Power Supply Resource Investigation

December 7, 2022

Power Supply

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IRP Identified Need

- 20 Year Outlook
  - 55MW (4 hour) Battery Storage- Capacity Adjusted 9 MW
  - 380MW Solar - Capacity Adjusted 114MW
  - 135MW Wind - Capacity Adjusted 54MW
  - 8MW SMR/CFPP -Capacity Adjusted 7.6MW
- 5 Year
  - 30MW Battery Storage - Capacity Adjusted 5MW
  - 85MW Solar - Capacity Adjusted 25.5 MW
  - 105 MW Wind - Capacity Adjusted 42 MW

Source: Los Alamos County 2022 Integrated Resource Plan, p. 15, exhibit 3.

Future Resource Being Investigated

Types		Resources	Considerations
Baseload	Thermal	Combined Cycle (CC)	Inconsistent with carbon neutral goal
		Laramie River Station (LRS)	Exit when economical, no later than 2042[1]
	Nuclear	Carbon Free Power Project (CFPP)	Subscription levels: 0, 8, 36 MW
	Hybrid	ATC PPA with 28% Renewable[2]	Near term bridge PPA to replace San Juan Unit 4
	Firm Renewables	Solar + Wind	Uniper contract + more
		Solar + Battery	Solar weather dependent
		Geothermal	High cost, opportunistic and geography dependent
		Fuel Cells	< 5 MW size, implemented in other national labs
Peaking	Thermal	Reciprocating Internal Combustion Engine (RICE)	Explore in IRP for dispatchability and balancing
		Simple Cycle Gas Turbine (SCGT)	Explore in IRP for dispatchability and balancing
	Storage	Pumped Hydro	Cost and ownership of water rights; Opportunistic and geography dependent
		Lithium-ion Battery	Duration considerations
		Vanadium Redox Flow Battery	High-cost; lack of actual projects development
Intermittent	Renewables	Solar (onsite or offsite)	Weather dependent
		Onshore Wind	Weather dependent; transmission constraints

Resources being investigated currently

Source: Los Alamos County 2022 Integrated Resource Plan, p. 45, exhibit 32.

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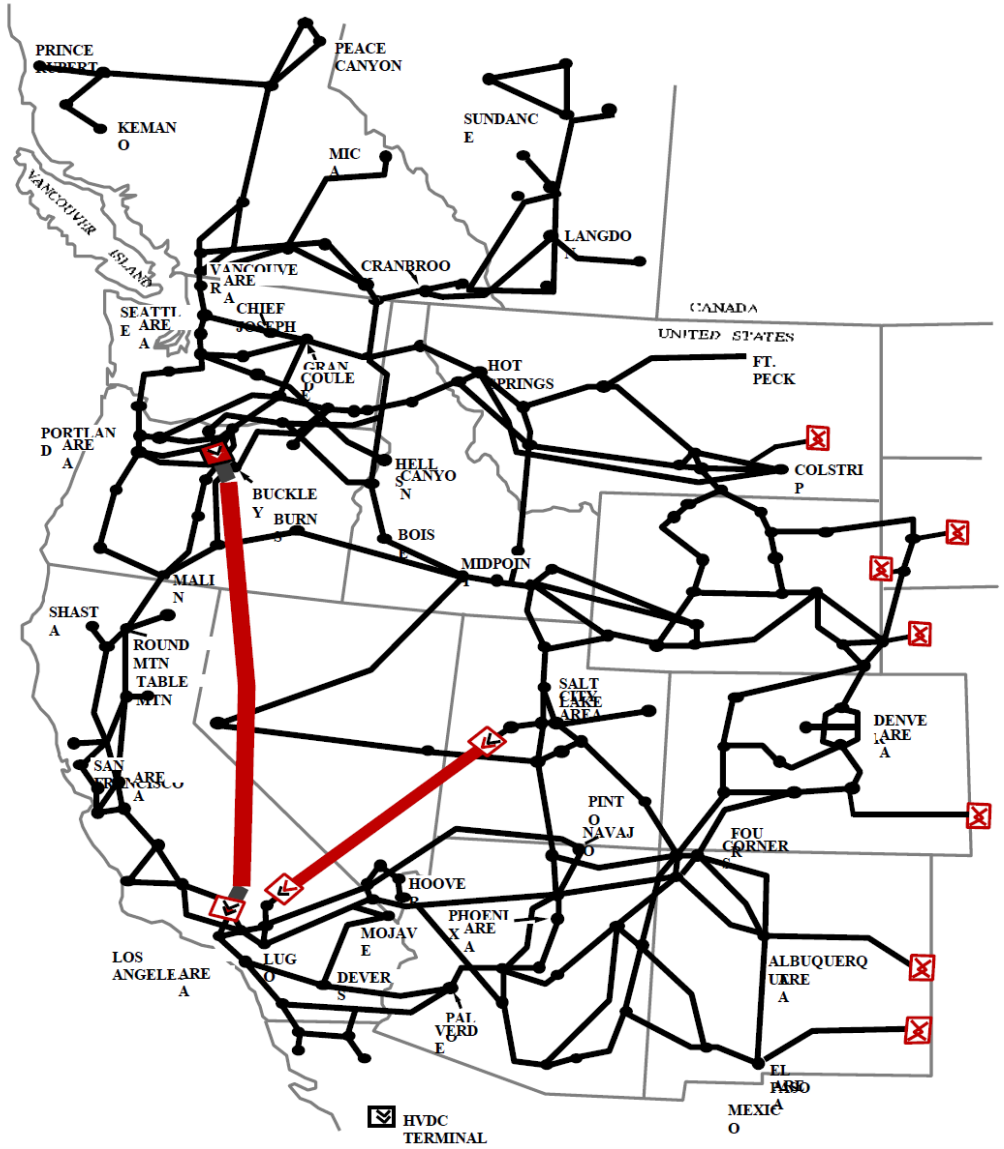
IRP Pivot Strategies Identified

- Investigate
  - Simple Cycle Gas Turbine
  - Reciprocating Internal Combustion Engine
- When cost effective:
  - Hydrogen
  - Flow battery
  - Compressed Air Storage
- Partners and Potential locations for Resources listed above
  - San Ildefonso Pueblo
  - NGI-NTUA Generation Inc.
  - Jicarilla Energy Center
  - UNIPER
  - Mercuria Energy
  - Four Corners
  - San Juan
  - UAMPS
  - Affordable Solar
  - CREDA

Transmission Considerations



Transmission Cost by Resource				
Existing Resource	Transmission cost above PNM	PNM BA Ancillaries & Transmission	LANL/DOE Transmission	Total Transmission Cost
Abiquiu	$ 2.50	$ 6.00	$ 2.50	$ 11.00
Economy Purch	$ -	$ 6.00	$ 2.50	$ 8.50
El Vado	$ 5.97	$ 6.00	$ 2.50	$ 14.47
Lincoln-Wyoming	$ 3.50	$ 6.00	$ 2.50	$ 12.00
San Juan	$ -	$ 6.00	$ 2.50	$ 8.50
WAPA (LAC)	$ -	$ 6.00	$ 2.50	$ 8.50
WAPA Firm (DOE)	$ -	$ 6.00	$ 2.50	$ 8.50
Proposed Resources				
CFPP-Proposed	$ 7.00	$ 6.00	$ 2.50	$ 15.50
Uniper-Proposed	$ -	$ 6.00	$ 2.50	$ 8.50

