2023 Electric Integrated Resource Plan

Technical Advisory Committee Meeting No. 3 Agenda

Wednesday, March 9, 2022
Virtual Meeting

Topic	Time	Staff
Introductions	8:30	John Lyons
Existing Resource Overview	8:35	Mike Hermanson
Resource Requirements	9:15	James Gall
Break		
Non-Energy Impact Study	10:00	DNV
Lunch	11:30	
Natural Gas Market Overview & Price Forecast	12:30	Tom Pardee
Wholesale Electric Price Forecast	1:15	Lori Hermanson
Adjourn	2:00	

2023 IRP Introduction

2023 Avista Electric IRP

TAC 3 – March 9, 2022

John Lyons, Ph.D. Senior Resource Policy Analyst

Meeting Guidelines

- IRP team is working remotely and is available for questions and comments
- Stakeholder feedback form
  - Responses shared with TAC at meetings, by email and in Appendix
  - Would a form and/or section on the web site be helpful?
- IRP data posted to web site – updated descriptions and navigation are in development
- Virtual IRP meetings on Microsoft Teams until able to hold large meetings again
- TAC presentations and meeting notes posted on IRP page
- This meeting is being recorded and an automated transcript made

Virtual TAC Meeting Reminders

- Please mute mics unless commenting or asking a question
- Raise hand or use the chat box for questions or comments
- Respect the pause
- Please try not to speak over the presenter or a speaker
- Please state your name before commenting
- Public advisory meeting – comments will be documented and recorded

Integrated Resource Planning

The Integrated Resource Plan (IRP):

- Required by Idaho and Washington* every other year
  - Washington requires IRP every four years and update at two years
- Guides resource strategy over the next twenty + years
- Current and projected load & resource position
- Resource strategies under different future policies
  - Generation resource choices
  - Conservation / demand response
  - Transmission and distribution integration
  - Avoided costs
- Market and portfolio scenarios for uncertain future events and issues

Technical Advisory Committee

- Public process 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
  - Please ask questions
  - Always soliciting new TAC members
- Open forum while balancing need to get through topics
- Welcome requests for new studies or different modeling assumptions.
- Available by email or phone for questions or comments between meetings
- Due date for study requests from TAC members – October 1, 2022
- External IRP draft released to TAC – March 17, 2023, public comments due – May 12, 2023
- Final 2023 IRP submission to Commissions and TAC – June 1, 2023

2023 IRP TAC Meeting Schedule

- TAC 4: August 2022
- TAC 5: Early September 2022
- TAC 6: End of September 2022
- TAC 7: October 2022
- Technical Modeling Workshop: October 2022
- TAC 8: February 2023
- Public Meeting Gas & Electric IRPs: February/March 2023
- TAC 9: March 2023

Today's Agenda

8:30	Introductions, John Lyons
8:35	Existing Resource Overview, Mike Hermanson
9:15	Resource Requirements, James Gall
	Break
10:00	Non-Energy Impact Study, DNV
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2:00	Adjourn

Existing Resource Overview

2023 Avista Electric IRP

TAC 3 – March 9, 2022

Mike Hermanson - Power Supply/CETA Analyst

Existing Resource Types

Avista-owned Hydro

Avista-owned Thermal

- Natural Gas
- Coal
- Biomass

Contracted Resources

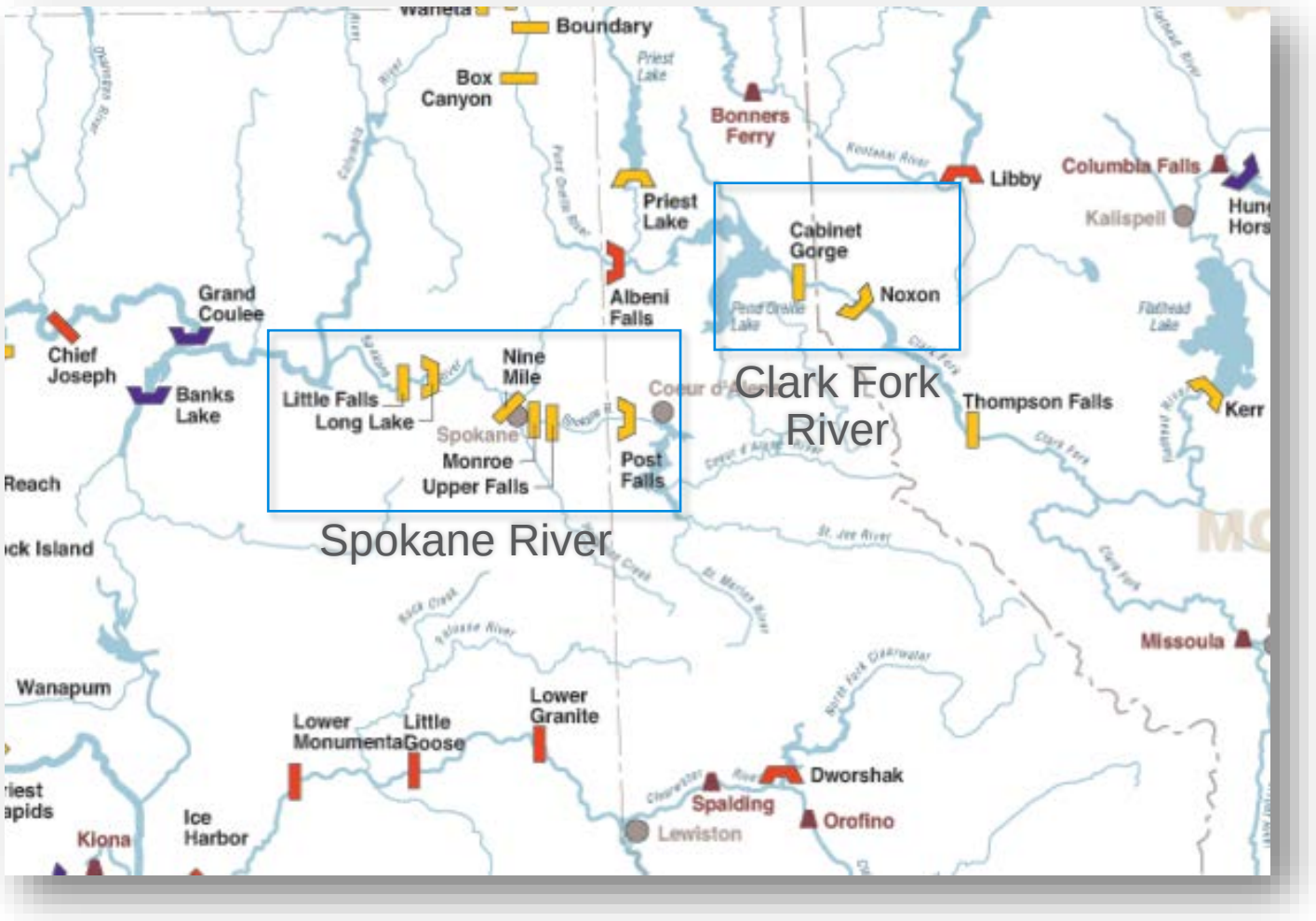
- Mid Columbia Hydro
- Natural Gas
- Wind
- Solar
- PURPA

Customer-Owned Resources




Avista Owned Hydro

- Spokane River
  - Post Falls (14.8 MW)
  - Upper Falls (10 MW)
  - Monroe St. (14.8 MW)
  - Nine Mile (36 MW)
  - Long Lake (81.6 MW)
  - Little Falls (32 MW)
- Clark Fork River
  - Noxon Rapids (518 MW)
  - Cabinet Gorge (265.2 MW)



Spokane River

Project	Nameplate Capacity (MW)	Maximum Capability (MW)	Expected Energy (aMW)*
Post Falls	14.8	18	11.2
Upper Falls	10	10.2	7.3
Monroe Street	14.8	15	11.2
Nine Mile	36	32	22.6
Long Lake	81.6	89	56
Little Falls	32	35.2	11.2
TOTAL	**189.2**	**199.4**	**119.5**

* based on 80-year hydrologic record


Long Lake

- Post Falls refurbishment – additional 3.8 MW incremental winter capacity and 4 aMW of incremental clean energy.

Clark Fork River

Project	Nameplate Capacity (MW)	Maximum Capability (MW)	Expected Energy (aMW)*
Cabinet Gorge	265.2	270.5	123.6
Noxon Rapids	518	610	196.5
TOTAL	**783.2**	**880.5**	**320.1**

* based on 80-year hydrologic record


Cabinet Gorge

Avista Owned Thermal Resources

Project Name	Fuel Type	Winter Maximum Capacity (MW)	Summer Maximum Capacity (MW)	Nameplate Capacity (MW)
Colstrip	Coal	222	222	247
Coyote Springs 2	Gas	317.5	286	306.5
Rathdrum	Gas	176	130	166.2
Northeast	Gas	66	42	61.8
Boulder Park	Gas	24.6	24.6	24.6
Kettle Falls	Wood	47	47	50.7
Kettle Falls CT	Gas	11	8	7.2
	Total	**864.1**	**759.6**	**864.0**

Colstrip Units 3 & 4

- Located in eastern Montana
- Avista owns 15% of units 3 & 4
- After 2025 will not be used to serve Washington customers
- Max net capacity of 222 MW


Colstrip

Coyote Springs 2

- Natural gas-fired combined cycle combustion turbine (CCCT)
- A combined-cycle power plant **uses both a gas and a steam turbine together to produce up to 50% more electricity from the same fuel than a traditional simple-cycle plant**. The waste heat from the gas turbine is routed to the nearby steam turbine, which generates extra power.
- Max winter capacity of 317.5 MW, Max summer capacity of 286 MW

Rathdrum, Northeast, & Boulder Park

- Rathdrum
  - Simple cycle combustion turbine (CT) units
  - Winter max – 176 MW, Summer Max 126 MW
- Boulder Park
  - Six natural gas internal combustion reciprocating engines
  - Max – 24.6 MW
- Northeast
  - Two aero-derivative simple cycle CT units
  - Winter max 68 MW, Summer max 42 MW
  - Air permit allows 100 run hours per year

Rathdrum

Kettle Falls Generating Station

- Among the largest biomass generation plants in North America
- Open loop steam plant uses waste wood products (hog fuel) from area mills and forest slash.
- Max capacity of 50 MW
- Also has 7.5 MW gas combustion turbine increasing max capacity to 55-58 MW

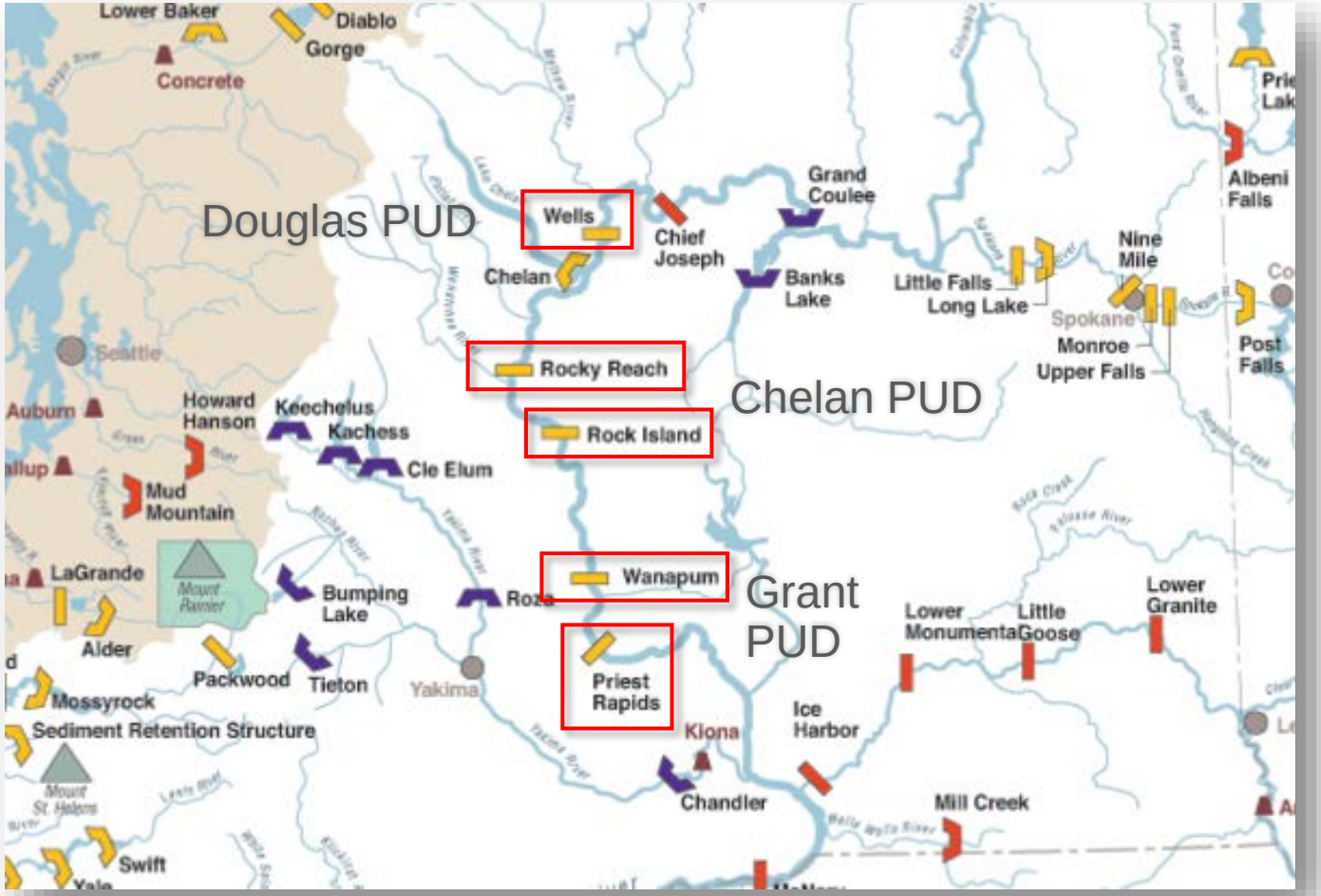

Kettle Falls

Power Purchase and Sale Contracts

Contract	Type	Fuel Source	End Date	2021 Annual Energy (aMW)
Mid Columbia Hydro	Purchase	Hydro	varies	132.9
Lancaster	Purchase	Natural Gas	Oct-26	207.8
Palouse Wind	Purchase	Wind	2042	41.2
Rattlesnake Flats	Purchase	Wind	2040	48.3
Adams-Nielson	Purchase	Solar	2038	4.95
Nichols Pumping	Sale	System	2023	-6.4
Morgan Stanley	Sale	Clearwater Paper	2023	-48.4
Douglas PUD	Sale	System	2023	-47

Mid-Columbia Hydroelectric Contracts

- Douglas PUD
  - Wells – Total Capacity 840 MW
- Chelan PUD
  - Rocky Reach – Total Capacity 1254 MW
  - Rock Island – Total Capacity 503 MW
- Grant PUD
  - Priest Rapids – Total Capacity 953 MW
  - Wanapum – Total Capacity 1,220 MW



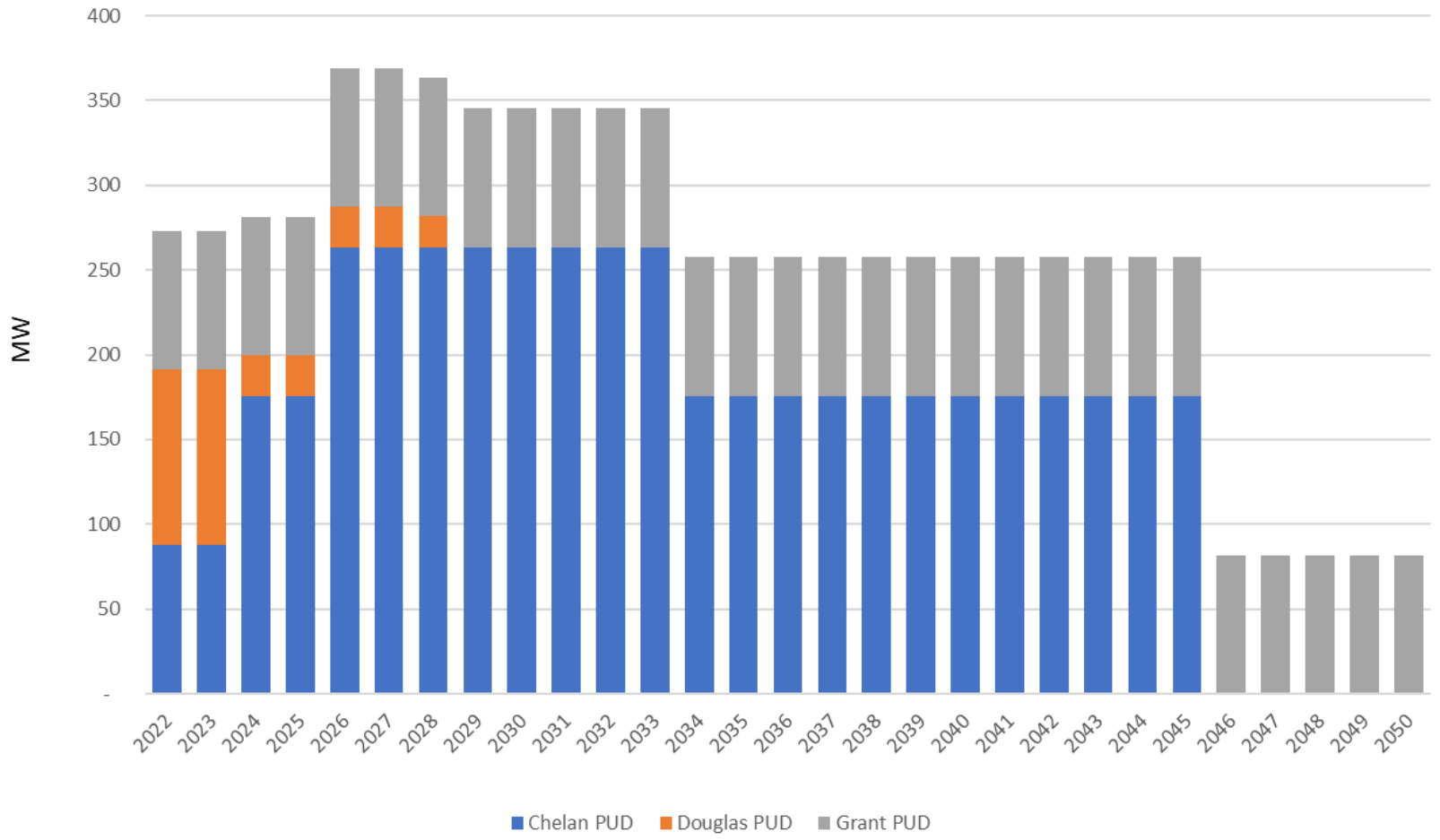
Note: Total capacity represents overall capacity of project, not total capacity of Avista's share.

Mid-Columbia Hydroelectric Contracts

Counter Party	Project(s)	Percent Share (%)	Start Date	End Date	2020 Estimated On-Peak Capability (MW)	2020 Annual Energy (aMW)
Grant PUD	Priest Rapids	3.79	Dec-2001	Dec-2052	30	19.5
Grant PUD	Wanapum	3.79	Dec-2001	Dec-2052	32	18.7
Chelan PUD	Rocky Reach	5	Jan-2016	Dec-2030	57	35.9
Chelan PUD	Rock Island	5	Jan-2016	Dec-2030	19	18.4
Douglas PUD	Wells	12.76*	Oct-2018	Dec-2028	107	57
Canadian Entitlement					-14	-5.6
2020 Total Net Contracted Capacity and Energy					231	143.90

* % share varies each year depending on Douglas PUD's load growth

Mid Columbia Hydroelectric Contracts



Wind & Solar Resources

- Palouse PPA
  - Capability – 105 MW
  - 30-year power purchase agreement (PPA)
  - 2021 output – 41.2 aMW
- Rattlesnake Flat PPA
  - Capability - 160.6 MW
  - 20-year PPA
  - 2021 output of 48.3 aMW
- Adams-Nielson Solar PPA
  - Capability – 19.2 MW
  - 80,000 panel facility
  - 2021 output – 4.95 aMW


Palouse Wind

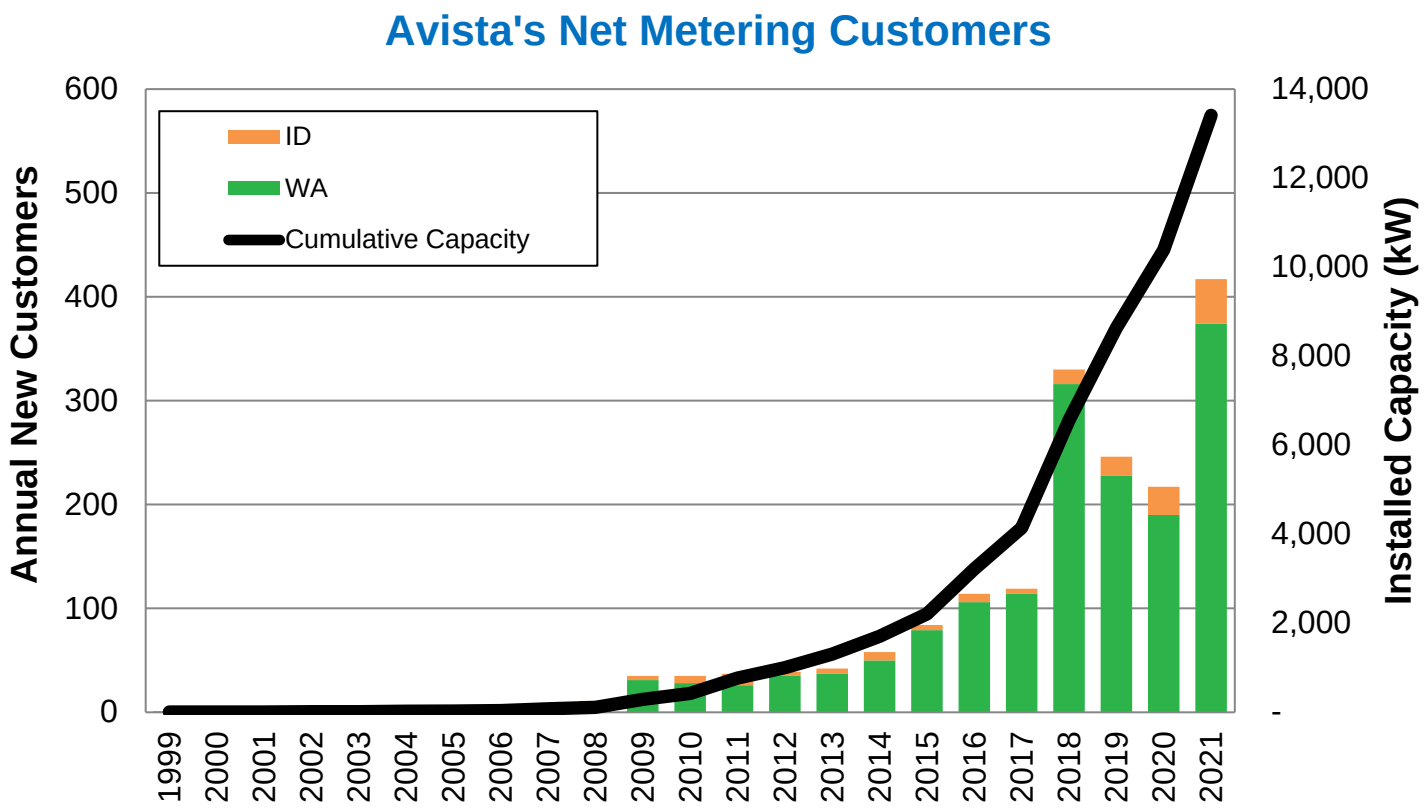
Public Utility Regulatory Policies Act (PURPA) Contracts

Owner	Fuel Source	Location	Contract End Date	Capability (MW)	Estimated Energy (aMW)
Sheep Creek Hydro Inc	Hydro	Northport, WA	12/31/2025	1.40	0.79
Hydro Technology Systems Inc.	Hydro	Kettle Falls, WA	12/31/2025	1.30	1.05
Deep Creek Energy	Hydro	Northport, WA	12/31/2022	0.41	0.23
Spokane County Water Reclamation*	Biomass	Spokane, WA	8/31/2030	0.26	0.14
Phillips Ranch	Hydro	Northport, WA	N/A	0.02	0.01
City of Spokane Upriver Dam*	Hydro	Spokane, WA	12/31/2024	17.60	6.17
City of Spokane Waste to Energy	Municipal Waste	Spokane, WA	12/30/2022	18.00	16.00
McKinstry*	Solar	Spokane, WA	5/3/2035	0.25	0.05
			WA Total	**39.24**	**24.44**
University of Idaho*	CHP Steam	Moscow, ID	2/15/2042	0.825	0.74
University of Idaho*	Solar	Moscow, ID	2/15/2042	0.1322	0.033
Ford Hydro LP	Hydro	Weippe, ID	6/30/2022	1.41	0.39
John Day Hydro	Hydro	Lucille, ID	9/21/2022	0.90	0.25
Clark Fork Hydro	Hydro	Clark Fork, ID	12/31/2037	0.22	0.12
Stimson Lumber	Wood Waste	Plummer, ID	12/31/2023	5.80	4.00
Clearwater Paper	Wood Waste	Lewiston, ID	12/31/2023	60.00	43.00
City of Cove	Hydro	Cove, OR	6/30/2038	0.80	0.29
			ID Total	**70.09**	**48.82**
			Total PURPA	**109.3**	**73.3**

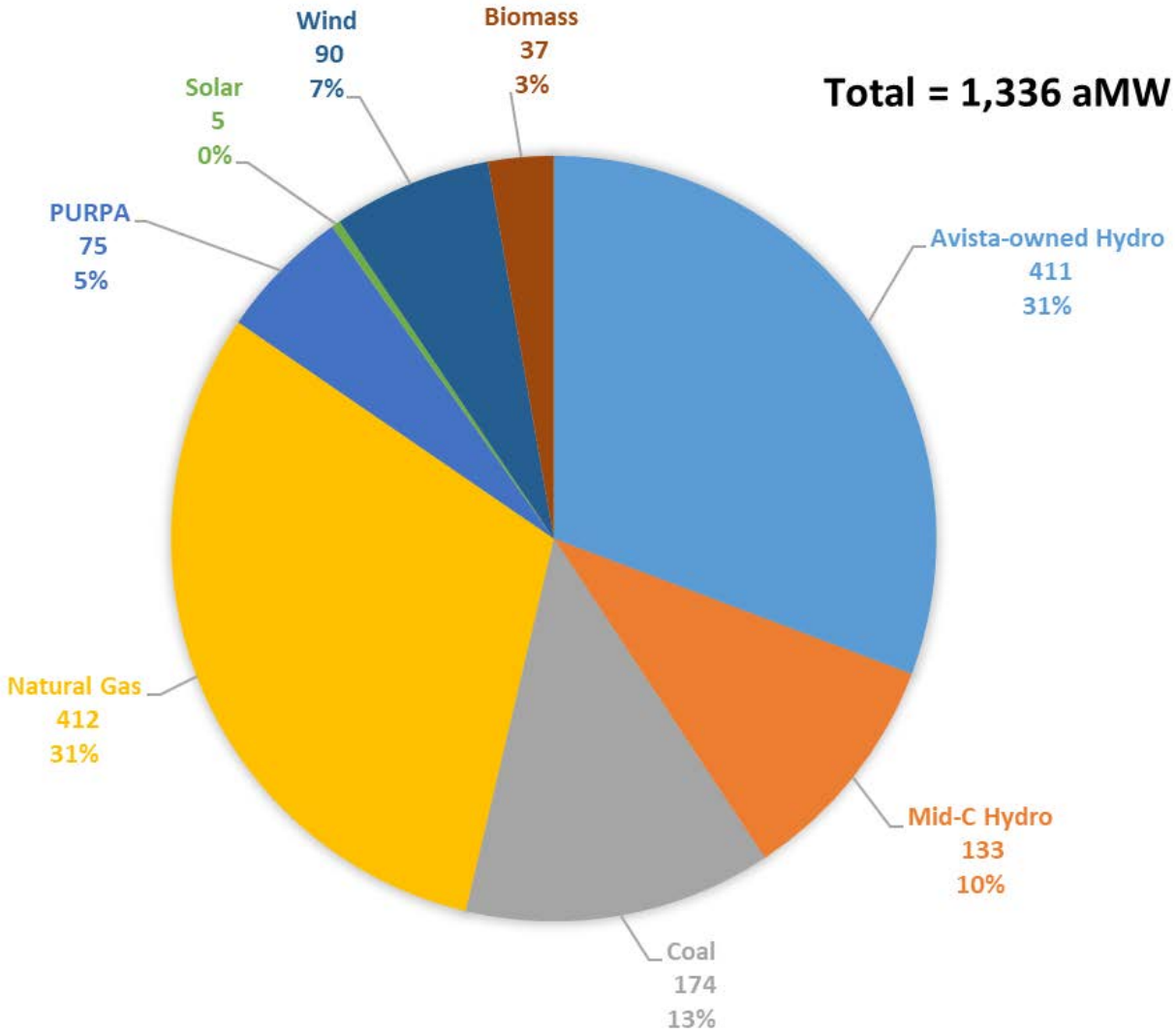
*connection is net metered and only contributes when generation exceeds load at facility

Customer Owned Generation

- 1,798 customer installed systems
- Technology
  - Primarily Solar
  - Some wind, combined solar & wind, and biogas
- Average system is 7.63 kW
- 93% of systems in Washington
- 2021 estimated 1.21 aMW

