Modernization of the Energy Delivery System and Processes

June 6, 2022

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Safety Moment

- June is national safety month
- Keep all environment safe at work and at home
- Reminder to update your first-aid kit and test fire alarms / smoke detectors
- Smoke detectors should be replaced every 10 years

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Welcome to the webinar and thank you for participating!

If you **want to type a question regarding the presentation,** insert **"Slide X followed by your question"** in the chat box!

If you **have a technical issue or a general question**, please type it in the chat box.

Please **keep yourself on mute** unless you are speaking.

If you want to **ask a question verbally,** click the 'Reaction' button and click on the **'Raise Hand'** option and we will call on you.

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Facilitator Requests

- Engage constructively and courteously towards all participants
- Respect the role of the facilitator to guide the group process
- "Take space and make space"
- Avoid use of acronyms and explain the technical questions

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Agenda

Time	Agenda Item	Presenter
9:00 – 9:05 a.m. (*5 min)*	Opening	Sophie Glass
9:05 – 9:15 a.m. (*10 min)*	Follow-up from March IRP Meetings	Kara Durbin
9:15 – 9:25 a.m. (*10 min)*	Delivery System Planning Overview	Cathy Koch
9:25 – 10:20 a.m. (55 min)	Delivery System Planning - Ongoing Improvements	Jens Nedrud Reid Shibata Niecie Weatherby
10:20 – 10:30 a.m. (10 *min)*	Break	All
10:30 – 11:30 a.m. (60 min)	Delivery System Planning – Integrating different voices	Cathy Koch Jens Nedrud Eleanor Ewry
11:30 – 11:45 a.m. (15 *min)*	Resource Interconnection Costs	Eleanor Ewry Elizabeth Hossner
11:45 a.m. – 12:00 p.m. (*15 min)*	Next steps	Sophie Glass
12:00 p.m.	Adjourn	Sophie Glass

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Today's Speaker

Cathy Koch
Director, Planning, PSE

Kara Durbin
Director, Clean Energy Strategy, PSE

Jens Nedrud
Manager, Electric System Planning, PSE

Reid Shibata
Manager, Grid Modernization Strategy & Enablement, PSE

Niecie Weatherby
Manager, Gas Systems Integrity, PSE

Eleanor Ewry
Supervisor, Strategic System Planning, PSE

Elizabeth Hossner
Manager, Resource Planning and Analysis, PSE

Sophie Glass
Co-facilitator, Triangle Associates

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Follow up from March IRP Meeting

Kara Durbin, Director, Clean Energy Strategy

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How input from March meetings is shaping our work

Themes heard at March 22nd meeting (electric)	What we did with it
Cyclical degradation in addition to calendar degradation	PSE is considering battery storage cyclical degradation by limiting the amount of cycles per day. For battery storage, PSE assumes an annual or calendar- based degradation assuming a limited amount of cycling. The augmentation for degradation is included in the fixed operations and maintenance (O&M).
Source for lithium battery degradation	In the 2017 IRP, PSE used a 2% degradation on the battery energy storage per year, meaning the total available capacity of the battery decreased 2% each year until end of life. In the 2019 IRP process and the 2021 IRP, PSE moved to including augmentation in the fixed O&M. So, no degradation was modeled, and the fixed O&M was increased for augmentation. PSE will continue this approach for the 2023 Electric Progress Report, as opposed to a degradation of capacity.
Concerns over 5 miles of transmission for battery installation	IRP staff reviewed generating resource interconnection assumptions and costs with PSE System Planning and are updating our assumptions, including the cost per mile for interconnection transmission lines. Also, in reviewing the assumptions for the National Renewable Energy Lab (NREL) Annual Technology Baseline (ATB) costs, we found that the costs only cover those "inside the fence," meaning just the generic resource costs and construction costs and not the cost of transmission lines or substations for interconnection. PSE will review this at today's meeting.
Suggest PSE use up to date data to assess resource costs and might have different weighting of cost sources for different resource types as a result.	PSE will use the National Renewable Energy Lab's Annual Technology Baseline 2021 Report (2021 NREL ATB) for resource costs for the 2023 Electric Progress Report, which were also used in PSE's 2021 Clean Energy Implementation Plan (CEIP).

More responses on unanswered questions from March 22nd meeting and feedback form are addressed in Feedback Report.

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How input from March meetings is shaping our work

Themes heard at March 31st meeting (gas)	**What we did with it**
Barriers to using social cost of carbon	PSE will model a scenario to show the SCGHG on RNG and its benefits to decarbonization.
Renewable gas resources	PSE will include supply curves for RNG for the scenarios discussed in the 2023 Gas Utility IRP. This will help clarify volumes and prices for different kinds of renewable gas. Supply curves for both the Washington-only RNG as well as North America-wide RNG scenarios will be included.
Suggestion to focus on cold weather heat pumps and ground source heat pumps	PSE will include the cold weather heat pumps and ground source heat pumps in its study along with hybrid heat pumps.
Suggestion on ensuring the electric and gas IRP processes are integrated holistically	PSE plans to publish the accompanying electric portfolio analysis within the 2023 Gas Utility IRP, as these are gas IRP scenarios. We also see the strong interaction between the demand forecast for both utilities and the Conservation Potential Assessment (CPA). PSE plans to leverage the CPA heat pump analysis to analyze the demand forecast impacts on both the gas and electric portfolio.
Suggest PSE reduce its own emissions under CCA rather than treating the renewable attributes of RNG as unbundled RECs	PSE will be studying a host of carbon reduction resources, including typical conservation measures, hybrid heat pumps, other kinds of electrification, green hydrogen, RNG that is sourced locally and RNG sourced from a broader geographic footprint. As the Washington Department of Ecology's CCA rules are not written yet, PSE will examine the impact of the RNG footprint using scenario analysis in this IRP.
Questions regarding the California carbon pricing ceiling and floor and its alignment with the recent California auction	PSE is exploring more options regarding carbon pricing, which also include the California Energy Commission (CEC) Integrated Energy Policy Report (IEPR) projection for 2021.
Model the same components as State Energy Strategy for the electrification scenario	PSE is reviewing the State Energy Strategy and plans on leveraging as many assumptions and parameters as is applicable for the electrification scenario.

Additional responses for unanswered questions from the March 31st meeting and feedback form are addressed in Feedback Report.

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Delivery System Planning (DSP) Overview

Cathy Koch, Director, Planning, PSE

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Participation Objectives

- PSE will review the Delivery System Planning approach including Grid and Pipeline Modernization to support further Distributed Energy Resources (DER) and Non-Wire Alternative (NWA) integration.
- PSE will review DSP enhancements, including equity and portfolio benefits and get feedback from stakeholders on future hosting capacity map enhancements.

IAP2 level of participation:

- INFORM & CONSULT

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Overview

- History
- Delivery System Planning ongoing improvements
  - Interconnectedness with IRP
  - Modernization of the grid and pipeline system
- Delivery System Planning integrating additional voices and feedback
  - Stakeholder engagement in planning and equity considerations
  - Transparency through hosting capacity maps
- Delivery System Planning inputs into the IRP process
  - Non-wires alternative progress
  - Transmission and distribution deferral value – incremental vs. new
  - Electric infrastructure cost to meet "Electrification" (Gas IRP)
- Resource interconnection cost

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Delivery System Planning (DSP) Ongoing Improvements

Jens Nedrud, Manager, Electric System Planning, PSE
Reid Shibata, Manager, Grid Modernization Strategy & Enablement, PSE
Niecie Weatherby, Manager, Gas Systems Integrity, PSE

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Historic IRP and Delivery System Planning integration discussions

Date	IRP and Delivery System Planning Engagement
February 2021	IRP Webinar Meeting #12 – Delivery System and Grid Modernization Solutions
November 2020	IRP Webinar Meeting #10 – Delivery System and Grid Modernization Needs
August 2020	IRP Webinar Meeting #6 – DER Integration between Delivery System Planning & Integrated Resource Planning
January 2019 Tag Meeting #4	IRP TAG Meeting #4 – Delivery System Planning (Transmission & Distribution)
March 2017 – IRP Advisory Group	IRP Advisory Group – Delivery Infrastructure Planning
2013	IRP – Delivery Infrastructure Planning

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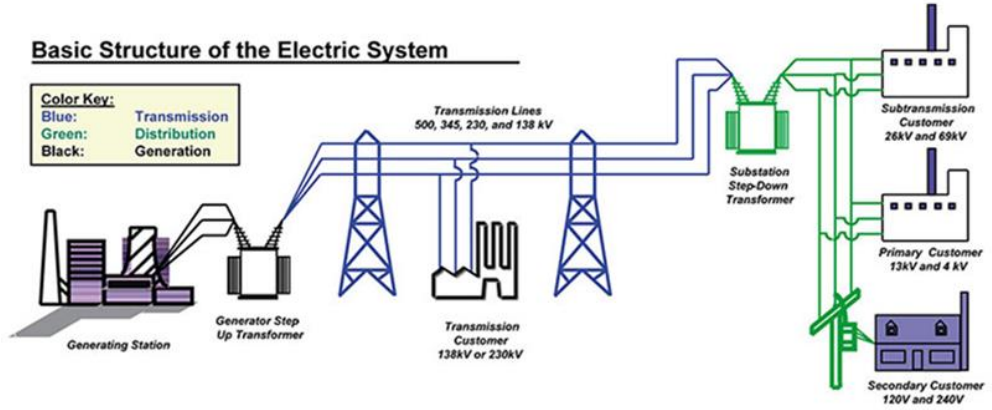
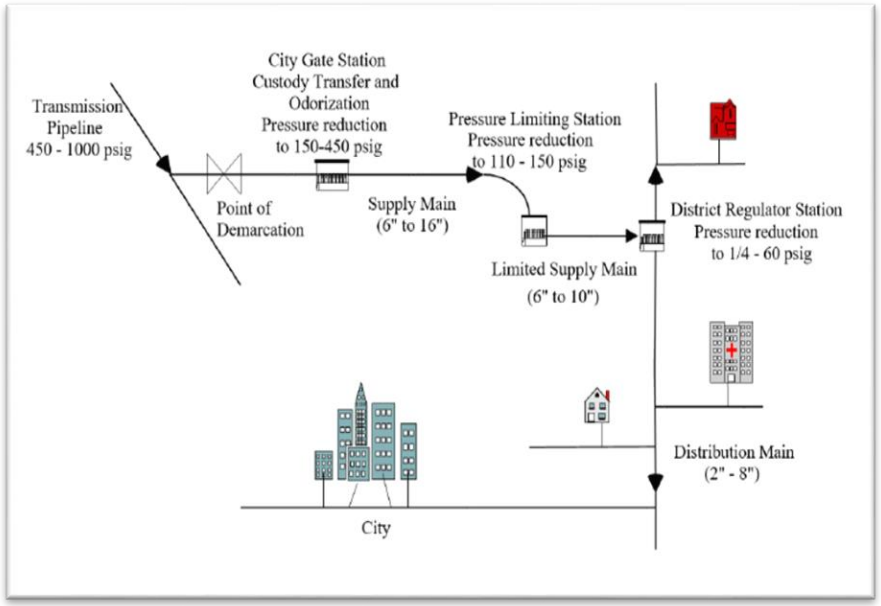
Overview of the Delivery System and planning

The energy delivery system is the network of wires and pipelines, both distribution and transmission, that deliver power and natural gas from where energy enters PSE's system to a customer meter.