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Transmission

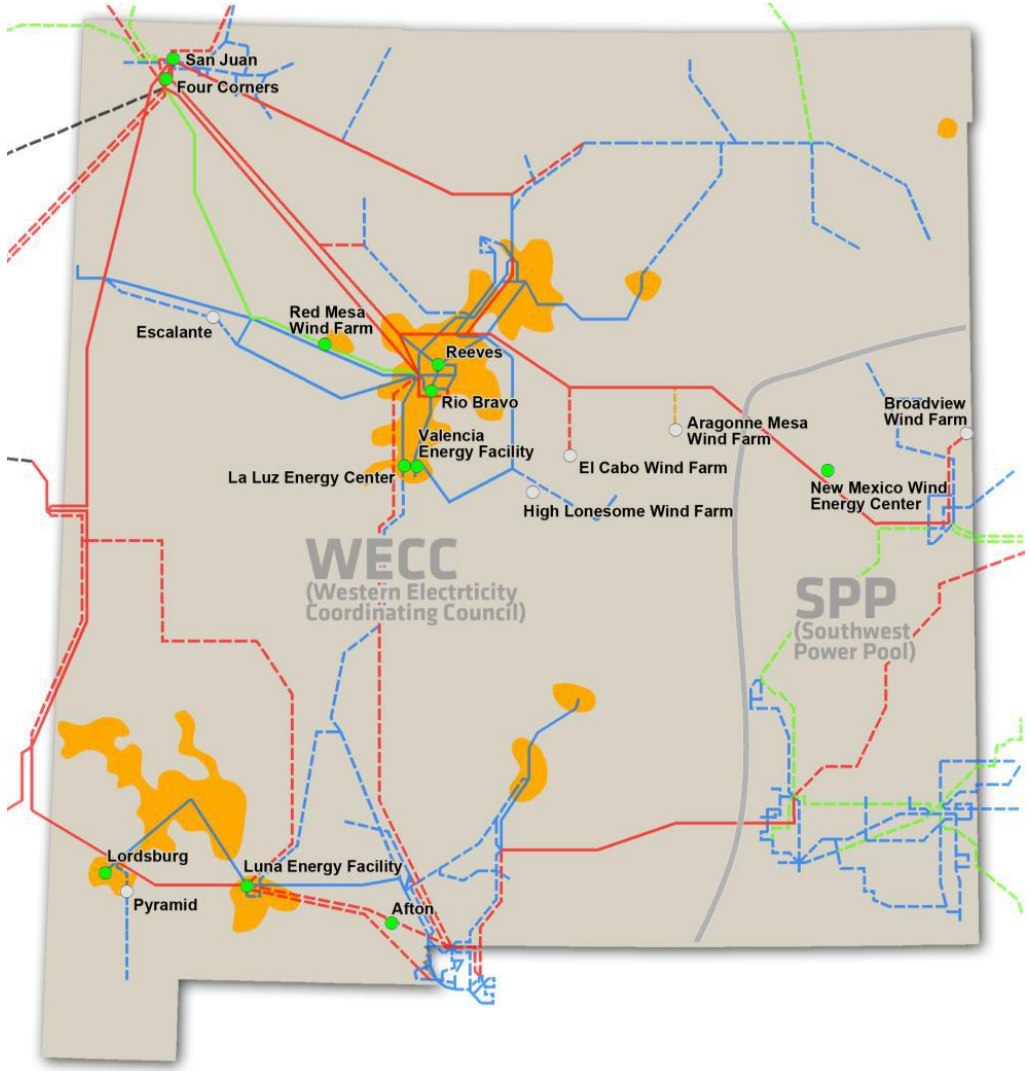
Existing Transmission

- PNM 115kV
- PNM 230kV
- PNM 345kV
- Other 115kV
- Other 230kV
- Other 345kV
- Other 500kV

Existing Generation

- PNM
- Other

PNM Service Areas



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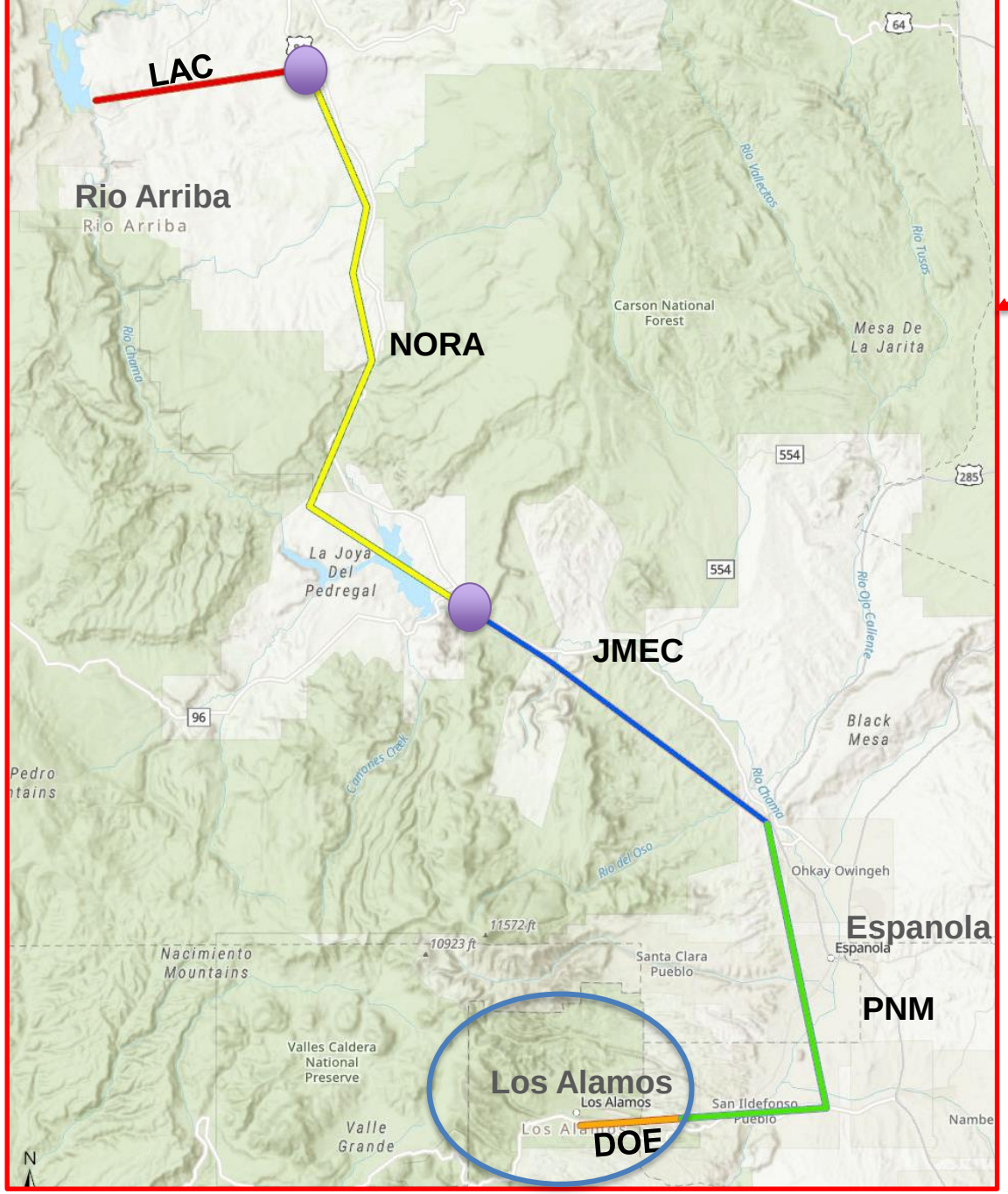