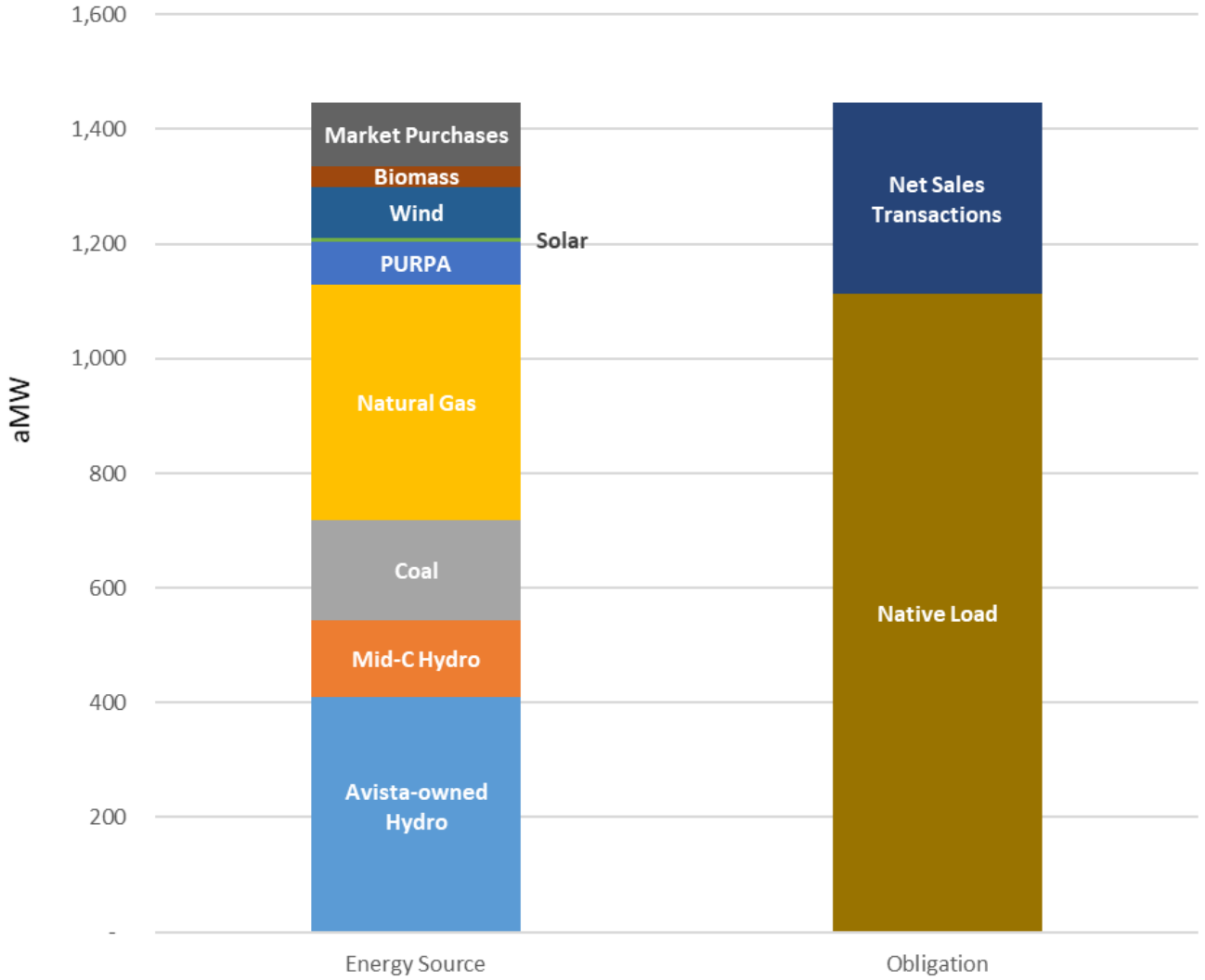


2021 System Generation by Resource Type (aMW)



Data is not adjusted for renewable energy credit sales or specified energy sales

2021 System Obligations & Energy Sources



Load & Resource Balance Update

Avista, Electric Technical Advisory Committee

March 9th, 2022 – TAC 3

James Gall, Electric IRP Manager

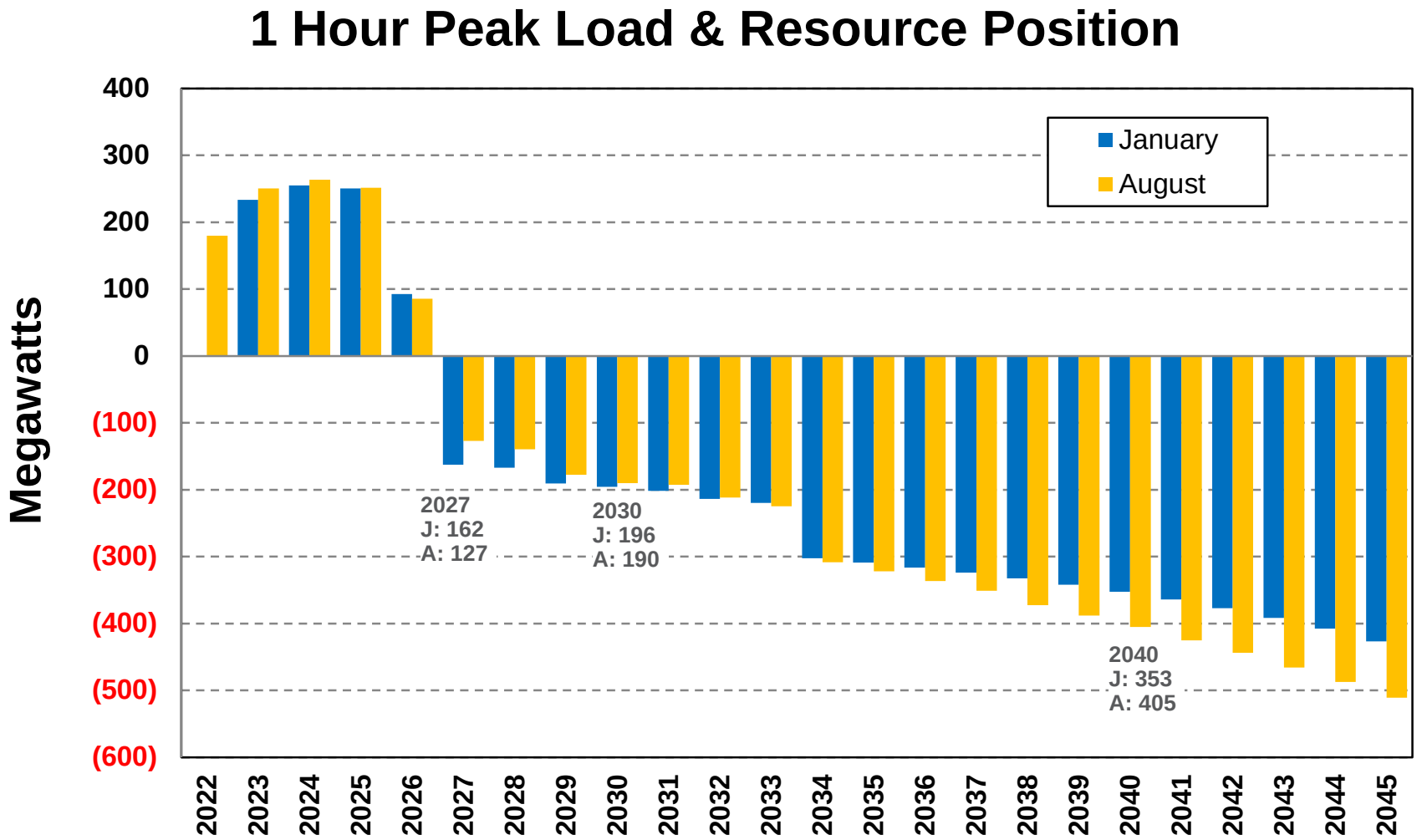
Major L&R Changes Since 2021 IRP

- Load forecast
- 30 MW industrial demand response (Washington Rate Case Settlement)
- Chelan County PUD purchase
  - ~88 MW or ~54 aMW equal to 5% of Rocky Reach and Rock Island projects

	2022	2023	2024	2025	2026-2030	2031-2033	2034-2045
Existing Slice	5%	5%	5%	5%	5%		
April 2021 Contract			5%	5%	5%	5%	
December 2021 Contract					5%	10%	10%

System Capacity Position

Western Resource Adequacy Program not included at this time



Peak Planning Criteria

16% winter PRM

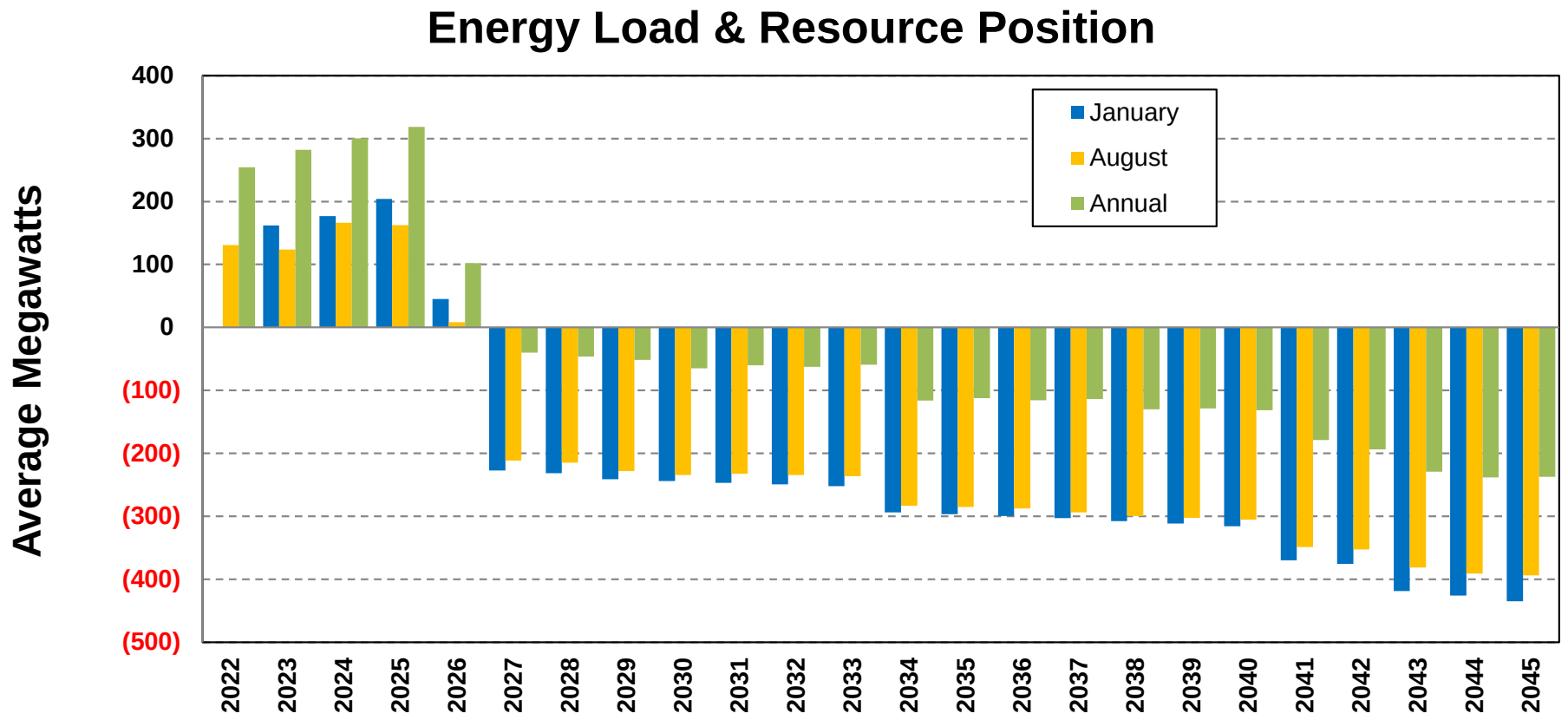
7% summer PRM

Operating reserves (~6%)

Regulation (16 MW)

Seasonal winter/summer peak not included at this time, short position begins in Nov 1, 2026

System Planning Energy Position



Energy Contingency Metrics

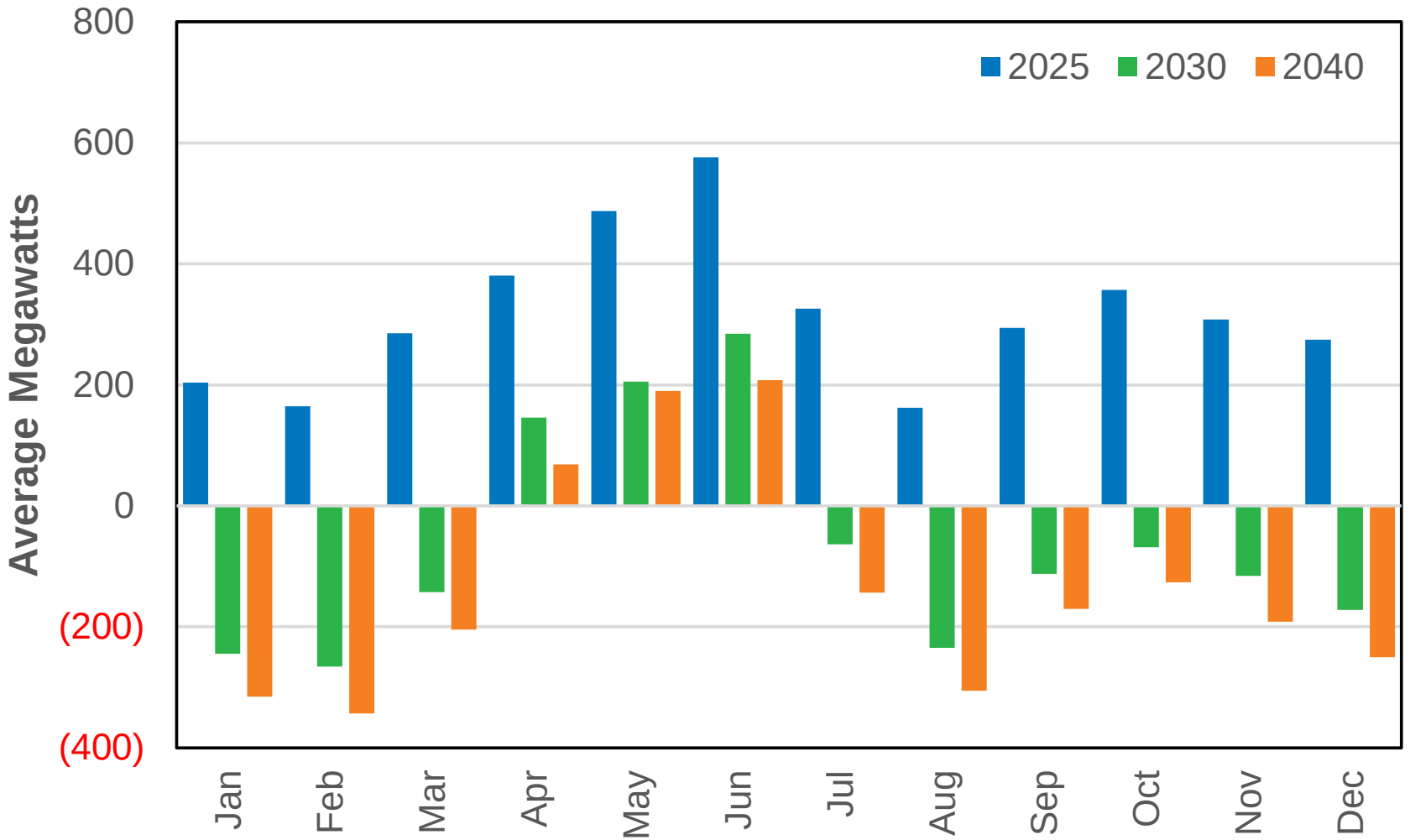
10th percentile hydro

90th percentile load

2023 IRP will update contingency metrics for wind/solar variability (TBD in future TAC meeting)

2023 IRP with energy planning constraint beyond annual

Monthly Planning Energy Position



2030 Washington CETA Planning

- Draft rules were released January 19th, 2022
- Creates a planning requirement and operation requirements
  - **Planning requirement** designs system for renewable energy to deliver to load
  - Operating requirement is creation of renewable energy and retaining nonpower attributes
- The planning standard uses two compliance mechanisms
  - Must plan for renewable generation equal to or greater then 80% of retail load to qualify as primary compliance by 2030
  - Remaining retail load must be offset using Alternative Compliance
    - Alternative compliance could be an unbundled REC, energy transformation project, compliance payment
- Planning standard time step and risk level is not defined in the draft rule

Avista Clean Energy Position for Planning Standard (strawman- for illustrative purposes)

- Monthly retail load vs generation comparison
- Renewable generation exceeding monthly retail load qualifies as alternative compliance
  - On/off peak estimates could be used
- Expected Case Methodology
  - Median Hydro
  - Expected Loads
  - Historical average wind/solar if available
- Resource allocation
  - Existing hydro (PT Ratio)
  - Wind (PT Ratio + WA purchase hourly Idaho share of energy)
  - Solar (allocated to WA)
  - Kettle Falls (PT Ratio + WA purchase hourly Idaho share of energy, 95.4% qualifying)
  - New Chelan PUD contracts (PT Ratio + WA purchase hourly Idaho share of energy)

PT Ratio is ~65.5% Washington, and 34.5% Idaho

2030 Monthly Accounting Illustration (WA Only)

Average Megawatts

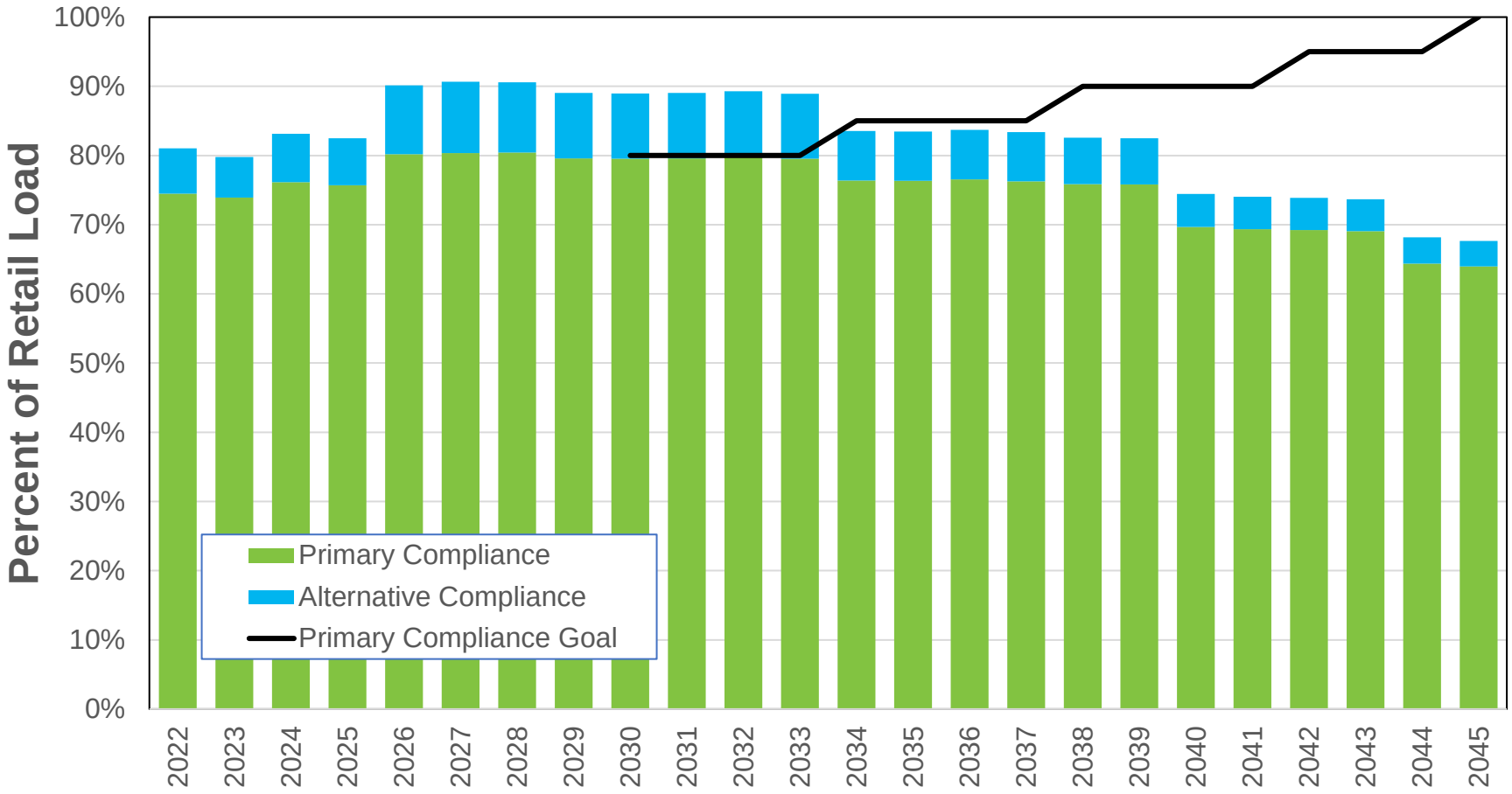
Illustration Purposes Only

					Washington Share									
Month	**Sales Forecast**	**WA PURPA**	**Net Retail Load**		**Hydro**	**Wind**	**Solar**	**Biomass**		**Energy Exchange from Idaho**		**Total Renewable Generation**		**Primary Compliance**	**Alternative Compliance**
Jan	801	21	780		362	62	2	27		84		537		537	-
Feb	822	24	798		333	66	4	26		80		508		508	-
Mar	688	27	661		348	70	5	23		78		524		524	-
Apr	647	28	620		519	66	7	15		81		688		620	68
May	582	25	558		706	55	8	0		78		847		558	289
Jun	600	19	580		730	58	8	10		82		888		580	307
Jul	600	17	583		498	45	9	23		74		650		583	67
Aug	668	15	653		279	46	8	26		70		429		429	-
Sep	664	16	648		252	49	6	28		63		399		399	-
Oct	583	19	564		259	60	4	27		69		419		419	-
Nov	636	19	617		308	68	2	27		79		484		484	-
Dec	752	21	730		377	63	1	29		80		549		549	-
Avg	**669**	**21**	**649**		**414**	**59**	**5**	**22**		**77**		**577**		**516**	**61**
														79.6%	9.4%

Note: “Energy Exchange from Idaho” includes wind, biomass, and “new” Chelan PUDs contracts

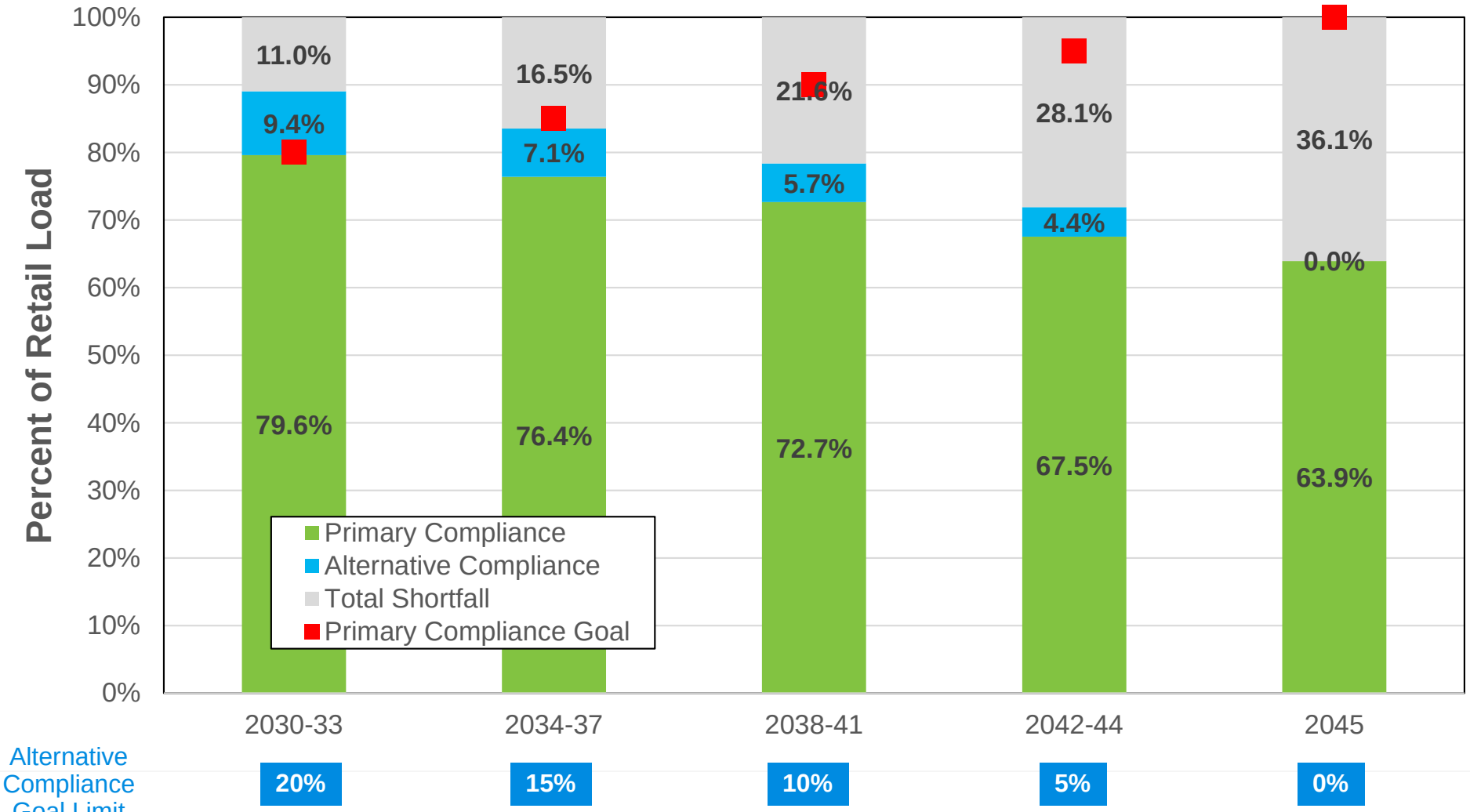
For 2030, Avista does not have any voluntary renewable energy programs planned.

Current Annual CETA Energy Position



Does not include Idaho hydro used for Alternative Compliance

Compliance Window CETA Energy Position



Supply Side Non-Energy Impacts

09 March 2022

Agenda

01 Project Overview

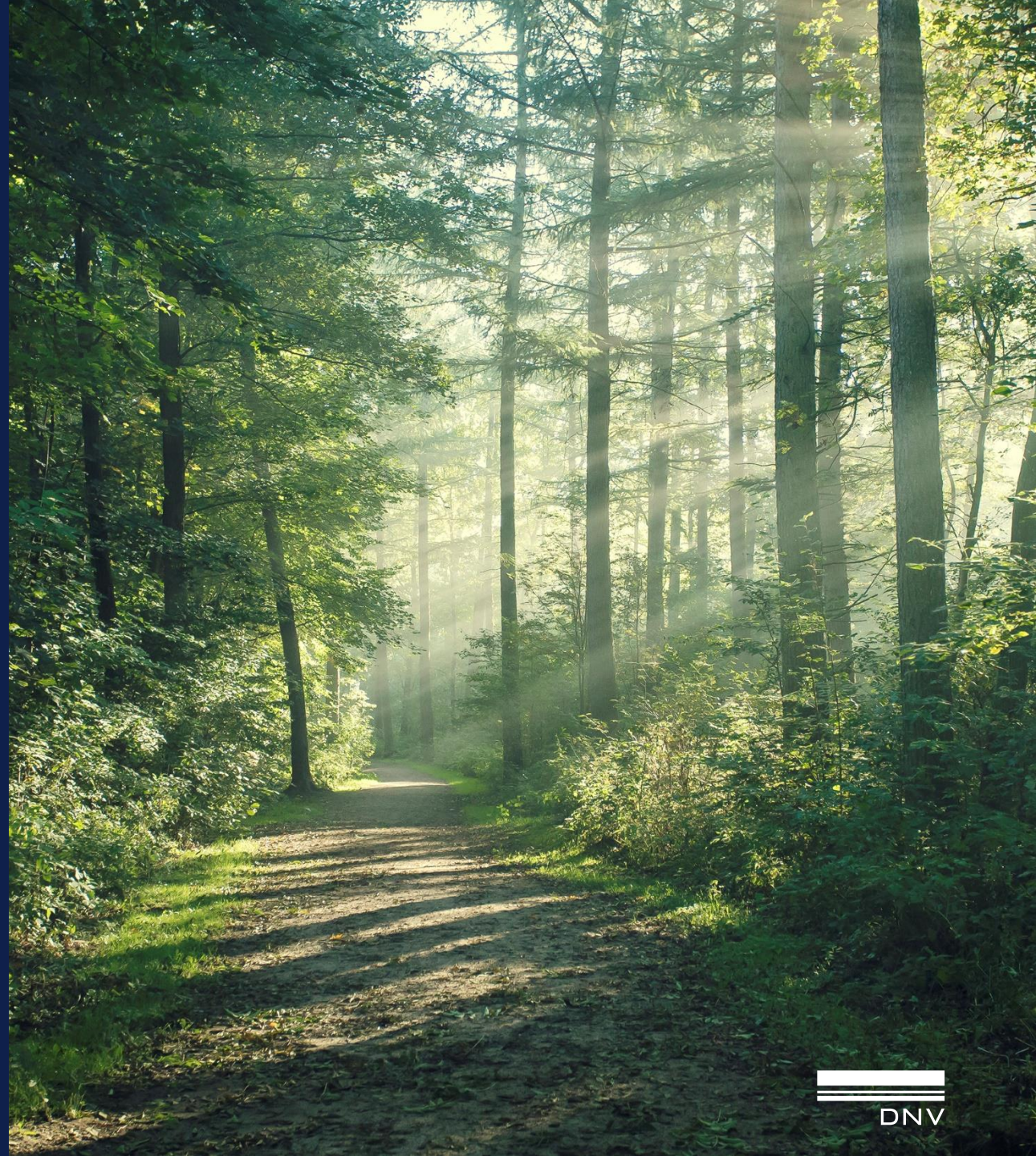
02 Approach

03 Results

04 Gap Analysis

05 Discussion

Project Overview



What is a Supply Side Non-Energy Impact (NEI)?