- The IRP should include delivery system investments that support DER growth and provide energy to customers that is clean, affordable, reliable and equitably distributed.
  - This includes tools, monitoring, controls, metering, DERs, and expansions or upgrades to existing bulk transmission and distribution facilities.
- We need to review the delivery system needs to understand the specific delivery system investments to be included in the IRP, Clean Energy Action Plan (CEAP) or Clean Energy Implementation Plan (CEIP).

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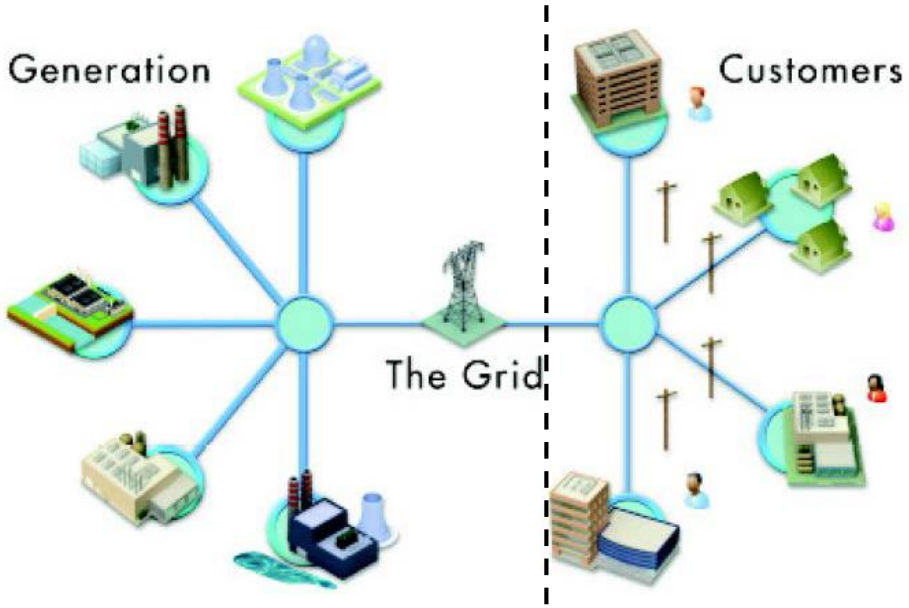
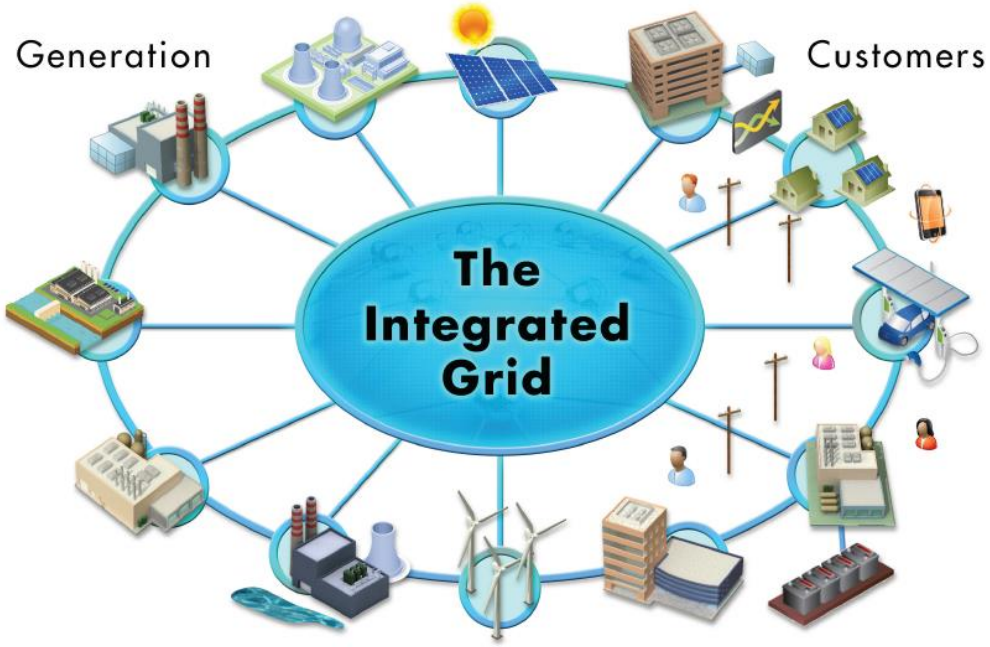
PSE's IRP and Delivery System Planning are closely linked

Integrated Resource Planning (IRP) optimizes resources which deliver power to the grid.

Delivery System Planning (DSP) ensures that electricity gets to our customers



Existing grid design – push power to customers
EPRI - 2014



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Distributed Energy Resources enable customers to play an important role in the delivery of energy

"Distributed Energy Resources (DERs) and Non-Wire Alternatives (NWAs) are a set of technologies including PV cells, battery storage, fuel cell, wind, thermal, hydro, biogas, cogeneration, compressed air, flywheel, combustion generators, demand response (DR), and energy efficiency"
NY Reform the Energy Vision (REV)

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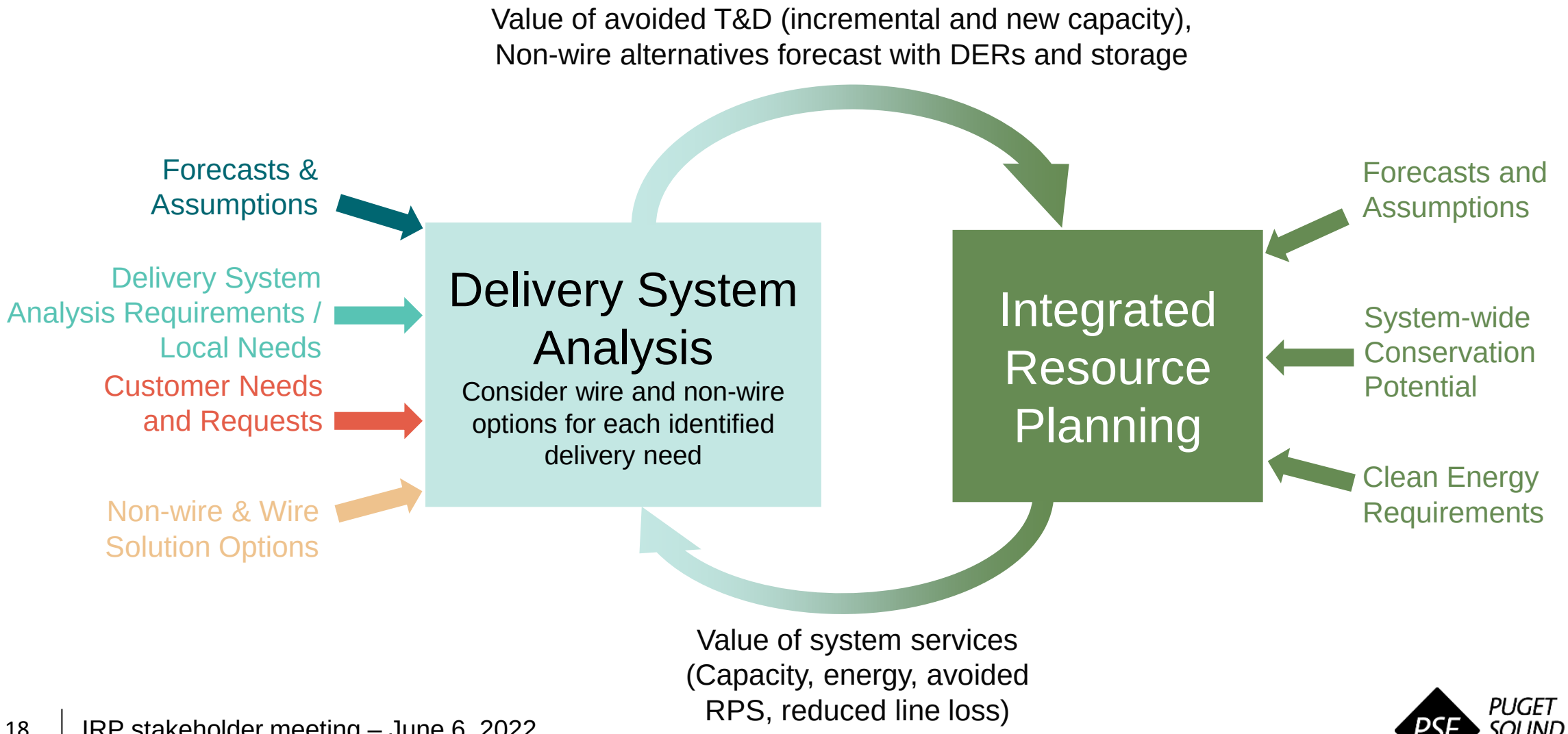
Delivery System Planning and IRP process integration continues to evolve to support DERs