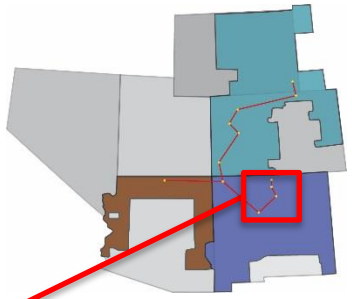

Pancaking Transmission Rates

NORA Electric Co-op Transmission		$3.47/MWh
TSGT Substation		$0.50/MWh
JMEC		$2.00/MWh
PNM	Approx.	$6.00/MWh
DOE-NNSA	Approx.	$2.50/MWh

Example:
El Vado Trans. Cost $14.47/MWh

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CFPP

- Carbon Free Power Project, January 2023 decision point on DCRA (Development Cost Reimbursement Agreement) and Economic Competitive Test model
- Present Class 3 estimate summary
- Revised Levelized Cost, Budget & Plan of Finance, and Development Cost Reimbursement Agreement
- More information to follow on January 11th 2023

ATC PPA

- Consider 2-year extension of the 25 MW Uniper resource
- Gives time to acquire and construct resources per the IRP Implementation plan
- Availability and cost under evaluation

Solar + Battery on LANL Site

- 8-10MWs of PV on LANL Site
- DOE/NNSA would lease land to LAC with the intention of LAC developing the PV site
- DOE/NNSA would install interconnection power lines
- LAC has engaged a PV developer for initial concept exploration
- LAC has requested a battery study for potential locations within our service territory with the new possibilities the Inflation Reduction Act has enabled
- Suitability and cost under evaluation

Solar + Battery with UAMPS

- UAMPS currently investigating solar + battery options
- Investigation is looking at 100 MW solar projects
  - 50 MW storage with 4-hour duration
- Interconnection planned for PacifiCorp East control area
- Anticipate COD ranging from 2026 to 2028
  - COD dependent on generator interconnection timing – uncertainty on most projects
- 25-year PPA
- Limited ability for load following with storage
- General price ranges, not specific to any projects
  - Solar $30-50/MWh
  - Battery $100-200/MWh
  - Solar + Battery 4-hour $60-100/MWh
  - Solar + Battery around the clock $130-250/MWh

Solar and Storage Example Scenario

27%

73%

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Solar and Storage Example Scenario

