Prineville

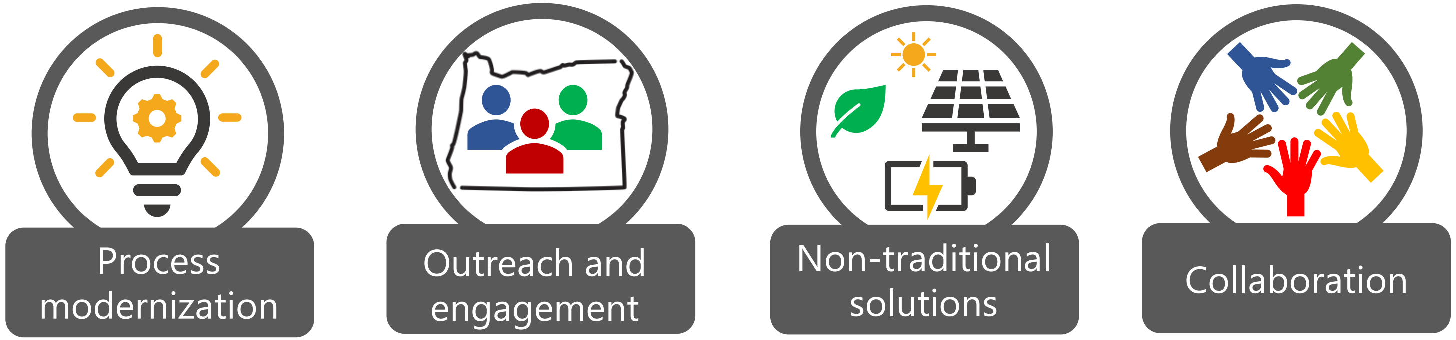
Distribution System Planning

Community Workshop #1

April 17th, 2023

Presenters:

Ian Hoogendam – DSP Manager, Shauna Thomas – T&D Program Specialist, Daniel Talbot – Sr. Engineer



Workshop #1 Information

Microsoft Teams meeting info:

Join on your computer, mobile app or room device

Click here to join the meeting

Meeting ID: 244 500 768 379

Passcode: gzLViu

Or call in (audio only)

+1 563-275-5003,,35993095#   United States, Davenport

Phone Conference ID: 359 930 95#

- Please **place your phone on "Mute"** when not speaking
- If you call in using your phone in addition to joining via the online link, please make sure to **mute your computer audio**
- Please **do not use the "Hold"** function on your phone

Participation:

This workshop is available to the public, and there is a Questions/Comment section at the end of the workshop for online participants.

Please input your name and organization into the chat when you enter, and please "raise your hand" during the Open Discussion section to ask questions or provide input.

This workshop will be recorded and published to the PacifiCorp DSP website.

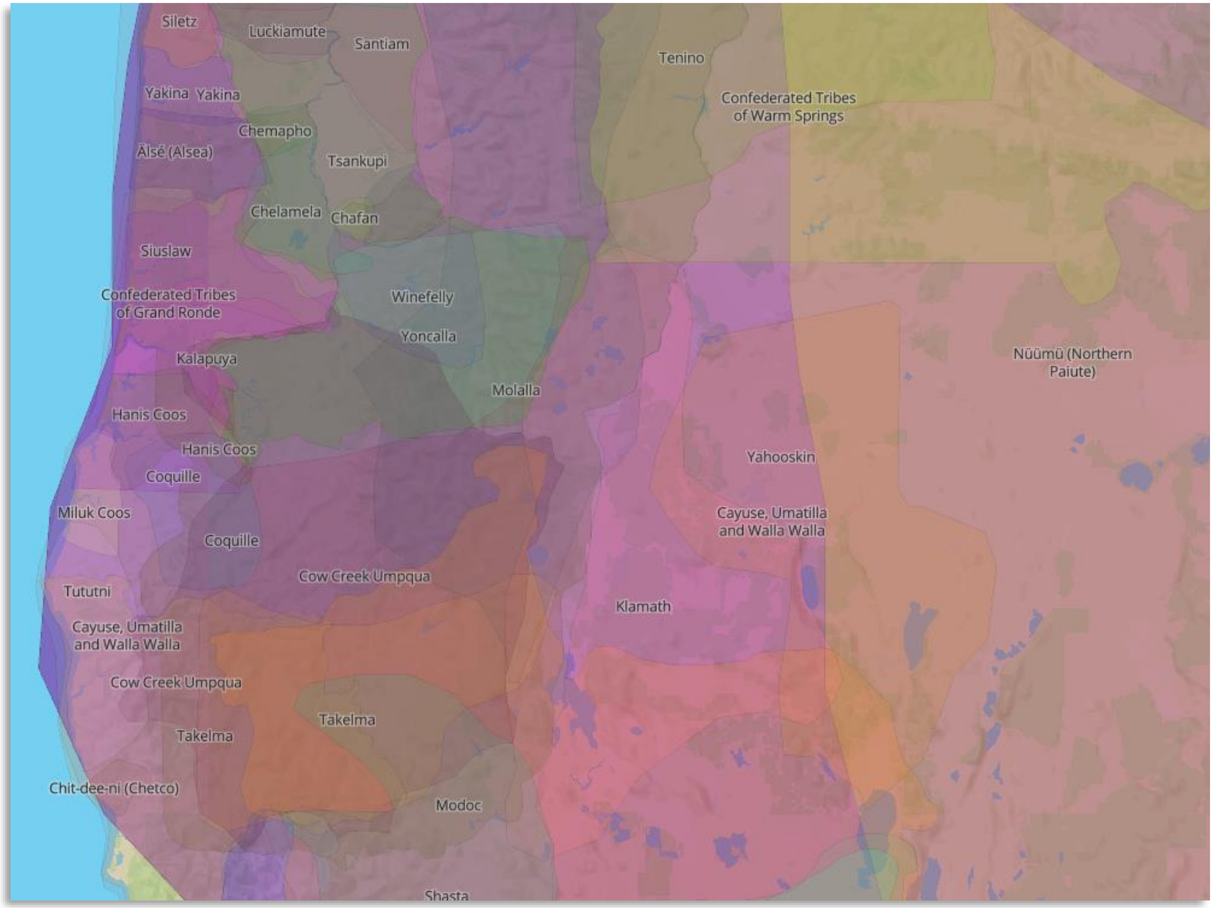
Land Acknowledgement

We are meeting online from various locations within the United States.

To learn about the original stewards of the land where you are now, this is a wonderful resource:

Native Land Digital

https://native-land.ca



By acknowledging Indigenous peoples and tribes, their traditional homeland ties are renewed and reaffirmed.

SOURCE: [Native-Land.ca | Our home on native land]

Today's Agenda

- **10 Mins** Introductions
- **10 Mins** Power Utility Overview
- **15 Mins** Distribution System Planning Overview
- **15 Mins** Study Area Overview
- **BREAK(15 mins)**
- **30 Mins** Load Forecasting and Next Steps
- **10 Mins** Community Engagement
- **15 Mins** Conclusions and Open Discussion

Introductions – Pacific Power Team Members

Distribution System Planning

- Jon Connelly* – Director T&D Asset Management
- Ian Hoogendam* – Manager
- Shauna Thomas* – Program Specialist
- Daniel Talbot* – Engineer
- Daniel Morgan – Engineer
- John Rush* – Project Manager

Local Bend/Prineville

- Steve Cook – Field Engineer
- Matthew Chancellor* – Regional Business Manager
- Ian Treadway – Area Operations Manager

*Planned to attend

Introductions – Prineville Participants

Please share with us:

- Name
- Organization and role
- What you hope to get out of today's discussion

- ➢ Steve Forrester, Prineville City Manager
- ➢ Caroline Ervin, Capital Project Manager - City of Prineville
- ➢ Matt Smith, Fire Chief - City of Prineville
- ➢ Russ Deboodt, Fire Marshall - City of Prineville
- ➢ Steve Uffelman, Prineville City Councilor
- ➢ Josh Smith, City Engineer - City of Prineville
- ➢ Kelsey Lucas, Prineville/Crook County Director Economic Development for Central Oregon
- ➢ Kim Daniels, Executive Director Prineville/ Crook County Chamber of Commerce
- ➢ Will Van Vactor, Community Development Director -Crook County
- ➢ Kira Buresh, Manager of Support Services – St. Charles Health
- ➢ NewSun Energy

Introduction Survey

Interactive Live Poll:

What do you love about the Prineville community?

Workshop Objectives

Success is a transparent, robust, and holistic distribution system planning framework.

Education	Engagement	Transparency

• Explaining distribution planning, and how it is changing
• Forecasting:
  • Process evolution
  • Drivers of load growth
  • Preliminary forecast results
	• Gathering input from participants
	• Understanding the demographics, needs, values, and awareness of the community
		• Involving the community throughout the process
		• Sharing of processes, analysis results, decisions, and learnings

Power Utility Overview

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Electric Grid Overview

Generation

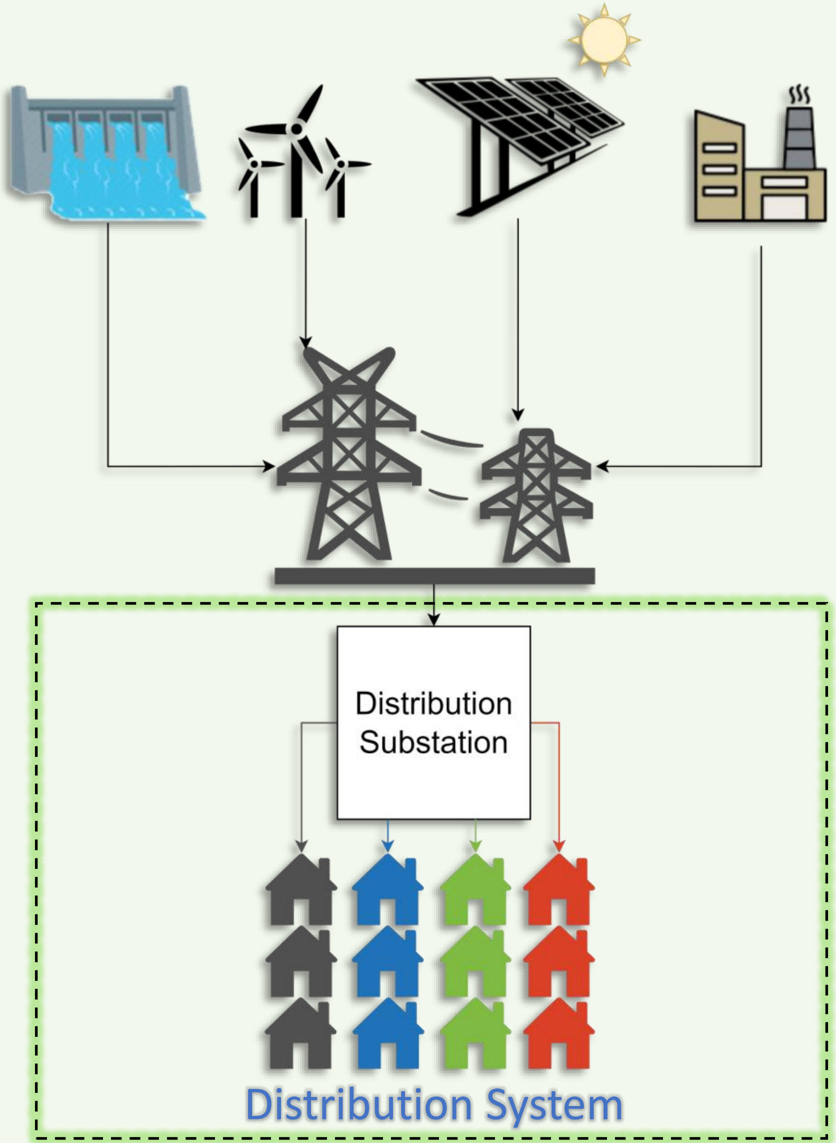
- Produces power

Transmission System

- Transmits power from generation plants to distribution substations
- Interstate highway of the electric grid
- High voltage
- High redundancy

