowlitz PUD*
Inland P&L*
Oregon Trail EC
PacifiCorp*
PNGC
PGE*
Seattle City Light*
Tacoma Power*

Midwest:
Ameren Illinois*
Ameren Missouri*
Citizens Energy
Empire District Electric
Indianapolis P&L*
Indiana & Michigan Utilities
Kansas City Power & Light
MERC
NIPSCO*
Omaha Public Power District
State of Michigan
Vectren Energy*



Northeast & Mid Atlantic:
Central Hudson G&E*
Con Edison of NY*
New Jersey BPU
PECO Energy
PSEG Long Island
State of Maryland (*BG&E, DelMarva, PEPCO, Potomac Edison, SMECO*)

Southwest:
HECO
LADWP
NV Energy*
Public Service New Mexico*
State of Hawaii
State of New Mexico
Xcel/SPS

South:
OG&E
Kentucky Power
Southern Company (*APC, GPC, Gulf Power, MPC)*
TVA

Regional & National:
Midcontinent ISO*
EEI/IEE*
EPRI
FERC

* Two or more studies

AEG has conducted more than 60 planning studies for more than 40 utilities / organizations in the past five years.

AEG has a team of 11 experienced Planning staff plus support from AEG's Technical Services and Program Evaluation groups

AEG

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AEG CPA Methodology

CPA OBJECTIVES

The Avista Conservation Potential Assessment (CPA) supports the Company's regulatory filing and other demand-side management (DSM) planning efforts and initiatives.

The two primary research objectives for the 2020 CPA are:

- **Program Planning:** insights into the market for electric and natural gas energy efficiency (EE) measures and electric demand response (DR) measures in Avista's Washington and Idaho service territories
  - For example, CPAs provide insight into changes to existing program measures as well as new measures to consider
- **IRP:** long-term forecast of future EE and DR potential for use in the IRP
  - Technical Achievable Potential (TAP) for electricity
  - Economic Achievable Potential (EAP) for natural gas

AEG utilizes its comprehensive LoadMAP analytical models that are customized to Avista's service territory.

OVERVIEW OF AEG'S APPROACH

Overview – Electric and Gas

Market Characterization

- Avista control totals
- Customer account data
- Secondary data
- Avista market research

Identify Demand-Side Resources

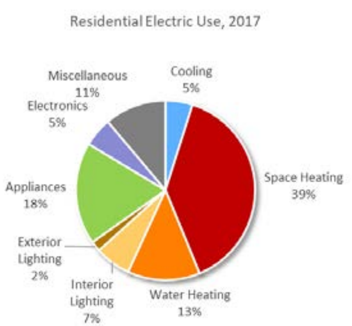
- EE technologies
- EE measures
- Emerging measures and technologies

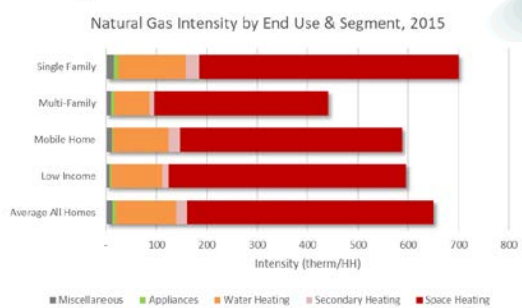
Baseline Projection

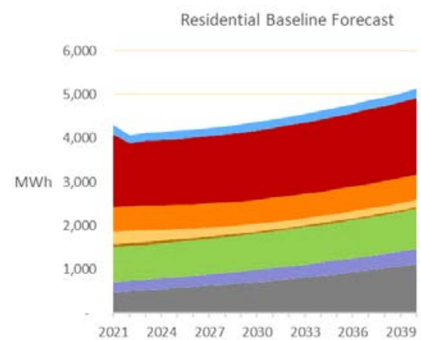
- Avista Load Forecast
- Customer growth
- Standards and building codes
- Efficiency options
- Purchase Shares

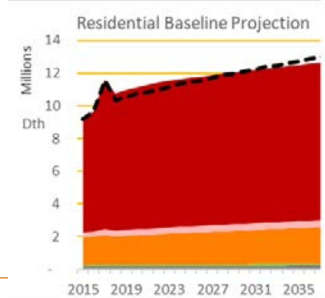
Potential Estimation

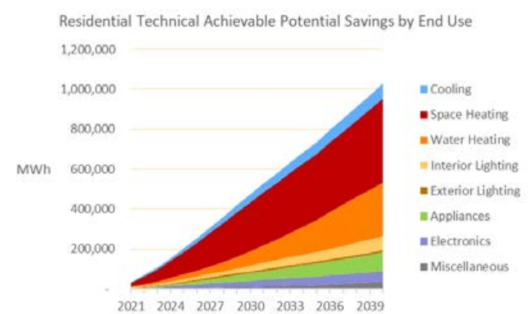
- Technical
- Technical Achievable
- Economic Screen *(TRC and UCT) are handled by Avista's IRP*

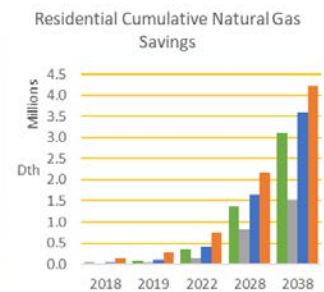












KEY SOURCES OF DATA

Prioritization of Avista Data

Data from Avista was prioritized when available, followed by regional data, and finally well-vetted national data.

Avista sources include:

- 2013 Residential GenPop Survey
- Forecast data and load research
- Recent-year accomplishments and plans

Regional sources include:

- NEEA studies (RBSA 2016, CBSA 2019, IFSA)
- RTF and Power Council methodologies, ramp rates, and measure assumptions

Additional sources include:

- U.S. DOE's Annual Energy Outlook
- U.S. DOE's projections on solid state lighting technology improvements
- Technical Reference Manuals and California DEER
- AEG Research

BASELINE PROJECTION

Overview

"How much energy would customers use in the future if Avista stopped running programs now and in the absence of naturally occurring efficiency?"

- The baseline projection answers this question

The baseline projection is an independent end-use forecast of electric or natural gas consumption at the same level of detail as the market profile

The baseline projection:

Includes	Excludes
• To the extent possible, the same forecast drivers used in the official load forecast, particularly customer growth, natural gas prices, normal weather, income growth, etc. • Trends in appliance saturations, including distinctions for new construction. • Efficiency options available for each technology , with share of purchases reflecting codes and standards (current and finalized future standards) • Expected impact of appliance standards that are "on the books" • Expected impact of building codes, as reflected in market profiles for new construction • Market baselines when present in regional planning assumptions	• Expected impact of naturally occurring efficiency (except market baselines) • **Exception:** RTF workbooks have a market baseline for lighting, which AEG's models also use. • Impacts of current and future demand-side management programs

Electric CPA

AVISTA 2020 ELECTRIC CPA

CPA Methodology Overview

- Levels of Potential
- Economic Evaluation and IRP Integration
- Retained enhancements from 2018 Action Plan

Summary of EE Results

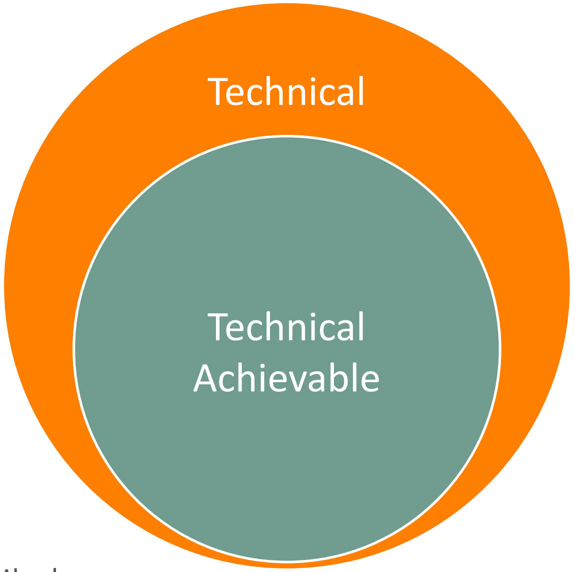
- Summary of Potential
  - High level results
  - Top measures
  - Potential by cost bundles
- Comparison to previous CPA

Summary of DR Results

TWO LEVELS OF SAVINGS ESTIMATES

Power Council Methodology

- Focus of the study is to explore a wide range of options for reducing annual energy use
- This study develops two sets of estimates:
  - Technical potential (TP): everyone chooses the most efficient option possible when equipment fails
    - This may include emerging or very expensive ultra-high efficiency technologies
  - Technical Achievable Potential (TAP) is a subset of TP that accounts for customer preference and likelihood to adopt through **both** utility-and non-utility driven mechanisms
    - To better emulate likely programs, Technical Achievable Potential calculates savings from efficient options more likely to be selected by the IRP



- In addition to these estimates, the study produces cost data for the TRC and UCT tests that can be used by Avista's IRP process to select energy efficiency measures in competition with other resources

ECONOMIC METRICS

Two Cost-Effectiveness Tests

AEG provided a levelized net cost of energy ($/kWh) for each measure within the achievable potential within Avista's Washington and Idaho territories from two perspectives.

- **Utility Cost Test (UCT):** Assesses cost-effectiveness from a utility or program administrator's perspective.
- **Total Resource Cost Test (TRC):** Assesses cost-effectiveness from the utility's and participant's perspectives. Includes non-energy impacts if they can be quantified and monetized.

Component	UCT	TRC
Avoided Energy	Benefit	Benefit
Non-Energy Benefits*		Benefit
Incremental Cost		Cost
Incentive	Cost	
Administrative Cost	Cost	Cost
Non-Energy Costs* (e.g. O&M)		Cost

*Council methodology includes monetized impacts on other fuels within these categories

Both values are provided to Avista for all measure level potential, so that the IRP can use the appropriate evaluation for each state: TRC for WA and UCT for ID.

ENHANCEMENTS RETAINED FROM 2018 CPA

AEG has preserved the enhancements to the CPA process that were included in the previous CPA:

- Any measures screened out in advance of technical potential are documented in the measure list along with the reason. As before, very few measures were excluded in this step
  - Measures that were excluded were generally either emerging measures with insufficient data to characterize properly, or highly custom measures that are instead modeled within broader retrocommissioning or strategic energy management programs.
- Full Technical Achievable potential is provided to the IRP along with TRC and UCT costs for each measure
- The Measure Assumptions appendix is again available, containing UES data and other key assumptions and their sources
- Demand Response potential includes analysis of both Summer and Winter possible programs

POTENTIAL ESTIMATES
Achievability

All potential "ramps up" over time – all ramp rates are based on those found within the NWPCC's 2021 Power Plan

- Max Achievability
  - NWPCC 2021 Plan allows some measures max achievability to reach up to 100% of technical potential
  - 7th Power Plan and prior CPA had a max achievability of 85%
  - AEG has aligned assumptions with the 2021 Plan and measures such as lighting reach greater than 85%

Measures examples over 85% Achievability:

- All Lighting
- Washers/Dryers
- Dishwashers
- Refrigerators/Freezers
- Circulation Pumps
- Thermostats
- C&I Fans

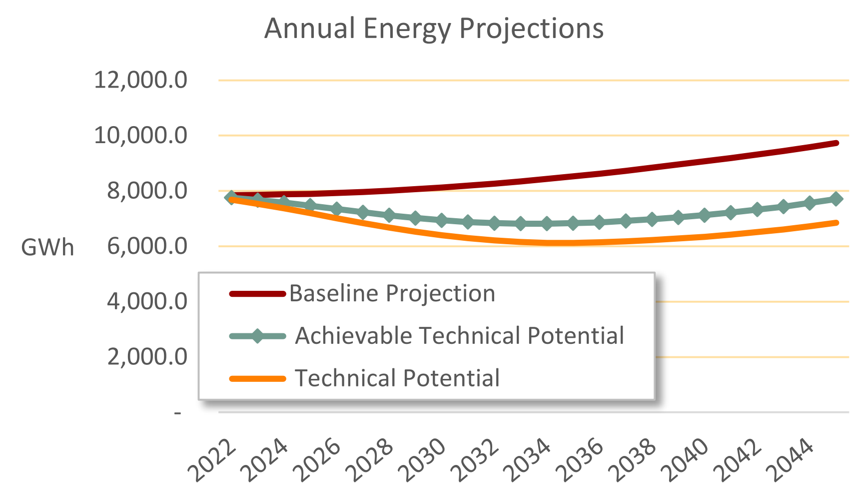
- **Please note** Power Council's ramp rates include potential realized from outside of utility DSM programs, including regional initiatives and market transformation

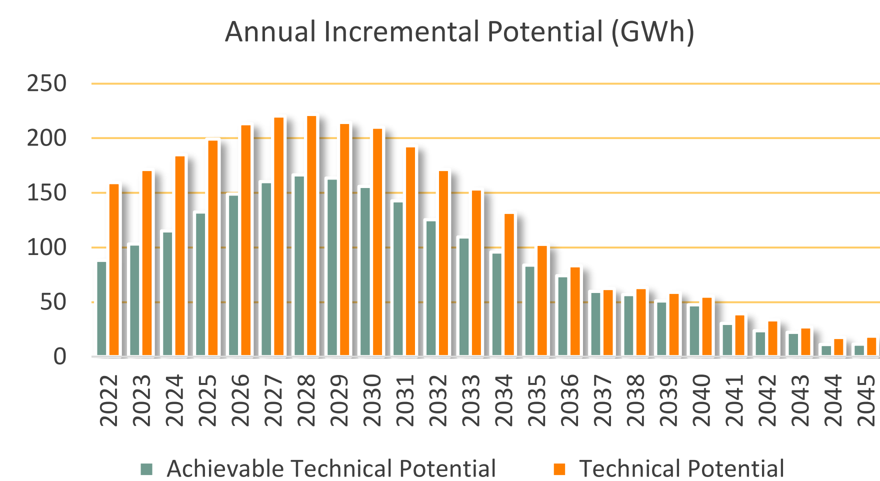
ENERGY EFFICIENCY POTENTIAL

Potential Summary –WA & ID All Sectors

Projections indicate that energy savings of ~1.0% of baseline consumption per year are Technically Achievable.

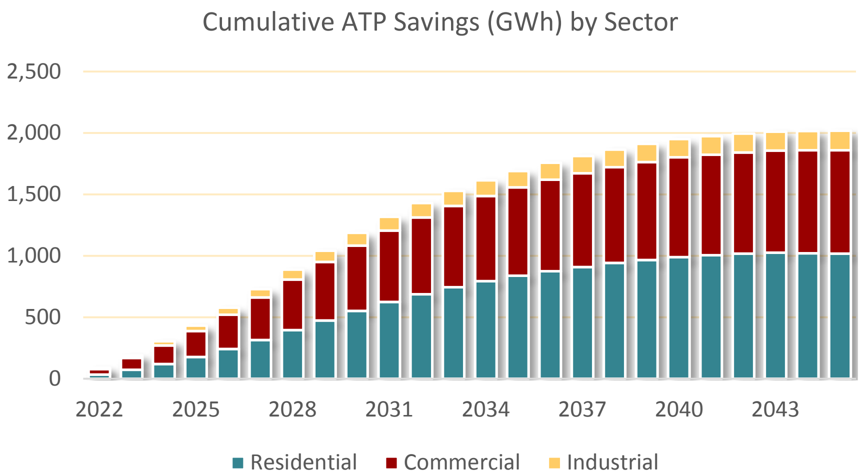
- 190 GWh (22 aMW) in biennium period (2022-2023)
- 1,317 GWh (150 aMW) by 2031
- This level of savings offsets future load growth

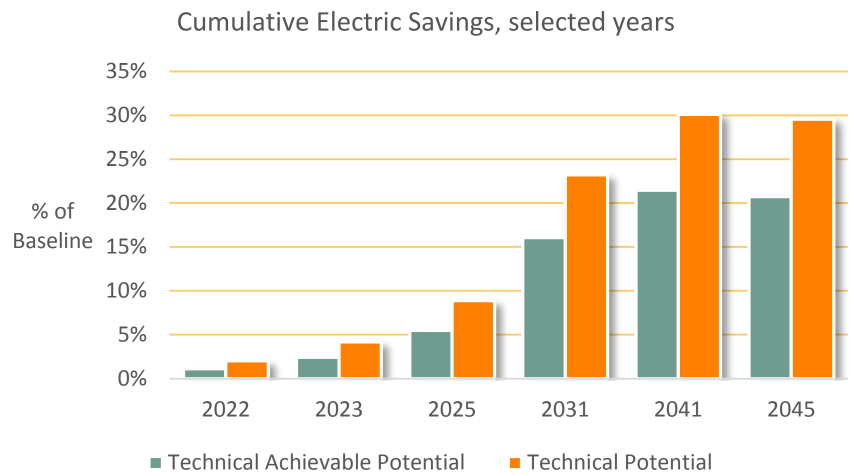




EE POTENTIAL, CONTINUED

Potential Summary – WA & ID, All Sectors

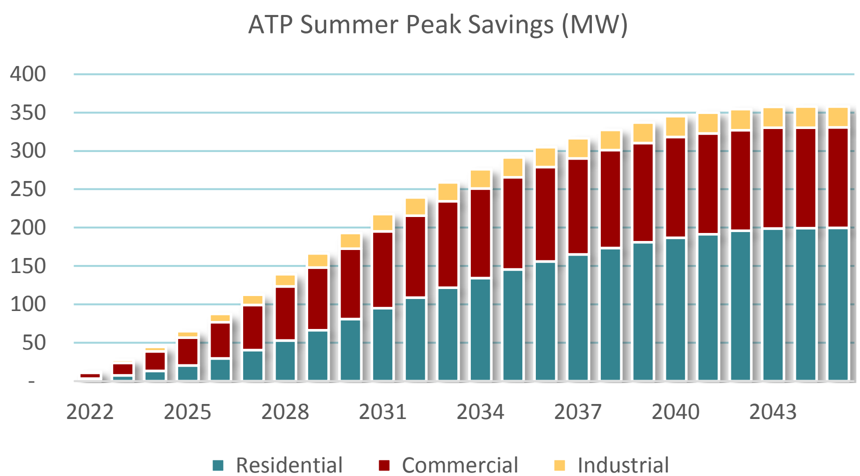


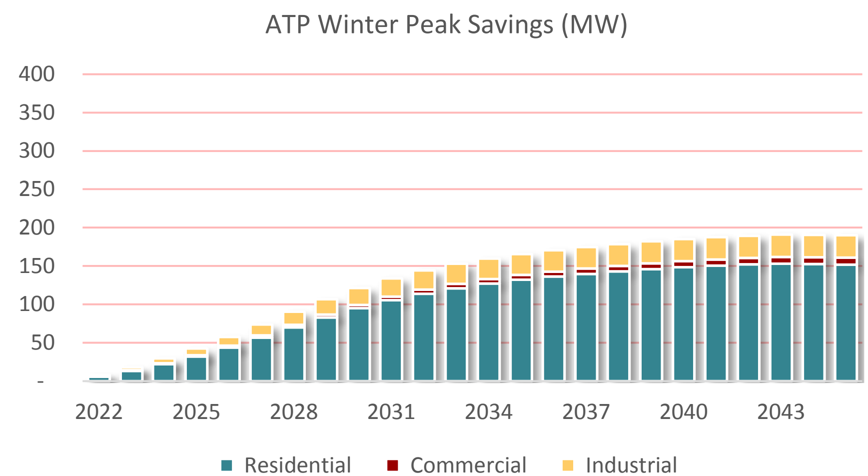


Summary of Energy Savings (GWh), Selected Years	2022	2023	2025	2031	2041	2045
Reference Baseline	7,842	7,863	7,898	8,192	9,193	9,727
Cumulative Savings (GWh)						
Technical Achievable Potential	88	190	432	1,317	1,974	2,019
Technical Potential	159	327	703	1,901	2,770	2,878
Energy Savings (% of Baseline)						
Technical Achievable Potential	1.1%	2.4%	5.5%	16.1%	21.5%	20.8%
Technical Potential	2.0%	4.2%	8.9%	23.2%	30.1%	29.6%
Incremental Savings (GWh)						
Technical Achievable Potential	88	103	133	143	31	11
Technical Potential	159	171	199	193	39	19

EE POTENTIAL - CONTINUED

ATP Peak Savings Summary – WA & ID, All Sectors



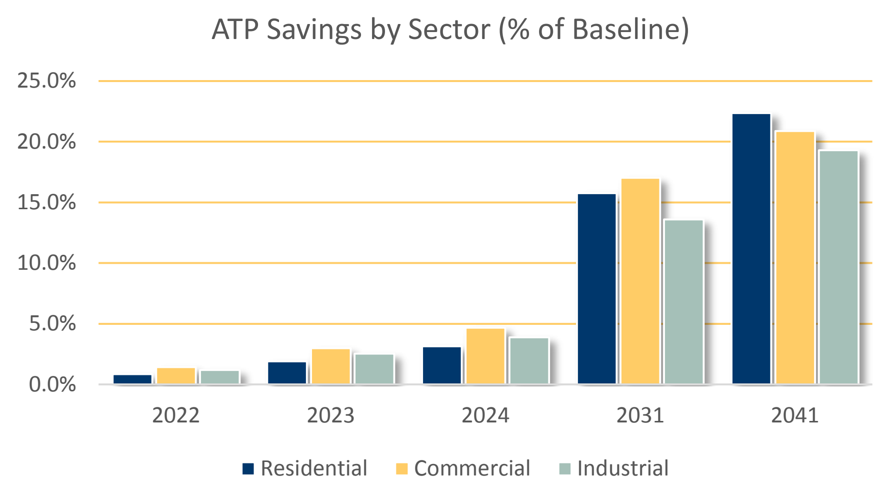


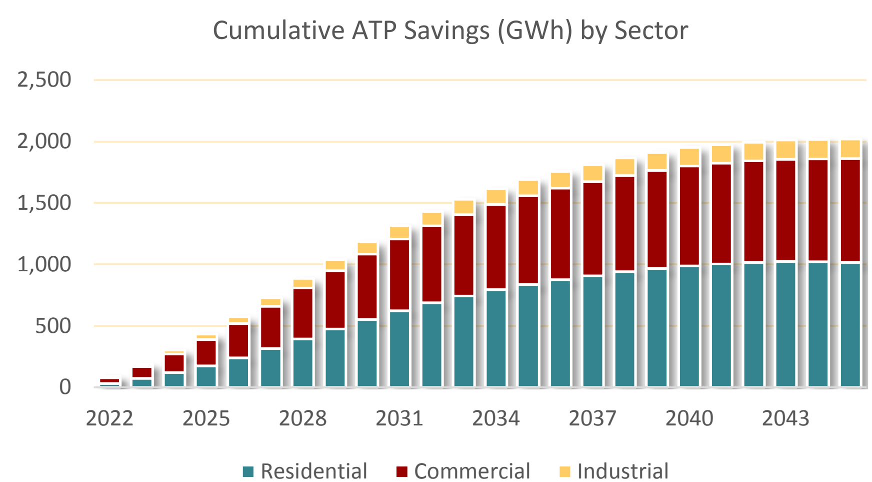
EE Peak Savings (MW), Selected Years	2022	2023	2025	2031	2041	2045
Reference Baseline						
Summer Peak MW	1,626	1,642	1,677	1,834	2,272	2,406
Winter Peak MW	1,518	1,522	1,529	1,574	1,716	1,791
Cumulative Savings (MW)						
Summer Peak	12.6	27.5	64.9	217.6	349.9	357.8
Winter Peak	8.2	18.2	42.6	134.1	187.5	190.1
Cumulative Savings (% of Baseline)						
Summer Peak	0.8%	1.7%	3.9%	11.9%	15.4%	14.9%
Winter Peak	0.5%	1.2%	2.8%	8.5%	10.9%	10.6%
Incremental Savings (MW)						
Summer Peak	12.8	15.2	20.4	25.9	4.9	0.9
Winter Peak	8.2	10.1	13.5	14.5	2.7	0.2