27%

73%

Later in the day

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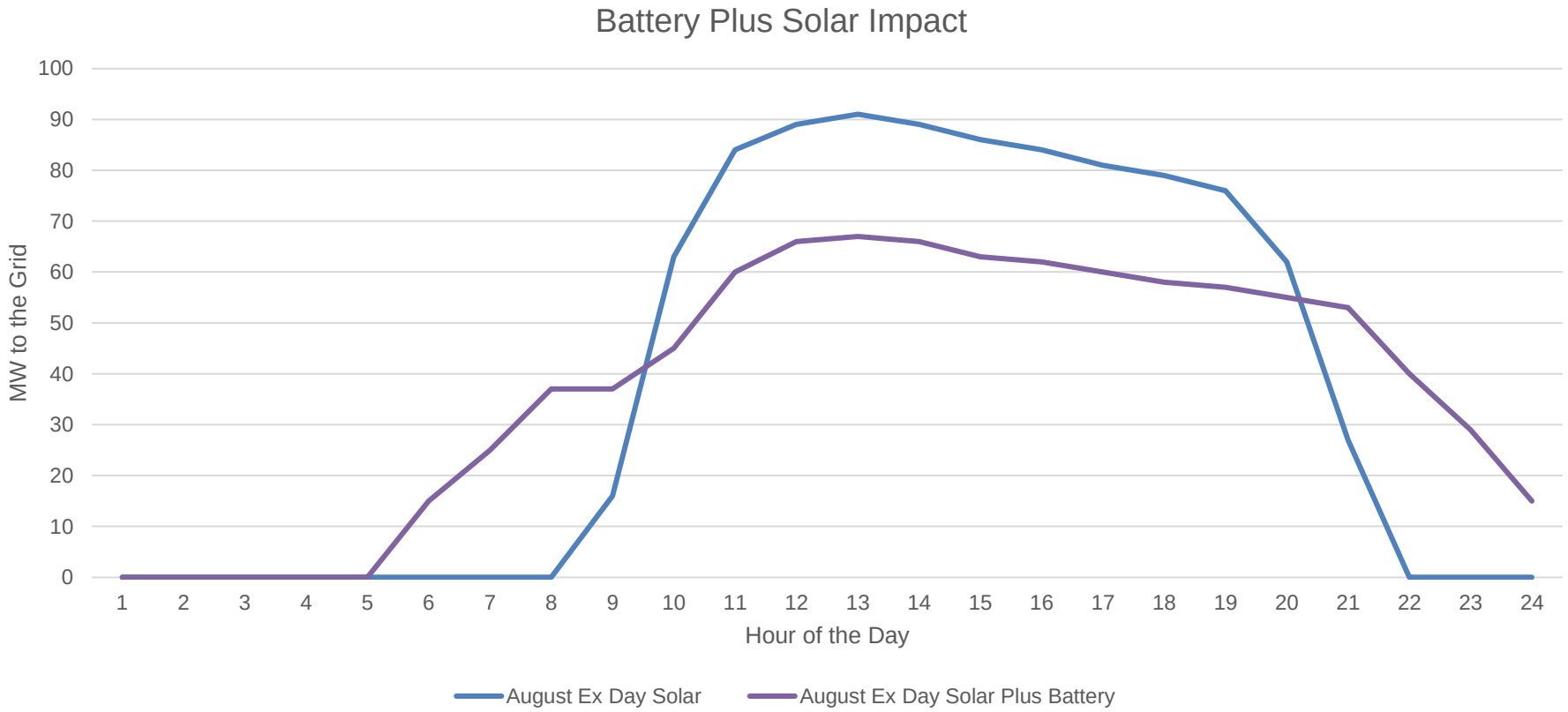
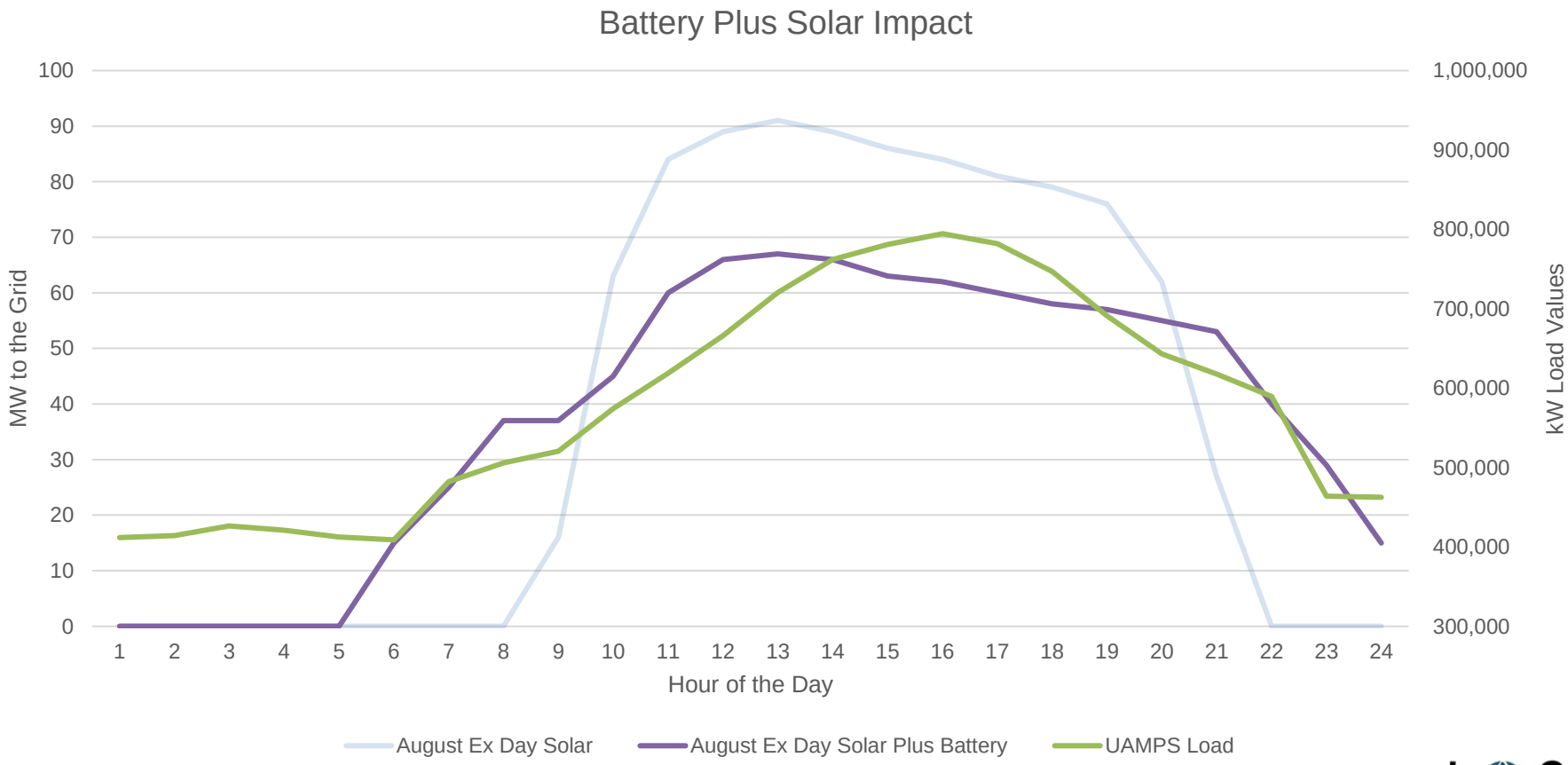
Solar and Storage Profile Example



Solar and Storage Profile with Load



Geothermal-UAMPS

- UAMPS currently investigating geothermal options
- There is significant interest across the west in geothermal
  - Most available options are under contract
- Projects are often in the 30 MW size range
- 15-25 year PPA desired
- Most options are “take or pay”
  - Good for base load, but expensive to use for load following
- Some flexibility on location, depending upon project
- General price range, not specific to any projects $65-120, can be >$400/MWh

Natural Gas Generation-UAMPS

- Limited certainty into the future
  - Air permits, carbon taxes
  - Uncertain gas pricing into the future
  - Short amortization period, maybe 10 years
- Flexible, able to ramp quickly and follow load
- Smaller “behind the meter” options will be investigated as well as larger projects
- Timeline for transmission interconnection a concern
- Investigating potential hydrogen fuel capability
- General price range, not specific to any project $80-120, fuel cost dependent

LAC Exploration of Gas Generation

- Different Options for participation in a gas resource:
  - Call option:
    - Pay monthly demand fee
    - Pay for energy as it is called upon
    - Premium due to limited ownership liability
  - Resource Investment/Ownership
    - Similar structure to San Juan
    - Demand and Energy Costs
    - Shutdown Liabilities born by Ownership
  - Access to Bulk Electric System for Offloading into Market

Pumped Hydro-Very Preliminary

- Modular 10MW, 40MWh tank-based pumped hydro system, first considered by DPU in 2020
- Concept has matured over the past 2 years, with 4 projects in pre-construction development
- 2+ years development timeline
- 8MW return pumping load per module
- $120/MWh + $6/kW-month rough estimate
- Local, provides resilience and fire protection
- 2-month preliminary evaluation at no cost to DPU

