PNM 2023-2042 IRP: Modeling Updates

TECHNICAL SESSION #5

JULY 27, 2022

DISCLOSURE REGARDING FORWARD LOOKING STATEMENTS

The information provided in this presentation contains scenario planning assumptions to assist in the Integrated Resource Plan public process and should not be considered statements of the company's actual plans. Any assumptions and projections contained in the presentation are subject to a variety of risks, uncertainties and other factors, most of which are beyond the company's control, and many of which could have a significant impact on the company's ultimate conclusions and plans. For further discussion of these and other important factors, please refer to reports filed with the Securities and Exchange Commission. The reports are available online at www.pnmresources.com.

The information in this presentation is based on the best available information at the time of preparation. The company undertakes no obligation to update any forward-looking statement or statements to reflect events or circumstances that occur after the date on which such statement is made or to reflect the occurrence of unanticipated events, except to the extent the events or circumstances constitute material changes in the Integrated Resource Plan that are required to be reported to the New Mexico Public Regulation Commission (NMPRC) pursuant to Rule 17.7.4 New Mexico Administrative Code (NMAC).

MEETING GROUND RULES

THE FOCUS OF THE MEETING IS THE DEVELOPMENT OF THE 2023 IRP

01 

- Questions and comments are welcome – One Person Speaks at a Time

02 

- Reminder; today's presentation is not PNM's plan or a financial forecast, it is an illustration of the IRP process

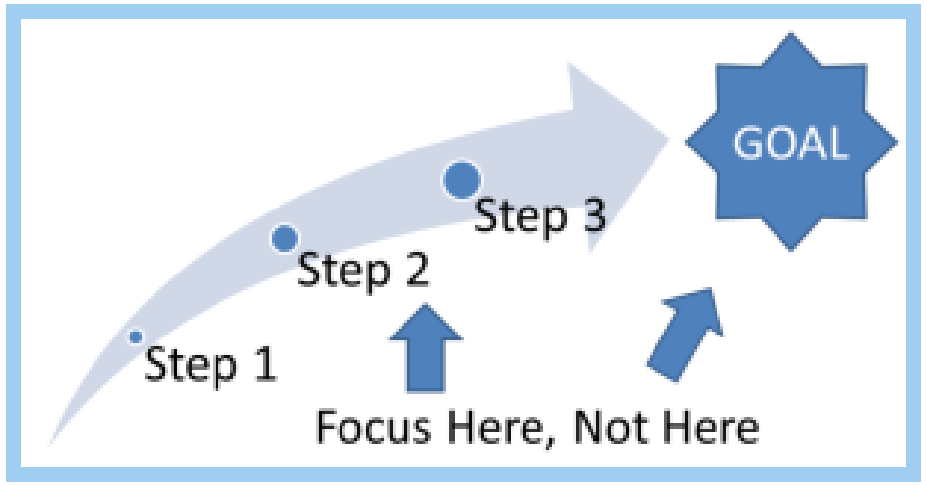
03 

- When asking a question, please speak clearly and slowly as all questions will be logged and labeled with the person and organization responsible for asking the question

04 

- These meetings are about the 2023 IRP, questions and comments should relate to this IRP. Any questions or comments related to other regulator proceedings should be directed towards the specific filing.

THE FOCUS OF THE MEETING IS THE DEVELOPMENT OF THE 2023 IRP



The technical sessions are about discussing the advantages and disadvantages regarding the application of different technical methodologies within the IRP modeling framework.

We are not here to focus on the results or drive towards a specific result. **We all know where we are going: 100% Carbon Free by 2040. The focus in the IRP development is how do we get there in the best way possible for PNM's customers and New Mexico.**

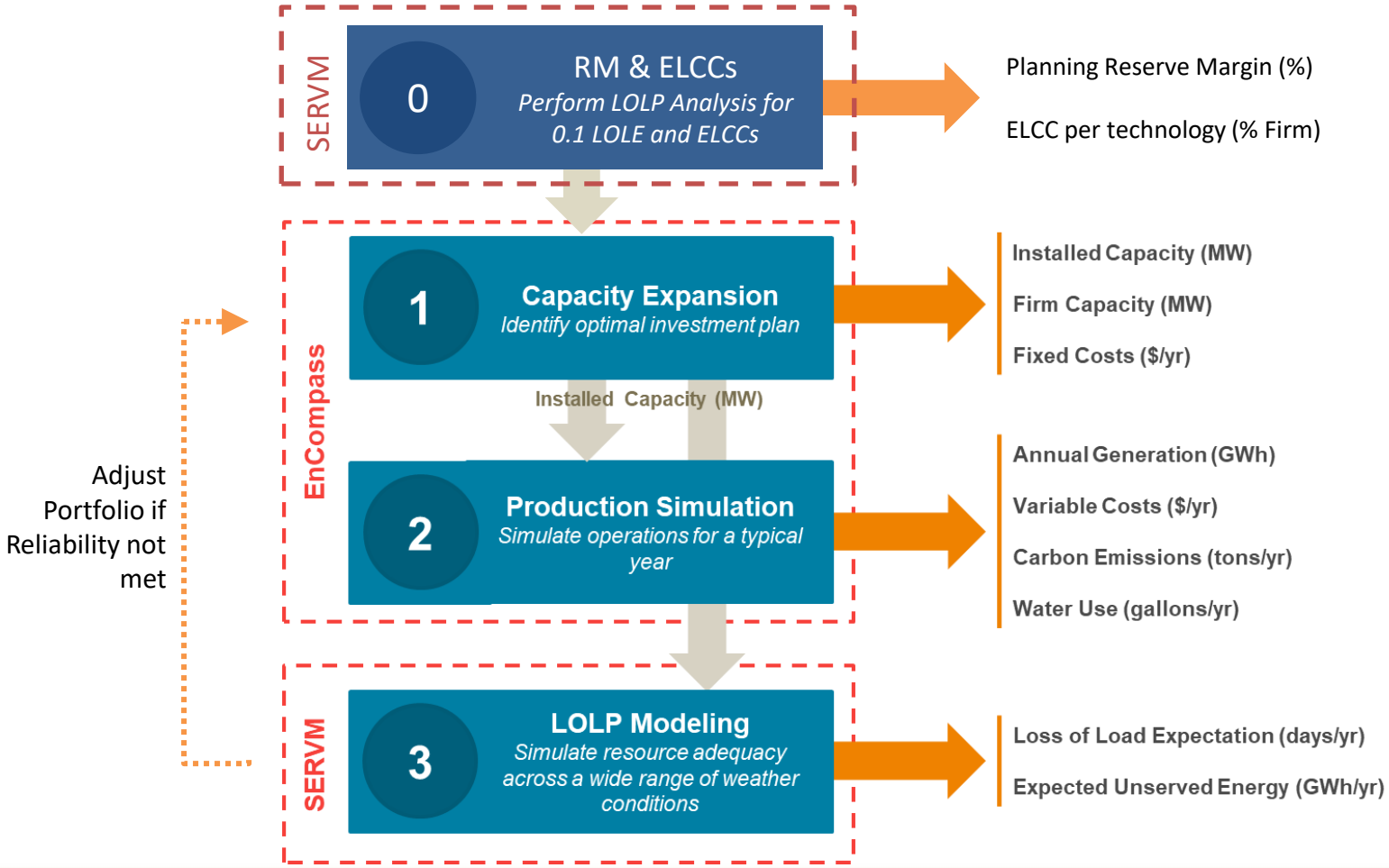
MEETING AGENDA

- Welcome and Introductions
- Modeling Improvements & Testing
- Next steps and Near-Term Schedule

Modeling Improvements and Testing

- **Modeling Framework**
- **Performance**
- **Energy Efficiency Modeling**
- **Long Term Storage**
- **Power to Hydrogen**