Distribution System

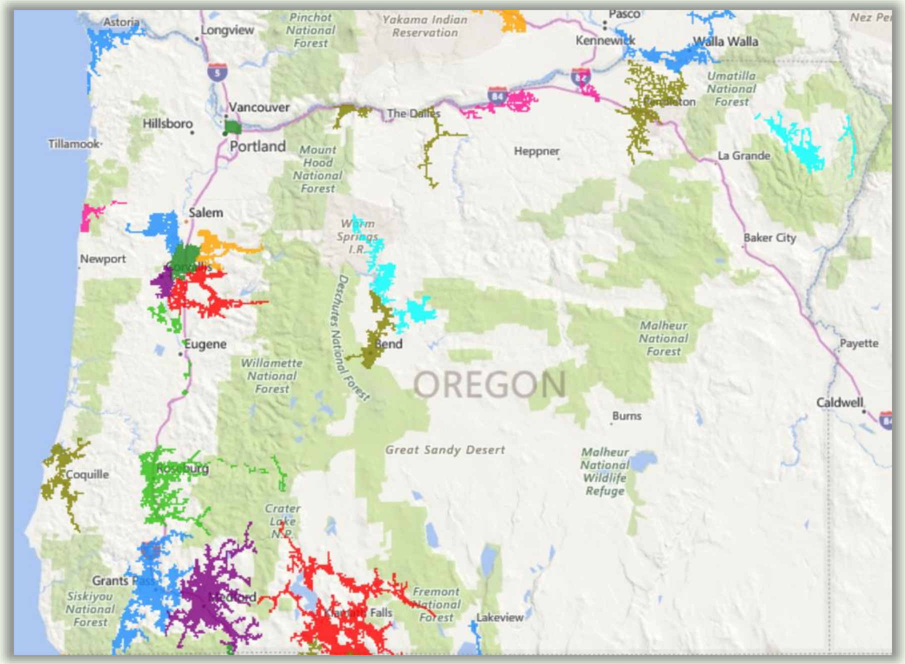
- Starts at distribution substation and ends at customer meter
- Distribution **substations:** interstate highway exits
- Distribution **circuits:** roads that connect the exit to the homes and businesses of the community
- Delivers power to consumers via poles and wires (overhead and underground)
- Medium voltage



Overview of Pacific Power - Oregon

Oregon Service Area

Distribution Substations: 197
Distribution Circuits: 535
Distribution Line Miles: 19,000
Customers: 629,000



North Region		Central Region			South Region	
Portland	Walla Walla	Bend	Albany	Roseburg	Klamath Falls	Medford
Operating Areas / Districts						
Astoria Portland	Hermiston Pendleton Enterprise	Prineville Madras Hood River Bend Redmond	Albany Corvallis Dallas Independence Cottage Grove Stayton Lebanon Lincoln City	Coos Bay Roseburg	Lakeview Klamath Falls	Grants Pass Medford
Distribution System Stats						
Circuits: 102 Line Miles: 1,200 Customers: 112,000	Circuits: 40 Line Miles: 1,700 Customers: 26,000	Circuits: 67 Line Miles: 2,800 Customers: 99,000	Circuits: 89 Line Miles: 3,700 Customers: 139,000	Circuits: 69 Line Miles: 2,300 Customers: 69,000	Circuits: 47 Line Miles: 2,300 Customers: 40,000	Circuits: 122 Line Miles: 5,200 Customers: 144,000
Unique Attributes						
*Distribution Automation Pilot *Portland Underground Mesh Network	*Fire High Consequence Area	*High Growth Rate	*Distribution Automation Pilot	*Fire High Consequence Area	*Fire High Consequence Area *Energy Storage Pilot	*Distribution Automation Pilot *Fire High Consequence Area

Distribution System Planning Overview

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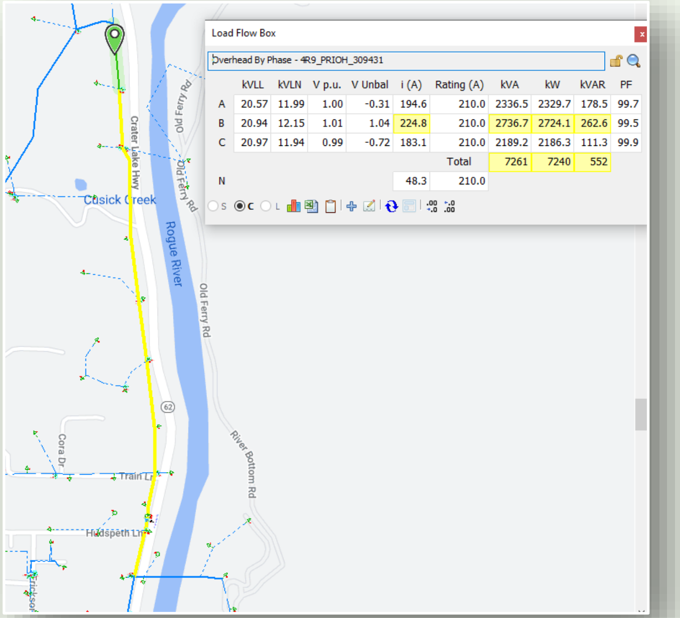
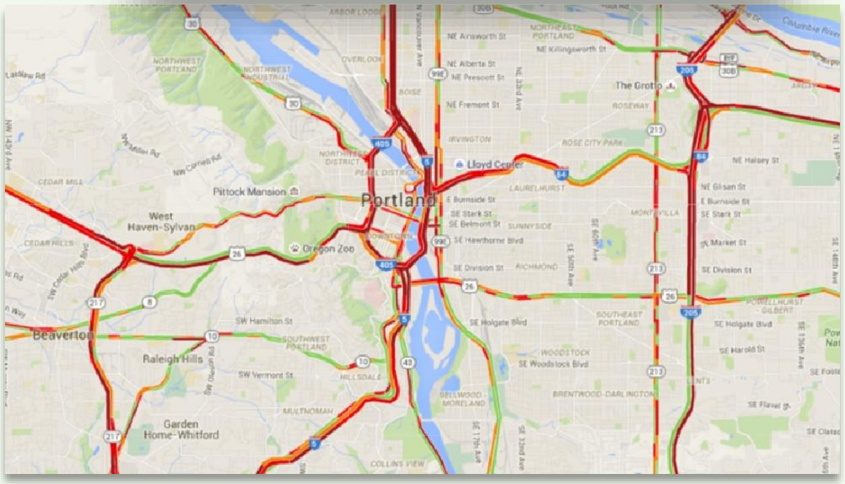
Distribution Planning Overview

What is Distribution System Planning?

- Like roads, wires have limited capacity and can become congested.
- The distribution system is designed to accommodate the power demand (load) of a community for the foreseeable future.
- If equipment loading guidelines are exceeded solutions are required to accommodate the anticipated load.
- Distribution system planning assesses future needs by forecasting load on distribution circuits and running simulations on models.
- Traditionally, distribution system planning studies have been conducted by a local field engineer on a 5-year cycle.





5-Year Cycle vs. Ad-Hoc Studies

5-Year Cycle Distribution Planning Studies

- Scheduled to be completed on a 5-year cycle
- 5-year planning horizon
- Schedule may shift depending on several factors (high load growth activity, large load additions, etc.)
- 99 planning studies are on 5-year cycle in Pacific Power service area
- Study process takes 2-3 months

Ad-hoc Studies (Generation Interconnect or System Impact Study)

- Initiated by load, generation interconnection, or transmission service requests
- Focused on a limited area, and the immediate effects of the request on reliability and load service
- Shorter timeframes to meet customer needs (~ 3-4 weeks for initial study)
- Customer shares in solution costs and influences what solutions are implemented

Traditional Distribution System Planning Study Process (5-Year Cycle)

Load Forecasting

Tasks Required:

- ✓ Review historical summer/winter peak load SCADA data at circuit breaker level
- ✓ Adjust for large load additions and planned system changes
- ✓ Adjust for large Distributed Generation additions

Load Flow Model Verification/Updates

Tasks Required:

- ✓ Review equipment and line data in load flow model
- ✓ Field verification and updating of load flow model

Identify Grid Needs

Tasks Required:

- ✓ Load flow analysis based on load forecast
- ✓ Identify and analyze grid need
- ✓ Identify timing requirements

Example Grid Needs:

- Voltage above/below acceptable limits
- Loading exceeds equipment rating

Identify Potential Solutions

Tasks Required:

- ✓ Identify primary solutions and alternatives to resolve grid needs

Solution Examples:

- Load transfer
- Phase balancing
- Capacitor bank
- Upgrade equipment

Develop Project Proposals

Tasks Required:

- ✓ Develop proposal for each project that includes:
  - Description of work to be performed
  - Purpose and Necessity
  - Risk Assessment
  - Alternatives Considered
  - Preliminary Cost Estimate

- ✓ **Apply each solution to model and re-analyze**
- ✓ **Iterate until solutions have addressed issues**

Advancements in Distribution System Planning (DSP)

What is Oregon DSP?

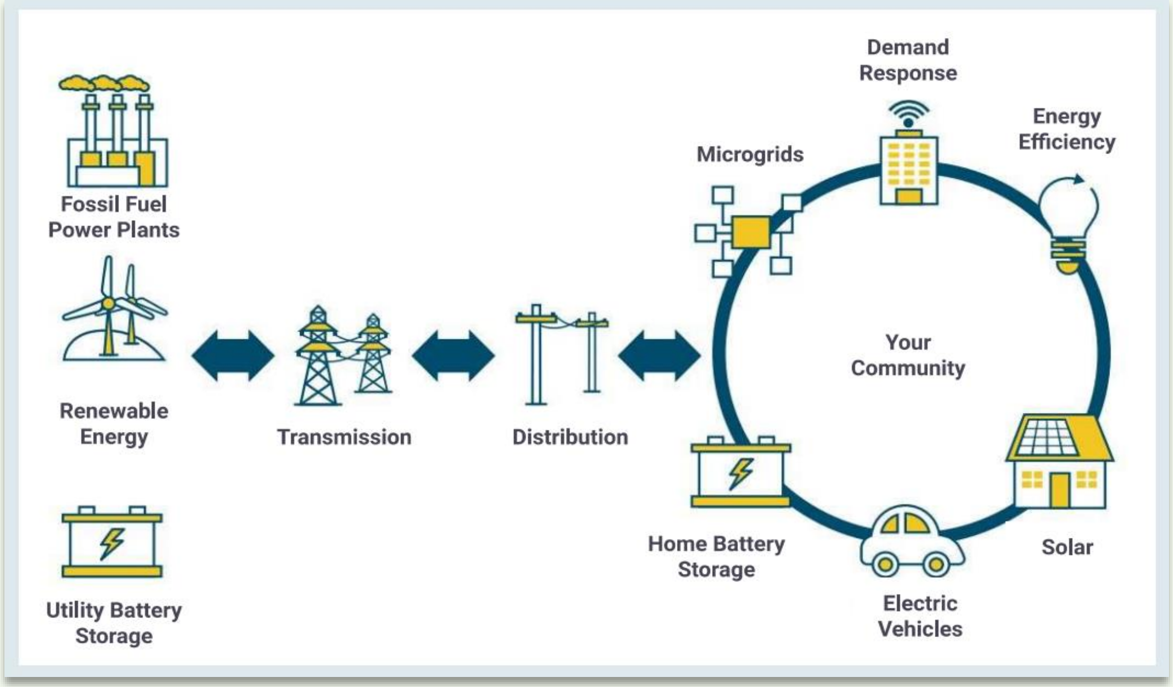
- Based on guidelines proposed by Oregon PUC staff
- Increased transparency and modernization of traditional DSP to meet the needs and leverage the capabilities of the modern grid

Key changes to traditional DSP:

- Consideration of non-traditional solutions to meet grid needs
- Increased community engagement
- Enhanced forecasting
  - 24-hour load profiles
  - Inclusion of incremental electric vehicle (EV) and solar adoption rates

Past Grid

Modern Grid



2023 DSP Study Process and Local Engagement Plan

Study Area Selection

- Establish criteria for selecting study areas
- Collaborate and align with field engineering
- Stakeholder feedback
- Final selection

Load Forecasting

- Review historical circuit configuration
- Load forecasting with weather normalization
- Layer incremental EV and DER adoption forecast

Q2

Local Stakeholder Workshop

- Introductions to DSP and team
- Utility overview
- Preliminary forecast results
- Feedback on process and forecasts
- Customer survey
- Engagement series overview

Load Flow Model Updates and Verification

- Verify and update load flow model
- Customer to transformer review and correction
- Develop seasonal peak and minimum load scenarios based on AMI

Identify and Determine Potential Solutions

- Run load flow for seasonal peak and minimum load scenarios
- Identify grid needs (loading and voltage constraints)
- Identify potential traditional and non-traditional solutions

Q3

Second Stakeholder Workshop

- Review potential solutions with stakeholders
- Discuss benefits, complexity, risks, and feasibility
- Listen to feedback