Cost of Energy

Impacts included in the cost of energy

Examples:

- Jobs and direct economic impacts
- Fuel costs
- Water use

NEI (Externality)

Impacts **not** accounted for in the cost of energy

Examples:

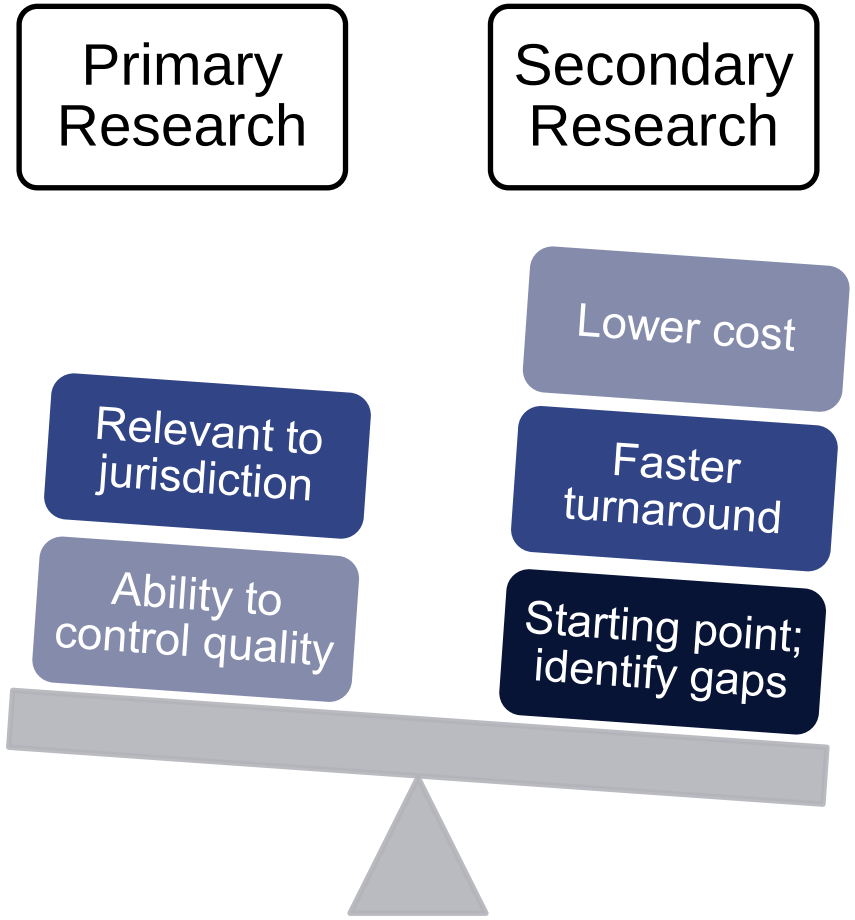
- Health impacts due to emissions
- Fatalities
- Water use

Project Overview

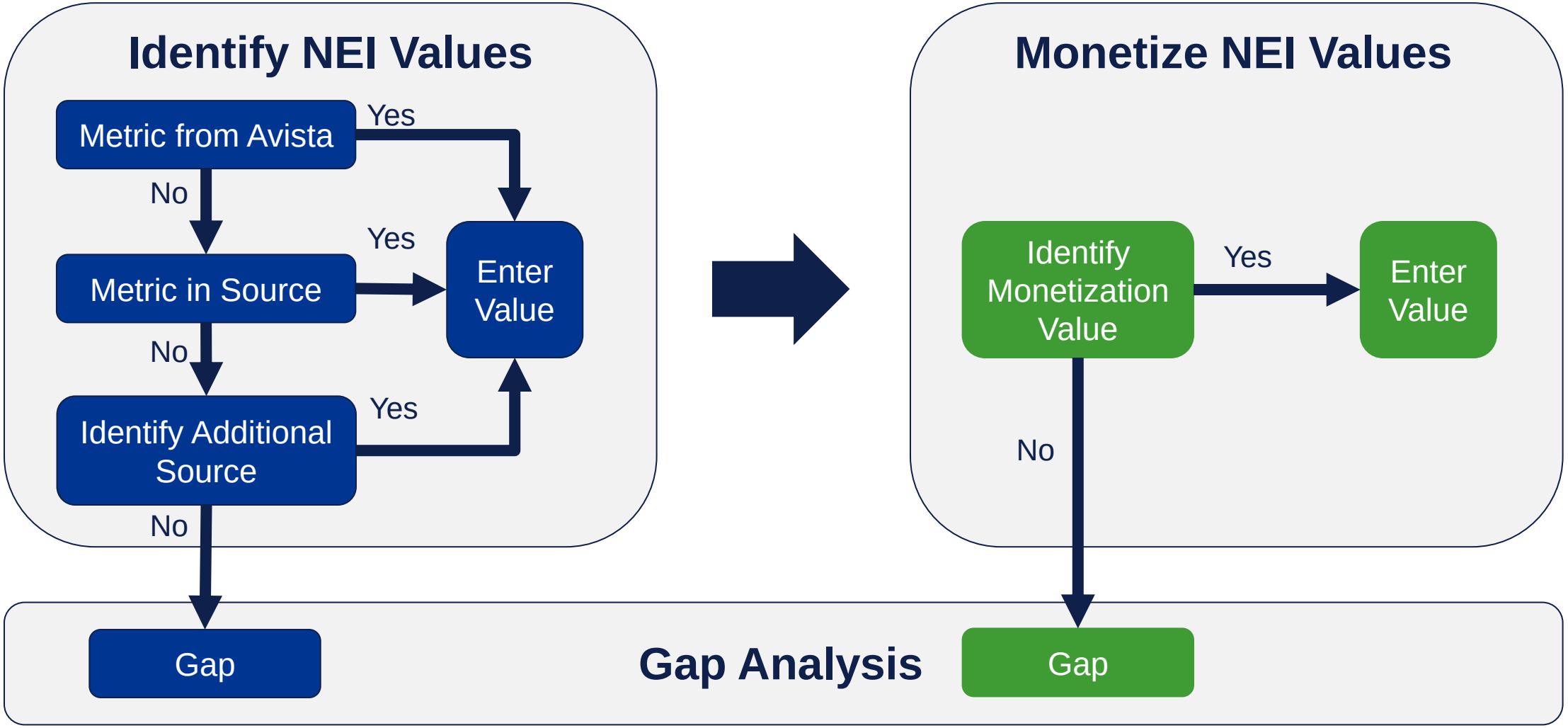
- Jurisdictional Scan
- NEI Database Development
- Database Application
- Gap Analysis

Approach

Potential NEI Approaches



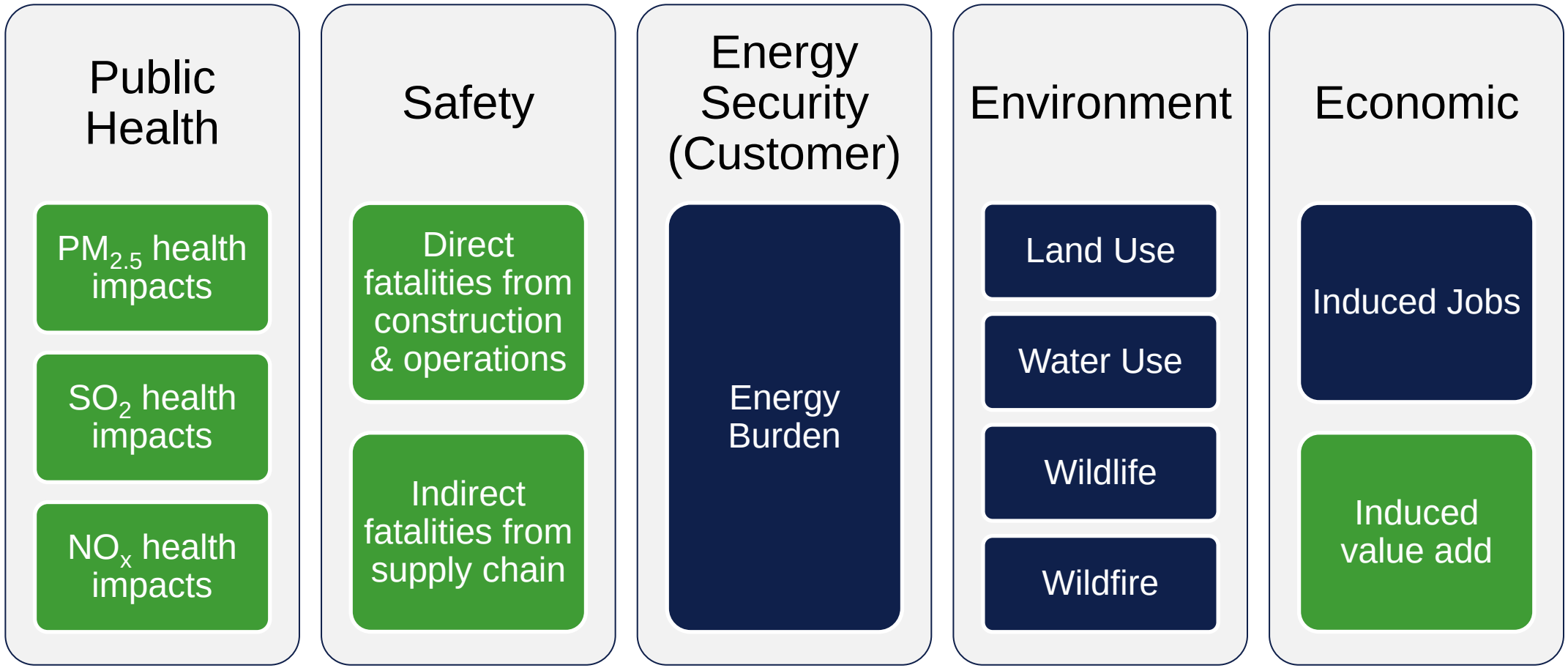
Database Compilation: Generalized Approach



Approach Limitations

- NEI values are not always comparable across regions
- Potential limitations:
  - Outdated studies
  - Issues with methodology
  - Lack of documentation for some values
- Gaps in secondary research, particularly for monetization

NEI Metrics


Public Health
$PM_{2.5}$ health impacts
SO_2 health impacts
NO_x health impacts
Safety
Direct fatalities from construction & operations
Indirect fatalities from supply chain
Energy Security (Customer)
Energy Burden
Environment
Land Use
Water Use
Wildlife
Wildfire
Economic
Induced Jobs
Induced value add

Summary of Compiled Data

Group	Generator Types	Public Health	Safety	Environment			Economic
				Land Use	Water Use	Wildlife	
Biomass	Biomass	✓	✓	✓	✓		✓
Coal	Coal	✓	✓	✓	✓	✓	✓
	Coal CCS		✓	✓	✓	✓	≈
Hydro	Hydro-PB	✓					✓
	Hydro-GF	✓					✓
	Hydro-Res	✓	✓	✓	✓		✓
	Hydro-RR	✓					✓
	Hydro-RRS	✓					✓
Hydrogen Electrolyzer	HE-LG			✓			
	HE-SM			✓			
Lithium-ion Storage	Batt-LG						
	Batt-SM						
Natural gas	NG-Aero	✓	✓	✓		✓	✓
	NG-CCCT	✓	✓	✓	✓	✓	✓
	NG-CT	✓	✓	✓	✓	✓	✓
	NG-ICE	✓	✓	✓	✓	✓	✓

Group	Generator Types	Public Health	Safety	Environment			Economic
				Land Use	Water Use	Wildlife	
Non-natural gas	NNG-Bio		✓				
	NNG-CF						≈
	NNG-Hyd			✓			
	NNG-LAir						
	NNG-Ren			✓			
Nuclear	Nuclear	✓	✓	✓	✓	✓	
Solar	Solar-Com	✓	✓	✓			≈
	Solar-Rft	✓	✓	✓	✓		≈
	Solar-Utl	✓	✓	✓	✓		≈
Wind	Wind-LG	✓	✓	✓	✓	✓	✓
	Wind-Off	✓	✓	✓	✓		≈
	Wind-SM	✓	✓	✓	✓	✓	✓

Results

Public Health: Approach

Emissions Values

- Values: $PM_{2.5}$, SO_2, and NO_x tons/MWh
- Sources: Avista, eGRID

Public Health Costs

- Values: \$/ton of $PM_{2.5}$, SO_2, or NO_x
- Source: COBRA model by county

Monetized Impacts (\$/MWh)

$$Monetized\ Health\ impacts\ \left[\frac{\$}{MWh}\right]$$

$$= Emissions\ \left[\frac{tons}{MWh}\right] \times Health\ Impacts\ from\ pollutant\ \left[\frac{\$}{ton}\right]$$

Results for: All Contiguous U.S. States

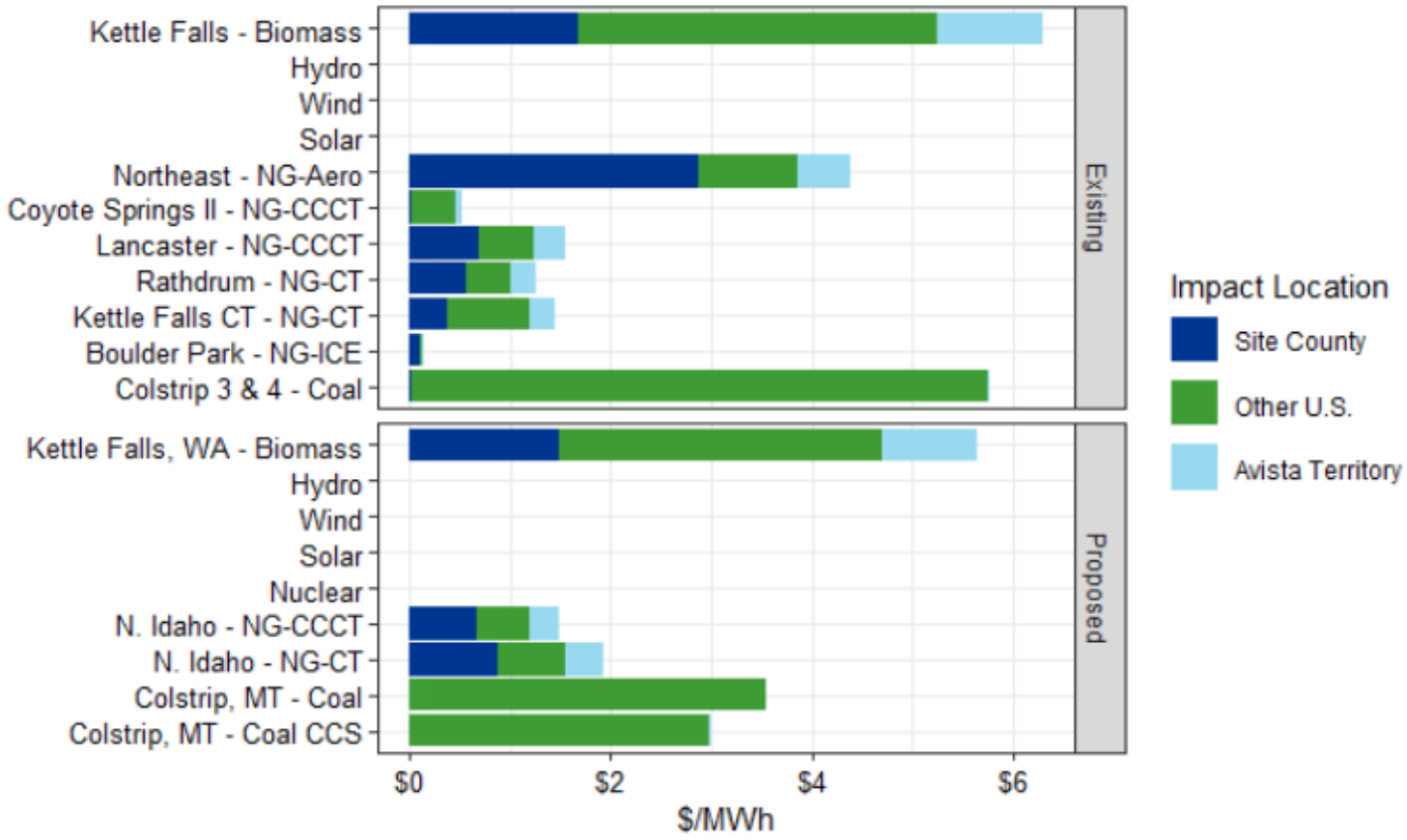
Export: All results | Current filter

Health Endpoint	Change in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.004	0.010	$48,754	$110,385
Nonfatal Heart Attacks *	0.000	0.004	$76	$709
Infant Mortality	0.000	0.000	$298	$298
Hospital Admits, All Respiratory	0.001	0.001	$40	$40
Hospital Admits, Cardiovascular **	0.001	0.001	$55	$55
Acute Bronchitis	0.006	0.006	$4	$4
Upper Respiratory Symptoms	0.107	0.107	$5	$5
Lower Respiratory Symptoms	0.075	0.075	$2	$2
Emergency Room Visits, Asthma	0.002	0.002	$1	$1
Asthma Exacerbation	0.112	0.112	$8	$8
Minor Restricted Activity Days	3.087	3.087	$271	$271
Work Loss Days	0.522	0.522	$105	$105
Total Health Effects			**$49,619**	**$111,882**

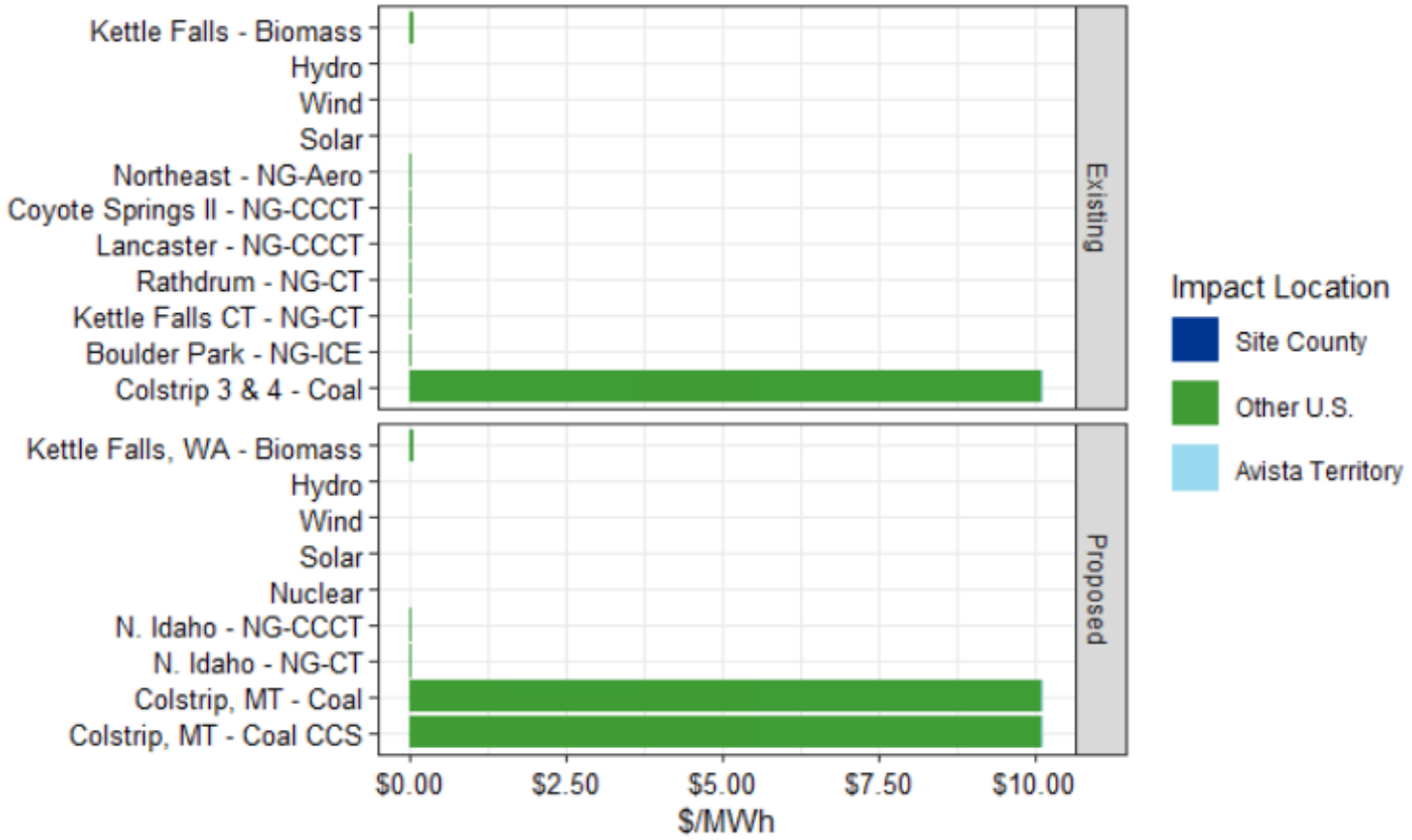
* The Low and High values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of $PM_{2.5}$ on mortality in the United States.

** Except heart attacks.

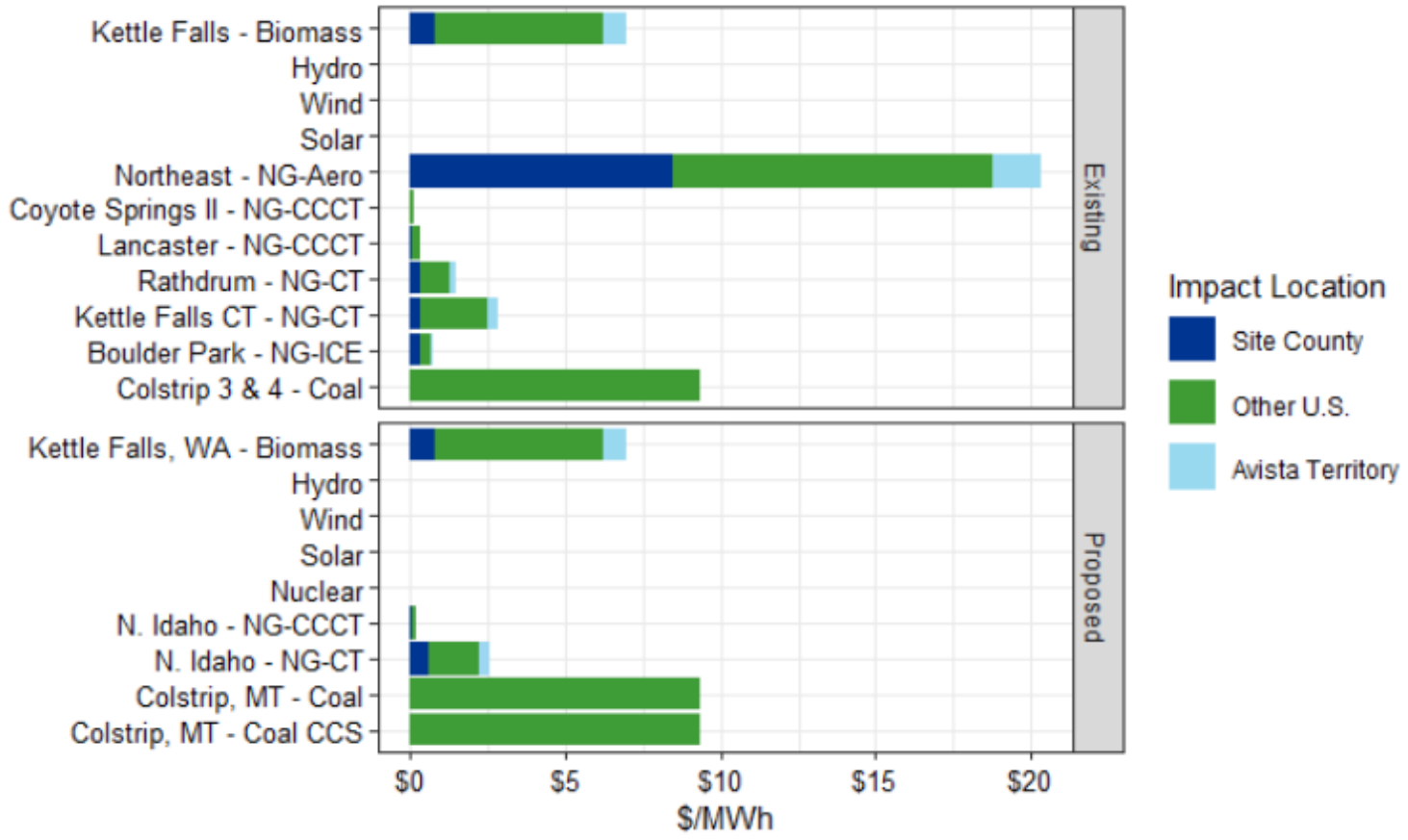
Public Health: $PM_{2.5}$



Public Health: SO_2



Public Health: NO_x



Safety: Approach

Fatality Values

- Values: direct fatalities, indirect fatalities
- Sources: BLS, BTS, MSHA, CDC, DOT

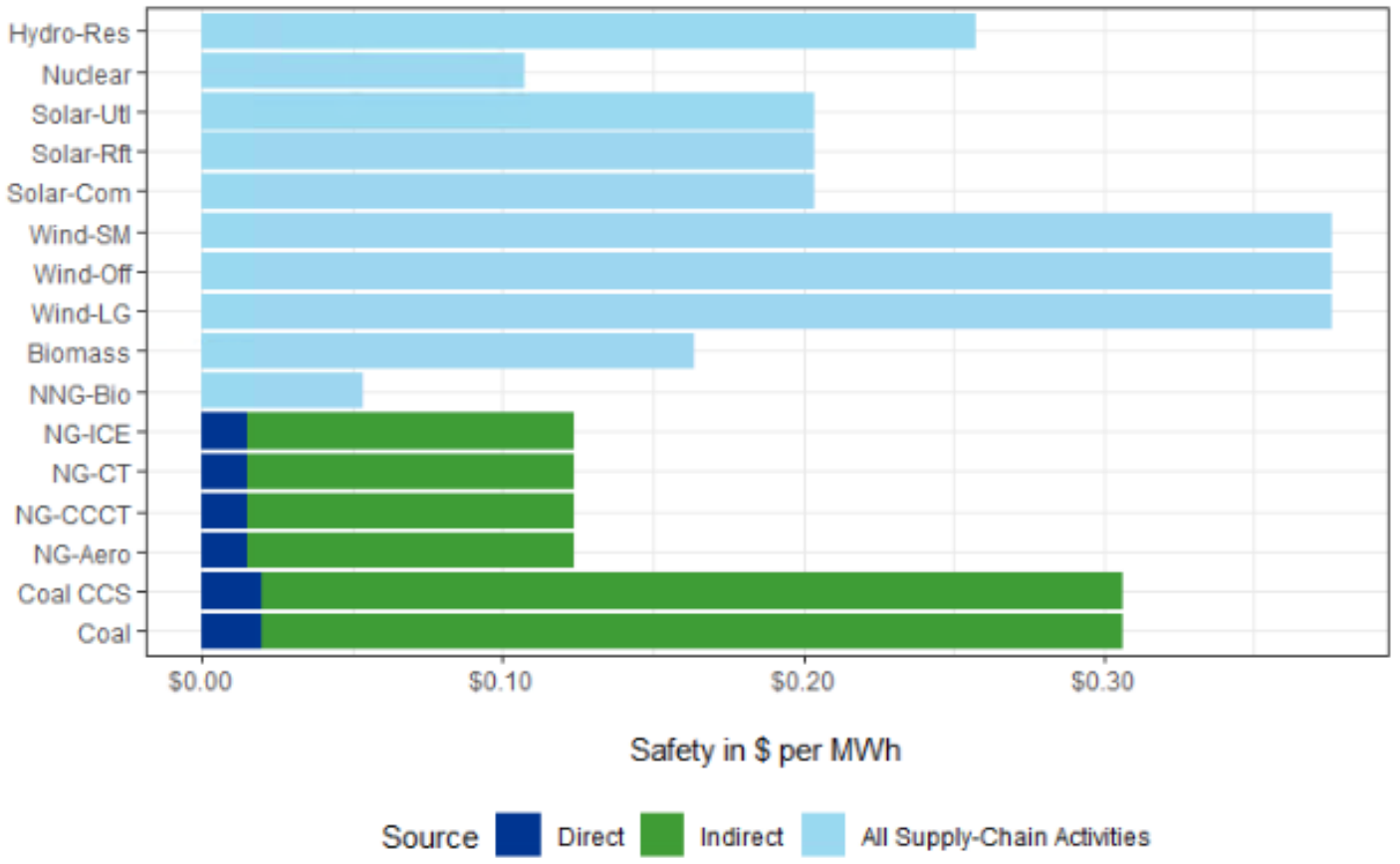
Safety Costs

- Values: value of statistical life, $/MWh
- Source: EPA

Monetized Impacts ($/MWh)

$$Monetized\ \text{safety}\left[\frac{\$}{MWh}\right] = Safety\left[\frac{Fatalities}{MWh}\right] \times Value\ of\ a\ Statistical\ Life\left[\frac{\$10{,}742{,}916.67}{Fatality}\right]$$

Safety: Fatalities

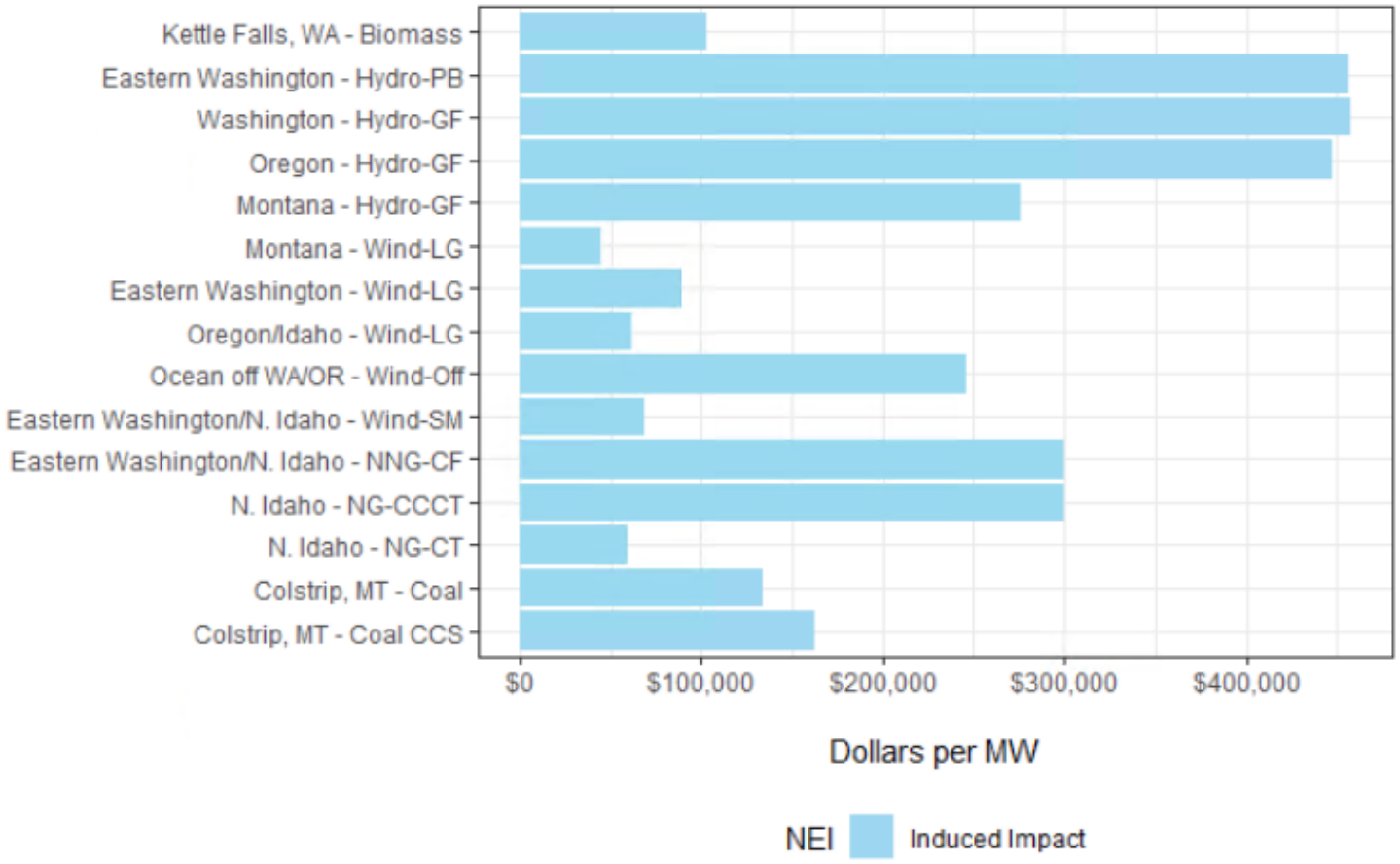


Economic: Approach

- NREL JEDI models
  - 6 different models
  - Specified location, year of construction, & MW
- Types of impacts:
  - **Direct**: Labor directly related to onsite development, construction, and operations
  - **Indirect**: Supporting industry impacts
  - **Induced**: Impacts due to reinvestment and spending driven by the direct and indirect impacts
- **Value added**: The difference between total gross output and the cost of intermediate inputs. Equivalent to gross domestic product.

