Northwest **Power** and **Conservation** Council

April 2, 2024

MEMORANDUM

TO: **Council Members**

FROM: **Annika Roberts & Dylan D'Souza**

SUBJECT: **Reference Plant Updates for Annual Assessments**

BACKGROUND:

Presenter: Annika Roberts & Dylan D'Souza

Summary: Staff will present on recent updates to generating the 2021 Plan's resource reference plants made in support of the upcoming annual assessments. These updates focus on capital costs of renewable and storage resources and the drivers behind the price changes being seen. Changes made to resource costs have been reviewed by the Generating Resource Advisory Committee (GRAC) and received general consensus, confirming their alignment with costs and cost trends regional stakeholders are seeing and expecting.

Relevance: Reference plant updates will be used in the market price and availability study for the 2029 adequacy assessment, which will ultimately inform updates to the Council's Mid-Term Assessment of the 2021 Power Plan. The Council may also choose to update the Mid-Term Assessment summary based on the updated price information presented.

Workplan: A.1.6. Maintain Mid-Term Assessment, updating recommendations as new information is available.

More Info: GRAC meeting and materials: https://www.nwcouncil.org/calendar/generating-resources-advisory-committee-2024-03-26/

Reference Plant Updates For Annual Assessments

Annika Roberts & Dylan D'Souza

April 2024 Power Committee Meeting

Northwest Power and Conservation Council

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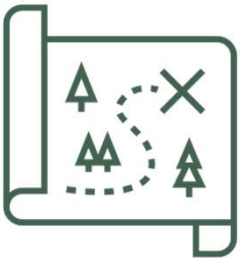
Agenda

- Background information
  - Annual Assessment & Reference Plants defined
- Focus of updates & reasoning
  - Regional/National resource trends & future projections
- Resource cost updates:
  - Renewables: Wind & Solar
  - Storage: Li Ion, Long Duration, Pumped Storage
- Other factors impacting cost
  - Tax credits



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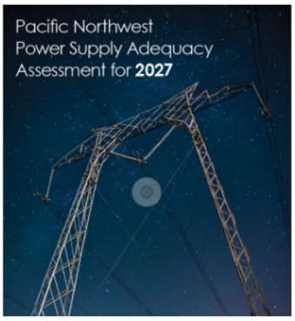
Annual Assessments

- The Council conducts annual assessments of resource adequacy.
  - Looking five years out check if the Council's 2021 Power Plan recommendations continue to provide sufficient direction to the region to ensure an adequate power supply
- The Adequacy Assessment for 2029 is currently underway and will be published this summer
- A number of studies and inputs are being updated to support the assessment and ensure current power system conditions are being represented
  - Price forecasts (Natural Gas & Market)
  - Load forecast
  - Reference plants

TODAY'S TOPIC



Read full report >

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Reference Plants

For generating resources, staff develop reference plants that assign defining attributes for each resource. These are then used as inputs to the Council's models

For the 2021 Plan reference plants were developed for the following resources: Onshore Wind*, Solar PV*, Battery Storage*, Pumped Storage*, Solar PV + Storage, Natural Gas, Conventional Geothermal, and an Emerging Technology Proxy

Today's presentation is focused on updating reference costs. These updated costs will be used in the annual market price and availability study for the annual assessments and may inform updates to the Mid-Term Assessment

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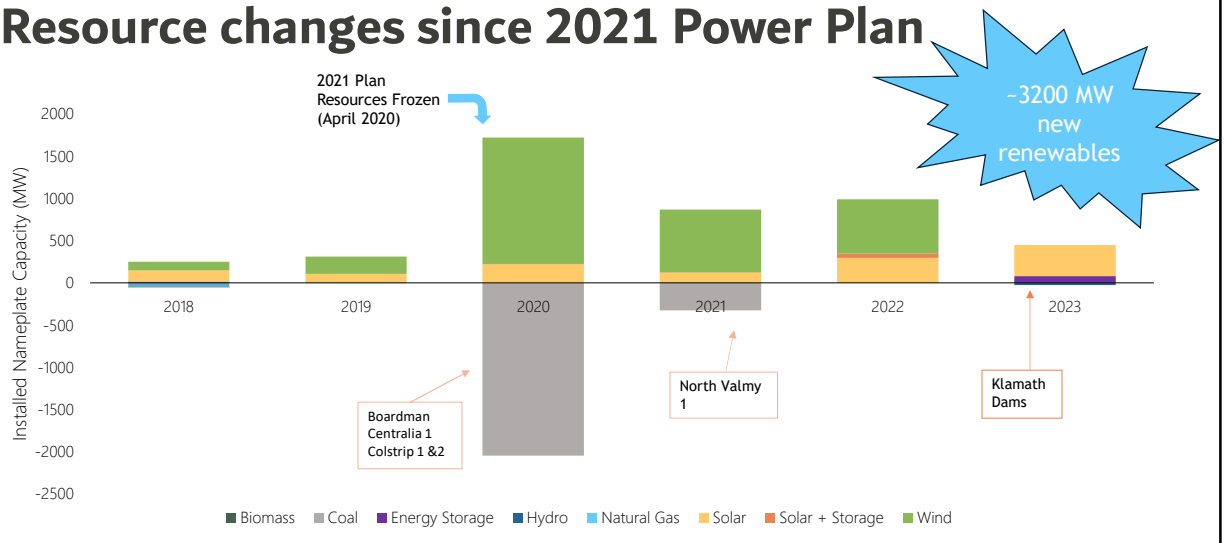
Resource changes since 2021 Power Plan



