



KENTUCKY MUNICIPAL ENERGY AGENCY



IRP2020 Presentation

Doug Buresh

June 24, 2021

- **IRP Process**
- Community Involvement
- Identify Resource Needs
- Near-Term Decision Elements
- Near-Term Preferred Plan
- Near-Term Plan Option
- Long-Term Plan Analysis
- IRP Publication Schedule

Process For Producing an IRP

kymeal.org/irp/irp-faqs/

What is the process for producing an IRP?

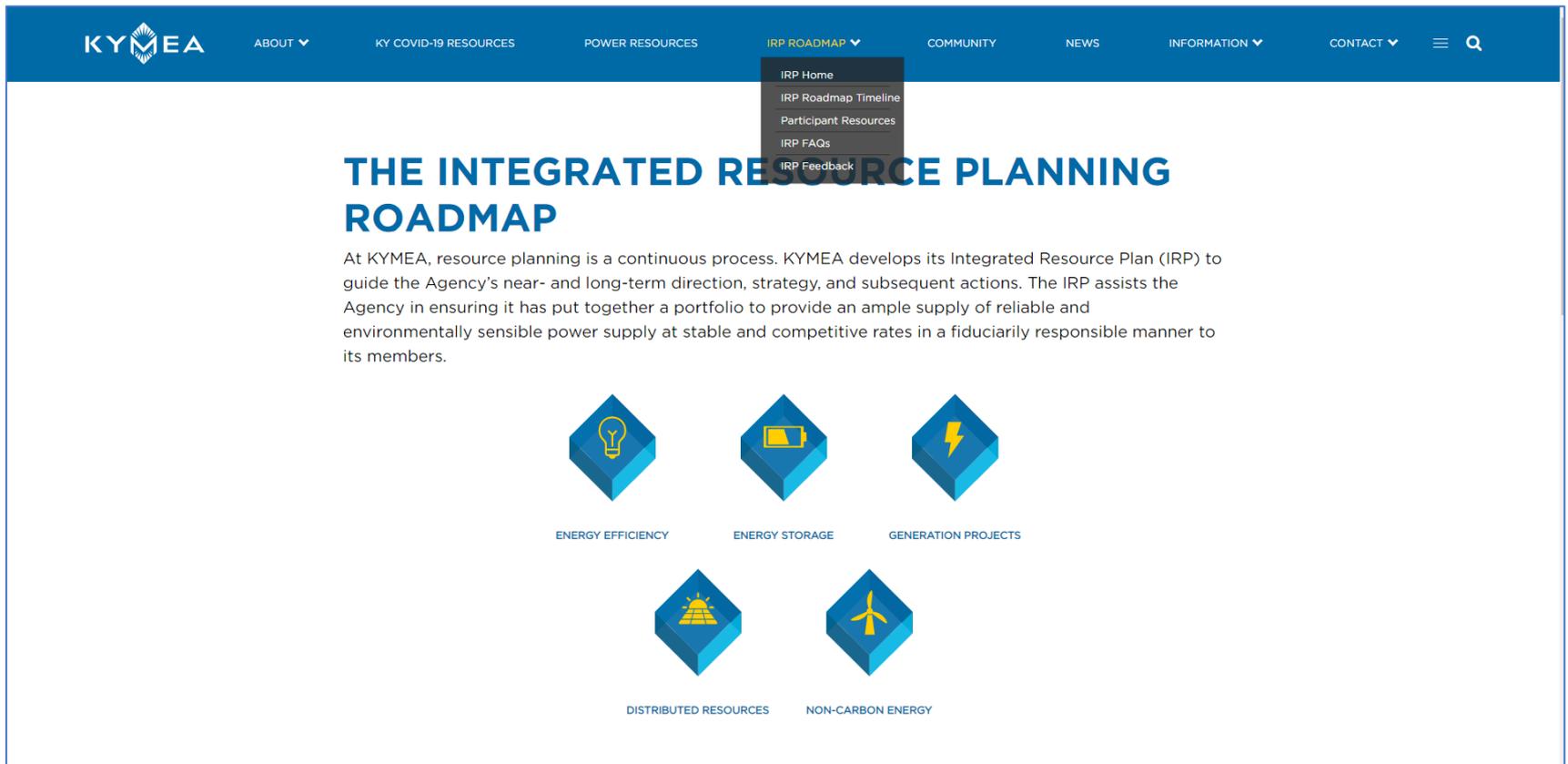
Because of the magnitude of information, modeling, and supporting studies that must be performed and evaluated, an IRP may take over a year to complete. KYMEA's process will consist of the following efforts:

- Community Focus Group sessions to assess customer sentiment toward the composition, reliability, and cost of KYMEA's future generating mix
- Collecting information to be used in the evaluation of future generation portfolios, such as technology, cost, and performance characteristics
- Reports and assistance from subject matter experts regarding matters that will provide insight to guide the overall IRP analysis
- An analysis of a wide range of generation options that can be used to meet portfolio planning objectives
- Measurement of key variables to determine a range of possible cost and performance outcomes and risk for proposed generation groups
- Distribution of findings, including final recommendations and action plan to the KYMEA Board of Directors

AGENDA

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kymea.org/irp/



KYMEA ABOUT ▾ KY COVID-19 RESOURCES POWER RESOURCES **IRP ROADMAP ▾** COMMUNITY NEWS INFORMATION ▾ CONTACT ▾ ☰ 🔍

- IRP Home
- IRP Roadmap Timeline
- Participant Resources
- IRP FAQs
- IRP Feedback

THE INTEGRATED RESOURCE PLANNING ROADMAP

At KYMEA, resource planning is a continuous process. KYMEA develops its Integrated Resource Plan (IRP) to guide the Agency's near- and long-term direction, strategy, and subsequent actions. The IRP assists the Agency in ensuring it has put together a portfolio to provide an ample supply of reliable and environmentally sensible power supply at stable and competitive rates in a fiduciarily responsible manner to its members.