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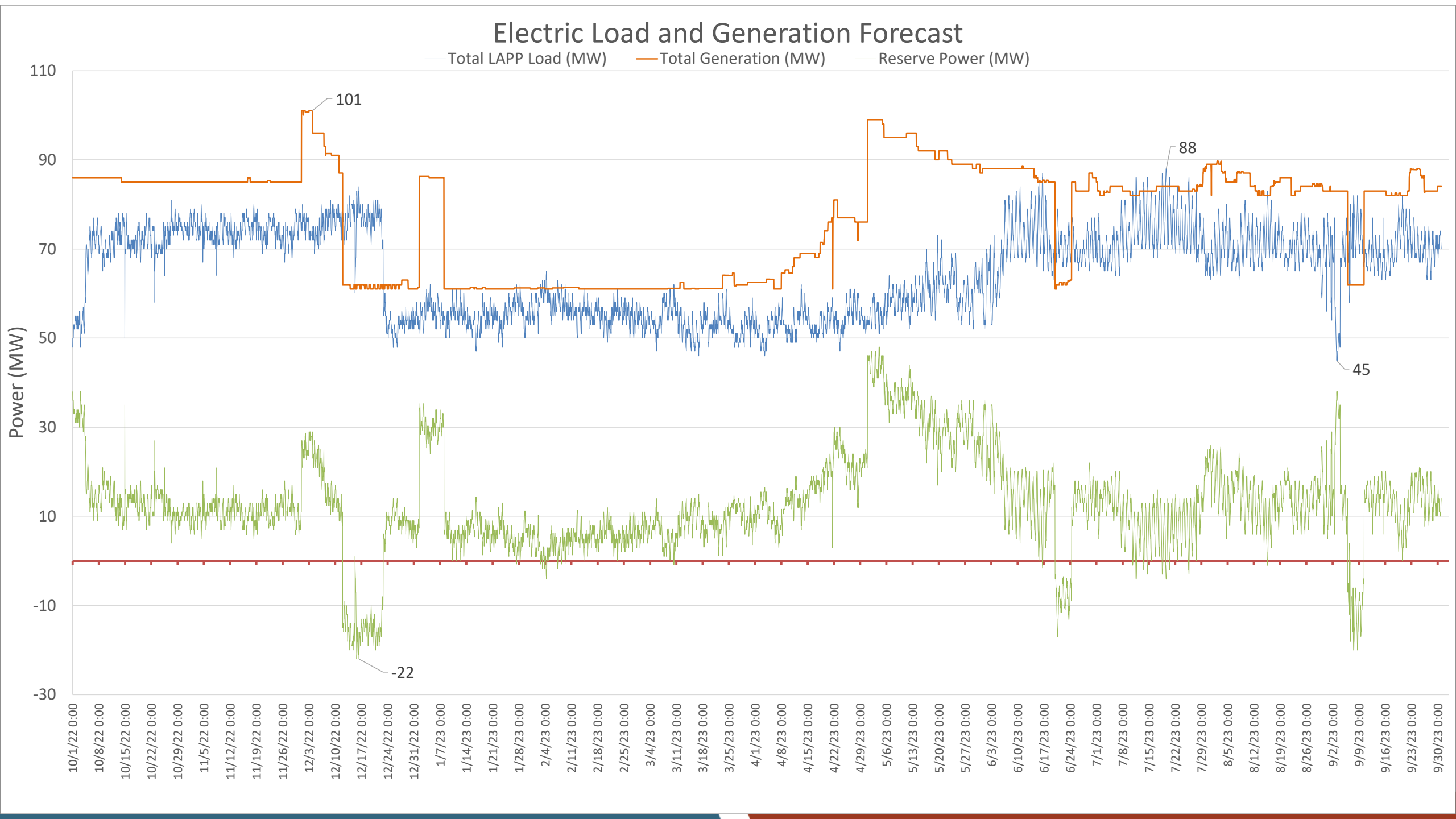
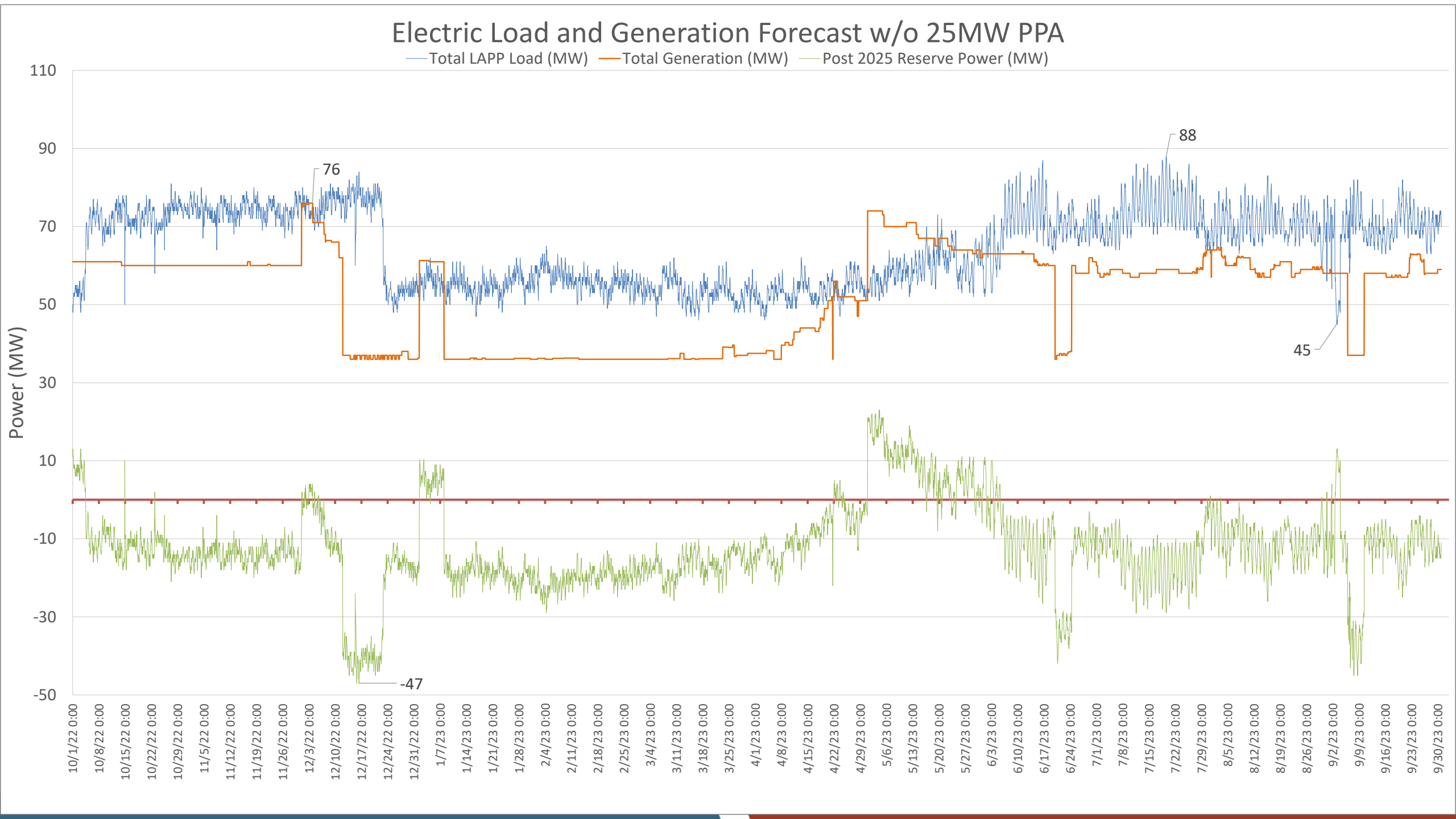
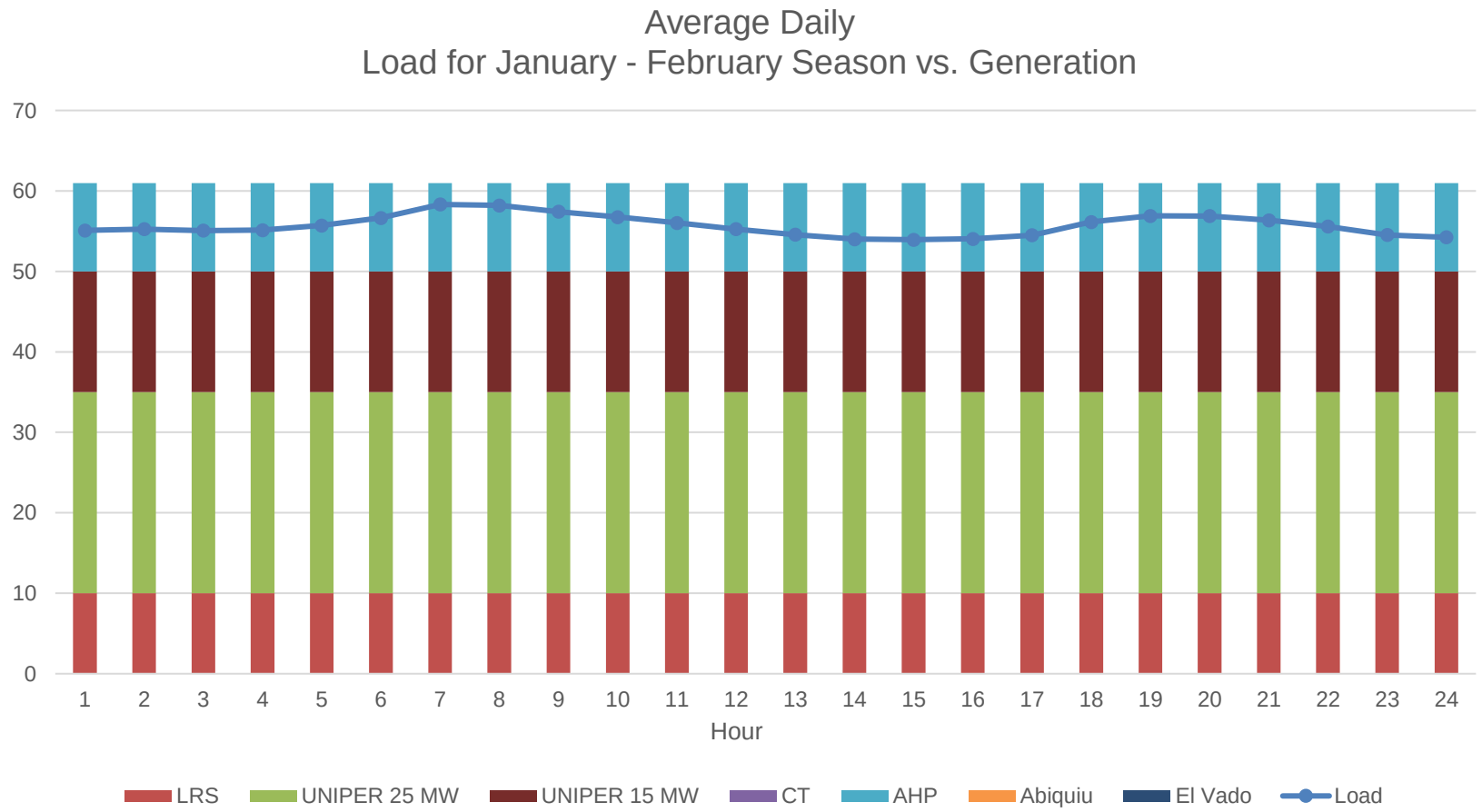
Load and Generation