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National Resource Trends

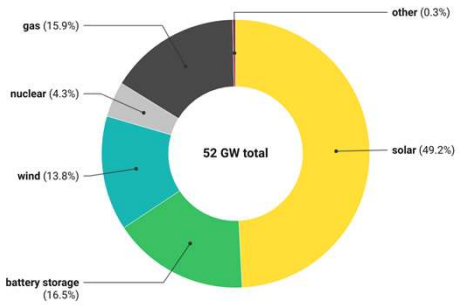
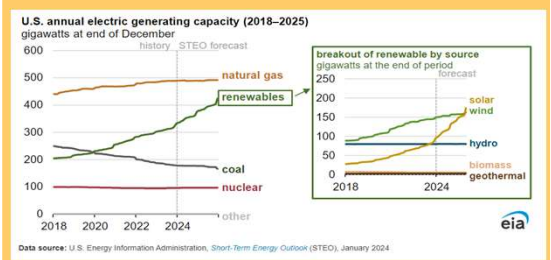


Chart: Canary Media • Source: Preliminary Monthly Electric Generator Inventory, January 2023 data

US utility scale power plant capacity added in 2023

- Lots of renewable capacity added in 2023
  - Lots of solar in 2023, similar to the region, which is expected to continue
  - 84% of added capacity was solar, wind & battery storage



Source: EIA Energy Outlook

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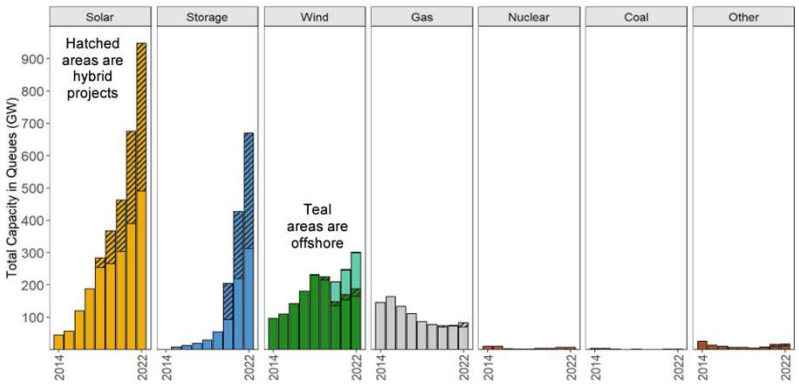
So what?



Not all this capacity will be built: <25% historical completion rate
Source: LBNL "Land-Based Wind Market Report: 2023 Edition"

- Renewables and storage are what's being built in the region and the country
- As we're interested in representing current power system conditions, we prioritized updates to these resources because:
  - Newer tech/less mature markets leaving more opportunity for change since the last plan
  - The 2021 Plan resource strategy & recent/planned builds indicate they're what the model will be choosing from

