Distribution System Planning Introduction

2023 Avista Electric DSP

DPAG 1 – March, 2023

Damon Fisher, P.E. Principal Engineer, System Planning

Welcome to the first DPAG meeting

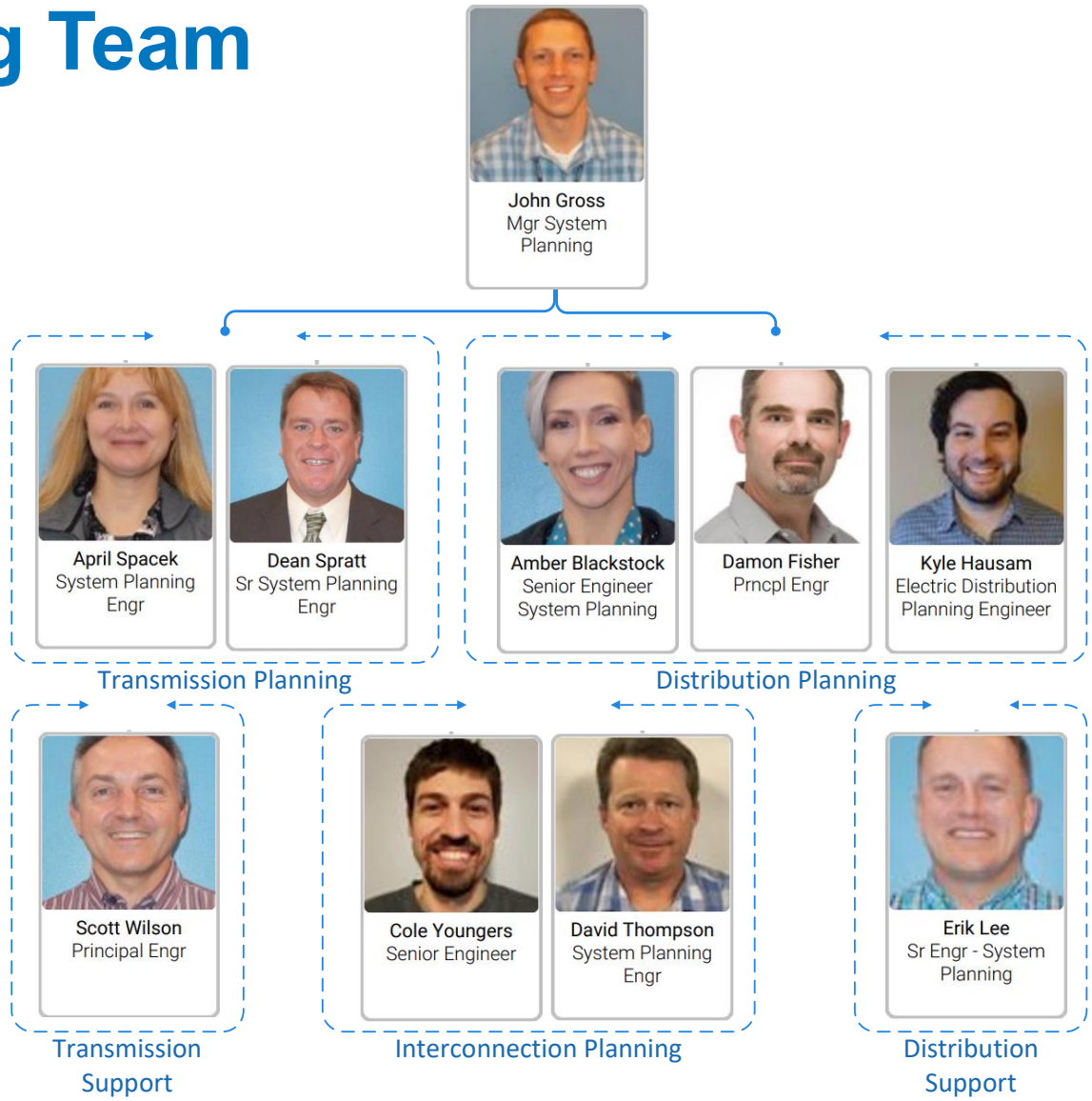
Today's Agenda

- Meeting Reminders
- Introductions
- Distribution Planning Advisory Group
- Training: Power delivery 101
- Avista's Distribution System
- Distribution Planning: Basics
- Final thoughts and what's next

Virtual Meeting Reminders

- Please mute mics unless commenting or asking a question
- Raise hand or use the chat box for questions or comments
- Please try not to speak over the presenter or a speaker
- Public meeting – this meeting is being recorded

Avista's Planning Team



Distribution Planning Advisory Group Vision

- Provide expertise and support towards informing a transparent, robust, holistic planning process for electric system operations and investment.
- Contribute to and inform the long-term plan to ensure operational efficiency and customer value are maximized.

Distribution Planning Advisory Group Goals

- Inform stakeholders about the electric system
- Provide greater transparency in planning process
- Provide opportunity for feedback
- Open to all stakeholders
- Flexible to adjustments

Distribution Planning Advisory Group Strategy

	January - March	April - June	July - September	October - December
Meetings	2-3 hours in February	2-3 hours in April 2-3 hours in June	2-3 hours in August	TBD
Topics	• DPAG Introduction • Distribution System and Electrical Concepts • Avista's Distribution System Overview • Planning Processes • Load Forecast and DER Potential Assessment	• Distribution Planning Process • Performance Criteria • System Needs Identification • Identify Solutions • Solution Examples	• Review Solution Selection • DER Potential Assessment Update • Hosting Capacity • Review System Plan	• To be determined

Power Grid 101

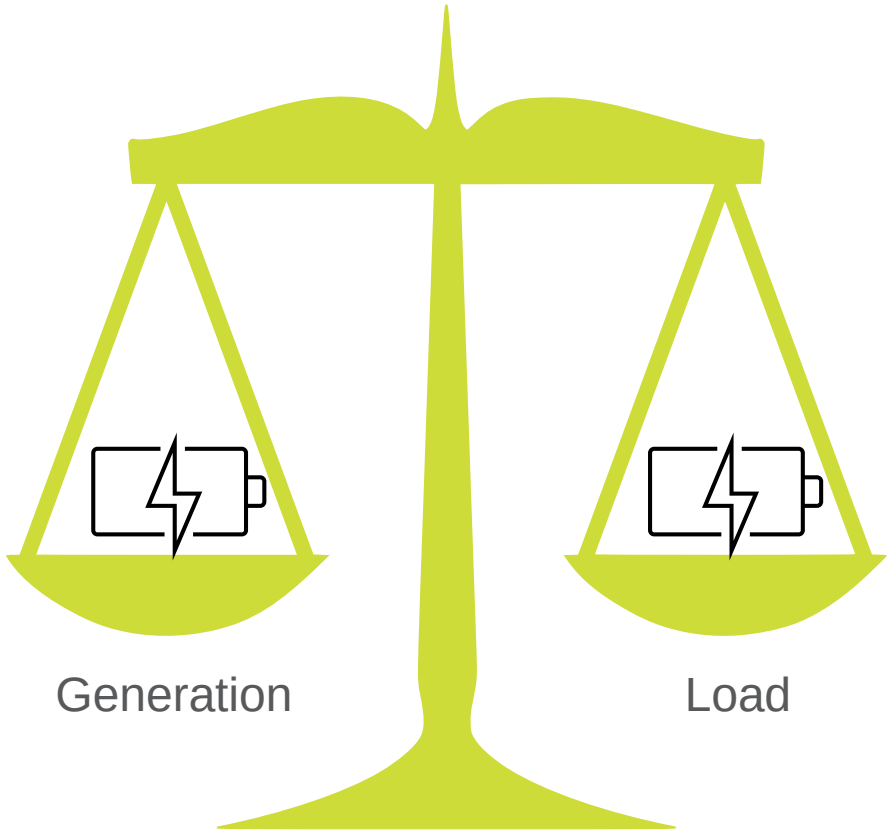
- What does the grid do? It connects sources of energy to the consumers of energy.
- Energy Sources = Hydro, wind, solar, thermal, efficiency
- Energy Consumers = Lights, refrigerators, motors, AC, EV's, storage

Grid

Grid

Power Grid 101

- As energy is put onto the grid, energy needs to flow off the grid. Balance needs to be maintained.

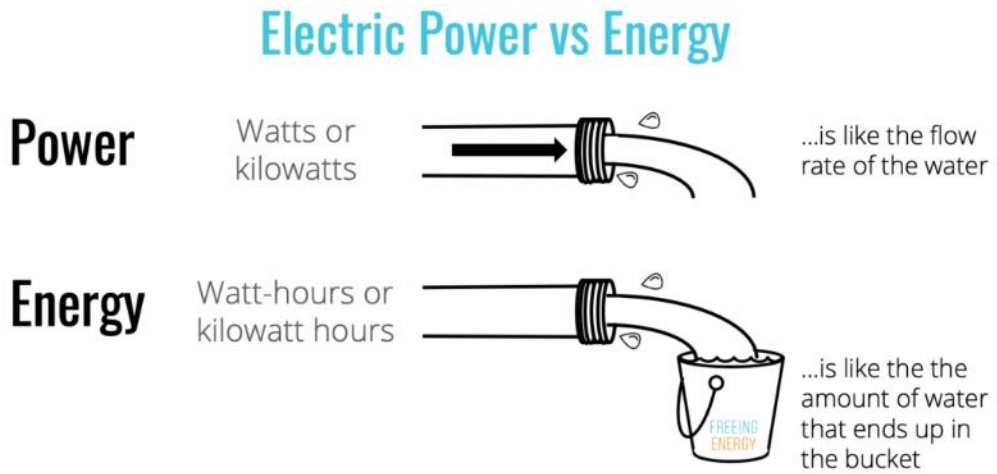


Power Grid 101

Electricity, Energy and Power

- Electricity is energy in the form of charged particles that are static or moving.
- Energy delivered is the quantity of work done
- Power is how fast the work was done

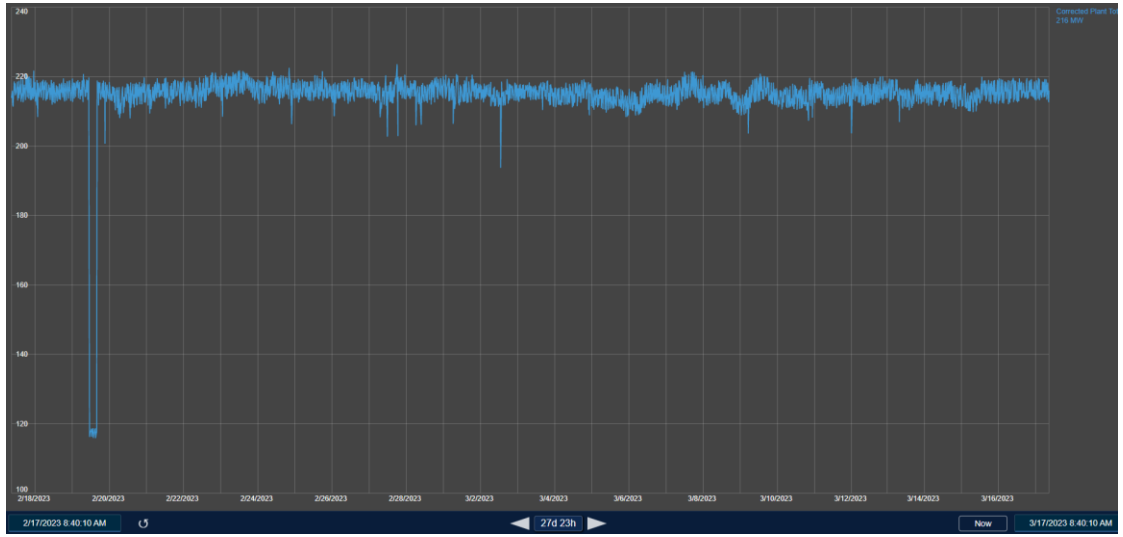
Energy and Power are closely related by time