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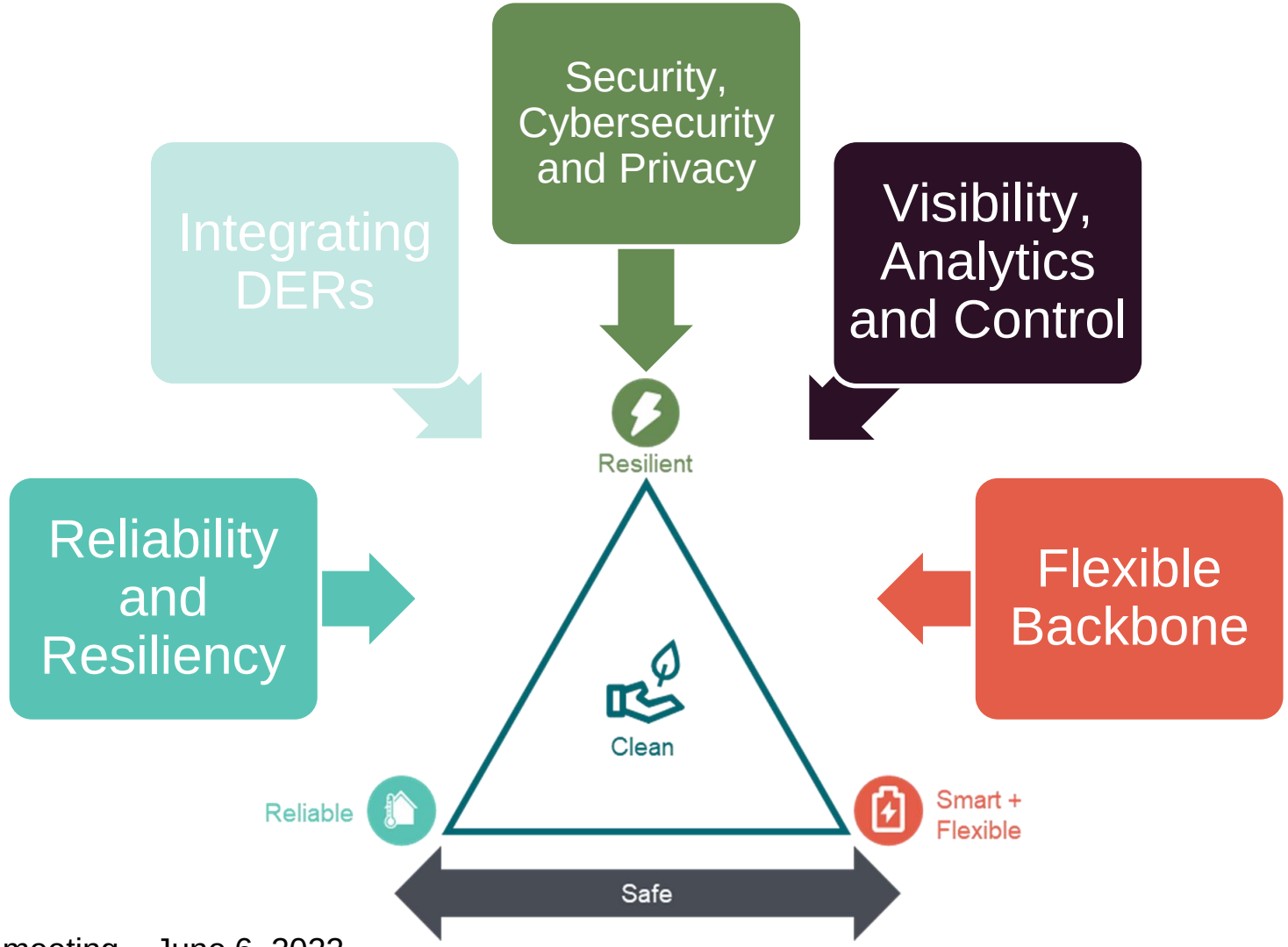
A reimagined modern grid starts with a vision to enable a clean energy future



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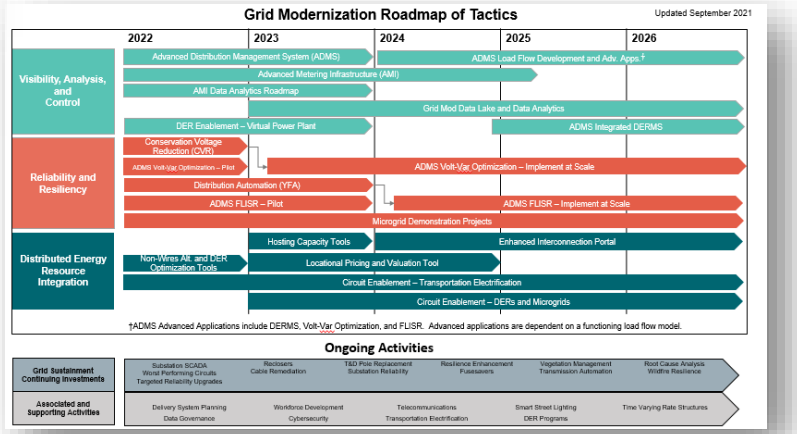
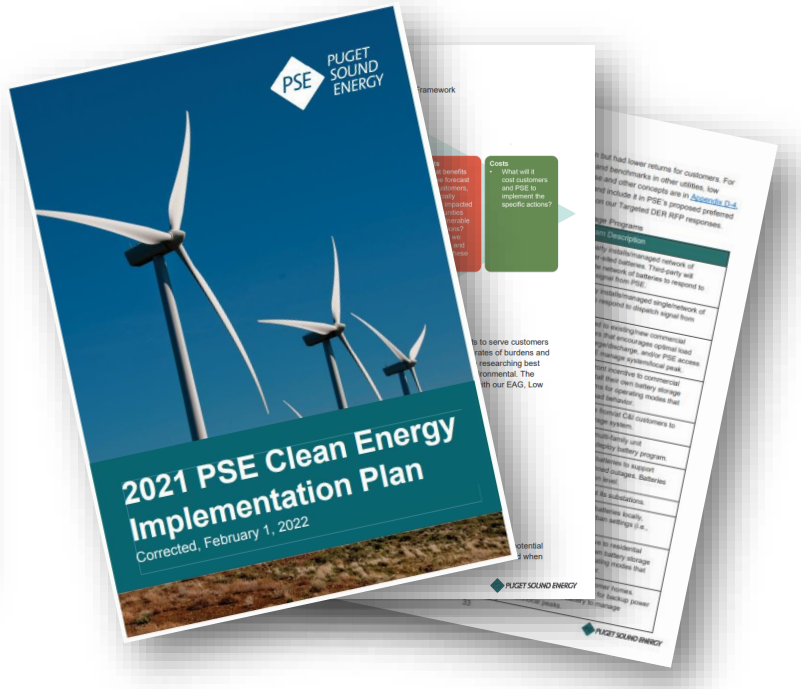
Grid Modernization Strategy progress





Grid Modernization Strategy Report

Roadmap of Tactics

CEIP Integration

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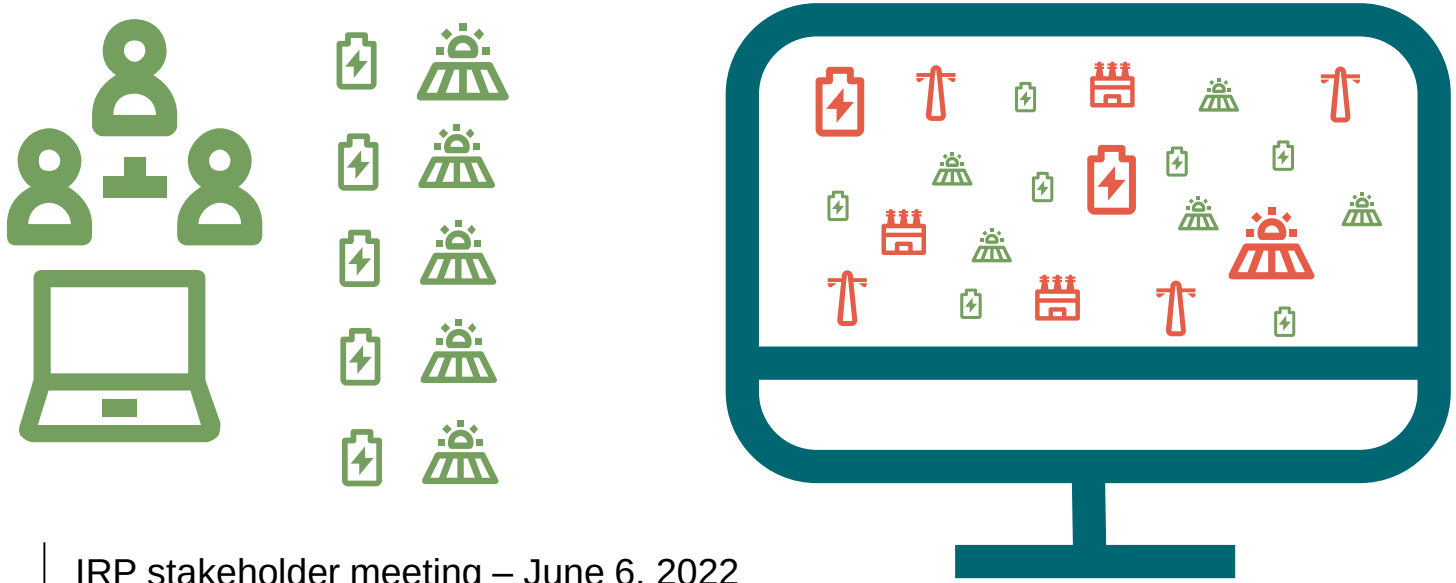
Enabling Tools for increasing utility & customer sited DERs

Customer/Utility Interface	Operational Platforms	Planning Analysis
Meter Data Visibility	*ADMS*	*NWA Evaluation/Methodology*
Hosting Capacity Map	*DERMS*	*Hosting Capacity Analysis*
Interconnection Portal	*Virtual Power Plant*	*Geospatial Load Forecasting*