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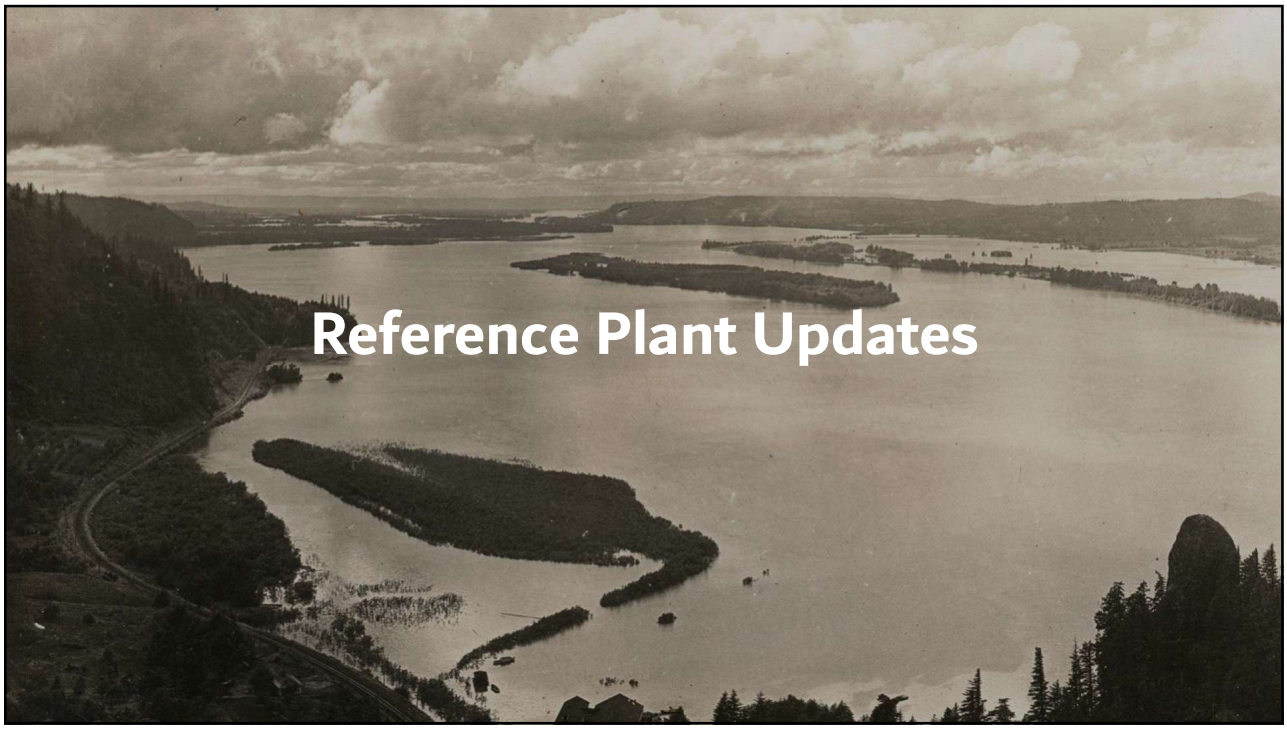

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Renewables

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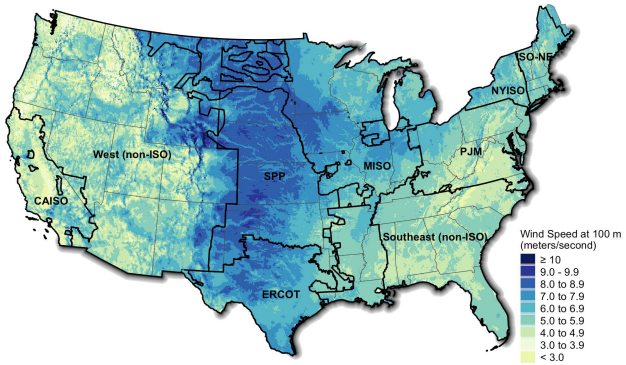
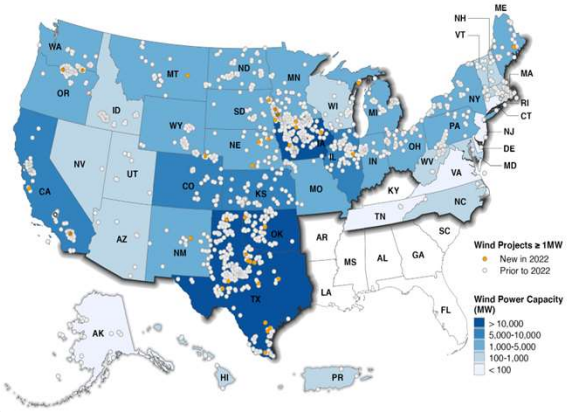
Technology Description: Land Based Wind





- The US has a great wind resource in the middle of the country
- Much of that resource is being taken advantage of—a lot of wind has been built
- Technology to capture that resource has been improving

Source: LBNL "Land-Based Wind Market Report: 2023 Edition"

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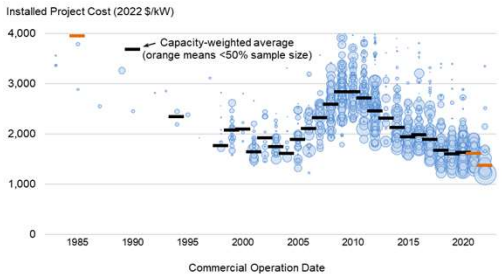
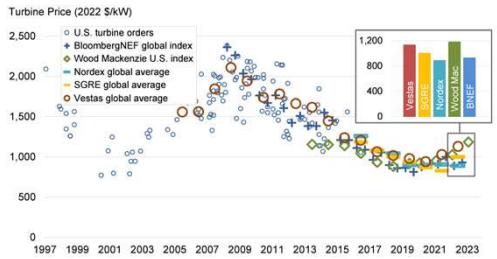
What's impacting wind costs?