EE POTENTIAL BY SECTOR

Achievable Technical Potential – WA & ID

	2022	2023	2024	2031	2041
Baseline projection (GWh)					
Residential	3,774	3,785	3,796	3,953	4,489
Commercial	3,223	3,234	3,248	3,427	3,924
Industrial	845	843	839	812	780
Total Consumption (GWh)	**7,842**	**7,863**	**7,883**	**8,192**	**9,193**
ATP Cumulative Savings (GWh)					
Residential	32	72	120	623	1,004
Commercial	46	97	152	583	819
Industrial	10	21	33	110	151
Total Savings (GWh)	**88**	**190**	**304**	**1,317**	**1,974**
ATP Cumulative Savings (aMW)					
Residential	4	8	14	71	115
Commercial	5	11	17	67	94
Industrial	1	2	4	13	17
Total Savings (aMW)	**10**	**22**	**35**	**150**	**225**
ATP Cumulative Savings as a % of Baseline					
Residential	0.8%	1.9%	3.1%	15.8%	22.4%
Commercial	1.4%	3.0%	4.7%	17.0%	20.9%
Industrial	1.2%	2.5%	3.9%	13.6%	19.3%
Total Savings (% of Baseline)	**1.1%**	**2.4%**	**3.9%**	**16.1%**	**21.5%**





EE POTENTIAL - TOP MEASURES

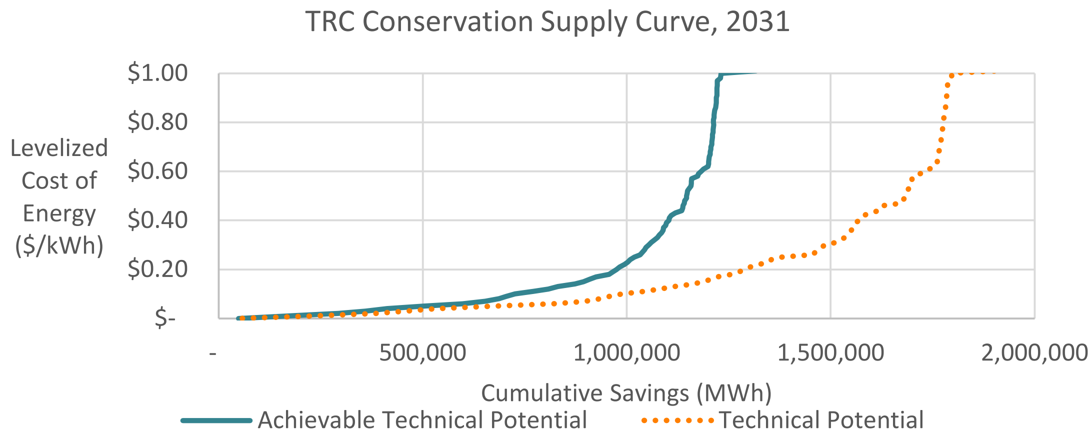
Cumulative Potential Summary – WA & ID All Sectors

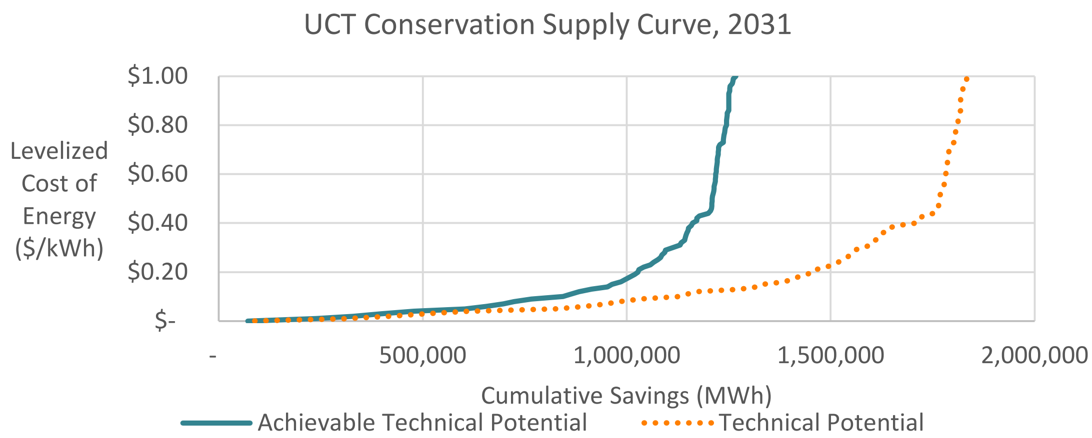
Technical Achievable Potential, Ranked by Savings in 2031 (MWh)

Rank	Measure / Technology	2023 Achievable Technical Potential (MWh)	% of Total	2031 Achievable Technical Potential (MWh)	% of Total	TRC Levelized $/kWh	UCT Levelized $/kWh
1	Commercial - Linear Lighting	9,139	4.8%	62,302	4.7%	$0.01	$0.00
2	Commercial - Retrocommissioning	9,318	4.9%	59,994	4.6%	$0.04	$0.04
3	Residential - Water Heater <= 55 Gal	2,647	1.4%	55,156	4.2%	$0.06	$0.05
4	Commercial - Strategic Energy Management	7,047	3.7%	44,581	3.4%	$0.09	$0.08
5	Residential - Ductless Mini Split Heat Pump (Zonal)	6,599	3.5%	42,085	3.2%	$0.60	$0.44
6	Residential - ENERGY STAR - Connected Thermostat	5,890	3.1%	40,216	3.1%	$0.18	$0.17
7	Residential - Windows - High Efficiency/ENERGY STAR	5,808	3.1%	35,780	2.7%	$1.14	$0.79
8	Residential - Ductless Mini Split Heat Pump with Optimized Controls (Ducted Forced Air)	1,485	0.8%	33,420	2.5%	$0.37	$0.26
9	Residential - Home Energy Management System (HEMS)	4,975	2.6%	30,271	2.3%	$0.27	$0.23
10	Residential - Windows - Cellular Shades	988	0.5%	28,248	2.1%	$0.18	$0.15
11	Commercial - HVAC - Dedicated Outdoor Air System (DOAS)	3,054	1.6%	21,141	1.6%	$0.68	$0.49
12	Residential - Insulation - Basement Sidewall Installation	2,933	1.5%	20,698	1.6%	$0.04	$0.03
13	Commercial - Space Heating - Heat Recovery Ventilator	5,128	2.7%	20,274	1.5%	$0.14	$0.10
14	Commercial - High-Bay Lighting	4,123	2.2%	19,394	1.5%	$0.00	$0.00
15	Residential - Windows - Low-e Storm Addition	2,832	1.5%	18,790	1.4%	$0.82	$0.33
16	Residential - Furnace - Conversion to Air-Source Heat Pump	639	0.3%	15,407	1.2%	$0.08	$0.06
17	Industrial - High-Bay Lighting	6,056	3.2%	14,687	1.1%	$0.00	$0.00
18	Commercial - General Service Lighting	3,181	1.7%	13,705	1.0%	$0.05	$0.03
19	Commercial - Interior Lighting - Embedded Fixture Controls	2,470	1.3%	13,523	1.0%	$0.08	$0.06
20	Residential - Connected Line-Voltage Thermostat	1,817	1.0%	13,433	1.0%	$0.12	$0.10
	Total of Top 20 Measures	**86,126**	**45.2%**	**603,105**	**45.8%**		
	Total Cumulative Savings	**190,351**	**100.0%**	**1,316,823**	**100.0%**		

SUPPLY CURVES

WA & ID Technical Achievable Potential by 2031





EE POTENTIAL

Top Measure Notes

- Some expensive or emerging measures have significant **technical achievable** potential, but may not be selected by the IRP due to costs
- Heat Pump measures, including DHPs and HPWHs, have significant annual energy benefits, however since heat pumps revert to electric resistance heating during extreme cold, they do not have a corresponding winter peak benefit
- In addition to being expensive, some emerging tech measures are included in Technical Achievable which may not prove feasible for programs at this time, but can be kept in mind for future programs, e.g.:
  - Advanced New Construction – Zero Net Energy
  - Connected Home Control Systems

EE POTENTIAL - CONTINUED

Peak Impacts – **Technical Achievable Potential**

	Top Measures - Winter Peak (MW) Reduction by 2031	2031 MW	% of Total
1	Residential - ENERGY STAR - Connected Thermostat	12	8.9%
2	Residential - Windows - High Efficiency/ENERGY STAR	10	7.8%
3	Residential - Windows - Cellular Shades	8	5.8%
4	Residential - Insulation - Basement Sidewall Installation	7	5.4%
5	Residential - Windows - Low-e Storm Addition	7	5.0%
6	Residential - Home Energy Management System (HEMS)	5	4.0%
7	Residential - Connected Line-Voltage Thermostat	5	3.4%
8	Commercial - Linear Lighting	4	3.2%
9	Residential - Building Shell - Air Sealing (Infiltration Control)	4	3.0%
10	Residential - Insulation - Floor Upgrade	4	2.9%
11	Residential - Ducting - Repair and Sealing	4	2.7%
12	Residential - Insulation - Floor Installation	3	2.5%
13	Residential - Water Heater <= 55 Gal	3	2.5%
14	Residential - Insulation - Ducting	3	2.4%
15	Residential - Ducting - Repair and Sealing - Aerosol	3	2.2%
16	Residential - Building Shell - Liquid-Applied Weather-Resistive Barrier	3	2.2%
17	Industrial - Fan System - Equipment Upgrade	3	1.9%
18	Industrial - Retrocommissioning	3	1.9%
19	Residential - Building Shell - Whole-Home Aerosol Sealing	2	1.8%
20	Industrial - Strategic Energy Management	2	1.6%
	Total of Top 20 Measures	**95**	**70.9%**
	Total Cumulative Savings	**134**	**100.0%**

	Top Measures - Summer Peak (MW) Reduction by 2031	2031 MW	% of Total
1	Commercial - Retrocommissioning	12	5.6%
2	Residential - ENERGY STAR - Connected Thermostat	11	5.0%
3	Residential - Windows - High Efficiency/ENERGY STAR	11	5.0%
4	Residential - Windows - Cellular Shades	10	4.8%
5	Residential - Ductless Mini Split Heat Pump (Zonal)	8	3.7%
6	Commercial - Strategic Energy Management	8	3.6%
7	Residential - Whole-House Fan - Installation	7	3.2%
8	Residential - Room AC - Removal of Second Unit	7	3.1%
9	Residential - Home Energy Management System (HEMS)	6	2.7%
10	Commercial - HVAC - Dedicated Outdoor Air System (DOAS)	6	2.6%
11	Residential - Insulation - Ceiling Installation	6	2.6%
12	Commercial - RTU - Evaporative Precooler	5	2.4%
13	Commercial - Linear Lighting	5	2.2%
14	Residential - Ductless Mini Split Heat Pump with Optimized Controls (Ducted Forced Air)	4	1.9%
15	Residential - Insulation - Wall Sheathing	4	1.9%
16	Commercial - Chiller - Variable Flow Chilled Water Pump	4	1.8%
17	Residential - Central AC	4	1.8%
18	Residential - Building Shell - Liquid-Applied Weather-Resistive Barrier	4	1.7%
19	Commercial - RTU - Advanced Controls	3	1.5%
20	Residential - Behavioral Programs (Incremental)	3	1.5%
	Total of Top 20 Measures	**128**	**58.7%**
	Total Cumulative Savings	**218**	**100.0%**

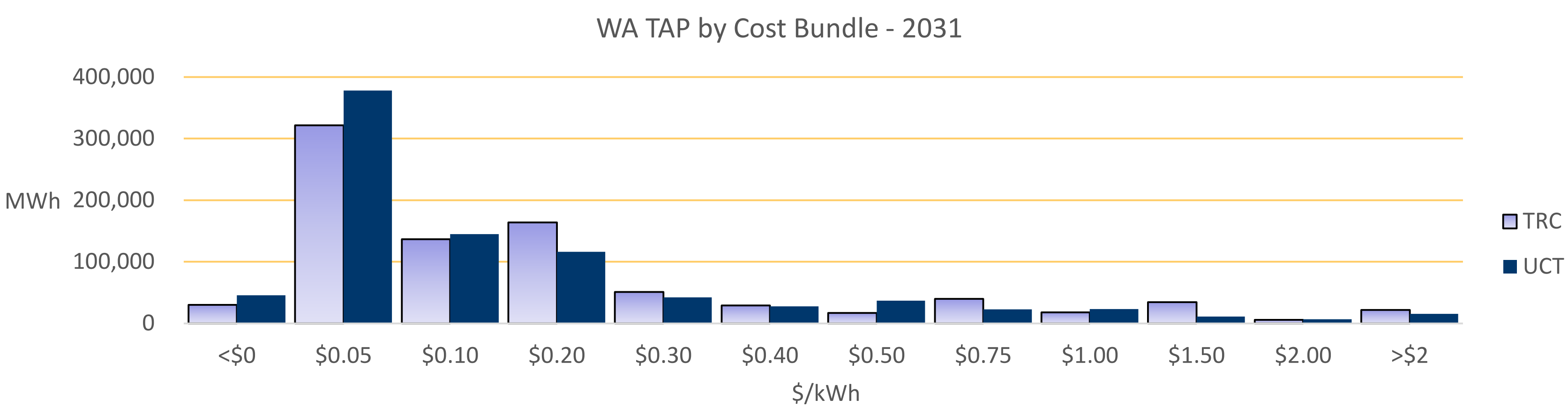
COST OF SAVINGS

WA – TAP by Bundled $/kWh

Washington

TRC $/kWh	2022	2023	2031
< $0.00	2,899	6,276	30,063
$0.00 - $0.05	21,071	45,441	321,449
$0.06 - $0.10	7,784	17,210	136,569
$0.11 - $0.20	8,689	19,108	163,687
$0.21 - $0.30	3,809	7,928	50,997
$0.31 - $0.40	1,680	3,665	29,050
$0.41 - $0.50	985	2,128	16,590
$0.51 - $0.75	2,750	5,952	39,772
$0.76 - $1.00	1,233	2,685	17,996
$1.01 - $1.50	2,754	5,954	34,569
$1.51 - $2.00	419	880	5,849
> $2.00	1,671	3,574	21,755

UCT $/kWh	2022	2023	2031
< $0.00	3,050	6,417	45,484
$0.00 - $0.05	25,187	54,710	377,861
$0.06 - $0.10	7,546	16,772	144,587
$0.11 - $0.20	6,766	14,588	115,890
$0.21 - $0.30	3,248	6,814	42,005
$0.31 - $0.40	1,603	3,418	27,599
$0.41 - $0.50	2,349	5,229	36,677
$0.51 - $0.75	1,639	3,542	22,466
$0.76 - $1.00	1,959	4,190	23,004
$1.01 - $1.50	712	1,522	10,768
$1.51 - $2.00	623	1,296	6,795
> $2.00	1,061	2,305	15,209



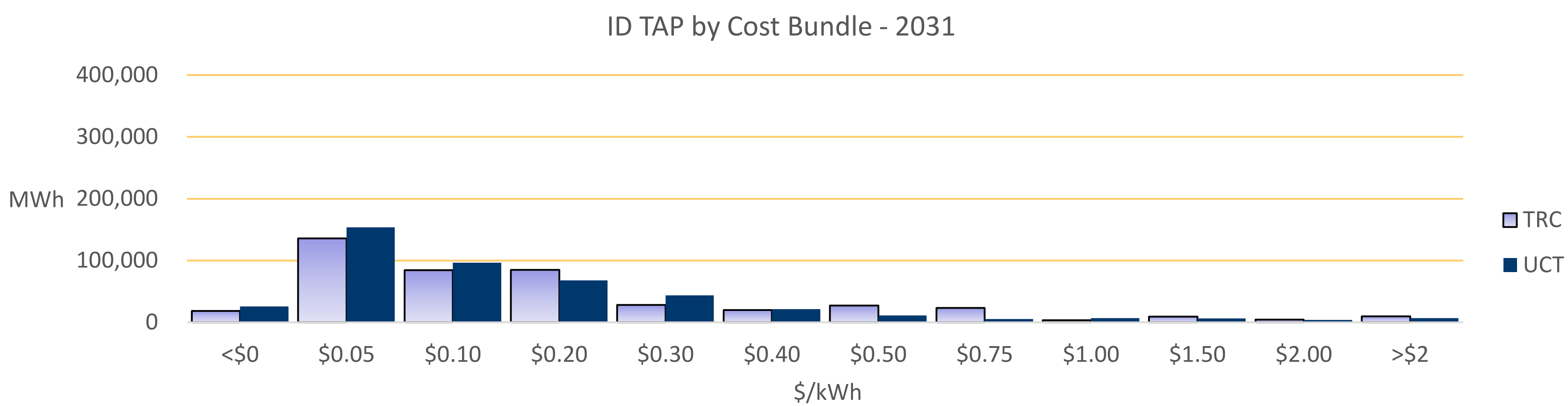
COST OF SAVINGS

ID – TAP by Bundled $/kWh

Idaho

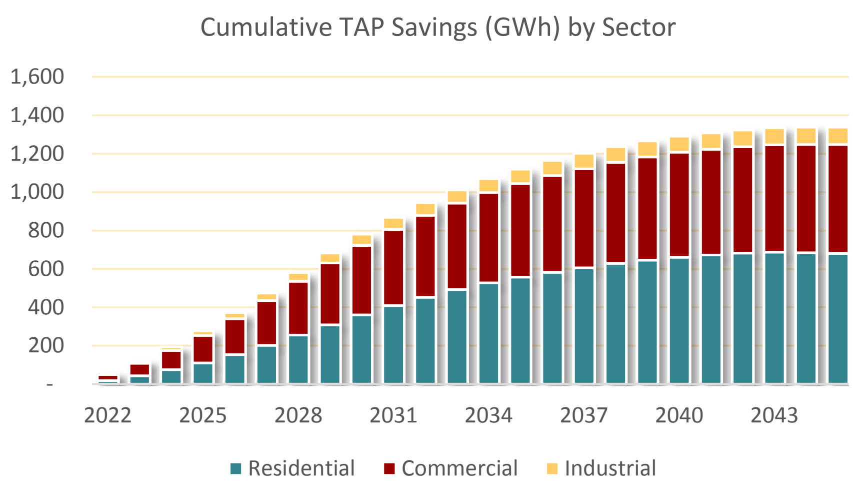
TRC $/kWh	2022	2023	2031
< $0.00	1,906	4,142	18,262
$0.00 - $0.05	11,189	23,472	135,613
$0.06 - $0.10	5,225	11,304	84,553
$0.11 - $0.20	5,335	11,461	84,826
$0.21 - $0.30	1,776	3,826	28,334
$0.31 - $0.40	1,037	2,306	19,831
$0.41 - $0.50	1,959	4,258	27,243
$0.51 - $0.75	1,638	3,594	23,138
$0.76 - $1.00	304	638	3,560
$1.01 - $1.50	806	1,705	9,065
$1.51 - $2.00	334	693	4,180
> $2.00	1,047	2,148	9,873

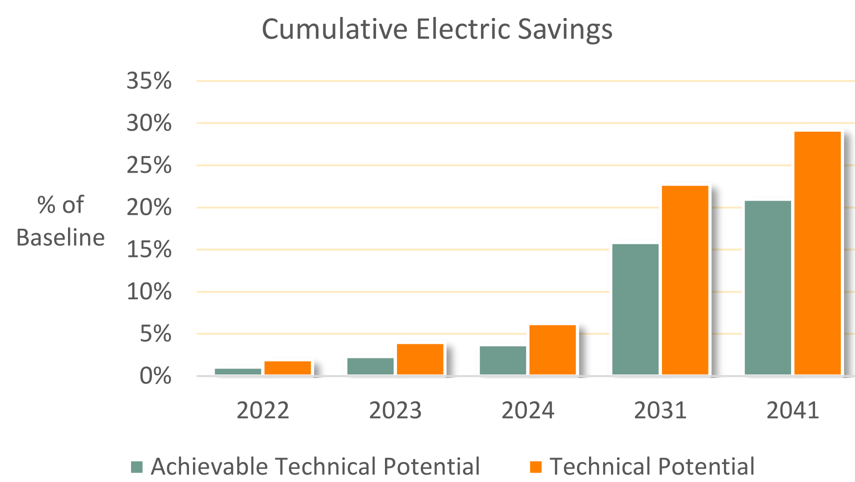
UCT $/kWh	2022	2023	2031
< $0.00	1,631	3,449	25,696
$0.00 - $0.05	12,929	27,284	153,798
$0.06 - $0.10	6,082	13,171	96,251
$0.11 - $0.20	4,224	9,124	67,796
$0.21 - $0.30	2,767	6,061	43,471
$0.31 - $0.40	1,455	3,140	21,259
$0.41 - $0.50	837	1,826	11,325
$0.51 - $0.75	406	884	5,279
$0.76 - $1.00	633	1,322	6,969
$1.01 - $1.50	540	1,124	6,089
$1.51 - $2.00	409	825	3,796
> $2.00	642	1,337	6,748



EE POTENTIAL, CONTINUED

Potential Summary – Washington, All Sectors

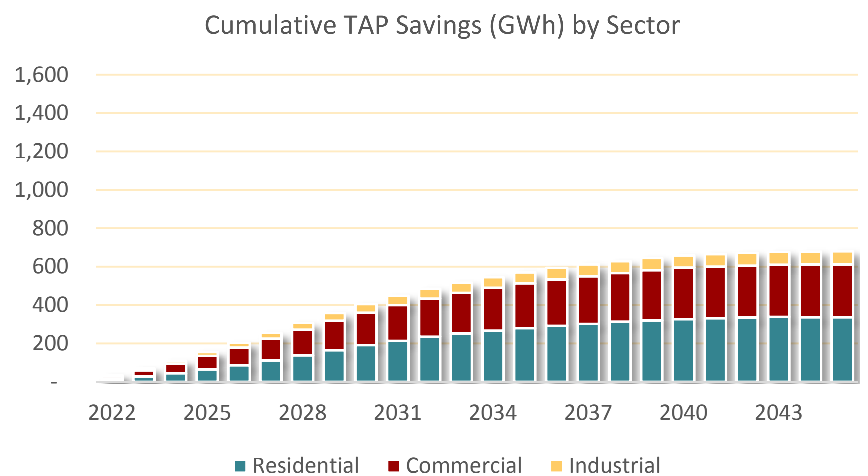


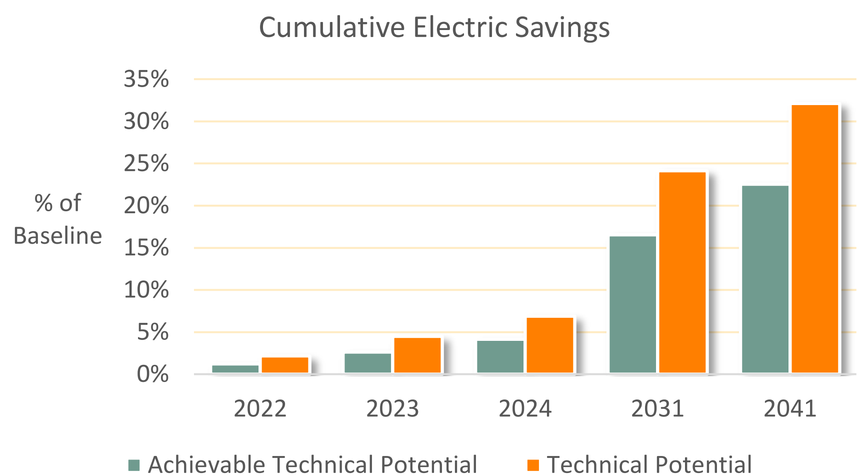


	2022	2023	2024	2031	2041
Baseline projection (GWh)	5,196	5,212	5,229	5,479	6,243
Cumulative Savings (GWh)					
Achievable Technical Potential	56	121	194	868	1,309
Technical Potential	101	209	325	1,247	1,822
Cumulative Savings (aMW)					
Achievable Technical Potential	6	14	22	99	149
Technical Potential	12	24	37	142	208
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.1%	2.3%	3.7%	15.8%	21.0%
Technical Potential	2.0%	4.0%	6.2%	22.8%	29.2%

EE POTENTIAL, CONTINUED

Potential Summary – Idaho, All Sectors





	2022	2023	2024	2031	2041
Baseline projection (GWh)	2,646	2,650	2,653	2,713	2,951
Cumulative Savings (GWh)					
Achievable Technical Potential	33	70	110	448	665
Technical Potential	58	119	183	654	948
Cumulative Savings (aMW)					
Achievable Technical Potential	4	8	13	51	76
Technical Potential	7	14	21	75	108
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.2%	2.6%	4.1%	16.5%	22.5%
Technical Potential	2.2%	4.5%	6.9%	24.1%	32.1%

Comparison with 2018 Electric CPA

NOTES ON COMPARISON

Comparison with Prior Potential Study

We are often asked to compare results between current and prior potential study estimates – it is important to define comparison parameters.