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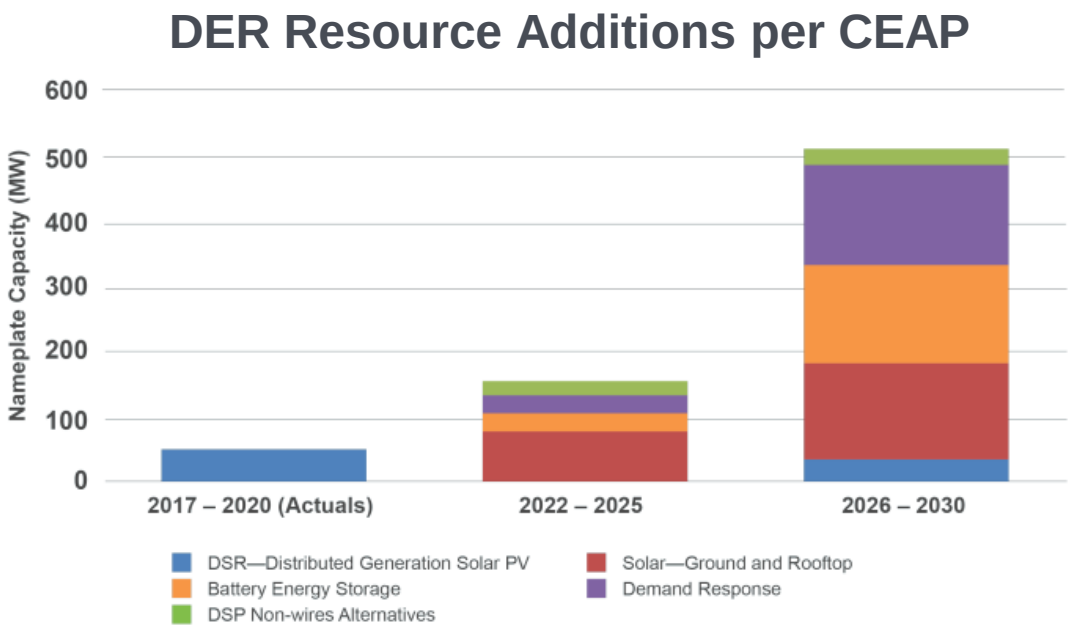
CEIP drives new and accelerates existing Grid Modernization investments



**Chapter 4, Figure 4-7 of PSE's CEIP*

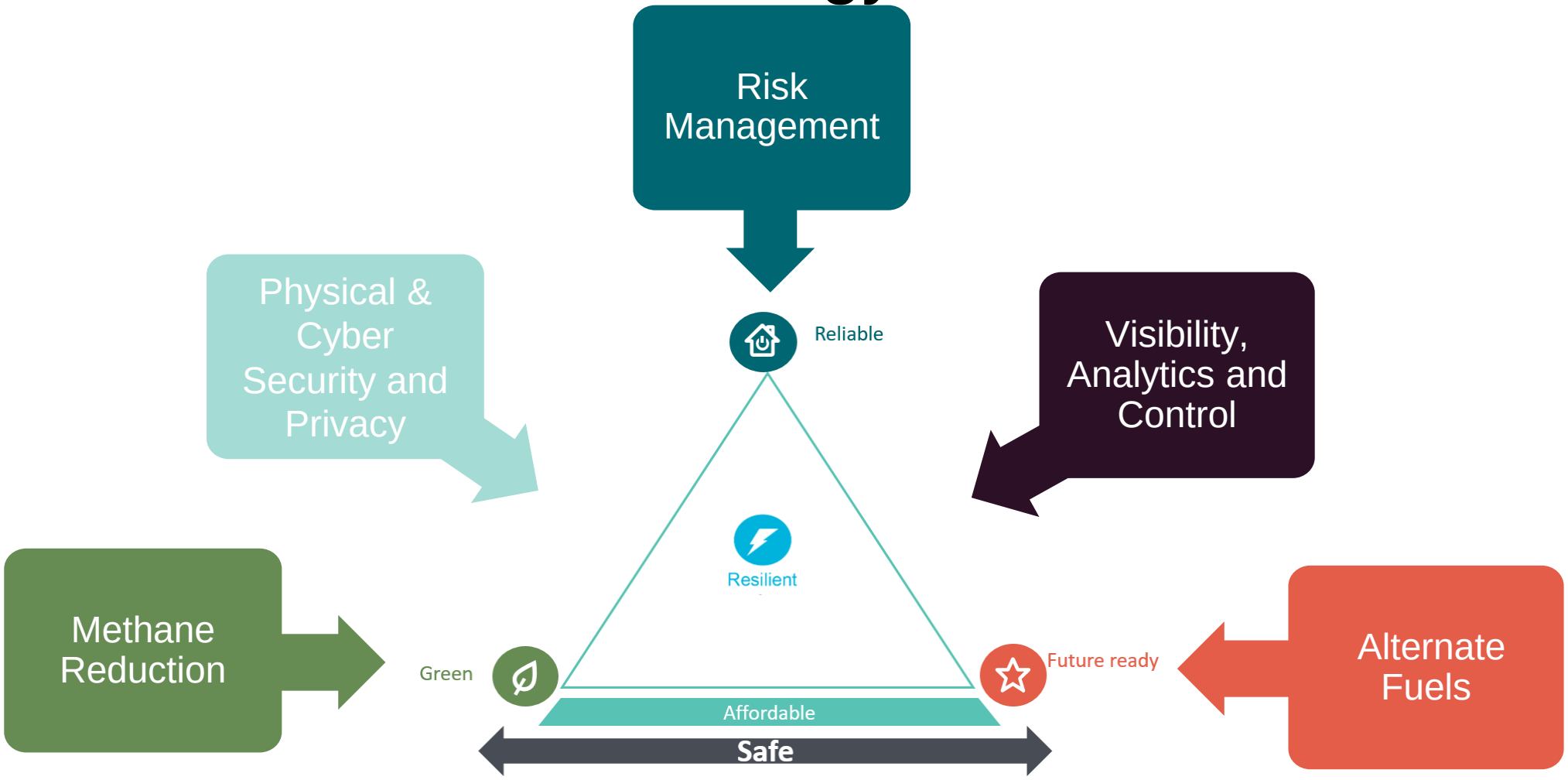
DER Enabling Tools/Technologies

- Virtual Power Plant
- DERMS
- Hosting Capacity Analysis
- Enhanced Interconnection Portal
- Data Lake & Data Analytics

Grid Modernization Programs

- Accelerated Substation SCADA
- DER & Microgrid Circuit Enablement
- Resilience Enhancement

A reimagined modern pipeline system starts with a vision to enable a clean energy future



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We’re preparing for a hydrogen future

- Hydrogen as an alternative fuel source is already in use in different parts of the world, and is scaling at a rapid pace in the US
- Our teams are involved in researching hydrogen and preparing our pipeline infrastructure to accept hydrogen in the future
  - In April 2021, we ran our first hydrogen pilot to test different levels of hydrogen and natural gas blends on our pipeline system, testing for leaks, air quality after combustion, gas quality and impact on appliances used
  - In Jan 2022, we ran our second hydrogen pilot to test long term impacts of hydrogen on components used in the pipeline system as well as leak testing
  - We are actively partnering with other industry groups and utilities to explore the possibilities of hydrogen
- We have also entered into an agreement with Mitsubishi Power to collaborate on green hydrogen production, storage and transportation facilities

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We’re committed to finding ways to decarbonize the piped energy system

These are some of the efforts underway right now:

- We’re conducting a **hybrid heating pilot** as part of our 2022-2023 Energy Efficiency biennial conservation plan
- We’re increasing the integration of **Renewable Natural Gas (RNG)**
- We’re exploring the potential of clean, alternative fuels like **hydrogen** on the pipeline system
- We’re **reducing methane** emissions on the pipeline system and in our operational practices

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Delivery System Planning process*

Planning Triggers
- Safety
- Customer requests
- Population and load growth
- Grid modernization
- Gas modernization
- Asset health management
- Asset reliability and integrity
- Compliance with regulation
- Resource integration

The delivery system planning process requires many robust capabilities across PSE from the beginning of the process such as gathering customer, load, and distributed energy resources information and forecasts to beyond the planning process ending with the testing of results and benefit delivery.

Local stakeholder engagement begins after project feasibility and planning

Assumptions, performance targets and modeling input → Establish Grid Needs → Alternative choices and assumptions → Screen and analyze alternatives → Analyze and optimize solution → Initiate project feasibility and planning

*https://pse-irp.participate.online/delivery-system-planning

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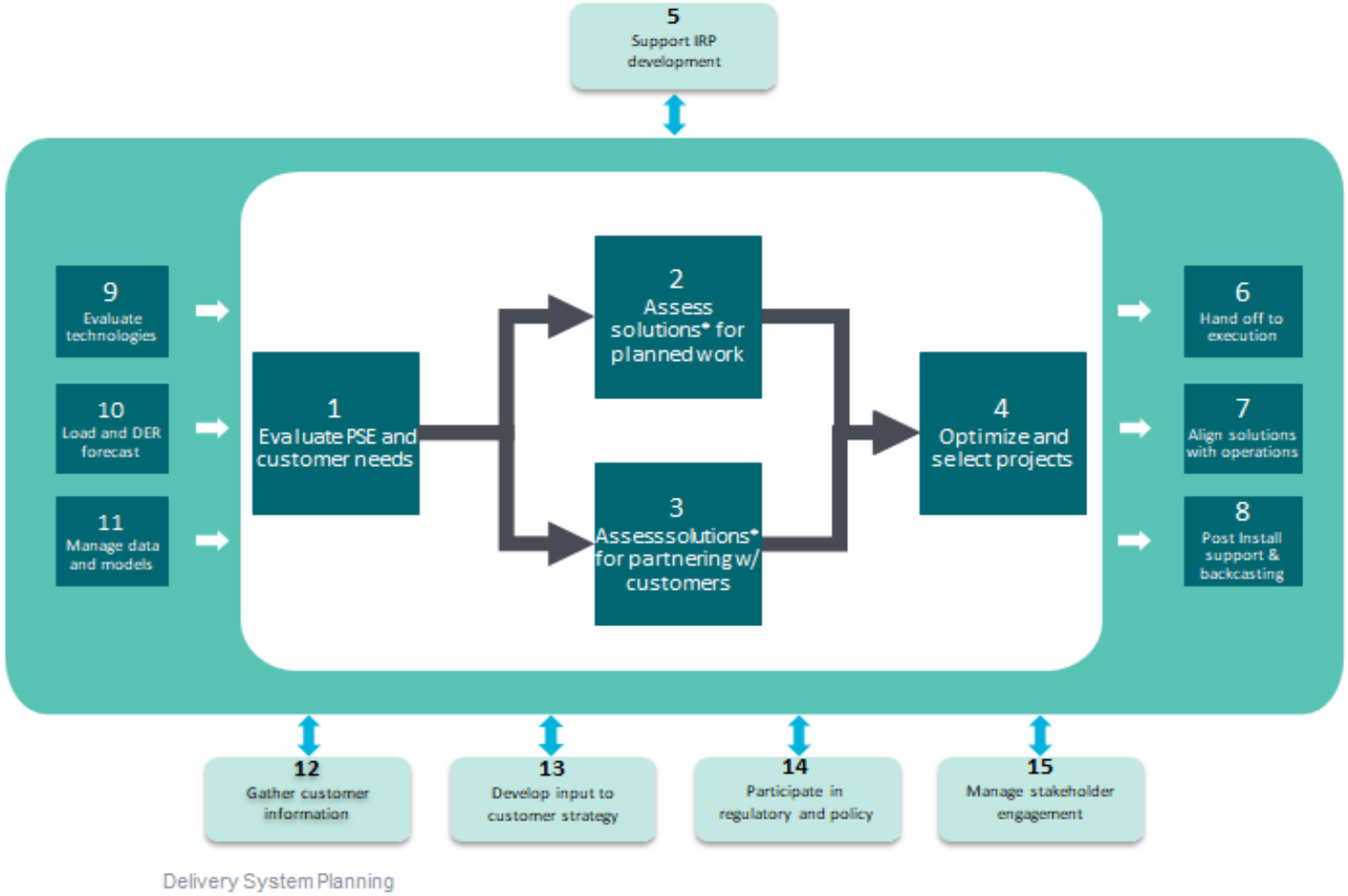
Energy Delivery System Planning (DSP) Operating Model



*Solutions are Wired & Pipes/ NWA and NPA/Hybrid alternatives.