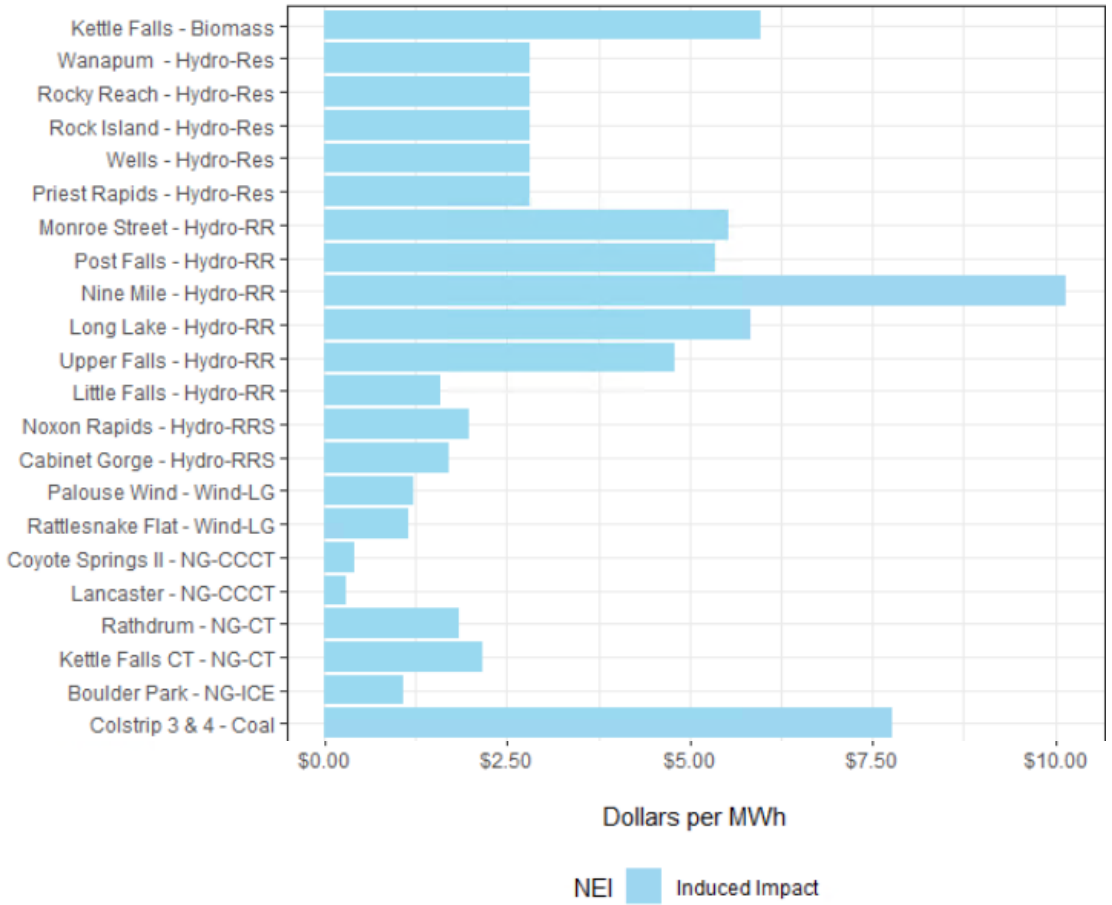
Local Economic Impacts - Summary Results	Jobs	Earnings	Output	Value Added
During construction period				
Project Development and Onsite Labor Impacts	1,087	$93.3	$180.6	$119.5
Construction and Interconnection Labor	657	$75.1		
Construction Related Services	431	$18.2		
Power Generation and Supply Chain Impacts	488	$22.0	$69.2	$35.3
Induced Impacts	364	$16.0	$50.1	$26.7
Total Impacts	1,939	$131.3	$299.9	$181.5
During operating years (annual)				
Onsite Labor Impacts	29	$2.6	$2.6	$2.6
Local Revenue and Supply Chain Impacts	44	$2.6	$10.5	$4.9
Induced Impacts	17	$0.8	$2.4	$1.3
Total Impacts	89	$5.9	$15.4	$8.8

Economic: Construction Impacts (proposed)

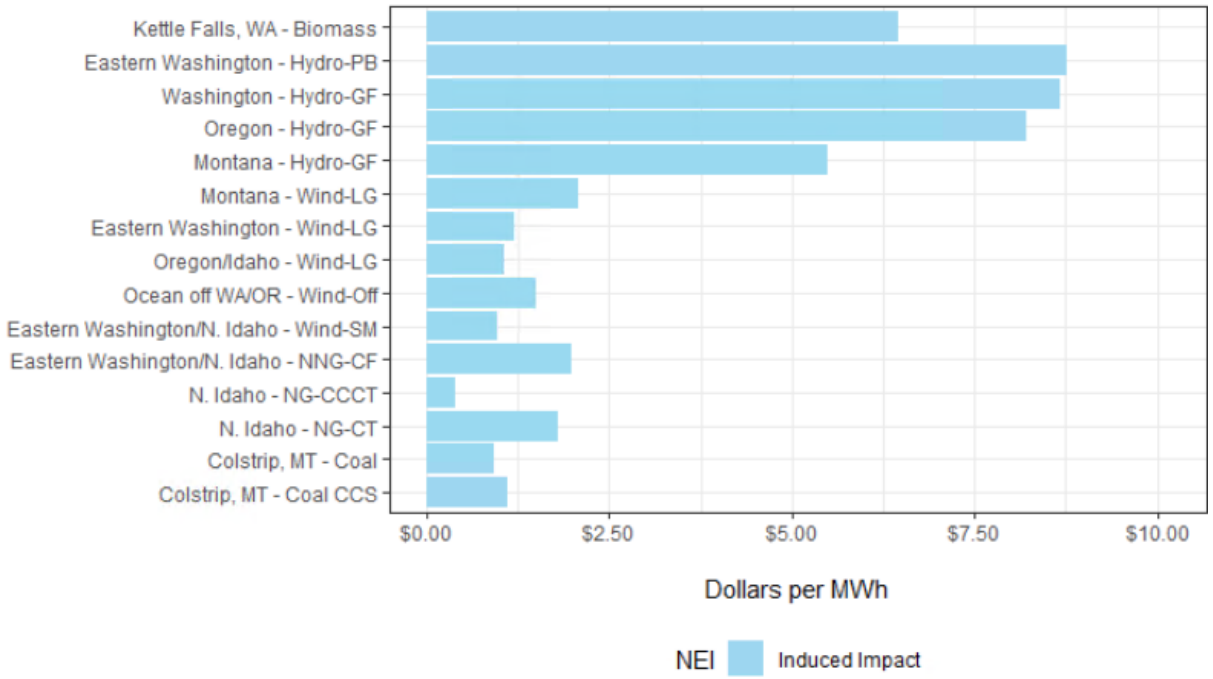


Economic: Operations Impacts

Existing



Proposed



DNV

Database Application Example: Proposed Eastern Washington Large Wind Farm

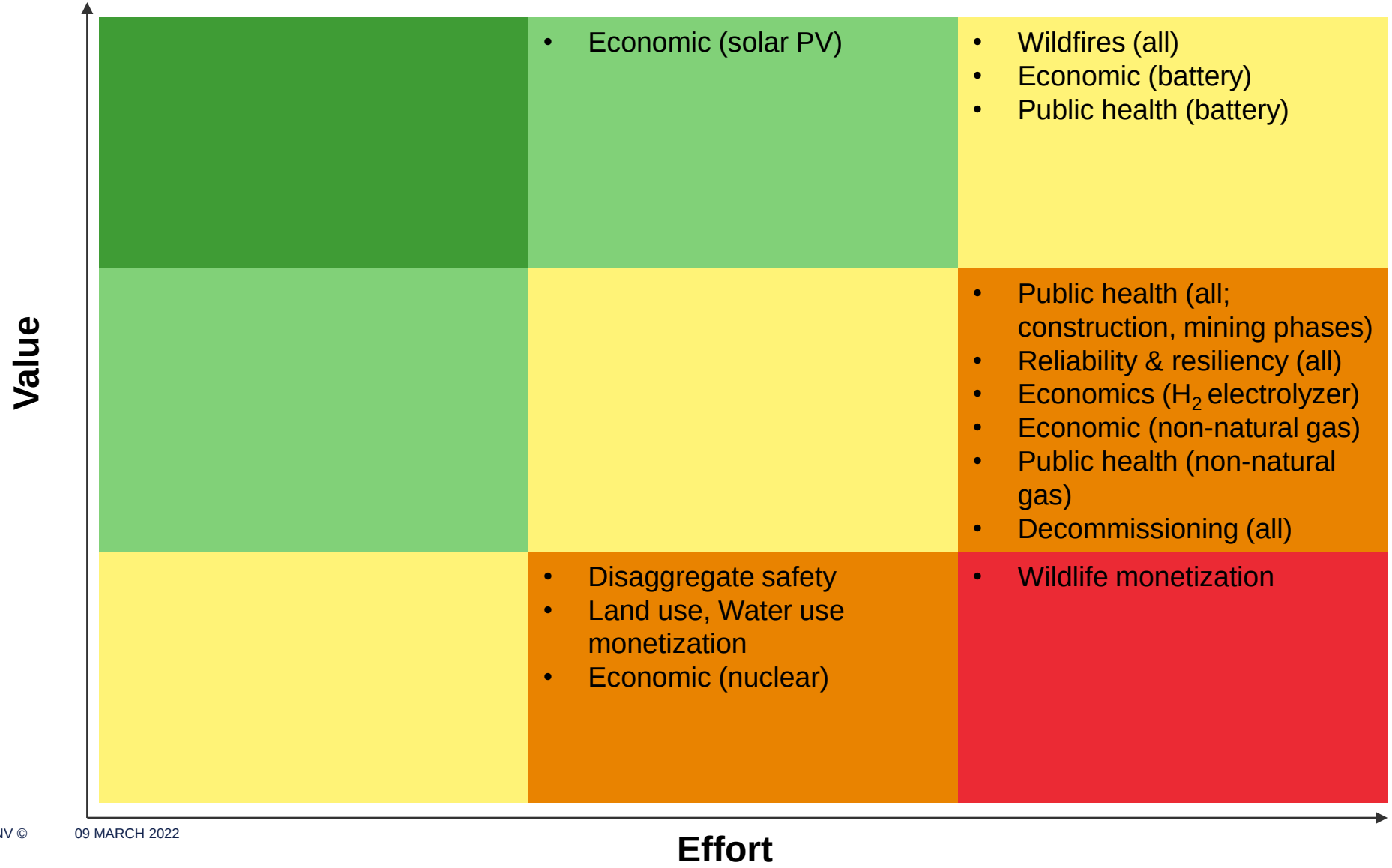
Impacts per MWh

Impacts per MW

NEI	Impact ($/MW)
Economic - Construction	$89,600

Gap Analysis

Gap analysis



Discussion

www.dnv.com

DNV

Database Compilation: Resource Types

Group	Technology	
	Abbreviation	Generator Types
Biomass	Biomass	Biomass
Coal	Coal	Coal
	Coal CCS	Coal with Carbon Capture
Hydro	Hydro-PB	Pumped hydro - brownfield
	Hydro-GF	Pumped hydro - greenfield
	Hydro-Res	Reservoir hydro
	Hydro-RR	Run-of-river hydro
	Hydro-RRS	Run-of-river hydro with storage
Hydrogen electrolyzer	HE-LG	Hydrogen electrolyzer - large
	HE-SM	Hydrogen electrolyzer - small
Lithium-ion storage	Batt-LG	Lithium-ion Storage - Large
	Batt-SM	Lithium-ion Storage - Small
Natural gas	NG-Aero	Natural gas Aero Turbine
	NG-CCCT	Natural gas CCCT
	NG-CT	Natural gas CT
	NG-ICE	Natural gas internal combustion engine
Non-natural gas	NNG-Bio	Non-natural gas (Bio-fuel)
	NNG-CF	Clean Fuel Turbine
	NNG-Hyd	Non-natural gas (Hydrogen)
	NNG-LAir	Non-natural gas (Liquid air)
	NNG-Ren	Renewable natural gas storage tank
Nuclear	Nuclear	Nuclear
Solar	Solar-Com	Community solar
	Solar-Rft	Rooftop solar
	Solar-Utl	Utility-scale solar
Wind	Wind-LG	Large wind
	Wind-Off	Off-shore wind
	Wind-SM	Small Wind

Natural Gas Price Forecast

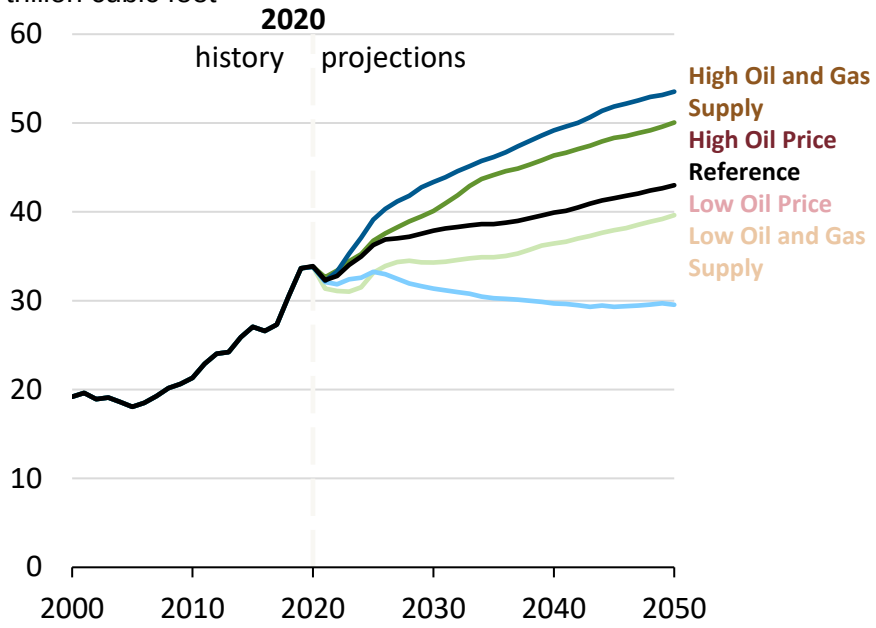
Avista, Electric Technical Advisory Committee

March 9th, 2022 – TAC 3

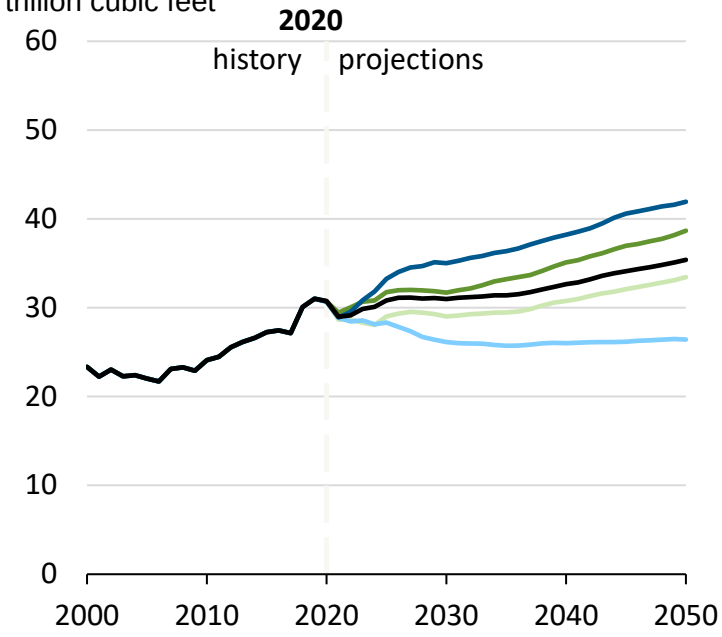
Tom Pardee, Natural Gas IRP Manager

U.S. dry natural gas production and consumption

U.S. dry natural gas production
AEO2021 side cases
trillion cubic feet

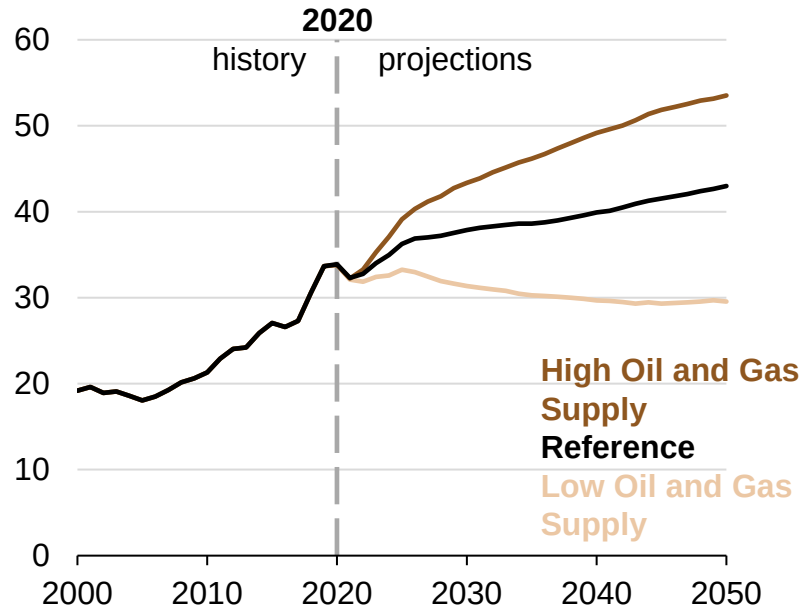


U.S. natural gas consumption
AEO2021 side cases
trillion cubic feet

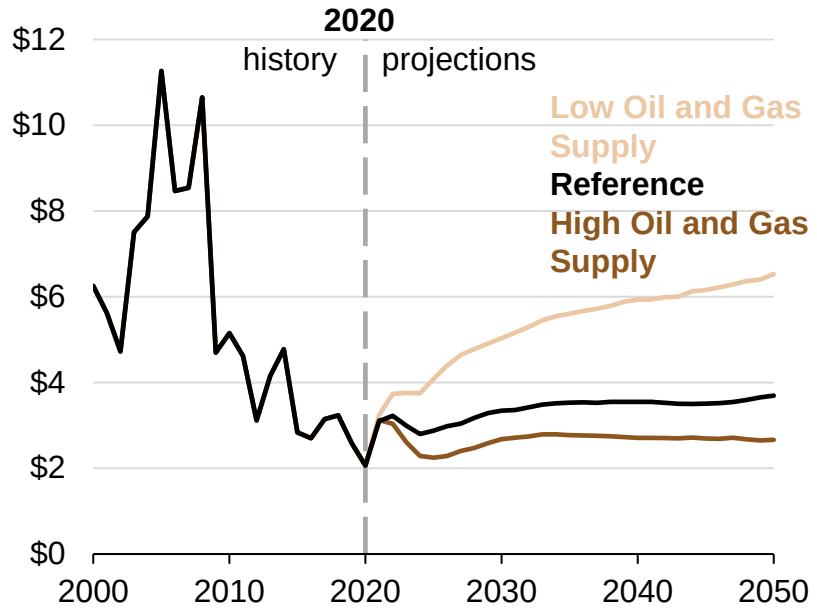


Natural gas production and prices

U.S. dry natural gas production
AEO2021 oil and gas supply cases
trillion cubic feet



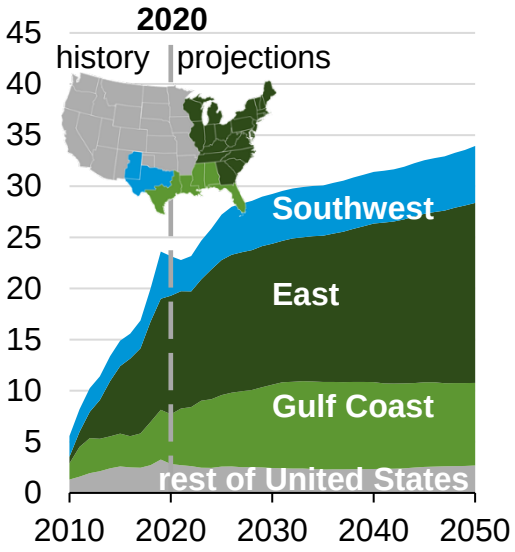
Natural gas spot price at Henry Hub
AEO2021 oil and gas supply cases
2020 dollars per million British thermal units



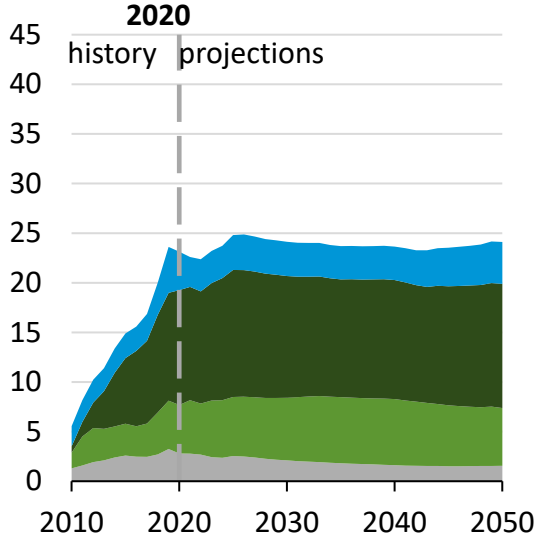
U.S. production of natural gas from shale resources

U.S. dry natural gas production from shale resources by region, AEO2021 oil and gas supply cases

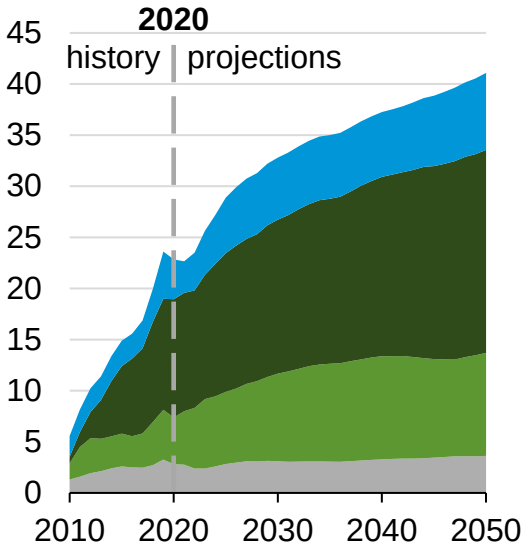
Reference case
trillion cubic feet



Low Oil and Gas Supply case
trillion cubic feet



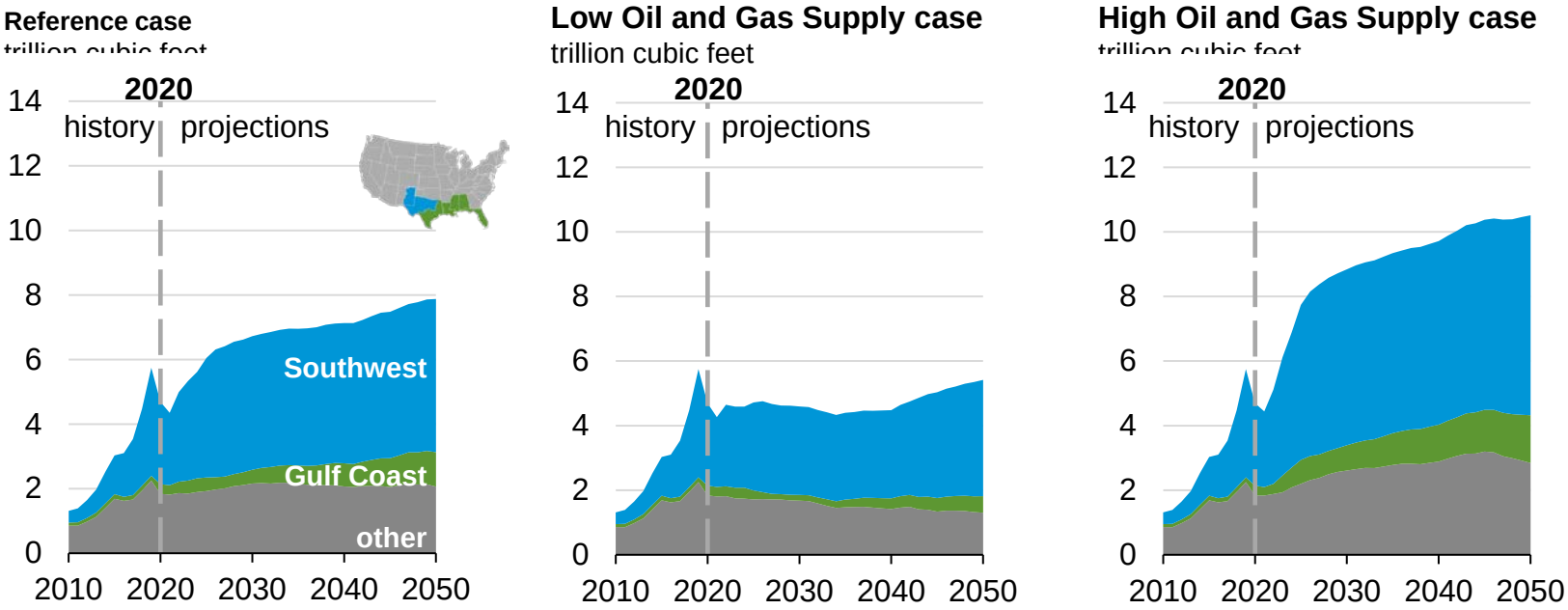
High Oil and Gas Supply case
trillion cubic feet



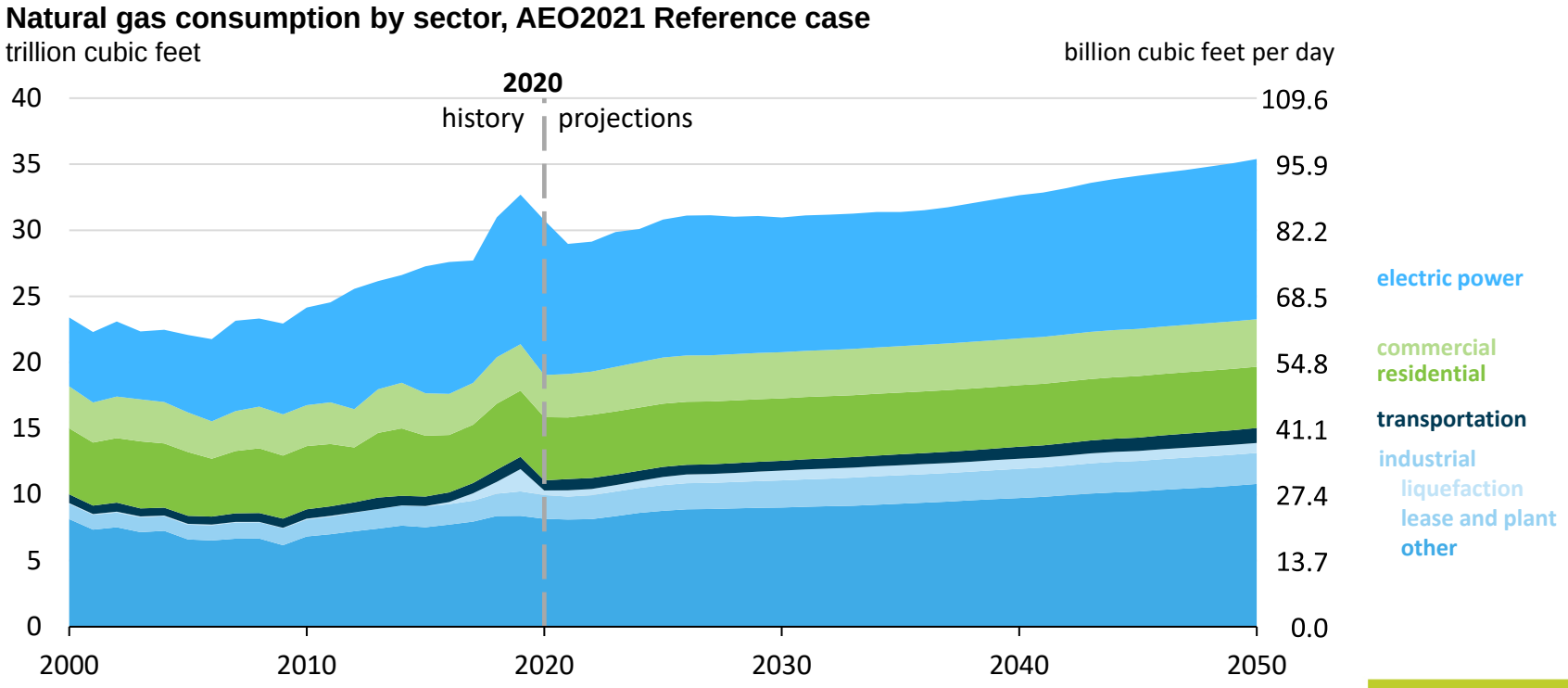
4

U.S. production of natural gas from oil formations

U.S. dry natural gas production from oil formations by region, AEO2021 oil and gas supply cases