Aligning calendar years, rather than study years results in a more thorough comparison

- This is mainly due to things like equipment standards, which come on by calendar year, not relative to the start year of the study

Since we are not estimating potential in 2021, potential for that year must be removed from the comparison

- **First-Year Incremental Potential** - 2022
  - Prior Study: 2nd year of potential
  - Current Study: first year

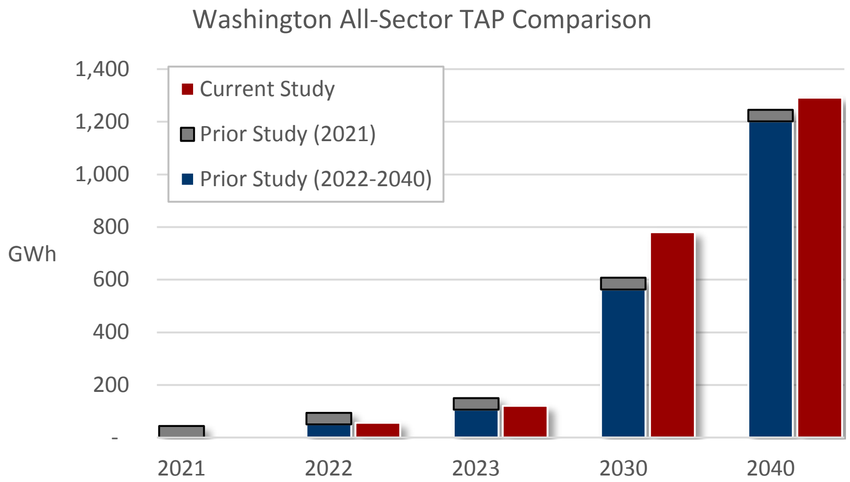
The previous study's 20-year look ended in 2040, therefore we must remove 2041-2045 from the comparison

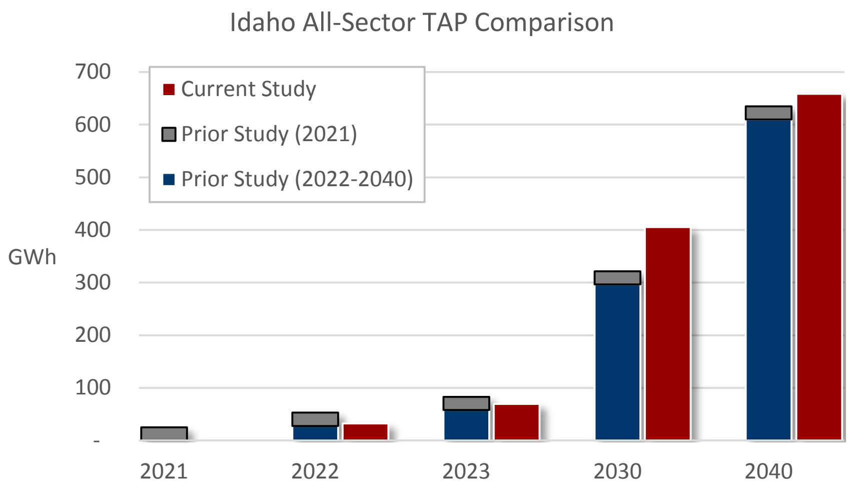
- **Cumulative Potential Comparisons** – 2022 through year 2040
  - This should have a minimal impact on potential since retrofits are mainly captured prior to this point

As a result, we can draw up to a 19 year comparison (2022-2040)

ACHIEVABLE POTENTIAL COMPARISON

Comparison with Prior Potential Study (2022-2037 **TAP**)

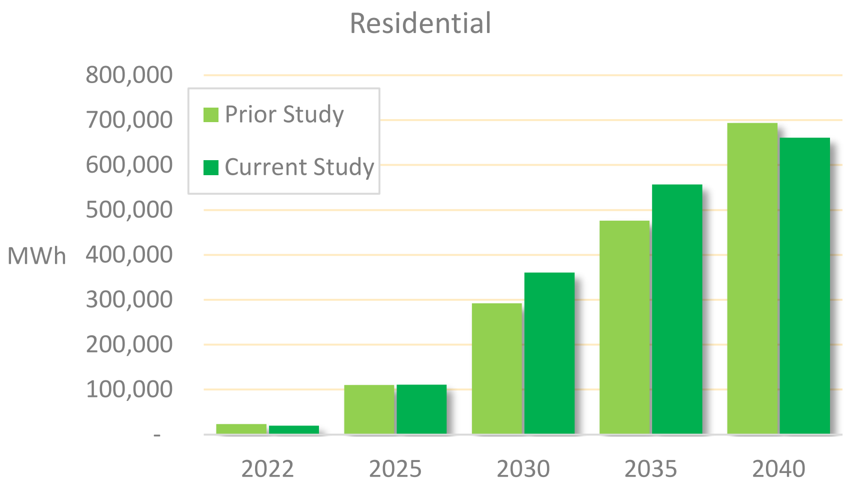


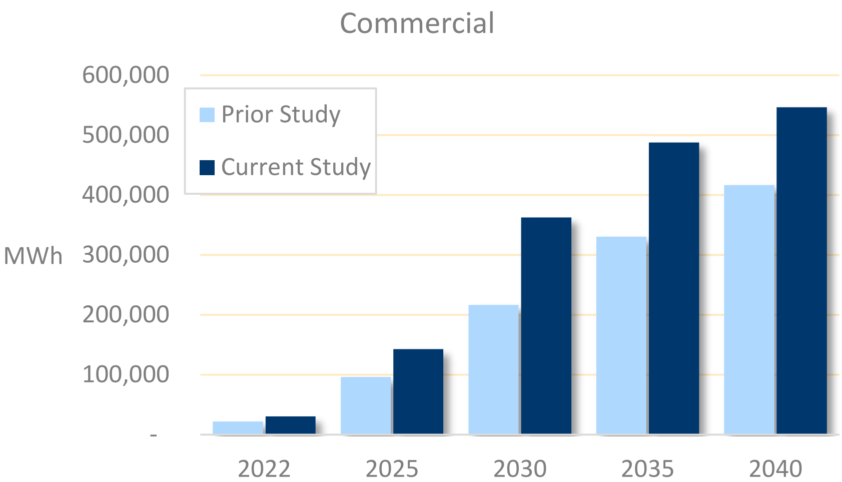


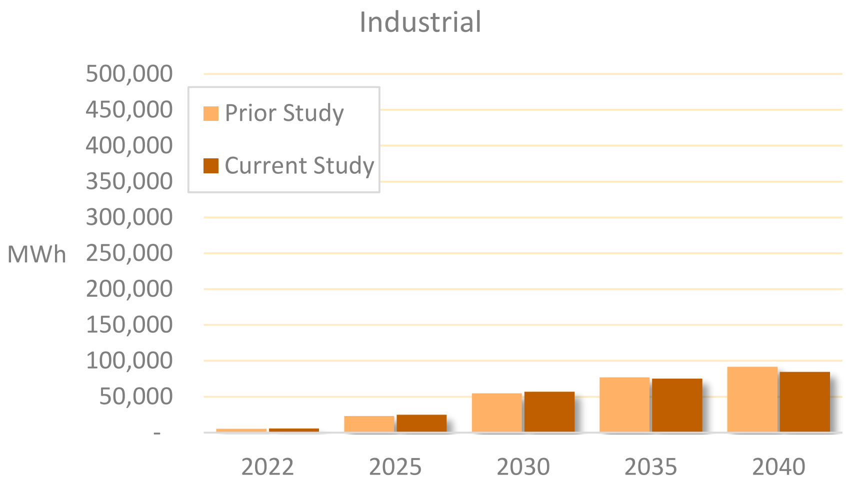
Sector (All States)	End Use	Prior CPA 2040 MWh	Current Study 2040 MWh	Diff.
Residential	Cooling	74,528	112,573	38,045
	Heating	444,182	442,897	-1,285
	Water Heating	267,144	217,843	-49,301
	Interior Lighting	63,331	24,122	-39,209
	Exterior Lighting	10,059	4,122	-5,937
	Appliances	91,966	82,297	-9,668
	Electronics	49,899	58,651	8,752
	Miscellaneous	35,248	45,661	10,413
Commercial	Cooling	99,708	145,262	45,554
	Heating	33,372	100,989	67,617
	Ventilation	73,363	116,241	42,878
	Water Heating	22,078	26,182	4,104
	Interior Lighting	261,940	210,469	-51,471
	Exterior Lighting	103,244	61,188	-42,057
	Refrigeration	42,103	119,602	77,499
	Food Preparation	0	8,517	8,517
	Office Equipment	3,805	14,945	11,139
	Miscellaneous	2,018	10,216	8,198
Industrial	Cooling	6,160	4,779	-1,381
	Heating	11,042	566	-10,476
	Ventilation	7,942	11,679	3,736
	Interior Lighting	52,125	49,781	-2,344
	Exterior Lighting	12,428	5,213	-7,215
	Motors	33,106	69,081	35,975
	Process	10,059	7,012	-3,047
	Miscellaneous	671	775	104
Grand Total		**1,811,520**	**1,950,662**	**139,142**

SECTOR-LEVEL ACHIEVABLE POTENTIAL

Washington - Comparison with Prior Study **– Technical Achievable**



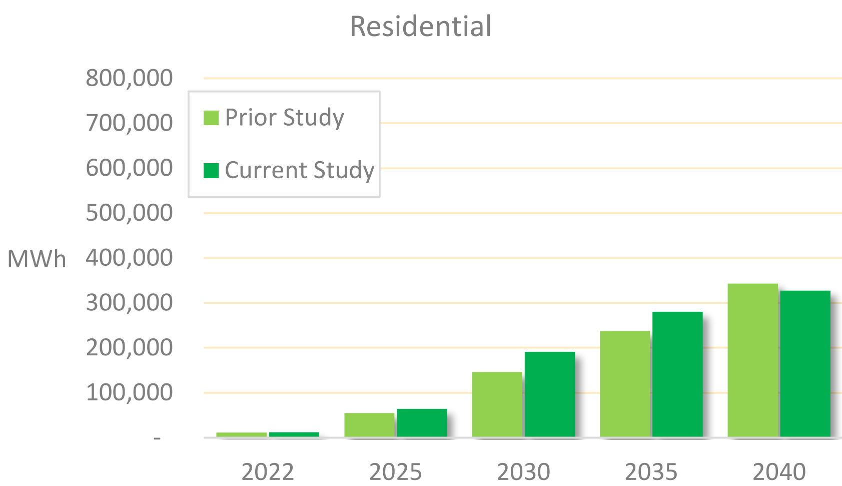


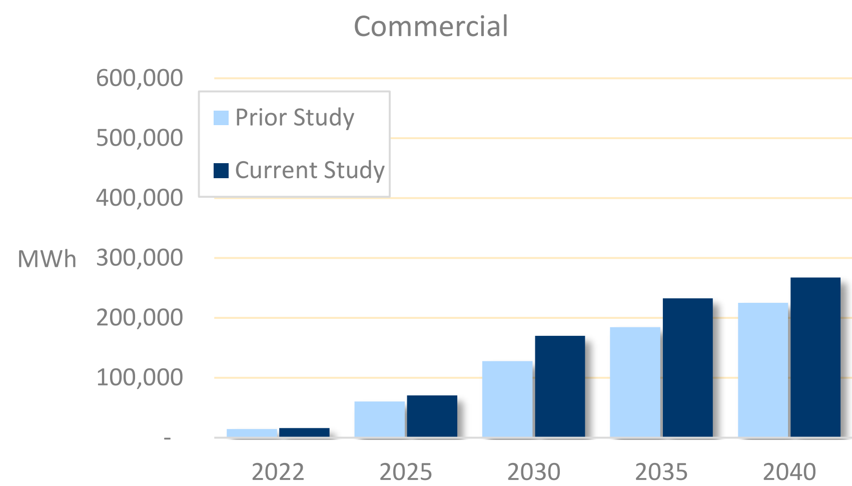


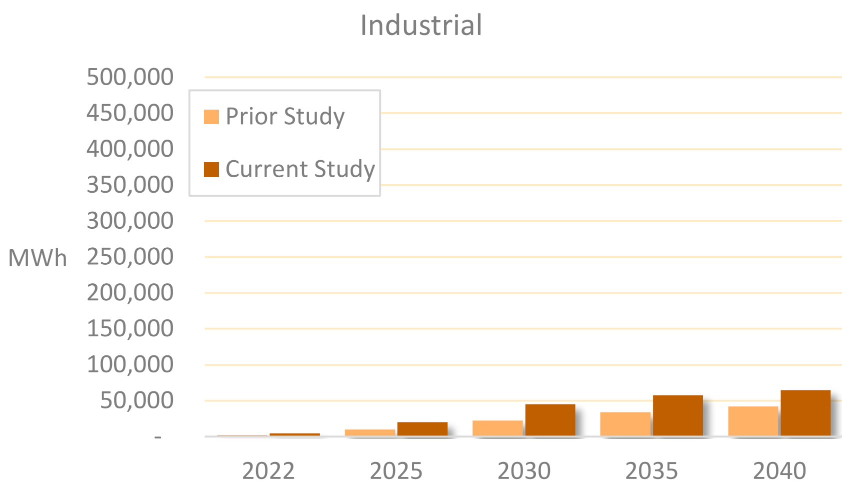
- 2020 savings already removed from prior study values

SECTOR-LEVEL ACHIEVABLE POTENTIAL

Idaho - Comparison with Prior Study – **Technical Achievable**







- 2020 savings already removed from prior study values

SECTOR-LEVEL NOTES

Comparison with Prior Potential Study – **Technical Achievable**

Residential:

- LED share of interior lighting market baseline continues to grow, reducing available potential from turnover of old units
  - This limits the extra potential Idaho gets from not having the EISA backstop in place
- HPWH savings have been revised slightly downward

Commercial:

- Decreases in interior lighting potential as base LED share grows in interior lighting; accelerated turnover and ramp rate compensates, but not completely
- Increased refrigeration potential from new and emerging measures, updated RTF workbooks
- HVAC retrocommissioning and controls (e.g. Strategic Energy Management systems) greatly expanded applicability in 2021 plan compared to prior study

Industrial:

- Increased potential in motors from updated retrofit applicability in 2021 plan

NEXT STEPS

- AEG has provided measure list and assumption appendices for EE to Avista for circulation
- Electric IRP will evaluate cost effective portfolio based on AEG provided savings and levelized costs
- Gas IRP will run with AEG-provided UCT cost effective potential

Thank You!

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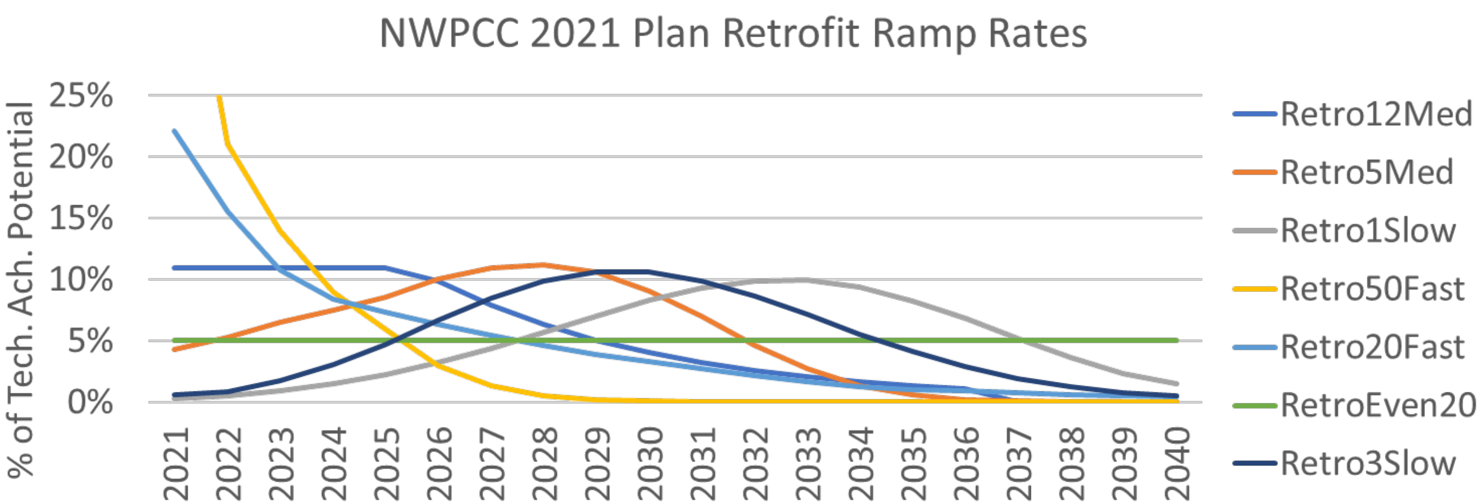
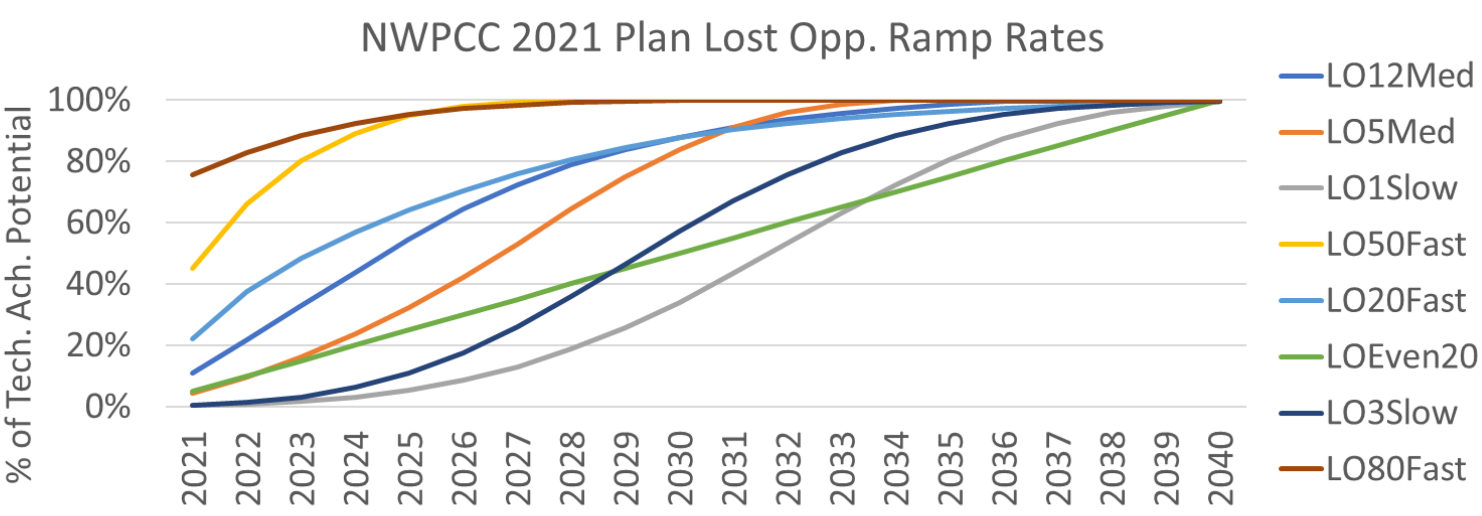
Supplemental Slides

NWPCC 2021 PLAN RAMP RATES





EE RAMP RATE CHANGES

Sector(s)	Measure Category	Equipment or Non-Equip	2019 CPA Ramp Rate	2021 Plan Ramp Rate
Res	Appliances	Equipment	LO1Slow	LO12Med
Res	Building Shell	Non-Equipment	Retro12Med	Retro5Med
Res	Energy Kits	Non-Equipment	Aerators: Retro3Slow, SH: Ret12Med	Retro3Slow
Res	HVAC	Equipment	LO5Med CAC, LO1Slow RAC	LO5Med CAC, LO12Med RAC
Res	HVAC	Non-Equipment	Thermostat&DHP Retro5Med, Retro3Slow	Thermostat&DHP Retro5Med, Retro5Med
Res	Lighting	Equipment	LO12Med & LO20 Fast	LO20Fast
Res	Water Heating	Equipment	LO3Slow	LO5Med
Res	Whole Home	Non-Equipment	LOEven20	NA
Res	Electronics	Non-Equipment	Retro3Slow	Retro3Slow

Sector(s)	Measure Category	Equipment or Non-Equip	2019 CPA Ramp Rate	2021 Plan Ramp Rate
C&I	Building Shell	Non-Equipment	RetroEven20	Retro1Slow
C&I	Compressed Air	Both	Retro5Med, Retro12Med	Retro5Med, Retro12Med
C&I	Energy Management	Non-Equipment	Retro12Med	Retro5Med
C&I	Food Service Equipment	Equipment	LO5Med, LO12Med	LO3Slow, LO1Slow
C&I	HVAC	Equipment	LO5Med, LO20Fast	LO5Med, LO12Med
C&I	HVAC	Non-Equipment	RetroEven20, Retro12Med, Retro3Slow, Retro1Slow	Retro12Med, Retro5Med
C&I	Irrigation	Non-Equipment	Retro12Med mostly	RetroEven20
C&I	Lighting	Equipment	LO20Fast/LO50Fast	LO80Fast
C&I	Motors	Non-Equipment	Retro12Med	Retro12Med
C&I	Refrigeration	Both	Retro12Med	Retro5Med

- Several residential categories were adjusted to faster ramp rates
- C&I changes mostly slowed adoption, except for lighting which is greatly accelerated and non-equipment HVAC (maintenance, tune ups, etc) which accelerated

Legend:
Faster Ramp
Slower Ramp
No Change
**compared to 2019 CPA Ramps*

DEFINITIONS OF POTENTIAL

Cumulative and Incremental

Over the following slides, we will display potential both as a **cumulative** impact on baseline as well as in annual **increments**

Cumulative potential includes the impacts of potential acquired from the first year of the study period (2022) through the year of interest, including effects of measures persistence