- Supply chain constraints
  - Increased equipment costs: raw materials and freight& logistics price increases
- Permitting challenges
- Transmission interconnection delays
  - As a location-dependent resource, wind power often requires or benefits from new transmission
- More mature resource/market, very location constrained
- Wood Mackenzie 2023 saw the global onshore wind energy market contract 11%
- Looking forward many are anticipating a rebound citing record wind turbine backlogs and unprecedented policy momentum





Source: LBNL "Land-Based Wind Market Report: 2023 Edition"

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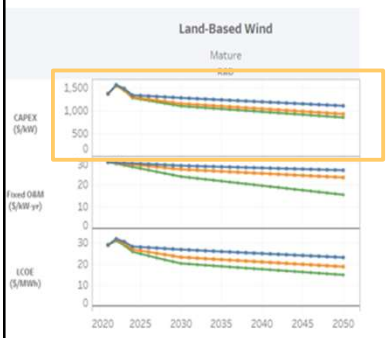
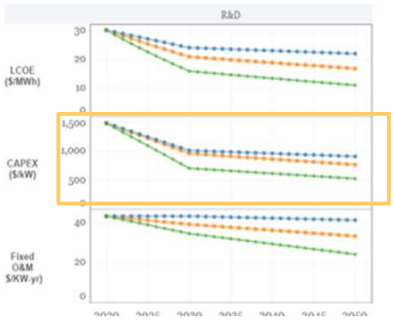
Cost Trends

Bump up in recent years, with an expected recovery
We can see a contraction of expected cost decline in forecasting across the years



NREL ATB 2023



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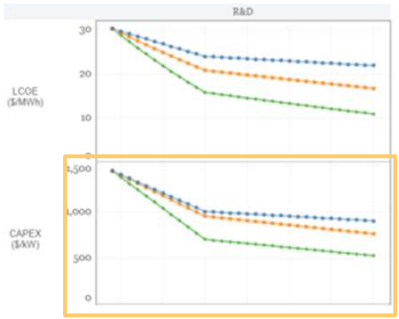

NREL ATB 2021

Source: NREL ATB Annual Update

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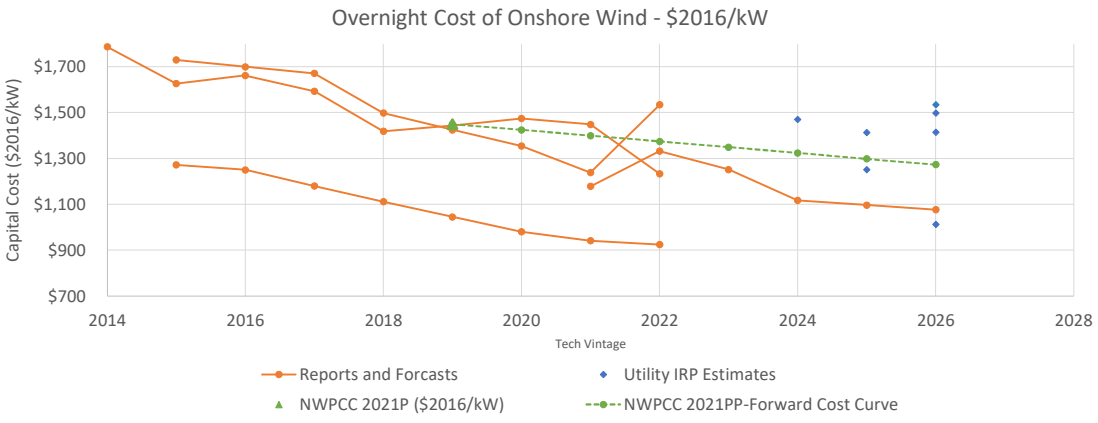
Overnight Capital Costs *literature review*



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PROPOSAL	Reminder: 2021 Plan Onshore Wind - C. Gorge, SE. Washington, MT	Proposed Update Onshore Wind - C. Gorge, SE. Washington, MT
Configuration	60 x 3.6 MW, 105 meter hub height	60 x 3.6 MW, 105 meter hub height
Location	OR&WA/SE WA/MT	OR&WA/SE WA/MT
Technology Vintage	2024	2024
Development Period (Years)	2	
Construction Period (Years)	1	
Capacity (MW)	216	
Capacity Factor	39.8%/41.2%/45.5%	
Overnight Capital Cost ($/kW)	1,324	1,400
Fixed O&M Cost ($/kW-yr)	30	30
Variable O&M ($/MWh)	0	0
Economic Life (years)	30	30
Financial Sponsor	IPP	IPP

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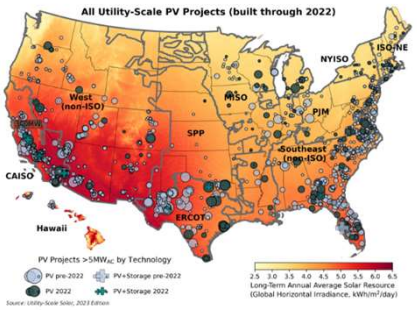
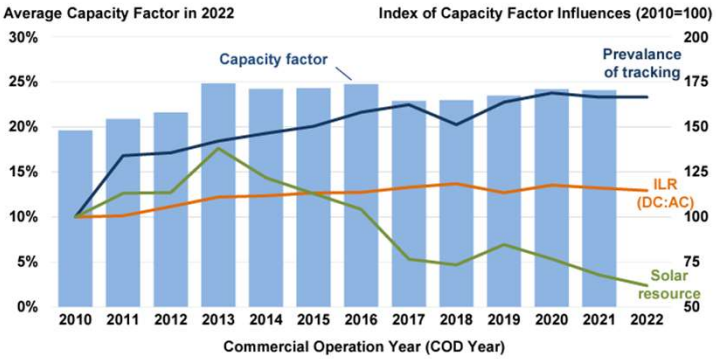
Technology Description: Solar PV