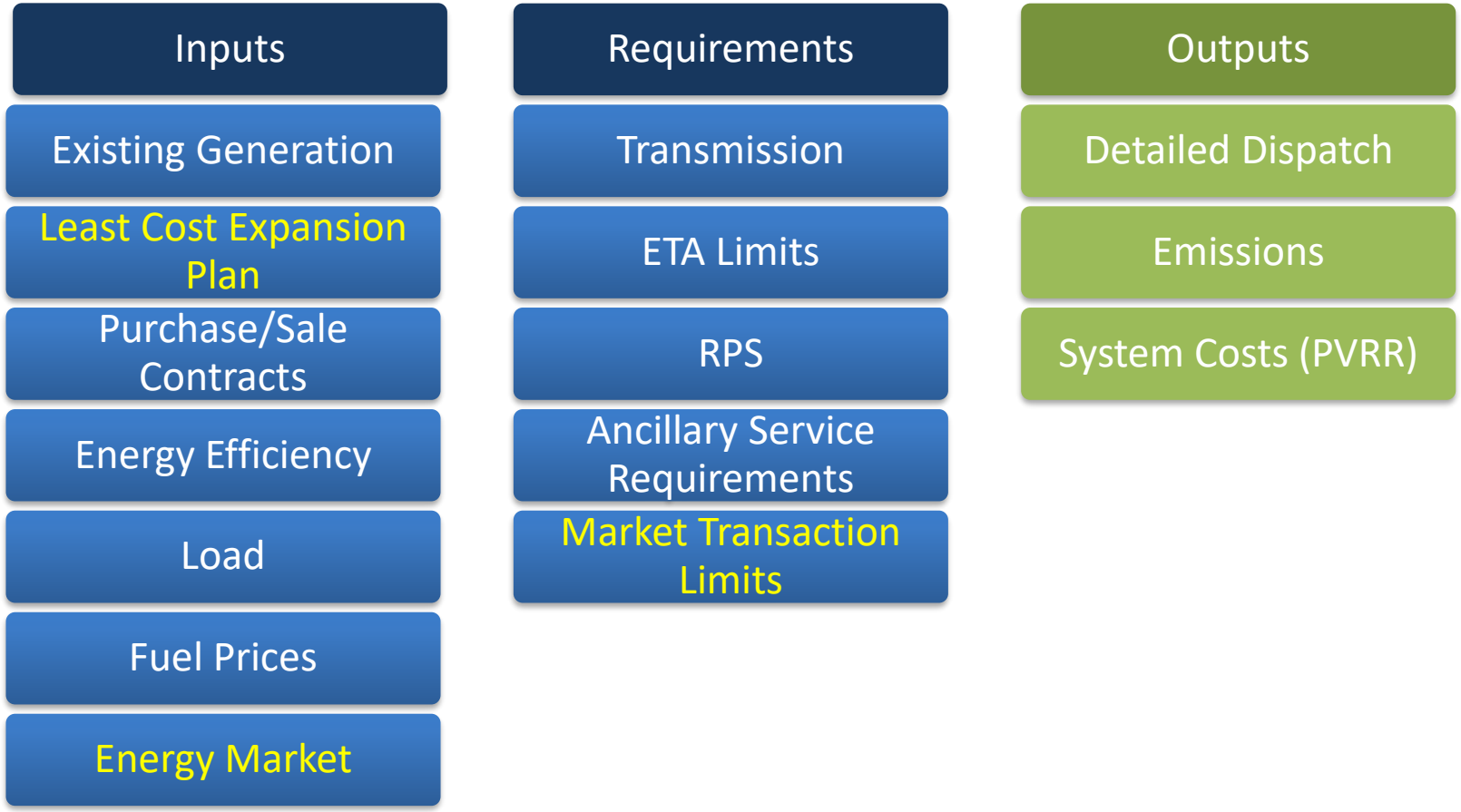
MODELING FRAMEWORK



PNM SYSTEM MODELING – CAPACITY EXPANSION

Inputs	Requirements	Output
Existing Generation	Transmission	Least Cost Expansion Plan
Generic Resource Options	ETA Limits	System Dispatch
Purchase/Sale Contracts	RPS	System Emissions
Energy Efficiency	Ancillary Service Requirements	System Cost (PVRR)
Load		
Fuel Prices		
RM/ELCC		

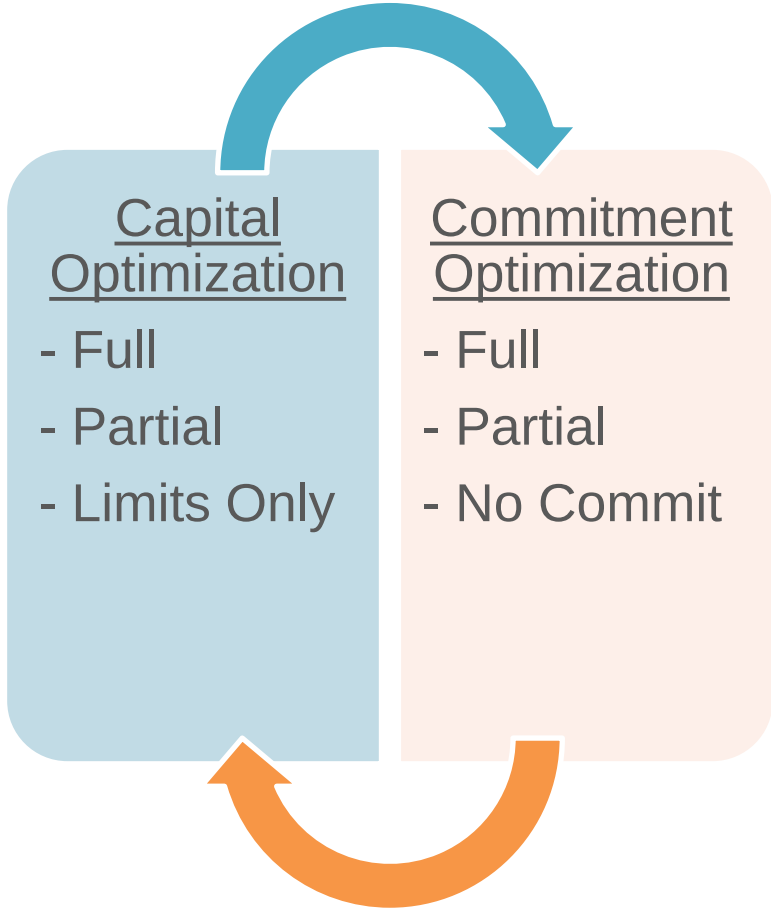
PNM SYSTEM MODELING – PRODUCTION COST MODELING



ENCOMPASS MODELING FOR PERFORMANCE

Maximize commitment and dispatch detail of existing and new resources within simulations

Minimize time to perform detailed simulations to allow more time for additional scenarios/and or in-depth analysis



ENCOMPASS MODELING FOR PERFORMANCE - COMMITMENT

No Commitment

Enforced
- Ramp rates
- Ancillary requirements (spin)

Ignored
- Min Capacity (non-must-run)
- Regulation (min/max range)
- Min Uptime/Downtime

Estimated
- Starts/Shutdowns

Best For:
- Scenario Capacity Expansion Planning

Partial Commitment

Enforced
- Starts/Shutdowns (fractional, i.e., 0.4 units = 1 unit @ 40%)
- Ramp rates
- Ancillary requirements (spin)
- Regulation (min/max range)
- Min Uptime/Downtime

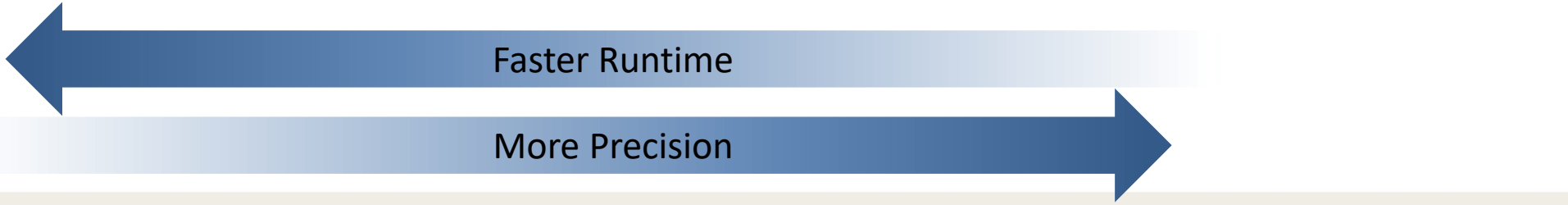
Ignored
- Min Capacity (non-must-run)

Best For:
- Scenario Production Cost Modeling (Annual/Monthly)
- Annual Emission Limits

Full Commitment

Enforced
- Starts/Shutdowns (integer)
- Ramp rates
- Ancillary requirements (spin)
- Min Capacity (non-must-run)
- Regulation (min/max range)
- Min Uptime/Downtime

Best For:
- Hourly Production Cost/Dispatch



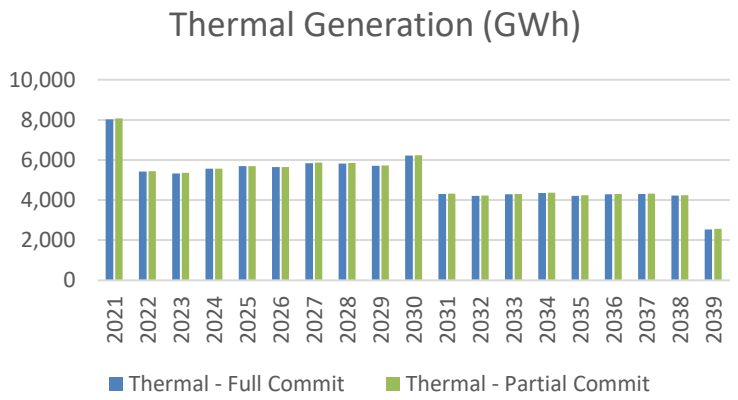
ENCOMPASS MODELING FOR PERFORMANCE - COMPARISON

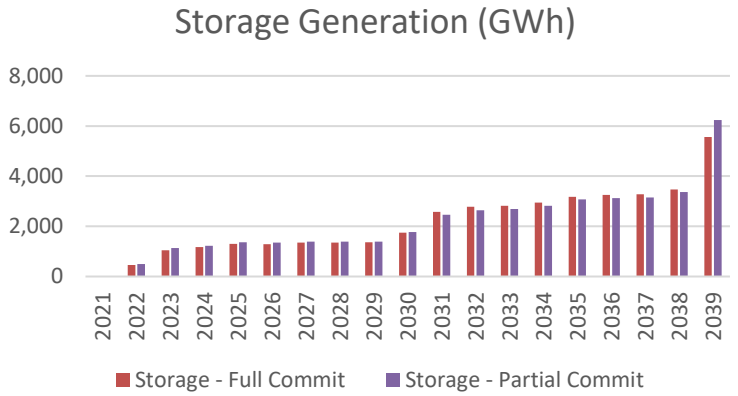
Time taken per simulation/scenario/sensitivity