Develop Proposal for Investment Delivery

- Project proposals:
- Description of work to be performed /alternatives considered
- Purpose and necessity
- Risk assessment
- Preliminary cost estimate

Q4

Final Stakeholder Workshop (TBD)

- Conclusions and next steps

Study Area Overview

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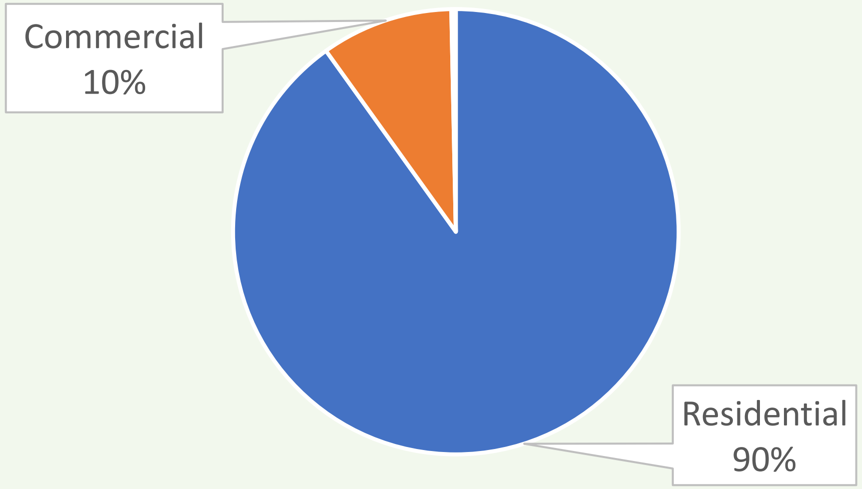
5D167(Northville) Summary

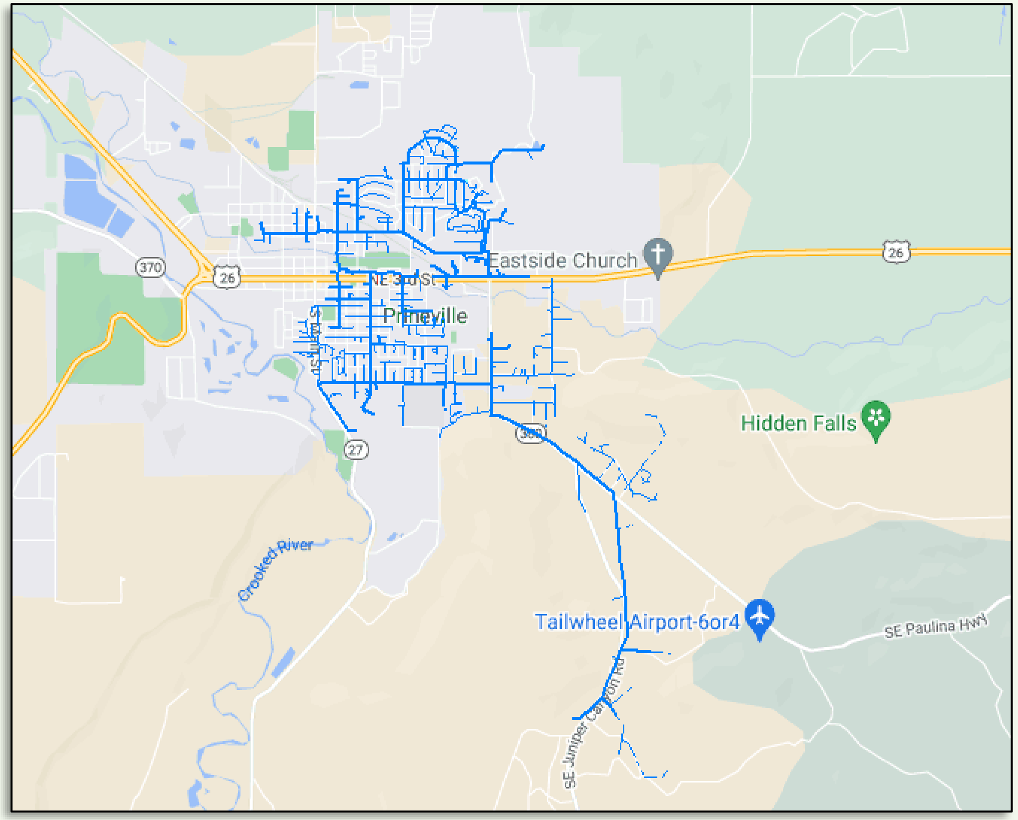
Selection Criteria

- High distributed generation growth predicted
- 35.6% of household incomes on this circuit have median incomes below 200% of Federal Poverty Limit

Other Considerations

- Approximately half of customers on this circuit have electric-source heating





Prineville Area Overview

Circuits

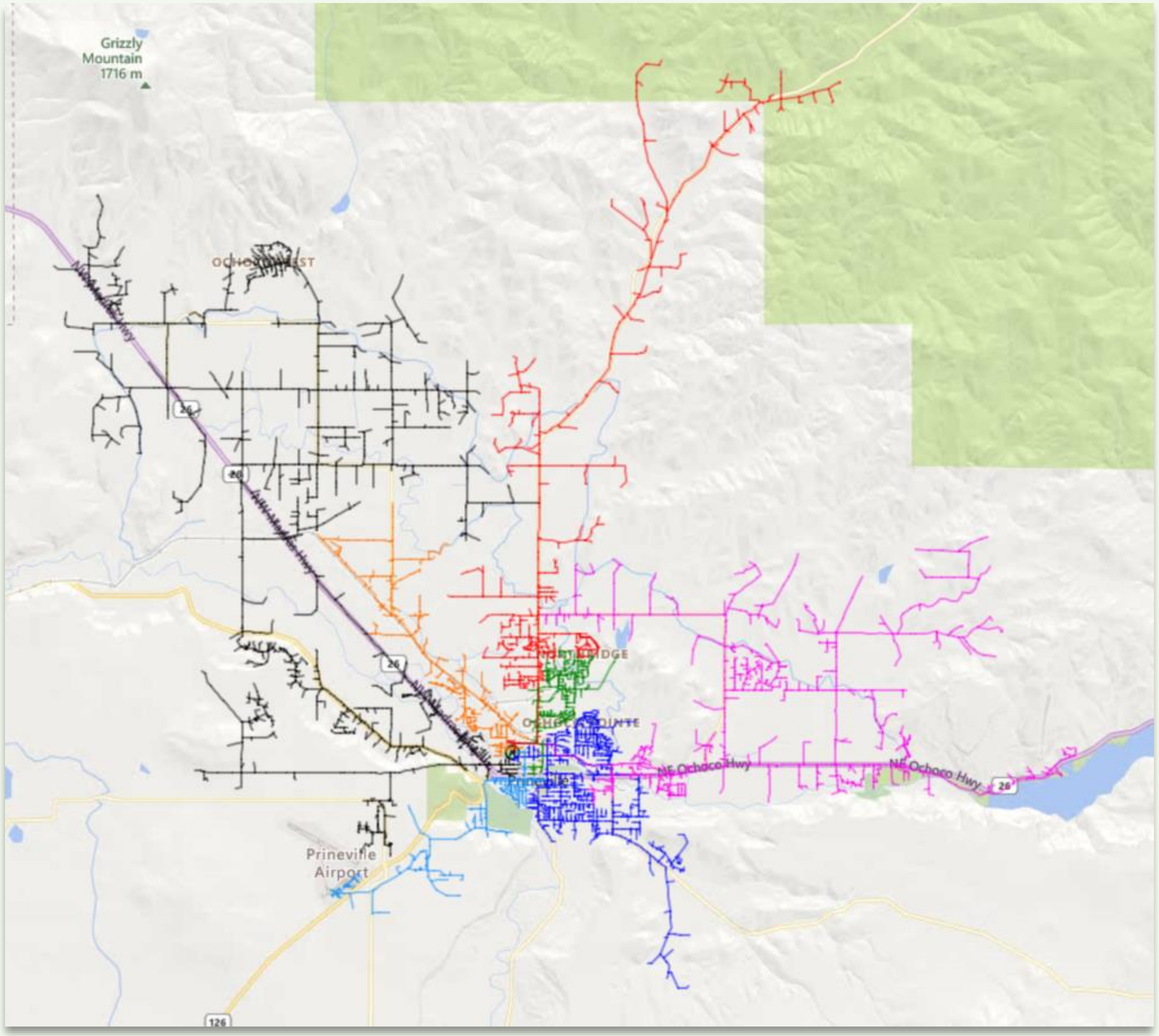
- Count: 7
- Line miles: 347 (sum of pole-to-pole distance)

Customers

- Residential: 7,490
- Commercial: 1,199
- Irrigation: 387
- Industrial: 37

Other Characteristics

- Limited SCADA history
- New substation transformer planned to be in-service by Fall 2023
- All large datacenters served from transmission substations
- Higher loads in winter, but equipment closer to capacity in summer



Prineville Area – Tell Us More

What else should we understand/consider about the Prineville community?

What are your concerns about energy?

Break (10ish Mins)

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TIME TO RESUME

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Load Forecasting and Next Steps

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New Forecasting Methods

Traditional

Inputs

- Manual Reads
- SCADA where available
- Load Loggers
- Planned Spot Loads

Analysis

- Linear Regression of Seasonal Peaks

Outputs

- 5-year Planning Horizon
- Seasonal Scenarios

Enhanced

Inputs

- Automatic SCADA
- Advanced Metering Infrastructure
- Planned Spot Loads
- Daily Weather Logs
- Local Stakeholder Engagement
- EV and Distributed Generation Forecasts

Analysis

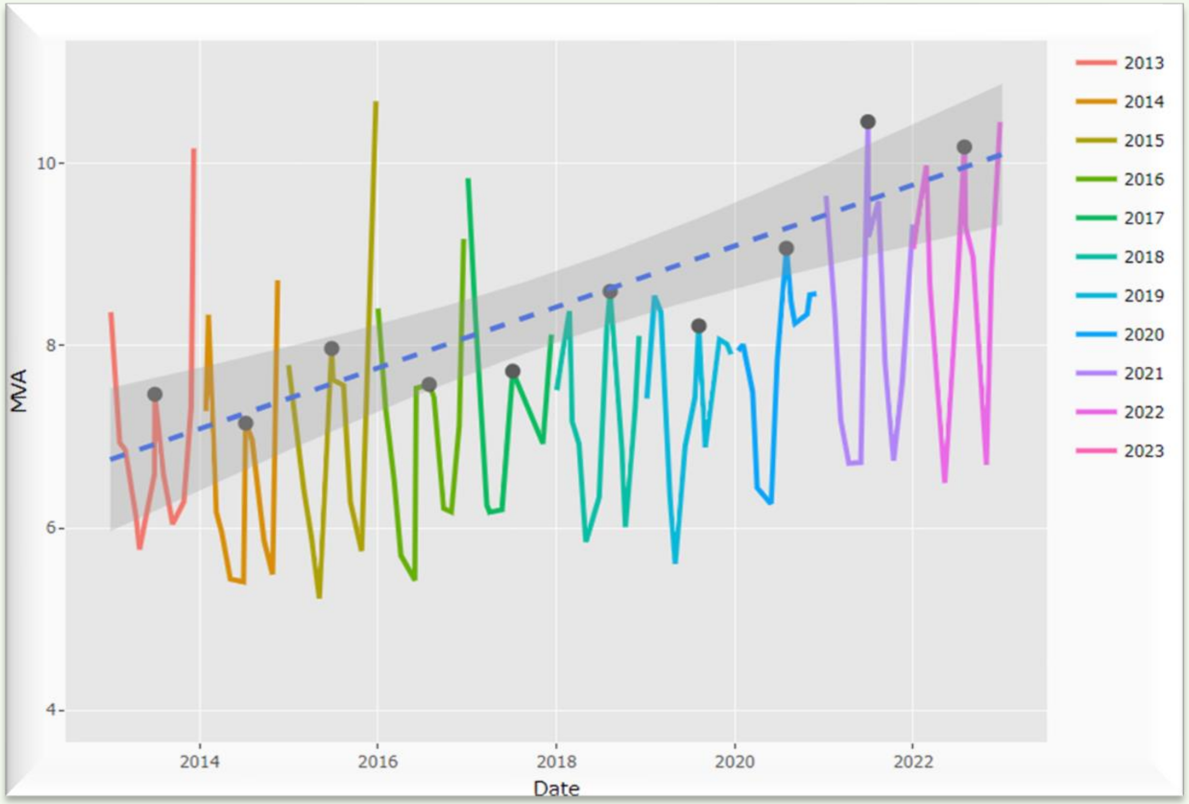
- Weather-Normalized Datasets
- Exponential Regression of Seasonal Peaks
- Multiple Scenario Analysis