- ENERGY EFFICIENCY
- ENERGY STORAGE
- GENERATION PROJECTS
- DISTRIBUTED RESOURCES
- NON-CARBON ENERGY

Community Focus Groups

The Community Focus Group sessions were open to the public. The sessions were advertised on the Agency's website at KYMEA.ORG. The session details were featured at the KYMEA Board meetings and in web and news outlets. To ensure public safety and compliance with the Centers for Disease Control and Prevention (CDC) guidelines in response to the pandemic, KYMEA made virtual participation available to its members and the public via live WebEx video meetings.

IRP2020 Community Focus Group Sessions

[kynea.org/irp/irp-resources/](https://www.kynea.org/irp/irp-resources/)

June 24, 2020, Community Focus Group

23 Attendees

The June 24, 2020, Community Focus Group session provided attendees an overview of the KYMEA portfolio, the IRP process and timeline, and an opportunity for live questions and answers. Speakers included the KYMEA team and industry experts from Boyd CAT and RWE Renewables Americas, LLC. The team allocated time to answer all questions asked in both the morning and afternoon Q&A sessions. Speakers fielded various questions regarding load growth, environmental stewardship, resource supply, and transparency. Participants were encouraged to review the list of the questions and answers that were subsequently published on the KYMEA website at <https://www.kynea.org/irp/irp-resources/>. Twenty-three people attended the meeting in person or via WebEx.

September 2, 2020, Community Focus Group

31 Attendees

During the September 2, 2020, Community Focus Group Session, staff primarily focused on scenario modeling and presenting preliminary results. The team allocated time to answer all questions that were asked during both the morning and afternoon Q&A sessions. Thirty-one people attended the meeting in person or via Webex.

All session videos, presentation materials, and public feedback were made available at <https://www.kynea.org/irp/irp-resources/>.

Community Participation

KYMEA thanks the public for the participation and feedback. The Agency believes it is important to consider a wide range of ideas are part of the IRP Process.

kymeas3.us-east-2.amazonaws.com/2020/09/General_Questions_Answers_and-Feedback_09-2-2020-R1.pdf

Summary of Feedback Comments

1. 100% zero-carbon renewable energy by 2030.
2. Go for innovative technologies that are on the upswing. Work with Kentucky colleges and universities to develop innovative sustainable energy programs.
3. KYMEA should be a leader and educator to the best energy alternatives.
4. Specific questions on load forecast, behind-the-meter generation, solar generation and irradiance, batteries, carbon emissions, air pollutants, geothermal generation.
5. Fiscal aspects of switching to more environmentally friendly energy.
6. KYMEA should join MISO.
7. Buy energy on the open market.
8. Don't invest in a single technology.
9. Provide report on carbon and other emissions.

Community Plans

Long-Term Plans - 100% zero-carbon renewable energy by 2030.

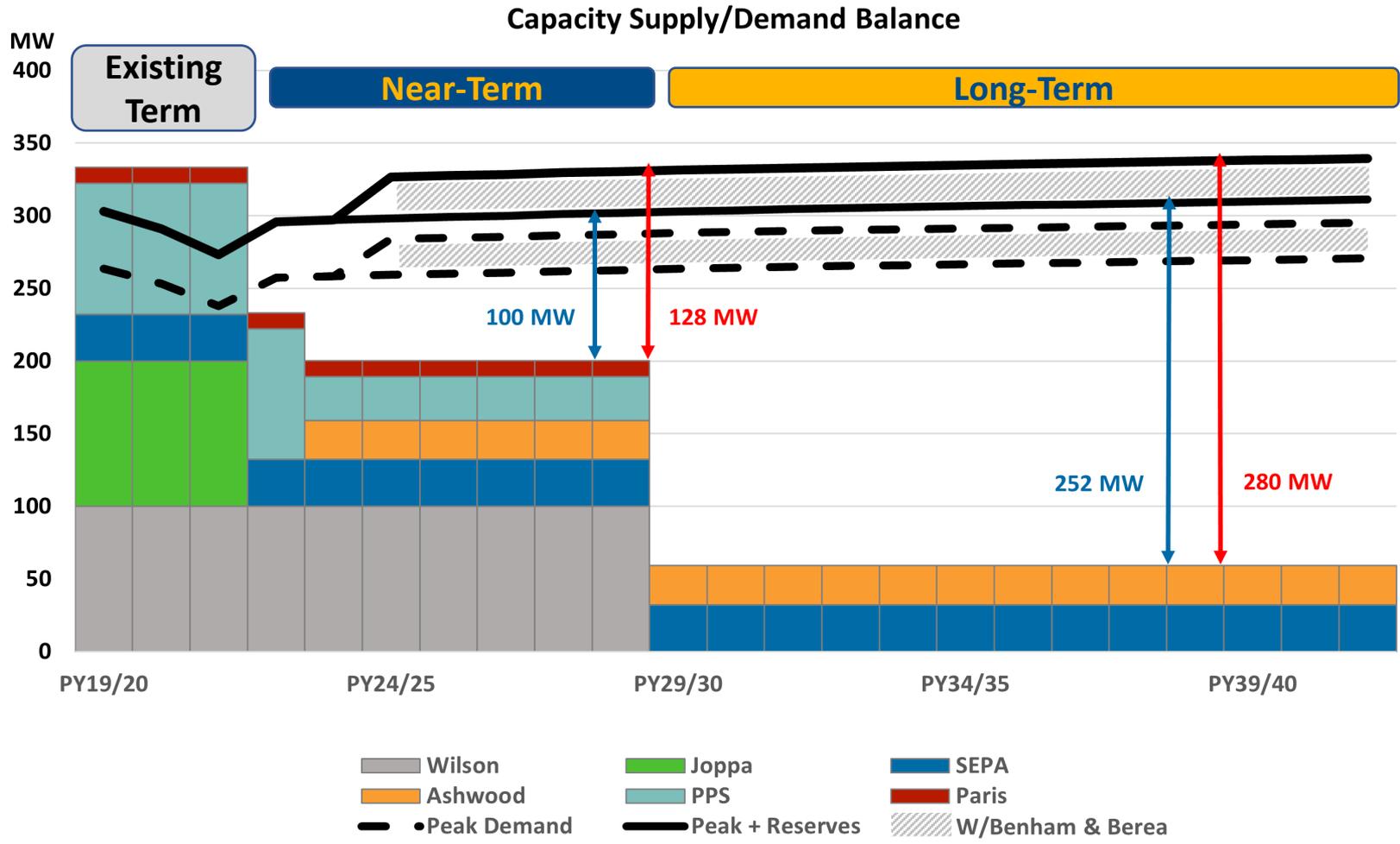
- KYMEA developed three specific plans to address “100% zero-carbon renewable energy by 2030”