Run Type	No Commitment	Partial Commitment	Full Commitment
Capacity Expansion	1-2 Hours	5-10 Hours	unachievable
Production Cost – Emission Limit Constrained	15-60 Minutes	45 Minutes to 4 Hours	4-10 Hours
Production Cost – with Existing Emission Limits	~1 Hour	1-2 Hours	1-3 Hours

ENCOMPASS MODELING FOR PERFORMANCE - RESULTS

- Partial Commitment runs can be used for Capacity Expansion simulations and high-level scenario production cost modeling
- Simulation testing has shown that using Partial Commitment is within 2% of the dispatch of the Full Commitment in production cost simulations
- Full Commitment dispatch should be reserved for detailed analysis and hourly production cost results





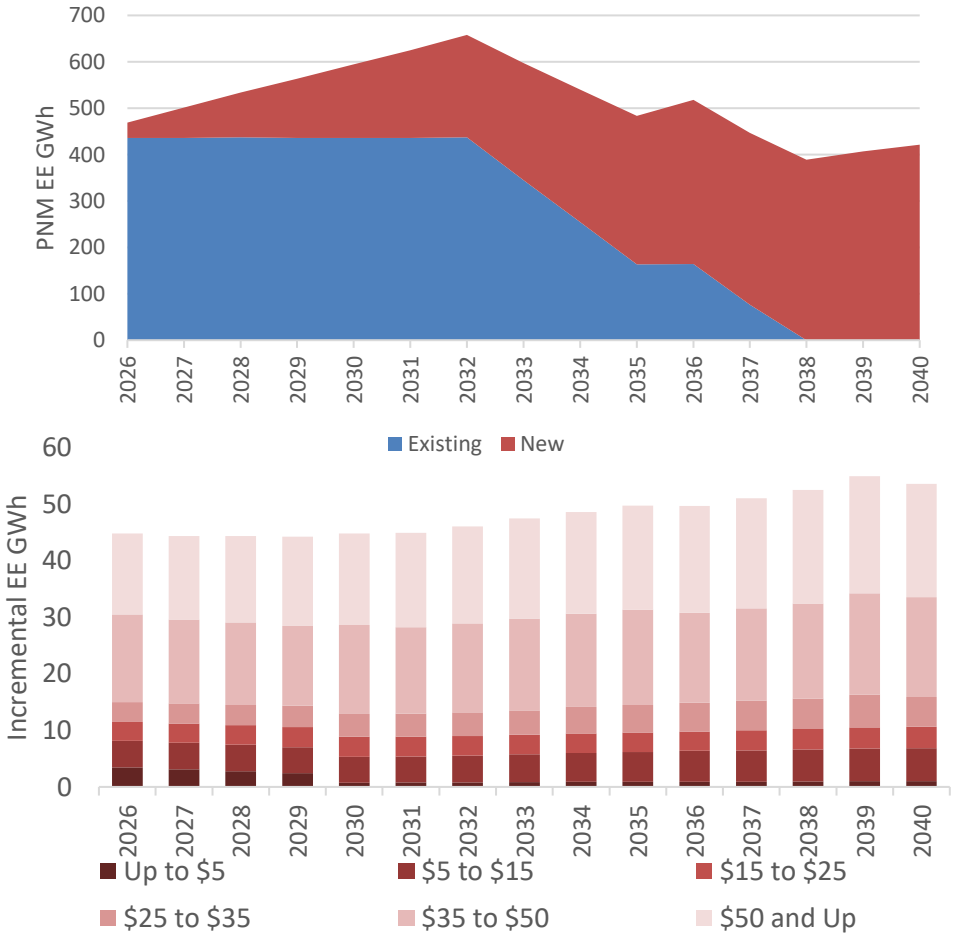
ENERGY EFFICIENCY MODELING IN ENCOMPASS

2020 IRP EE Modeling

- Modeled existing EE programs as existing resources
- New EE programs (EE Bundles) modeled as candidate resources

2020 IRP EE Candidates

- 6 Energy Efficiency Bundle Pricing levels
- Fifteen Different Start Years
- 90 Total Hourly Profiles
- Allowing all bundle options



ENERGY EFFICIENCY BUNDLES IN 2020 IRP LEAST COST PLANS

Program and Cost	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Base Program	100%	100%	100%	100%	100%															
Incremental Up to $50				99%	100%															
Incremental Up to $5						100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Incremental $5 to $15						100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Incremental $15 to $25						100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Incremental $25 to $35						100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	100%
Incremental $35 to $50						99%	100%	100%	99%	99%	100%	99%	100%	100%	100%	100%	99%	100%	99%	99%
Incremental $50 and Up				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

ENERGY EFFICIENCY MODELING IN ENCOMPASS

2023 IRP Option A

- Energy Efficiency Bundle Pre-solve
- Pursue Similar Setup as 2020
  - ➢ Run EE Bundles for Low, High, and Base Load Scenarios
  - ➢ Use the Selected Bundles in All Future Scenarios

2023 IRP Option B

- Reduced Energy Efficiency Bundles
- Consolidate Energy Efficiency Bundles into Two or Three Price Options

2023 IRP Option C

- Pursue similar analysis that was performed in 2020 IRP (run all bundles for all scenarios)
- Do not apply prevalent bundles to scenarios
- Do not consolidate bundles

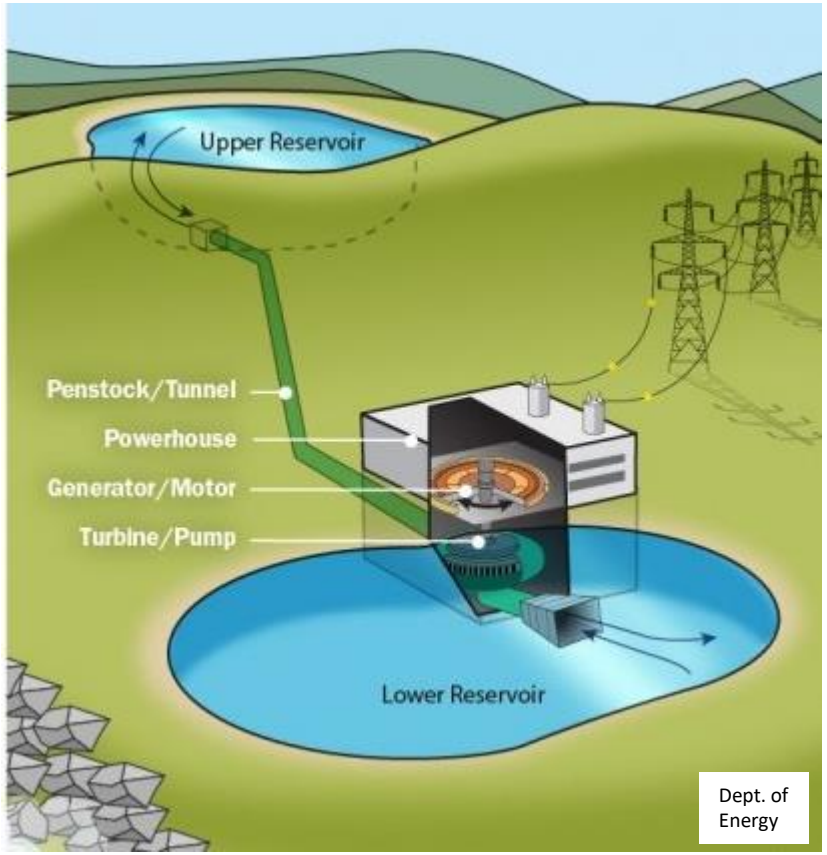
LONG DURATION STORAGE

- Objective is at least one week of Storage for Renewable Energy
- Pumped Storage
- Hydrogen Storage
- Battery Storage
    - Evaluating the value of duration vs capacity
    - Reviewing generic pricing and technology updates