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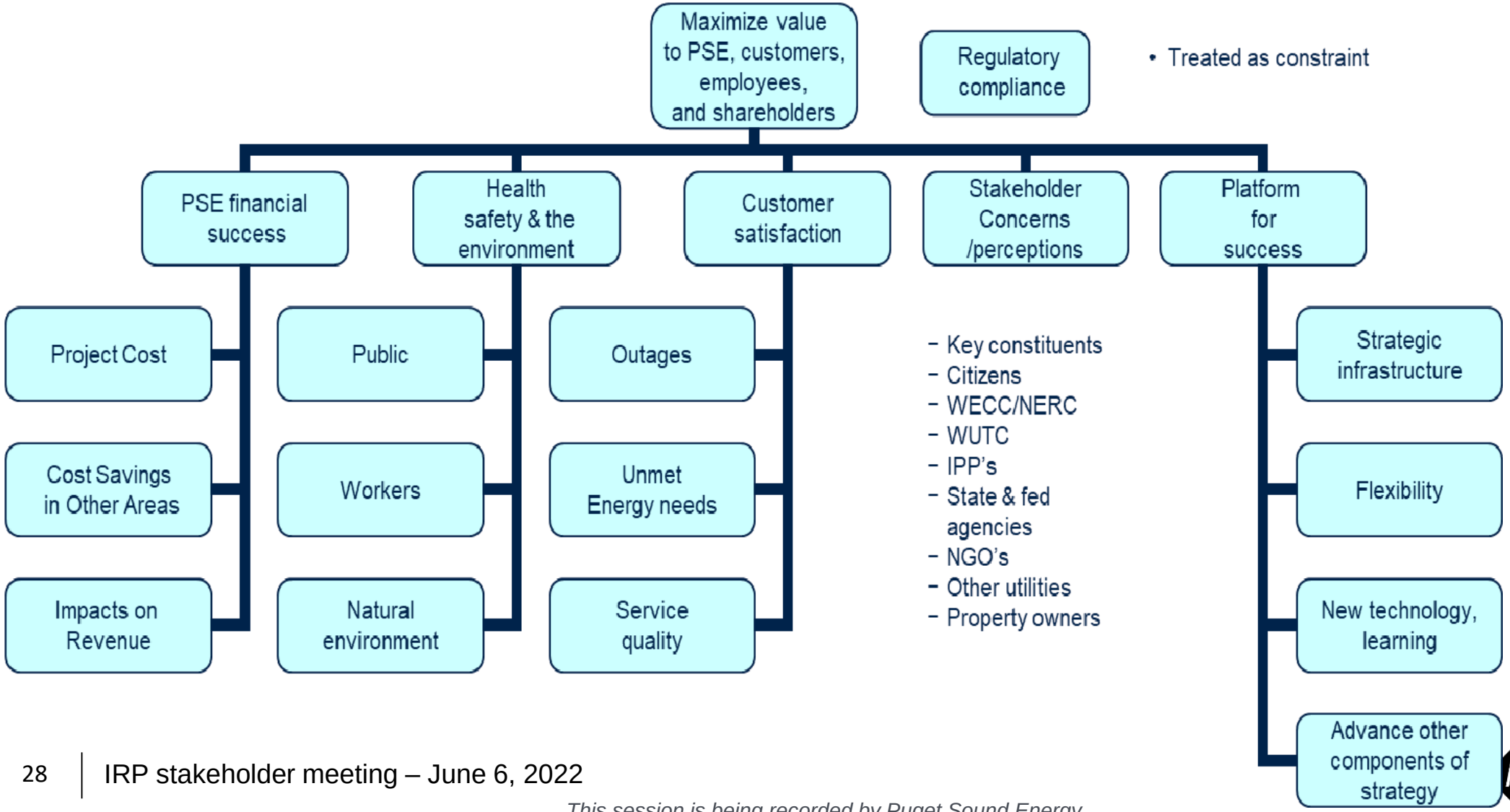
Investment decisions optimize qualitative and quantitative benefits which are weighted by importance



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Break

Please return in 10 minutes

*Monet Wind" by Eric Jensen of Roslyn, WA

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Delivery System Planning – Integrating different voices

Cathy Koch, Director, Planning, PSE
Jens Nedrud, Manager, Electric System Planning, PSE
Eleanor Ewry, Supervisor, Strategic System Planning, PSE

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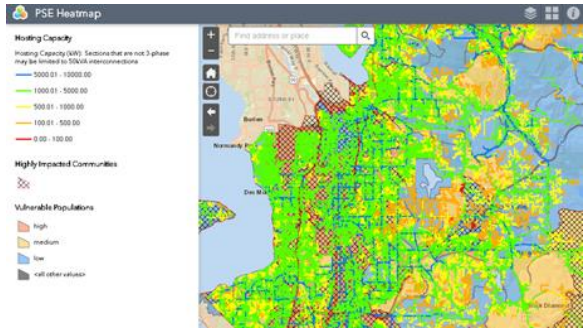
Delivery System Planning enhancements are underway

- Equity Inclusion
  - Broader stakeholder engagement
- Portfolio benefit weighting
- Hosting capacity map
  - Improved transparency and feedback



	PROJECT COST	RELIABILITY BENEFIT	CUSTOMER IMPACT	OPERATIONAL FLEXIBILITY
#1 UNDERGROUND CONVERSION	$ $			
#2 TREEWIRE / DA / NEW FEEDER TIE	$			
#3 LOCALIZED GENERATOR	$ $ $			
#4 LOCALIZED BATTERY	$ $ $			

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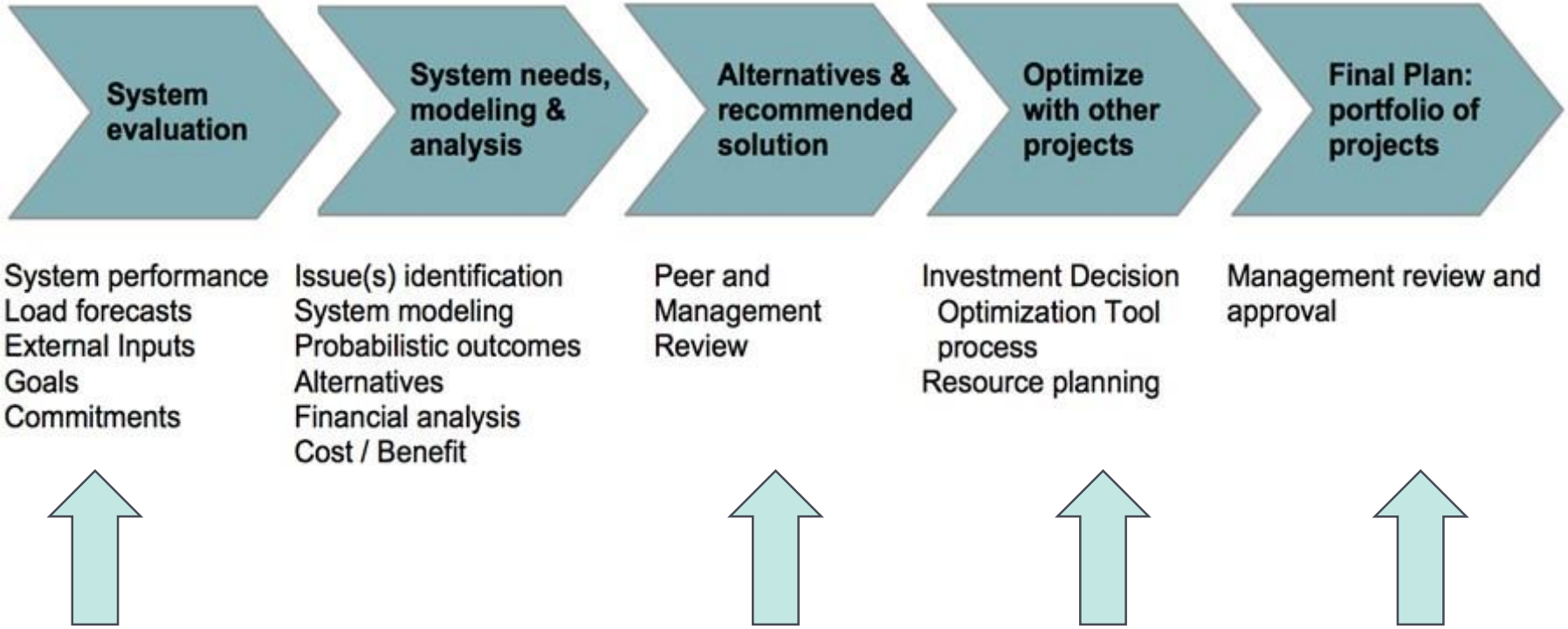
Four steps in the delivery system planning process where stakeholder input and “equity” considerations can be incorporated.