	NET ZERO	DECARBONIZATION	
	PLAN 4	PLAN 5	PLAN 6
Solar (MW)	131	702	298
Wind (MW)	325	0	250
Hydro (MW)	32	32	32
Batteries (MW)	78	22,008	8,395
Market (MW)	175	0	0
Annual Cost	\$0.140 Billion	\$13.2 Billion	\$5.0 Billion
CO2 Emission (lb/MWh)	427	0	0
% Carbon-Free (2030)	106%	100%	100%

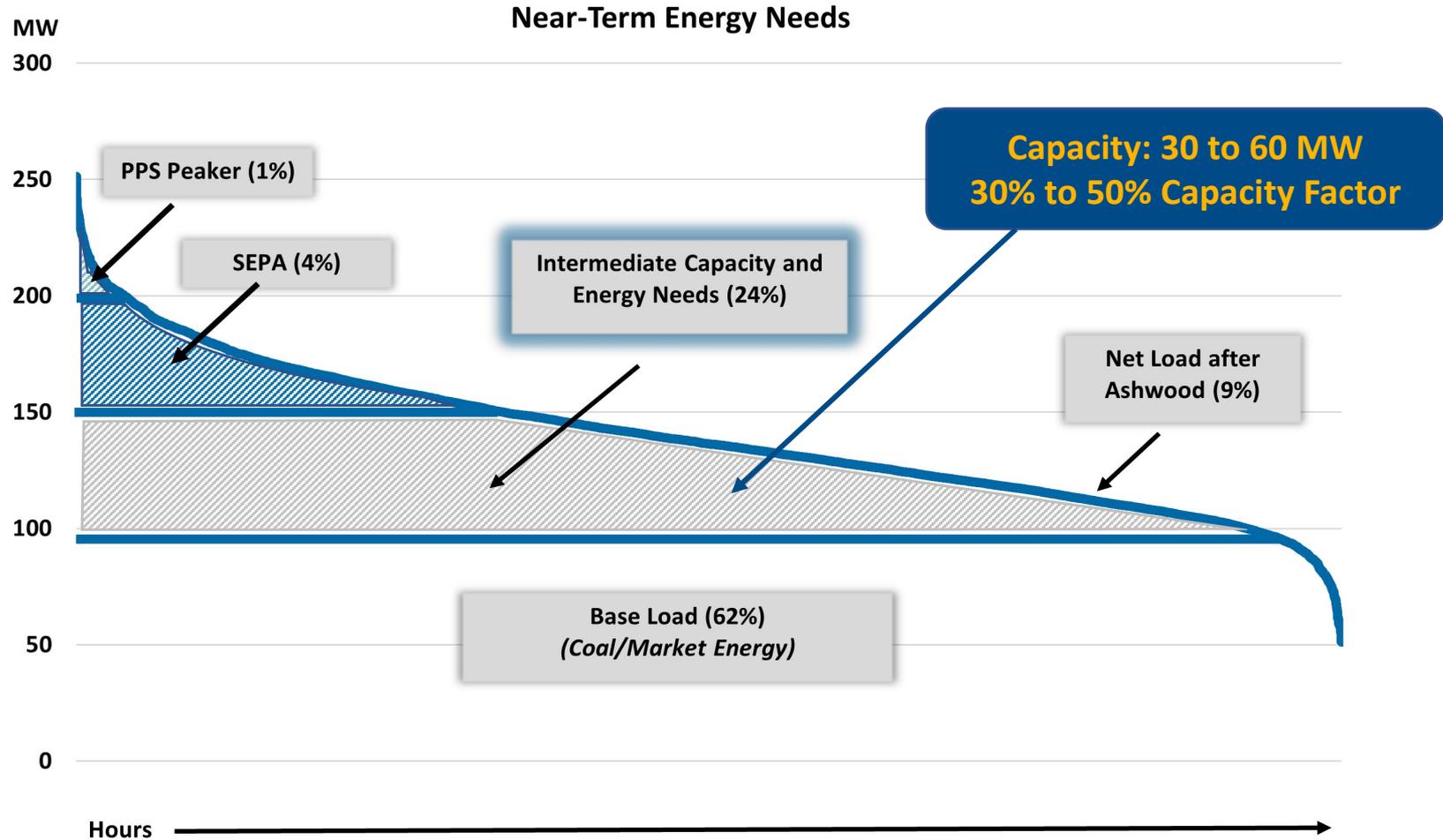
1. **NET ZERO (PLAN 4):** In this plan, the overall carbon footprint is 106%; however, the plan relies heavily on market sales and purchases (including fossil fuel generation) to balance the system.
 - 75% of the 325 MW Wind is not used by KYMEA, but rather is sold in the MISO market.
 - 55% of the energy required to serve KYMEA’s native load is purchased from the MISO market.
2. **DECARBONIZATION (PLAN 5 and PLAN 6):** These plans are completely decarbonized, no carbon emissions whatsoever. Presently, there is not a long duration battery storage (150 hour +) technology, so the plans relied on existing 10-hour battery storage which is financially impractical.