The columns represent the capacity factor (left axis), the lines show changes in major drivers (right axis)

- Solar development has ballooned in recent years, touching almost all 50 states
- Interestingly, while technology is improving, avg. capacity factors are not, likely due to expansion into less sunny places

Recent flat trend is not necessarily negative, but rather a sign of a market that is expanding geographically into less-sunny regions

Source: LBNL "Utility Scale Solar, 2023 Edition"

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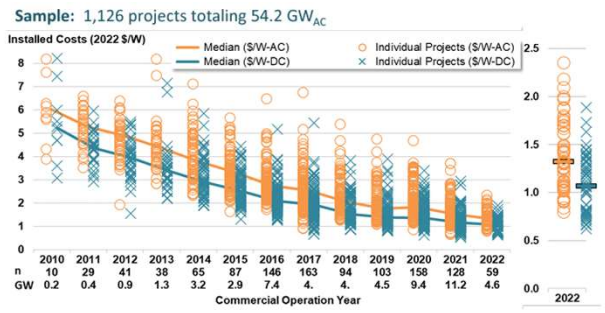
What's impacting solar costs



Source: LBNL "Utility Scale Solar, 2023 Edition"

- Solar has not seen costs rise to the extent that wind has, why?
  - Less affected by supply chain constrains
  - Less mature market
  - Less constrained geographically
  - Easier to permit/connect
  - Less freight/logistics requirements

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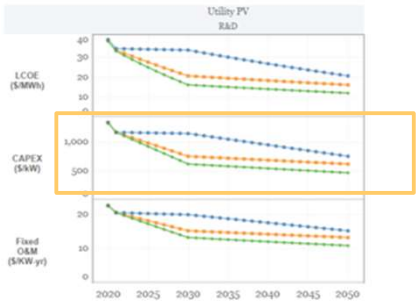
Cost Trends

Similar to wind, though slighter increase in the early 2020s
Slight tempering of expected cost decreases, still dropping

NREL ATB 2023



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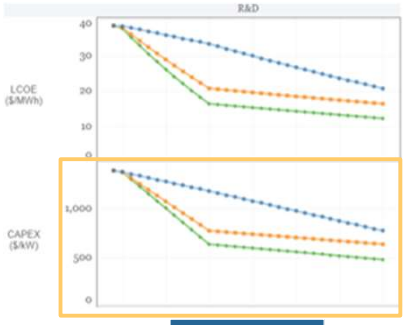

NREL ATB 2021

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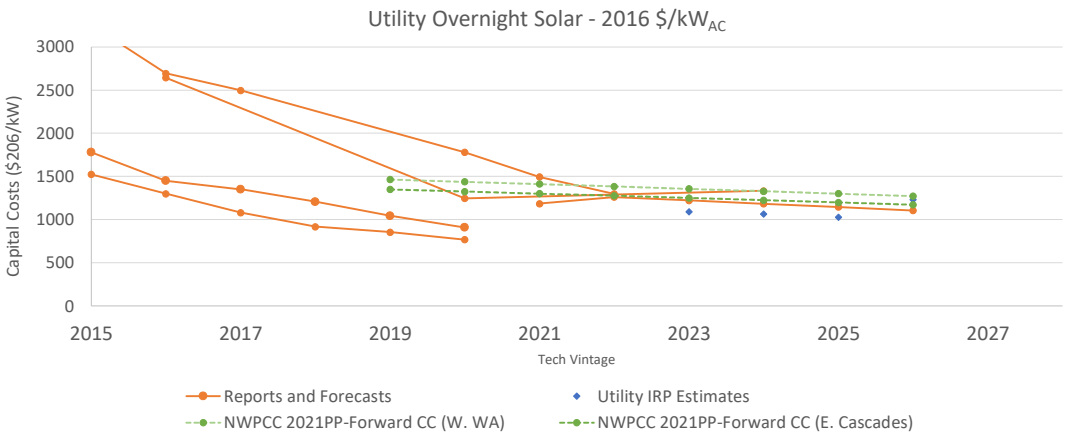
Overnight Capital Costs *literature review*