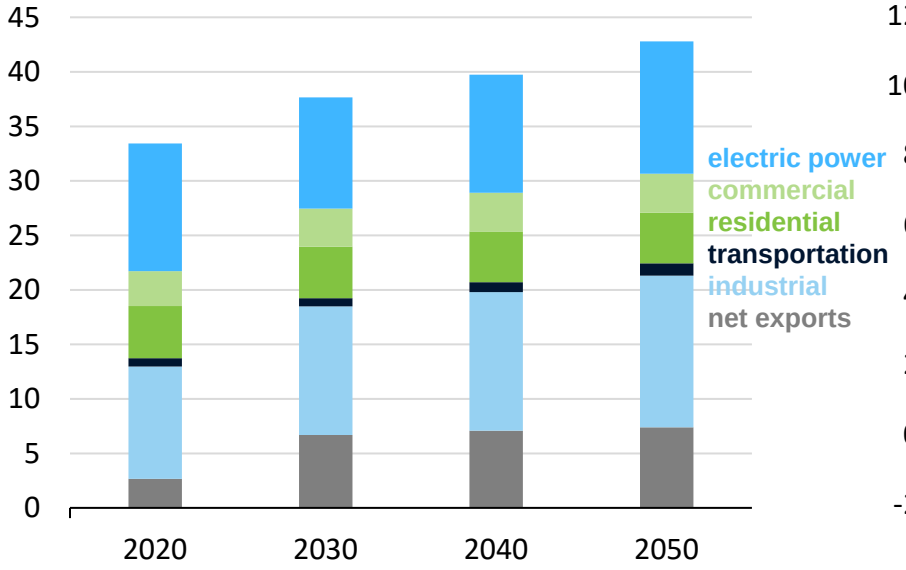


U.S. natural gas consumption by sector

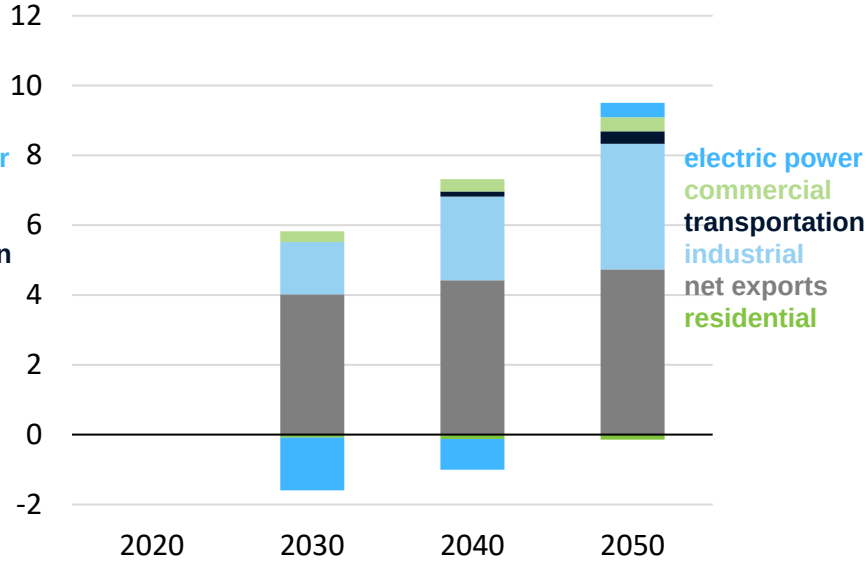


Change in natural gas disposition by sector and net exports

Natural gas disposition by sector and net exports
AEO2021 Reference case
trillion cubic feet



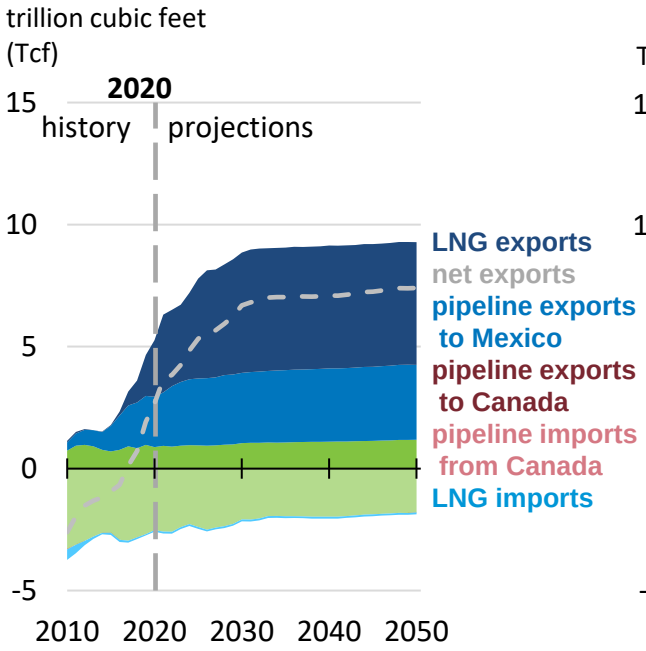
Change in natural gas disposition and net exports
AEO2021 Reference case
relative to 2020 in trillion cubic feet



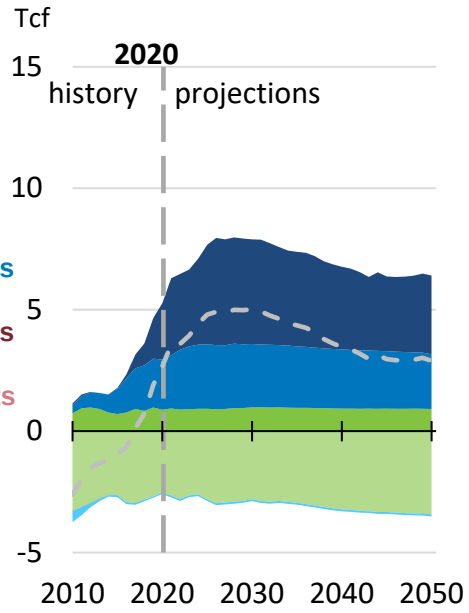
U.S. natural gas and liquefied natural gas (LNG) trade

U.S. natural gas and LNG trade, AEO2021 oil and gas supply cases

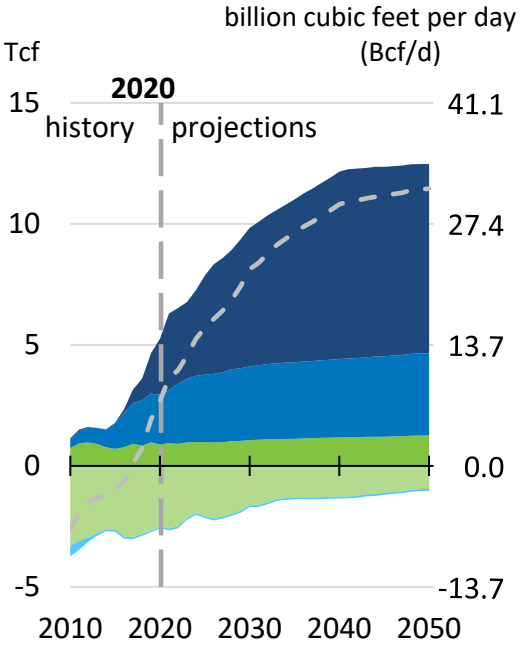
Reference case



Low Oil and Gas Supply case

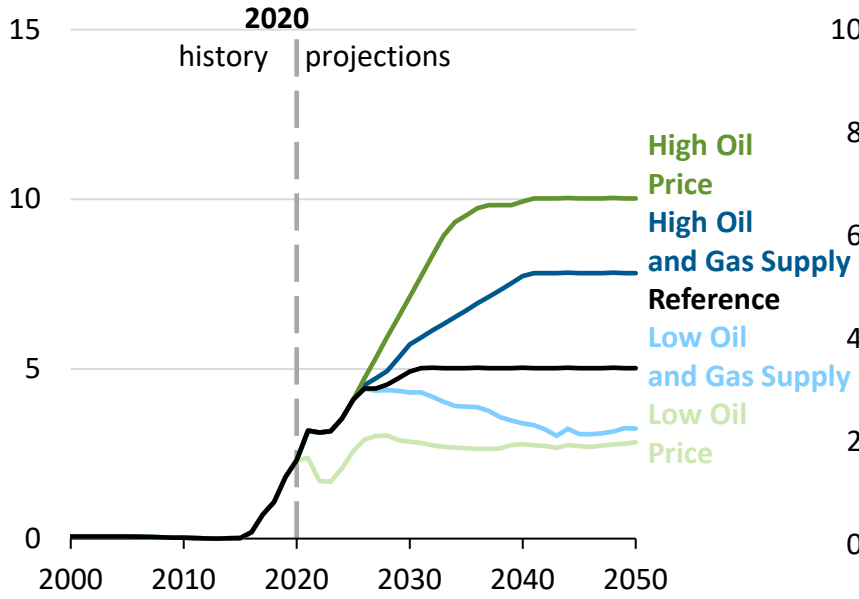


High Oil and Gas Supply case

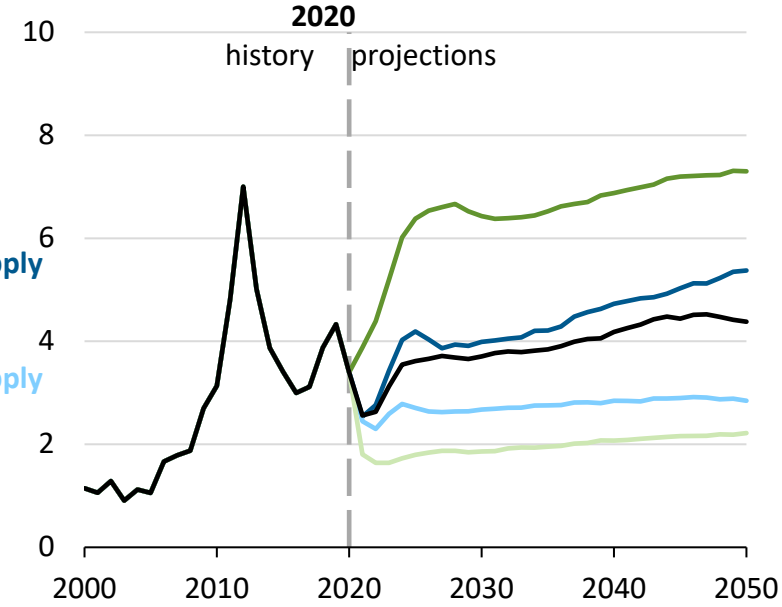


U.S. liquefied natural gas (LNG) exports and oil and natural gas prices

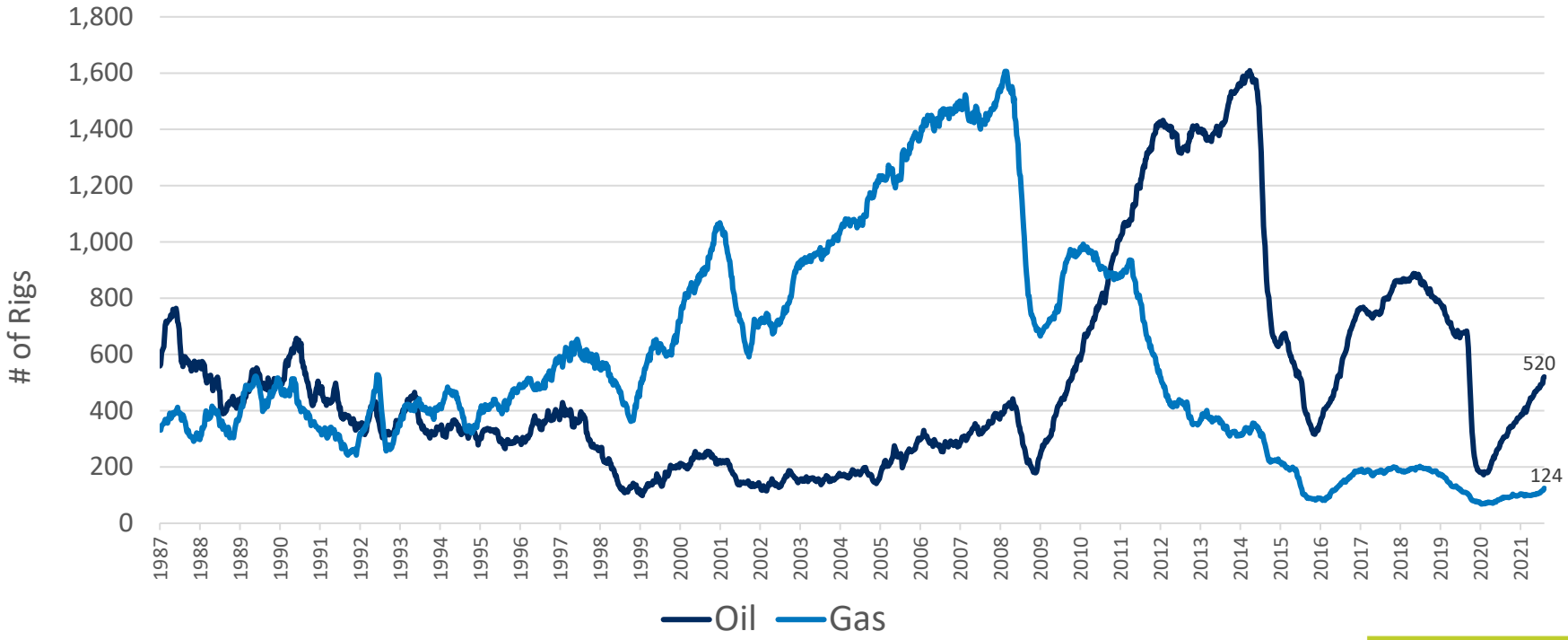
U.S. liquefied natural gas exports
AEO2021 supply and price cases
trillion cubic feet



Ratio of Brent crude oil price to natural gas price at Henry Hub, AEO2021 supply and price cases
energy-equivalent terms

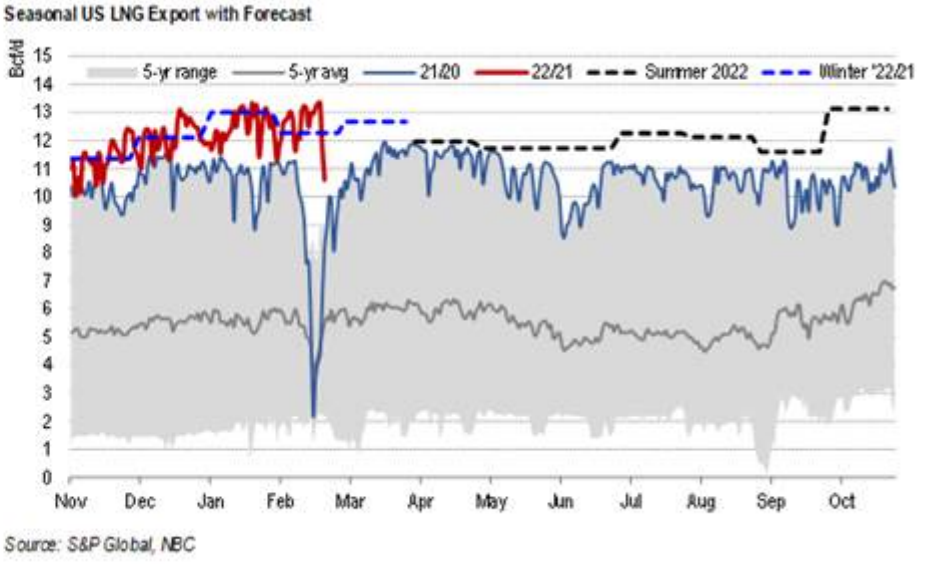


Rig Count


1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
# of Rigs
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
520
124
Oil
Gas

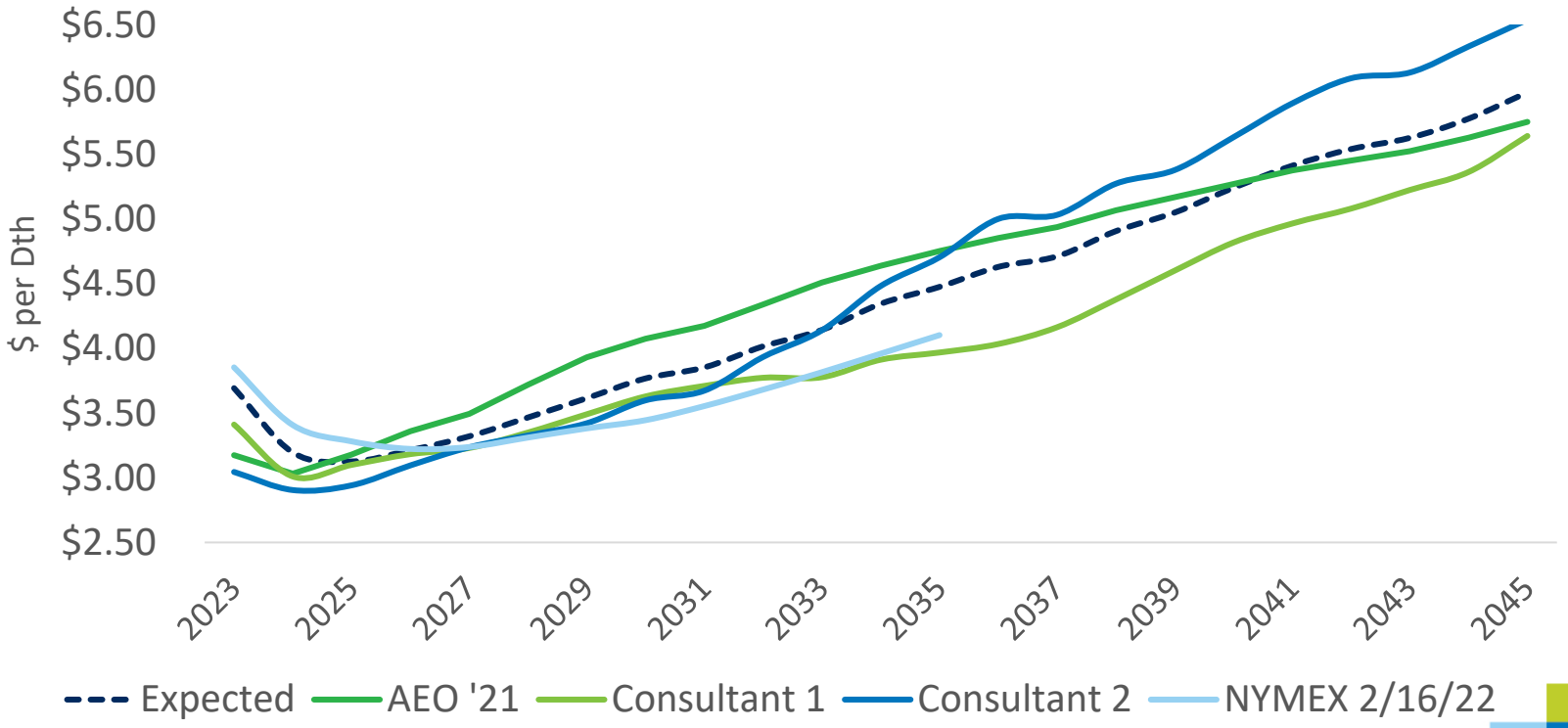
Production

Source: S&P Global, NBC

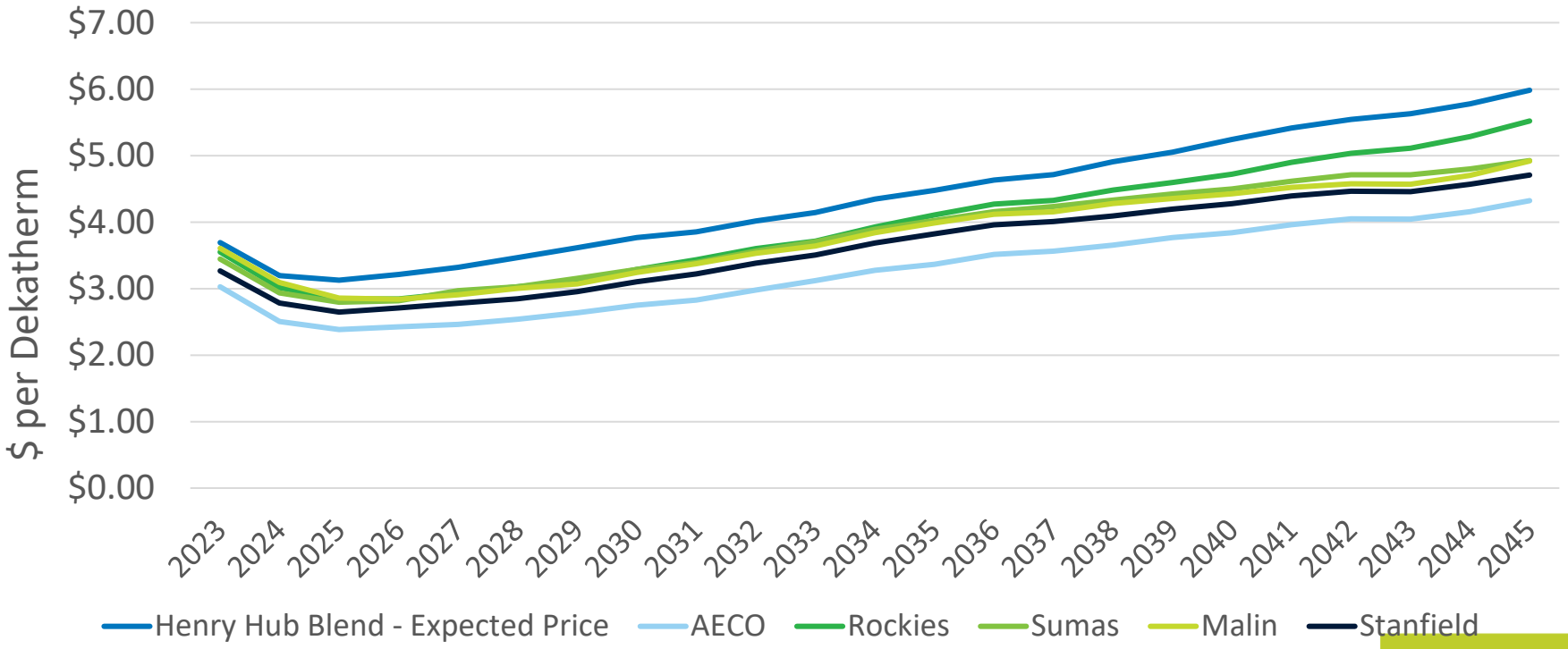


Source: S&P Global, NBC

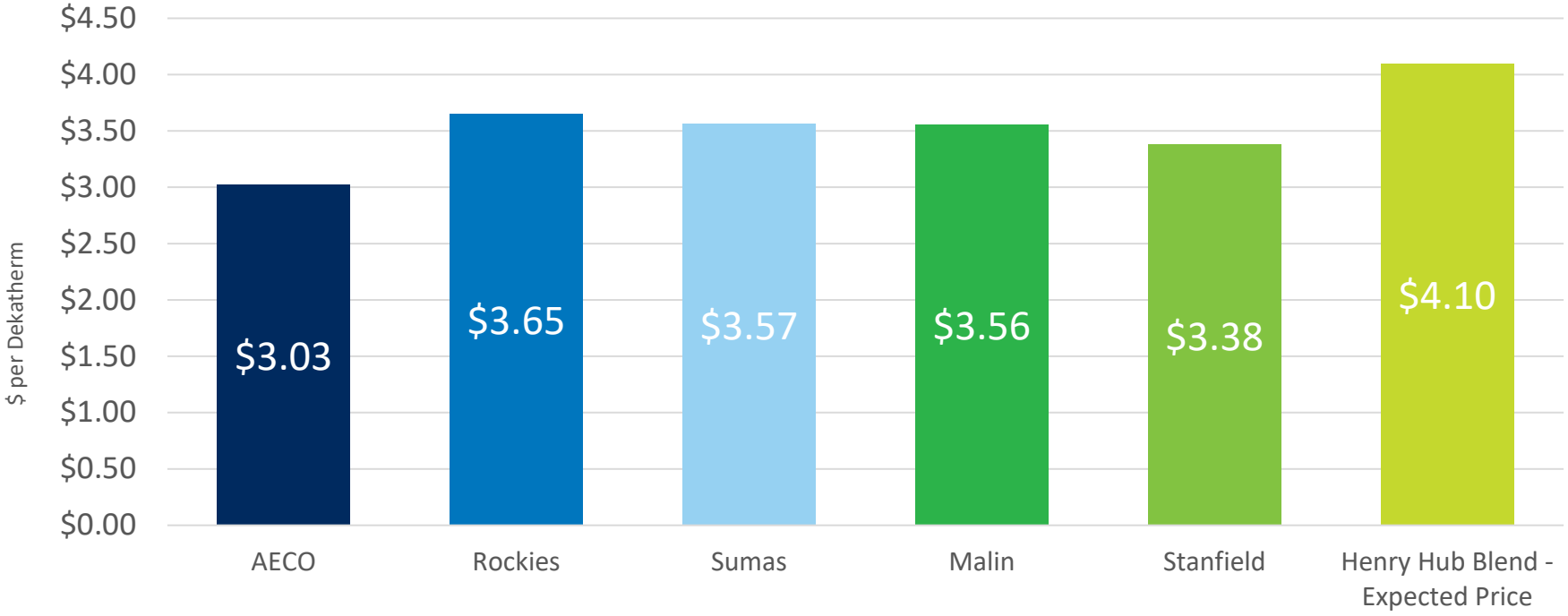
Expected Prices



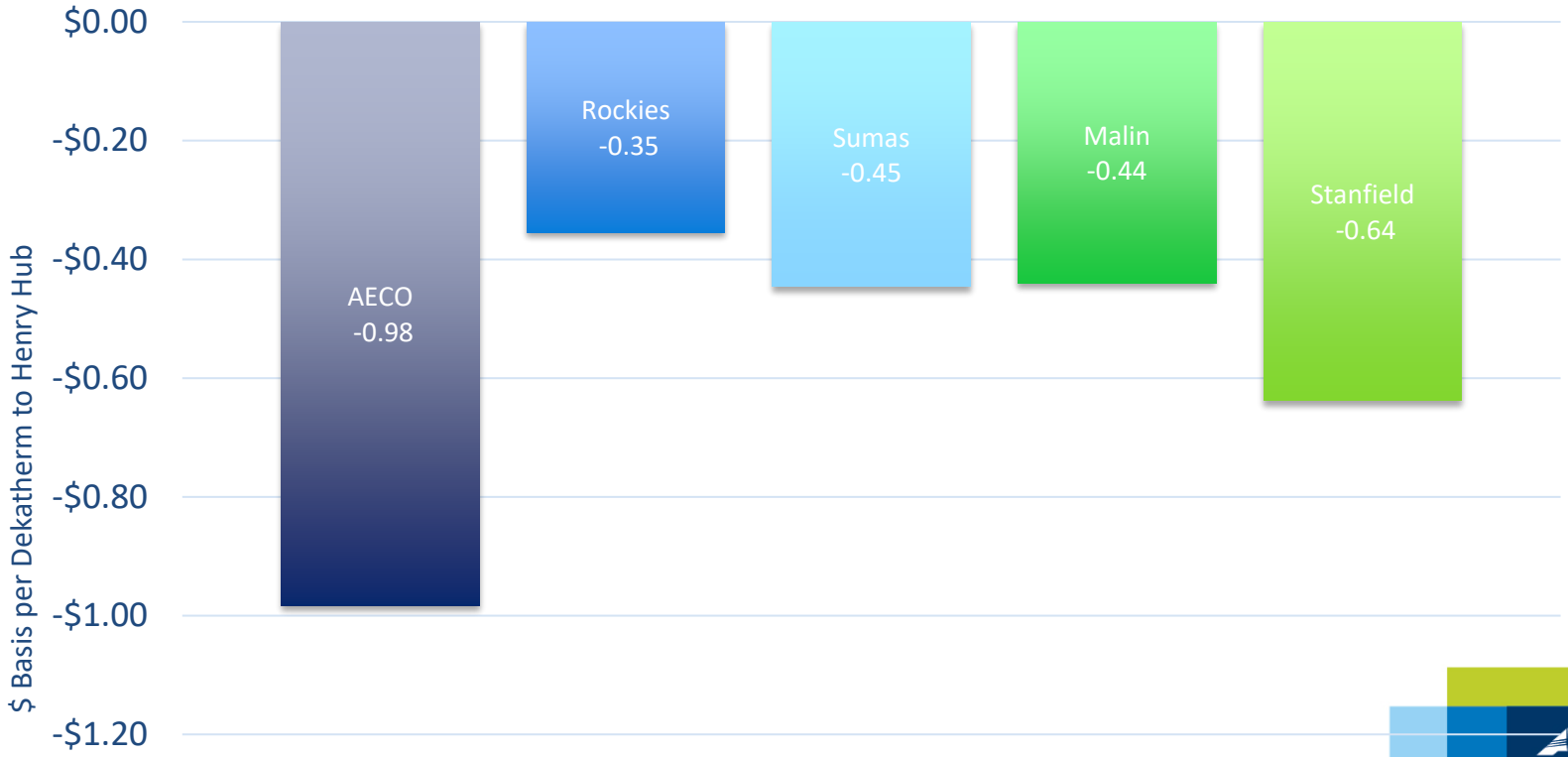
Expected Prices - Levelized



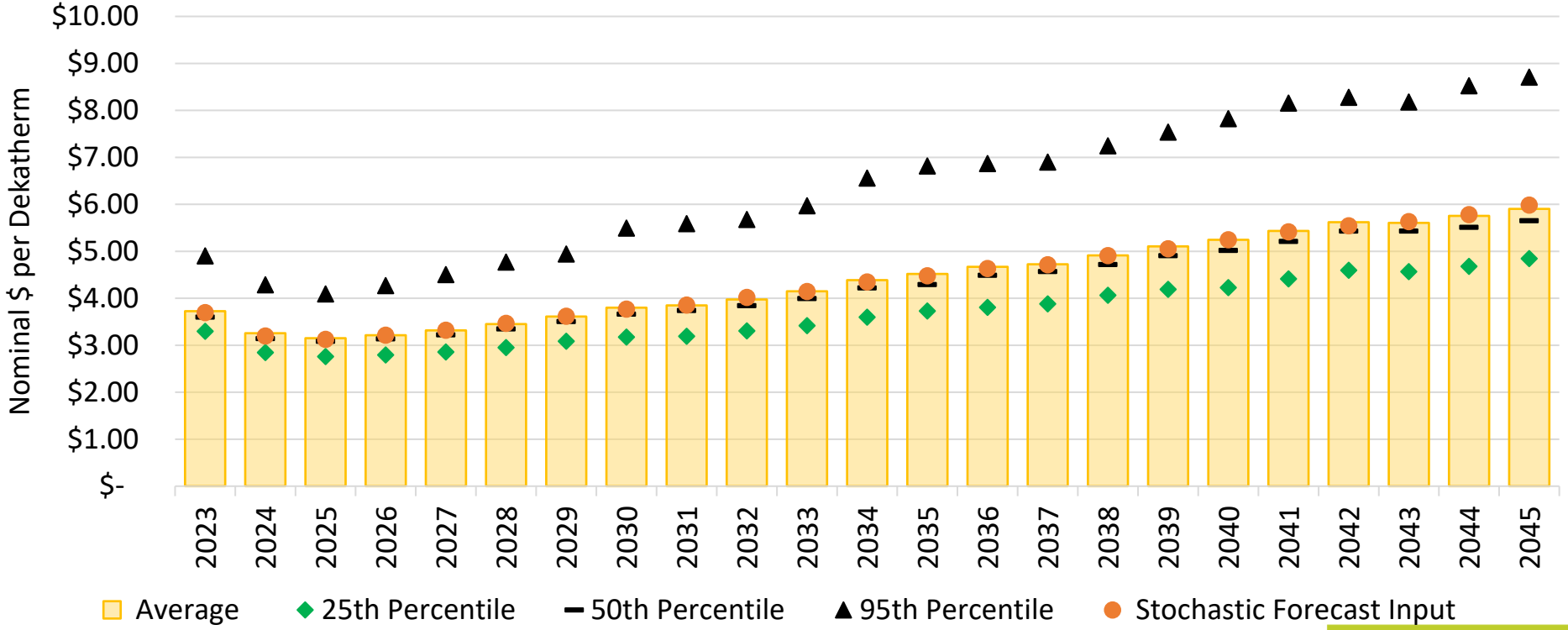
Levelized Costs (2023 – 2045)