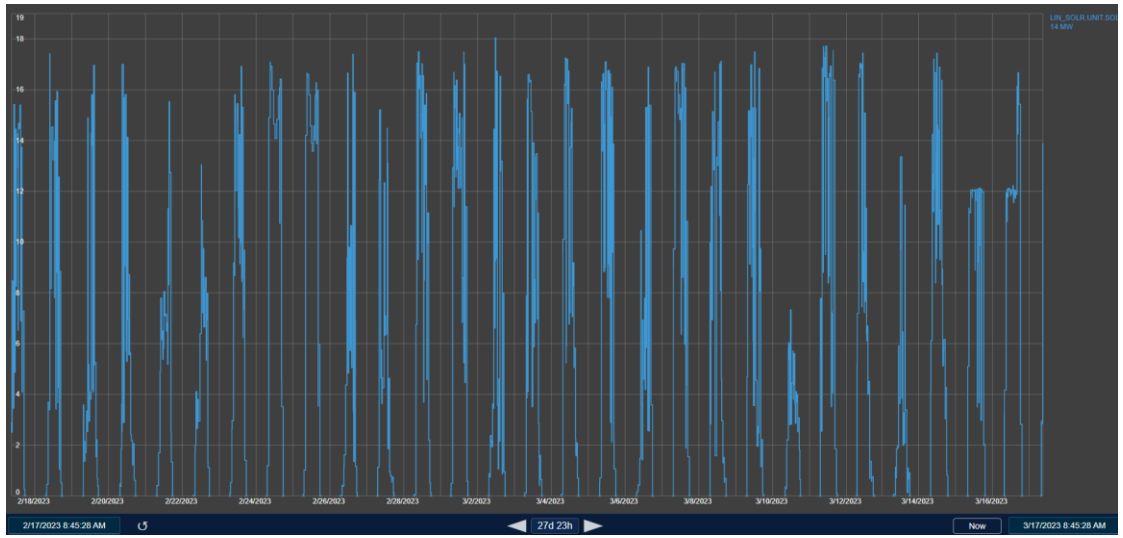
Power Grid 101

- Capacity = $$
  - The power that is possible
  - Same units as Power (Watts)
  - Generation Capacity
    - Constant (ish)
    - Variable

Colstrip

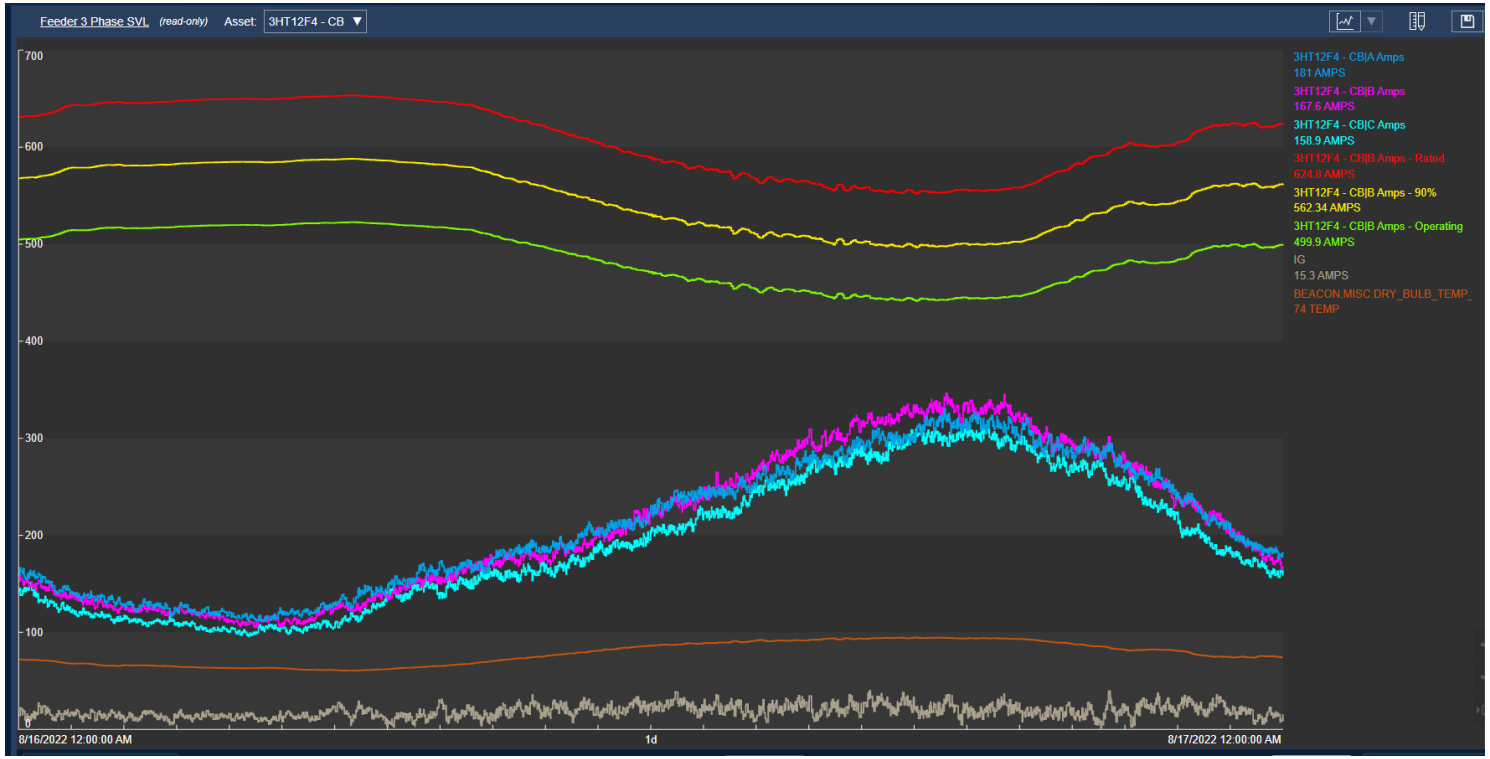


Lind Solar



Power Grid 101

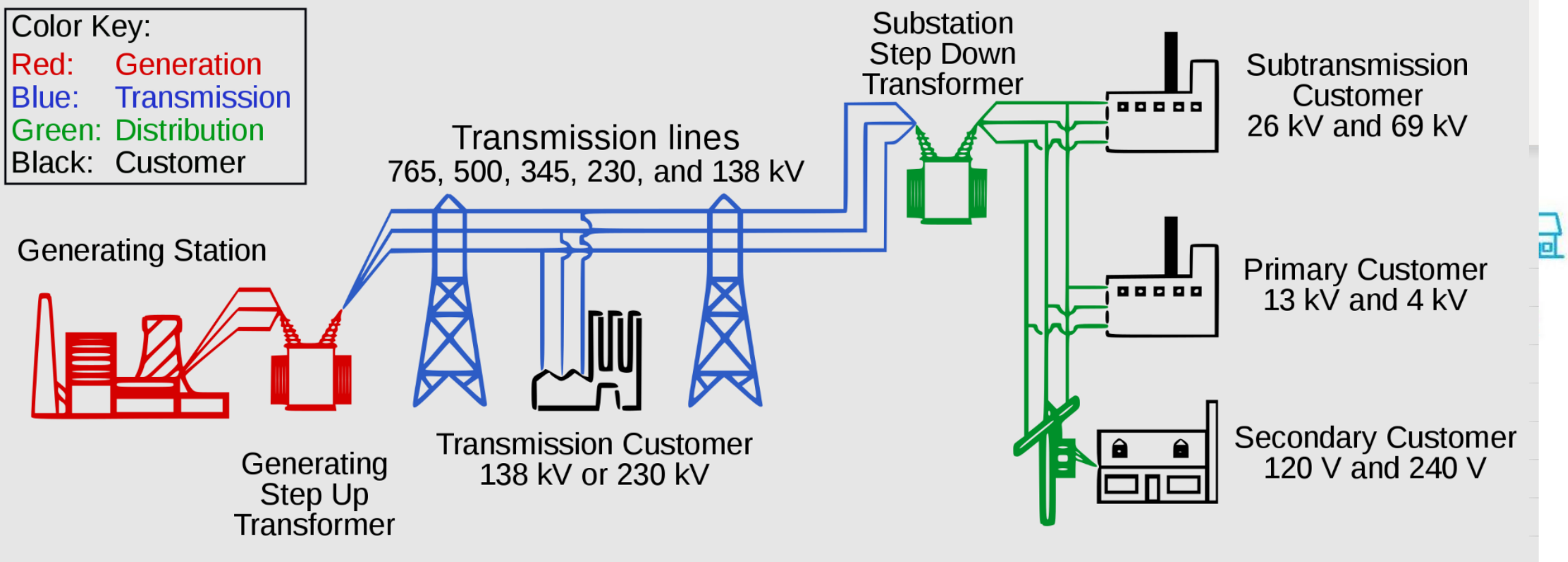
- Delivery Capacity
  - Temperature dependent