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	Reminder: 2021 Plan		Proposed Update	
PROPOSAL	**Solar PV - W. Washington**	**Solar PV - E. Cascades**	**Solar PV - W. Washington**	**Solar PV - E. Cascades**
Configuration			15 MW_{AC} mono PERC c-SI with single axis tracker	100 MW_{AC} mono PERC c-SI with single axis tracker
Location			West of the Cascades in Washington State	Areas with high solar irradiance in ID & MT, Southern OR, and East of the Cascades in OR & WA
Technology Vintage	2024	2024	2024	2024
Development Period (Years)	1	1	1	1
Construction Period (Years)	1		1	1
Capacity (MW)	15	100	15	100
Inverter Loading Ratio (DC:AC Ratio)	1.4:1	1.4:1	1.4:1	1.4:1
Capacity Factor	24.7%	32.5%	24.7%	32.5%
Overnight Capital Cost ($/kW)	1,330	1,225	1,200	1,100
Fixed O&M Cost ($/kW-yr)	14.55	14.55	14.55	14.55
Variable O&M ($/MWh)	0	0	0	0
Economic Life (years)	30	30	30	30
Financial Sponsor	IPP	IPP	IPP	IPP

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Storage

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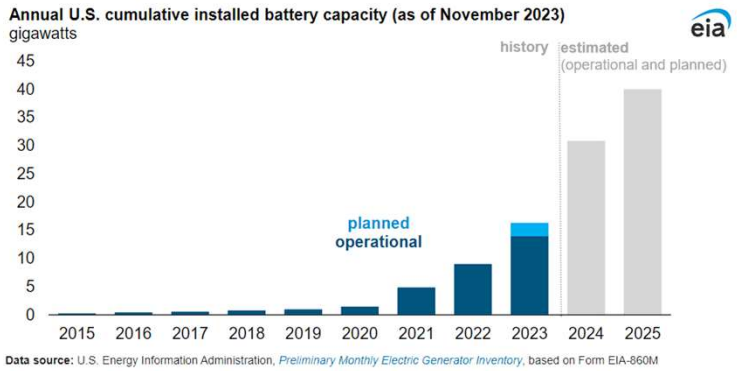
Technology Description: Battery Storage

Data Source: NREL NAATBatt

- Battery projects are continuing and only getting bigger: both in amount and capacity per project
- Largest to date 750MW Moss Landing facility in California



Source: EIA "U.S. battery storage capacity expected to nearly double in 2024"

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Battery Storage Reference Plant Update

- Market is still Growing; Costs are Improving
- Recovering from global instability and supply chain issues
- Battery Pack Component Still Dominates Installed Cost

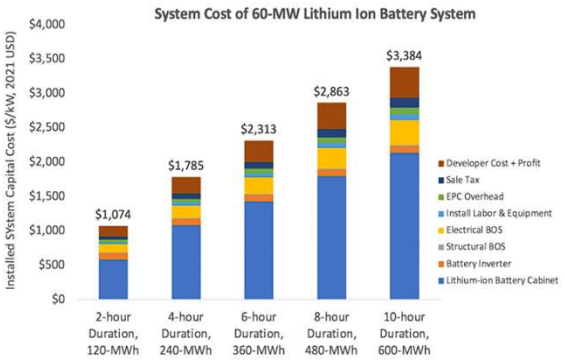
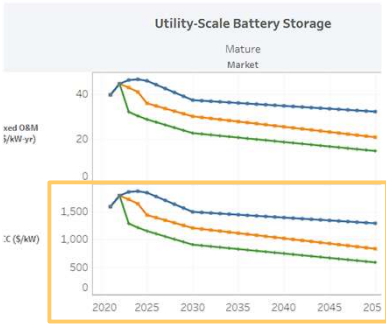


Figure 2. 2022 U.S. utility-scale LIB storage costs for durations of 2–10 hours (60 MW_{DC}) in $/kW

Source: NREL ATB "Utility-Scale PV"

Cost Trends

Similar to wind and solar though less sharp increase in the early 2020s, peaking in 2022
Tempering of expected cost decreases, costs heading into their downward trend



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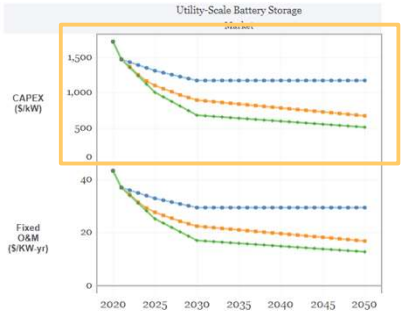