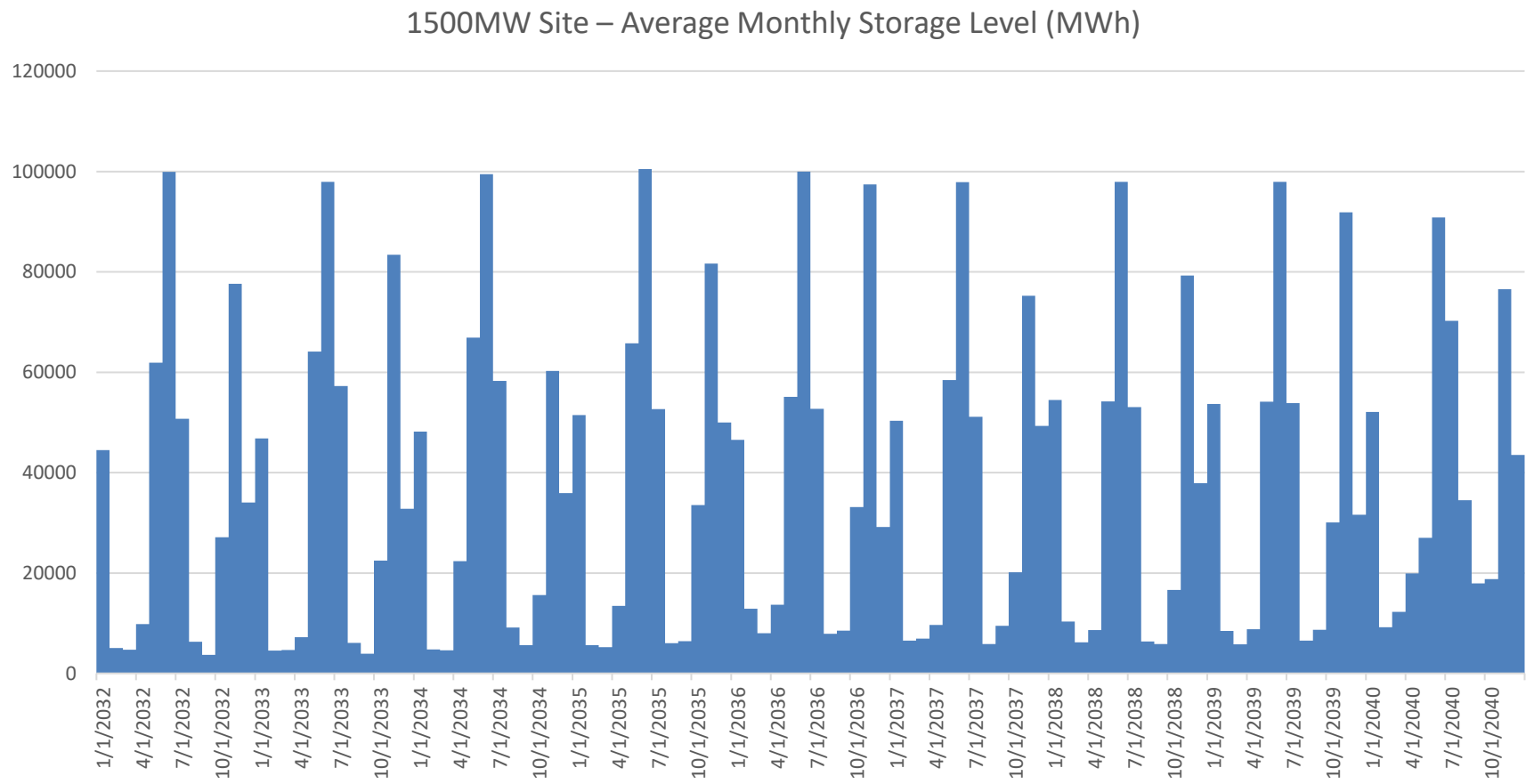
PUMPED STORAGE

Modeling for various configurations

1500MW Capacity
100GWh Energy Storage



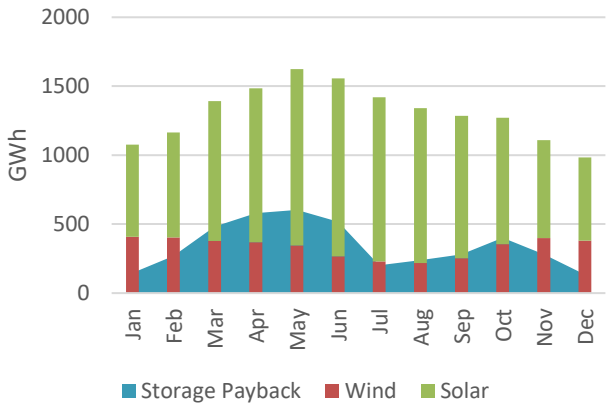
PUMPED STORAGE

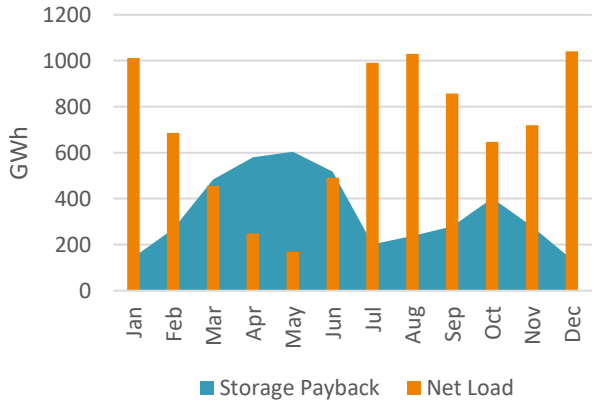


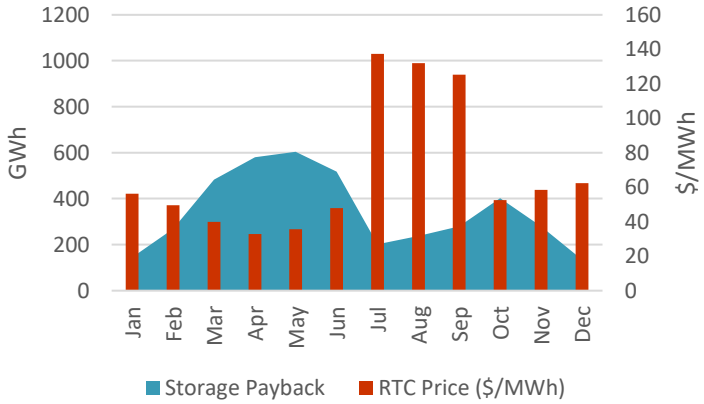
LONG TERM STORAGE

Seasonal Storage Drivers

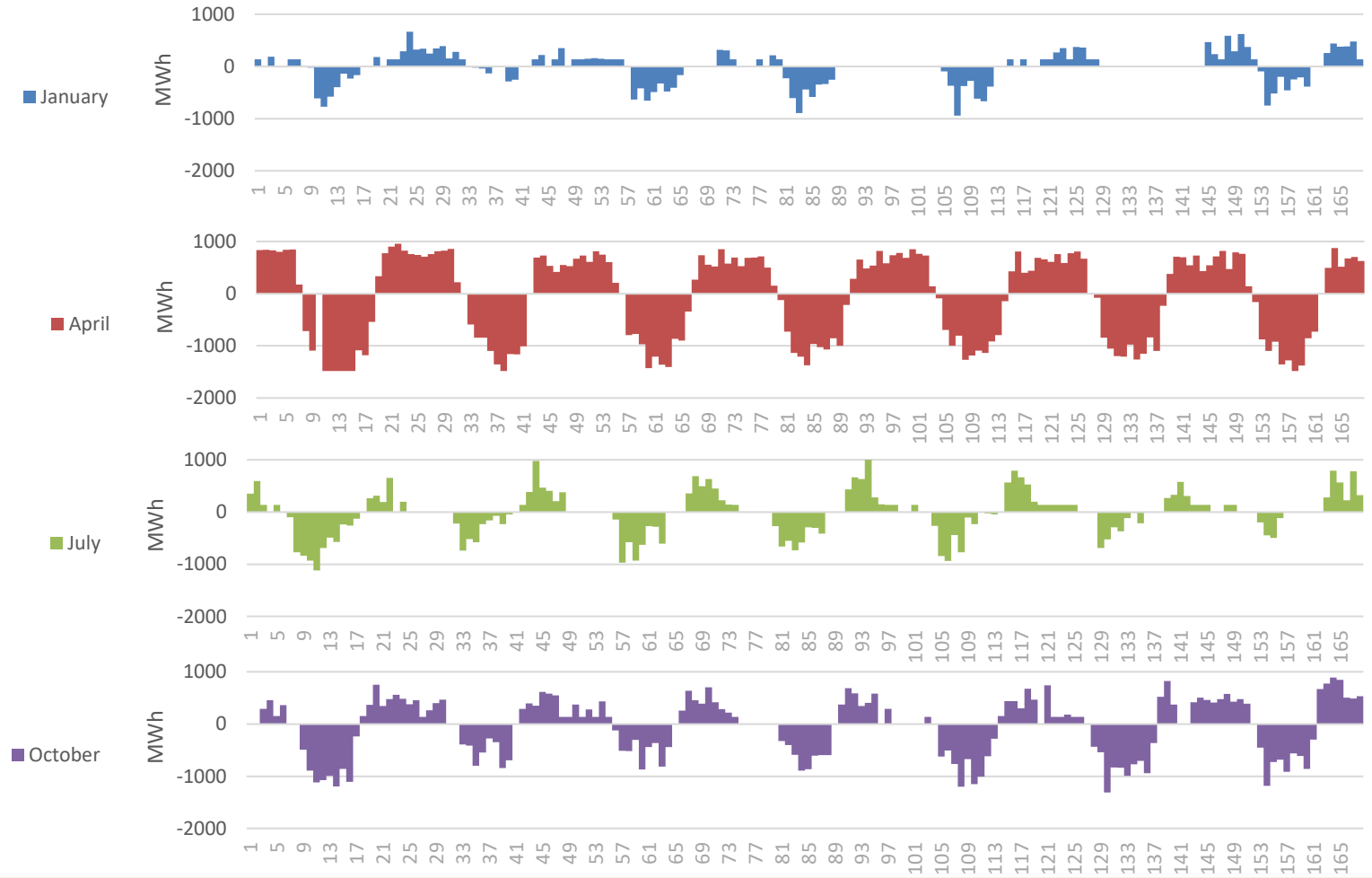
- Excess Solar/Wind
- Load Requirements
- Seasonal Price Differential