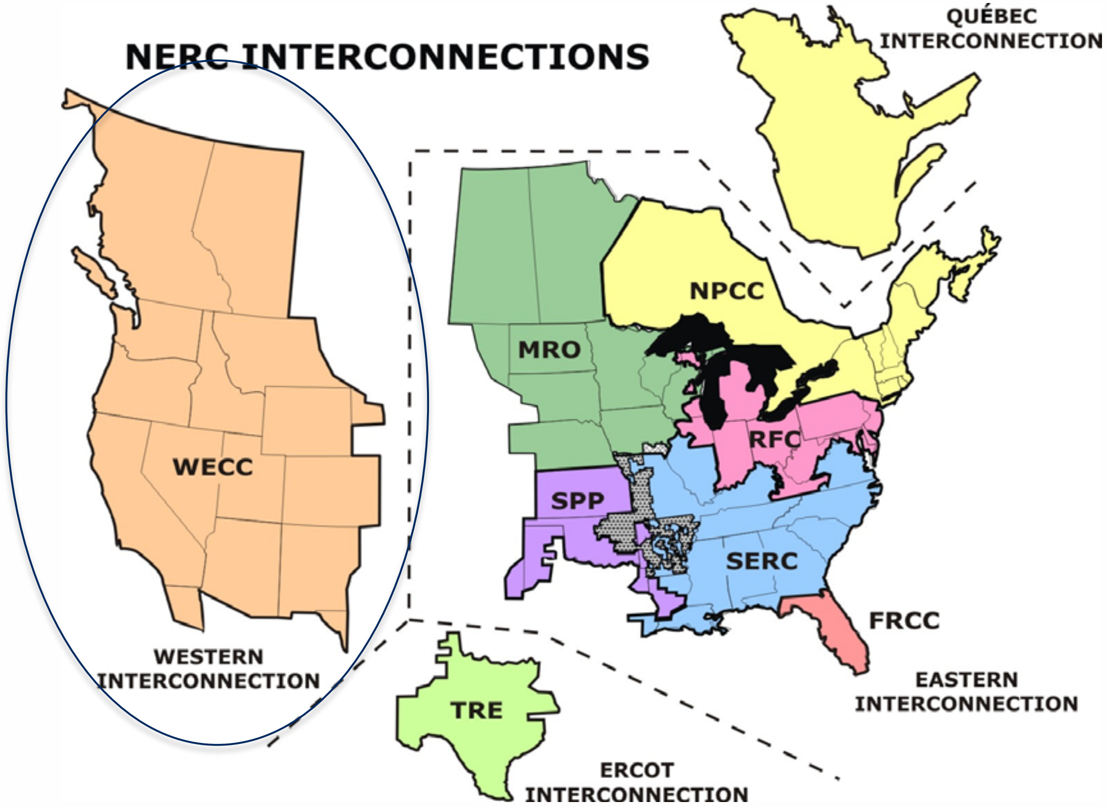
Incremental potential summarizes new impacts realized in any given year of interest, excluding the effects of measure repurchases

Electric Wholesale Market Price Forecast

James Gall, Electric IRP Manager
Third Technical Advisory Committee Meeting
September 29, 2020

Market Price Forecast – Purpose

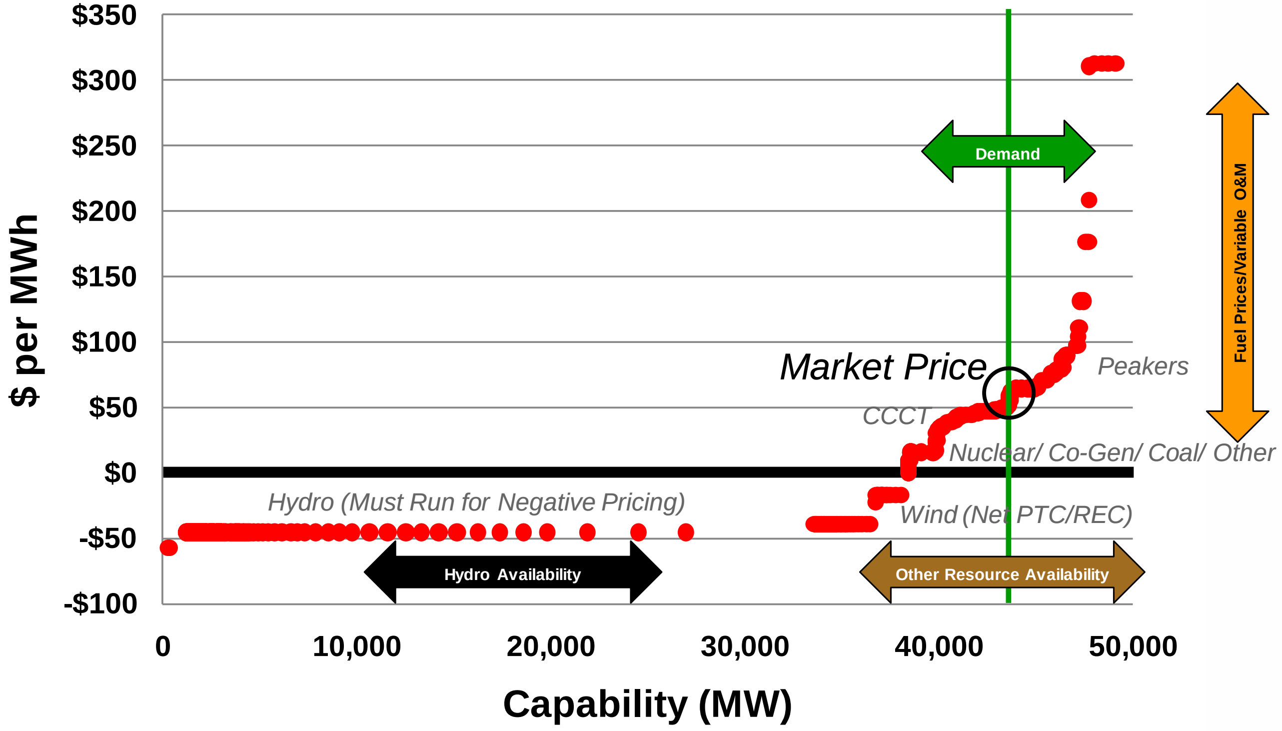
- Estimate "market value" of resources options for the IRP
- Estimate dispatch of "dispatchable" resources
- Helps estimate avoided costs
- May change resource selection if resource production is counter to needs of the wholesale market



Source: NERC

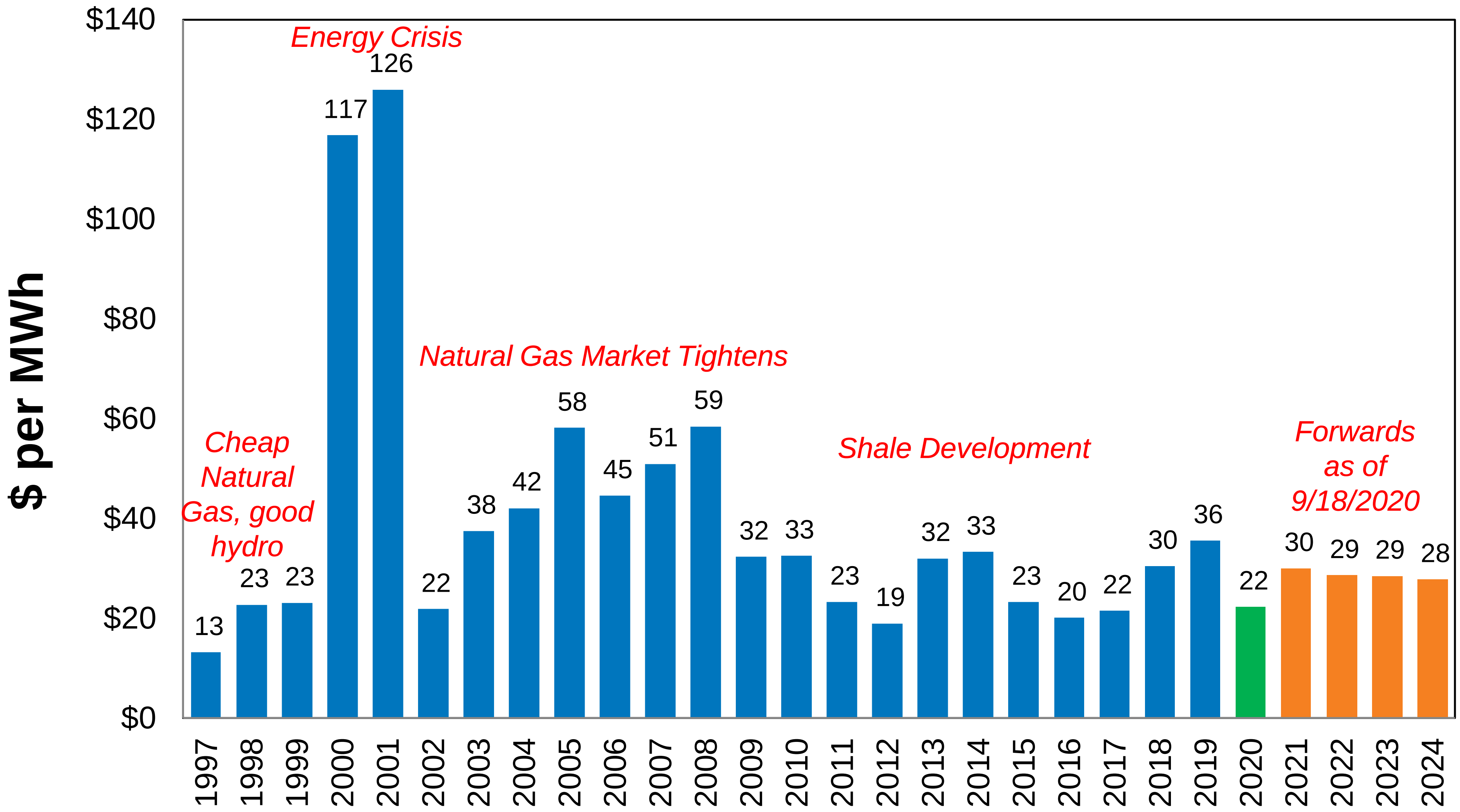
Methodology

- 3rd party software- Aurora by Energy Exemplar
- Electric market fundamentals- production cost model
- Simulates generation dispatch to meet regional load
- Outputs:
  - Market prices (electric & emission)
  - Regional energy mix
  - Transmission usage
  - Greenhouse gas emissions
  - Power plant margins, generation levels, fuel costs
  - Avista's variable power supply costs

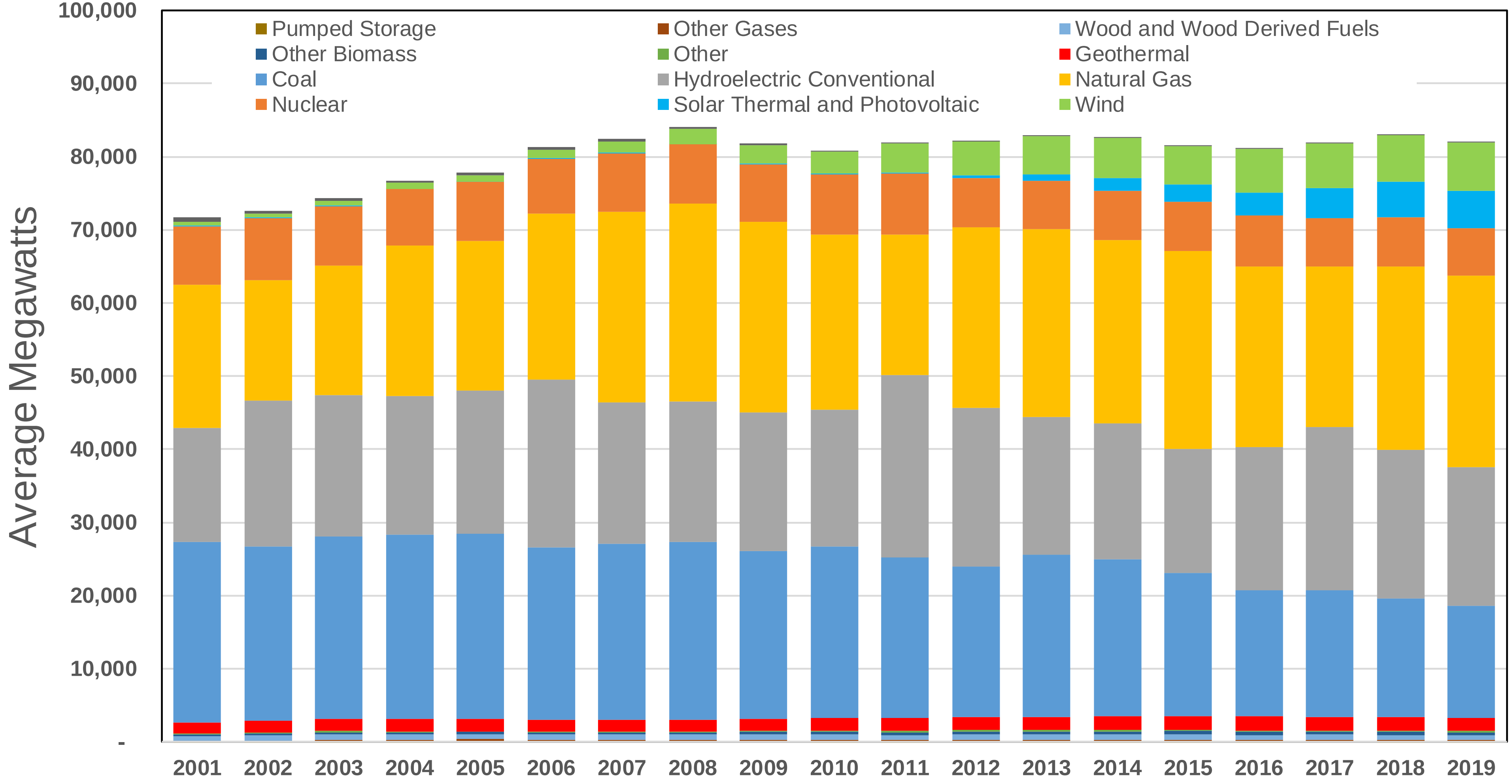


Note: minimum price is negative $25/ MWh (2018$)

Wholesale Mid-C Electric Market Price History



U.S. Western Interconnect Generation Mix



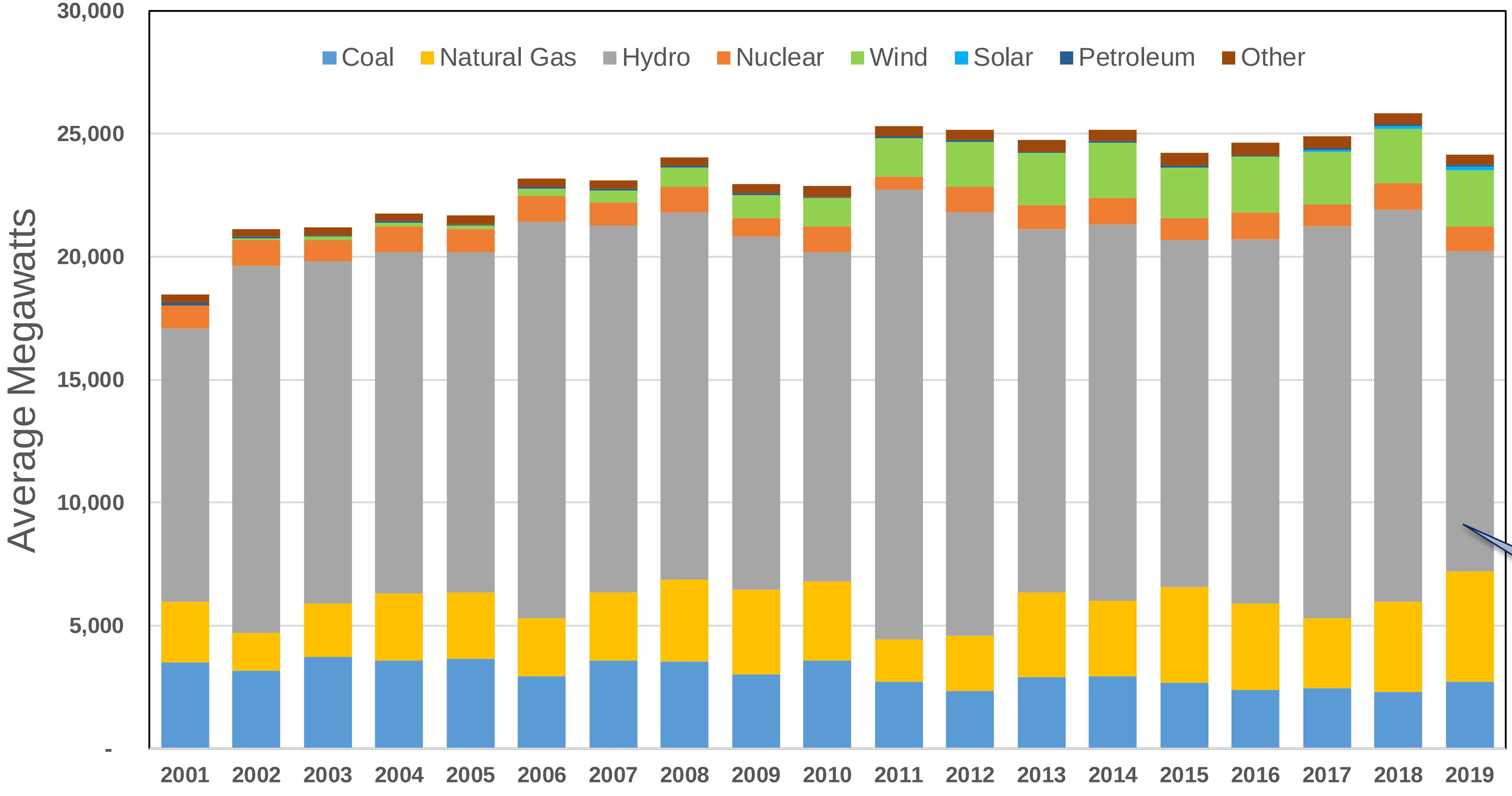
Significant changes (aGW)

Solar: + 5.0
Wind: + 6.2
Nat Gas: + 6.5
Coal: - 9.3
Nuclear: - 1.5
Total: + 11.0

Hydro: -4.2 / +5.2

Source: EIA

Northwest Generation Mix (ID, MT, OR and WA)



Significant changes (aGW)