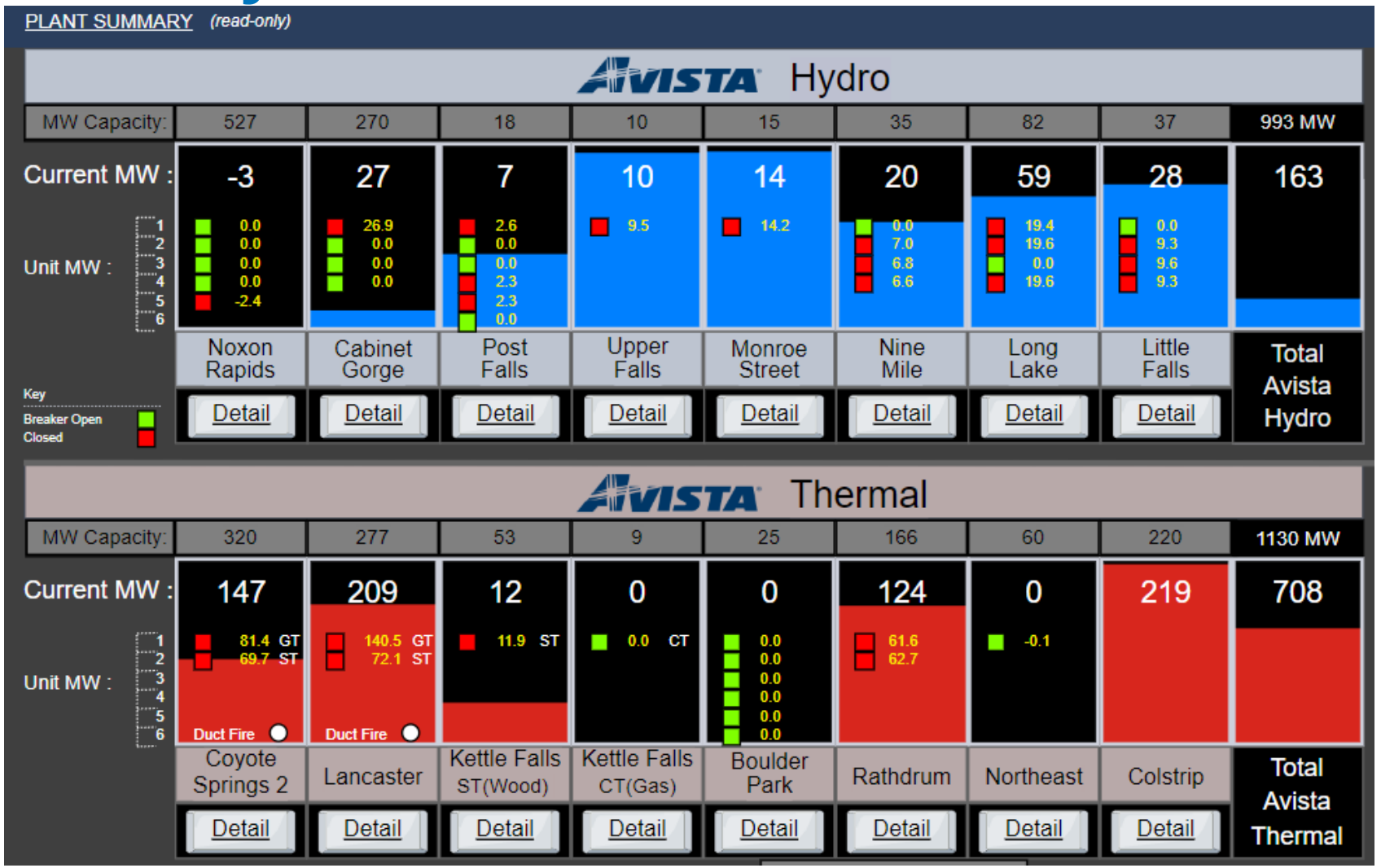
Power Grid 101

- Power: Flow rate
- Capacity: Size of the pipe (max flow rate)
- Energy: Total Flow
- Voltage: Pressure

Power Delivery 201



Power Delivery 201



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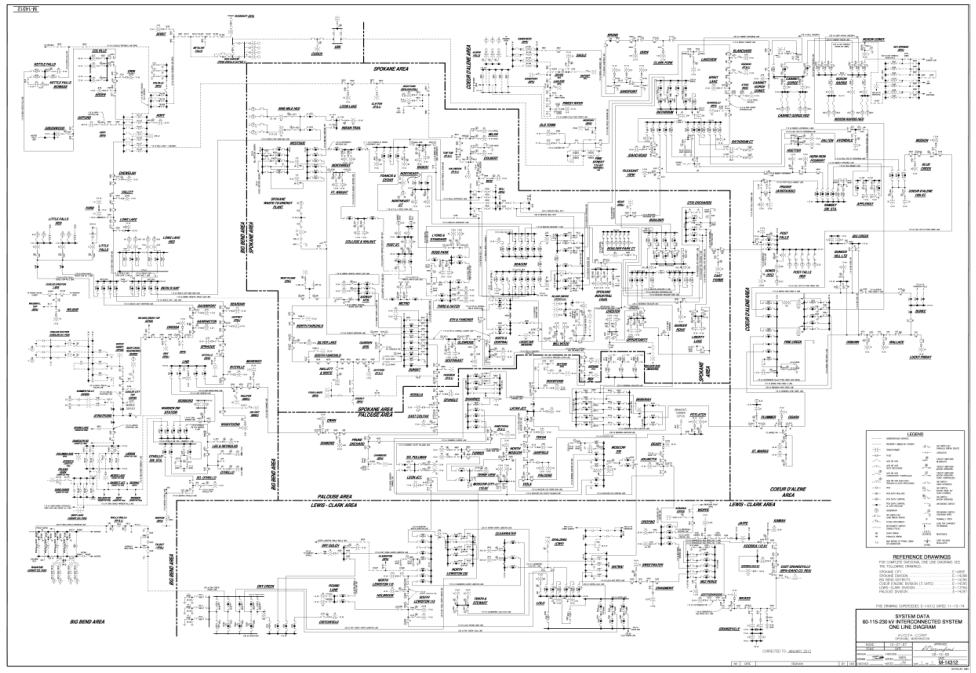