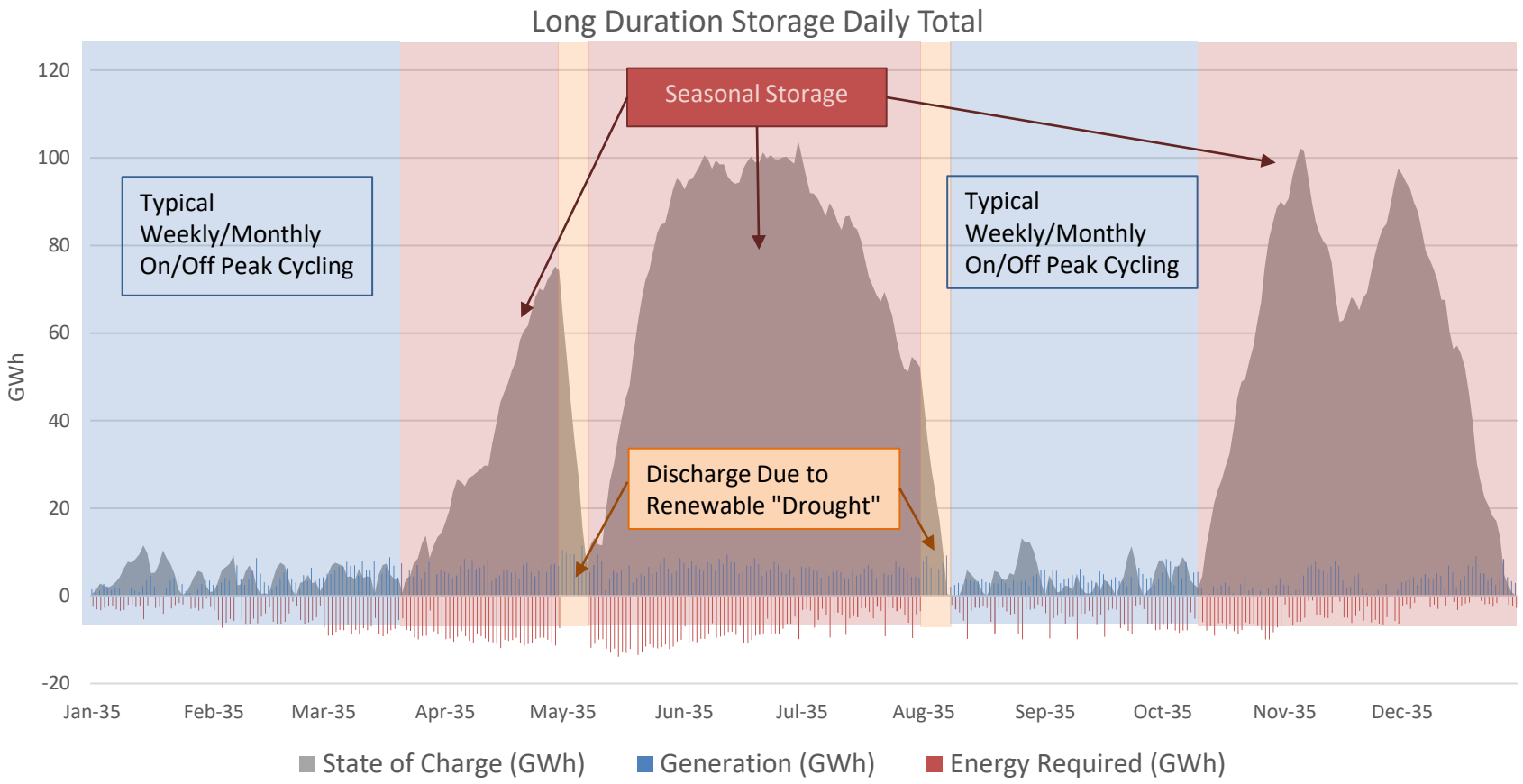




PUMPED STORAGE – TYPICAL WEEK 2035

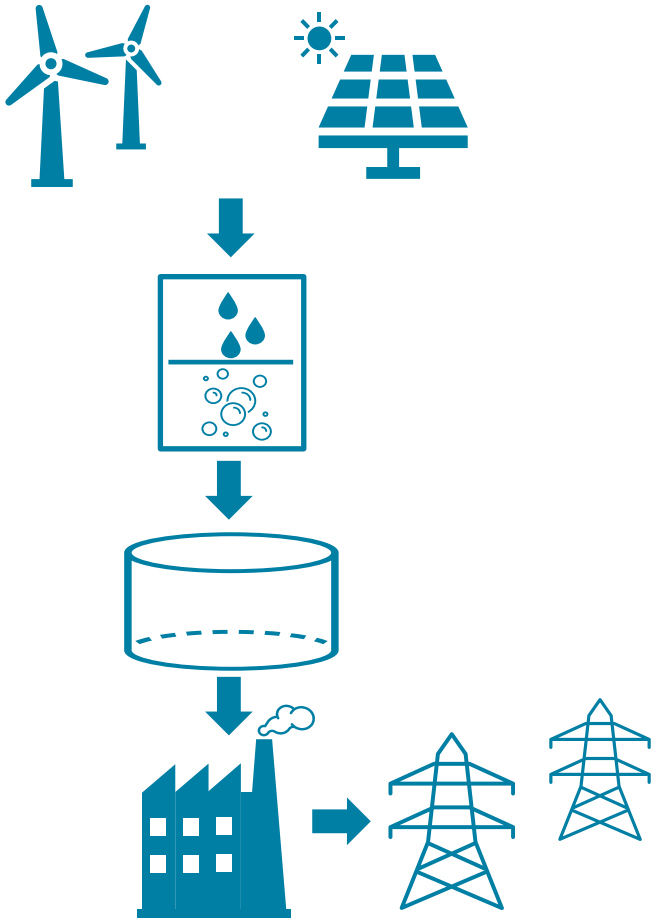


PUMPED STORAGE

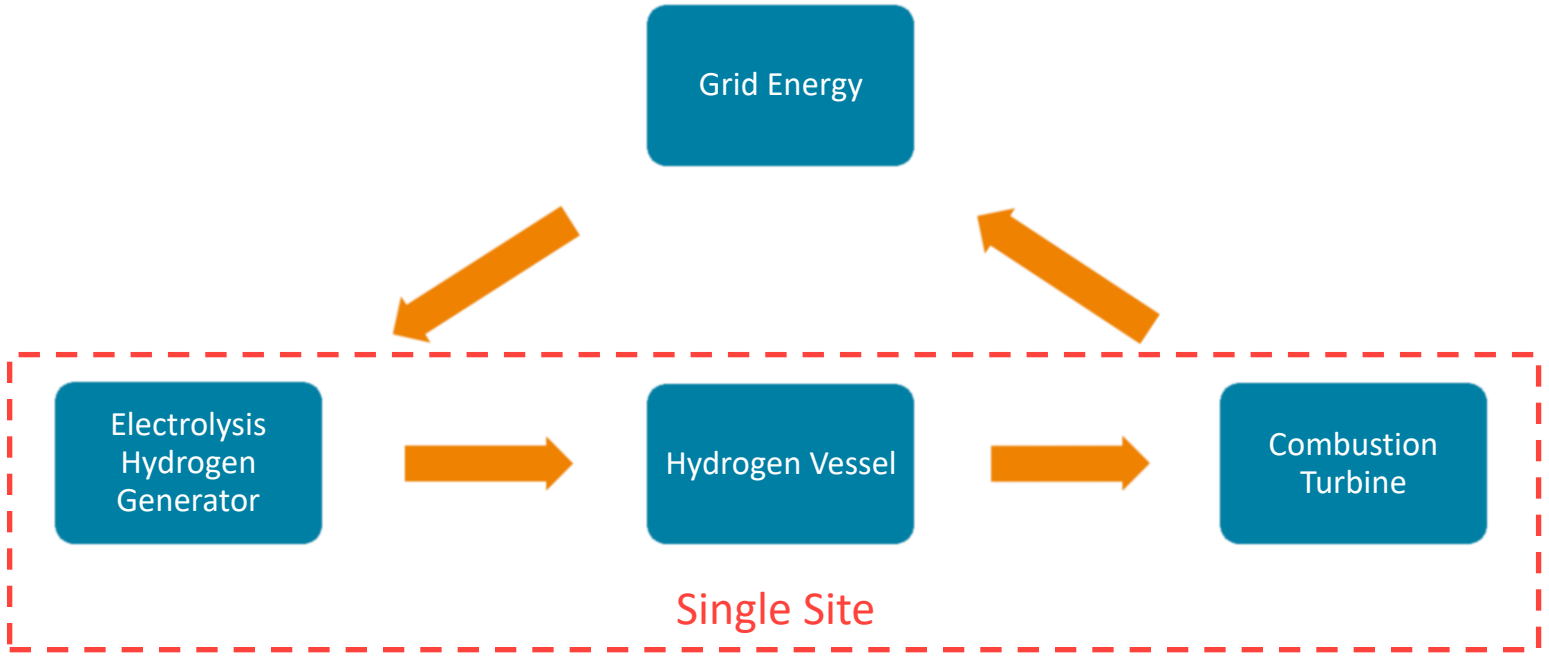


POWER TO HYDROGEN

- Single Site Hydrogen Electrolysis, Storage, and CT
- Distributed Hydrogen Electrolysis, Storage, and CTs
- Hydrogen Retrofit Project
    - Available Water
    - Available Transmission
    - Interim/Redundant Gas Supply