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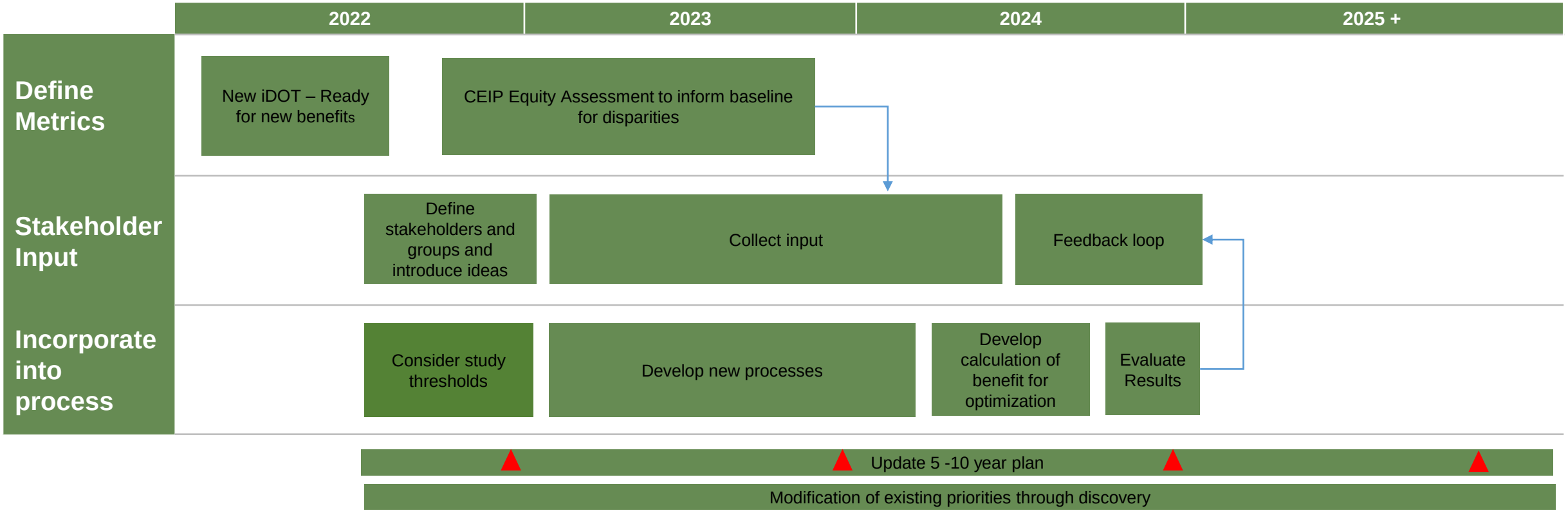
Enhancing Delivery System Planning Process with new benefits reflecting equity and closing the gap on disparities



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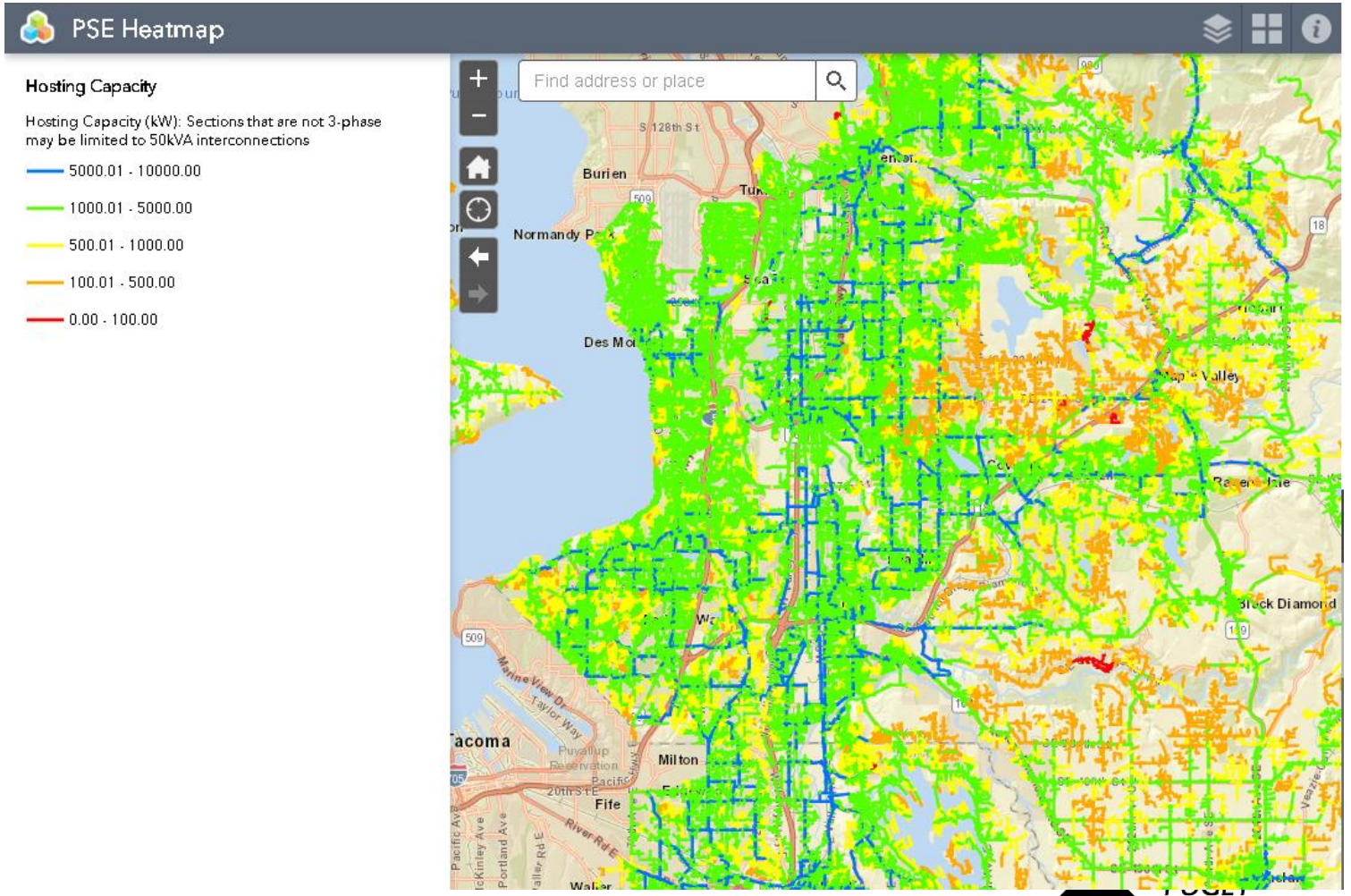
Hosting Capacity-Heat Map 1.0

Hosting Capacity Heat Map - provides insight into locations where Distributed Energy Recourses (DER) on PSE's distribution system could be more cost-effective

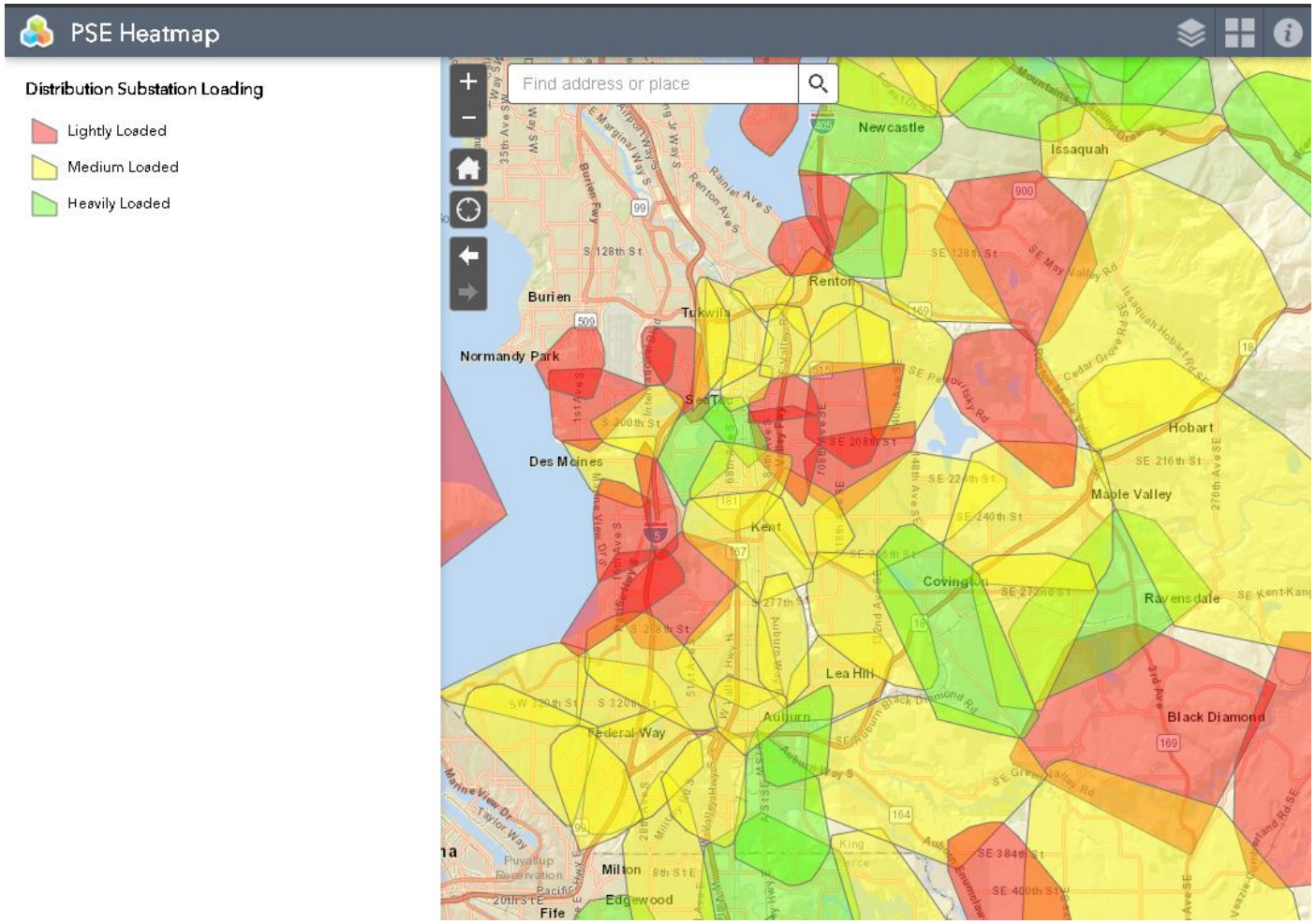
- Circuits are color coded to represent the amount of DER that can be accommodated on each circuit



Hosting Capacity-Distribution Substation Load Map (DSLM)

Distribution Substation Load Map (DSLM) – locations where DER could relieve existing distribution capacity constraints

- Intended to direct DERs to areas that would provide load relief for heavily loaded substations



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Hosting Capacity-Heat Map 2.0

- Mural Activity
- Seeking feedback on future heat map functionality in the following three areas:

What information should be included in the map?	How should the current information be categorized and represented?	How should the map incorporate forward-looking vs. current day information?
• Include both 1-phase and 3-phase hosting capacity? • Add the location of existing DER on the distribution system? • Link to an automated portal for DER interconnection applications (Schedule 152)?	• Display winter vs. summer capacity loading? • Display areas benefiting from known voltage concerns elimination? • Does the color coding display hosting capacity in a meaningful way?	• Implement time-series analysis vs. existing single-hour “snapshot.” • Implement forward looking map with future system improvements and their impact on hosting capacity?