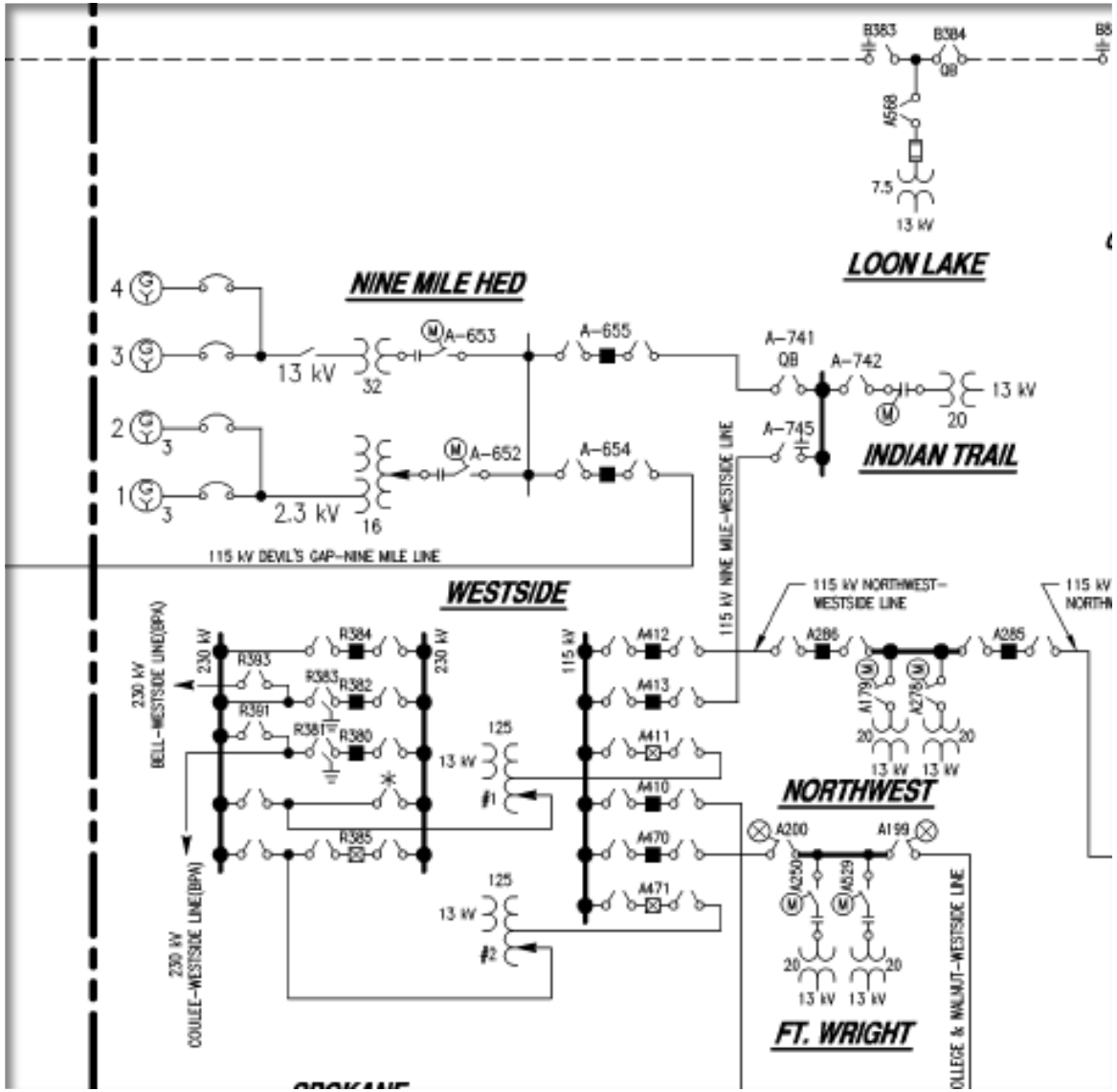

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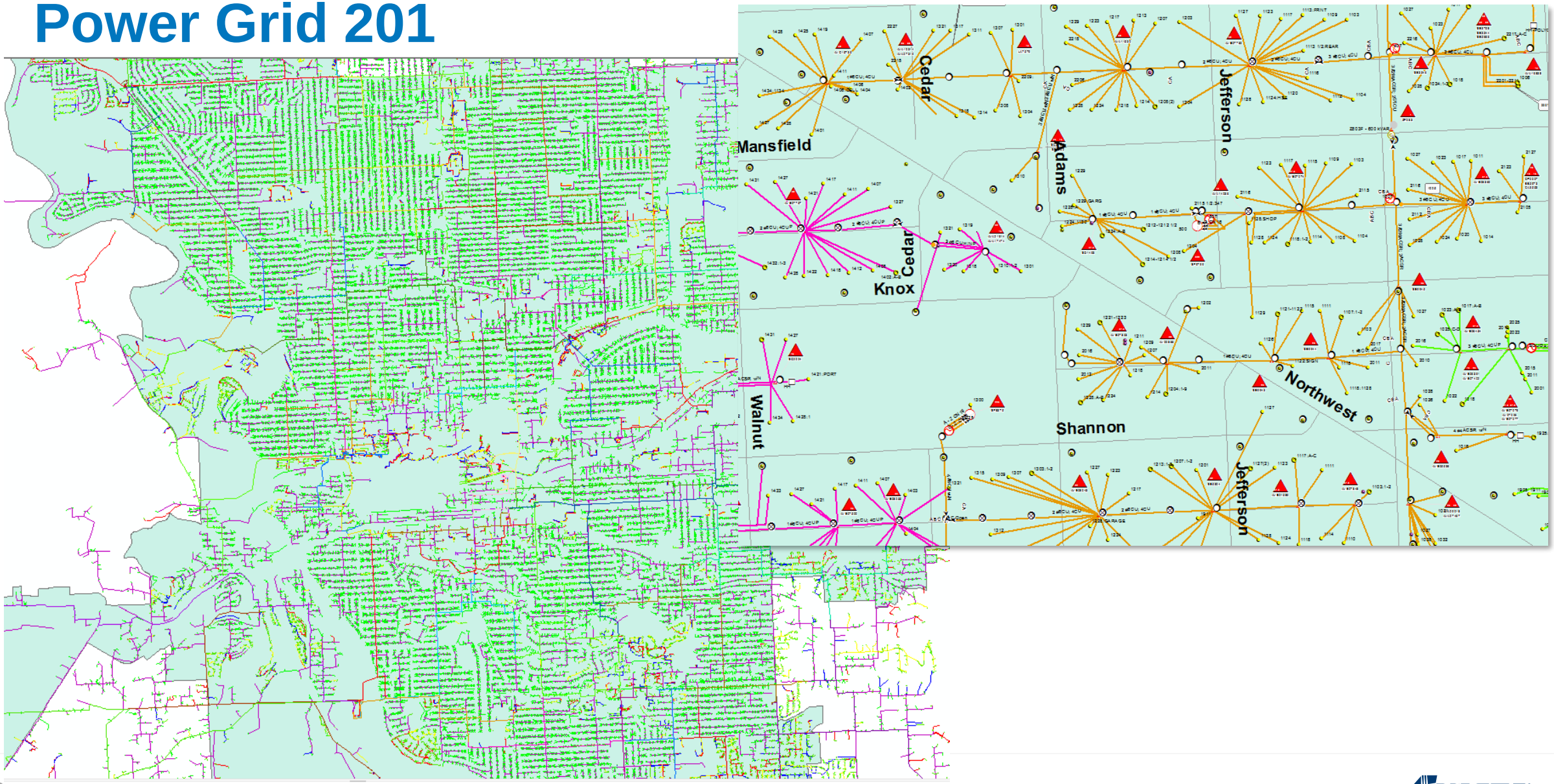
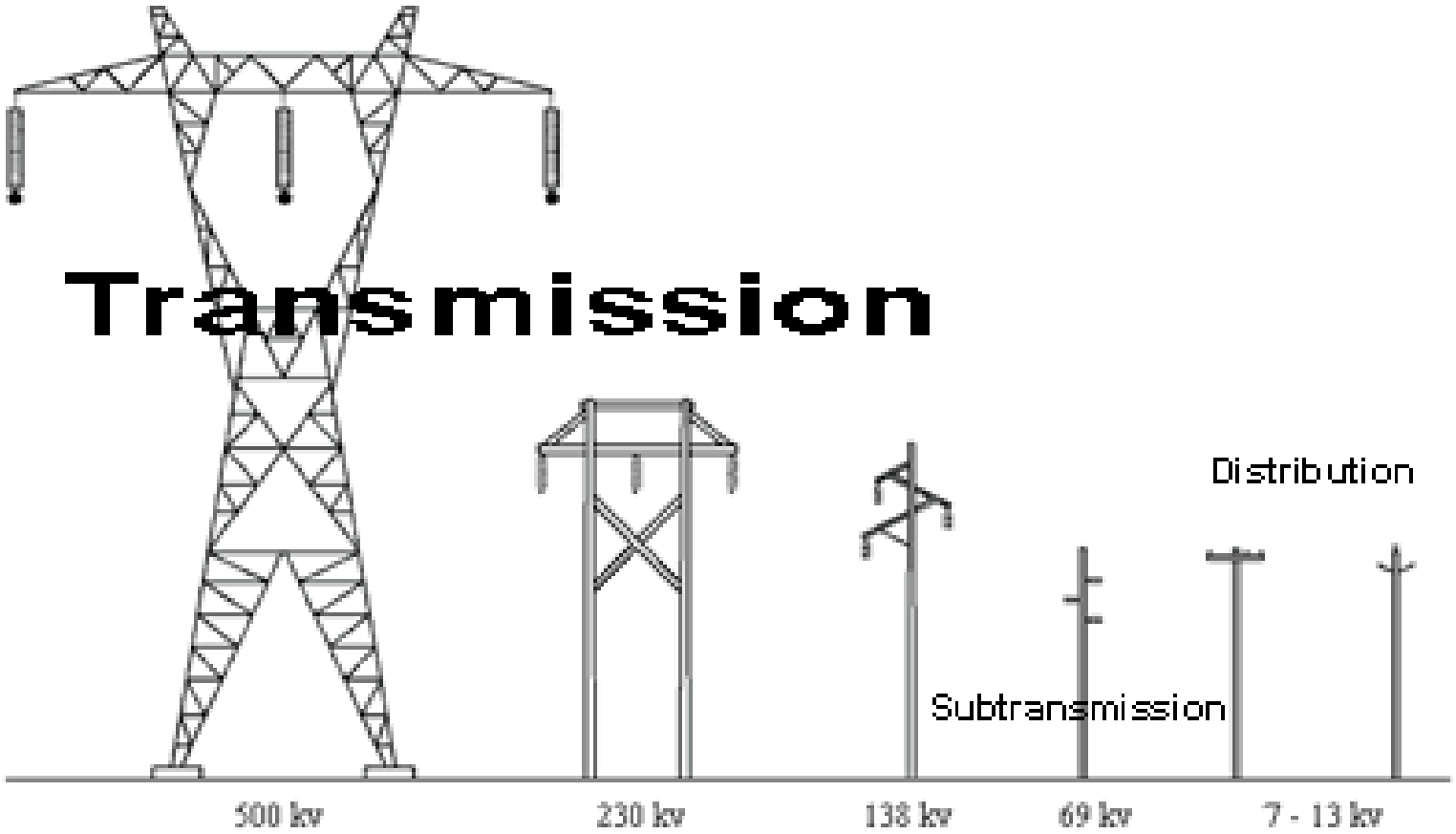


Power Grid 201



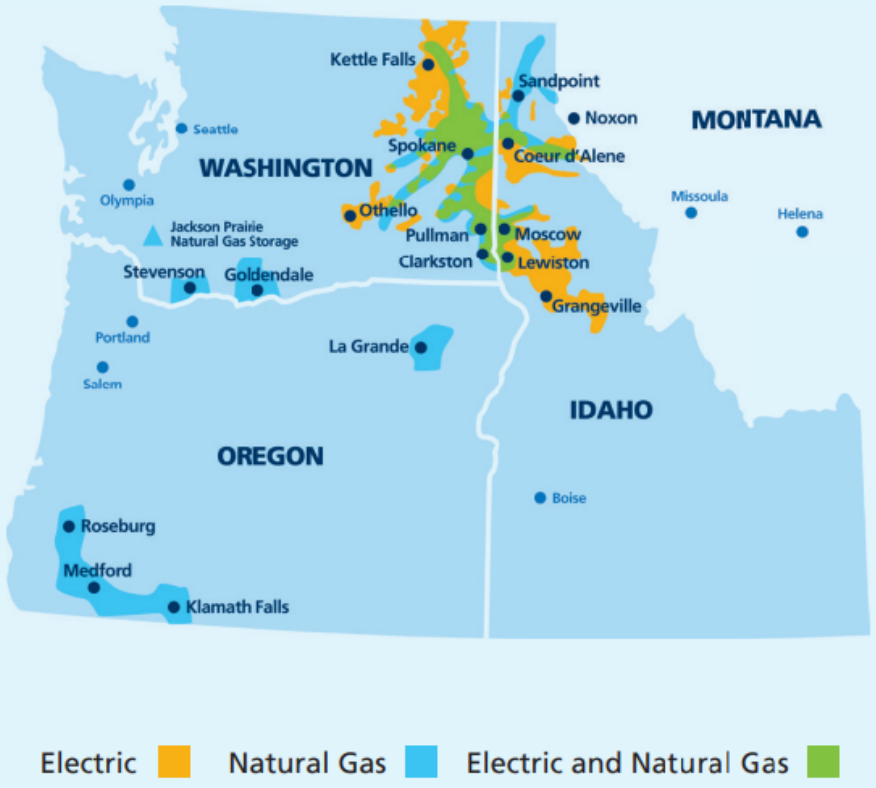
Avista's Distribution System

2022 QUICK FACTS

Avista Utilities

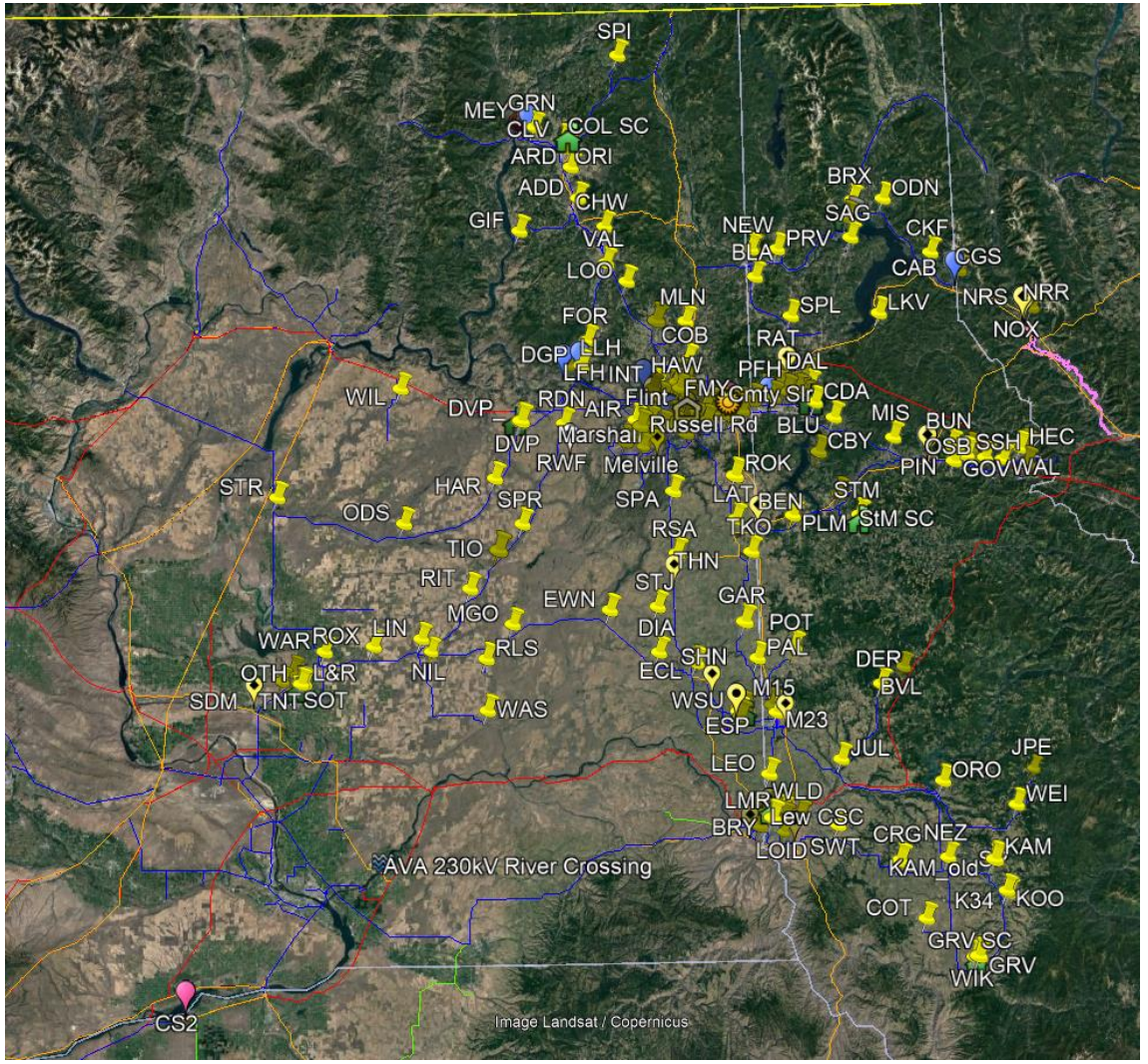
Population of Service Area	1,700,000
Miles of Transmission Line:	
230kV	700
115kV	1,600
500kV	500
Miles of Distribution lines	19,300
Miles of Natural Gas Distribution Mains	8,000
Percent of Utility Operating Revenues by Jurisdiction—Retail Revenue (Actual Sales to Customers)	
Washington	62%
Idaho	29%
Oregon	9%