POWER TO HYDROGEN – SINGLE SITE



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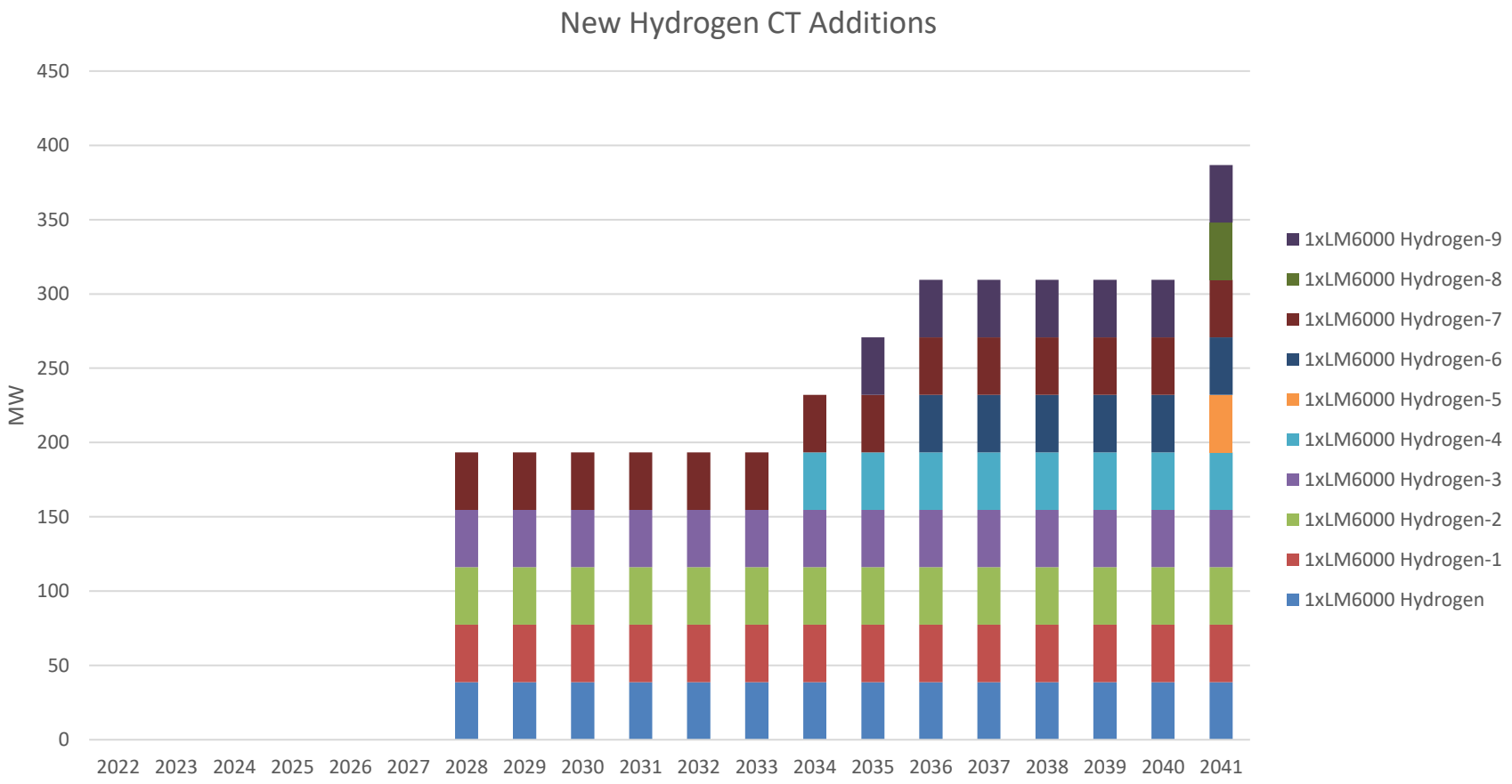
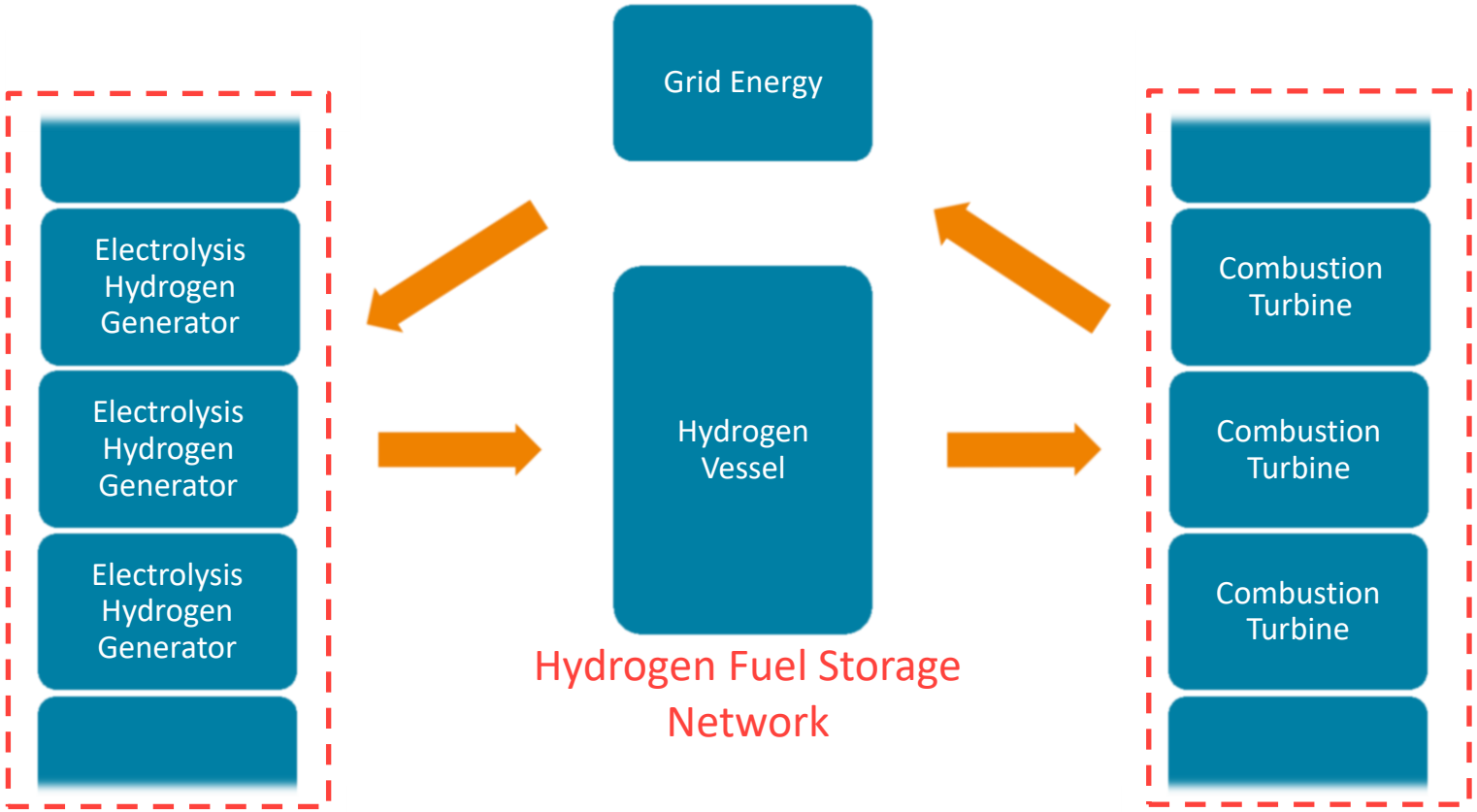
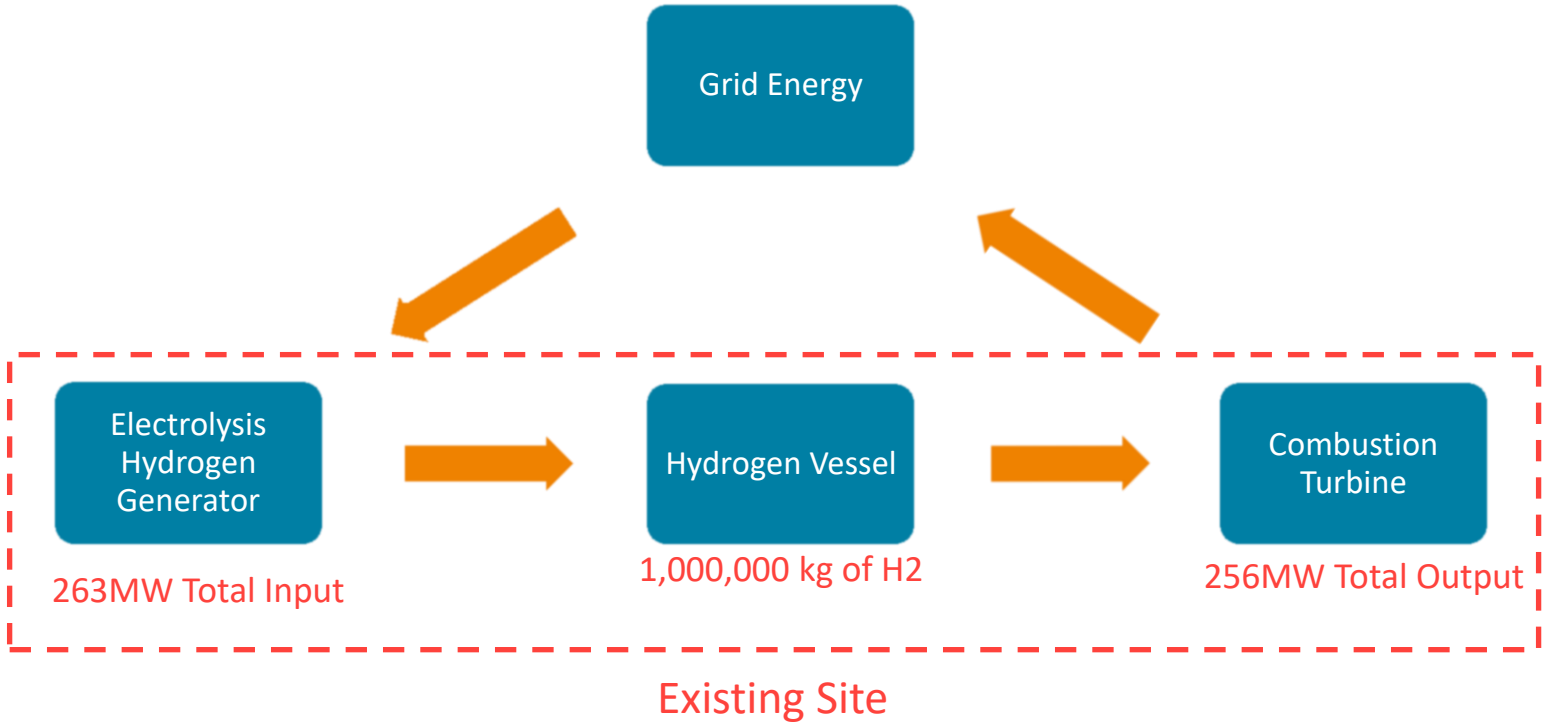