Solar: + 0.1
Wind: + 2.3
Nat Gas: + 2.0
Coal: - 0.8
Total: + 5.7

Hydro: -3.7 / +3.5

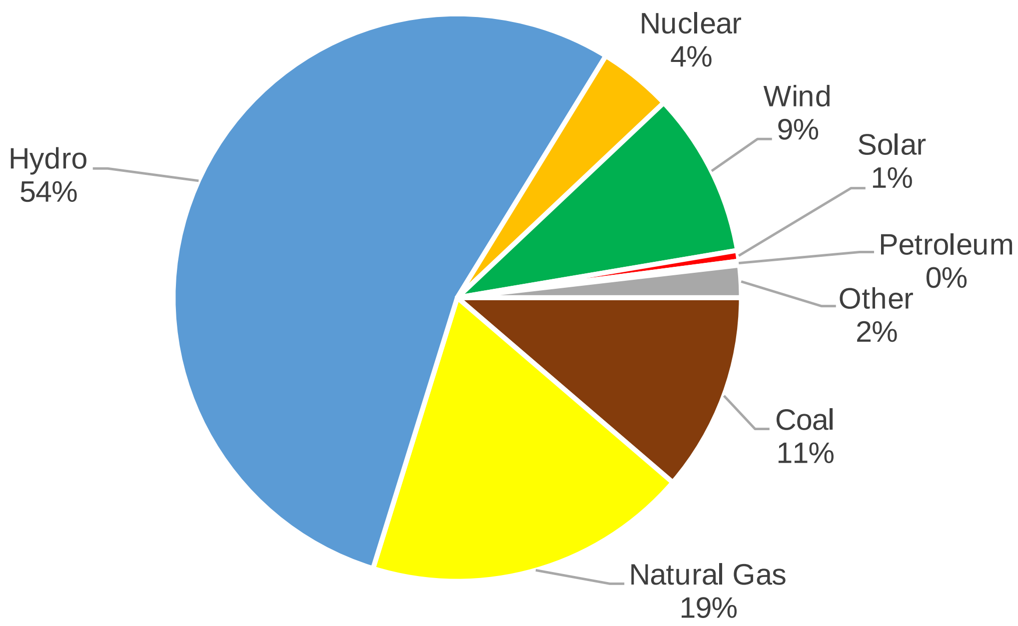
2019 2.0 aGW less than 2002-2018 Avg

Source: EIA

2019 Fuel Mix

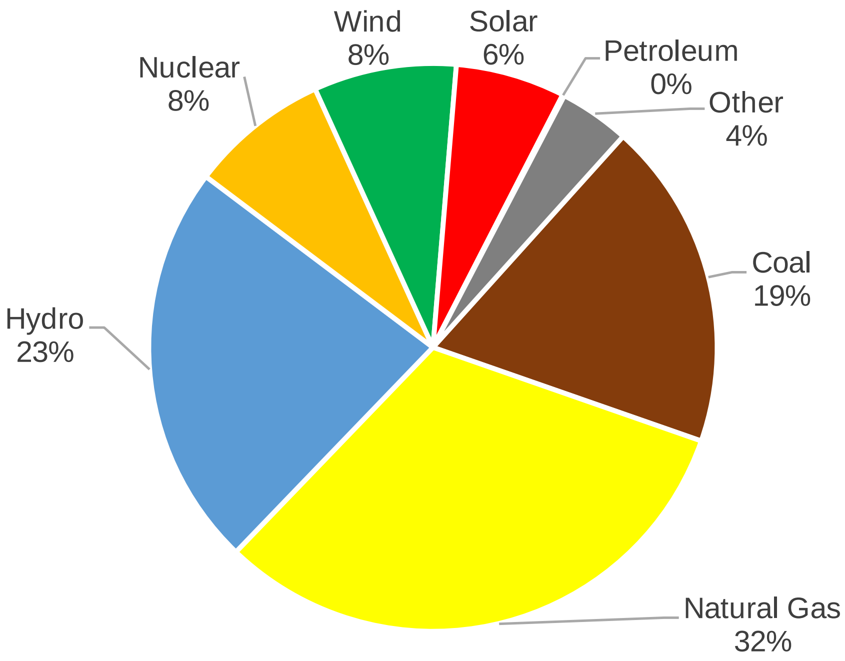
Northwest

70% GHG Emission Free*



U.S. Western Interconnect

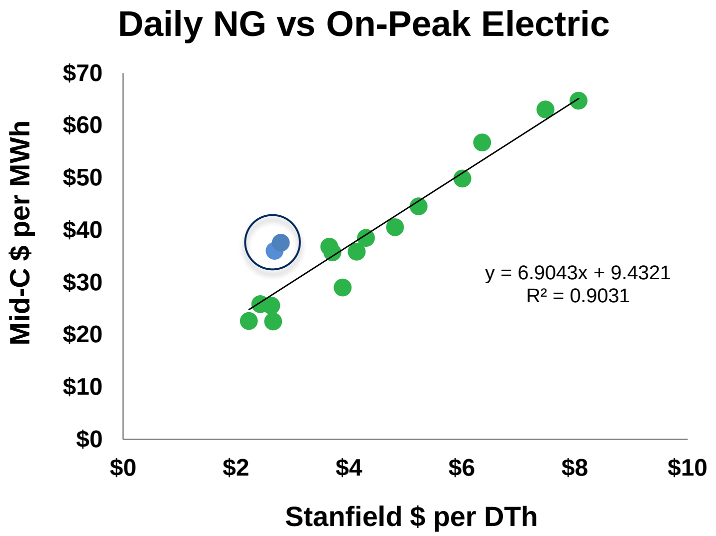
49% GHG Emission Free

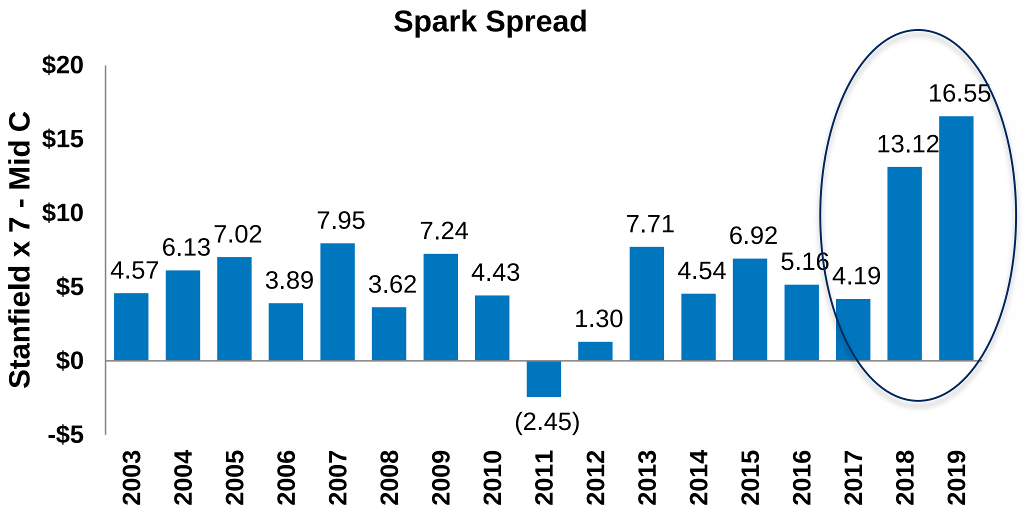


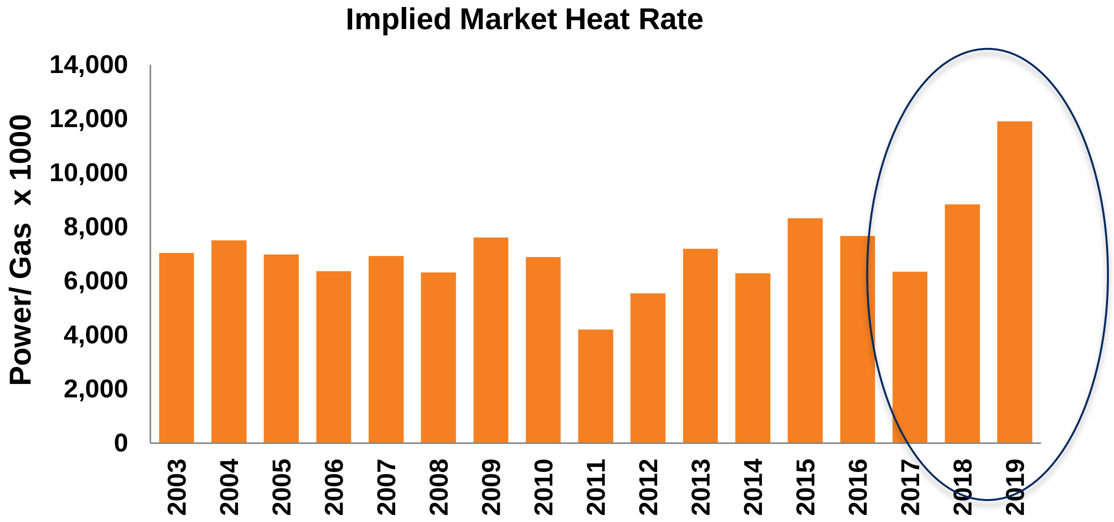
Source: EIA

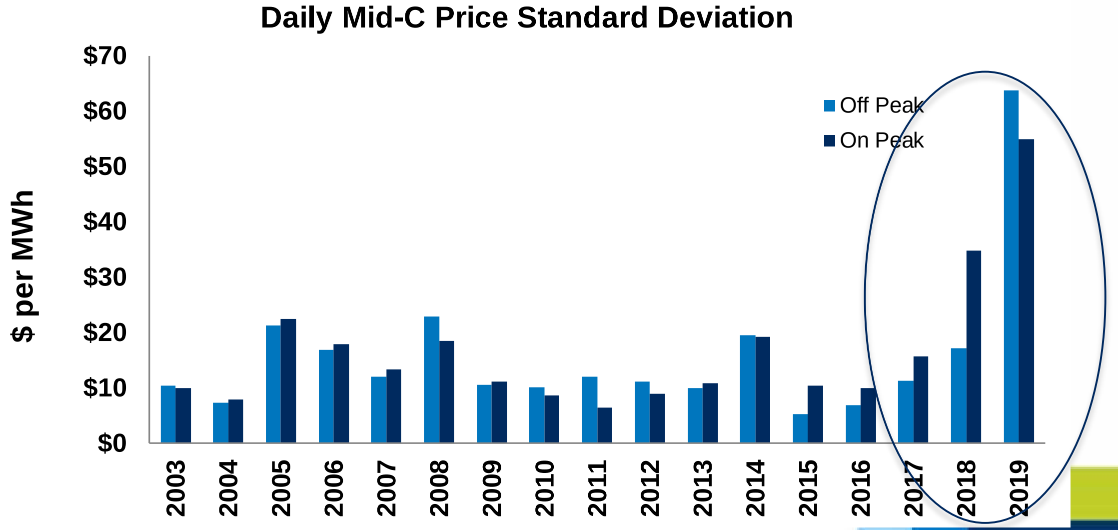
* Low hydro year dropped emission free statistic from 77% in 2018 to 70% in 2019

Market Indicators- Market is Tightening

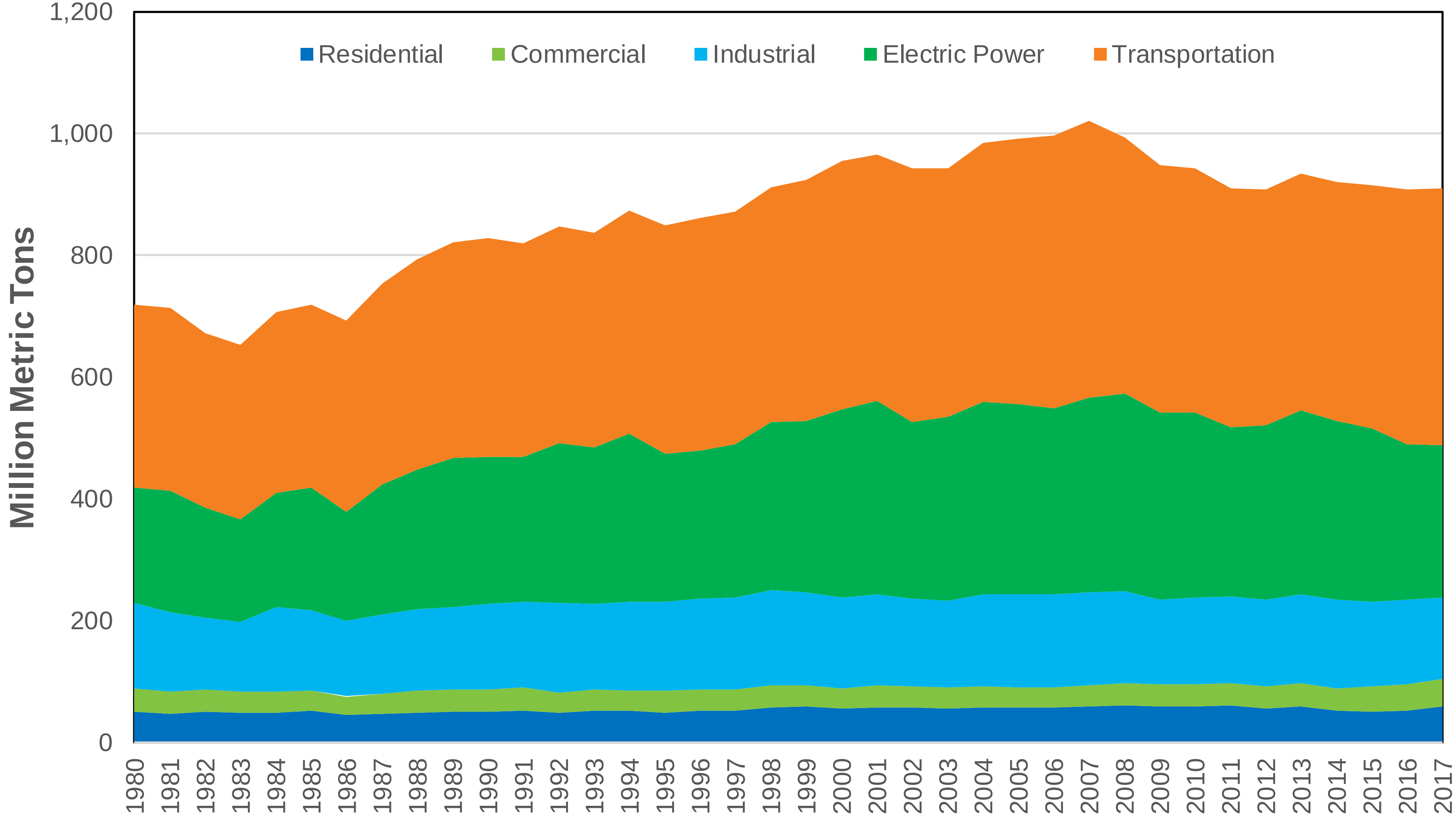








US Western GHG Emission End Use



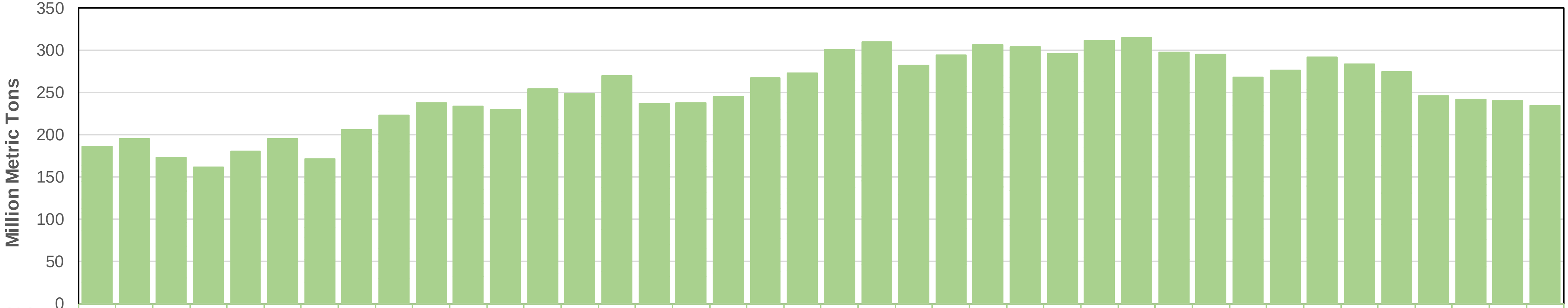
2017:
Transportation: 46%

Electric Power: 28%

Industrial: 15%
Commercial: 5%
Residential: 7%

Source: EIA

Electric Greenhouse Gas Emissions
U.S. Western Interconnect

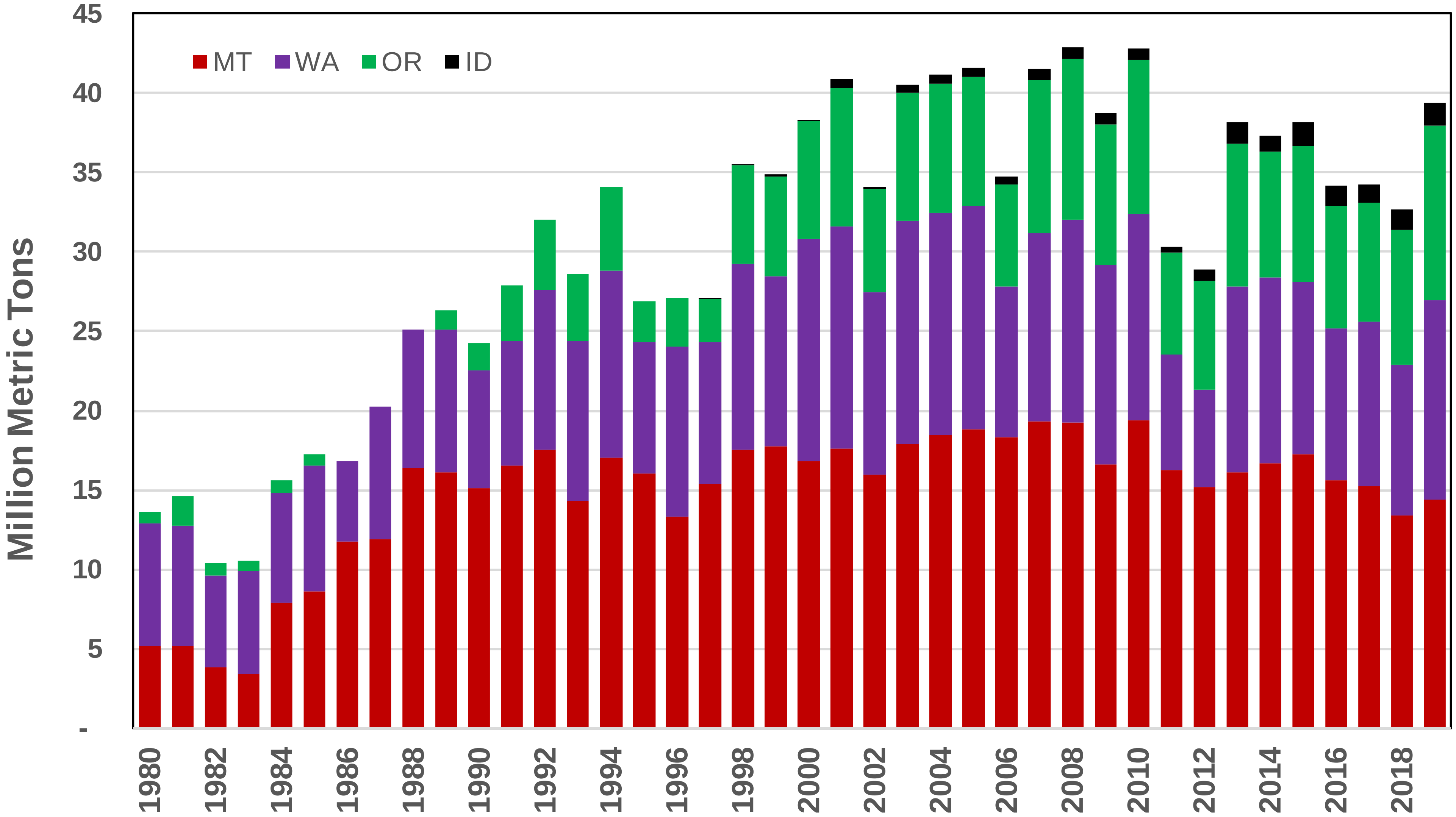


Change		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
+5.9	WY	22	24	23	21	25	29	23	31	33	31	33	33	36	34	36	34	35	34	38	36
+4.9	WA	8	8	6	7	7	8	5	8	9	9	7	8	10	10	12	8	11	9	12	11
+18.1	UT	11	11	11	11	12	14	15	25	27	28	29	28	30	31	32	30	30	31	32	33
+10.3	OR	1	2	1	1	1	1	-	-	-	1	2	4	4	4	5	3	3	3	6	6
-4.4	NM	21	20	22	25	24	26	23	24	25	27	26	22	25	26	27	26	27	28	28	29
+1.9	NV	11	13	14	13	15	12	16	15	18	17	17	18	19	18	20	18	20	19	21	22
+9.2	MT	5	5	4	3	8	9	12	12	16	16	15	17	18	14	17	16	13	15	18	18
+1.4	ID	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
+11.4	CO	21	23	24	23	25	27	26	27	28	30	31	30	31	32	33	32	34	34	35	36
-26.6	CA	61	59	38	31	34	40	27	37	37	44	40	38	46	42	50	37	33	36	39	43
+16.4	AZ	25	31	31	26	29	31	25	27	29	35	33	33	35	37	38	32	32	35	38	40

Change		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
+5.9	WY	37	37	36	37	37	36	36	37	37	36	36	34	36	39	37	36	33	34	33	28
+4.9	WA	14	14	12	14	14	14	10	12	13	13	13	7	6	12	12	11	10	10	10	13
+18.1	UT	33	33	34	35	35	36	36	38	39	36	35	34	32	35	34	33	27	27	30	29
+10.3	OR	7	9	7	8	8	8	6	10	10	9	10	6	7	9	8	9	8	8	9	11
-4.4	NM	30	29	28	30	30	31	32	30	29	31	27	29	27	26	23	22	21	21	16	17
+1.9	NV	25	24	21	23	25	26	17	17	18	18	17	15	15	15	16	14	14	13	13	13
+9.2	MT	17	18	16	18	18	19	18	19	19	17	19	16	15	16	17	17	16	15	13	14
+1.4	ID	0	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
+11.4	CO	39	41	40	40	40	41	42	43	41	38	40	39	39	39	38	37	35	35	33	32
-26.6	CA	53	58	44	43	46	42	47	50	51	48	44	36	48	46	46	44	37	33	37	35
+16.4	AZ	45	46	45	46	52	51	53	55	58	52	54	52	51	55	53	50	44	44	46	42

Emissions are adjusted for generation within the Western Interconnect
2018 and 2019 estimates are subject to adjustment

Northwest Greenhouse Gas Emissions



The Forecast: 2022 to 2045

Deterministic Model

- Simulate based on average conditions
- 210,240 hours simulation
- Takes about 6 hours on one processor
- Good approximation to estimate impacts of assumptions- great for scenario analysis, but not risk
- Output Files: 26 GB

Stochastic Model

- Simulate 500 varying conditions
- Fuel Prices, Loads, Wind, Hydro, Outages, Inflation
- 105 million hours of simulation
- Takes about 5 days on 33 processors
- Allows for full evaluation of resource alternatives and accounts for risk
- Output Files: 360 GB

Modeling Process

Vendor Database
(2019 North American)

Input Changes
80 yr hydro
NG prices
Regional Loads
Avista Resources/Loads
Operational Detail

Capacity Expansion
Add new resource forecast
(Capacity/RPS)
Include known retirements
Model adds resources to meet planning targets

Test Year Stochastic Study
Test Resource Adequacy

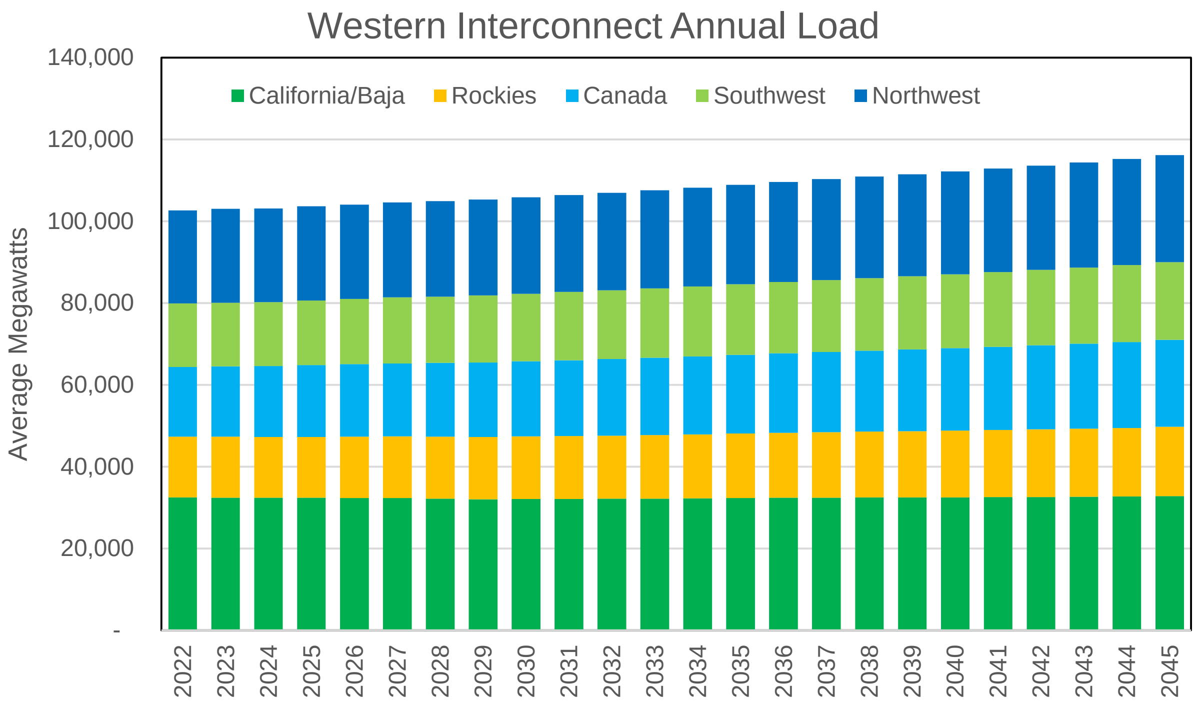
Re-Run Capacity Expansion
Increase/Decrease Planning Margin Targets

Run Full Forecast
Stochastic & Deterministic

Run Scenarios
Deterministic
Stochastic (if necessary)

Load Forecast

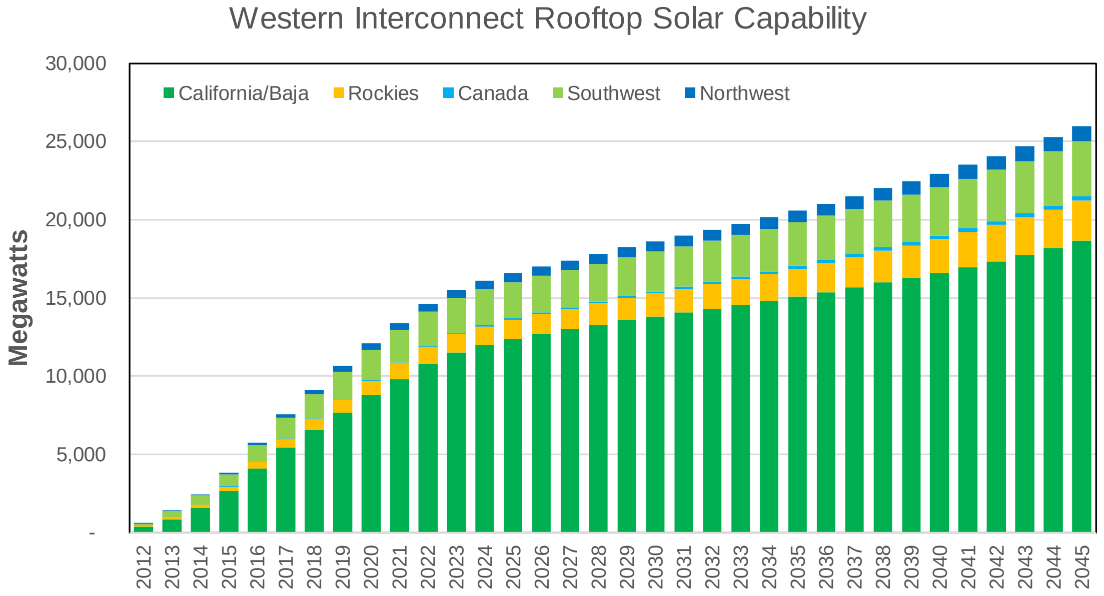
- Regional load forecast from ‘IHS
  - Forecast includes energy efficiency
- Add net meter resource forecast
  - Input annually with hourly shape
- Add electric vehicle forecast
  - Input annual with hourly shape
- Future load shape to be different then today’s load shape