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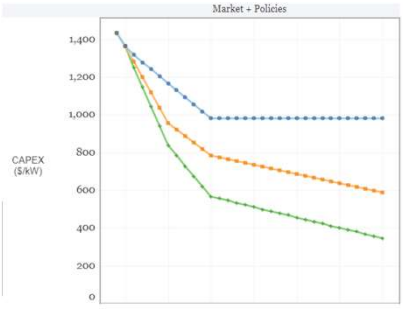
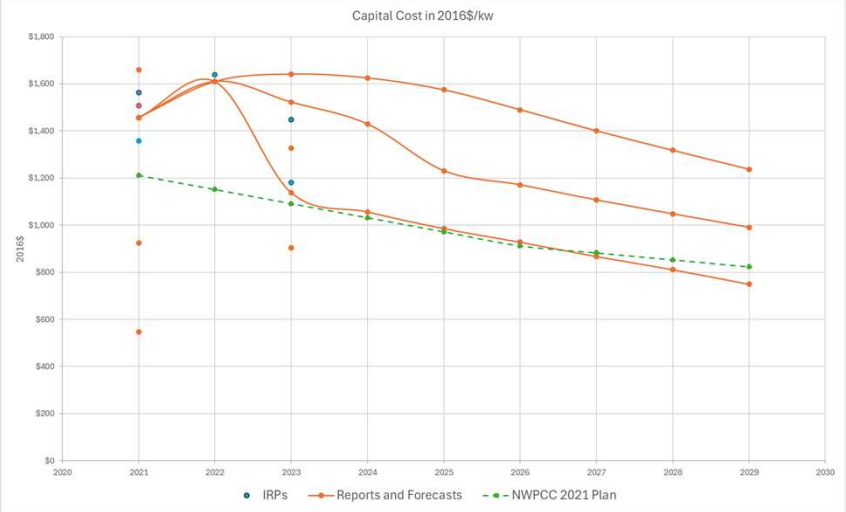


NREL ATB 2021

Source: NREL ATB Annual Update

Overnight Capital Costs *literature review*



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PROPOSAL	Reminder: 2021 Plan Utility Scale Lithium Ion Battery Storage - 4 hour	Proposed Update Utility Scale Lithium Ion Battery Storage - 4 hour
Configuration	100 MW, 400 MWh, Lithium-ion	100 MW, 400 MWh, Lithium-ion
Technology Vintage	2024	2024
Development Period (Years)	1	1
Construction Period (Years)	1	1
Capacity (MW)	100	100
Roundtrip Efficiency	88%	88%
Overnight Capital Cost ($/kW)	1,031	1,350
Fixed O&M Cost ($/kW-yr)	28	28
Variable O&M ($/MWh)	0	0
Economic Life (years)	20	20
Financial Sponsor	IOU	IOU

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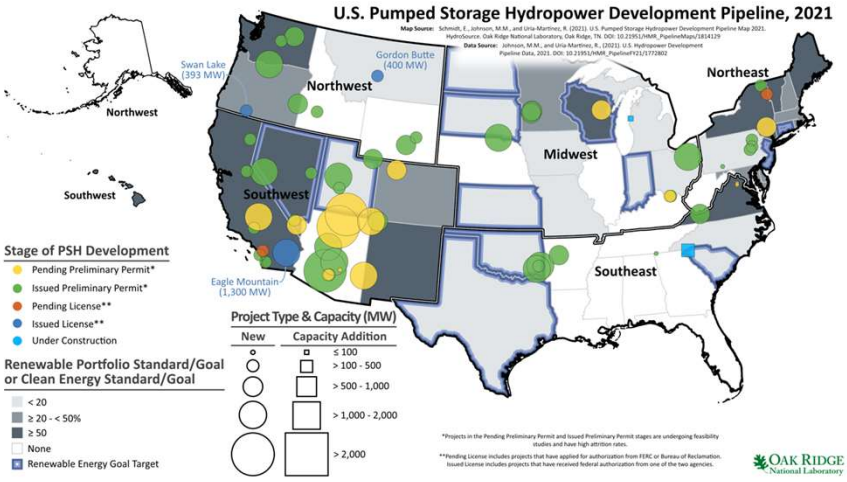
Technology Description: Pumped Storage

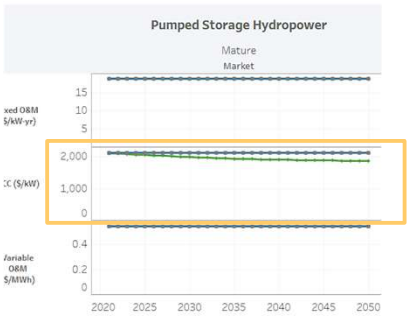
- Pumped Hydro Projects are continuing with continuing hurdles faced in other industries
- Even more site specific than wind and solar
- NW Region has Class 1 type pumped hydro



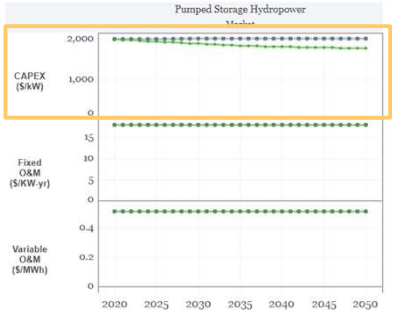
Source: Oak Ridge National Laboratory

Cost Trends

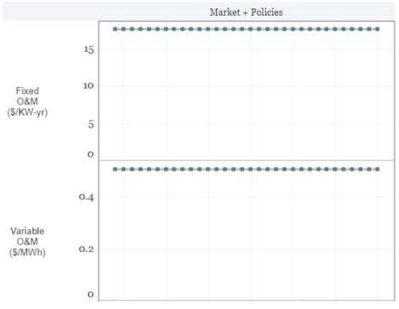
Conservative trends continue similar to previous forward cost curves, Advanced (green) trends see some cost decreases