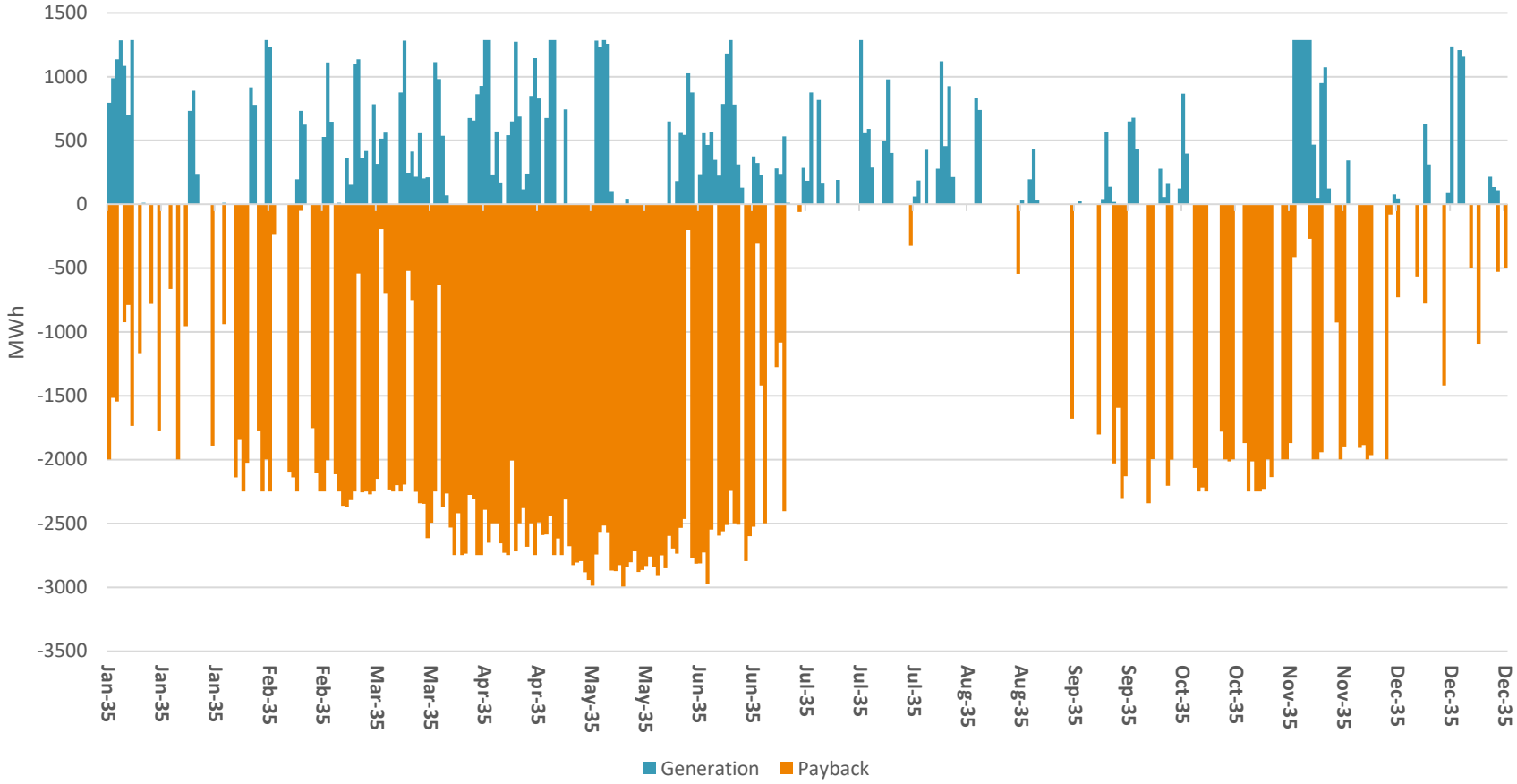
POWER TO HYDROGEN – DISTRIBUTED GENERATION