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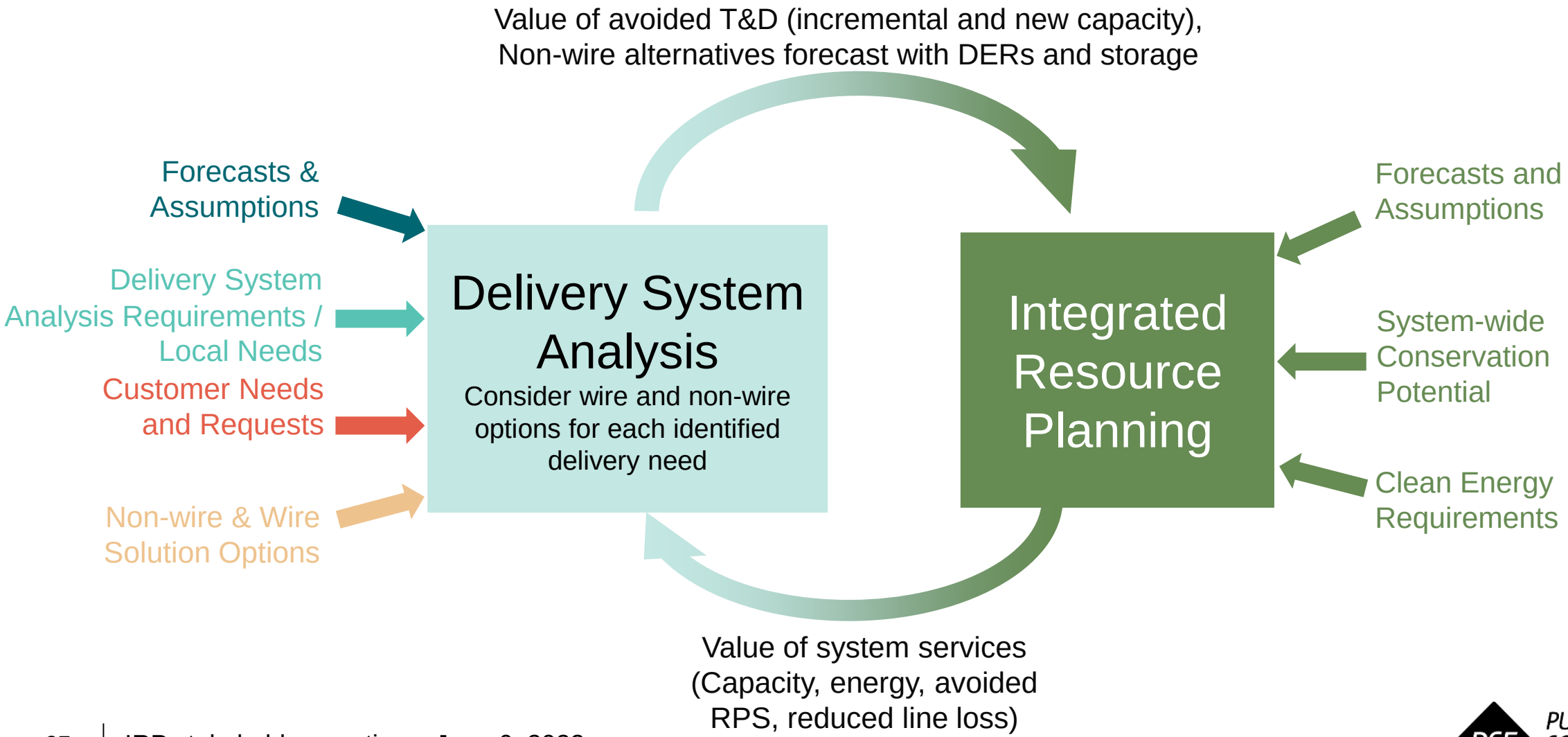
Delivery System Planning Inputs into the IRP Process



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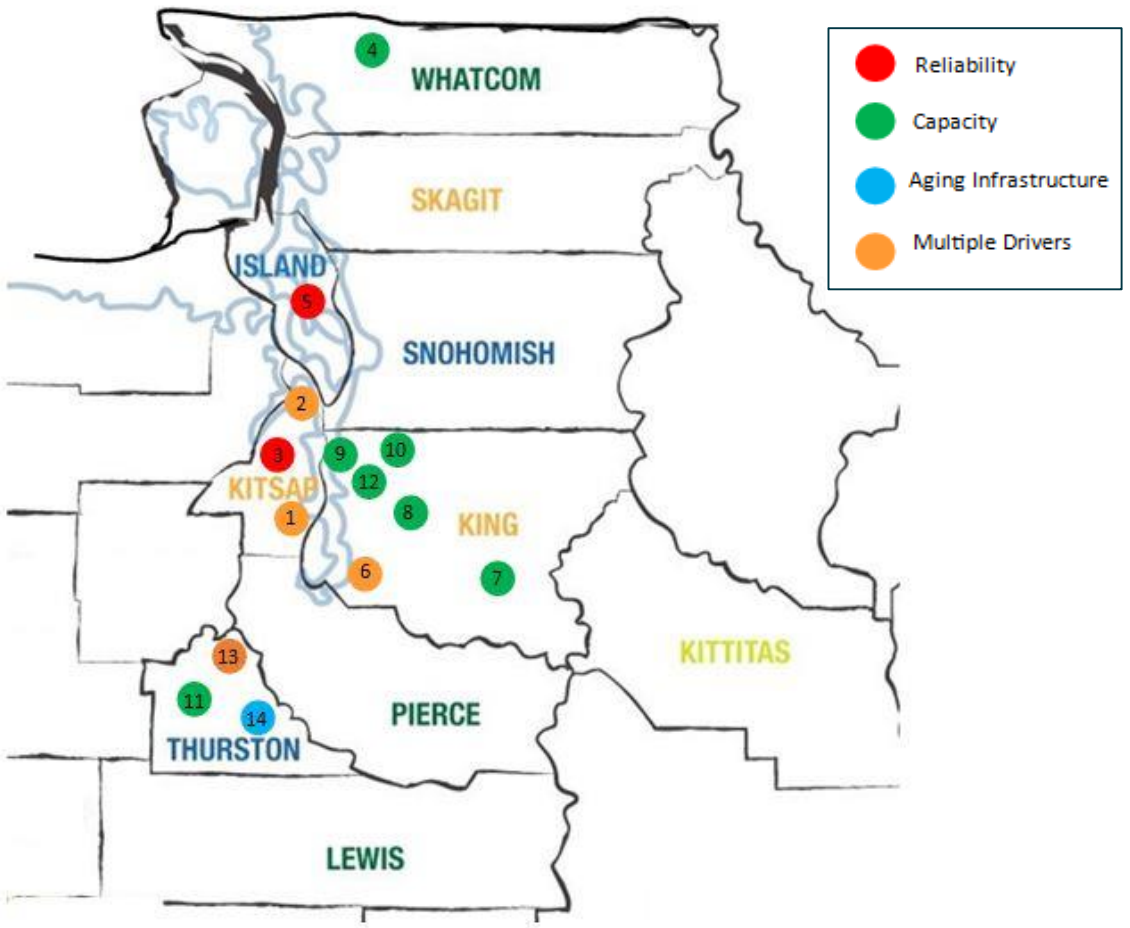
Areas of electric need

Reliability and Resiliency | Integrating DERs | Flexible Backbone

SUMMARY OF ELECTRIC PLANNED PROJECTS	NEED DRIVER
1. Bainbridge Island	Reliability & Capacity
2. West Kitsap Transmission Project (NWA Pilot)	Stability, Transmission Capacity & Aging Infrastructure
3. Seabeck	Reliability
4. Lynden	Capacity
5. Whidbey Island Transmission Improvements	Reliability
6. Kent / Tukwila New Substation	Capacity & Aging Infrastructure
7. Black Diamond Area New Substation	Capacity
8. Issaquah Area New Substation	Capacity
9. Bellevue Area New Substation	Capacity
10. Redmond Area New Substation	Capacity
11. Lacey Hawks Prairie	Capacity
12. Inglewood – Juanita Capacity Project	Capacity
13. Spurgeon Creek Transmission Substation Development (Phase 2)	Stability & Capacity
14. Electron Heights - Yelm Transmission Project	Aging Infrastructure