Outputs

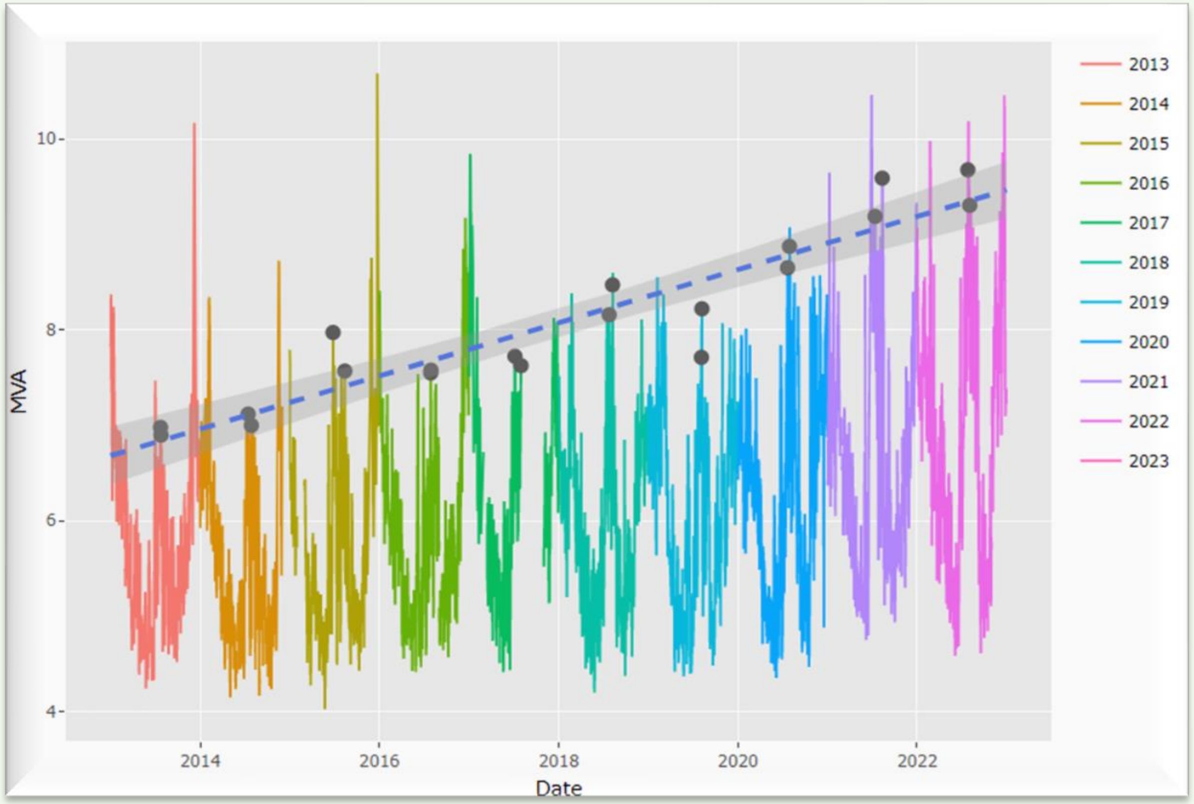
- 10-year Planning Horizon
- Multiple Seasonal and Load Growth Scenarios

Forecasting Example

Traditional



Enhanced



*Temperature outlier days excluded

Drivers for Load Growth

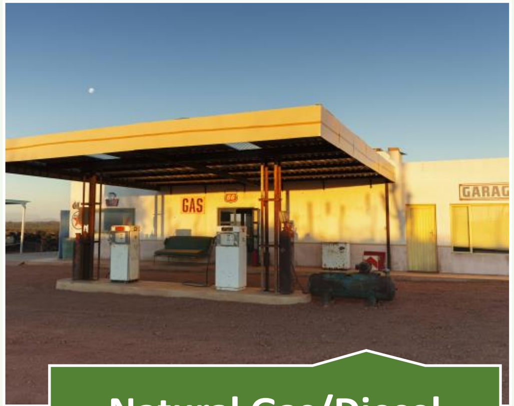
What drivers of load growth have you seen in your community and where are they occurring?

Commercial/Industrial Development

Population Growth

Heat Electrification

A/C Adoption



Natural Gas/Diesel Prices

Policy

Economic Output (Gross County Product)

Technology

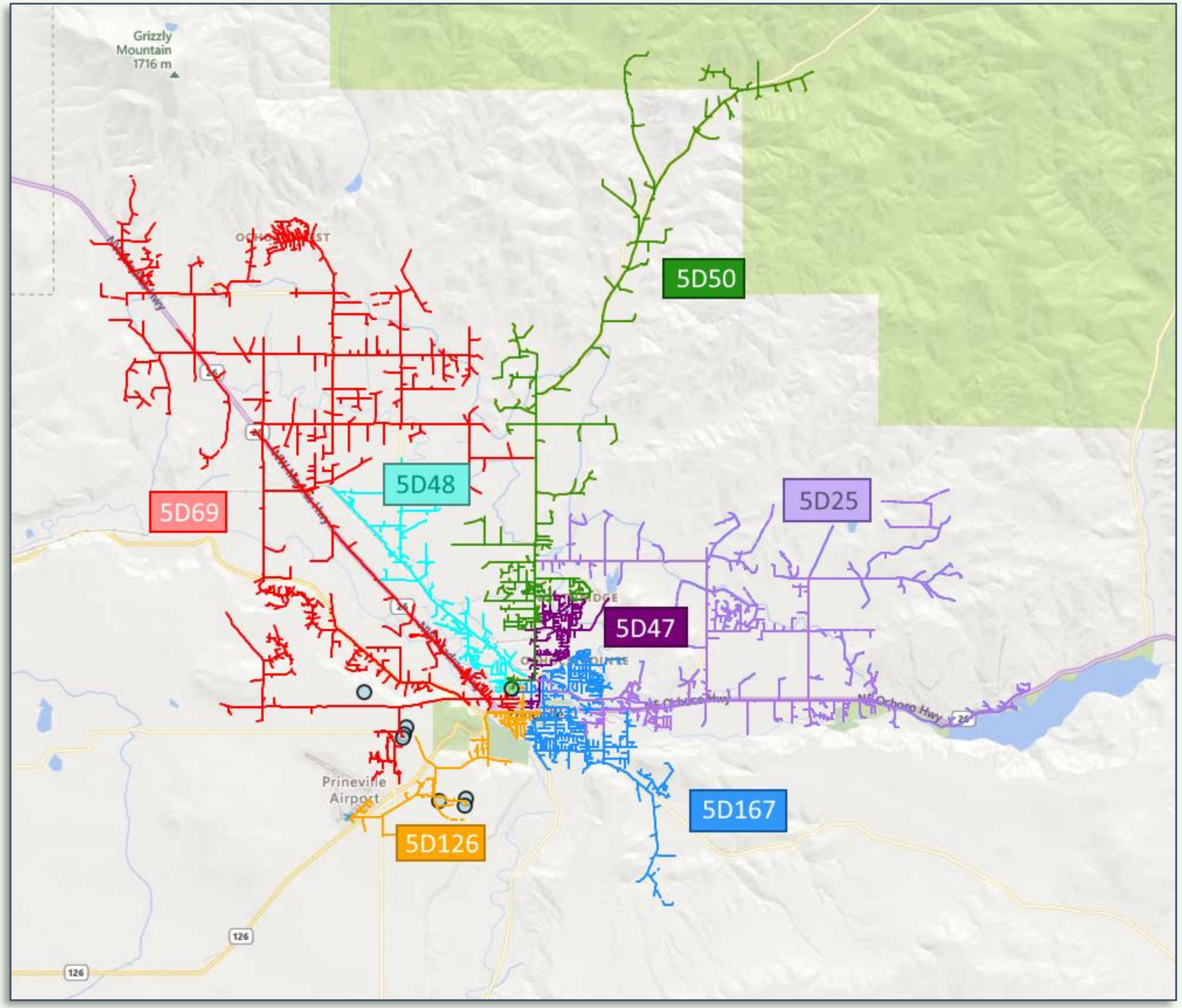
Area Load Forecast Summary (Summer)

Summer is typically the time of year when equipment is closest to capacity

Temperatures have seen significantly higher peaks in the past two years, stressing some equipment more than anticipated.

Circuit	Customer Mix	Projected Summer Load Growth	2022 Load (MVA)	Projected 2032 Load (MVA)	Capacity Utilized (2032)
5D25 Ochoco Mill	Residential/ Irrigation	3.0%*	4.7	6.3	48%
5D47 McKay	Residential/ Industrial	3.0%*	4.5	6.1	64%
5D48 Lamonta	Industrial/ Mixed	3.0%*	4.2	5.8	51%
5D50 Pine Cone	Residential/ Irrigation	3.0%*	7.4	10.0	88%
5D69 Grimes Flat	Residential/ Commercial/ Irrigation	3.0%*	7.8	10.6	44%
5D126 Rimrock	Residential/ Commercial	5.0%	4.2	6.9	61%
5D167 Northville	Residential	3.4%	10.5	14.9	132%

*Limited historical data, growth rate is conservative approximation



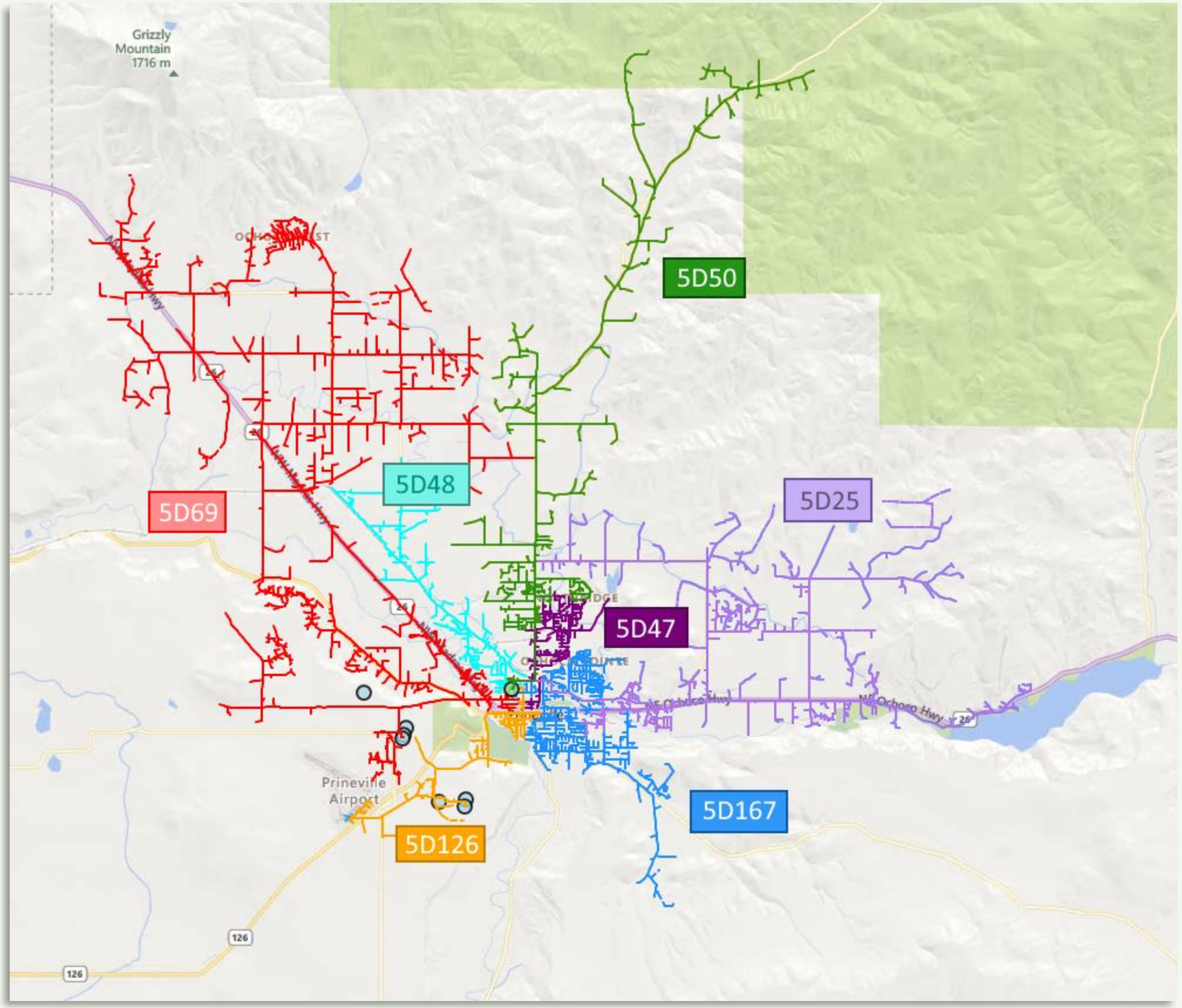
Area Load Forecast Summary (Winter)