Avista Service Area



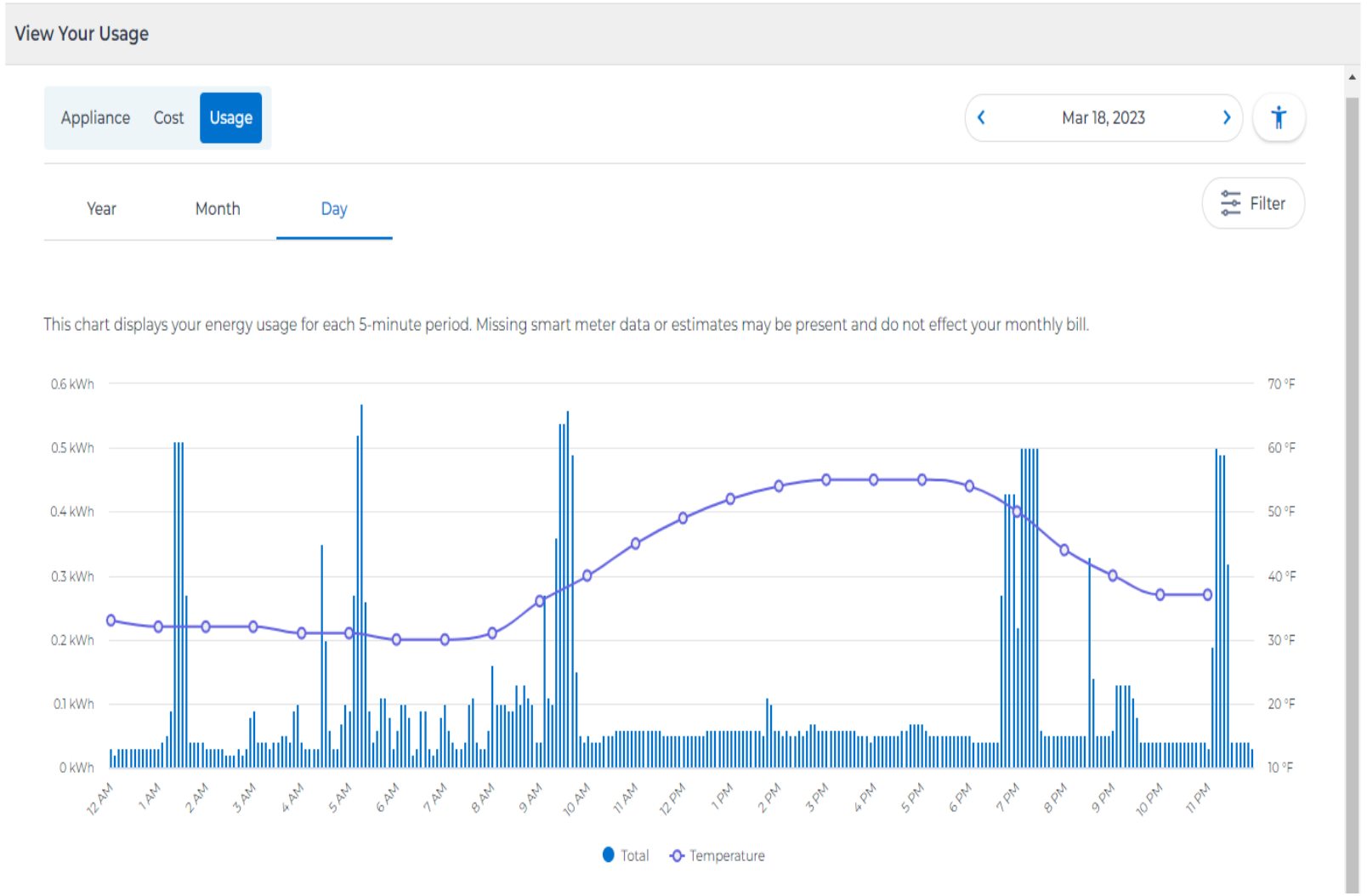
Avista's Distribution System

- 130 Distribution Substations
- 360 Feeders
- ~410,000 electric customers
- Feeder capacity varies in rural areas.
- Feeder capacity in urban areas ~10MW (2-3 thousand homes)
- Voltages range 12.5kV to 34.5kV

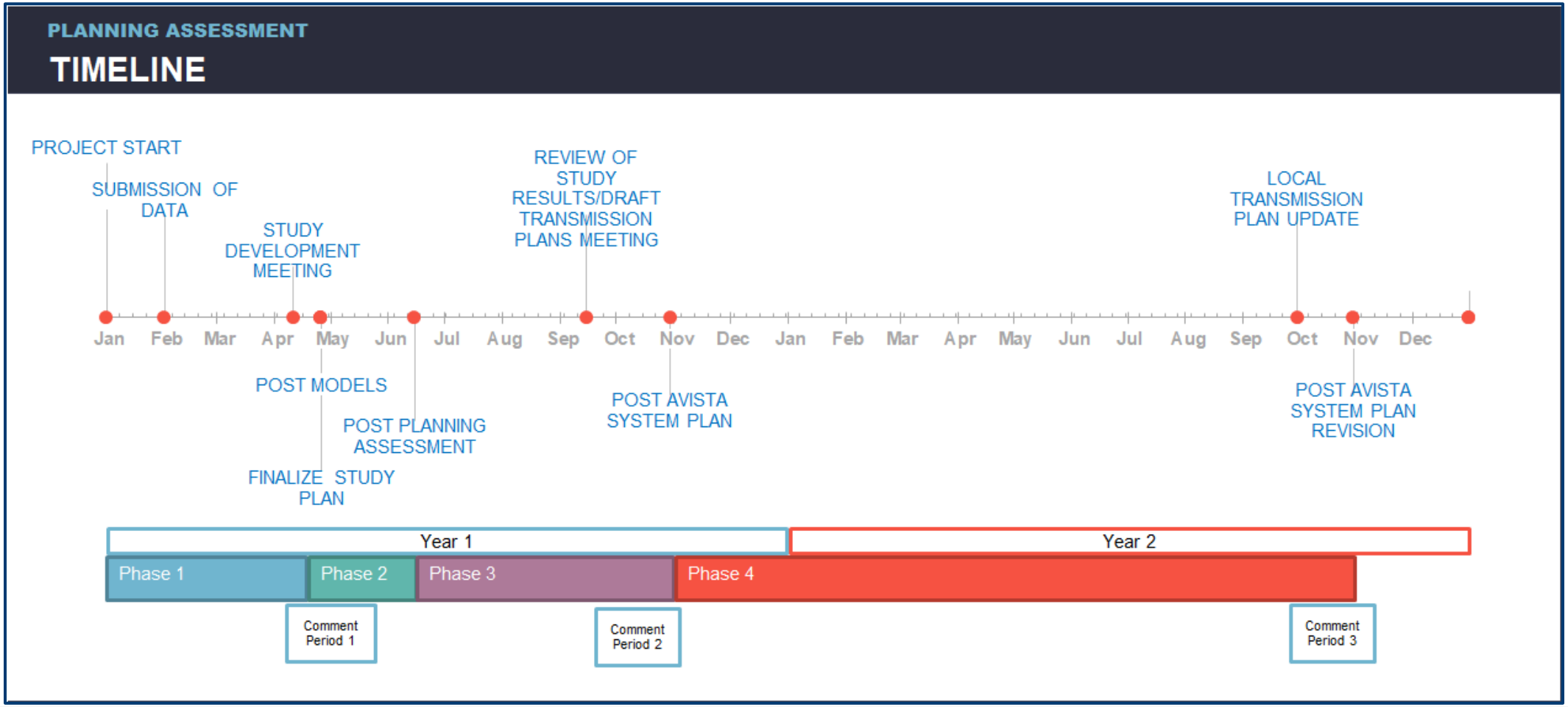


Avista's Distribution System

- 300 Feeders with SCADA
- Washington has AMI meters



System Planning

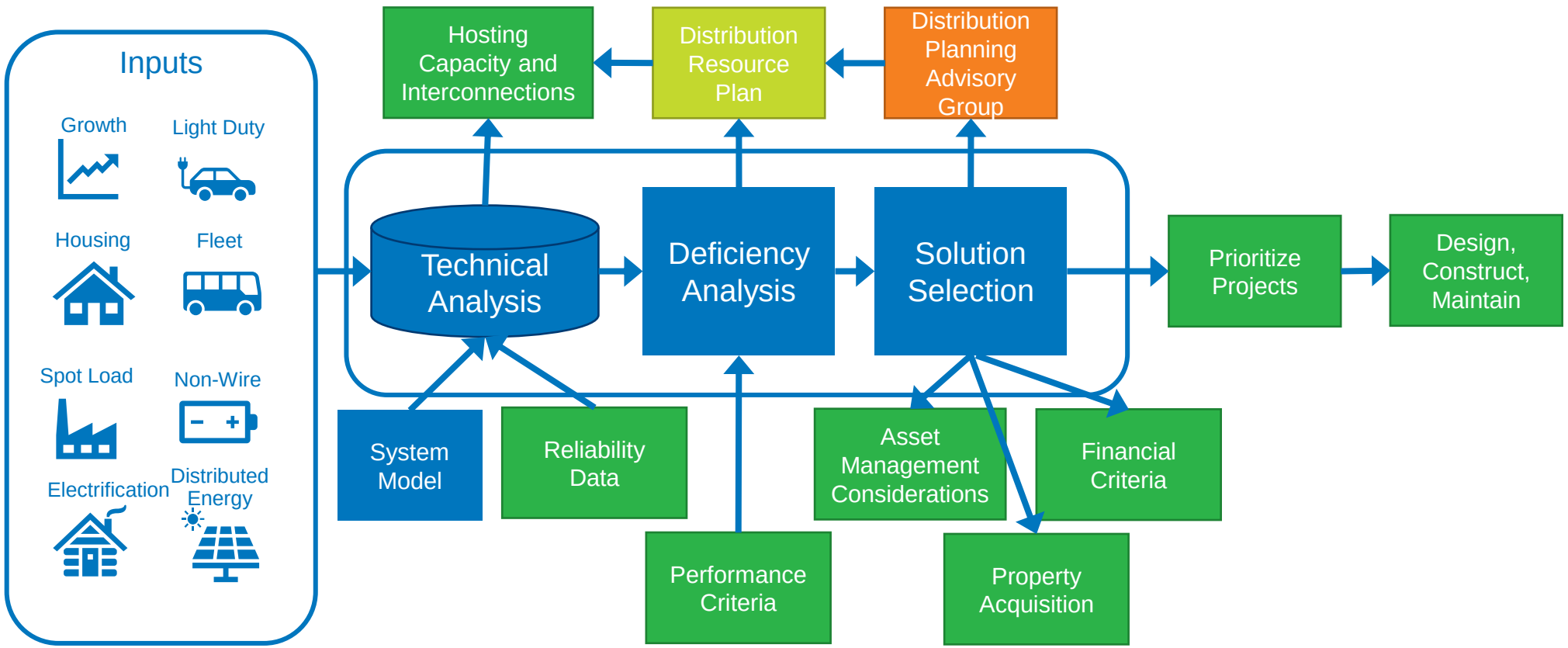


Distribution Planning

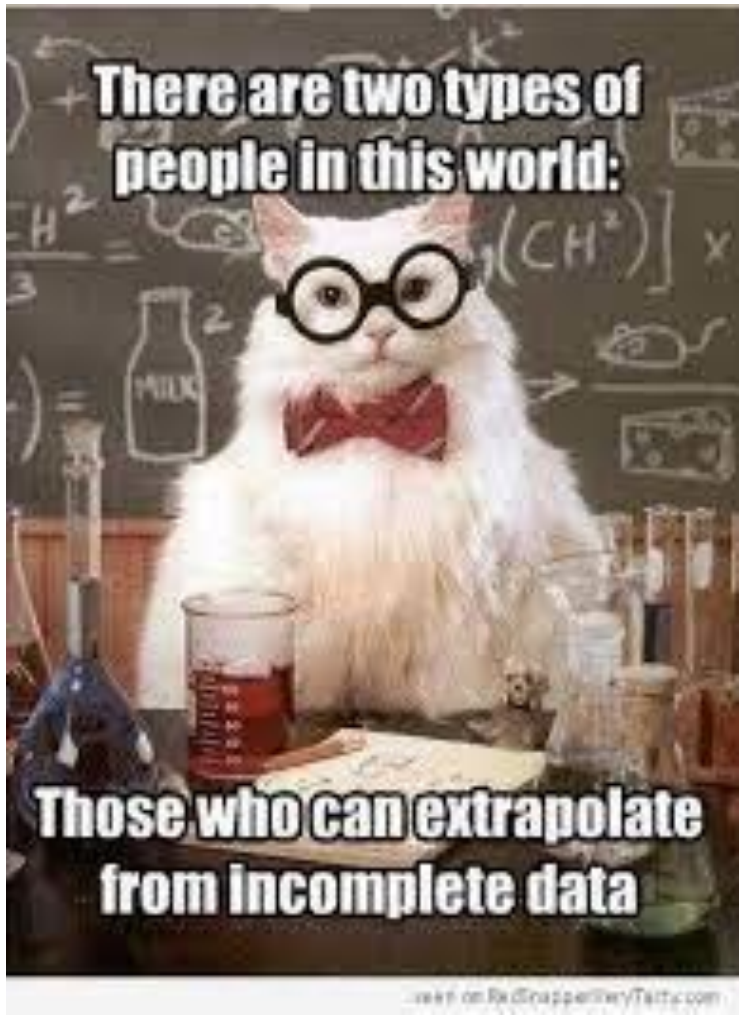
- Ensure electric distribution infrastructure is adequate to serve customers now and in the future.