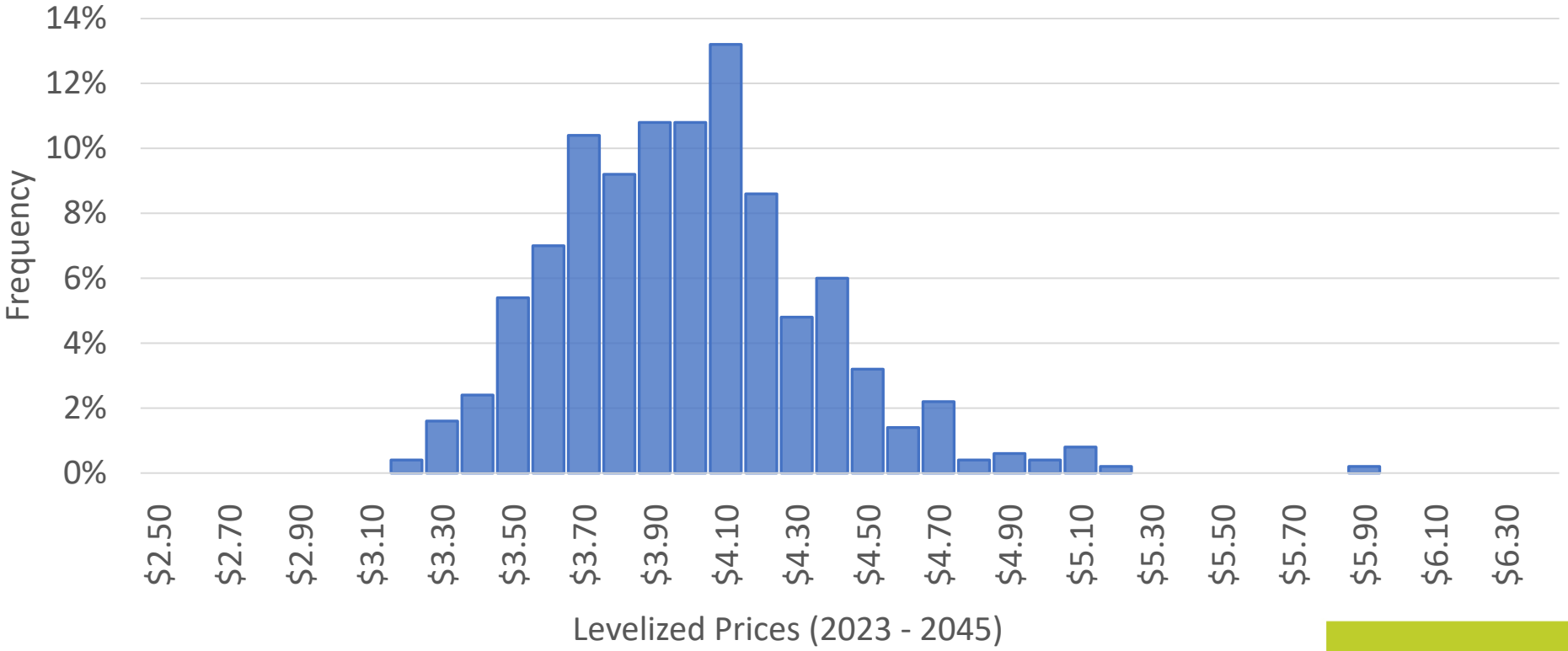
Basis to Henry Hub - Levelized



Henry Hub Stochastic Results (500 Draws)



Henry Hub Stochastic Results (500 Draws)



Electric Wholesale Market Price Forecast

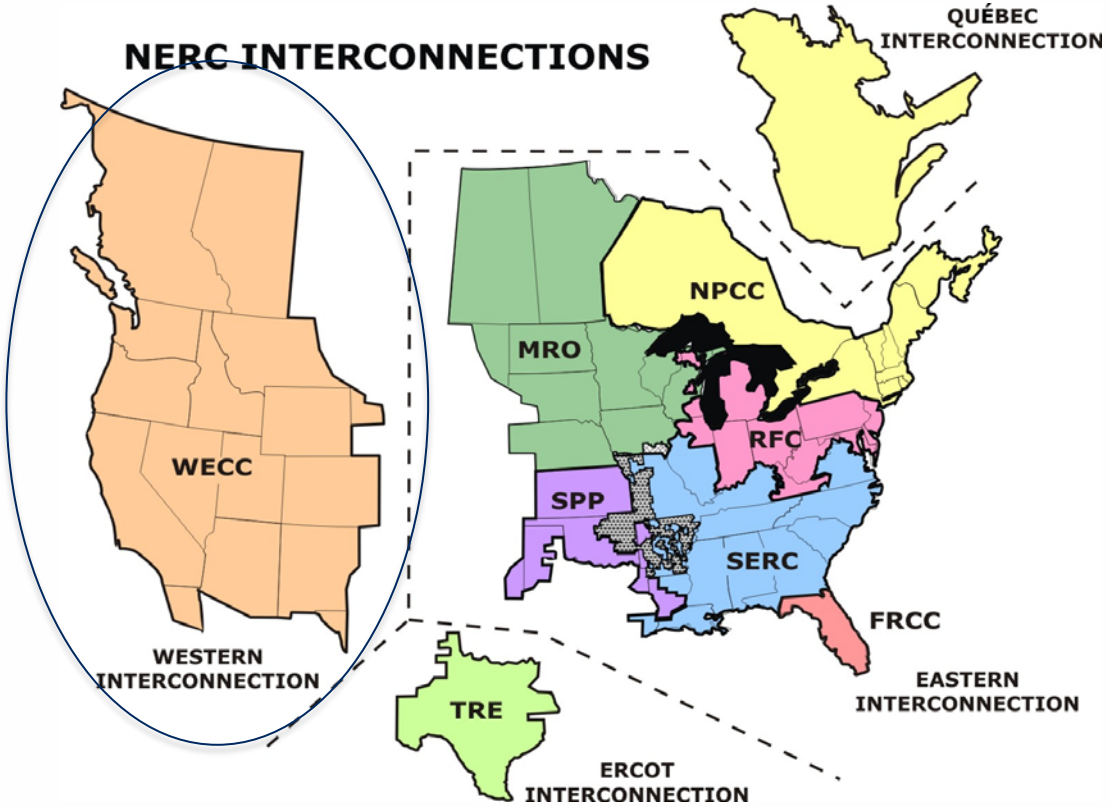
Lori Hermanson, Senior Resource Analyst
Electric IRP, Third Technical Advisory Committee Meeting
March 9, 2022

Overview

- Draft market price forecast based on preliminary analysis
  - To be used for RFP response comparison
- IRP will use this market price forecast with updated natural gas price and other assumptions (late summer)
- Stochastics pricing results will be discussed at a future TAC meeting

Market Price Forecast – Purpose

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

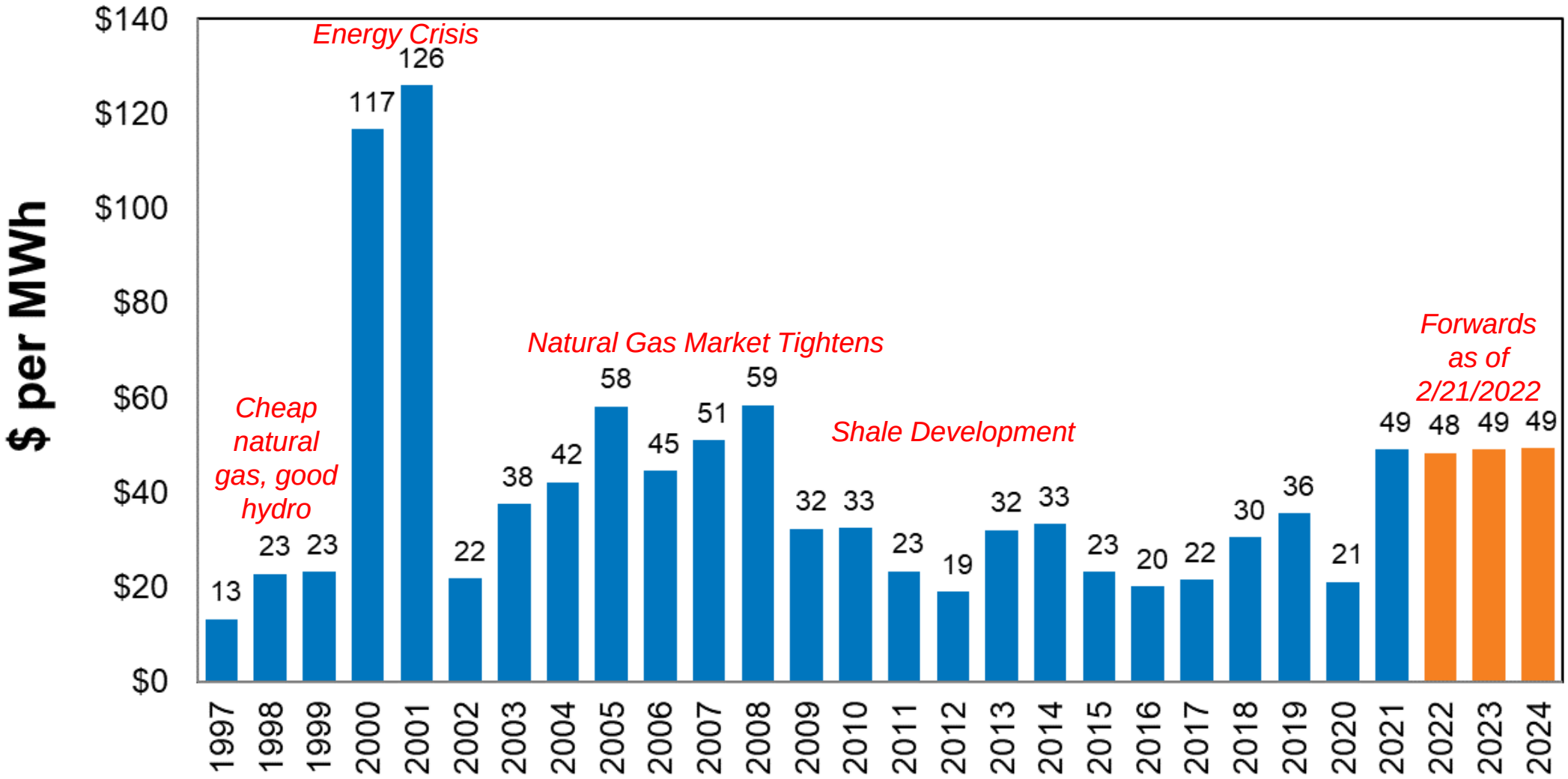


Source: NERC

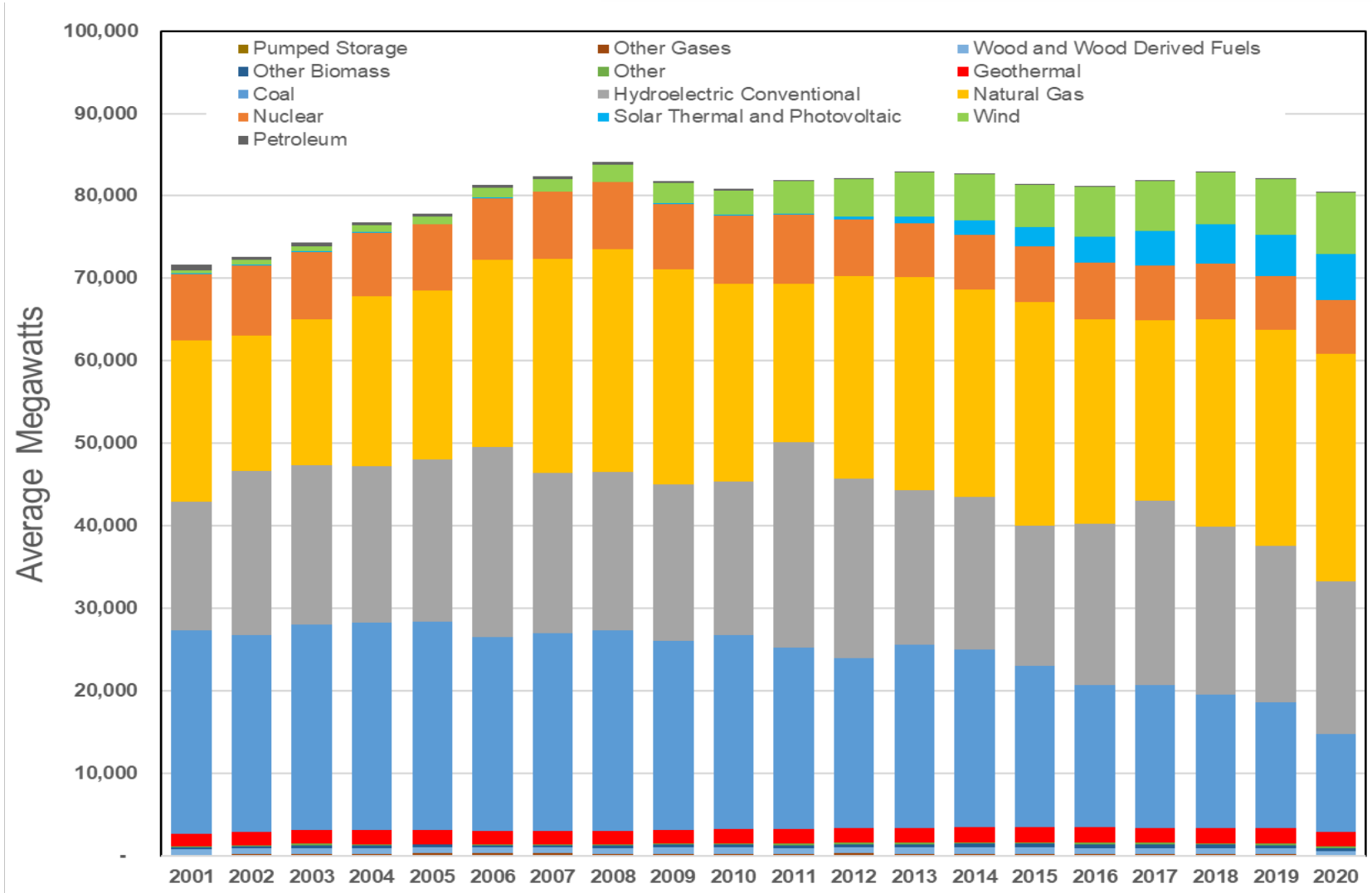
Methodology

- 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

Wholesale Mid-C Electric Market Price History



U.S. Western Interconnect Historical Generation Mix



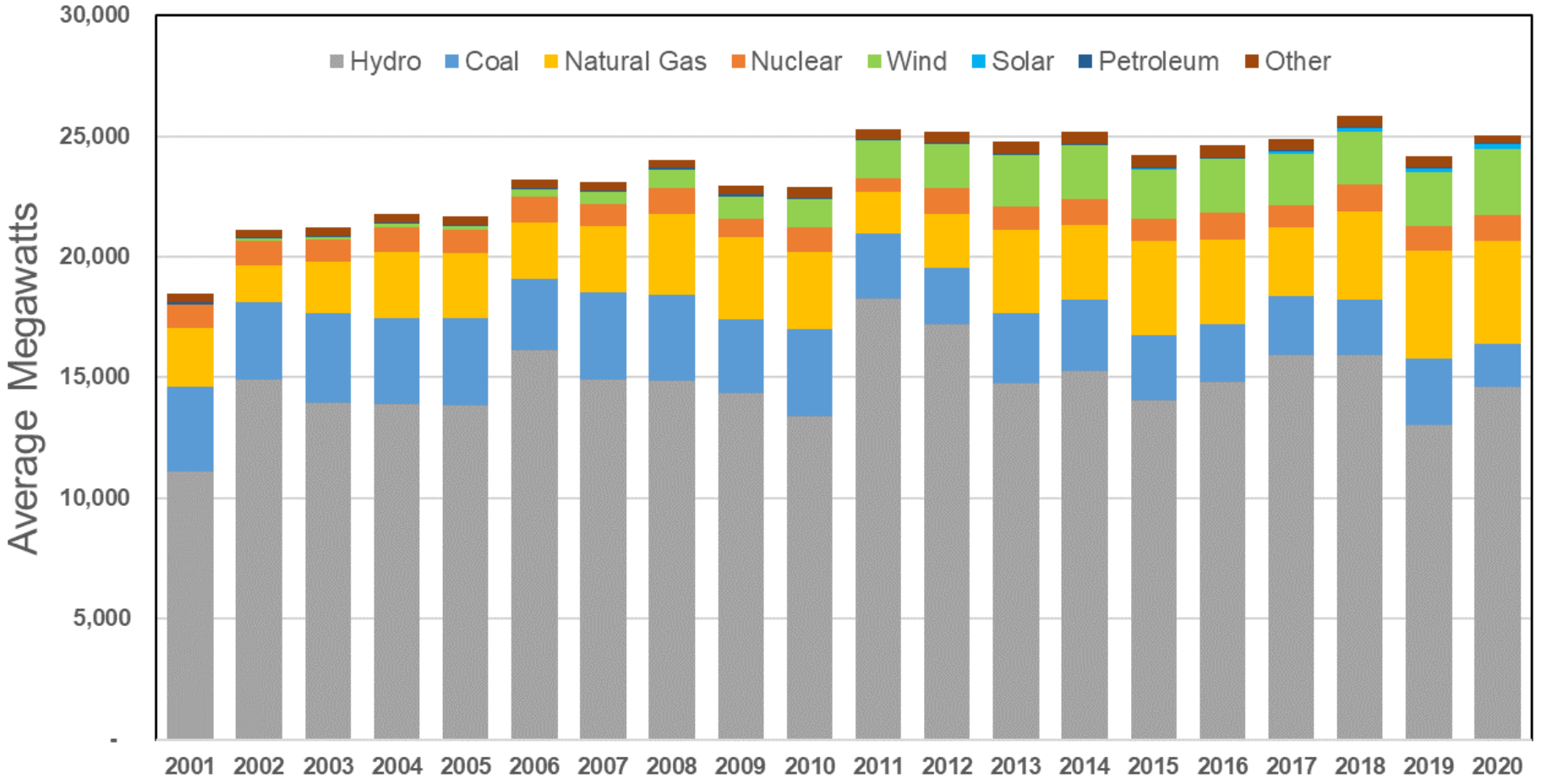
Source: EIA

Significant changes (aGW)

Solar:	+ 5.6
Wind:	+ 7.0
Nat Gas:	+ 7.9
Coal:	- 12.8
Total:	+ 9.5

Hydro: -4.1 / +5.3

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



Significant changes (aGW)