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20-Year Capacity Needs



Near-Term Energy Needs



RFP2020 Synopsis

The Kentucky Municipal Energy Agency (KYMEA) seeks written proposals from qualified suppliers of electric intermediate capacity and energy resources. KYMEA intends to purchase power from one or more suppliers commencing on June 1, 2022 for terms of 3 to 20 years.

Resources should: (i) be deliverable on a firm, non-interruptible basis to the LGE/KU transmission system, (ii) be delivered to KYMEA on a first call basis and not be committed for sale to third parties, and (iii) qualify for designation as network resources under the LGE/KU Open Access Transmission Tariff (“OATT”) to serve the loads of KYMEA’s Member municipal electric systems.

Proposers may propose a specific amount of capacity or indicate that the amount of capacity to be purchased would be within a range from 30 MW to 60 MW, with the specific amount to be determined during negotiation of the power purchase agreement. The expected capacity factor is between 30% and 50%.

Proposers are required to submit by email their questions pertaining to this RFP no later than 2 pm EDT on August 12, 2020 and their proposals no later than 2 pm EDT on August 19, 2020, and meet other requirements specified in this RFP.

RFP2020 Responses

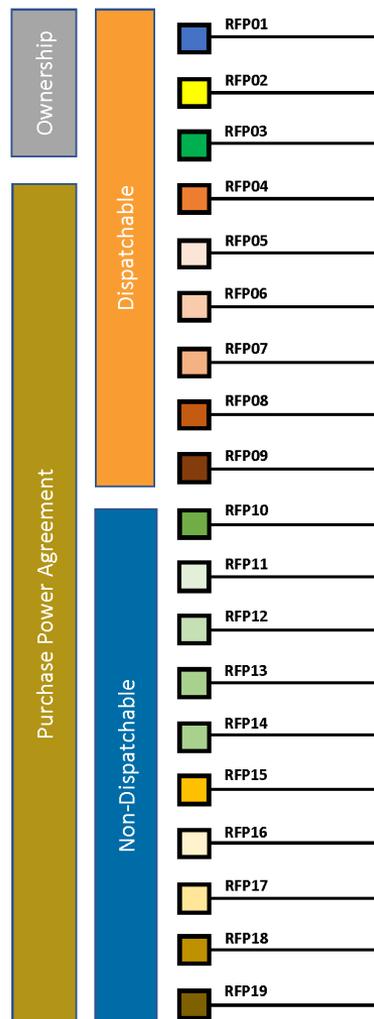
RFP2020 Response Summary

The RFP produced 32 proposals from 11 respondents. The proposals included ownership and PPA options for the specified capacity and energy product. Also included, were solar and battery storage proposals.

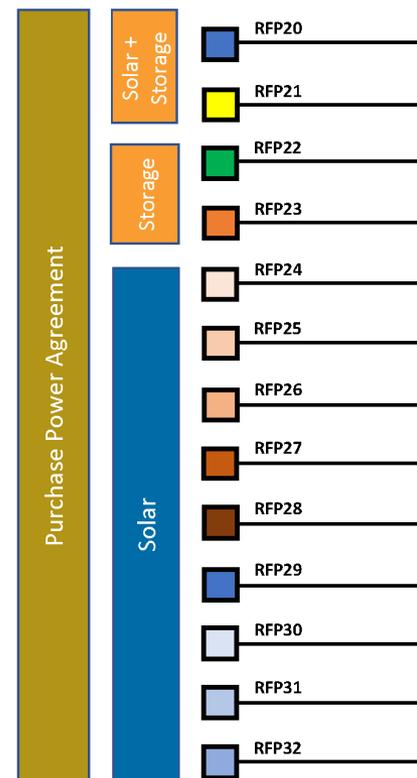
KYMEA is unable to publicly share the specific RFP responses due to non-disclosure agreements (NDA). The responses can be categorized as:

- Reciprocating Internal Combustion Engines (RICE)
- GE LM6000
- System Dispatchable Capacity/Energy
- 7x24 Fixed Price Capacity/Energy
- 5x16 Fixed Price Capacity/Energy
- 7x24 Indexed Price Capacity/Energy
- 5x16 Indexed Price Capacity/Energy
- Solar
- Solar + Storage
- Storage Only