- Historically, an endeavor in maintaining voltage and adequate capacity.
  - Bigger conductor
  - More feeders
  - Larger transformers
  - More substations

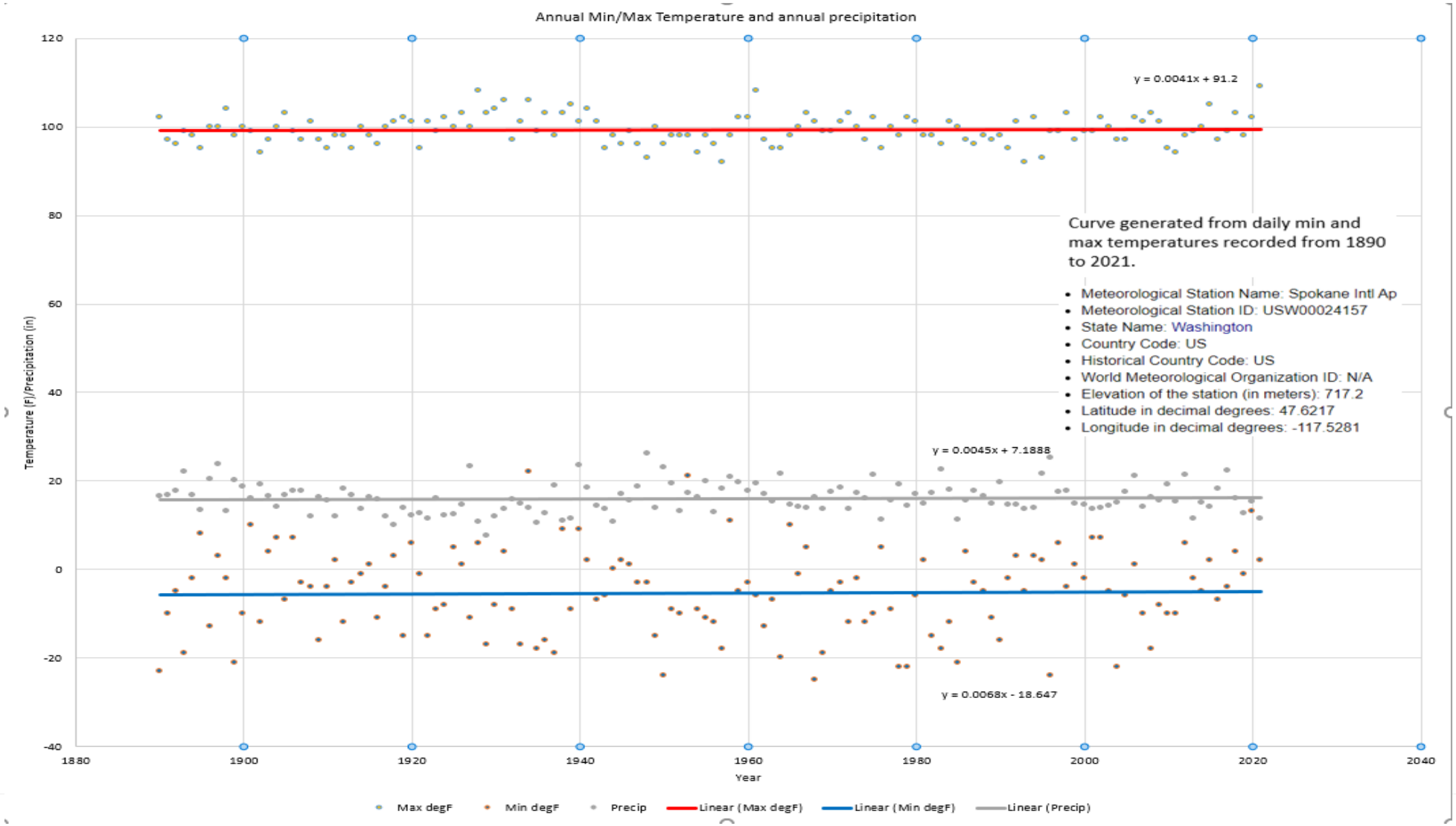
Distribution Planning



Distribution Planning

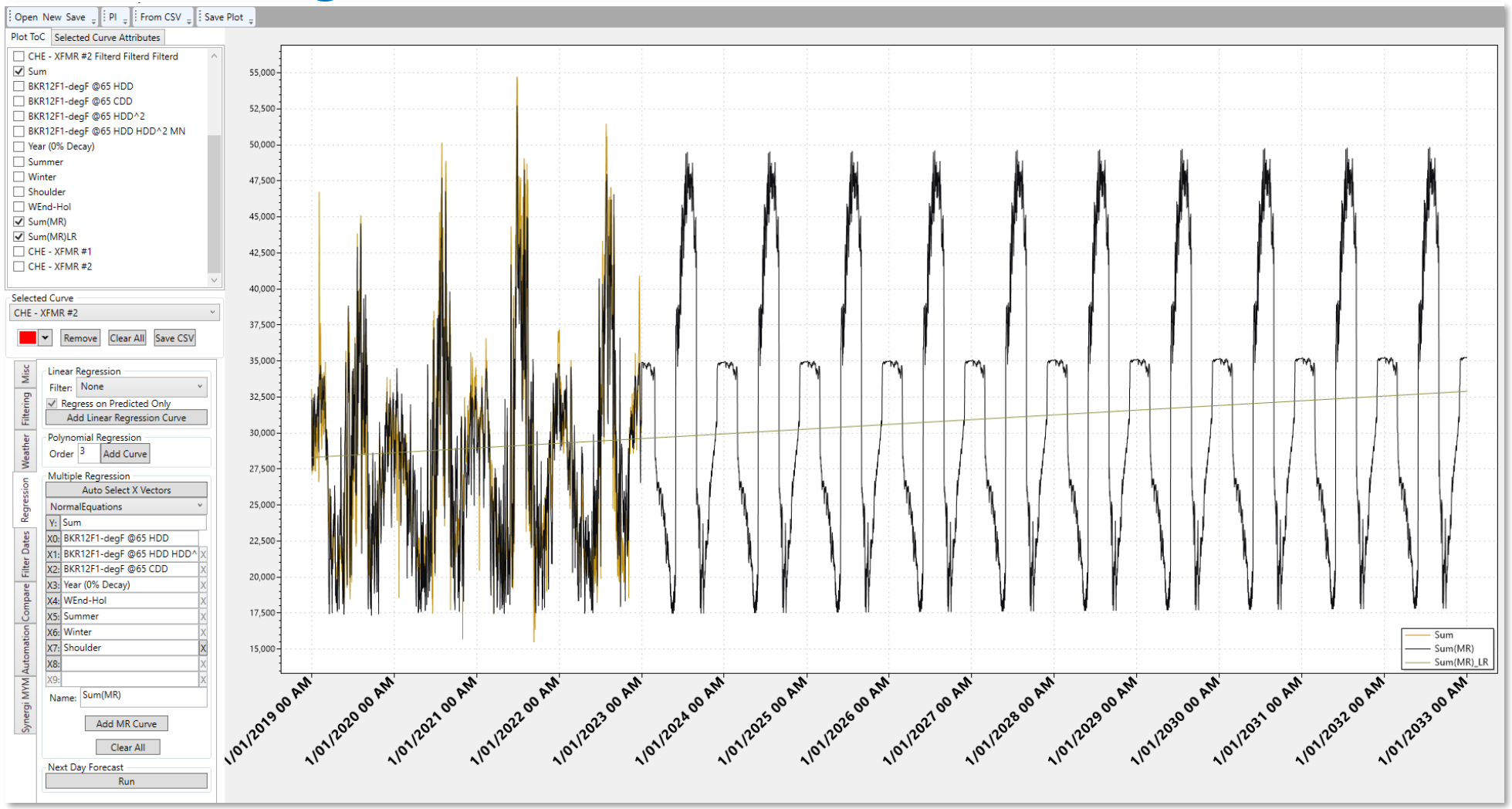


Distribution Planning



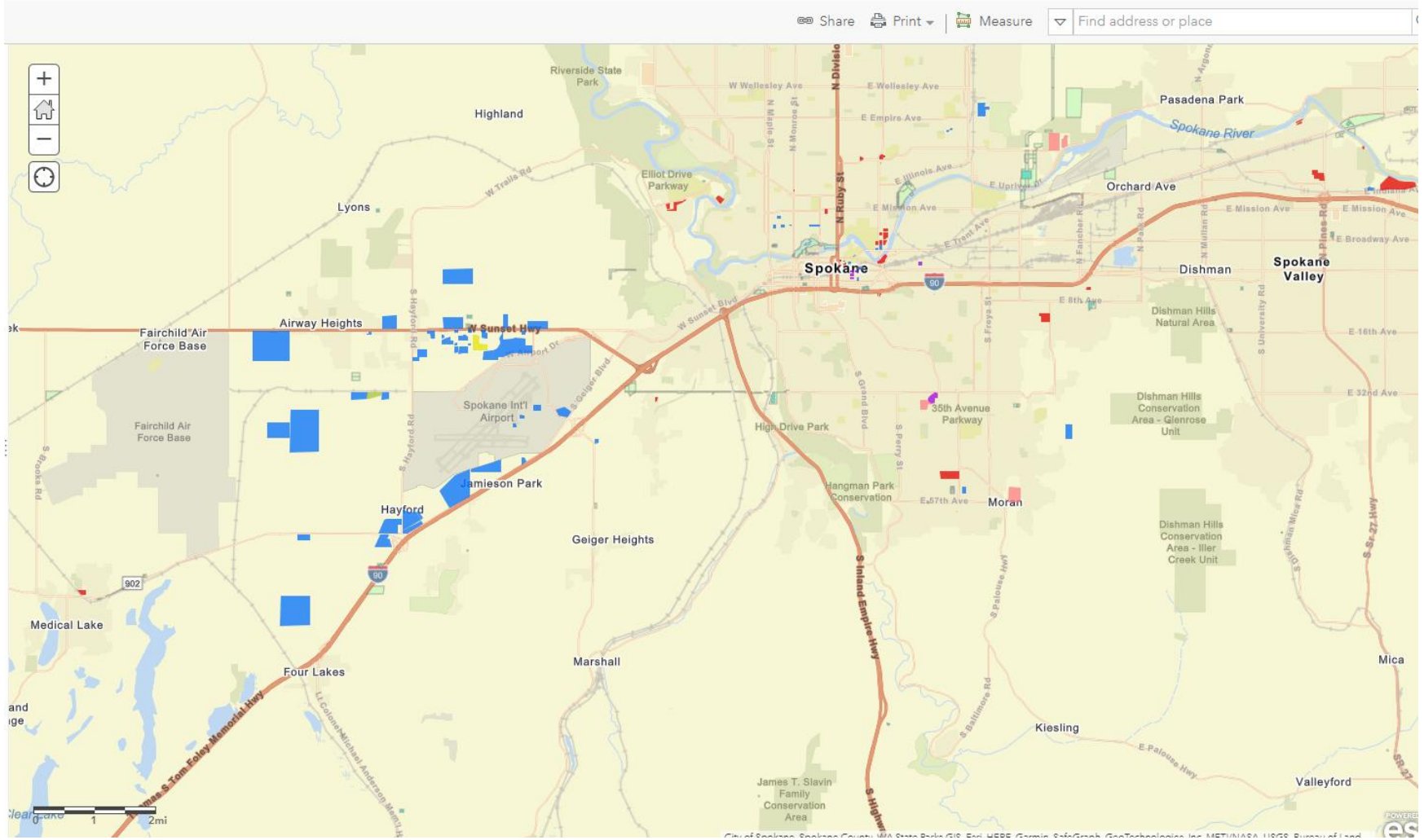
Distribution Planning

- Regression Forecasting



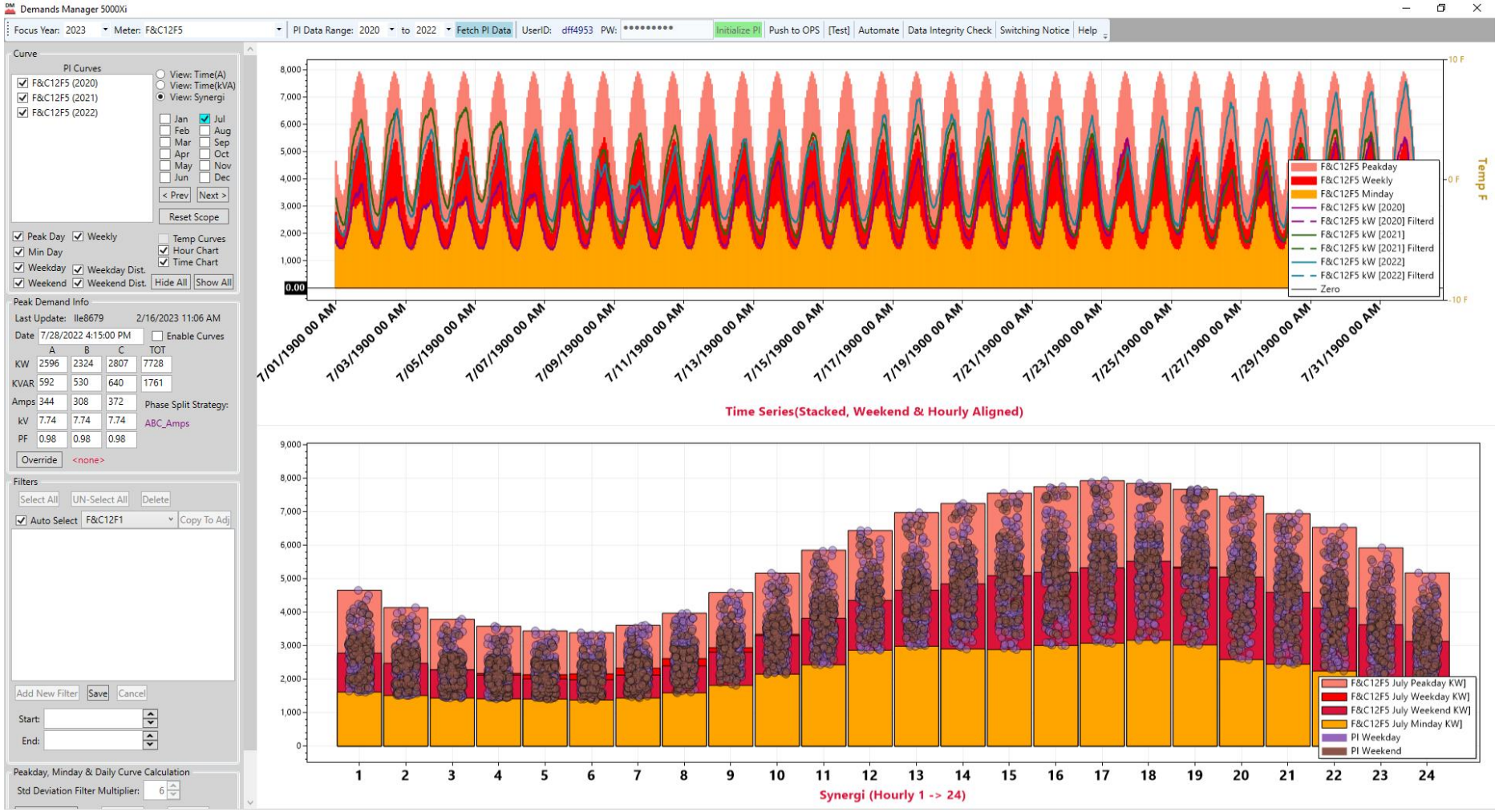
Distribution Planning

- Known developments map



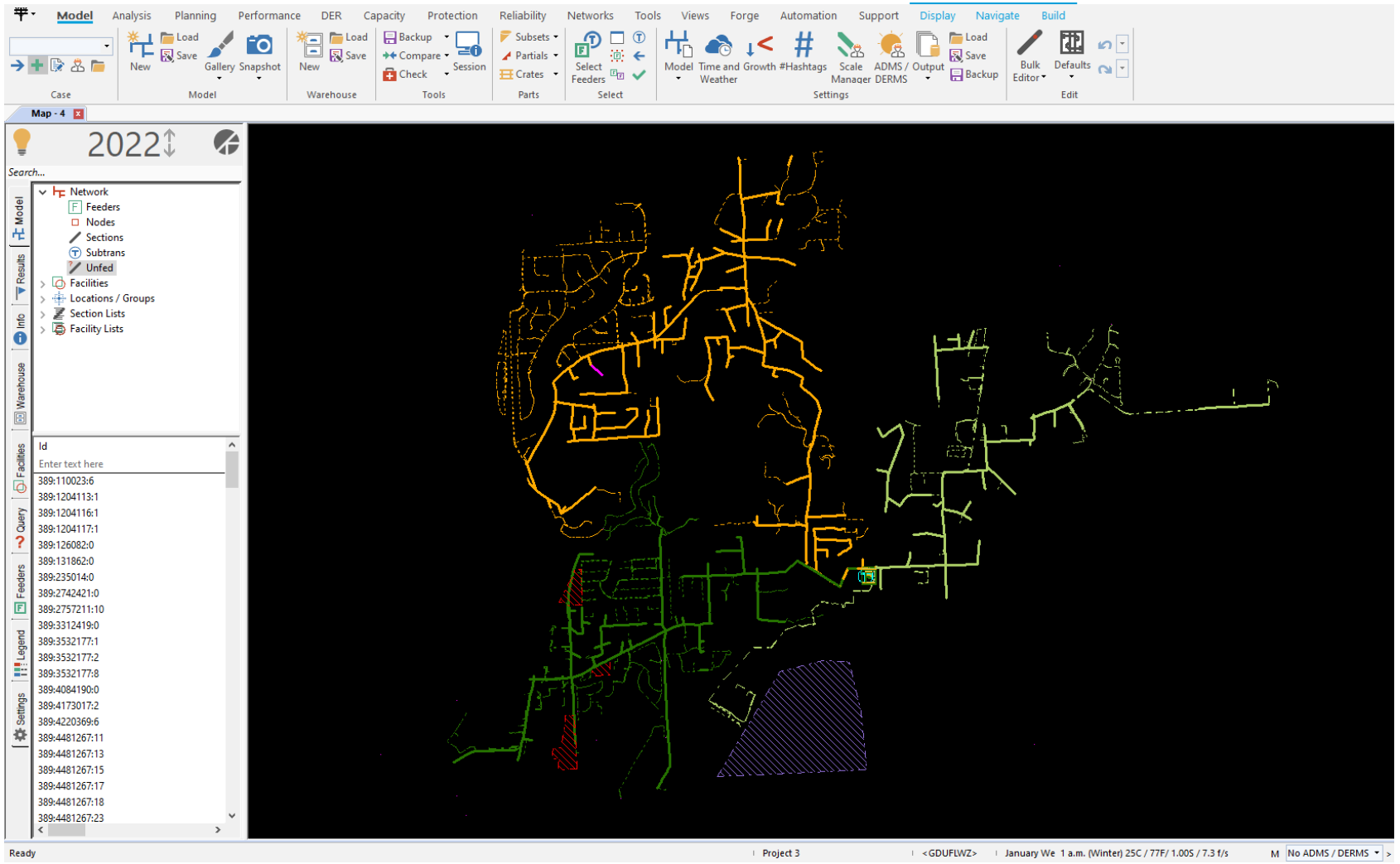
Distribution Planning

- Feeder Demand
- Feeder Curves



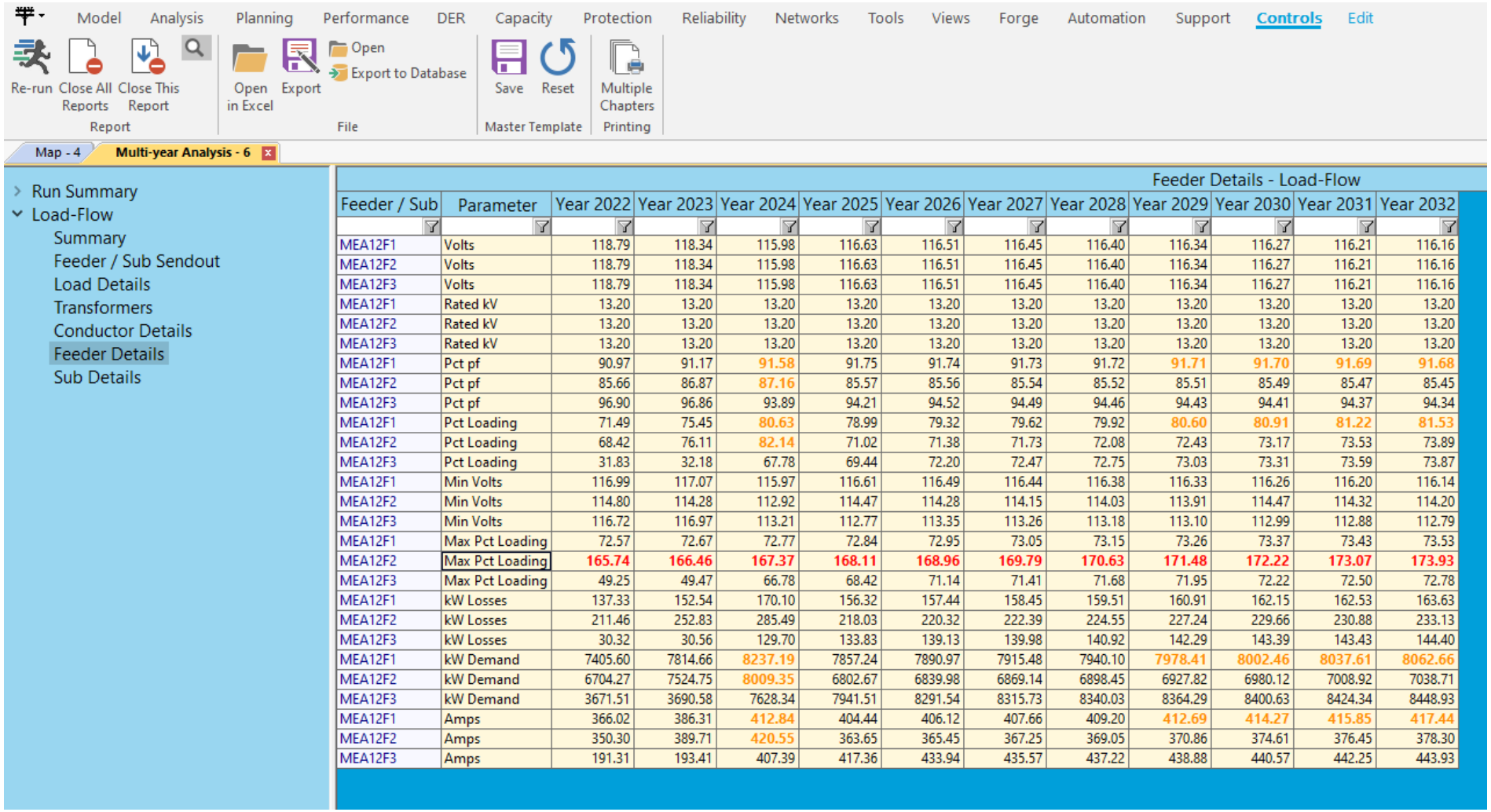
Distribution Planning

- Build a system model in Synergy Electric
- A Model is a computer representation of the distribution system that simulates what might happen in reality.



Distribution Planning

- 10 Year load flow analysis



Feeder Details - Load-Flow

Feeder / Sub	Parameter	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030	Year 2031	Year 2032
MEA12F1	Volts	118.79	118.34	115.98	116.63	116.51	116.45	116.40	116.34	116.27	116.21	116.16
MEA12F2	Volts	118.79	118.34	115.98	116.63	116.51	116.45	116.40	116.34	116.27	116.21	116.16
MEA12F3	Volts	118.79	118.34	115.98	116.63	116.51	116.45	116.40	116.34	116.27	116.21	116.16
MEA12F1	Rated kV	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20
MEA12F2	Rated kV	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20
MEA12F3	Rated kV	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20
MEA12F1	Pct pf	90.97	91.17	91.58	91.75	91.74	91.73	91.72	91.71	91.70	91.69	91.68
MEA12F2	Pct pf	85.66	86.87	87.16	85.57	85.56	85.54	85.52	85.51	85.49	85.47	85.45
MEA12F3	Pct pf	96.90	96.86	93.89	94.21	94.52	94.49	94.46	94.43	94.41	94.37	94.34
MEA12F1	Pct Loading	71.49	75.45	80.63	78.99	79.32	79.62	79.92	80.60	80.91	81.22	81.53