Solar: + 0.2
Wind: + 2.7
Nat Gas: + 1.8
Coal: - 1.8
Total: + 6.6

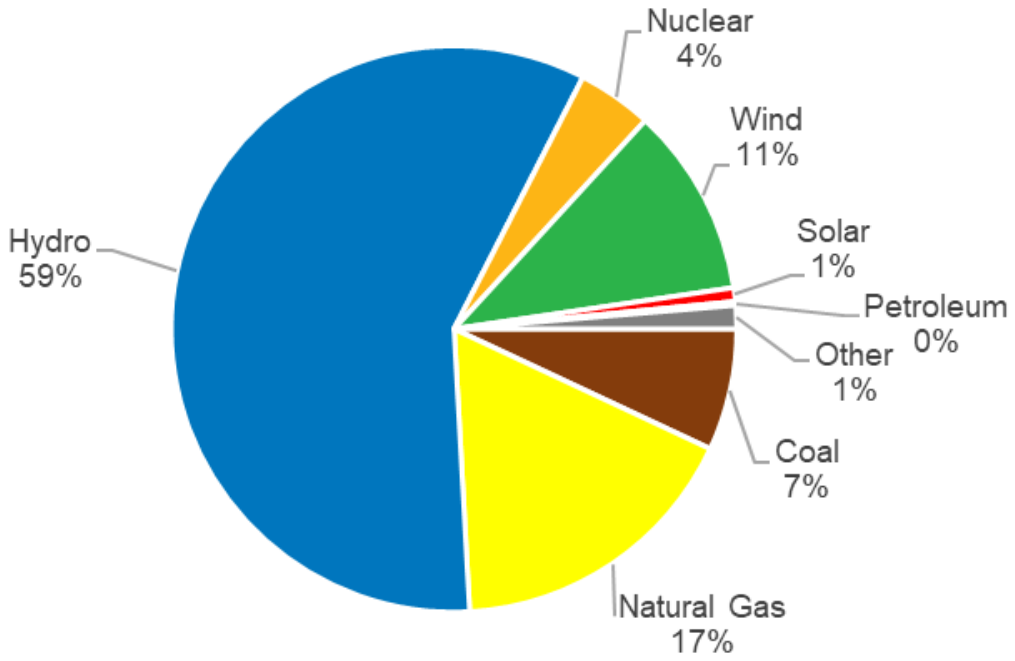
Hydro: -3.5 / +3.7

Source: EIA

2020 Fuel Mix

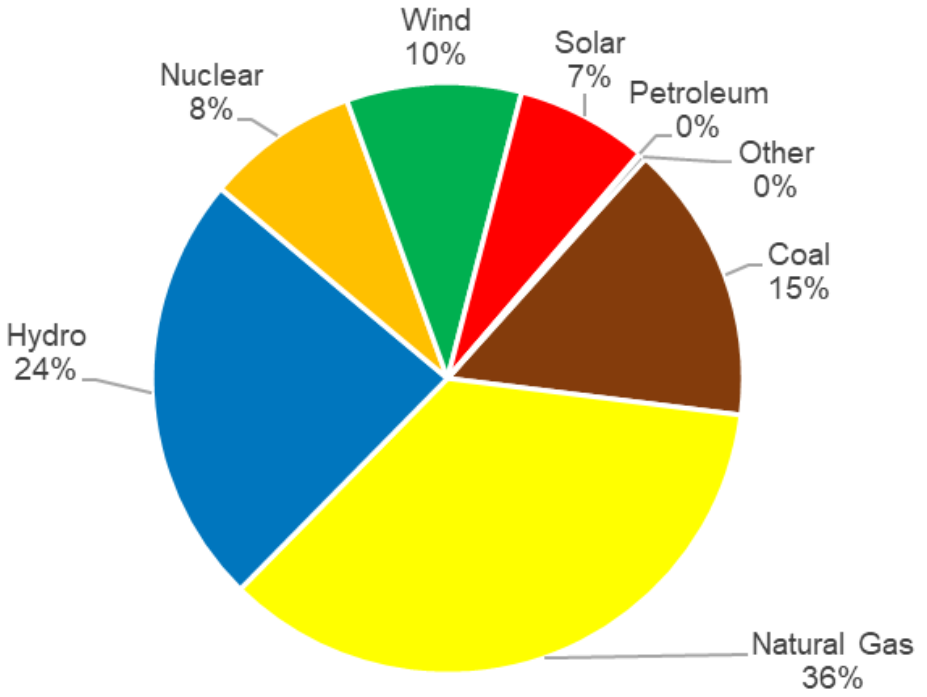
Northwest

75% GHG Emission Free



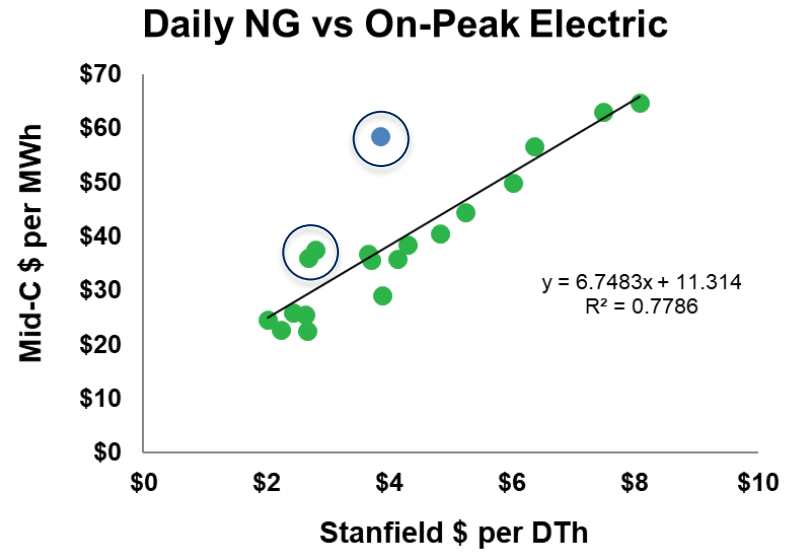
U.S. Western Interconnect

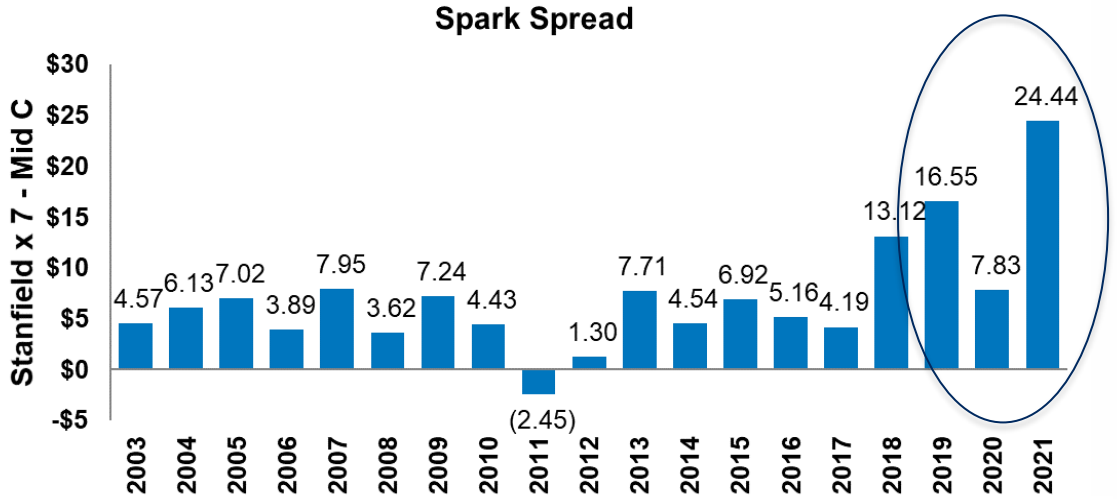
49% GHG Emission Free

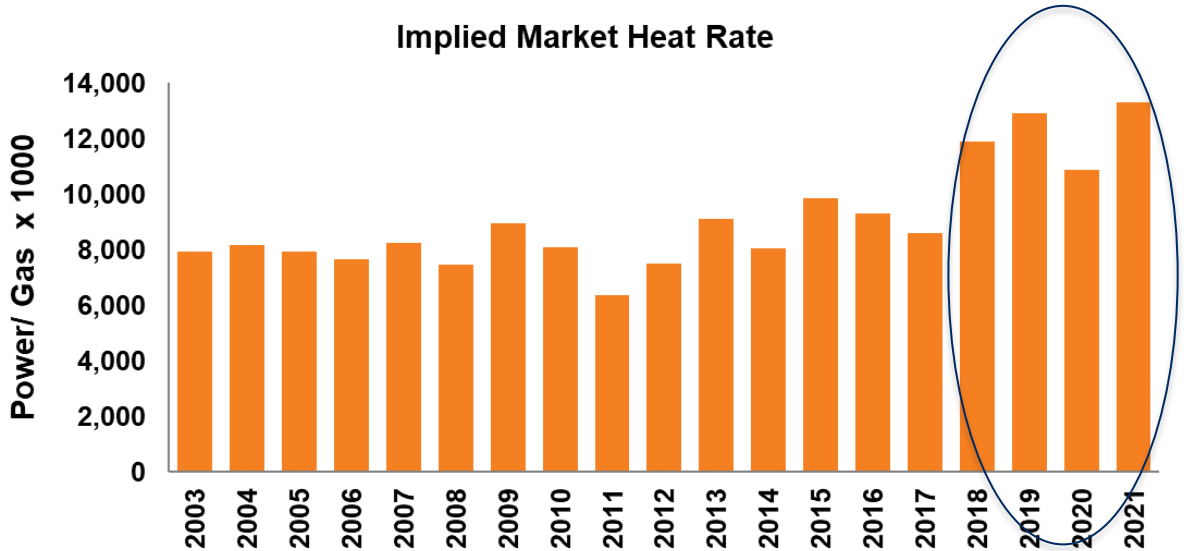


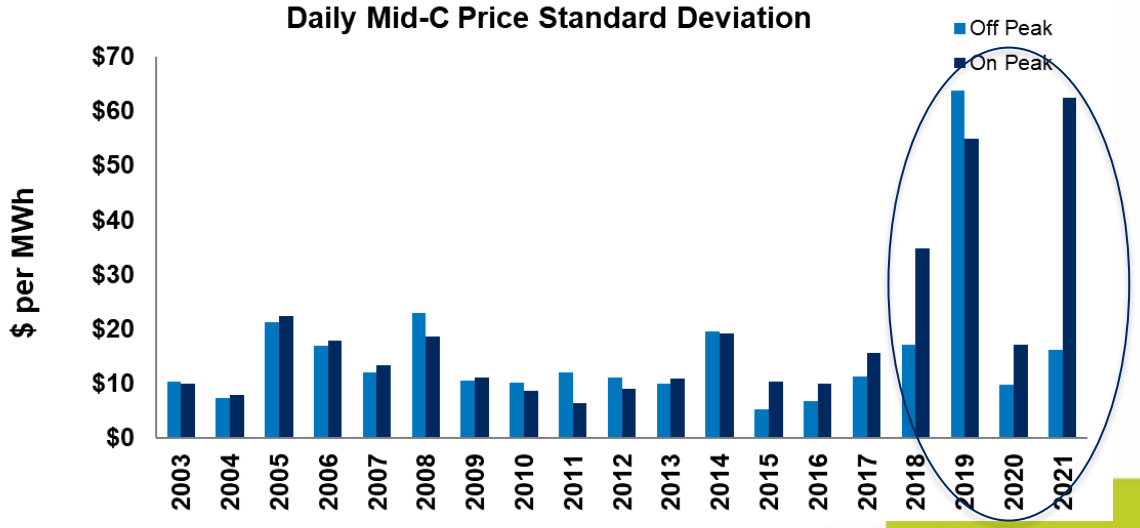
Source: EIA

Market Indicators- Market is Tightening

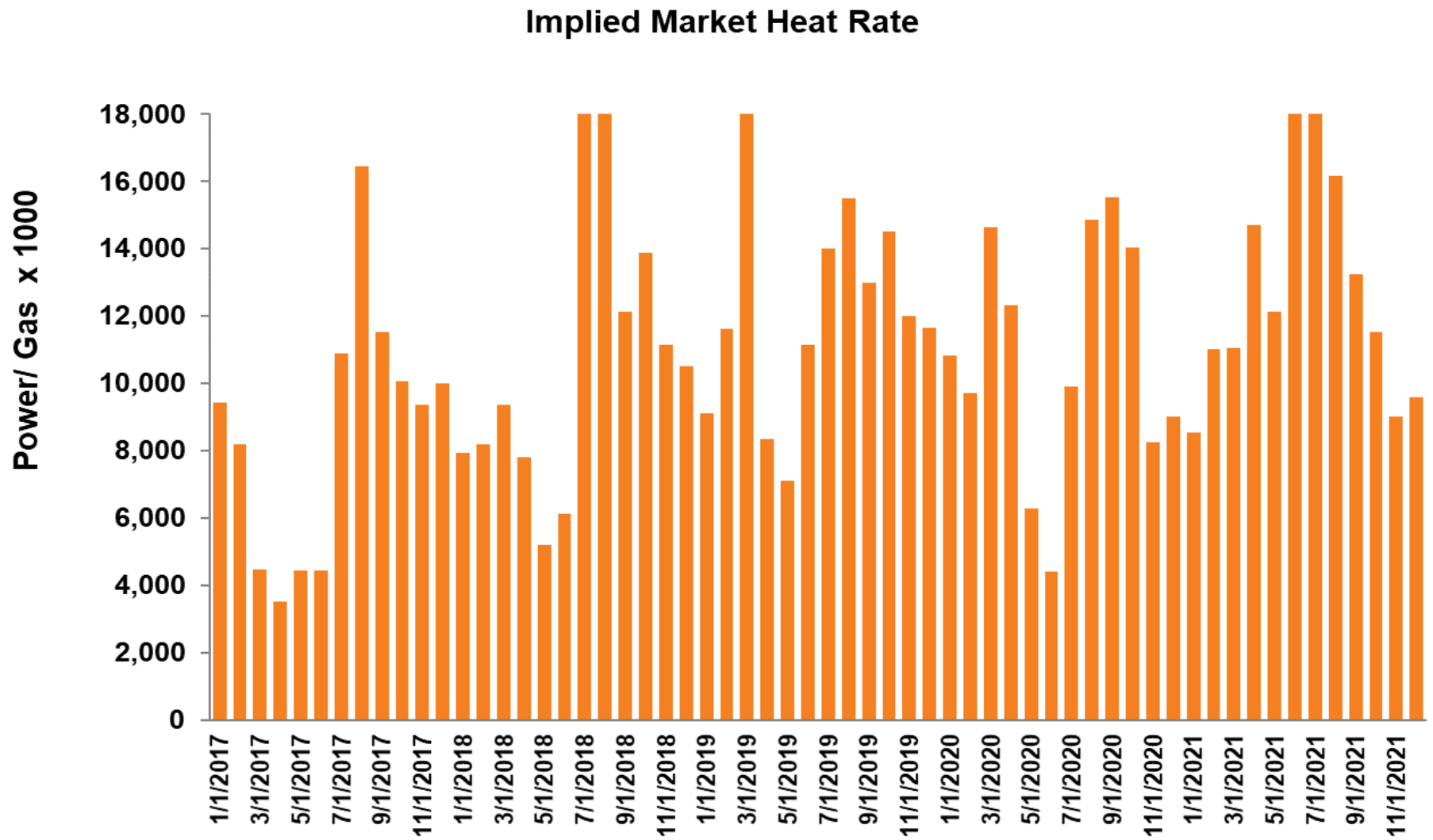




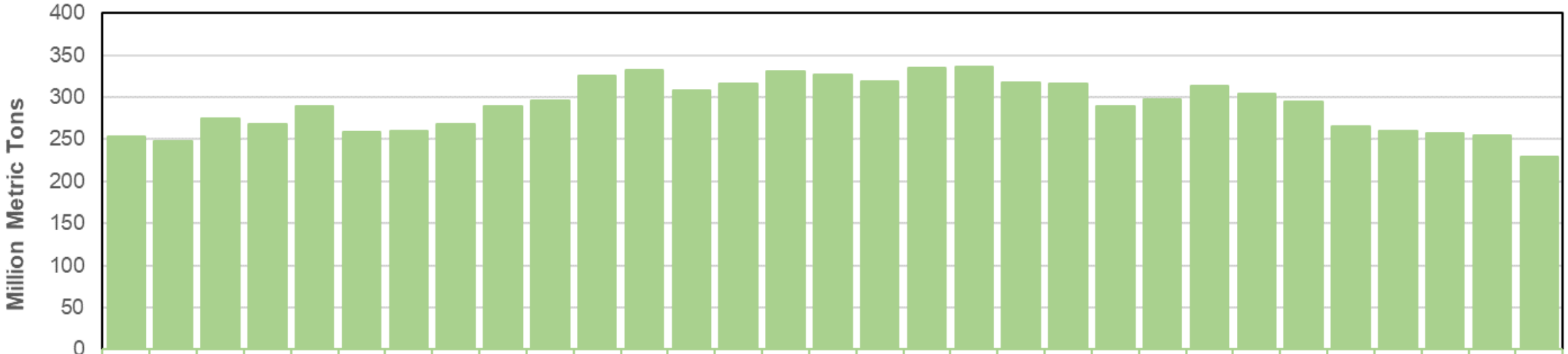




Monthly Implied Market Heat Rate (2017-2021)



Electric Greenhouse Gas Emissions
U.S. Western Interconnect



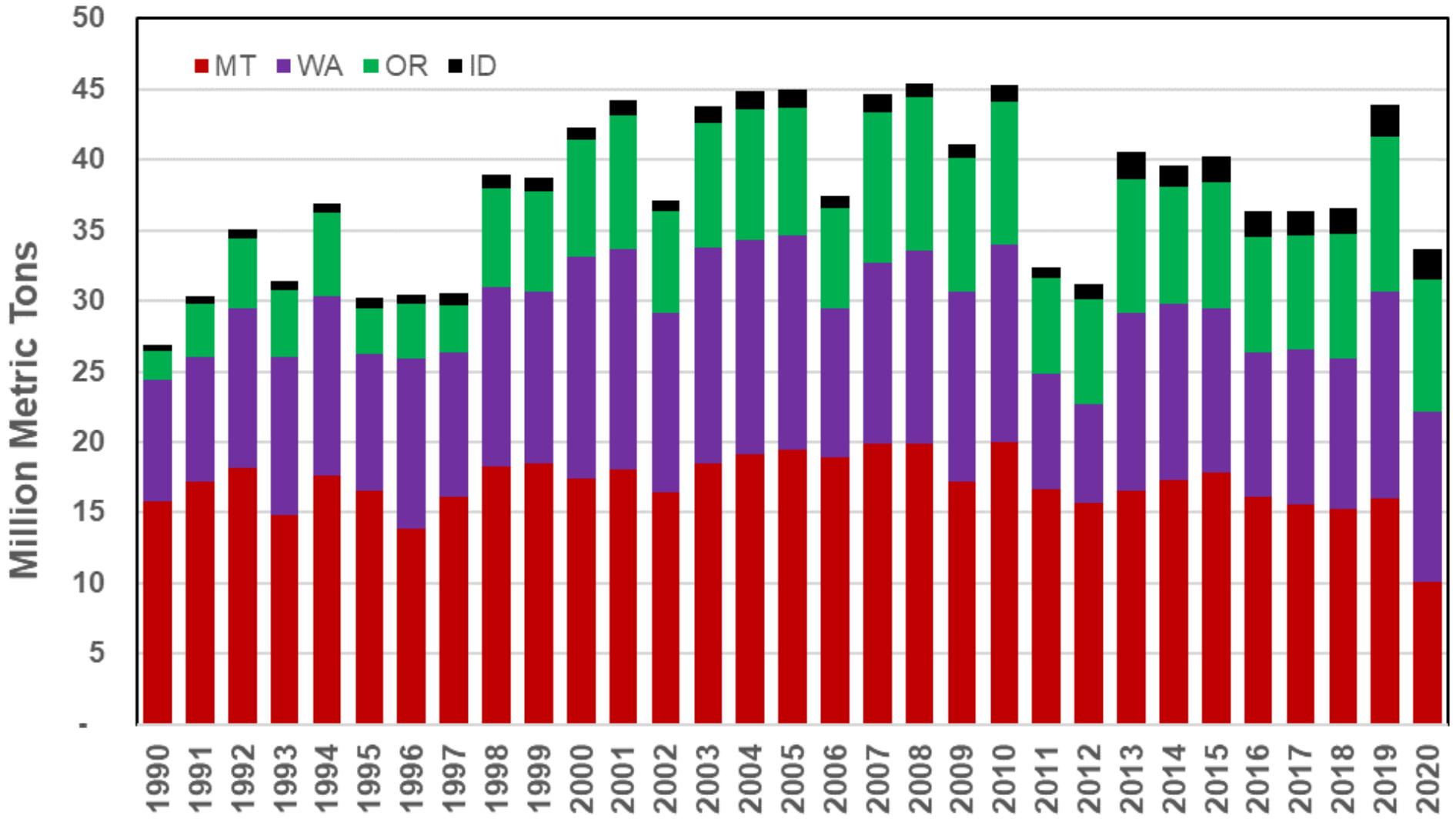
Change		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
-3.8	WY	36	35	38	36	39	36	37	36	40	38	40	40	39	39	40	39	39	40	40	38	39	38	40	43	41	40	37	37	37	33	32
+3.5	WA	9	9	11	11	13	10	12	10	13	12	16	16	13	15	15	15	10	13	14	14	14	8	7	13	12	12	10	11	11	15	12
-2.9	UT	29	28	30	31	32	30	30	31	32	33	33	33	34	35	36	36	37	39	39	37	36	34	32	36	35	34	28	28	29	28	26
7.3	OR	2	4	5	5	6	3	4	3	7	7	8	9	7	9	9	9	7	11	11	9	10	7	7	9	8	9	8	8	9	11	9
-11.3	NM	27	23	26	27	28	28	28	29	30	30	31	31	29	31	31	32	32	31	30	31	27	29	27	27	23	23	21	21	16	18	16
-3.2	NV	17	18	19	18	20	18	19	19	21	21	25	24	21	23	25	26	17	17	18	18	17	15	15	16	16	15	15	13	14	14	13
-5.7	MT	16	17	18	15	18	17	14	16	18	18	17	18	16	19	19	19	19	20	20	17	20	17	16	17	17	18	16	16	15	16	10
+1.7	ID	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	2	2	2	2	2
-2.4	CO	32	31	32	32	34	33	35	35	36	36	40	42	42	41	41	41	42	44	42	39	40	40	40	39	38	37	36	36	35	34	29
-9.2	CA	53	50	58	54	62	50	47	50	53	58	68	72	60	56	60	55	60	63	63	59	55	48	59	57	58	55	47	44	44	41	43
2.6	AZ	33	33	36	38	39	33	33	36	39	41	46	47	46	47	53	52	54	56	59	54	56	54	52	55	54	50	45	44	47	44	36

Source: EIA

Emissions are adjusted for generation within the Western Interconnect

2020 estimates are subject to adjustment

Northwest Greenhouse Gas Emissions

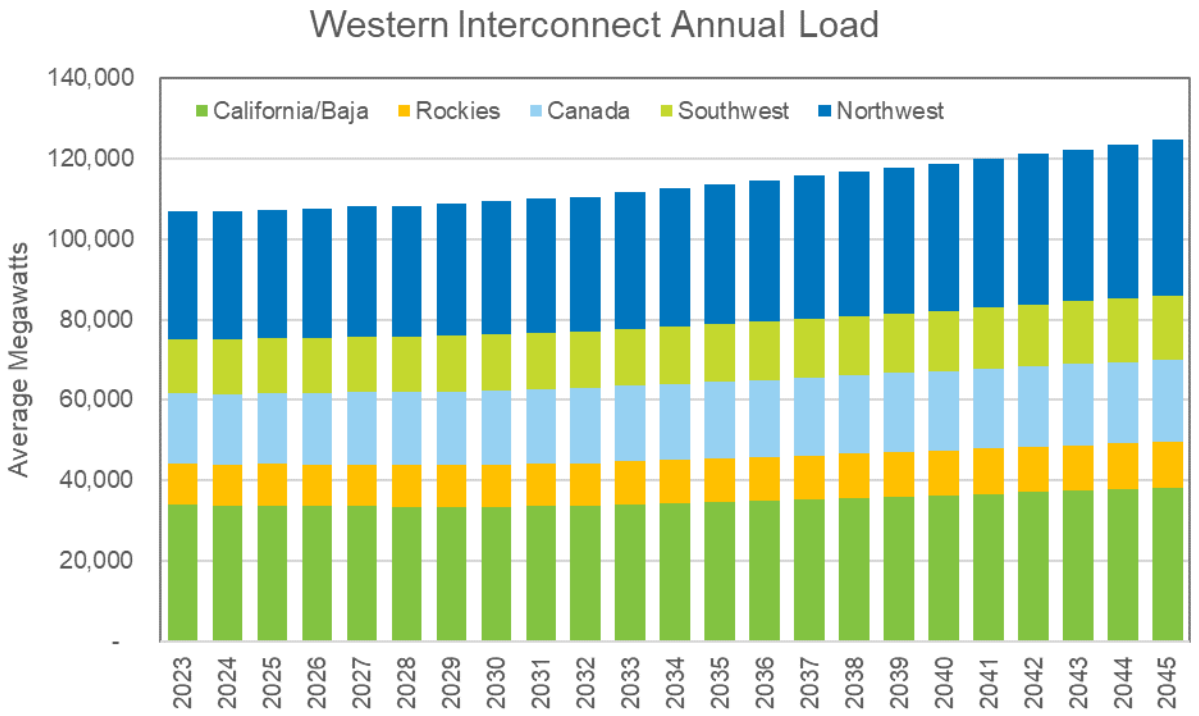


Source: EIA

Modeling Process

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 differs from today's load shape

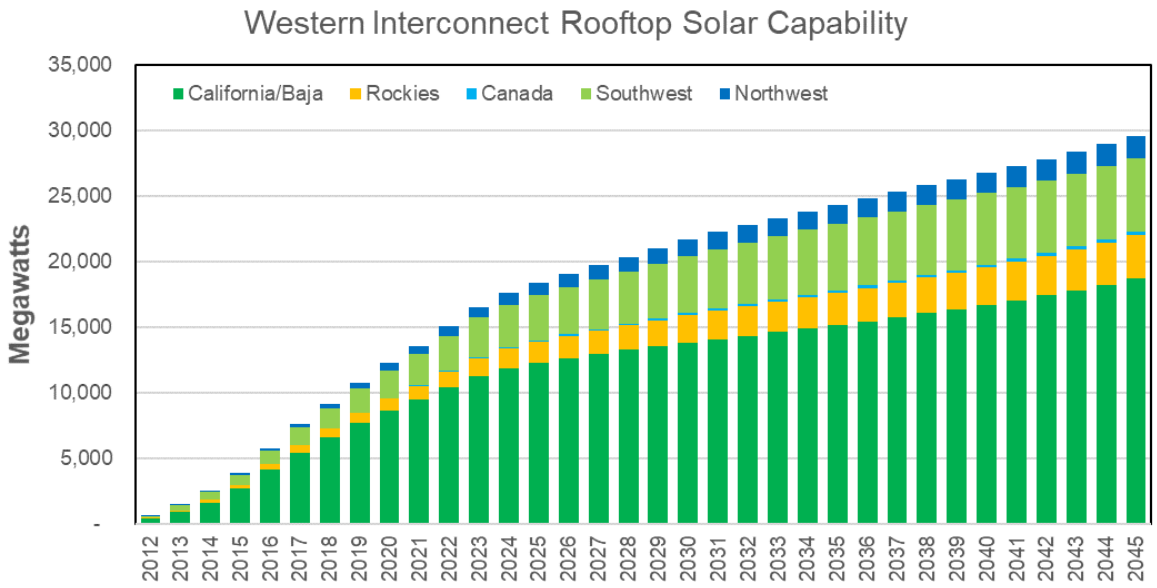


Draft Forecast

Electric Vehicle and Solar Adjustments

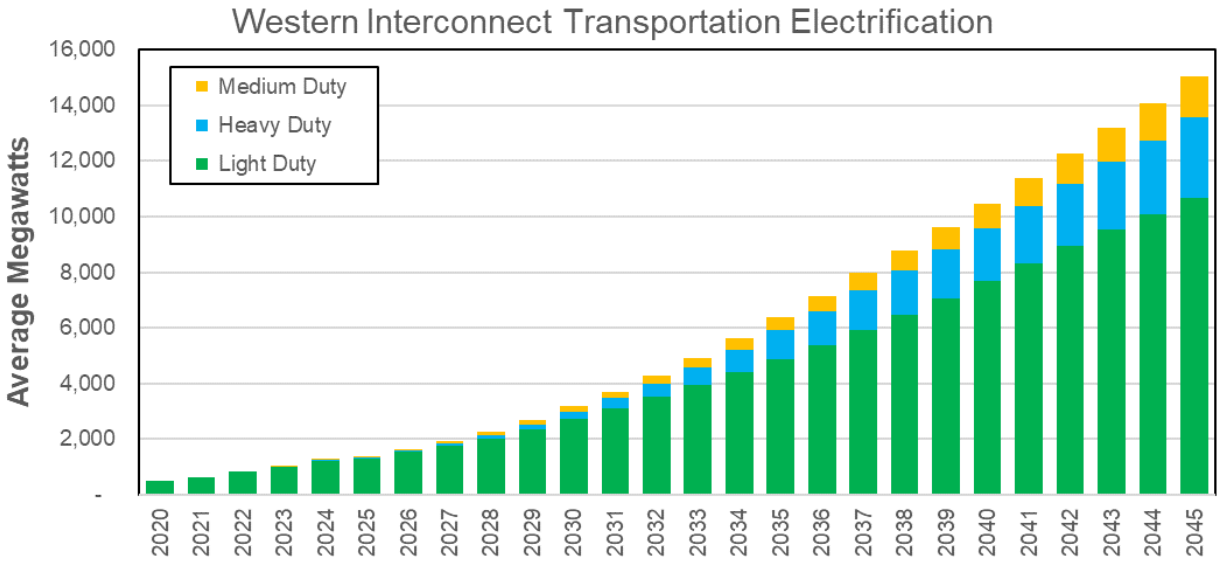
Roof Top Solar

- EIA existing estimates for history
- IHS regional growth rates



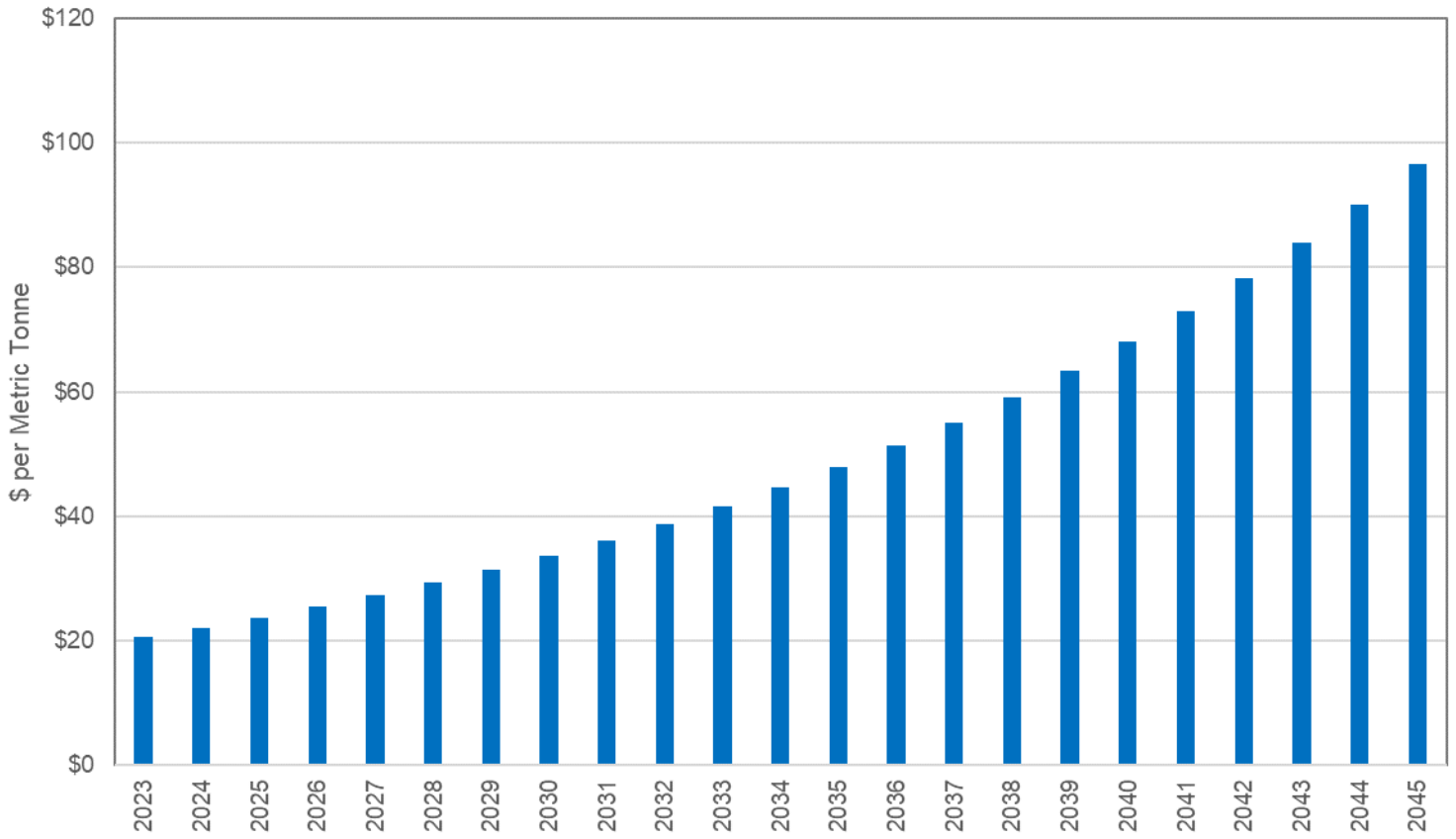
Electric Vehicles

- Penetration rates increase each year
- 15-65% light duty (2040)
- 12-15% medium duty (2040)
- 5% heavy duty (2040)



Draft Forecast

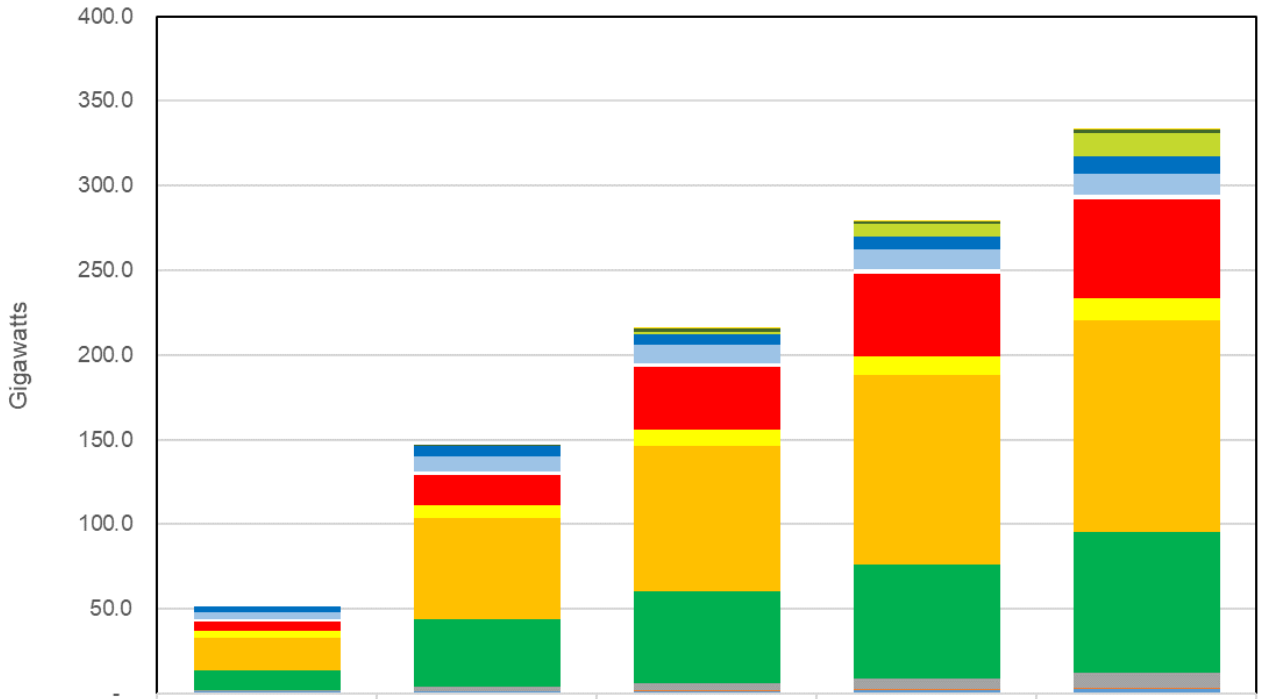
Northwest GHG Emission Prices



- $41.47 levelized
- Assumes California Emission Prices for the Northwest from the Revised 2019 IEPR Carbon Price Projections as placeholder for WA Climate Commitment Act and OR Climate Protection Program
- To address imports, exporting region includes a carbon price adder to transfer power

New Resource Forecast (Western Interconnect)