Cooler temperatures allow higher capacity on most equipment

But heat electrification may be driving load growth in some areas that may cause concern

Circuit	Customer Mix	Projected Summer Load Growth	2022 Load (MVA)	Projected 2032 Load (MVA)	Capacity Utilized (2032)
5D25 Ochoco Mill	Residential/ Irrigation	3.0%	5.3	7.1	55%
5D47 McKay	Residential/ Industrial	3.0%	4.5	7.1	55%
5D48 Lamonta	Industrial/ Mixed	3.0%	4.4	6.0	46%
5D50 Pine Cone	Residential/ Irrigation	3.0%	8.5	11.5	88%
5D69 Grimes Flat	Residential/ Commercial/ Irrigation	3.0%	9.2	12.3	51%
5D126 Rimrock	Residential/ Commercial	5.0%	4.8	7.8	60%
5D167 Northville	Residential	1.0%	10.6	11.7	90%

*Limited historical data, growth rate is conservative approximation



Next Steps

Load Flow Model Updates and Verification

- Verify an update load flow model
- Customer to transformer mapping review and correction
- Develop seasonal peak and minimum load scenarios based on AMI

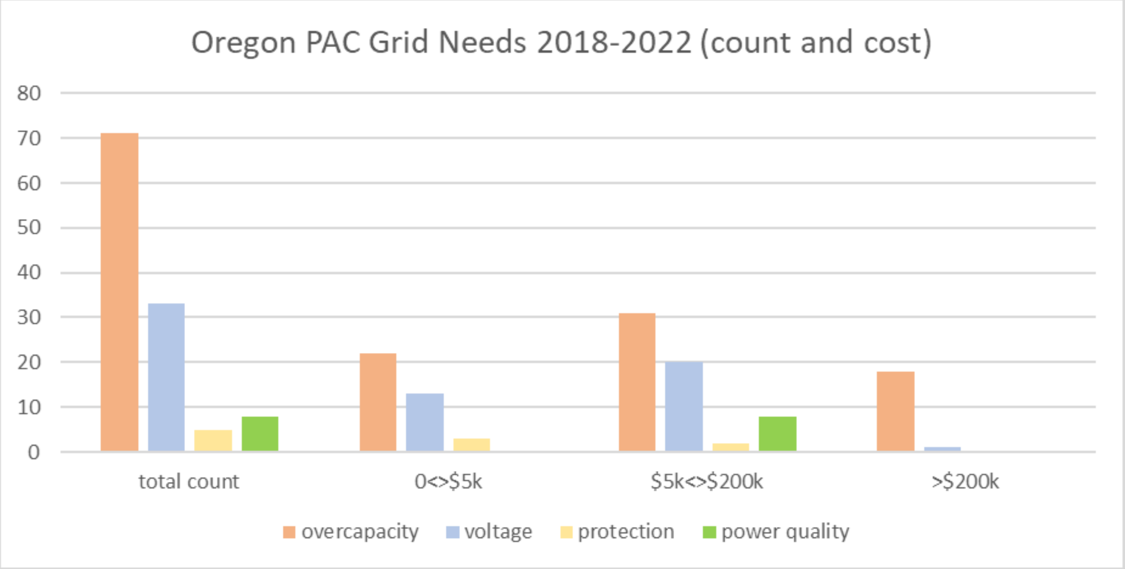
Identify and Determine Potential Solutions

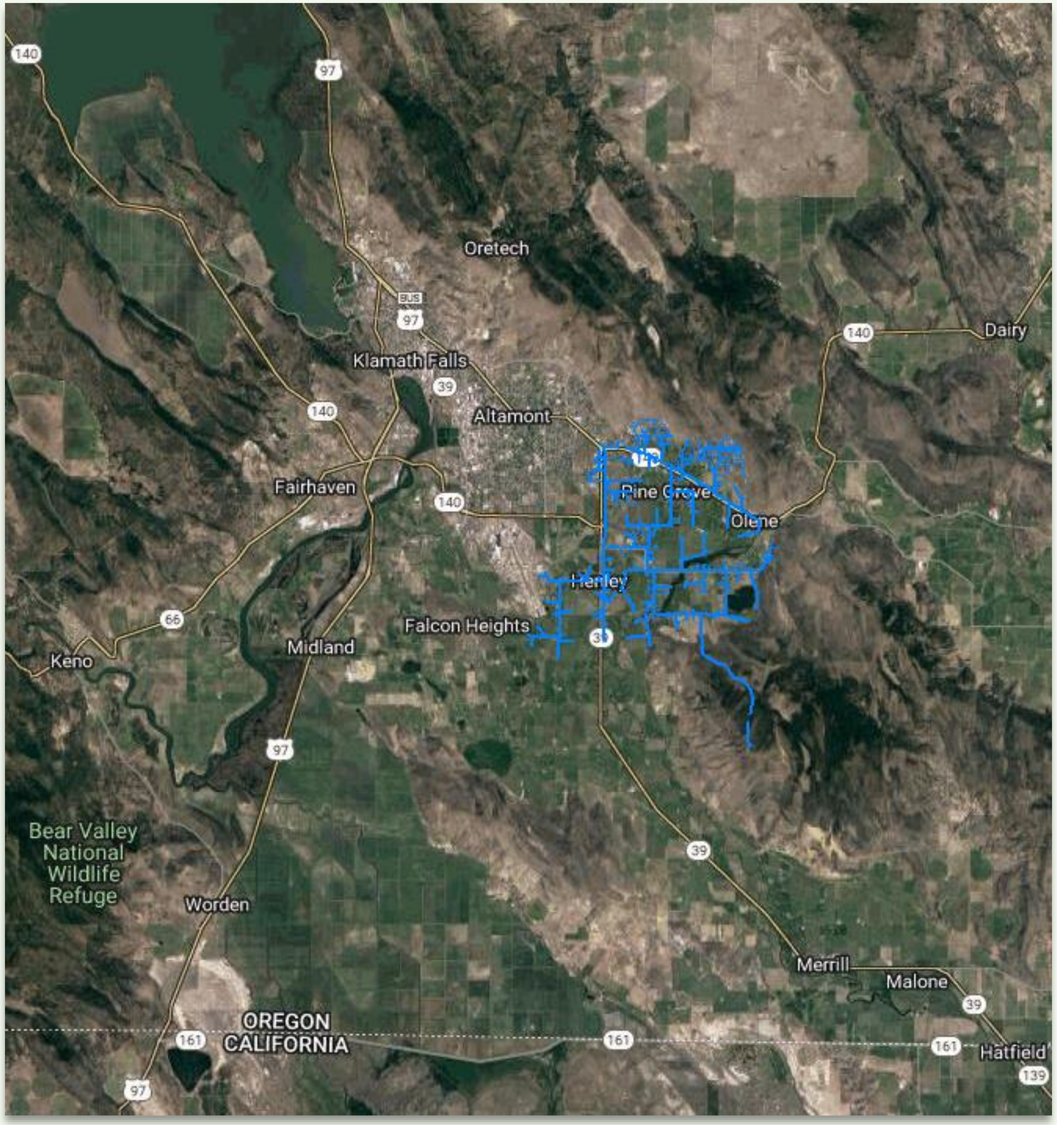
- Run load flow for seasonal peak and minimum load scenarios
- Identify grid needs (loading and voltage constraints)
- Identify potential traditional and non-traditional solutions

Take input from this workshop and develop follow up actions/ ideas about benefits to community

Klamath Falls Study Overview

- Klamath Falls was selected for a DSP study
- The area was examined thoroughly for an appropriate grid need
- Local feedback was incorporated into potential non-traditional solutions
- Model results were translated into estimated costs and compared for the most optimal and feasible outcome