- Base Load for the Power Pool is roughly 45 MW
- Summer Peak Load and Winter Peak Load are very close in terms of MWs
- LAPP is transitioning to a positive reserve margin.
  - Excess Capacity from dispatchable resources is preferred for optimization of resource fleet.


Electric Load and Generation Forecast
Total LAPP Load (MW)
Total Generation (MW)
Reserve Power (MW)
Power (MW)
110
90
70
50
30
10
-10
-30
101
88
45
-22
10/1/22 0:00
10/8/22 0:00
10/15/22 0:00
10/22/22 0:00
10/29/22 0:00
11/5/22 0:00
11/12/22 0:00
11/19/22 0:00
11/26/22 0:00
12/3/22 0:00
12/10/22 0:00
12/17/22 0:00
12/24/22 0:00
12/31/22 0:00
1/7/23 0:00
1/14/23 0:00
1/21/23 0:00
1/28/23 0:00
2/4/23 0:00
2/11/23 0:00
2/18/23 0:00
2/25/23 0:00
3/4/23 0:00
3/11/23 0:00
3/18/23 0:00
3/25/23 0:00
4/1/23 0:00
4/8/23 0:00
4/15/23 0:00
4/22/23 0:00
4/29/23 0:00
5/6/23 0:00
5/13/23 0:00
5/20/23 0:00
5/27/23 0:00
6/3/23 0:00
6/10/23 0:00
6/17/23 0:00
6/24/23 0:00
7/1/23 0:00
7/8/23 0:00
7/15/23 0:00
7/22/23 0:00
7/29/23 0:00
8/5/23 0:00
8/12/23 0:00
8/19/23 0:00
8/26/23 0:00
9/2/23 0:00
9/9/23 0:00
9/16/23 0:00
9/23/23 0:00
9/30/23 0:00

Electric Load and Generation Forecast w/o 25MW PPA




Average Daily
Load for January - February Season vs. Generation
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hour
LRS
UNIPER 25 MW
UNIPER 15 MW
CT
AHP
Abiquiu
El Vado
Load

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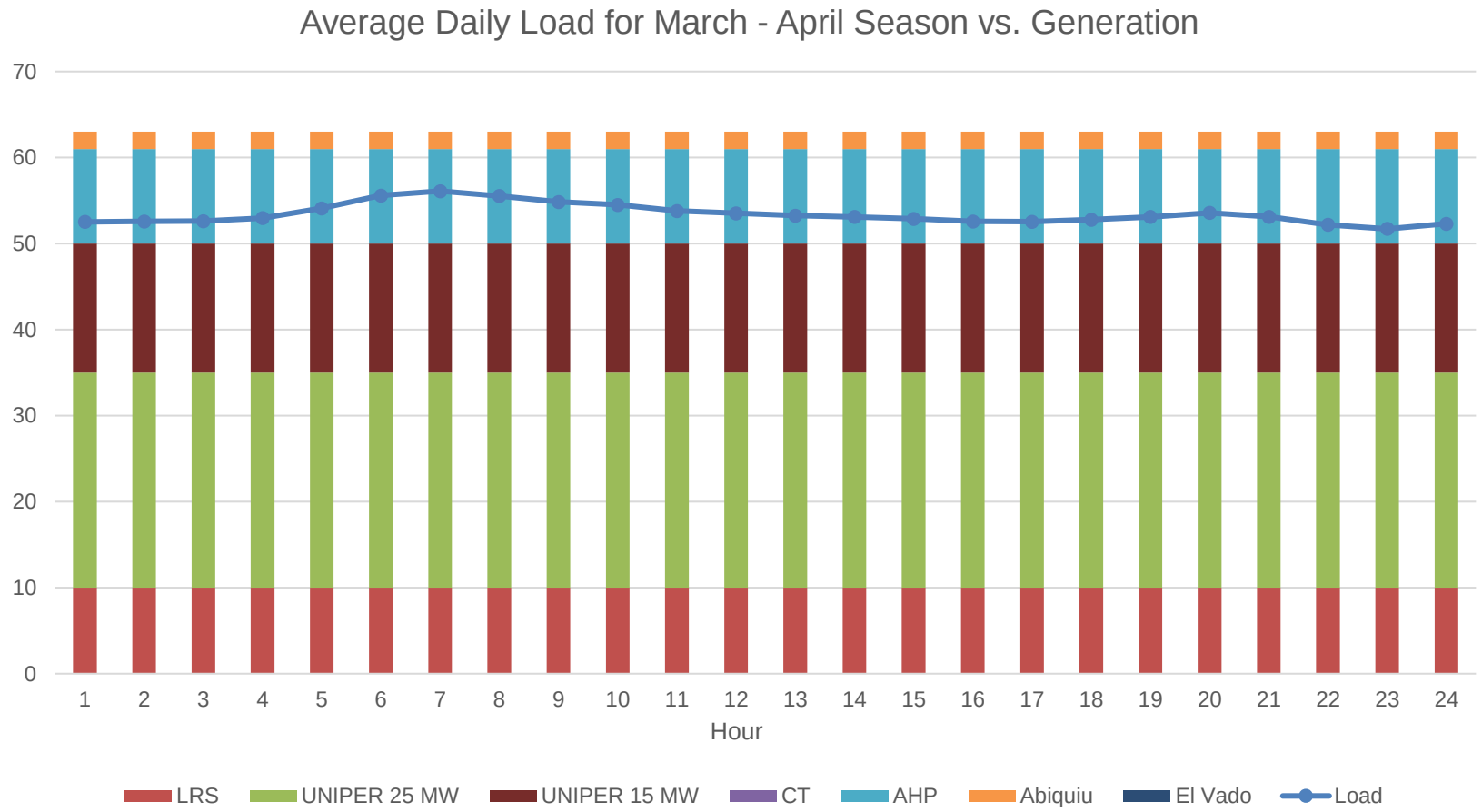