Capacity/Energy Proposals



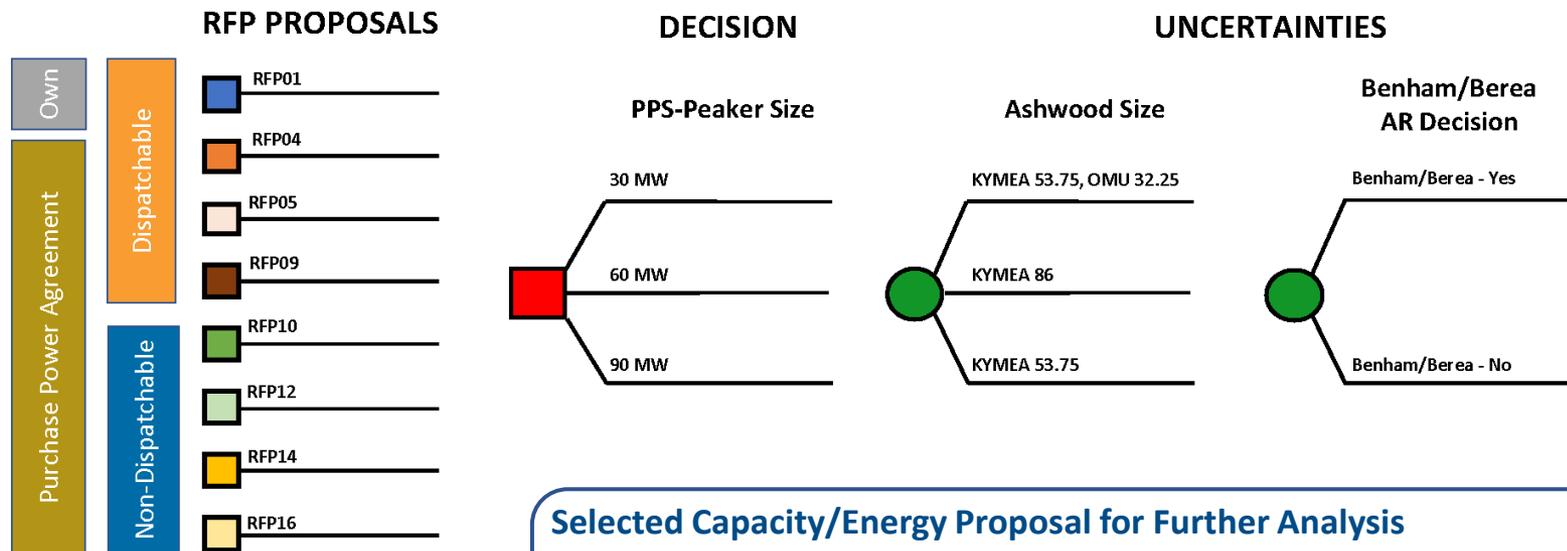
Solar/Storage Proposals



RFP2020 Capacity and Energy

RFP2020 Capacity and Energy Analysis Proposals

The 19 capacity and energy responses were reduced to eight proposals. Proposals that were similar but inferior to a better proposal with similar attributes were not simulated with EnCompass in the interest of reducing the viable options to a manageable size of eight proposals. KYMEA considered 144 combinations (8 x 3 x 3 x 2 = 144) to determine which RFP proposal provided the best fit to meet KYMEA’s near-term resource needs.



Selected Capacity/Energy Proposal for Further Analysis

A MISO Counterparty Intermediate Capacity and Energy Proposal was selected for possible inclusion in the near-term plan.

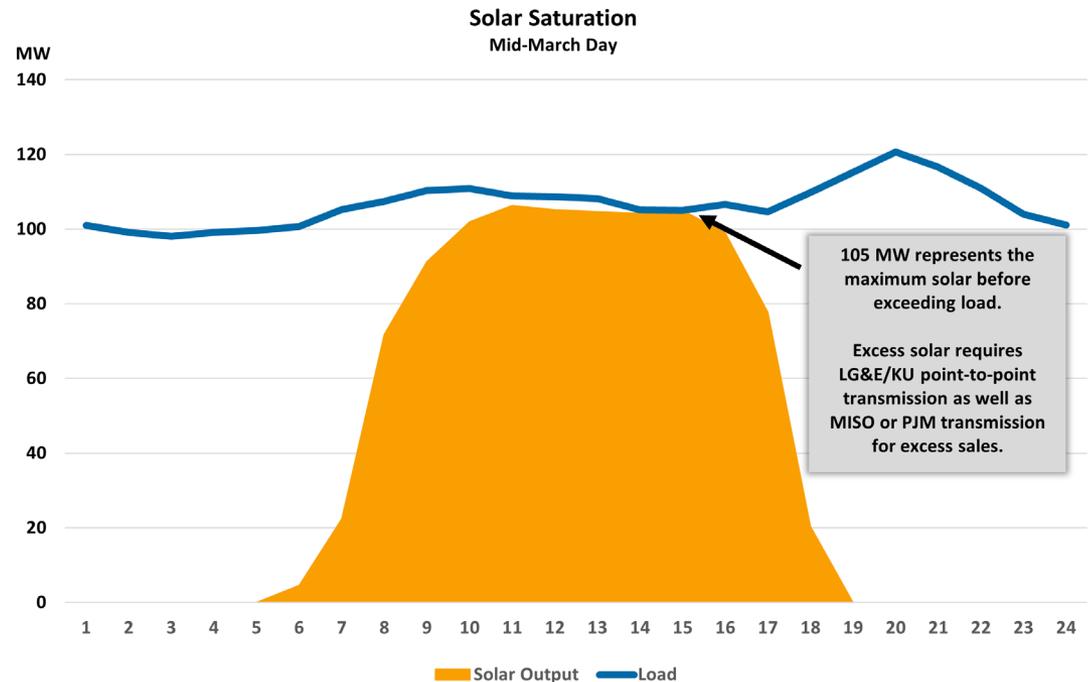
RFP2020 Solar and Storage

RFP2020 Solar and Storage Proposals

The 13 solar/storage responses were compared against the Right of First Refusal (ROFR) for the 32.25 MW of the Ashwood Solar I project. Since the Ashwood Project ROFR was the least-cost choice, no further analysis of the 13 RFP responses was performed. The storage options were eliminated as a viable replacement for the PPS Peakers due to the storage hours (2-4 hours) and cycling limitations of the lithium-ion batteries.