Electric Vehicle and Solar Adjustments

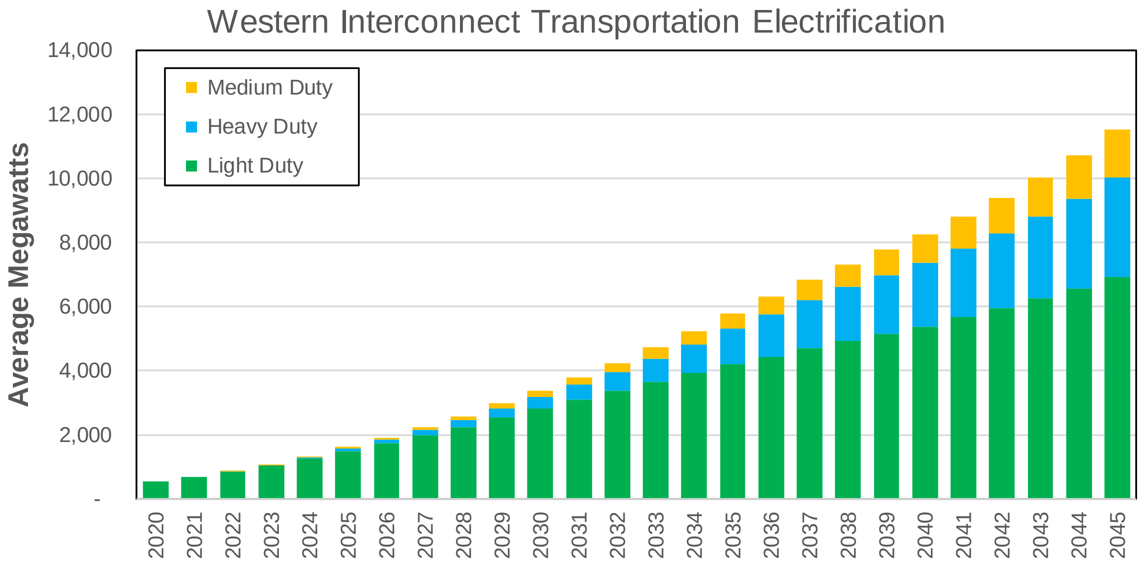
Roof Top Solar

- EIA existing estimates for history
- ‘IHS regional growth rates

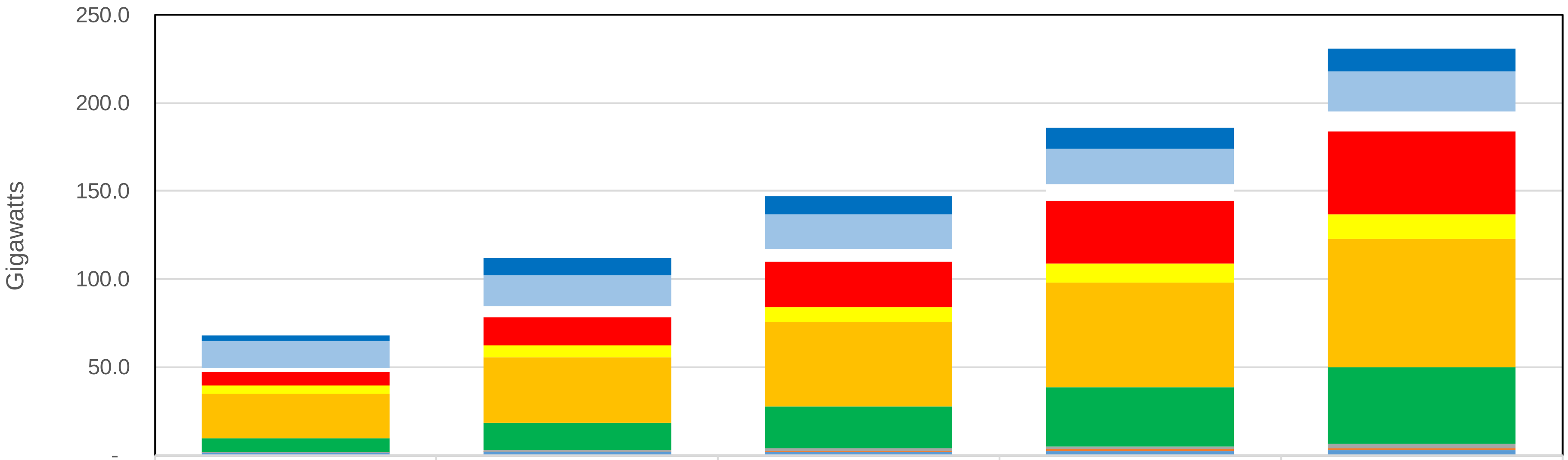


Electric Vehicles

- Penetration rates increase each year (2040 shown below)
- 15-30% light duty
- 12-15% medium duty
- 5% heavy duty

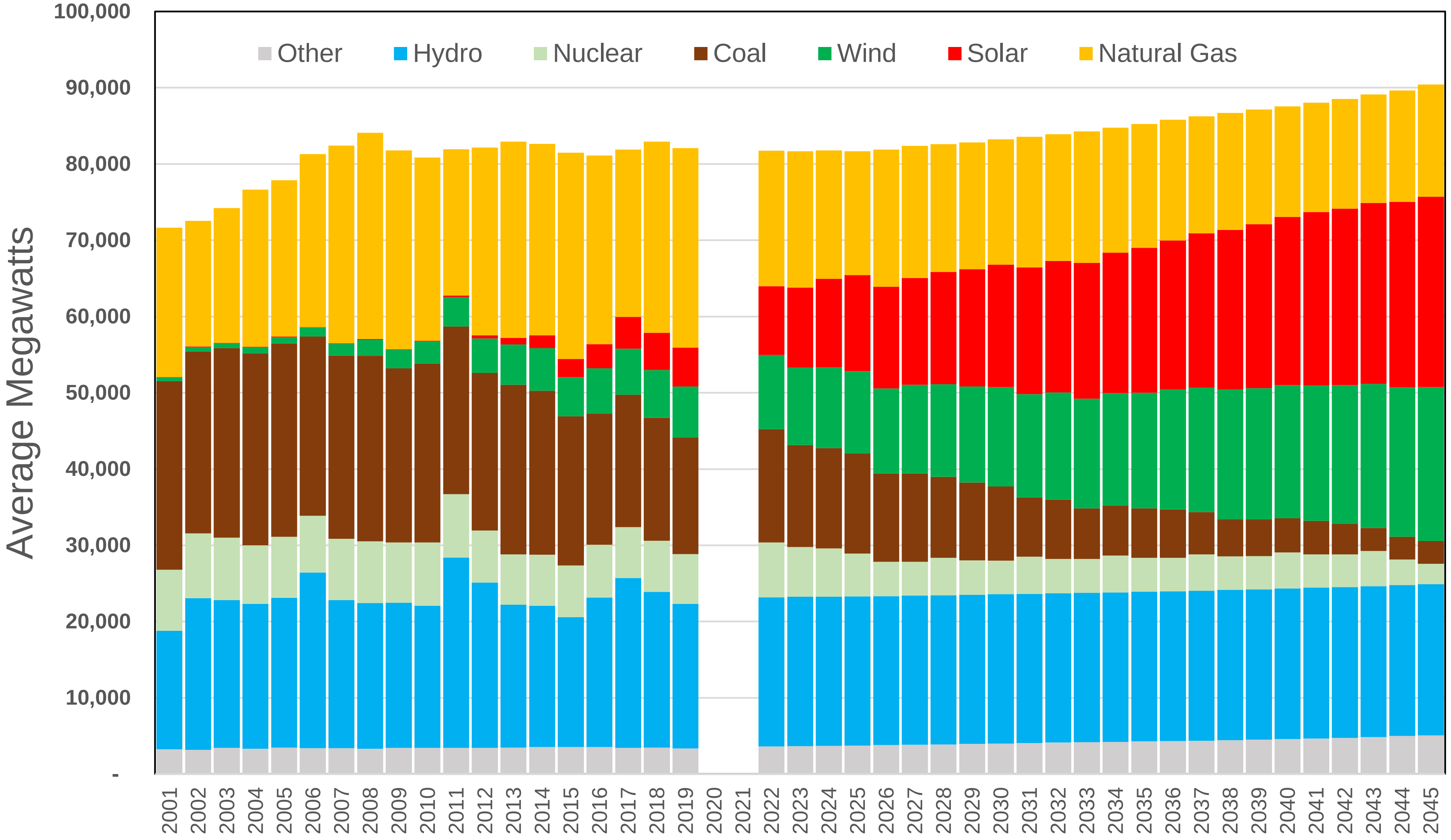


New Resource Forecast (Western Interconnect)



	2025	2030	2035	2040	2045
CCCT	3.3	9.9	10.7	11.6	12.8
SCCT	15.4	17.8	19.3	20.2	22.7
DR	2.1	6.0	7.6	9.5	11.5
Storage	7.9	16.2	25.7	35.5	47.1
Net-Meter	4.5	6.5	8.5	10.8	13.9
Solar	25.5	37.5	47.8	59.7	73.0
Wind	7.8	15.7	24.1	33.4	43.3
Geothermal	0.3	0.7	1.2	1.9	2.9
Biomass	0.2	0.4	0.6	0.7	0.9
Hydro	1.3	1.6	1.9	2.4	2.8

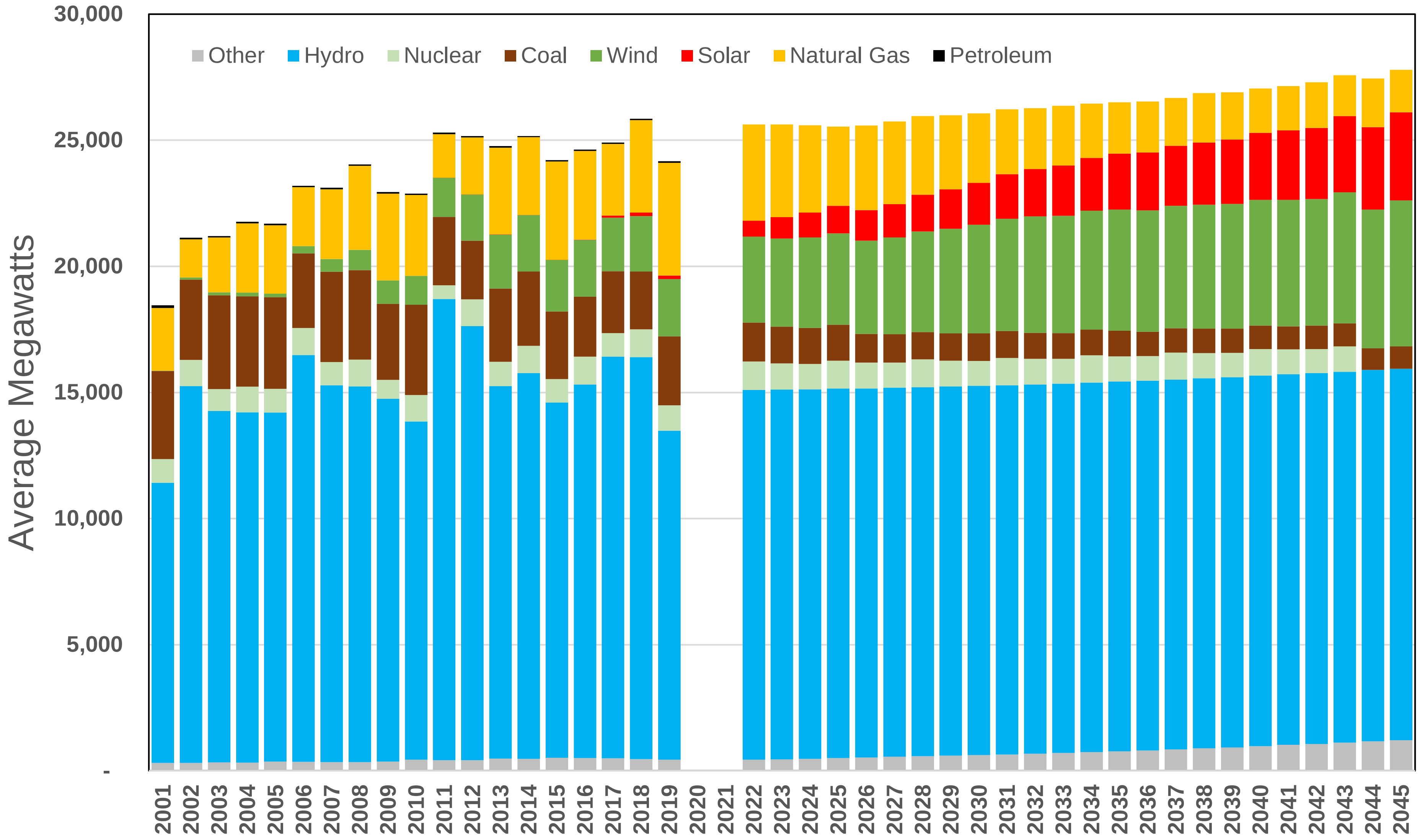
U.S. West Resource Type Forecast



Significant changes 2045 to 2022 (aGW)

Solar: + 15.9
Wind: + 10.5
Nat Gas: - 3.1
Coal: - 11.9
Nuclear: - 4.5
Other: + 1.5
Hydro: + 0.3
Total: + 11.9

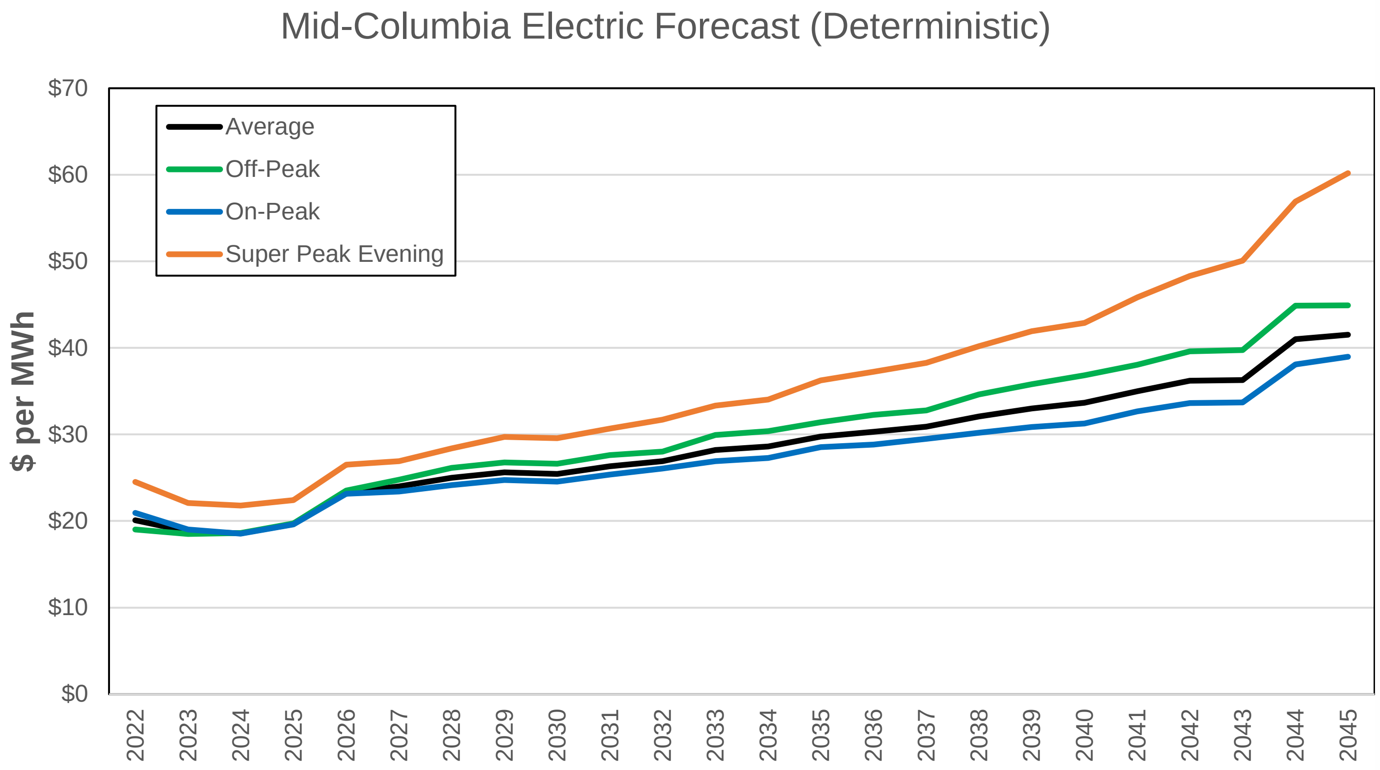
Northwest Resource Type Forecast



Significant changes (aGW) 2045 to 2022

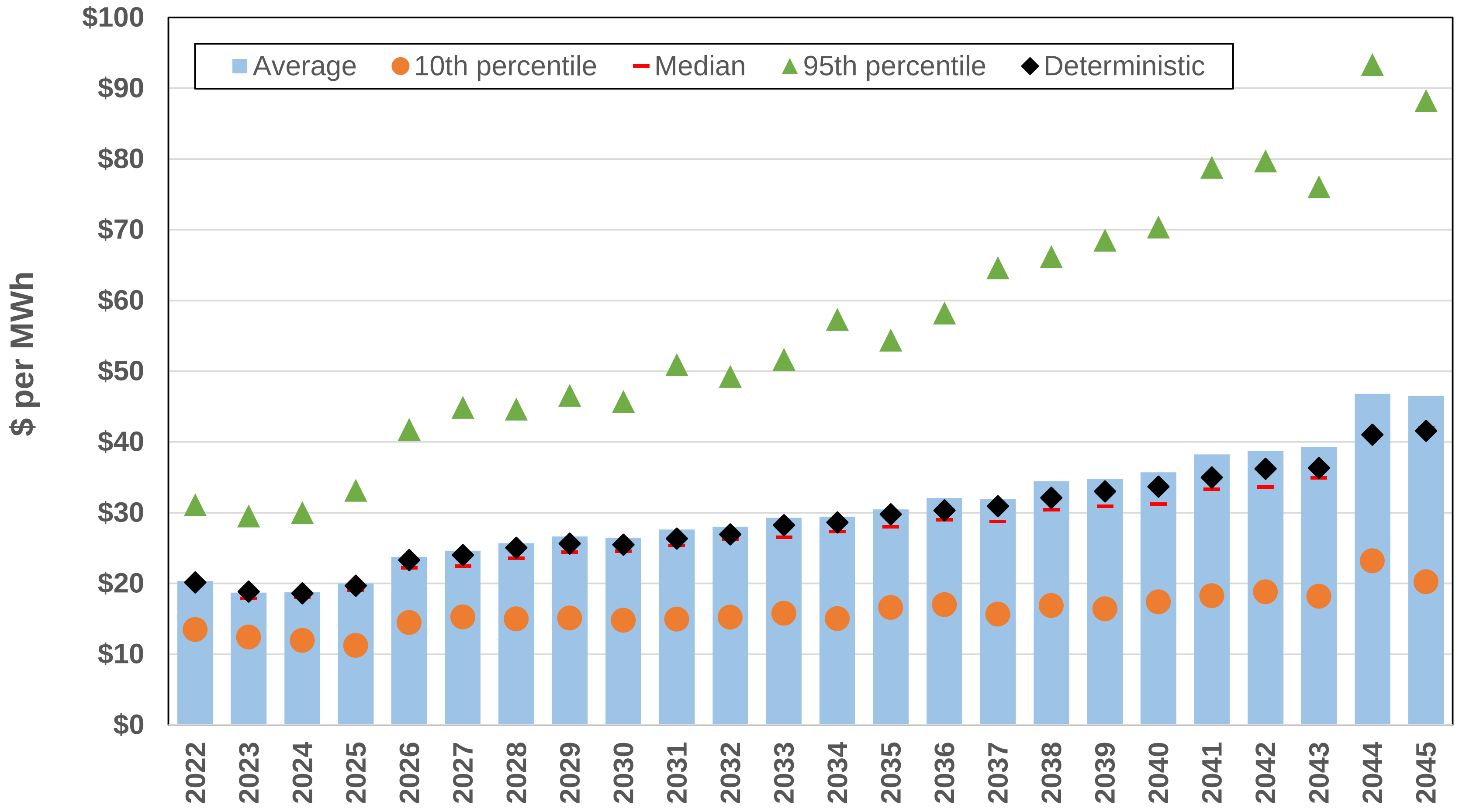
Solar: + 2.9
Wind: + 2.4
Nat Gas: - 2.1
Coal: - 0.6
Other: + 0.7
Nuclear: - 1.1
Total: + 2.2

Mid-C Electric Price Forecast



- Levelized Prices:
  - 2022-45: $26.05/MWh
  - 2022-41: $23.03/MWh
- Off-peak prices over take on-peak in 2024 on an annual basis
- Evening peak prices remain high (4pm-10pm)

Mid-C Price Forecast (Stochastic- Draft)