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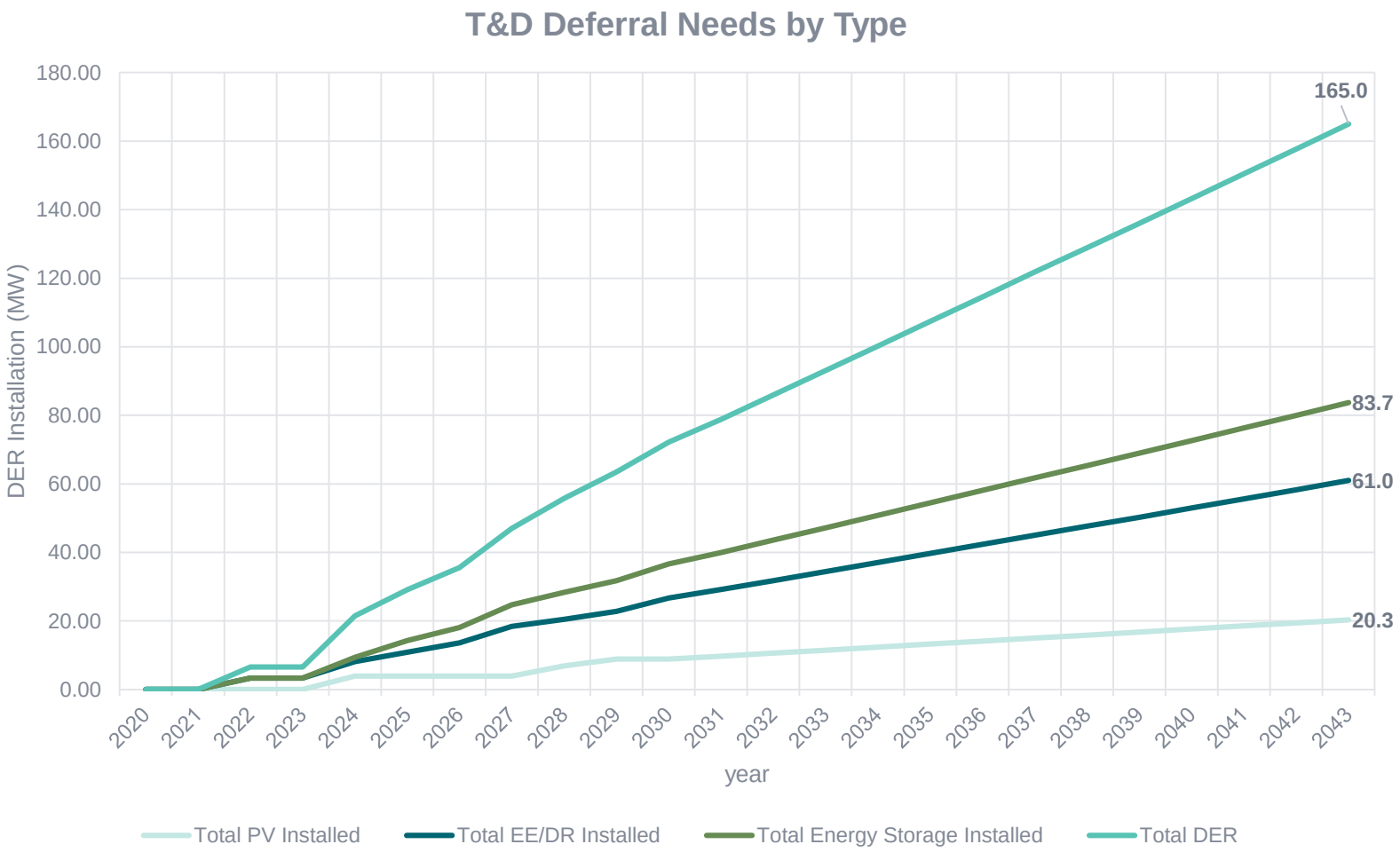
Delivery System Planning projected T&D DER Deferral by Project Type



20-Year Projected T&D Deferral by Project Type

	Energy Storage	Targeted EE/DR	PV Installation	Total DER
Planned Transmission System Projects*	7.1	6.0	0.0	13.1
Planned Substation Capacity Projects	17.6	12.4	3.9	33.9
Future Potential System Needs	59.0	42.6	16.4	118.0
Total	**83.7**	**61.0**	**20.3**	**165.0**

* As identified in the PSE Plan for Attachment K

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T&D Deferral Value: Electrification

- 2021 IRP demand forecast: Winter peak load forecast (with 2021 IRP conservation) including the effects of varying electrification scenarios
- The 2023 IRP demand forecast (with 2021 IRP conservation) could accelerate electrification growth by 3 years in the winter and 5 years in the summer compared to the 2021 IRP demand forecast

Year	F21 IRP Winter Peak Load Forecast (MW)*	Scenario: F21 IRP Winter Peak Load + Low Electrification (MW)	Scenario: F21 IRP Winter Peak Load + High Electrification (MW)
2020	4646	4648	4665
2025 (5-year)	4561	4598	4927
2040 (20-year)	4826	5137	7879

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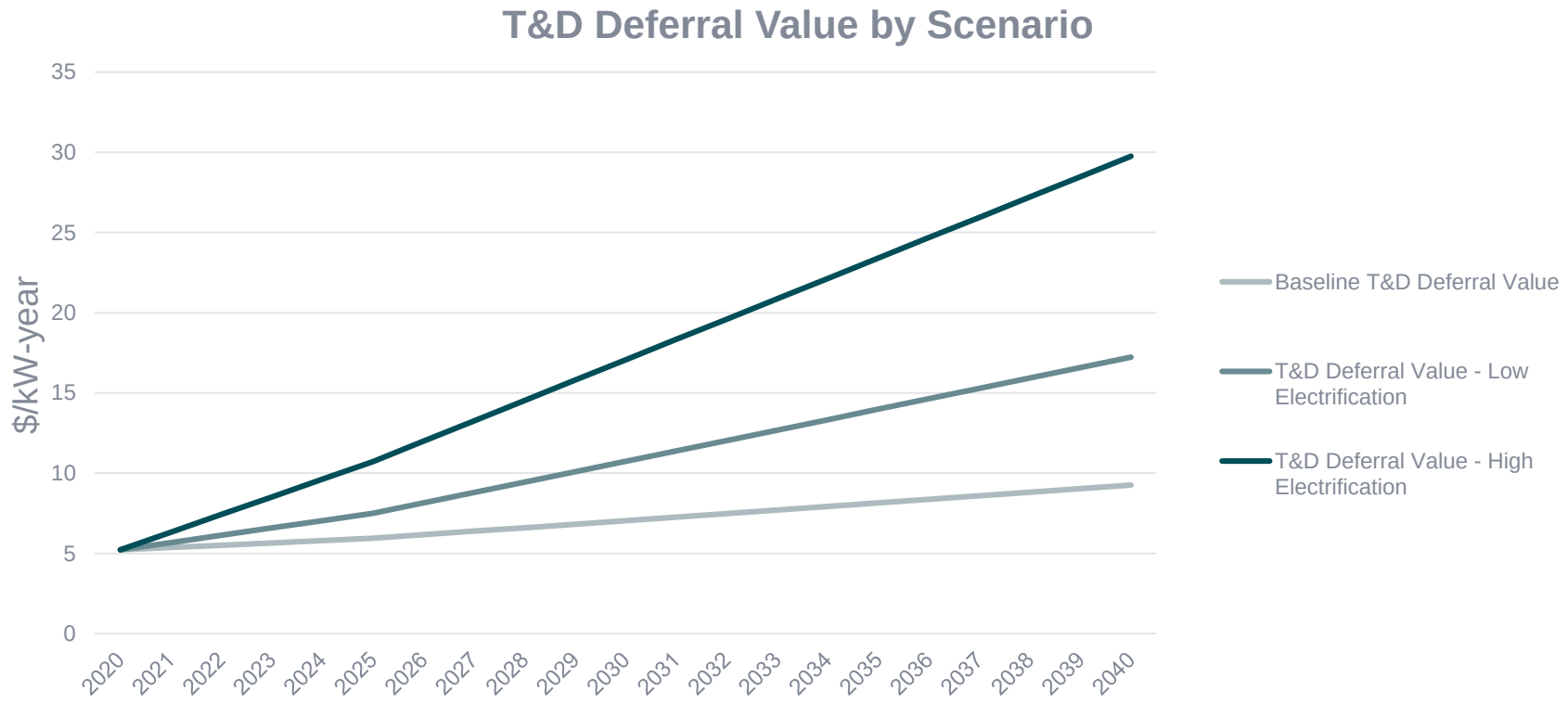
T&D Capacity Cost to Accommodate Electrification

- Cost to increase capacity of the T&D system goes up over time
  - Varying amounts of electrification can significantly increase the cost for T&D capacity
  - Cost is driven more by distribution substation capacity than transmission lines
    - Relatively small capacity addition at higher cost



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Resource Interconnection Costs

Eleanor Ewry, Supervisor, Strategic System Planning, PSE
Elizabeth Hossner, Manager, Resource Planning and Analysis, PSE

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Resource interconnection costs and assumptions

- Distribution interconnection costs - $0
  - DER circuit enablement and Substation SCADA investments being made as part of CEIP to support
- Transmission interconnection costs:
  - $2.8M/mile – 115 kV <300 MW nameplate
  - $4.5M/mile – 230 kV > 300 MW nameplate
  - Substation interconnection costs: $3M*
  - Reviewed location of new resources in development and used GIS to map out average location of resources and tie line length

Location	Resource	Tie Line Length (miles)
WA/OR	Wind, Solar	4.5
MT	Wind, PHS	55
WY/ID	Wind, Solar	25
PSE	Battery, Thermal	1

Tie line length is for utility scale resources. Distributed resources such as battery or solar are assumed to be zero miles.

*Includes cost for all equipment needed to interconnect the resource to PSE's system.

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Next Steps

Sophie Glass, Co-facilitator, Triangle Associates

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IRP stakeholder feedback process

Feedback form: PSE IRP - Feedback Form

June 8	A recording of the webinar and the transcript of the chat will be posted to the IRP website so those who were unable to attend can review
June 13	Feedback forms are due. Feedback should focus on topics related to Delivery System Planning. In particular, PSE is seeking input regarding its Hosting Capacity heat map.
July 1	A feedback report of comments collected from the feedback form, along with PSE's responses, and a meeting summary will be shared with stakeholders and posted to pse.com/irp

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Next steps and stay in touch

Next meetings with IRP stakeholders

- July 12, 2022 - Electric and gas demand forecast
- July 20, 2022 – Resource adequacy information session

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Appendix

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Common Acronyms

Acronym	Meaning
ADMS	Advance Distribution Management System
ATB	Annual Technology Baseline costs
CCA	Climate Commitment Act
CEAP	Clean Energy Action Plan
CEC	California Energy Commission
CEIP	Clean Energy Implementation Plan
CPA	Conservation Potential Assessment
DER	Distributed Energy Resources
DERMS	Distributed Energy Resources Management System
DR	Demand Response
DSLM	Distribution Substation Load Map
DSP	Delivery System Planning
IAP2	International association of public participation
IERP	Integrated Energy Policy Report
IRP	Integrated Resource Plan
NREL	National Renewable Energy Lab
NWA	Non-Wire Alternative
O&M	Operations and Maintenance
REV	Reform the Energy Vision
RNG	Renewable Natural Gas
SCGHG	Social Cost of Green House Gases
T&D	Transmission and Distribution

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