May is omitted because has enough year-to-year variability that in some years it fits in with March – April, and other years it fits in with October – December.

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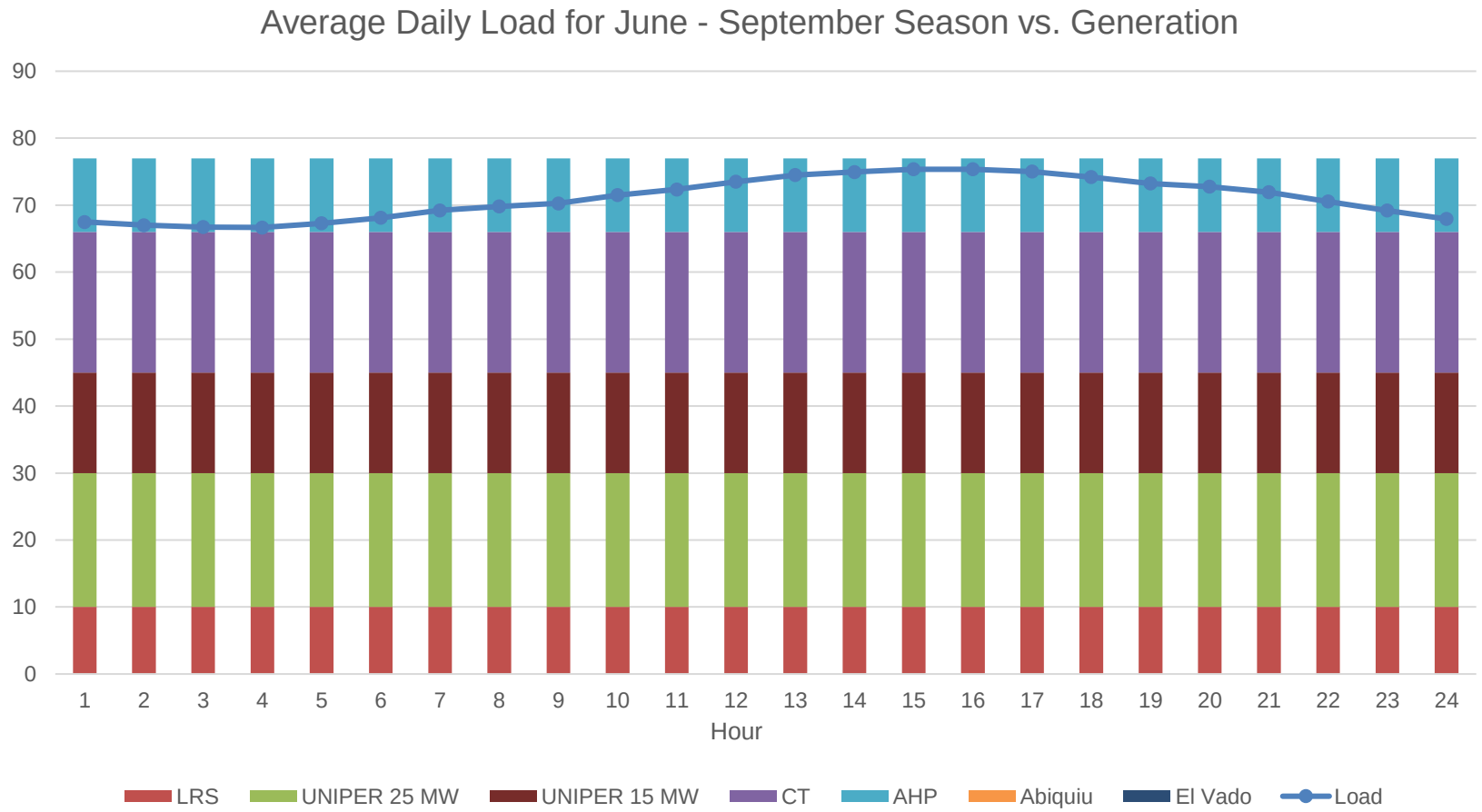
Average Daily Load for June - September Season vs. Generation
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hour
LRS
UNIPER 25 MW
UNIPER 15 MW
CT
AHP
Abiquiu
El Vado
Load