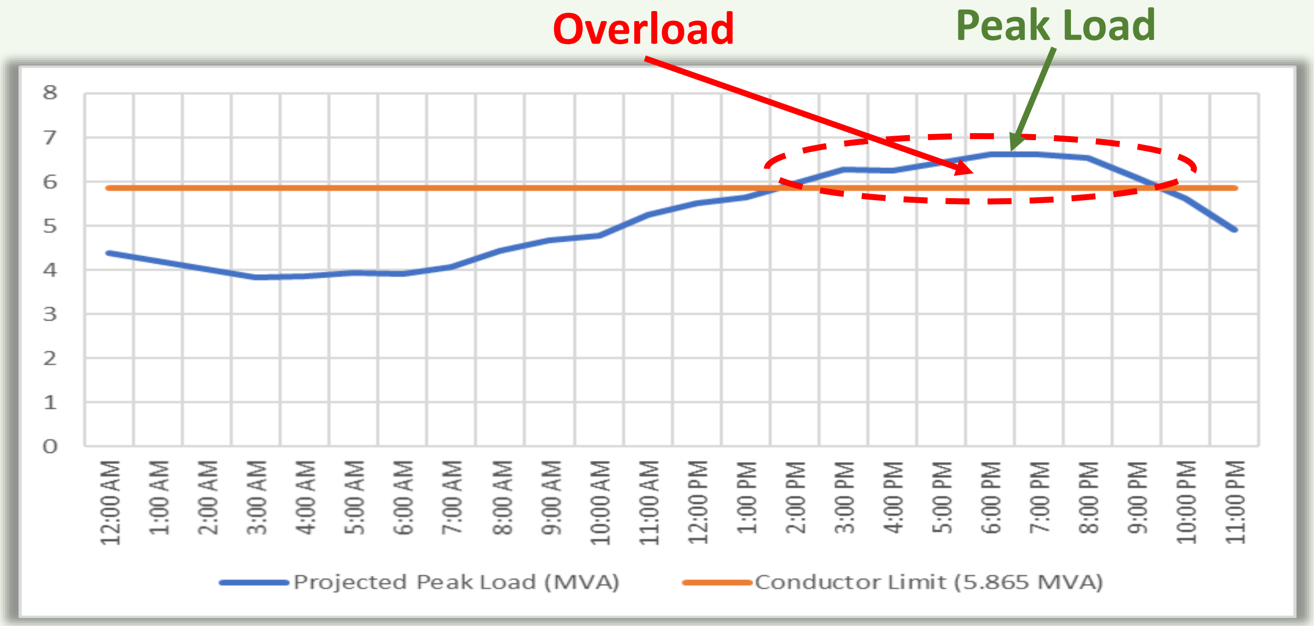


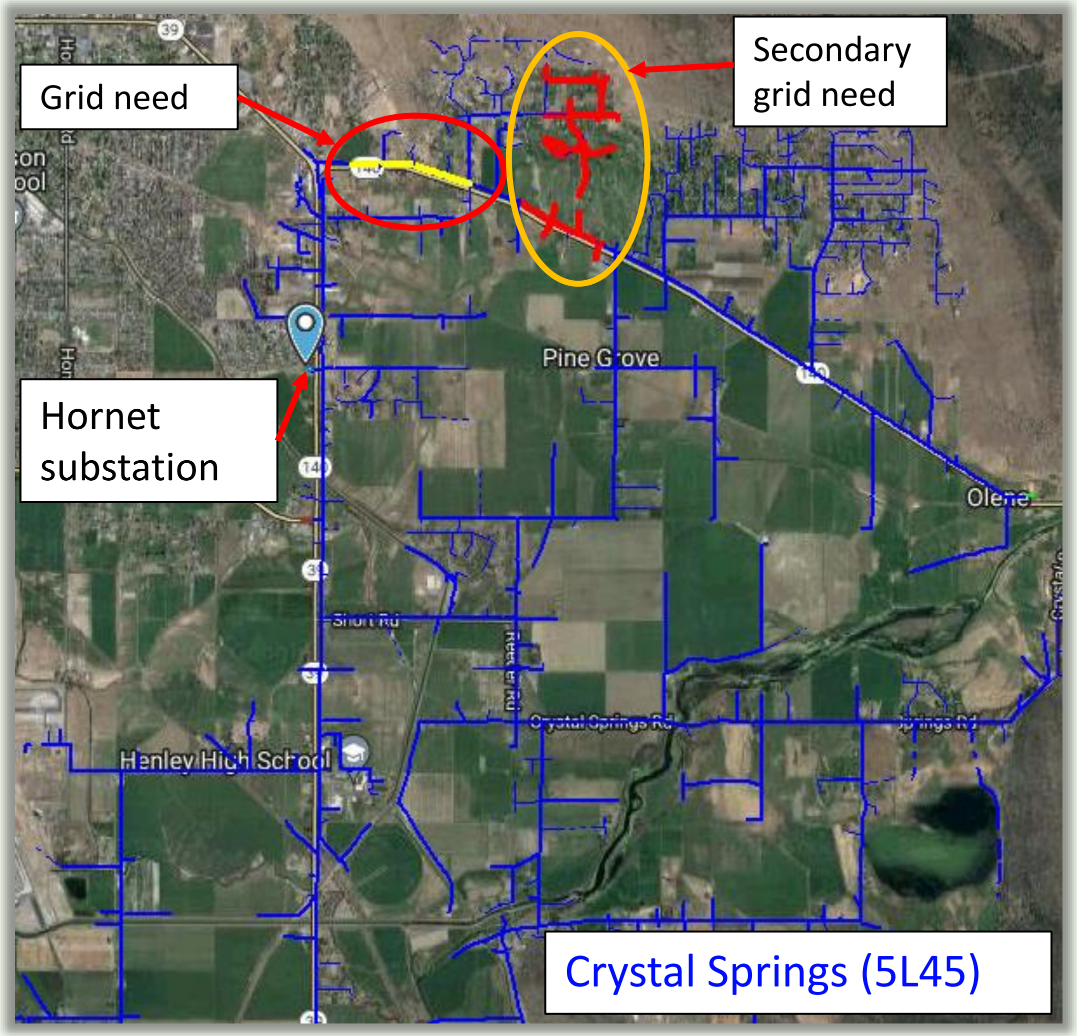


Klamath Falls Grid Need Analysis

Grid Needs:

- Study identified an overcapacity at peak load, causing conductor overload
- Also causes low voltage downstream
- Needed to be addressed in 2-3 years
- Peak load occurs during the summer in the evening

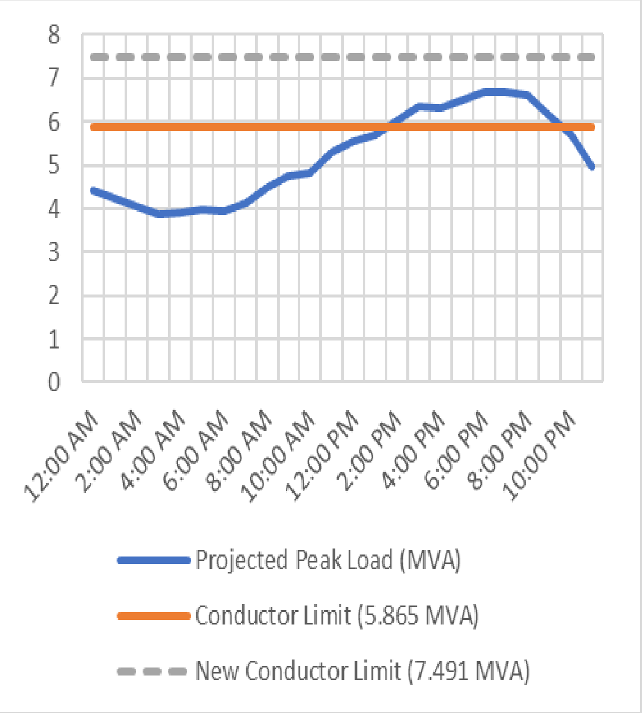




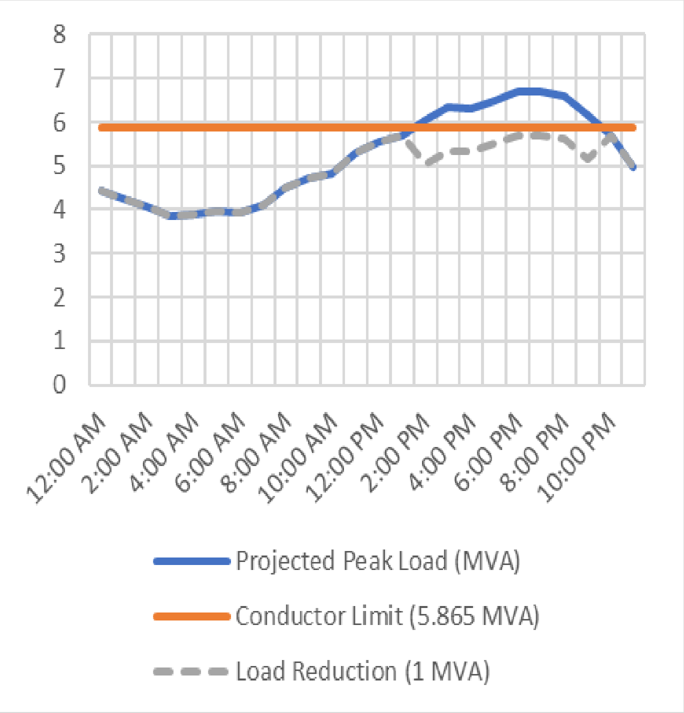
Klamath Falls Traditional and Non-Traditional Solutions

Non-traditional solution examples

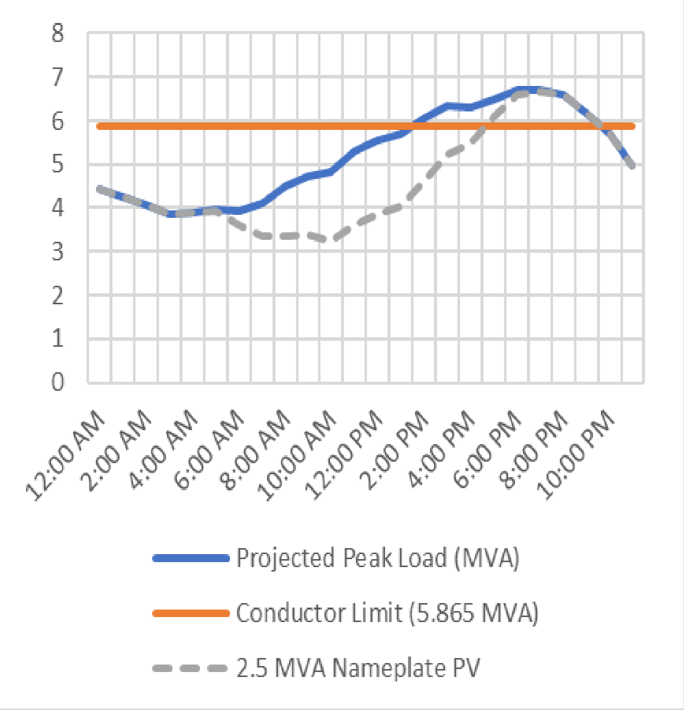
Traditional Solution –
Reconductor overloaded conductor



Demand Side Management (DSM) Solution - Load reduction



Distributed Generation (DG) Solution - Solar Only



Klamath Falls – Solution Evaluations and Final Conclusions

Traditional Solution:

- **Reconductor overloaded wire**

Non-traditional solution concepts considered:

- ***Solar + Battery Storage (Evaluation #1)***
- ***Targeted Energy Efficiency (Evaluation #2)***
- Demand Response, Curtailment, other Renewables

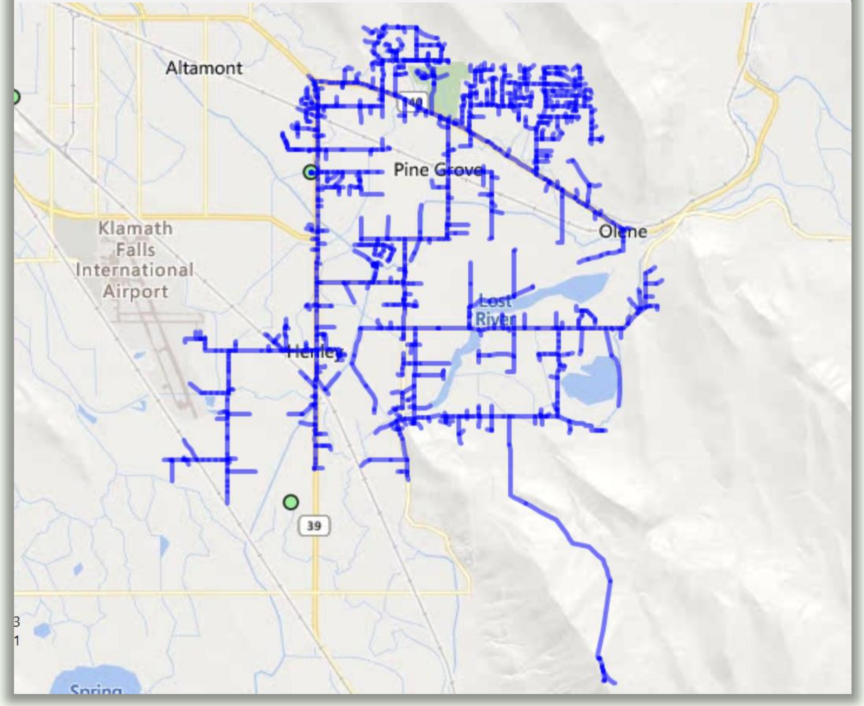
Conclusions:

- **Reconductoring was chosen due to several constraints**
  - Amount of Solar + Battery Storage was too costly
  - Energy Efficiency would have taken too long
- **Future studies need to evaluate a longer study horizon**
- **Futures studies will consider a hybrid approach of methods**

  (ex: solar + storage and energy efficiency)

Klamath Falls – Crystal Springs – 5L45

- Overloaded conductor during peak summer load
- Low voltages downstream of overload
- Needed to be addressed in 2-3 years



Next Steps: Planning with Greater Benefits in Mind

What kind of benefits could non-traditional solutions offer?

Benefits to Customers

- **Reduce energy bills** (for customer resources, e.g., rooftop solar)
- **Greater Reliability/Resilience**- expect lower likelihood of outages
- **Tax incentives** – programs to help with energy efficiency or other programs
- **Greater energy independence** (with certain solutions)
- **Improved Comfort** – especially with energy efficiency solutions

Society Benefits

- Reduce Green House Gas (GHG) and Particulate Emissions- cleaner air
- Potential for greater community resilience
- Potential for greater energy independence

Benefits to Utility

- Fuel savings
- Reduce volatility / increased flexibility
- Deferral of infrastructure investments

Stakeholder Engagement

Where Does DSP Fit in with Other Engagement Initiatives?

Transitioning to a clean energy future benefits from diverse stakeholder input

Clean Energy Plan (CEP) Engagement Series

- Meetings on various topics/groups receiving Stakeholder input.
- Public is welcome to attend meetings

- DSP — Distribution System Planning
- IRP — Integrated Resource Planning
- CEP — Clean Energy Plan
- CBIAG — Community Benefits and Impacts Advisory Group
- Tribal — Tribal Nations

Utility Planning

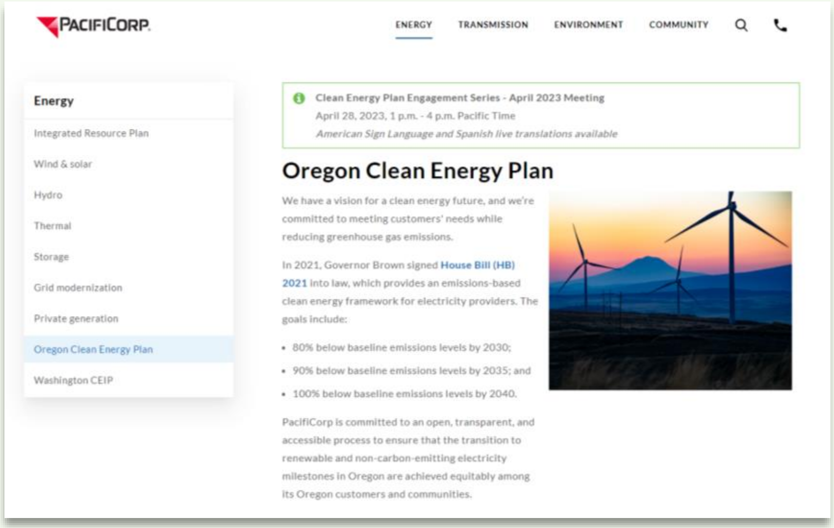
- Investments in generation, transmission, distribution (substations and circuits)
- Includes renewable energy, storage, demand response, community based renewable energy projects.