NREL ATB 2023



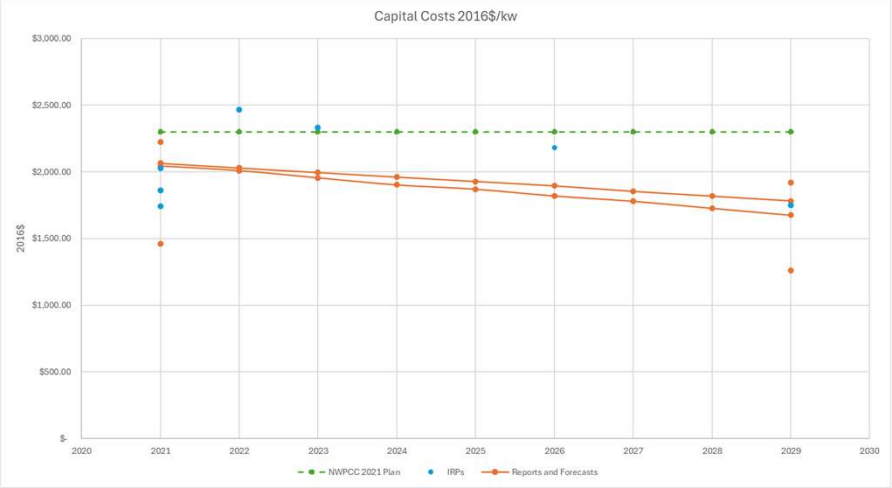
NREL ATB 2022



NREL ATB 2021

Source: NREL ATB Annual Update

Overnight Capital Costs *literature review*



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	Reminder: 2021 Plan	Proposed Update
PROPOSAL	**Pumped Storage - 8 hour**	**Pumped Storage - 8 hour**
Configuration	Closed loop, variable speed pump	Closed loop, variable speed pump
Technology Vintage	2024	2024
Development Period (Years)	1	1
Construction Period (Years)	1	1
Capacity (MW)	400	400
Round trip Efficiency	80%	80%
Overnight Capital Cost ($/kW)	2300	2100
Fixed O&M Cost ($/kW-yr)	14	15
Variable O&M ($/MWh)	0	0
Economic Life (years)	50	50
Financial Sponsor	IOU	IOU

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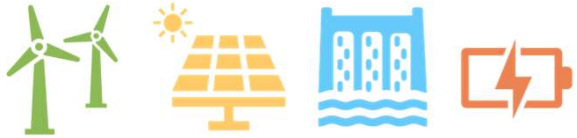
Long Duration Storage Reference Plant

	Standalone Long Duration Battery Storage - 100 hours
Configuration	X MW, 100X MWh Iron-Air Battery Storage
Technology Vintage	2024
Development Period (Years)	1
Construction Period (Years)	1
Capacity (MW)	5 MW
Round trip Efficiency	40%
Overnight Capital Cost ($/kW)	$1900
Fixed O&M Cost ($/kW-yr)	$20
Variable O&M ($/MWh)	0
Economic Life (years)	30
Financial Sponsor	IOU
Maximum Buildout	300 MW

Reasons for the Inclusion of Long Duration Energy Storage

- Why are we including this?
- The planned production capacity is roughly 30GWh by 2025
- Technically Available – based on the 4 pilot projects under construction or in operation and the factory in West Virginia
- 1 MW/100MWh is a single module of an iron-air system that can increase up to fit the 200 MWh/Acre
- Additional restrictions based on production and for total buildout

Summary of Cost Updates



These updates show changing prices since the 2021 Power Plan

- Wind prices have gone up
- Solar prices have decreased
- Battery Storage prices have increased
- Pumped Storage prices has decreased

Staff reviewed these with the Generating Resource Advisory Committee

- General consensus on these updated costs
- Staff will continue to work with the advisory committee in preparation of new reference plants for the ninth power plan

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Other Cost Impacts

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IRA Tax Credits (ITC/PTC)

- Technology neutral starting in 2025
  - Either PTC or ITC available to all eligible resources
- Extended through 2032
  - Will start to phase out only if GHG emission are below 25% of 2022 rates
- Direct reimbursement available for tax exempt entities
- Bonuses: Domestic materials, energy community

How are we treating tax credits?

- Credits are included when accounting for the cost of the measure.
  - Given the choice between the ITC (reducing upfront costs) or the PTC (providing benefit based on production), we are testing and working with the region on the best approach to apply these for the annual study and later the Plan

Production taxed credit: 30% of every $1 invested in installing clean electricity generation
Investment tax credit: $27.50 for every kWh generated by a clean electricity project

Assuming labor requirements met

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Questions?

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