MEA12F2	Pct Loading	68.42	76.11	82.14	71.02	71.38	71.73	72.08	72.43	73.17	73.53	73.89
MEA12F3	Pct Loading	31.83	32.18	67.78	69.44	72.20	72.47	72.75	73.03	73.31	73.59	73.87
MEA12F1	Min Volts	116.99	117.07	115.97	116.61	116.49	116.44	116.38	116.33	116.26	116.20	116.14
MEA12F2	Min Volts	114.80	114.28	112.92	114.47	114.28	114.15	114.03	113.91	114.47	114.32	114.20
MEA12F3	Min Volts	116.72	116.97	113.21	112.77	113.35	113.26	113.18	113.10	112.99	112.88	112.79
MEA12F1	Max Pct Loading	72.57	72.67	72.77	72.84	72.95	73.05	73.15	73.26	73.37	73.43	73.53
MEA12F2	Max Pct Loading	165.74	166.46	167.37	168.11	168.96	169.79	170.63	171.48	172.22	173.07	173.93
MEA12F3	Max Pct Loading	49.25	49.47	66.78	68.42	71.14	71.41	71.68	71.95	72.22	72.50	72.78
MEA12F1	kW Losses	137.33	152.54	170.10	156.32	157.44	158.45	159.51	160.91	162.15	162.53	163.63
MEA12F2	kW Losses	211.46	252.83	285.49	218.03	220.32	222.39	224.55	227.24	229.66	230.88	233.13
MEA12F3	kW Losses	30.32	30.56	129.70	133.83	139.13	139.98	140.92	142.29	143.39	143.43	144.40
MEA12F1	kW Demand	7405.60	7814.66	8237.19	7857.24	7890.97	7915.48	7940.10	7978.41	8002.46	8037.61	8062.66
MEA12F2	kW Demand	6704.27	7524.75	8009.35	6802.67	6839.98	6869.14	6898.45	6927.82	6980.12	7008.92	7038.71
MEA12F3	kW Demand	3671.51	3690.58	7628.34	7941.51	8291.54	8315.73	8340.03	8364.29	8400.63	8424.34	8448.93
MEA12F1	Amps	366.02	386.31	412.84	404.44	406.12	407.66	409.20	412.69	414.27	415.85	417.44
MEA12F2	Amps	350.30	389.71	420.55	363.65	365.45	367.25	369.05	370.86	374.61	376.45	378.30
MEA12F3	Amps	191.31	193.41	407.39	417.36	433.94	435.57	437.22	438.88	440.57	442.25	443.93

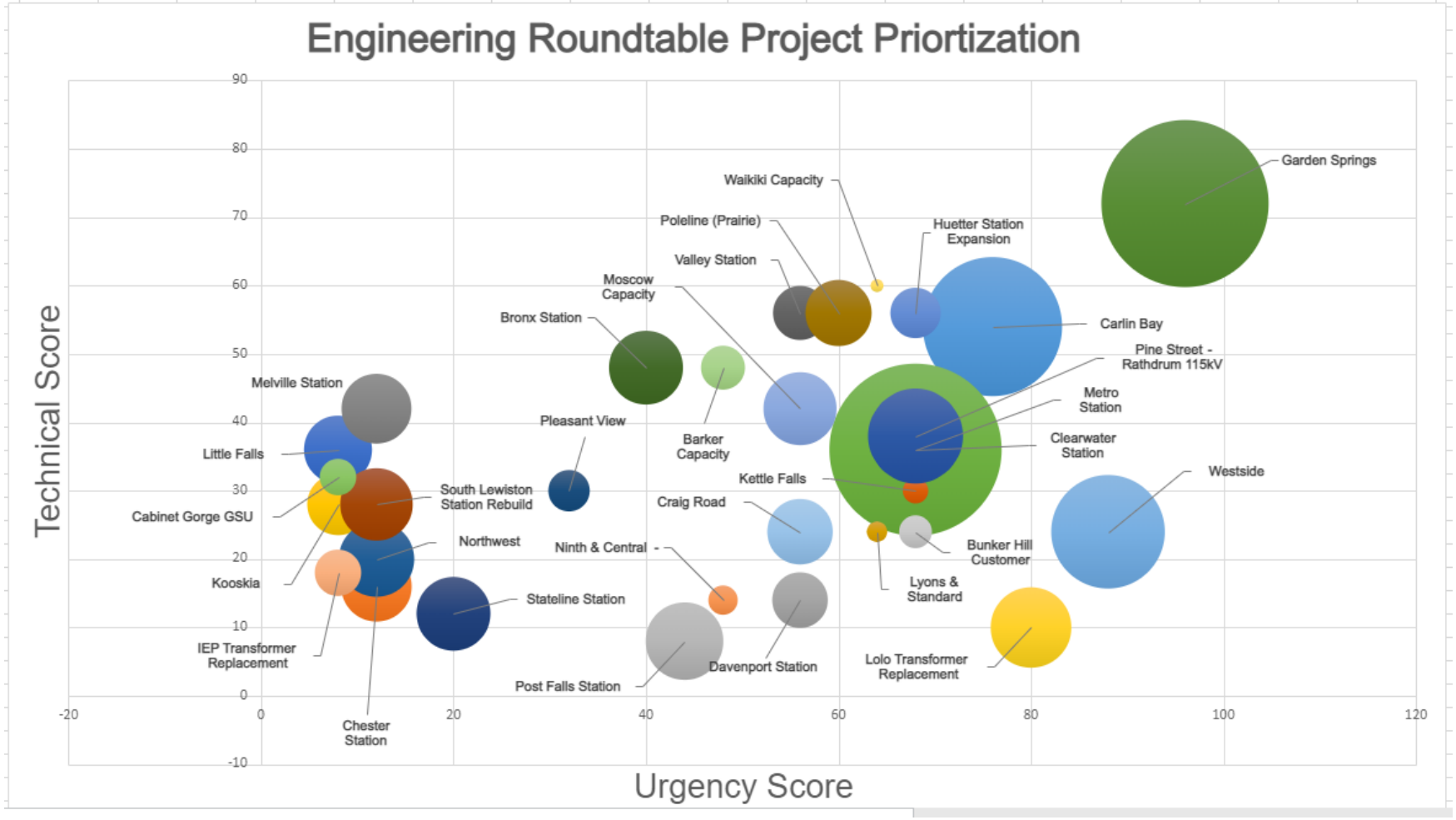
Distribution Planning

- Performance Criteria