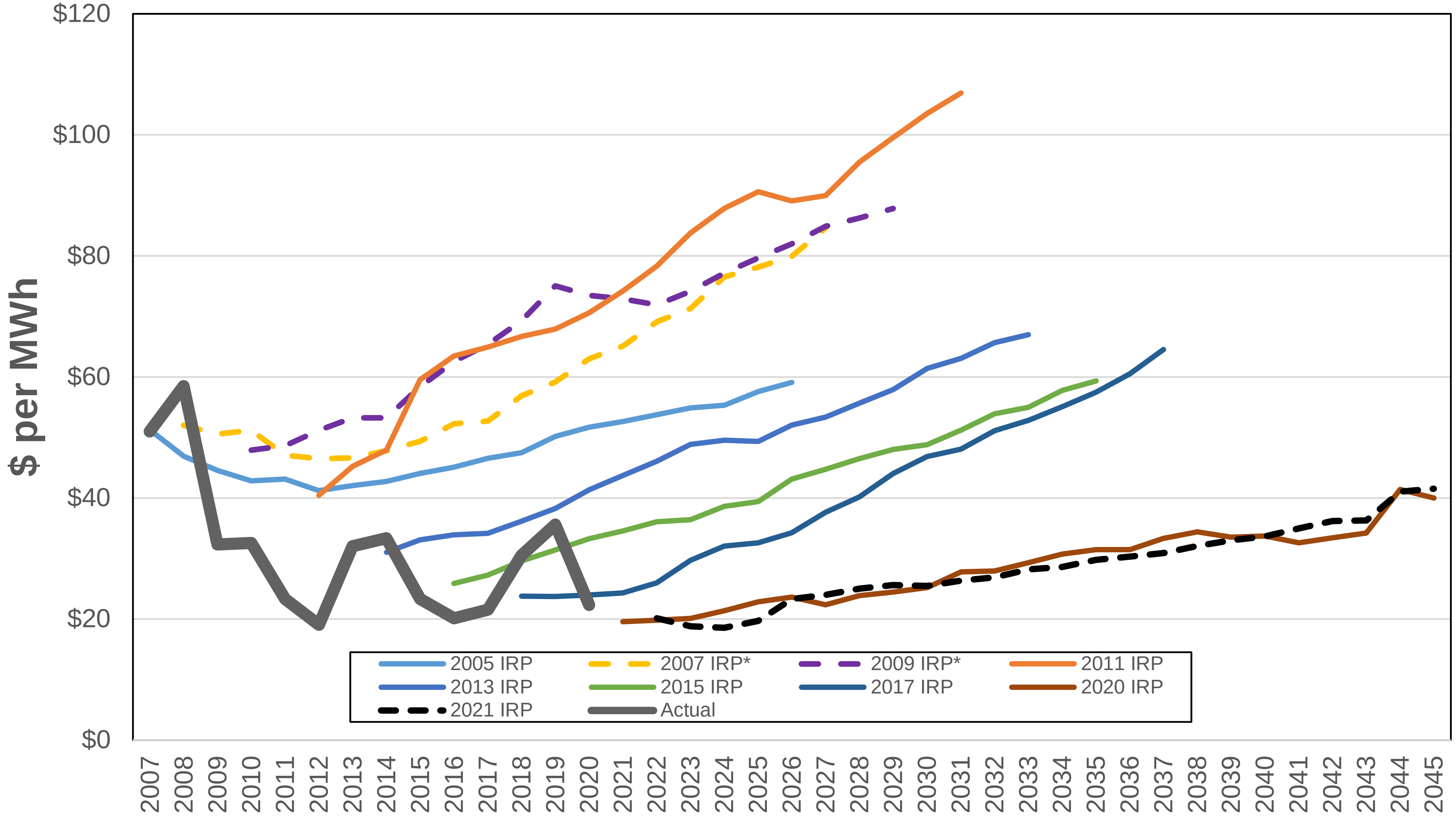
24-yr Levelized Prices

Mean: $27.11/MWh

Median: $24.84/MWh

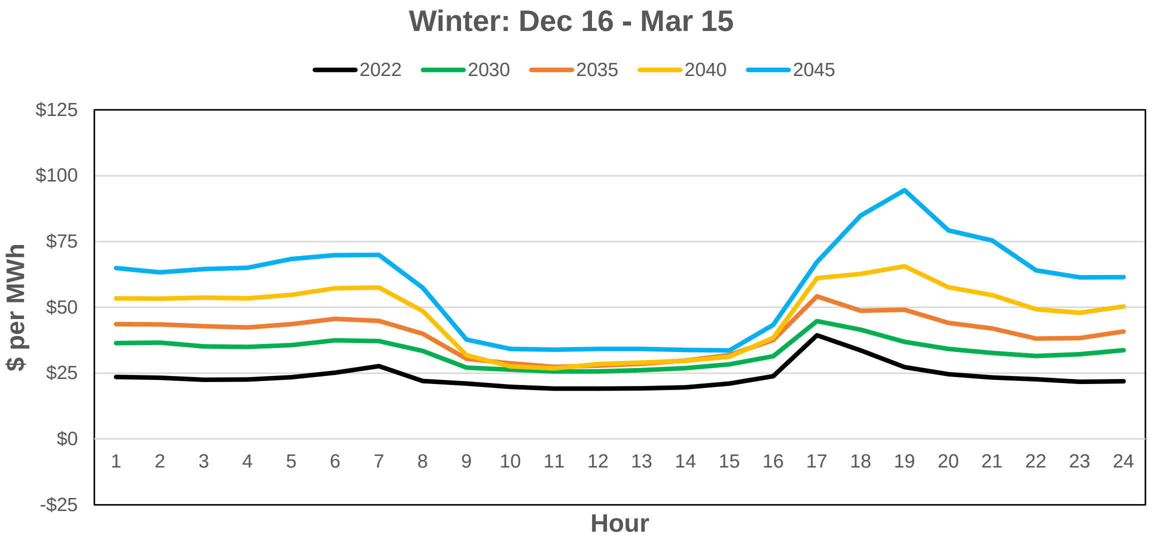
Deterministic: $26.05/MWh

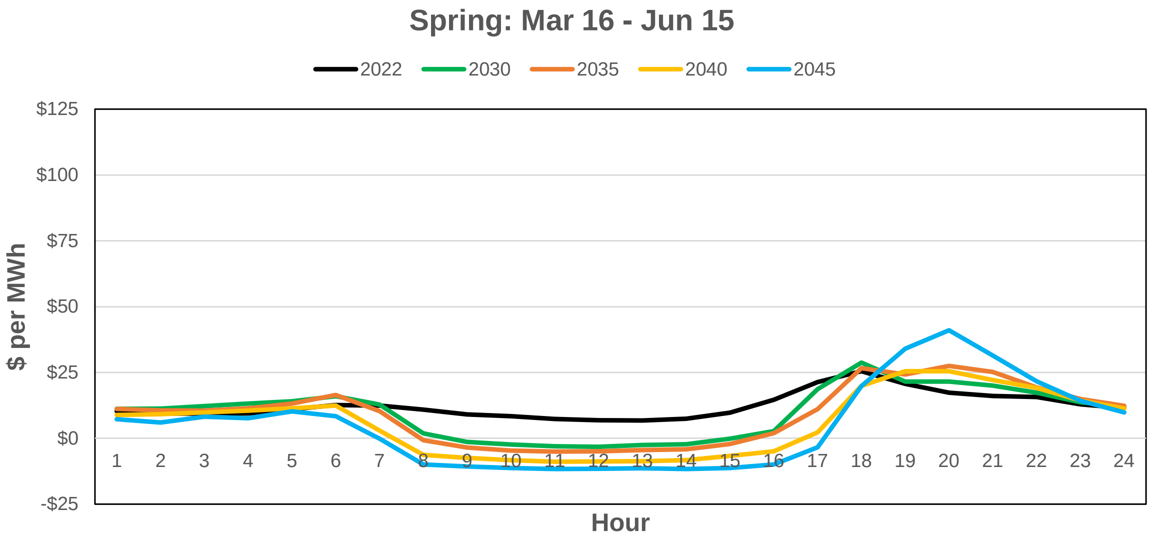
Mid-C Electric Price Comparison vs. Previous IRPs

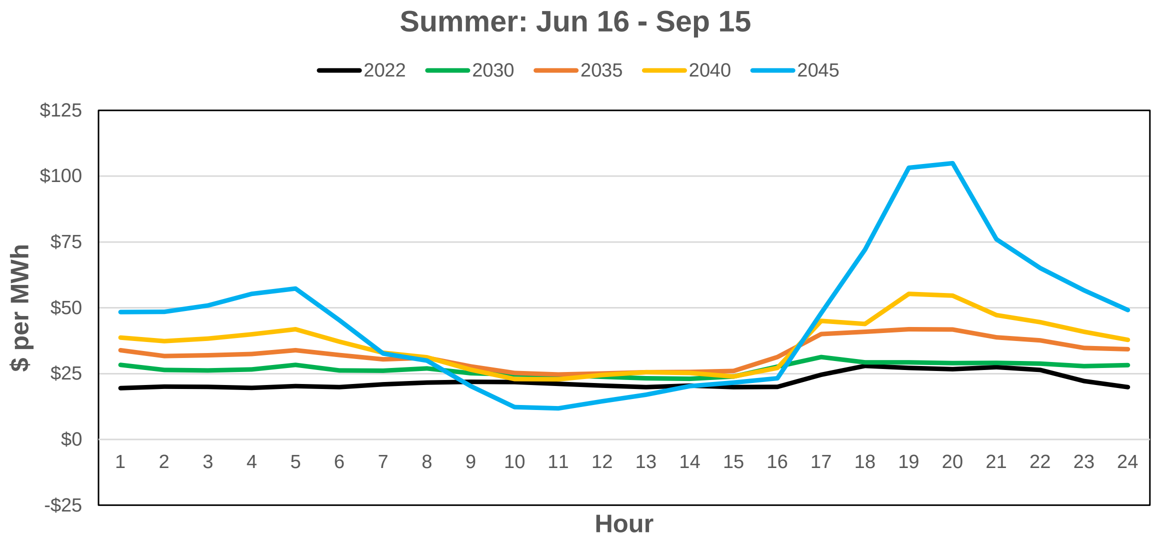


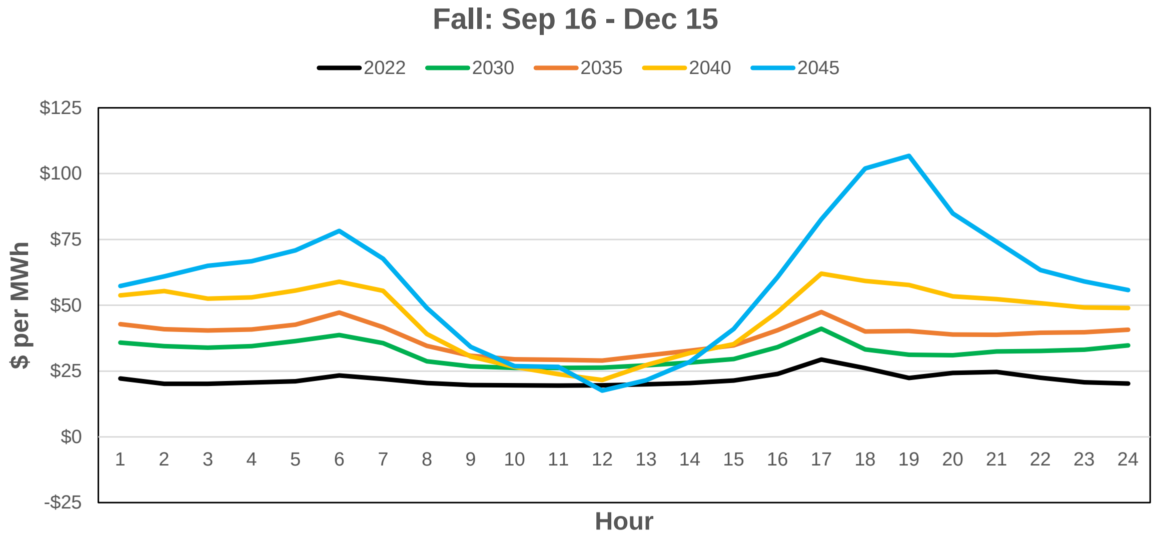
* These forecasts use price scenarios without GHG “taxes” to make all forecasts consistent

Hourly Wholesale Mid-C Electric Price Shapes

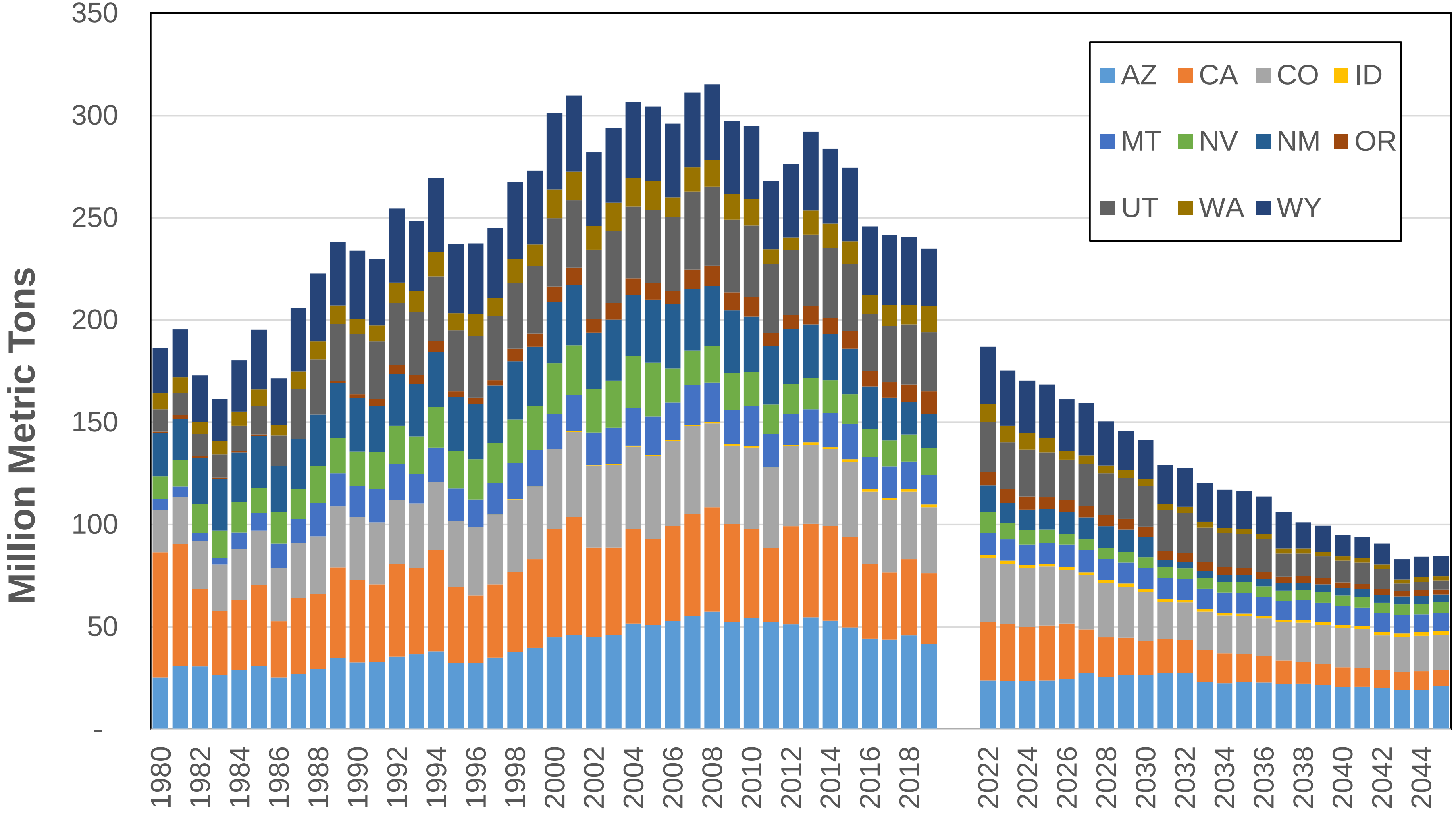




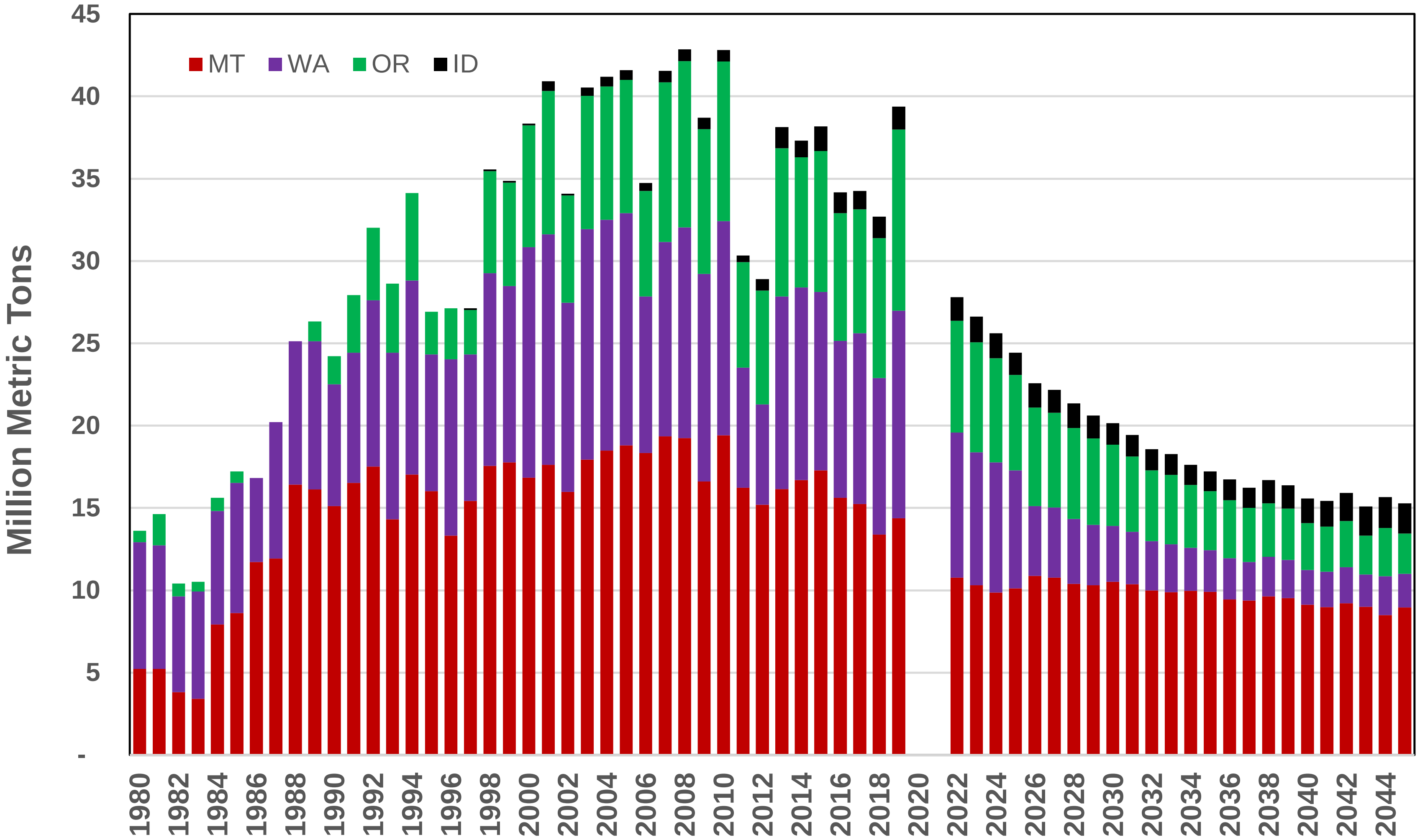




Greenhouse Gas Forecast
U.S. Western Interconnect

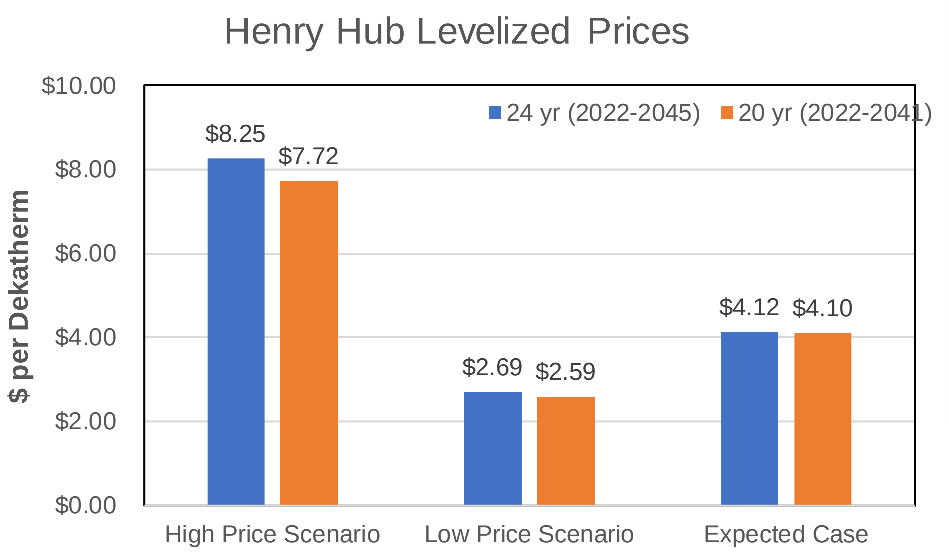


Greenhouse Gas Forecast
Northwest States



Market Scenario Assumptions

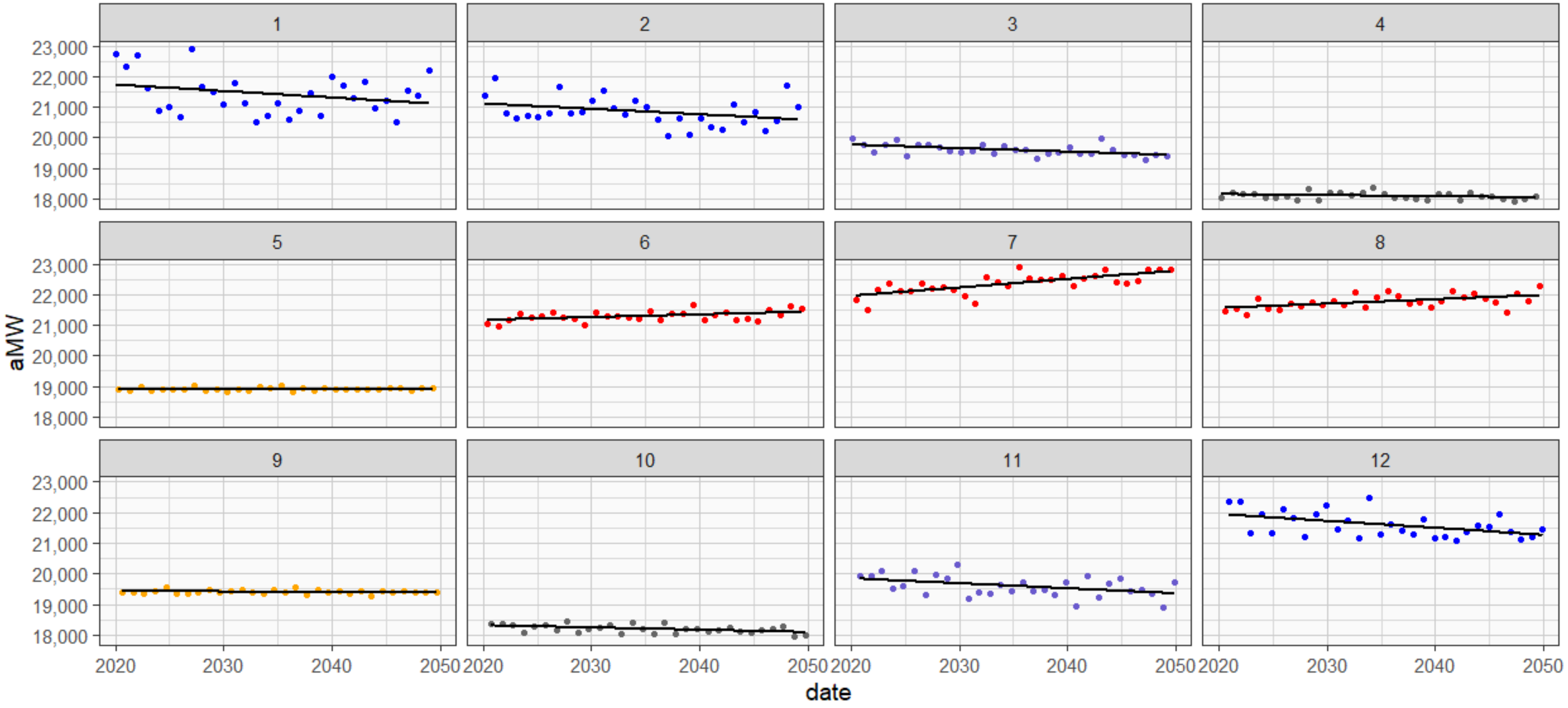
- **High Natural Gas Prices**
  - 90th percentile of stochastic prices using 1,000 draws
- **Low Natural Gas Prices**
  - 25th percentile of stochastic prices using 1,000 draws



- **Social Cost of Carbon “Tax”**
  - Western Interconnect Carbon “Tax” on Generation
  - SCC pricing beginning in 2025, trending up beginning in 2022.
- **Climate Shift**
  - Uses NWCC three climate futures
  - Trend Northwest hydro and loads for warming temperatures
  - Lower NG CT capability due to temperature change

Climate Shift Methodology (Loads)

- Uses 2024 operating year forecast.
- Overlays the 2020 to 2049 temperature forecast using an average of three climate models chosen by the NPCC.
- Create a linear trend of load based on changes in weather*- referred to as scalers.
- Apply scalers to expected case load forecast.