Solar Size Limitation

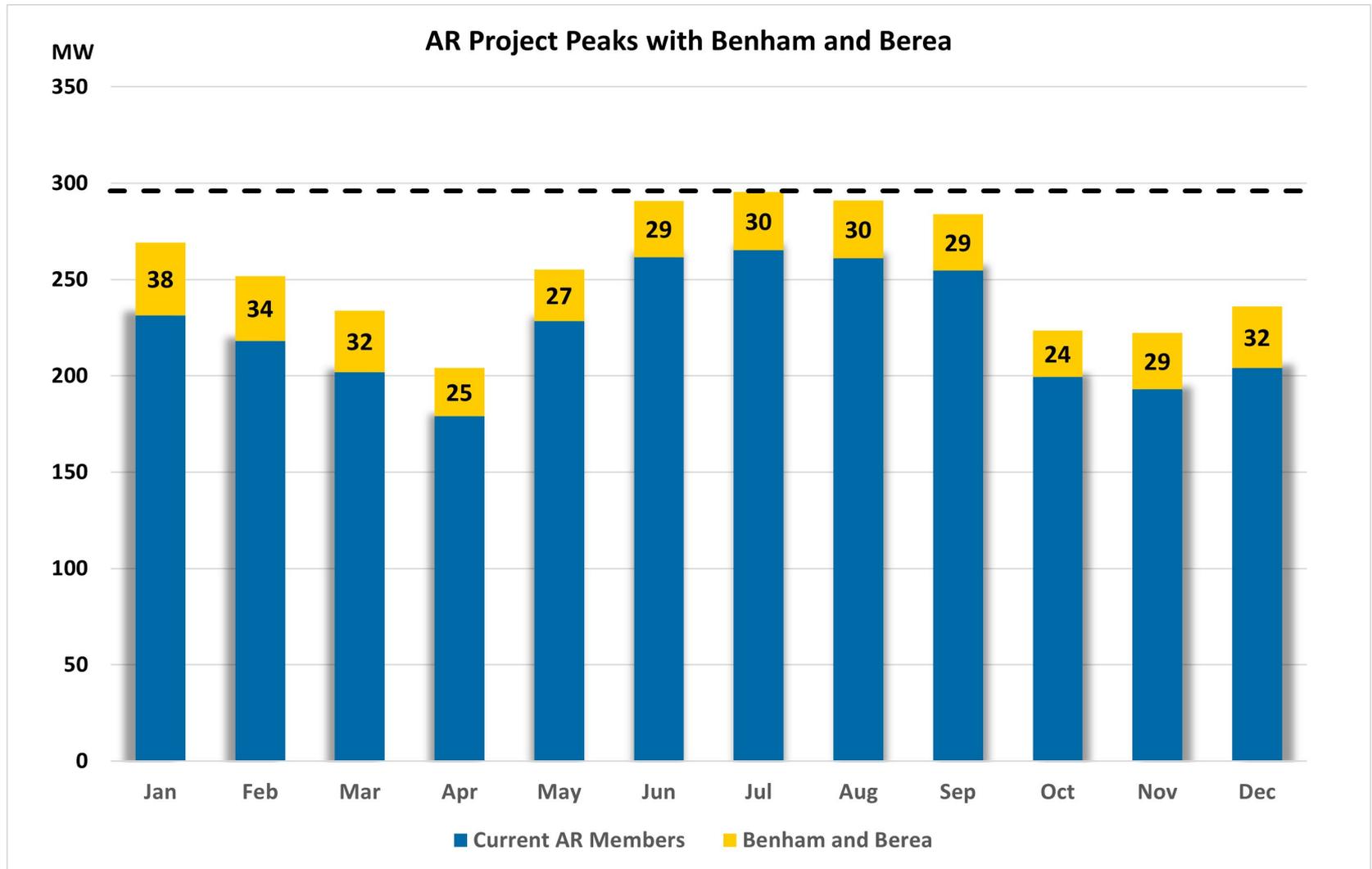
Since the majority of the KYMEA load is not in a competitive market (RTO), care must be taken to not over size solar to the point it exceeds our load. For the 8 AR Project members, the maximum size is 105 MW without additional transmission.



MISO Counterparty Proposal

- Capacity: Up to 60 MW
 - Firm Capacity
- Dispatch: Hourly (0 to Maximum)
 - Minimum 30% Annual Capacity Factor
 - Firm Energy (100% availability)
- Term: June 1, 2022 – May 31, 2027
- Energy Price: Monthly price tied to the counterparty monthly average fuel and energy cost
- Demand Charge: Fixed

Benham and Berea - IRP Participation



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Near-Term Decisions

The responses to RFP2020 provided KYMEA with near-term options to consider for the Agency's capacity and energy needs. In addition to selecting one or more suppliers from the RFP, the KYMEA Board also had several other decisions to make before the end of 2020 or shortly thereafter.