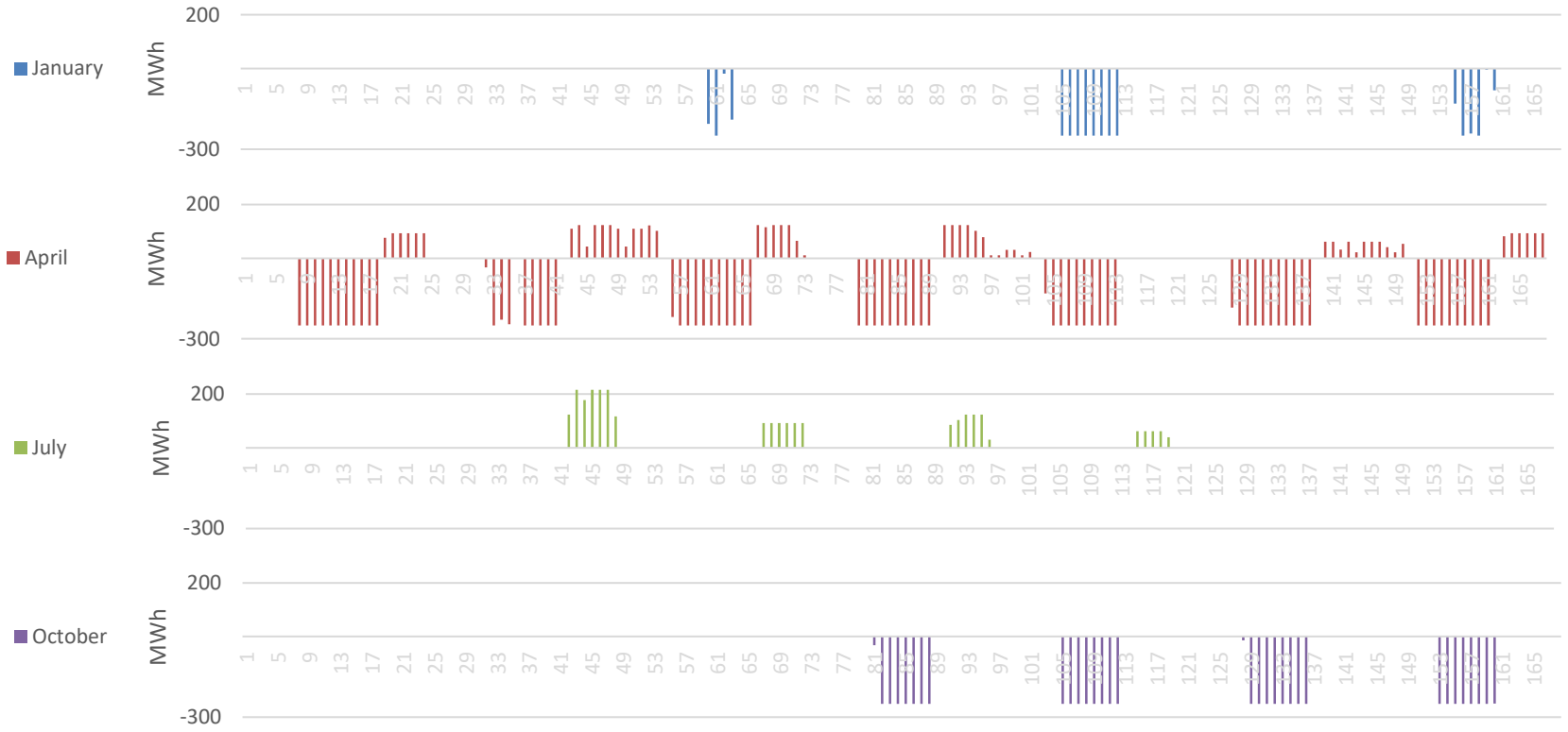
POWER TO HYDROGEN – HYDROGEN RETROFIT



POWER TO HYDROGEN – HYDROGEN RETROFIT



POWER TO HYDROGEN – HYDROGEN RETROFIT



BATTERY STORAGE NEEDS (ONGOING)

2020 IRP, Figure 85. Timing & seasonality of reliability events by 2025

Share of Expected Unserved Energy by Month & Time of Day, Technology Neutral Scenario, 2025

Month	Hour of Day (MST)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0%	0.4%	3.3%	5.8%	0.7%	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3%	1.5%	1.4%	17%	37%	14%	3.1%	0.3%	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3%	0.2%	5.5%	9.2%	0.6%	0.0%	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						-	-

Greatest risk of loss of load occurs after sundown

Approximate sunset (hours with typical solar capacity factors <5%)

2020 IRP, Figure 87. Timing and seasonality of reliability events, No New Combustion (Low Imports) scenario, 2040

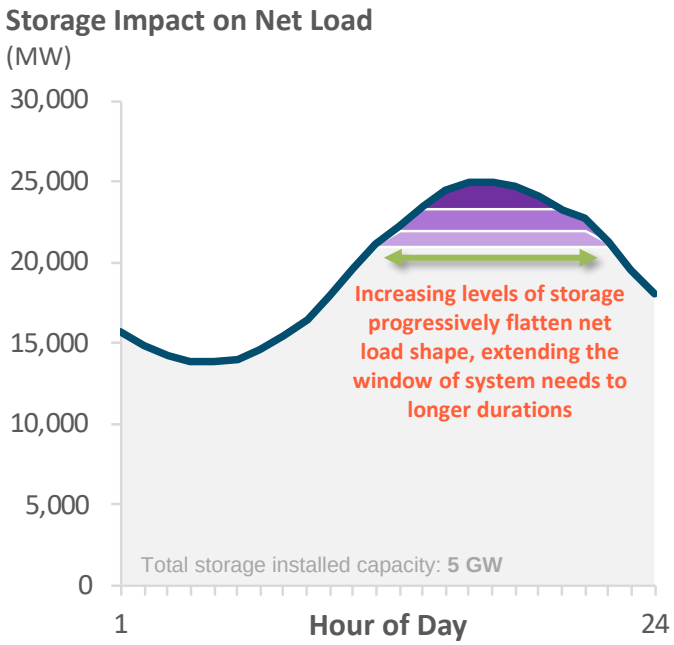
Share of Expected Unserved Energy by Month & Time of Day, No New Combustion (Low Imports), 2040

Month	Hour of Day (MST)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0.4%	0.5%	0.8%	1.1%	1.6%	2.8%	5.6%	1.8%	0.0%	-	-	-	-	-	-	-	0.0%	0.0%	0.0%	0.1%	0.1%	0.2%	0.3%	0.5%
2	0.0%	0.1%	0.1%	0.1%	0.3%	0.6%	1.3%	0.3%	0.0%	-	-	-	-	-	-	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.1%
3	-	-	-	0.0%	0.0%	0.2%	0.3%	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	0.1%	0.1%	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	0.3%	0.4%	0.5%	0.8%	1.4%	1.2%	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	0.0%	0.0%	0.0%	0.1%	0.2%
7	1.1%	1.9%	2.9%	4.5%	7.7%	7.8%	0.7%	0.0%	-	-	-	-	-	-	-	-	-	0.0%	0.1%	0.1%	0.2%	0.3%	0.7%	1.1%
8	1.0%	1.5%	2.3%	3.3%	5.2%	7.5%	1.8%	0.0%	-	-	-	-	-	-	-	-	-	0.0%	0.0%	0.1%	0.2%	0.4%	0.7%	0.9%
9	0.1%	0.1%	0.2%	0.3%	0.6%	1.2%	0.5%	0.0%	-	-	-	-	-	-	-	-	-	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%
10	0.0%	0.0%	0.1%	0.2%	0.6%	1.5%	1.4%	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0%
11	-	-	-	0.0%	0.0%	0.1%	0.3%	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	0.2%	0.3%	0.4%	0.8%	1.6%	2.9%	5.4%	1.4%	-	-	-	-	-	-	-	-	-	-	0.0%	0.1%	0.1%	0.1%	0.2%	0.3%

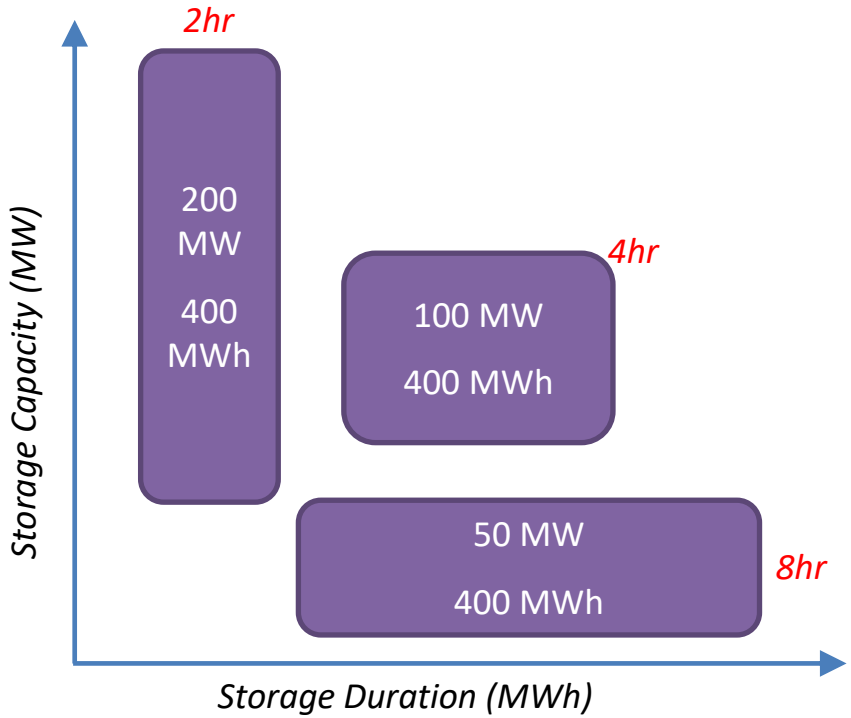
BATTERY STORAGE NEEDS (ONGOING)

Storage capacity contribution declining over time as net load shape flattens over time

Example from 6/27/2022 IRP Meeting



EnCompass to optimize storage requirements, however, additional analysis may be needed to determine if adjustments are needed to help meet/maintain reliability



RECAP

PNM is continuing to improve modeling

- Maximizing Speed and Detail
- Updated Modeling of Energy Efficiency Bundles
- Adding Longer Duration Storage
- Adding Power to Hydrogen

NEAR TERM SCHEDULE

FUTURE MEETING TIME & LOCATION

When: August 3, 2022

Topic: Public Advisory Technical Session #5 Open Stakeholder Presentations or Review Topics (as requested)

Start Time: 9:00 AM

Location: Virtual

PNM will hold virtual meetings until circumstances warrant a change. If there is strong interest to resume in person meetings for future sessions, please email us at IRP@pnm.com. We will continue to notify everyone through the email service list regarding upcoming meeting dates, topics and locations (virtual or in person).

NEAR TERM SCHEDULE

FUTURE MEETING TIME & LOCATION

When: August 17, 2022

Topic: Public Advisory Steering Meeting #4: Transmission

Start Time: 9:00 AM

Location: Virtual

PNM will hold virtual meetings until circumstances warrant a change. If there is strong interest to resume in person meetings for future sessions, please email us at IRP@pnm.com. We will continue to notify everyone through the email service list regarding upcoming meeting dates, topics and locations (virtual or in person).

NEXT MEETING

We encourage you to send in your thoughts ahead of time to IRP@pnm.com so that we can summarize them and distribute them for the next meeting. Please have your submissions in by July 31, 2022.

MAKE SURE WE HAVE UP TO DATE CONTACT INFORMATION FOR YOU

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Thank you