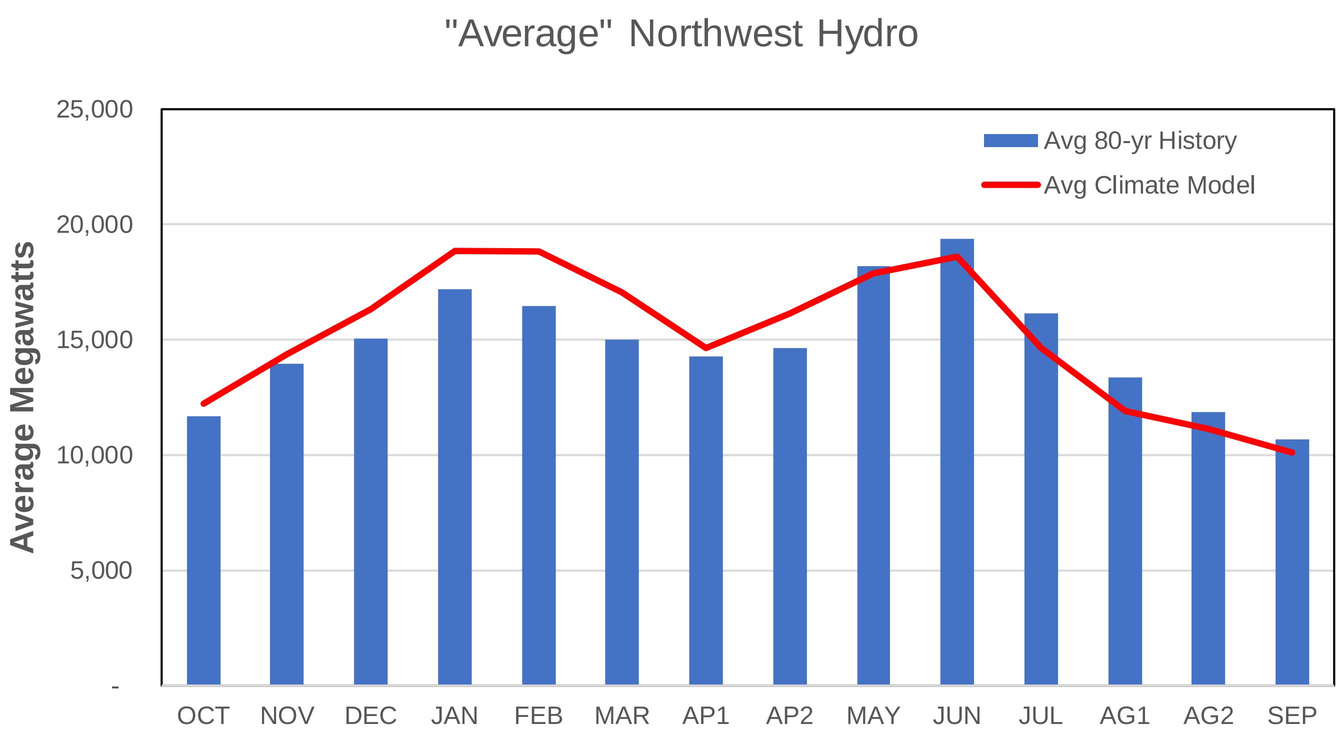


Data & scalars provided by PNUCC

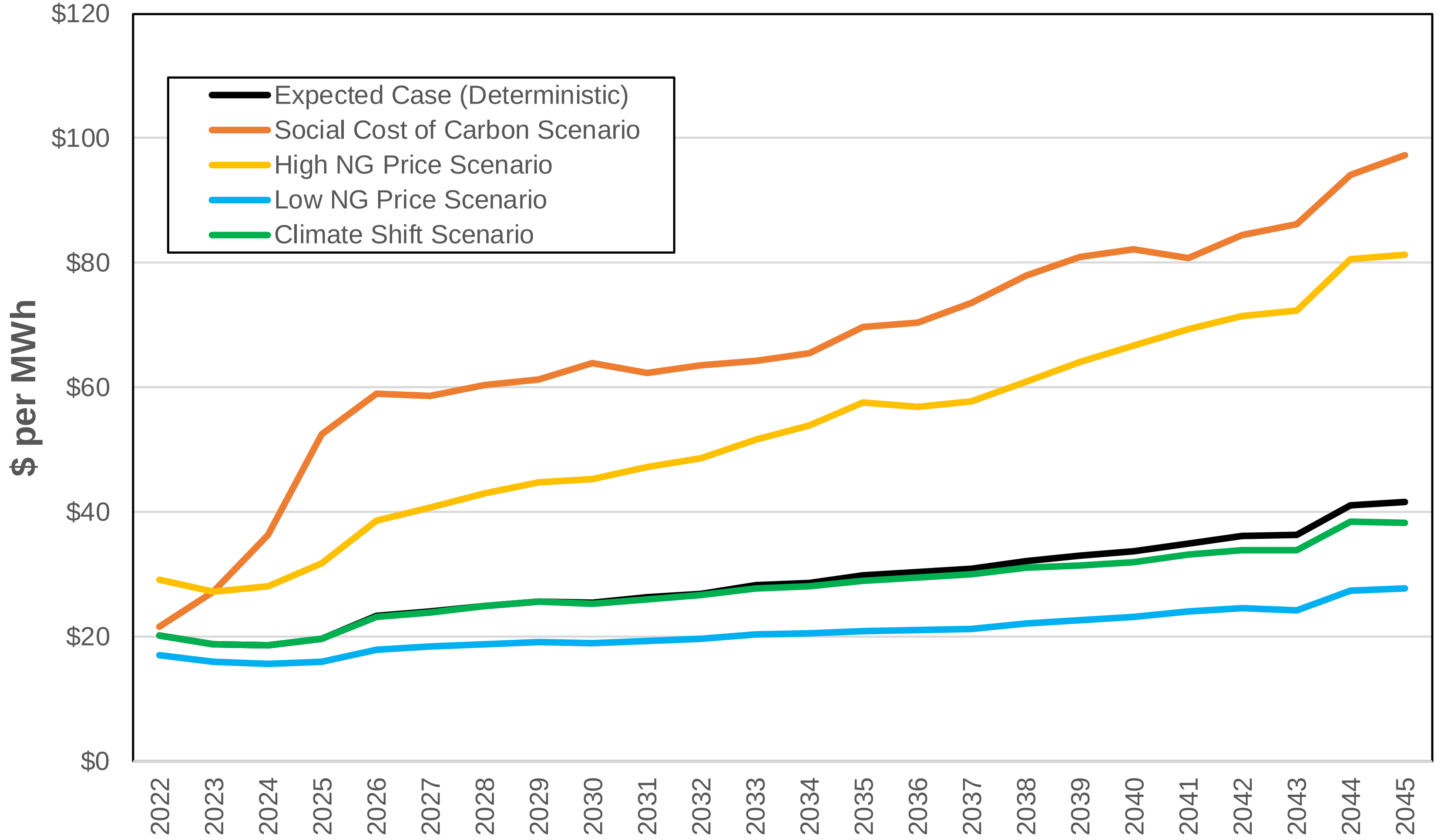
* does not include secondary changes in load due to climate shift

Climate Shift Methodology (Hydro)

- NPCC provides 80-year hydro history and three models with 30 years of potential hydro for the 2040’s.
- Compare the average of three climate models to the 80-year hydro history.
- Linearly trend the change between the beginning and the end of the forecast.



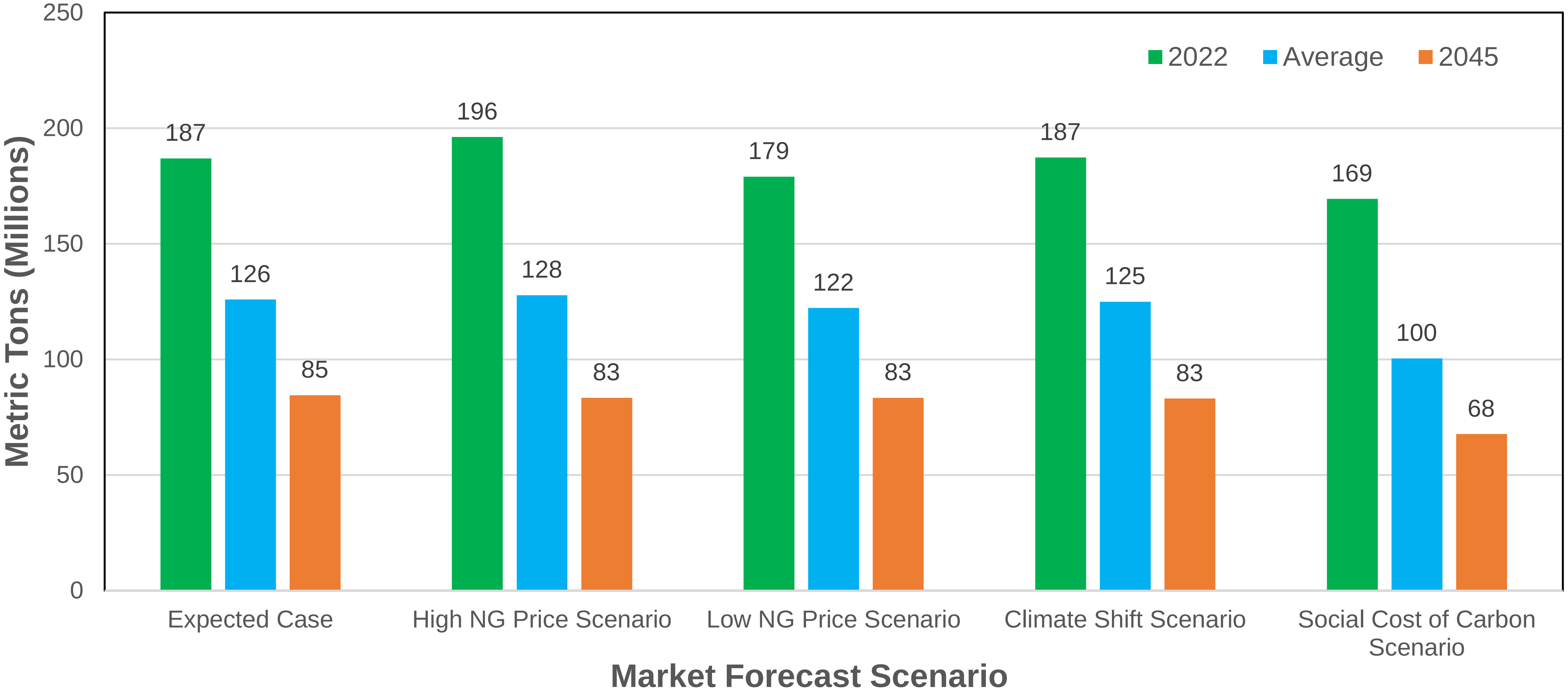
Scenario Results: Wholesale Electric Prices



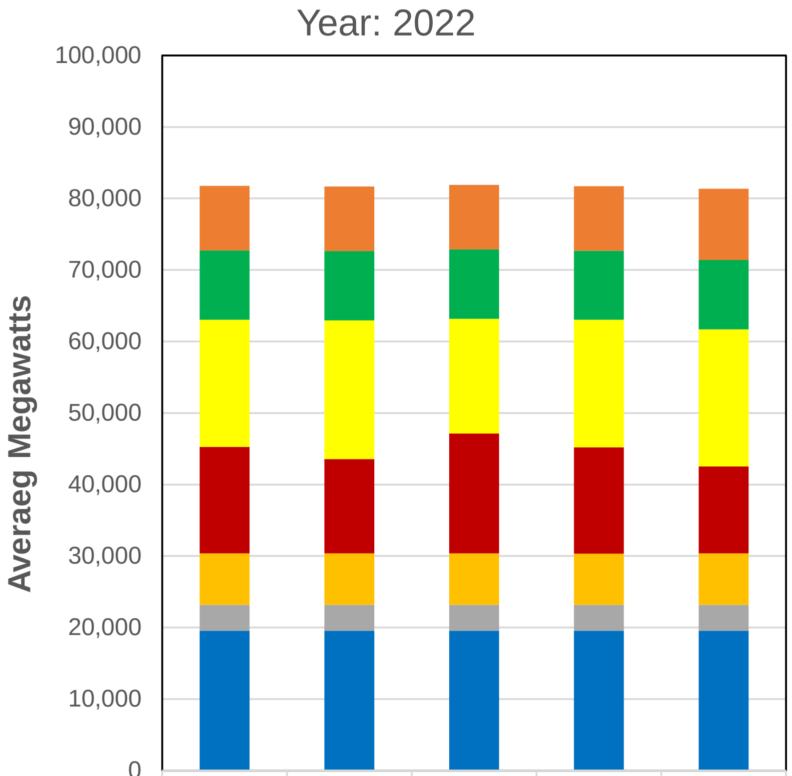
Levelized Prices (2022-2045)

- Expected Case: $26.05/MWh
- Social Cost of Carbon: $58.56/MWh
- High NG Prices: $46.07/MWh
- Low NG Prices: $19.35/MWh
- Climate Shift: $25.51/MWh

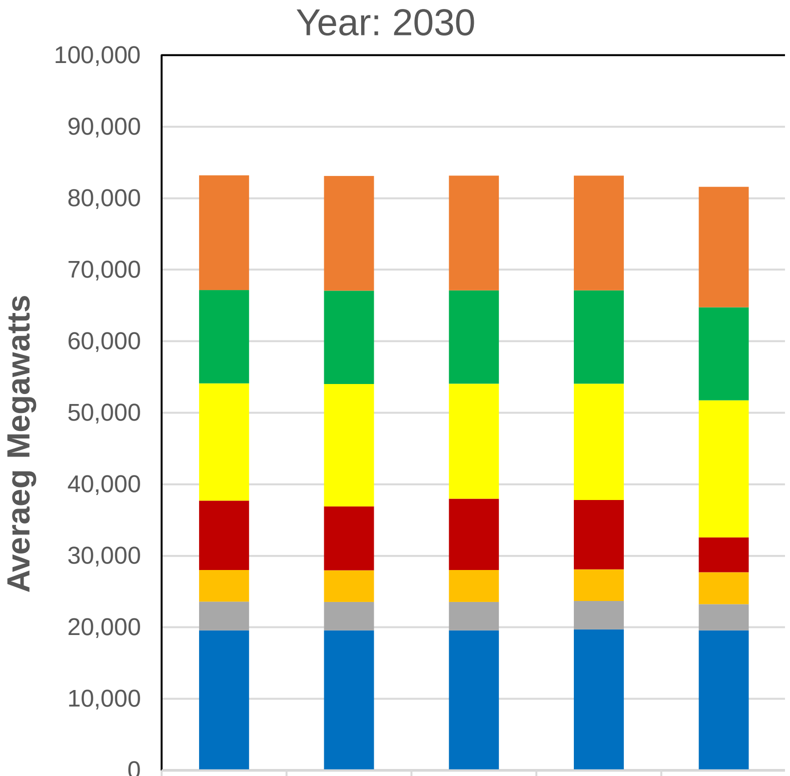
Scenario Results: US Western Interconnect GHG Emissions



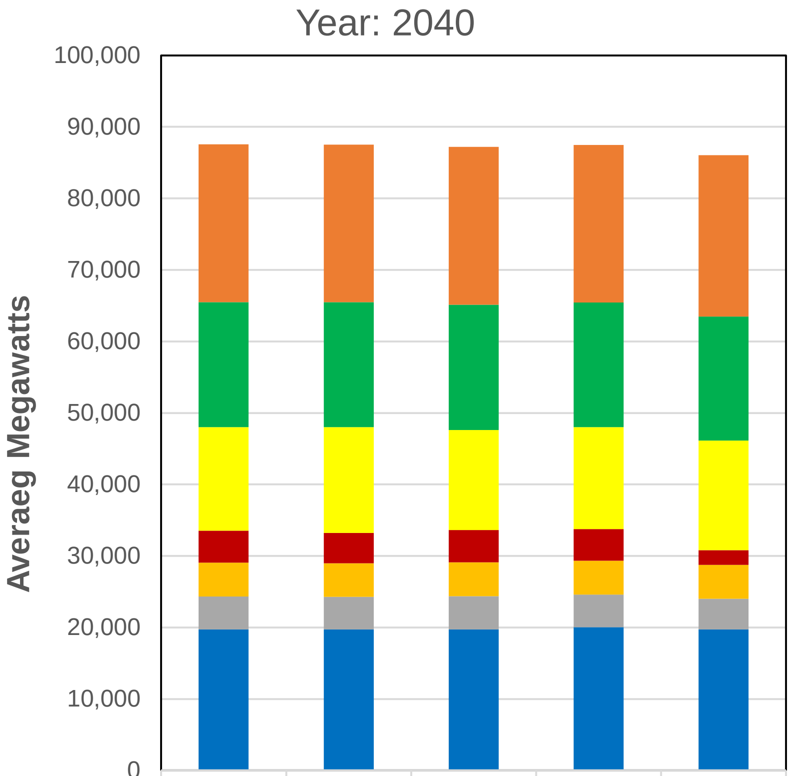
Scenario Results: U.S. Western Interconnect Resource Type



	Expected Case	Low NG Price Scenario	High NG Price Scenario	Climate Shift Scenario	Social Cost of Carbon Scenario
Solar	9,024	9,023	9,024	9,022	9,978
Wind	9,698	9,698	9,700	9,692	9,694
Natural Gas	17,785	19,394	16,002	17,788	19,158
Coal	14,870	13,160	16,783	14,886	12,164
Nuclear	7,188	7,187	7,195	7,178	7,185
Other	3,623	3,625	3,604	3,597	3,628
Hydro	19,570	19,570	19,570	19,570	19,571



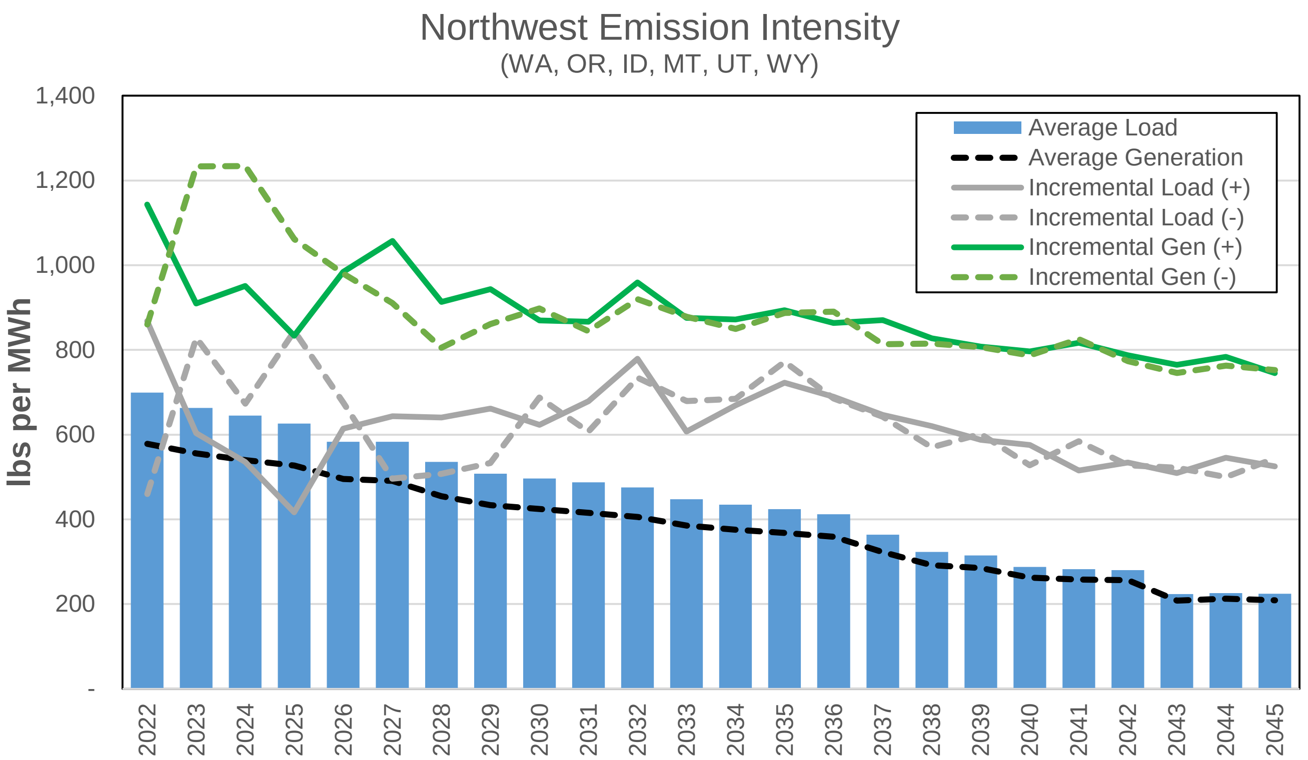
	Expected Case	Low NG Price Scenario	High NG Price Scenario	Climate Shift Scenario	Social Cost of Carbon Scenario
Solar	16,053	16,047	16,059	16,050	16,864
Wind	13,048	13,033	13,057	13,049	13,010
Natural Gas	16,411	17,126	16,094	16,267	19,170
Coal	9,699	8,935	9,973	9,670	4,874
Nuclear	4,426	4,416	4,432	4,424	4,440
Other	4,013	3,992	3,994	4,007	3,680
Hydro	19,568	19,568	19,568	19,694	19,568



	Expected Case	Low NG Price Scenario	High NG Price Scenario	Climate Shift Scenario	Social Cost of Carbon Scenario
Solar	22,059	22,040	22,071	22,033	22,550
Wind	17,477	17,461	17,498	17,455	17,367
Natural Gas	14,489	14,782	13,997	14,255	15,309
Coal	4,477	4,251	4,535	4,410	2,069
Nuclear	4,729	4,713	4,740	4,714	4,727
Other	4,605	4,550	4,632	4,585	4,295
Hydro	19,726	19,726	19,726	20,028	19,726

Incremental GHG Emissions for Energy Efficiency

- This IRP assumes GHG emissions from load reduction and associated emissions from market purchases/(sales)*
- 2020 IRP assumes average emissions each year based on average emissions compared to load each year. (See blue bars)
- Avista believes average emissions best represents the associated emissions for market purchases/sales:
  - Should this be based on load or generation?
- Avista is considering using incremental emissions for valuing energy efficiency for Washington's cost analysis:
  - Load or generation calculation method?
  - Increase load vs. decrease load method (or average)?
  - At what granularity to apply benefit?



* Purchases related to storage resources assumes a slightly different provide due to charging times

Data Availability

Outputs

- Expected Case: annual Mid-C prices by iteration (stochastic)
- Expected Case: hourly Mid-C prices (deterministic)
- Scenarios: monthly Mid-C electric prices
- Regional resource dispatch
- Regional GHG emissions
- Avista resource dispatch data will be included within PRiSM Model

Inputs (Not already Posted)

- Climate shift scaling factors for load/hydro
- High/low natural gas prices

2020 Electric Integrated Resource Plan
Draft Portfolio Scenario Analysis

John Lyons, Ph.D.
Third Technical Advisory Committee Meeting
September 29, 2020

Portfolio Scenarios – 2020 IRP

1. Preferred Resource Strategy
2. Least Cost Plan- w/o CETA
3. Clean Resource Plan: 100% net clean by 2027
4. Rely on energy markets only (no capacity or renewable additions) w/o CETA
5. 100% net clean by 2027, and no CTs by 2045
6. Least Cost Plan w/o pumped storage or Long Lake as options
7. Colstrip extended to 2035 w/o CETA
8. Colstrip extended to 2035 w/ CETA
9. Least Cost Plan w/ higher pumped storage cost
10. Least Cost w/ federal tax credits extended
11. Clean Resource Plan w/ federal tax credits extended
12. Least Cost Plan w/ low load growth (flat loads- low economic/population growth)
13. Least Cost Plan w/ high load growth (high economic/population growth)
14. Least Cost Plan w/ Lancaster PPA extended five years *(financials will not be public)*

Others: Efficient frontier portfolio (least risk, 75/25, 50/50, and 25/75)

Portfolio Scenarios- 2021 IRP

1. Preferred Resource Strategy
2. Baseline Portfolio 1 (No CETA renewable targets)
3. Baseline Portfolio 2 (No CETA renewable targets/SCC)
4. Clean Resource Plan (100% Portfolio net clean by 2027)
5. Clean Resource Plan (100% Portfolio clean by 2045)
6. Social Cost of Carbon applied to Idaho
7. Least Cost Plan- w/ low load growth
8. Least Cost Plan- w/ high load growth
9. Least Cost Plan- w/ Northwest Resource Adequacy Market Peak Credits
10. Heating Electrification Scenario 1
11. Heating Electrification Scenario 2
12. Heating Electrification Scenario 3
13. Least Cost Plan- w/ climate shift
14. Least Cost Plan- w/ 2x SCC prices
15. Colstrip serves Idaho customers through 2025
16. Colstrip serves Idaho customers through 2035
17. Colstrip serves Idaho customers through 2045
18. If necessary: CETA deliver to customers each hour
19. If necessary: other resource specific scenarios depending on outcome of PRS results