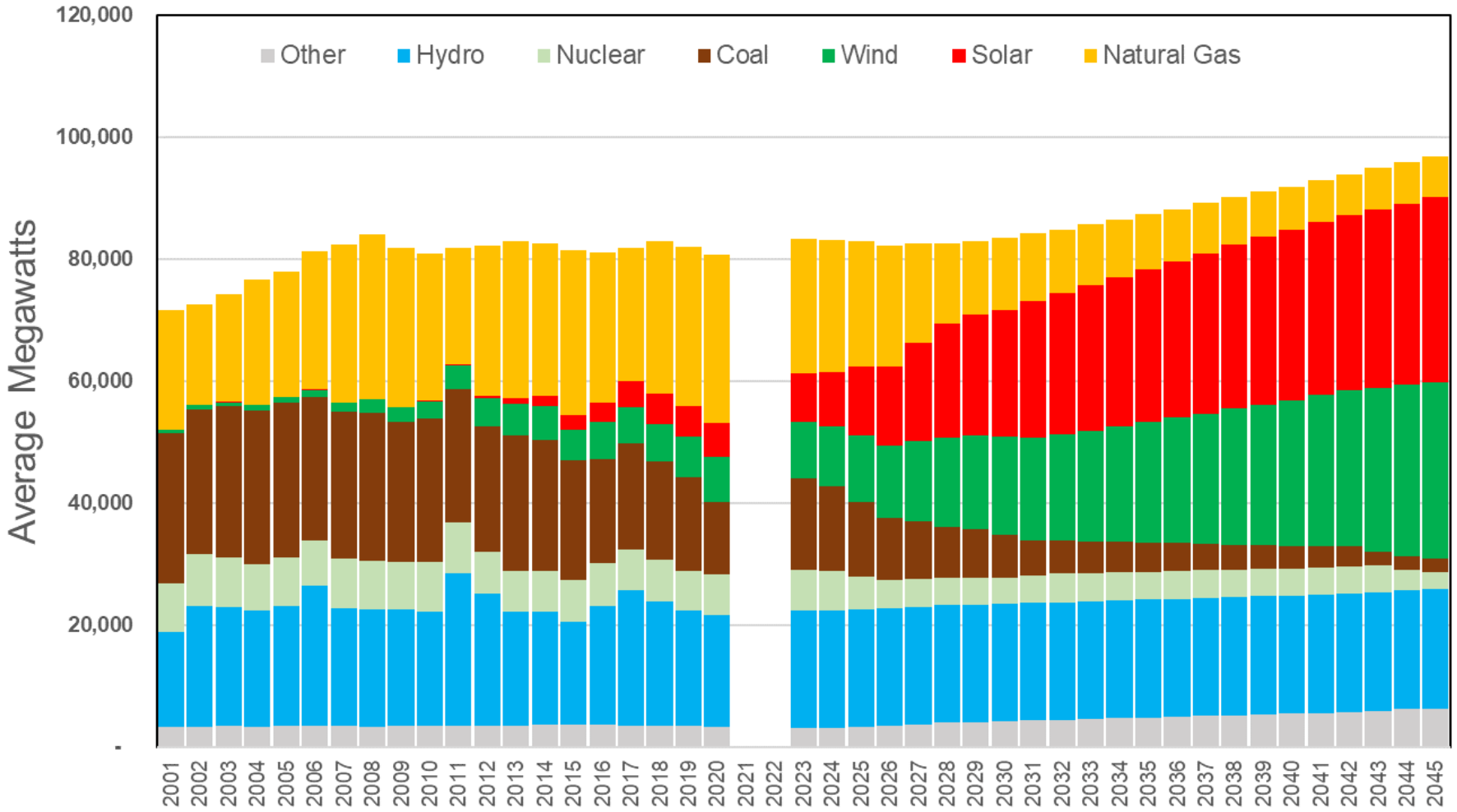
Draft Forecast



	2025	2030	2035	2040	2045
Nuclear	-	-	0.5	0.5	0.5
H2CT	-	0.5	1.4	1.7	2.4
OSWind	-	-	1.5	7.1	13.7
CCCT	3.8	6.2	6.2	7.9	10.0
SCCT	3.6	8.9	11.1	11.8	12.8
DR	1.5	2.1	2.3	2.5	2.8
Storage	5.2	18.3	37.0	48.7	58.1
Net-Meter	4.5	7.6	9.5	11.1	12.8
Solar	19.0	59.4	85.8	111.5	125.4
Wind	11.9	39.8	54.2	67.5	83.2
Geothermal	0.7	2.5	4.1	6.2	8.9
Biomass	0.1	0.3	0.5	0.7	0.8
Hydro	1.3	1.5	1.8	2.1	2.5

Draft Forecast

U.S. West Resource Type Forecast

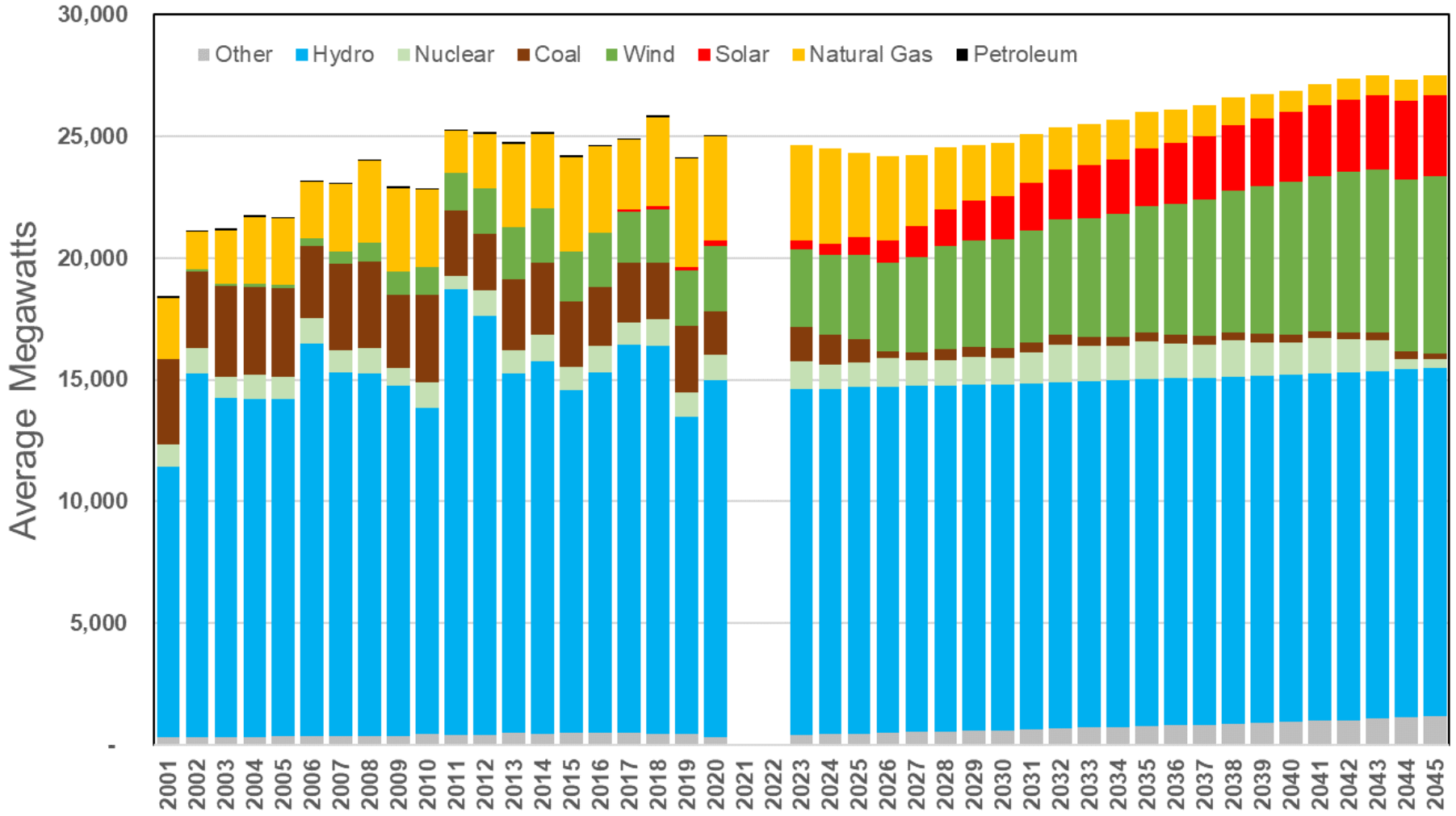


Significant changes
2045 to 2023 (aGW)

Solar:	+ 22.5
Wind:	+ 20.2
Nat Gas:	- 15.6
Coal:	- 13.4
Nuclear:	- 4.0
Other:	+ 3.3
Total:	+ 13.4

Draft Forecast

Northwest Resource Type Forecast

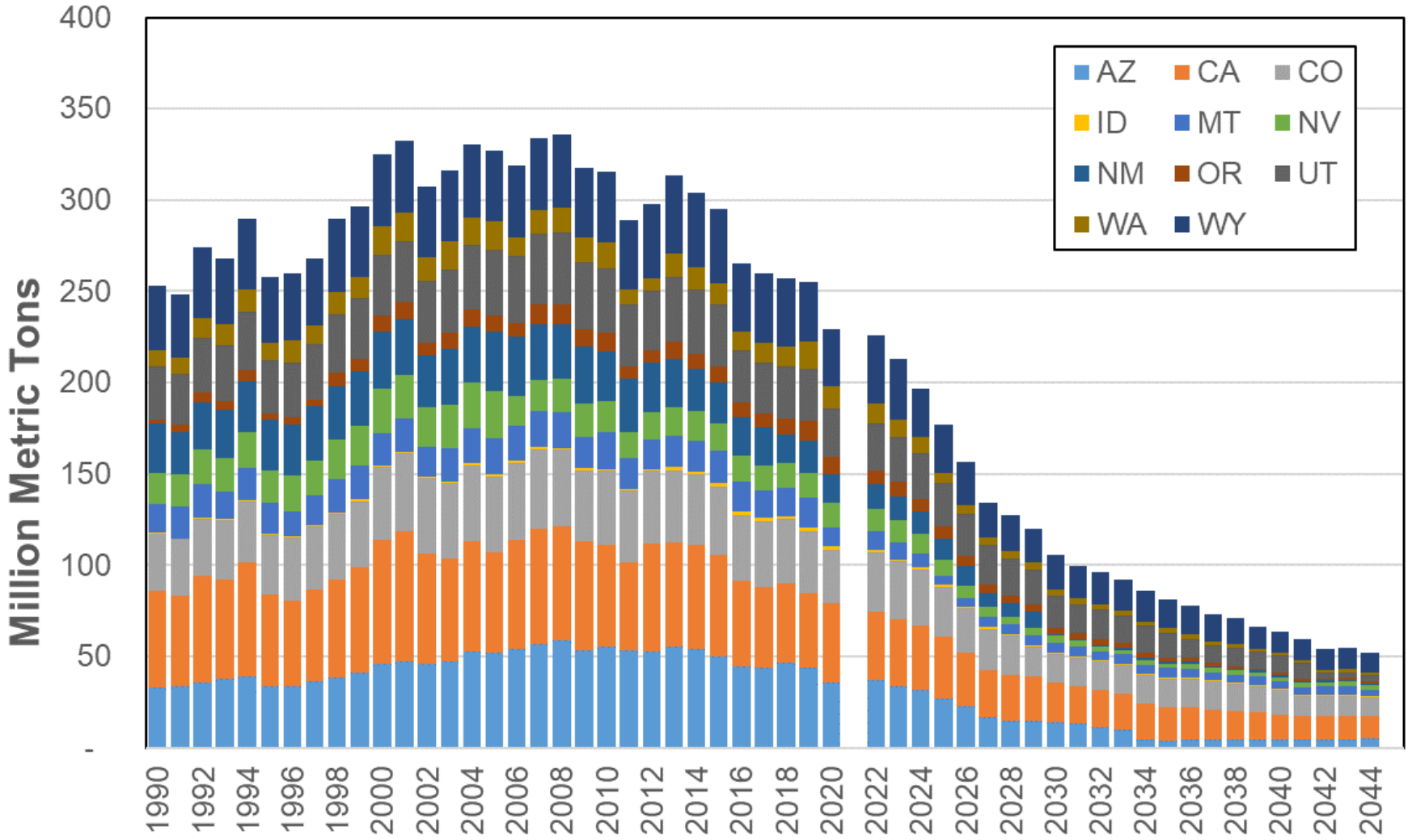


Significant changes (aGW)
2045 to 2023

Solar:	+ 2.9
Wind:	+ 4.0
Nat Gas:	- 3.1
Coal:	- 1.1
Other:	+ 0.8
Nuclear:	- 0.8
Total:	+ 2.9

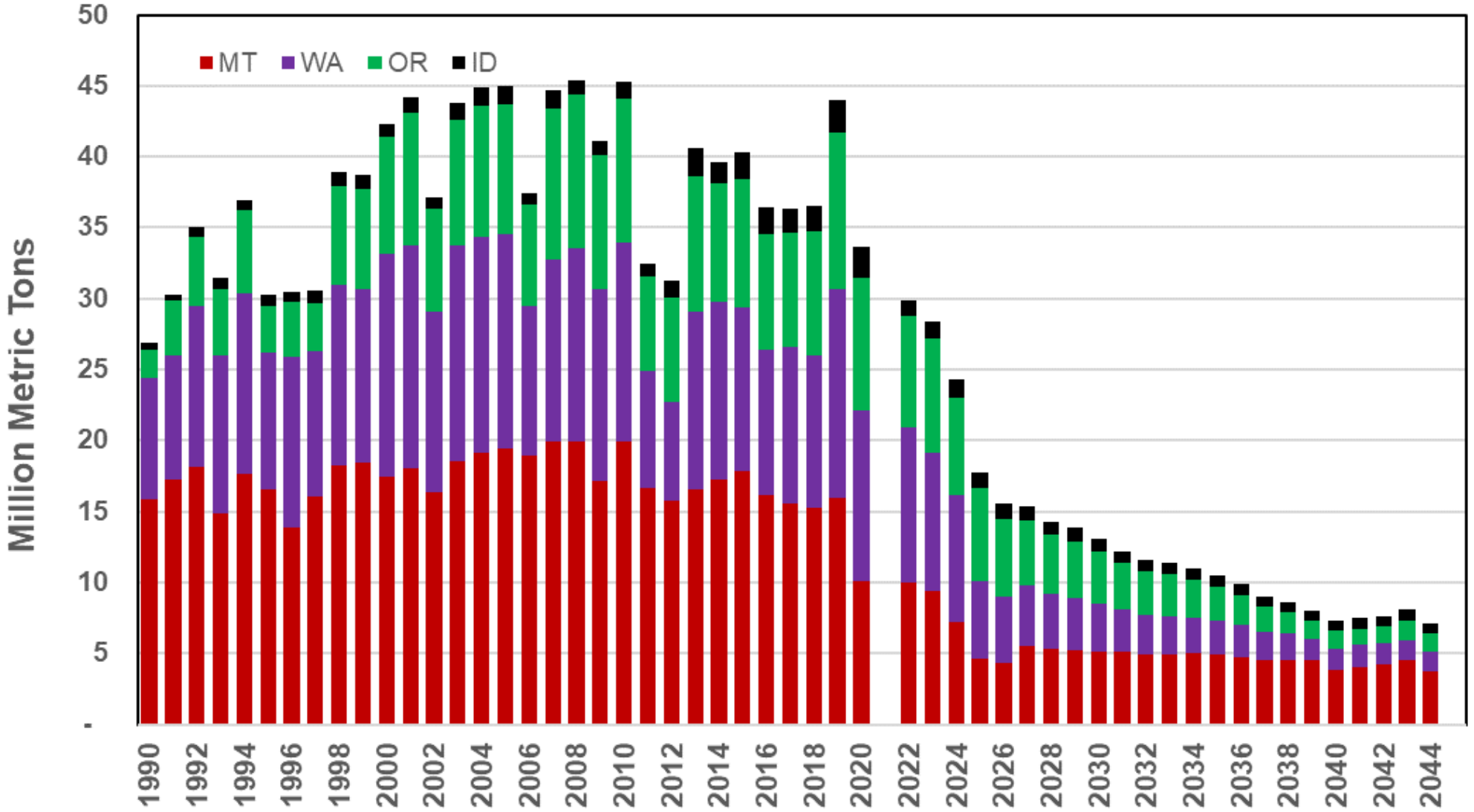
Greenhouse Gas Forecast
U.S. Western Interconnect

Draft Forecast



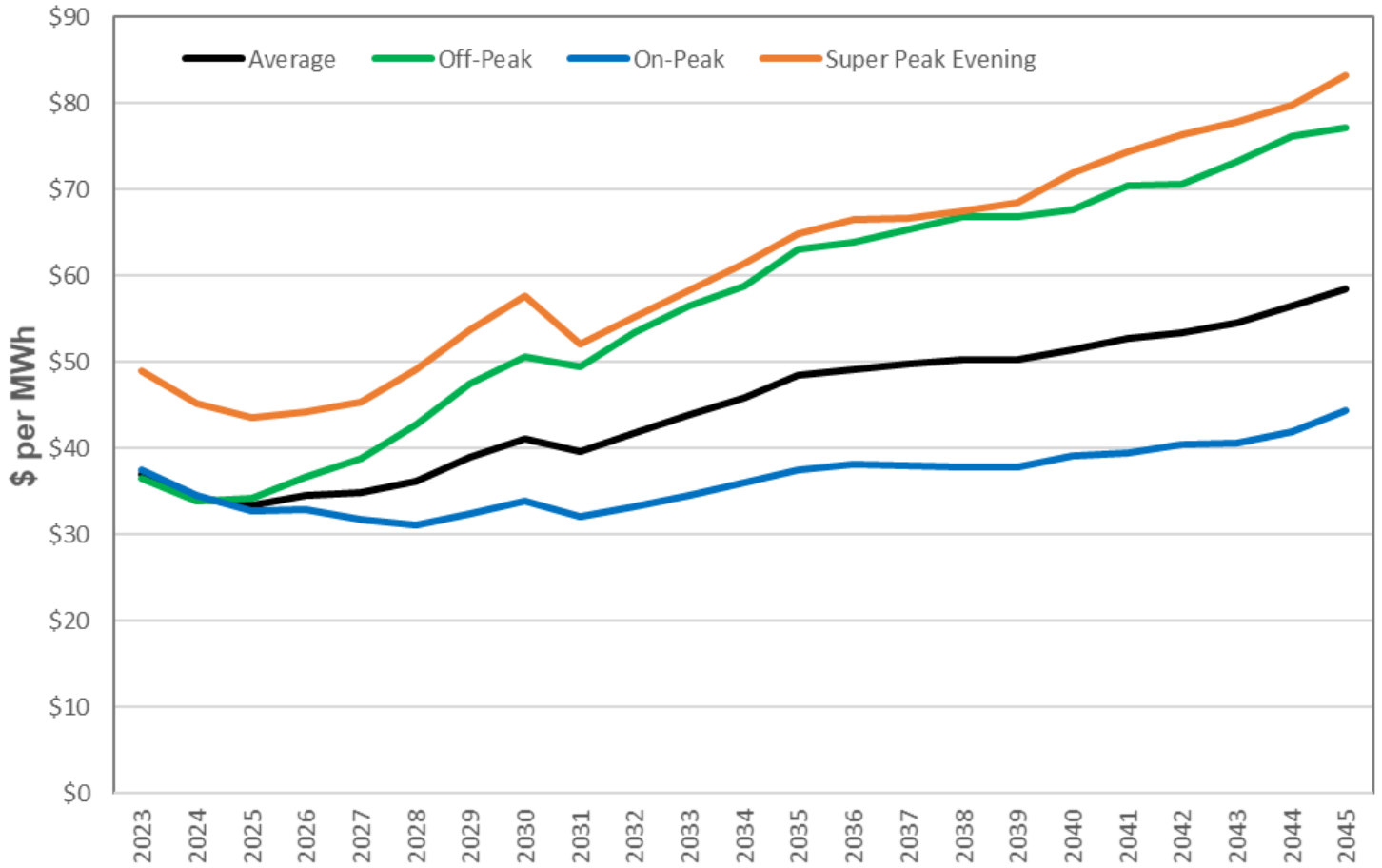
Greenhouse Gas Forecast
Northwest States

Draft Forecast



draft

Mid-C Electric Price Forecast

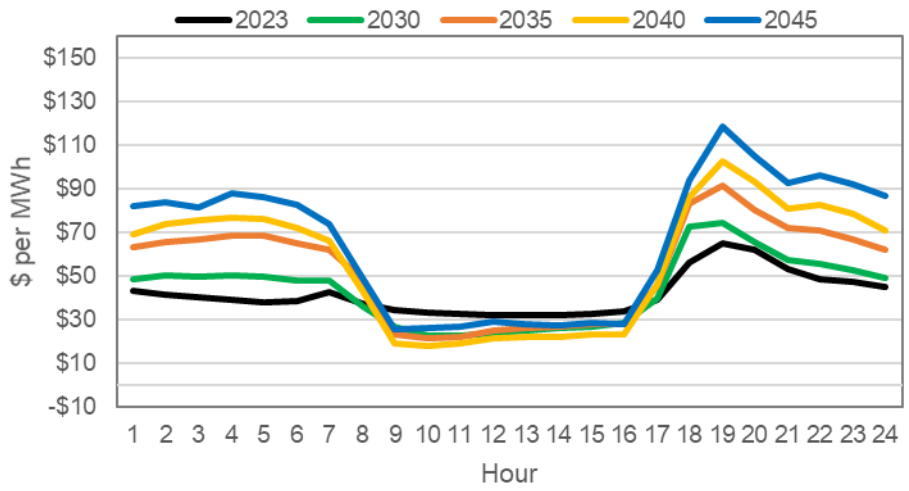


- Levelized Prices:
  - 2023-45: $41.76/MWh
- Off-peak prices overtake on-peak in 2023 on an annual basis
- Evening peak (4pm-10pm) and off-peak prices remain high

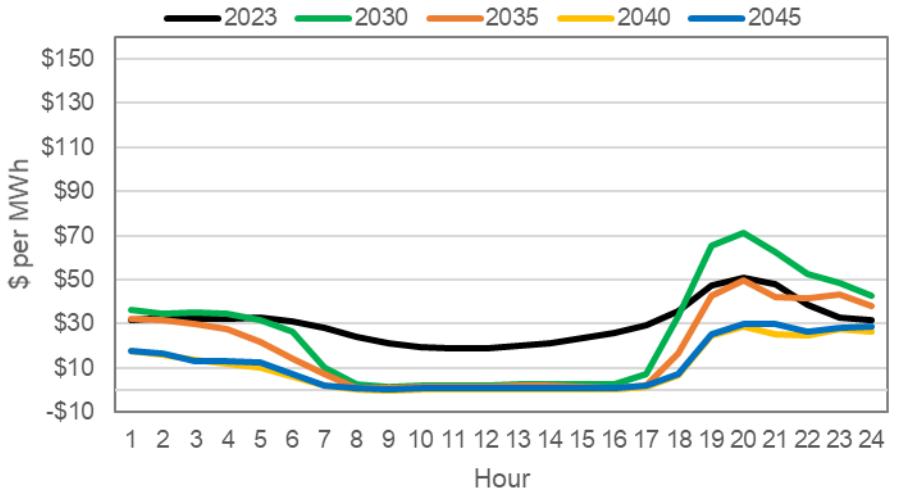
Draft Forecast

Hourly Wholesale Mid-C Electric Price Shapes

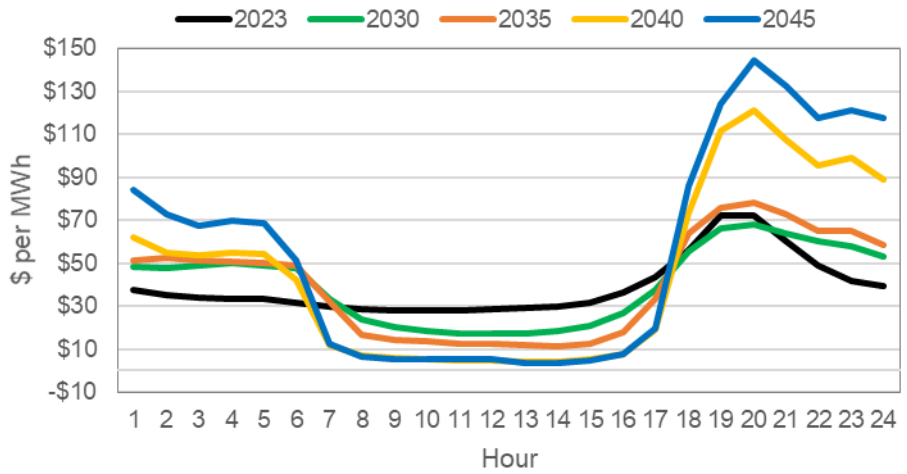
Winter: Dec 16 - Mar 15



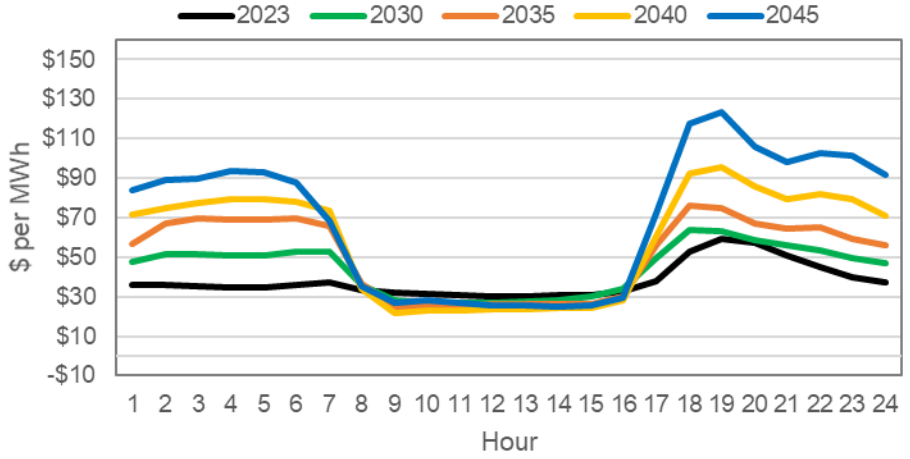
Spring: Mar 16 - Jun 15



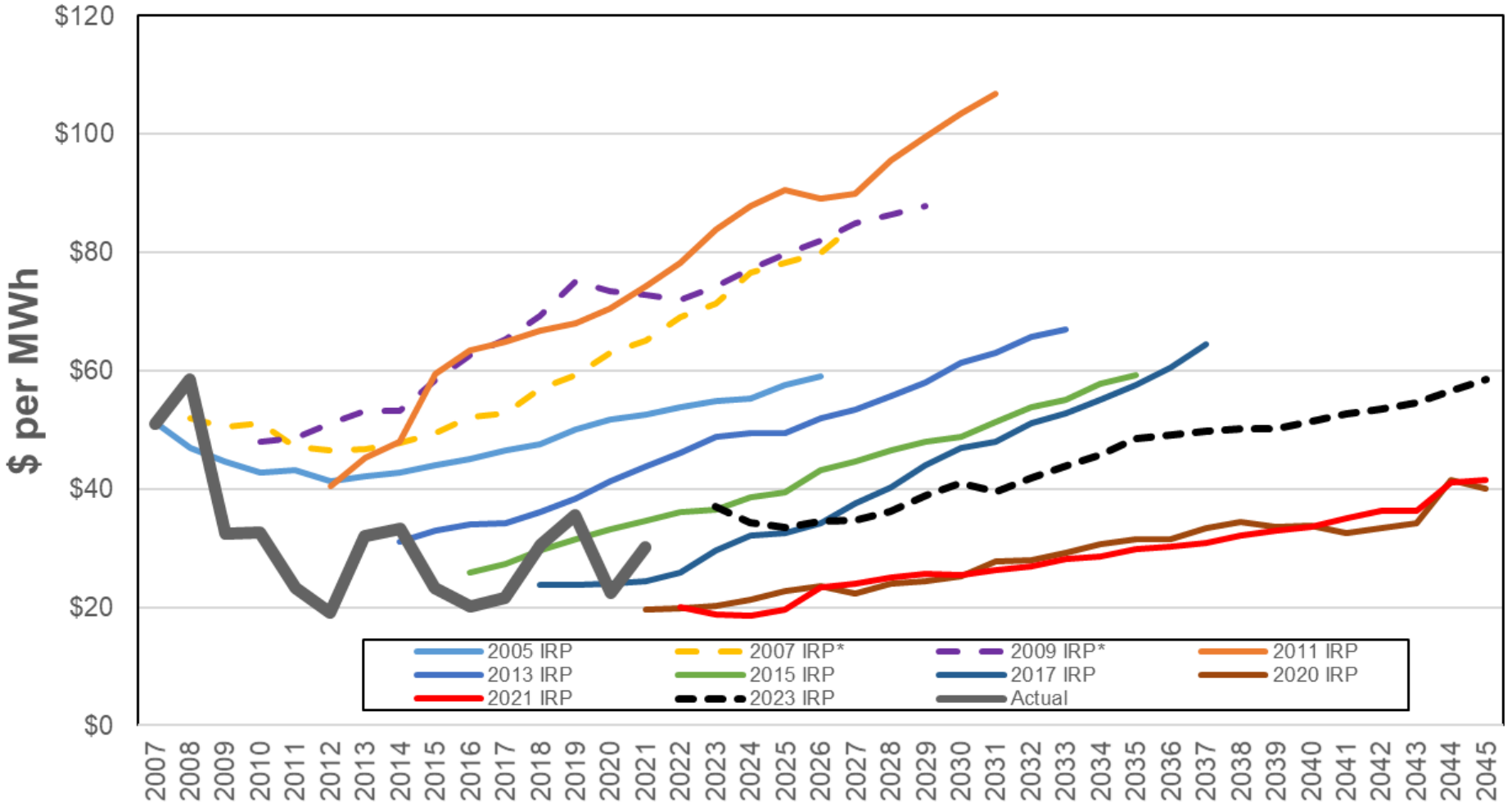
Summer: Jun 16 - Sep 15



Fall: Sep 16 - Dec 15



Mid-C Electric Price Comparison vs. Previous IRPs



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

Next Steps

- Conduct stochastic studies and verify resource adequacy

- Update price forecast this summer for final IRP analysis

  - Update gas prices (including stochastics),
  - Western Resource Adequacy Program (WRAP)
  - New IHS Markit forecast (load forecast and new regional resource forecast), if available
  - WA and OR carbon pricing update, if available

Data Availability

Outputs

- Expected Case: annual Mid-C prices by iteration
- Expected Case: hourly Mid-C prices
- Regional resource dispatch
- Regional GHG emissions