Category[2]	Outage[3]	Thermal Performance	Voltage Performance[4]	Regulator Performance	Current Imbalance	Voltage Imbalance	Customers Experiencing Interruption[5]	Customers Experiencing Sustained Outage Longer than 2 Hours[6]	Notes
D0 - No Contingency	None	< 80% *Continuous*[7]	118V < Volt < 127V	-12 < tap < +12	Line loading > 90%: 5% Line loading > 80%: 10% Line loading >70%: 15% Line loading < 70%: 20%	3%	N/A	N/A	• Seasonal load transfers can be used
D1 - Feeder Contingency	Loss of one of the following:	< 95% Continuous	114V[8] < Volt < 127V < 4V Deviation[9]	-15 < tap < +15	Line loading > 90%: 10% Line loading < 90%: NA	5%			• Field switching can be used to restore customers • Generator curtailment may be required for restoration
	1. Feeder Lockout						3000 or 10MVA	Suburban: 500 Rural: 3000	
	2. Generator Outage/Off						0	0	
	3. Automatic Transfer Switch Operation						N/A	N/A	
D2 – Multiple Contingency (Common Structure[10])	Loss of one of the following:	< 95% Continuous	114V< Volt < 127V		None	5%	4000	500	
	1. Loss of two feeders on common structure								
	2. Loss of three feeders on common structure								
D3 - Substation Contingency	Loss of one of the following:	< 95% Continuous	114V< Volt < 127V	-15 < tap < +15	None	5%			• Feeder breaker and/or regulator bypass is acceptable
	1. Feeder Regulator						3000	0	
	2. Feeder Breaker						3000	0	
	3. Substation Transformer						6000	Suburban: 0 Rural: 1500	

Distribution Planning

- Well scoped projects go to project delivery



Questions?

Next steps

- We are currently working on the system assessment. Expect an update on the findings.
- Next meeting will include a deeper dive into grid resources, non-wire alternatives and the expectations of planning in the future.
- If you have a topic suggestion, please send it to- DistributionPlanning@avistacorp.com