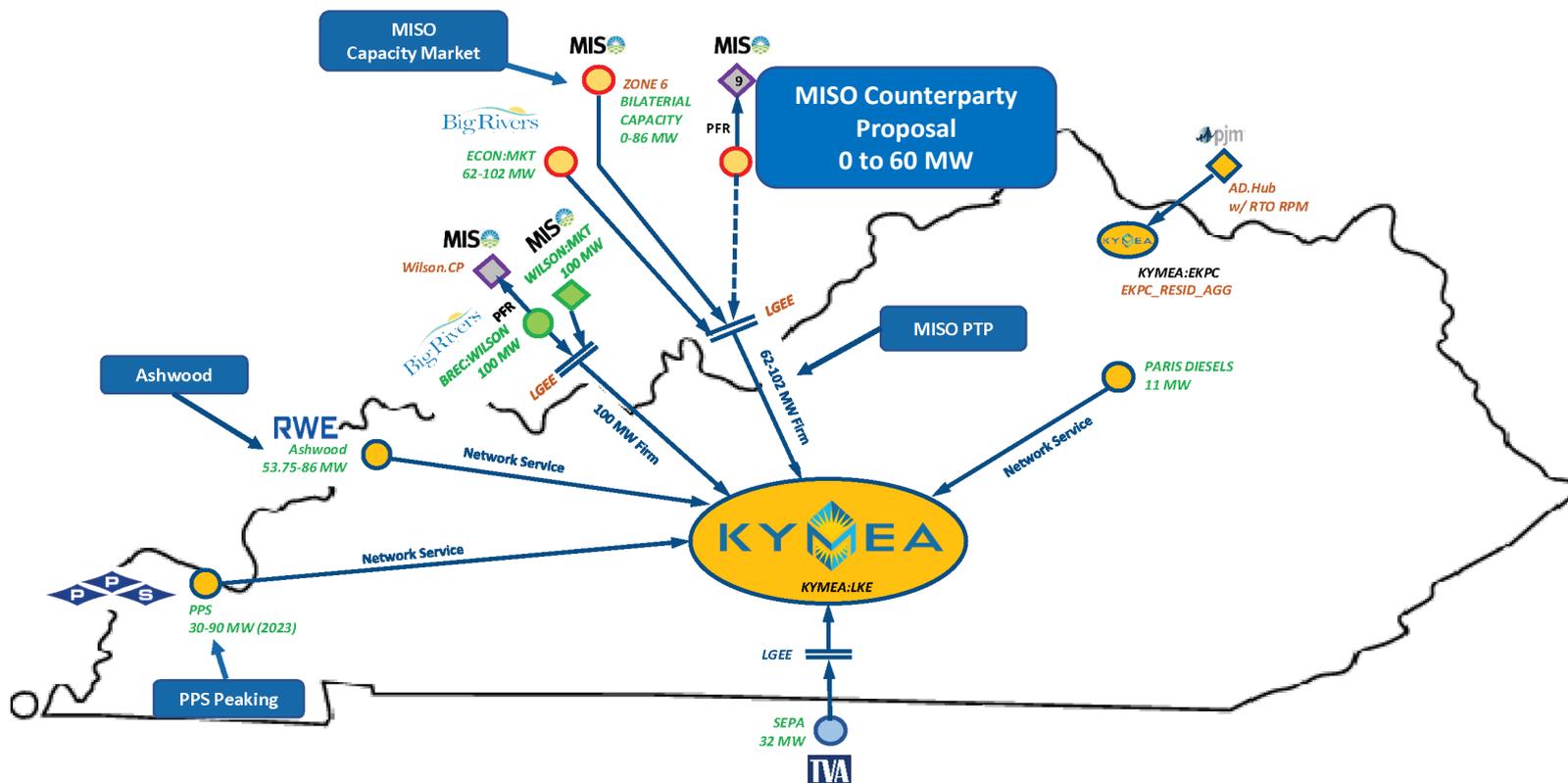
Immediate decisions before KYMEA were:

- 1. RFP Capacity/Energy Proposals.** Staff evaluated and ranked the RFP options and provided the results for the Board's consideration as described in Section 13 (Plan Development) where a counterparty provides MISO Intermediate Capacity and Energy proposal was selected as the preferred option for further analysis.
- 2. MISO Point-to-Point Transmission Service Reservation (TSR).** Staff recommended for the Board's consideration the appropriate size and term of a MISO (Source) point-to-point firm transmission path to the LG&E/KU balancing area (Sink) coupled with LKE network integrated transmission service (NITS) to ensure power delivery and operating reserves to satisfy a 1-in-10 peak demand forecast. The need for the additional MISO PTP and LKE NITS is dependent upon the RFP selection (Item 1)
- 3. Paducah Power System (PPS) Peaking Capacity.** By December 31, 2020, KYMEA could exercise a one-time election to decrease the PPS Peaking Capacity from 90 MW to no less than 30 MW. The election, if exercised, commences on June 1, 2023.
- 4. Ashwood Solar I Project.** The Ashwood Solar I project was designed as an 86 MW solar plant, which KYMEA would take 53.75 MW (62.5%) and Owensboro Municipal Utility (OMU) would take 32.25 MW (37.5%). OMU opted to not take their portion providing KYMEA an opportunity for 32.25 MW of additional solar.

Five Near-Term Decision Elements

Five Near-Term Decision Elements

With the inclusion of the MISO Company proposal, there were five (5) near-term decision elements before the KYMEA Board of Directors which needed to be made by the end of 2020 or shortly thereafter. The decisions are highlighted on the map.