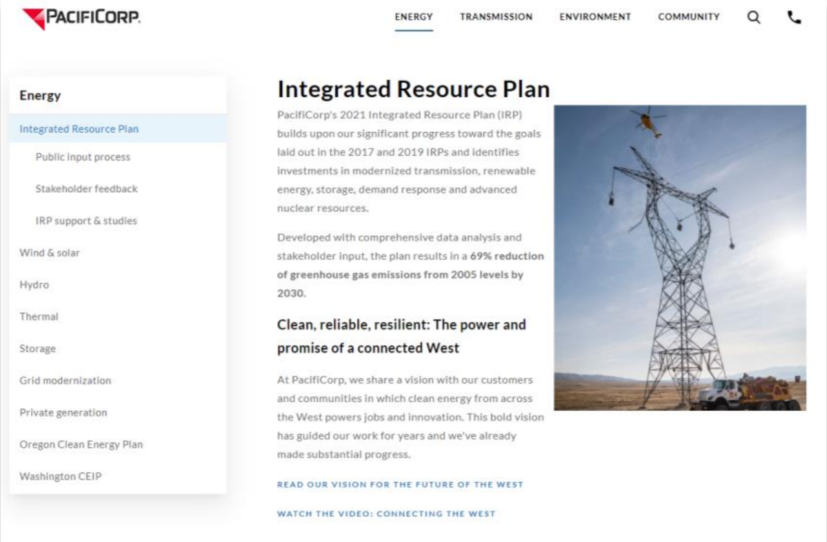
Community Specific

- Community input, surveys, outreach
- Customer support programs
- Community Benefits Indicators

Continued Engagement - Utility Planning

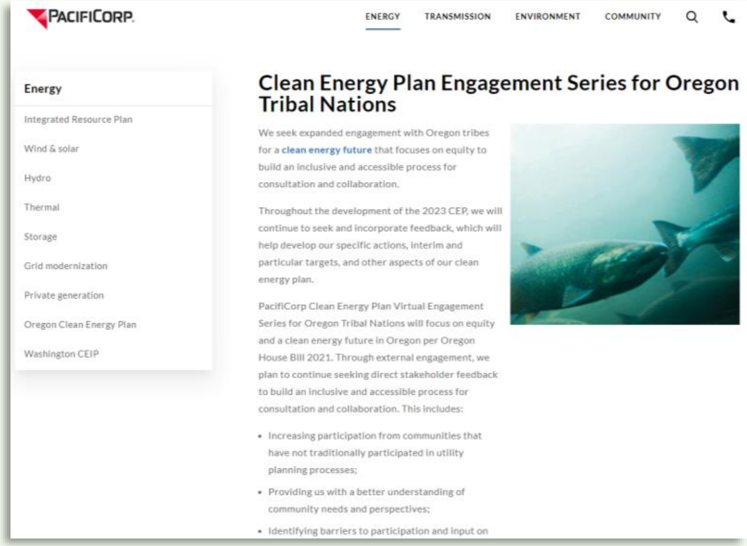
Integrated Resource Plan (IRP)	Oregon Clean Energy Plan (CEP) Stakeholder Group
To file twenty-year strategic plan that focuses on ten-year planning and two-to-four-year actionable plans with utility commission.	CEP goal is to develop an actionable strategy to provide emission free electricity for Oregon customers by 2040. CEP includes requirements for small-scale and Community Based Renewable Energy.
Intensive data forecasting, modeling, and portfolio analysis, to ensure PacifiCorp balances system needs, regulatory requirements and stakeholder input.	Works closely with IRP group to plan system needs, regulatory requirements, and stakeholder input.
Next meeting TBD- Online feedback form available [Integrated Resource Plan](#)	Next meeting April 28th [Oregon Clean Energy Plan](#)

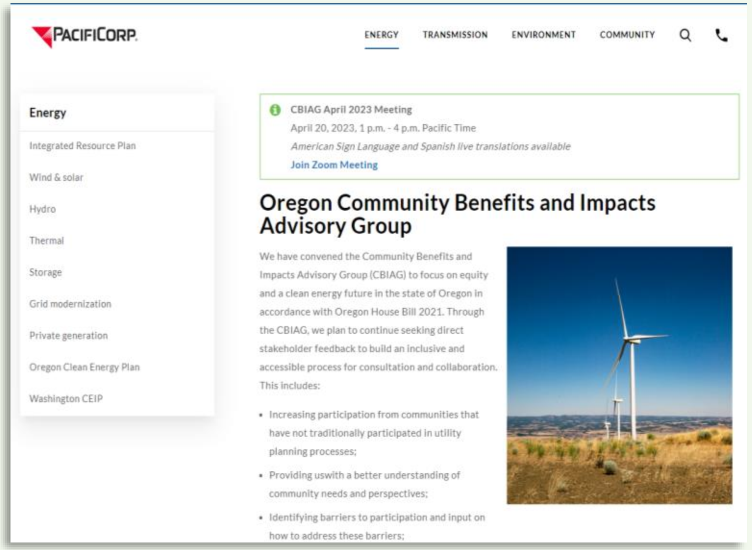




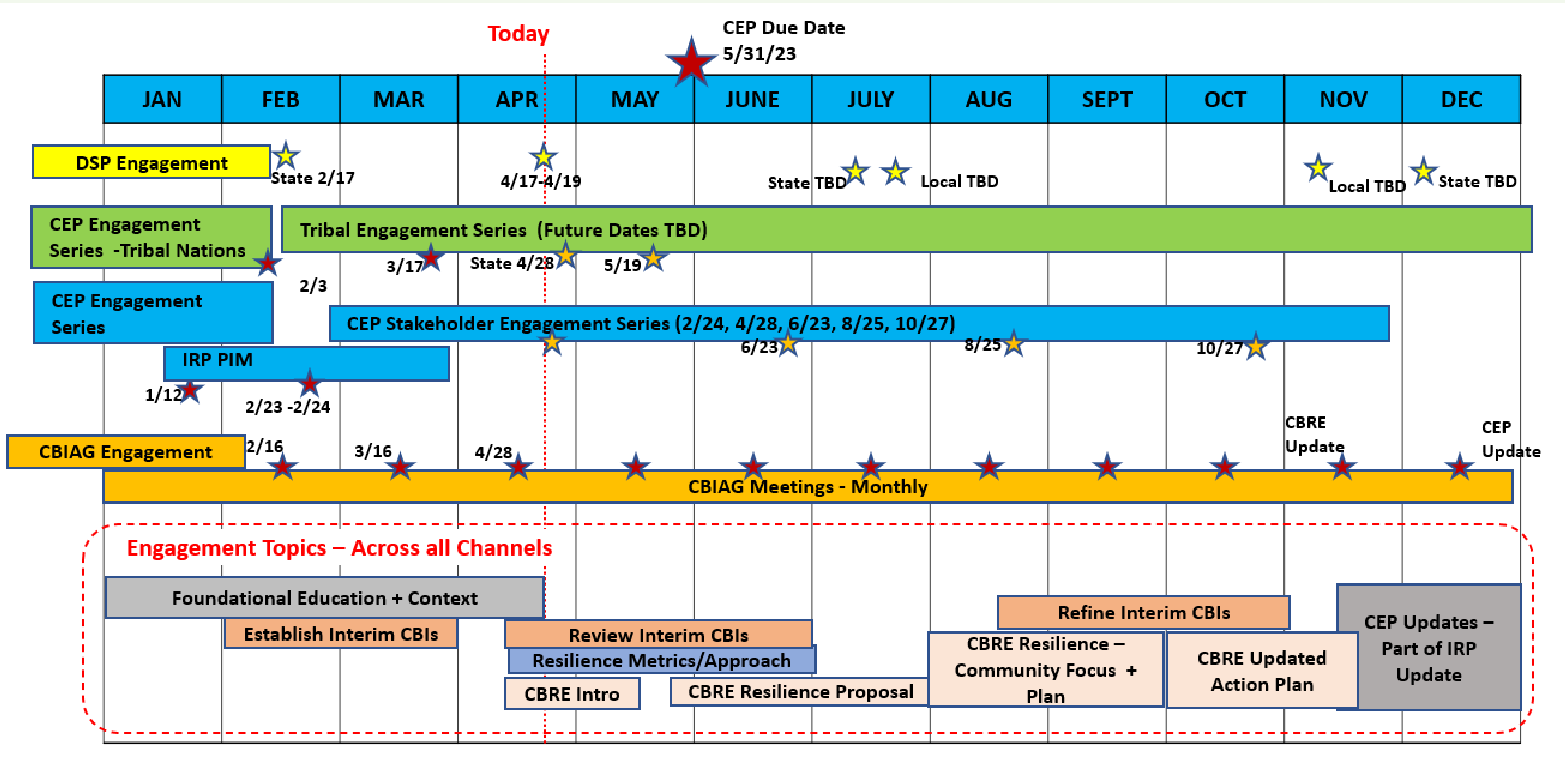
Continued Engagement - Group Specific

Engagement for Oregon Tribal Nations	Oregon Community Benefits and Impacts Advisory Group (CBIAG)
Increase feedback from communities that have not traditionally participated in utility planning process.	CBIAG composed of stakeholders that do not usually participate in utility planning processes to ensure community voices are heard. Primary topics: community benefits, concerns, guidance to utility on approach & engagement.
Provide us with better understanding of community needs, perspectives, barriers to participations, assisting with community outreach.	CBI indicators- using feedback/indicators from community to drive utility planning and actions.
Next meeting April 28th Tribal Nations	Next meeting April 20th Oregon Community Benefits and Impacts Advisory Group





Stakeholder Engagement Timeline



Final Survey/Discussion

What did you learn today?
What resonated with you today?
What are the benefits of moving to a clean energy future?
What comes to mind when you think of community resilience?
What special topics would you like to hear about at the next workshop?
Next workshop format: in-person or online only?

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Conclusion:

After forecasting the load out of the Prineville substation with enhanced forecasting methods, we have higher confidence of growth rates for summer and winter peaks. We hope you have gained a better understanding of Distribution System Planning and want to continue to engage with us throughout this process. Thank you for attending and improving our understanding of Prineville's community needs and values.

Questions/Comments?

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Online Participants Questions/Comments?

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Additional DSP Information

DSP Email / Distribution List Contact Information

- DSP@pacificorp.com

DSP Webpages

- Pacific Power Oregon DSP Website
- Planificación del Sistema de Distribución de Oregón (pacificorp.com)

Additional Resources

- PacifiCorp's DSP Part 1 Report
- PacifiCorp's DSP Part 2 Report
- DSP Pilot Project Suggestion Form

Thank you!

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Back up Slides

Initial Community Benefits Indicators (CBIs)

Customer Benefit Indicator Category	Interim Customer Benefit Indicators	Interim Customer Benefit Indicator Metrics	Purpose
Rulemaking Language	**Outcomes**	**How we Measure Outcomes**	**Why**
Resiliency (System and Community)	Reduce frequency and duration of energy outages Improve resiliency of vulnerable communities during electricity outages	Metric of Energy Not Served (ENS) from IRP portfolios SAIDI, SAIFI, and CAIDI at area level including major events	SAIDI, SAIFI and CAIDI scores show how reliable and resilient areas of PacifiCorp's system are. Producing these metrics for Census Tracts will demonstrate how reliable and resilient our system at the community level.
Health and Community Well-being	Decrease number of residential disconnections	Number of residential customer disconnections	Access to energy affects the provision and sustainability of basic human needs. Disconnections could be the result of a customer's decision whether to pay utility bills or pay for other basic needs like paying rent, buying food, or purchasing prescription drugs. Tracking disconnections by Census Tract provides an indicator of how communities may be struggling with their basic needs.
Environmental Impacts	Increase energy from non-emitting resources and reduce CO_2 emissions to meet HB 2021 targets	Amount of renewable and non-emitting resources serving Oregon retail customers Amount of emissions associated with Oregon retail sales	Reduce fossil fuel resources and increase renewable and non-emitting resources that currently power Oregon's grid, thereby leading to increased environmental benefits, while maintaining system reliability and on-demand service to customers.
Energy Equity (Distributional and Intergenerational Equity)	Decrease number of households experiencing high energy burden	Energy burden by census tract Energy burden for low-income customers, bill assistance participants and Tribal members	Energy equity is concept that all member of society should be able to afford and have access to a necessary and basic amount of energy. Energy burdened households spend a disproportionate amount of their income on home energy costs. Tracking energy burden by Census Tract provides an indicator of energy equity for communities in PacifiCorp's Oregon service territory.
Economic Impacts	Increase community-focused efforts and investments	TBD	The purpose of this CBI is to focus investments so that communities more equitably receive benefits. Impacts from these investments will have positive implications on communities.