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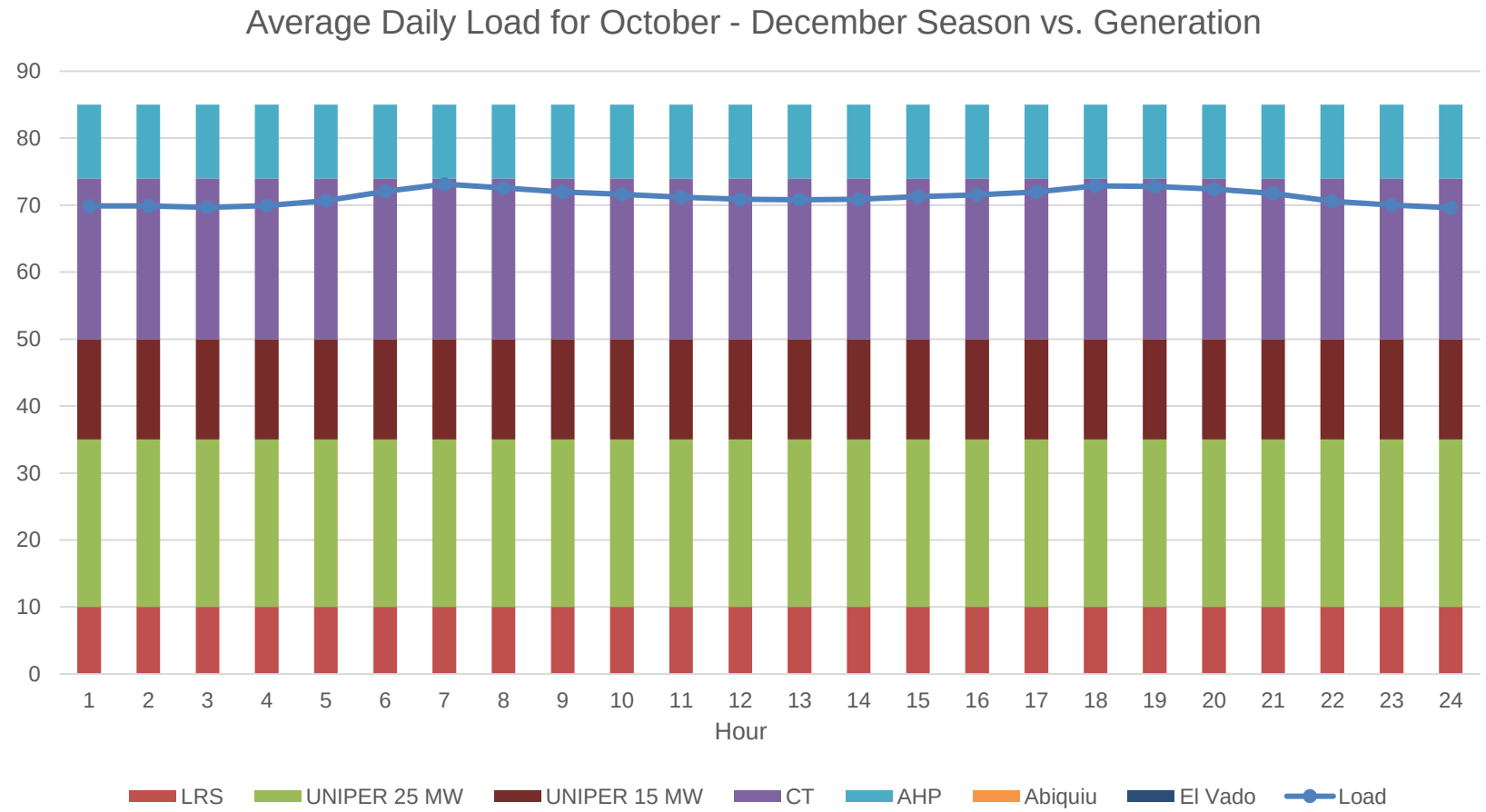

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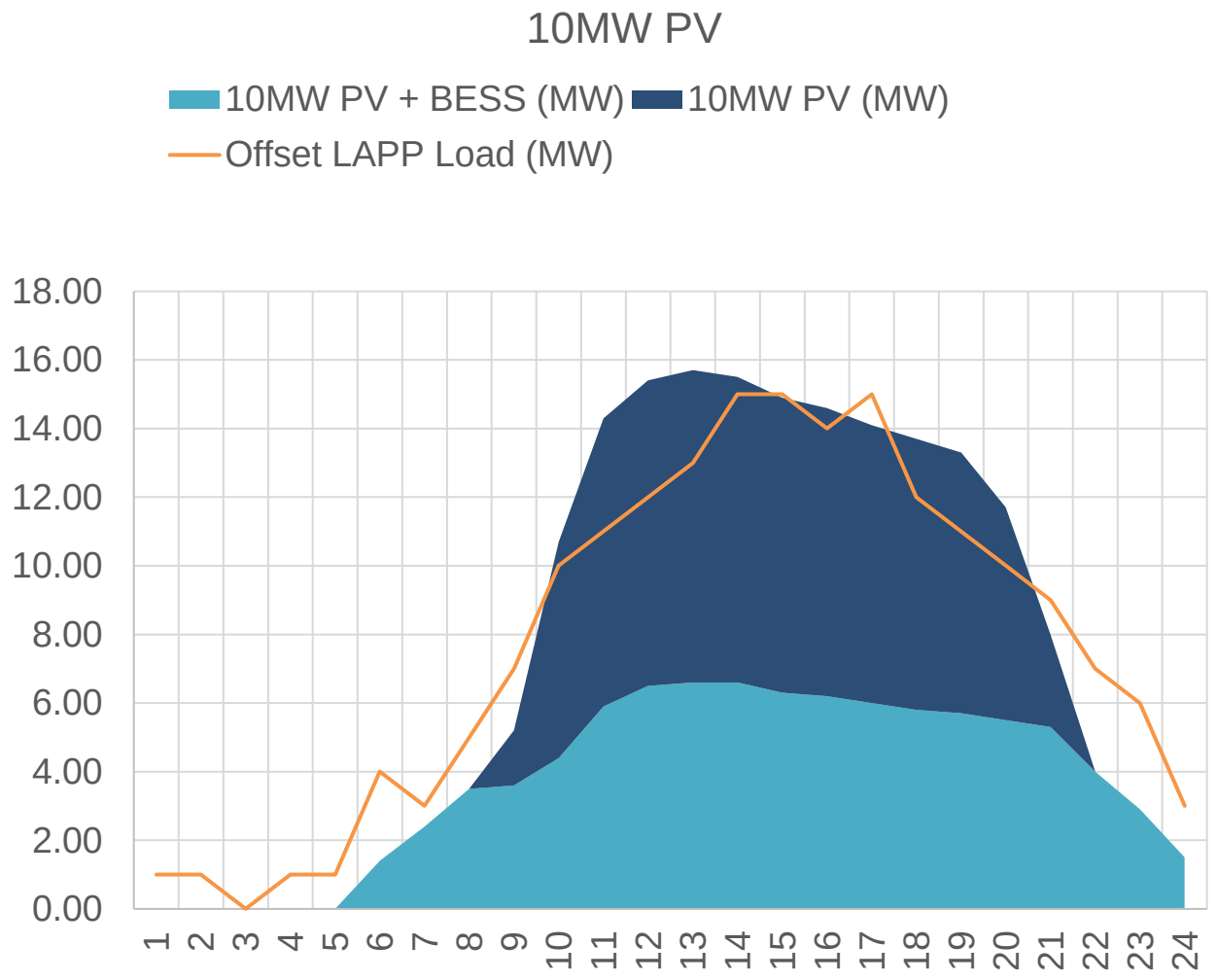
Load Following with Solar + Storage



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Operational Path Forward

- Continue search for Solar, Wind, BESS, and Thermal resources bearing in mind the new developments with the IRA
- Continue to evaluate CFPP's viability
- Explore Partnerships with other entities
  - Continue to Explore and Expand Partnerships listed in Slide 4
- The IRP and the projections presented do not account for extreme weather events
- Firm Dispatchable resources are extremely valuable for the pool from an Operational and Economical perspective