2023 DSP Study Area Selection Process

1. Establish New Selection Criteria for Initial Evaluation
2. Calculate Selection Metrics for all Oregon Circuits
3. Select 12 Circuits Based on Criteria
4. Preliminary Grid Needs Analysis on Selected Circuits
5. Share with Stakeholders and Get Feedback
6. Final DSP Study Area Selection

Selection methodology: Criteria and Metrics

- **Forecasted Solar Generation Growth *(MW)***
- **Forecasted Electric Vehicle Growth *(Count)***
- **Larger Potential Solar Sizing *(Ranked by kWH for targeted customers)***
- **Reliability (*3-year Average Reliability Metric*)**
- **Equity (*Median Income, Households Below 200% Poverty Level*)**
- **Reverse Power Flow *(MW)***
- **Availability of SCADA at Circuit Breaker *(Y/N)***

Selection Methodology: Results

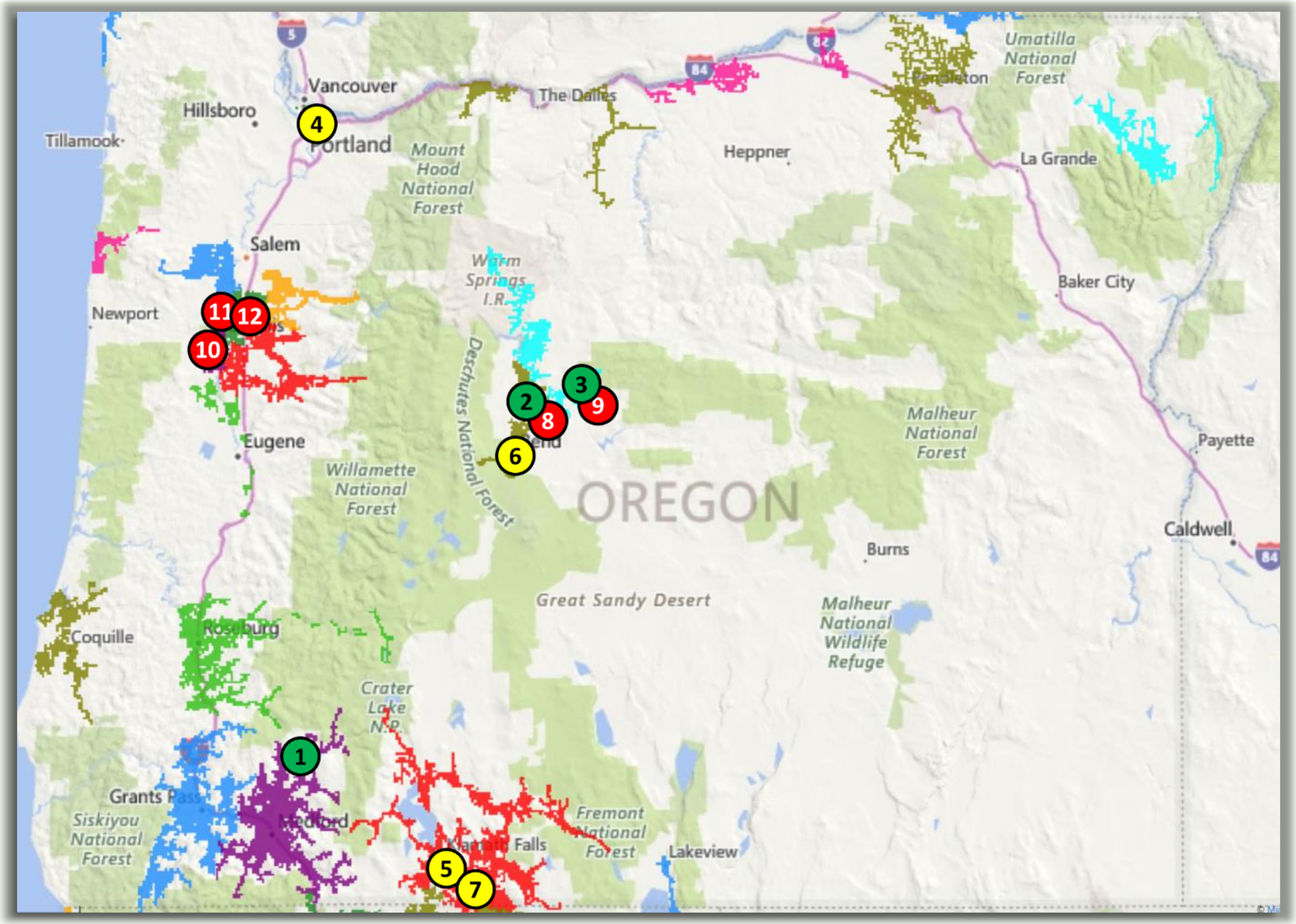
Circuit	High Solar Generation Growth	High Electric Vehicle Growth	Low Reliability Score	Larger Potential Solar Sizing	High Potential for Reverse Power Flow	SCADA Available	Median Income ≤ $50k	High Amount of Households Below 200% Poverty Level
4R9	✓	✓	✓			✓	✓	✓
5D22	✓	✓		✓		✓		
5D167	✓	✓				✓		✓
5P395	✓	✓				✓		
5L45	✓	✓	✓	✓		✓		
5D261		✓			✓	✓		
5D227		✓			✓	✓		
5L27				✓		✓	✓	
5D50			✓	✓		✓		✓
4M182		✓				✓		✓
4M16	✓	✓						
4M15	✓	✓					✓	✓

Selection Methodology: Preliminary Grid Needs Analysis

1. Identify significant planned changes to the circuits
2. Basic 10-year peak load forecast based on 10 years of circuit load (if available)
3. CYME load flow analysis for grid needs using peak projected load
4. CYME load flow for worst case reverse power flow (if applicable)
5. Discuss findings and models with local field engineers and incorporate feedback

Preliminary Selection for Full Area DSP Study

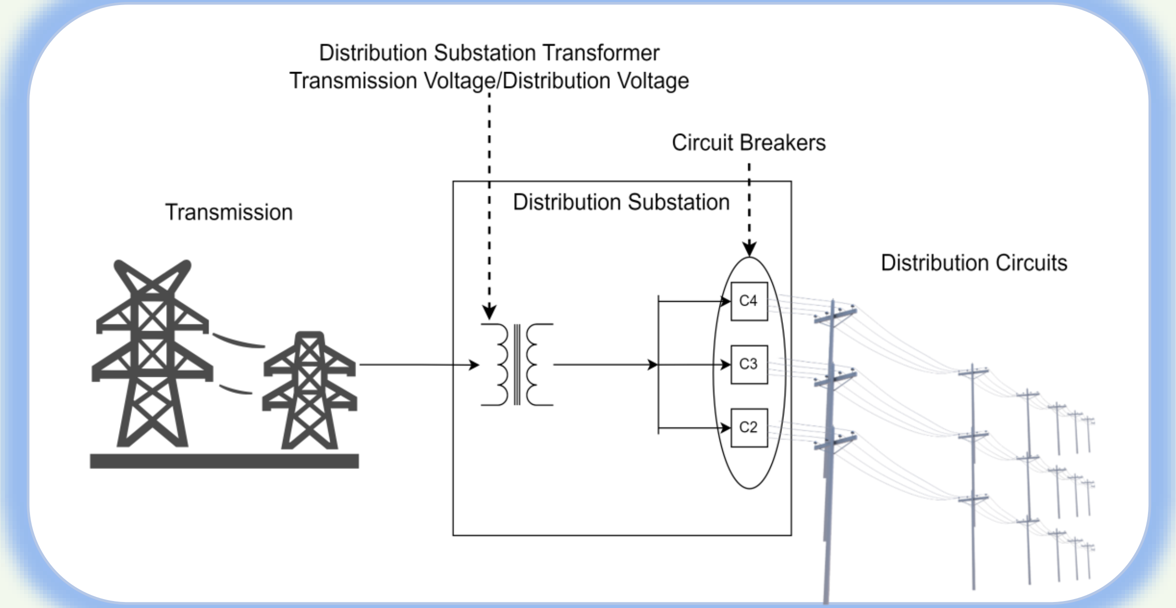
#	Circuit	Evaluation Likelihood: High / Low / Disqualified
1	4R9	Grid needs identified
2	5D22	Grid needs identified
3	5D167	Grid needs identified
4	5P395	No grid needs identified
5	5L45	No grid needs identified
6	5D261	No grid needs identified
7	5L27	No grid needs identified
8	5D227	New substation
9	5D50	Large planned load transfer
10	4M182	New substation
11	4M16	New substation
12	4M15	New substation



Distribution Substation Overview

Distribution substation transformer

- Lowers voltage from transmission levels to distribution levels
- Manages distribution voltage levels
- Load measurements
- Sized to accommodate loading levels for the foreseeable future



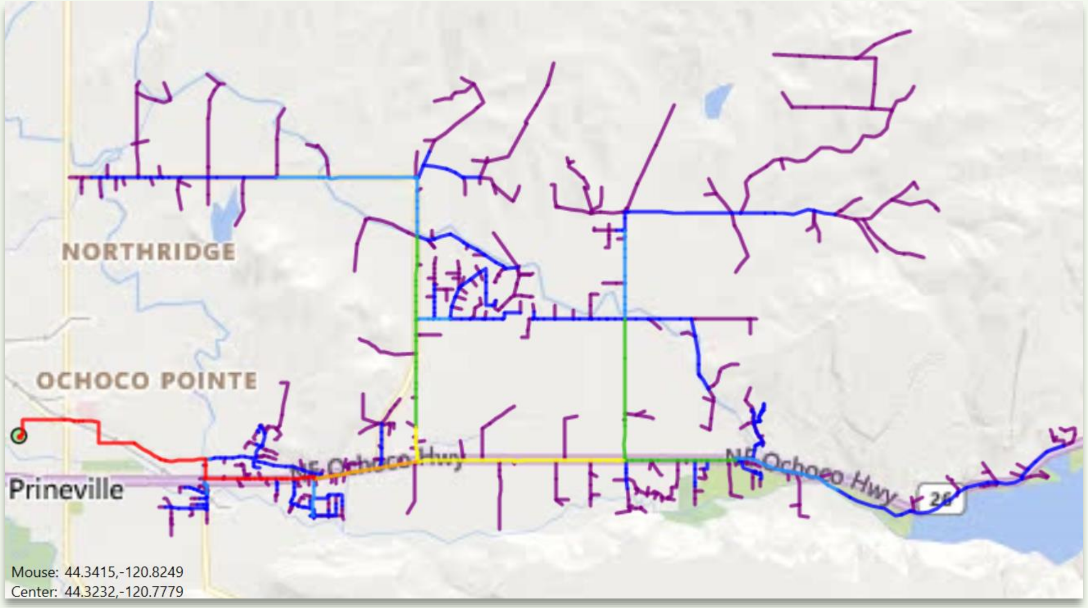
Distribution circuit breakers

- Starting point for distribution circuits
- System protection
- Load measurements

Distribution Circuit Overview

What is a distribution circuit?

- Starts at the distribution circuit breaker, ends at the customer meter
- Distribution circuit components:
  - Poles
  - Wires (overhead and underground): load capacity starts out large from the substation and decreases as the amount of load downstream decreases
  - System protection: public safety, protects system, minimizes customer outages
  - Switches: maintenance, circuit reconfiguration, outage restoration
  - Voltage management devices: maintain acceptable voltage levels along the circuit
  - Service transformers (pole mounted and pad mounted): lowers primary distribution voltage to service levels
  - Customer meters: Advanced Metering Infrastructure (AMI) captures power usage at hourly intervals. Used for billing and load research.
- Circuit designed to accommodate anticipated load for the foreseeable future



Why Is Weather Normalization Important?

What we have observed:

- Load in summer has a strong correlation with max temperature and an even stronger correlation with Cooling Degree Days (CDD)
- Load in winter has a strong correlation with min temperature. Heating Degree Days (HDD) can have a strong correlation as well.
- Large yearly variations of extreme heat and cold
- 2021 and 2022 had exceptional heat waves

Why does this matter?

- Peak load has strong correlation to yearly weather extremes. Load growth is masked by yearly variations in temperature extremes.
- Purpose of weather normalization is to remove this yearly variation.