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Risk Analysis Quadrants

Risk Assessment

Near-Term Evaluation

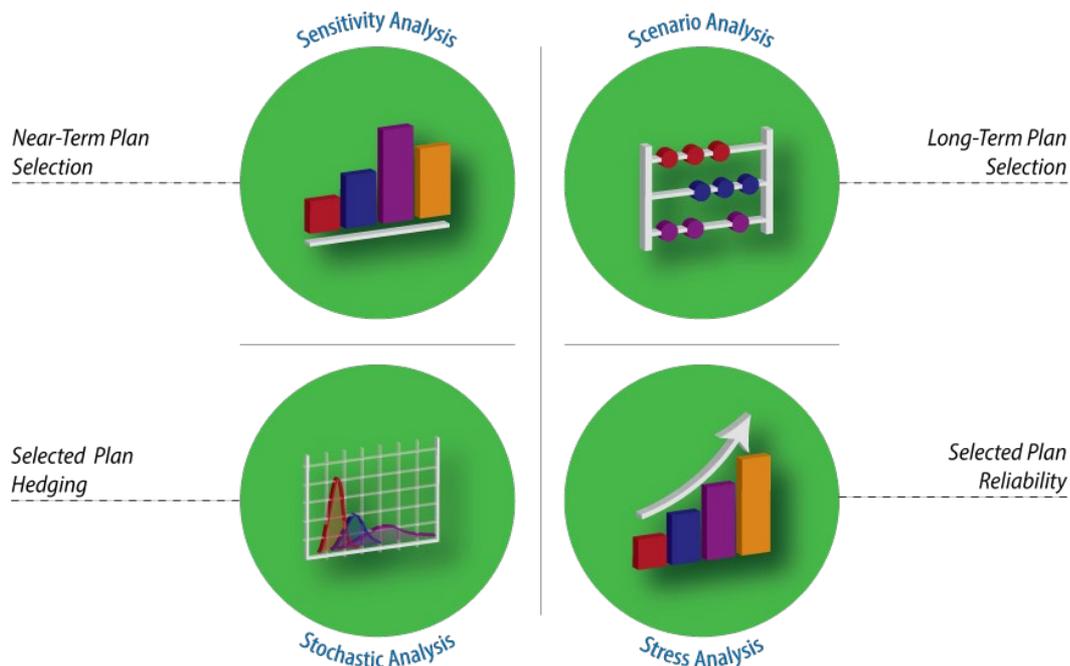
The near-term evaluation focused on actionable decisions that needed to be made by the KYMEA Board of Directors at the time this IRP was being written.

- Evaluation Period: 5 Years
- Risk Analysis Quadrant: Market Sensitivities

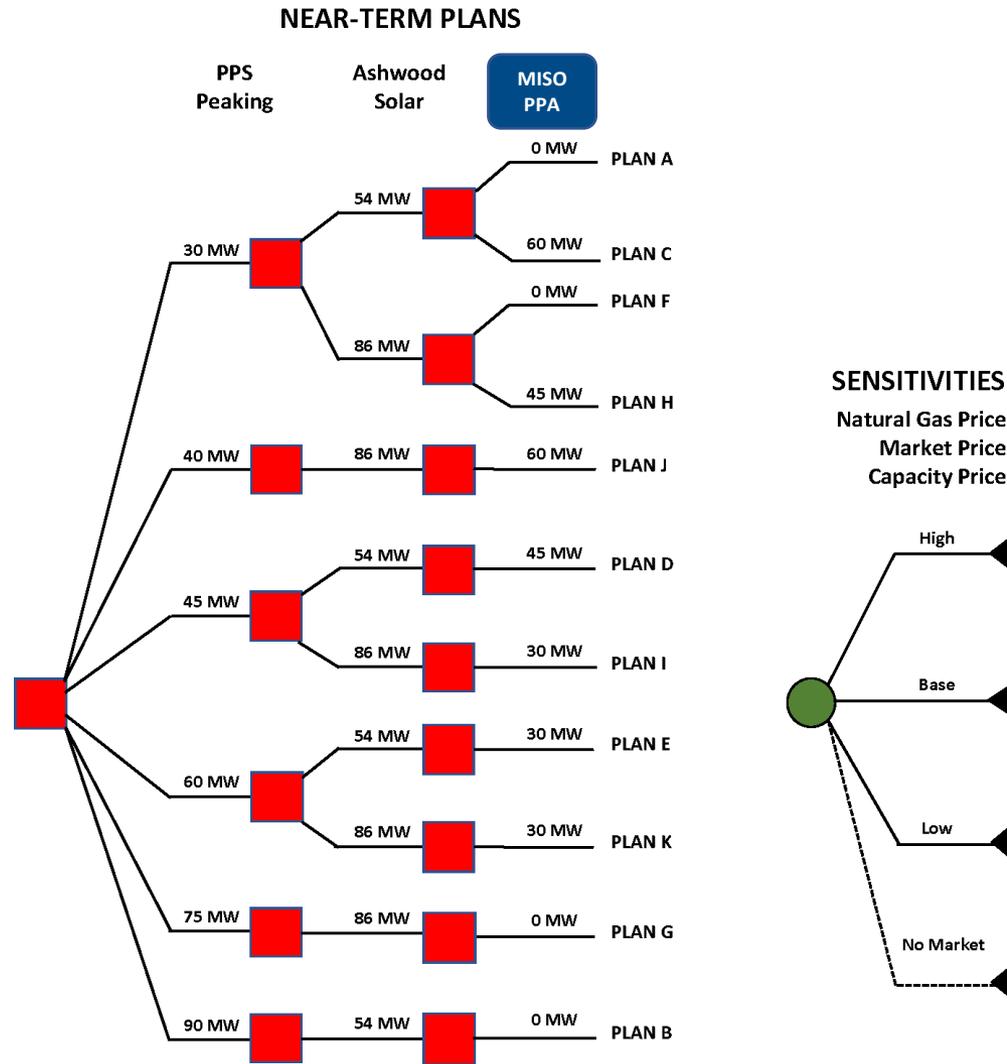
Long-Term Evaluation

The long-term evaluation focused on possible future plans. There were no immediate actions that need to be considered for the long-term evaluation. The purpose of the evaluation was to assess how each long-term plan would perform under the nine plausible scenarios

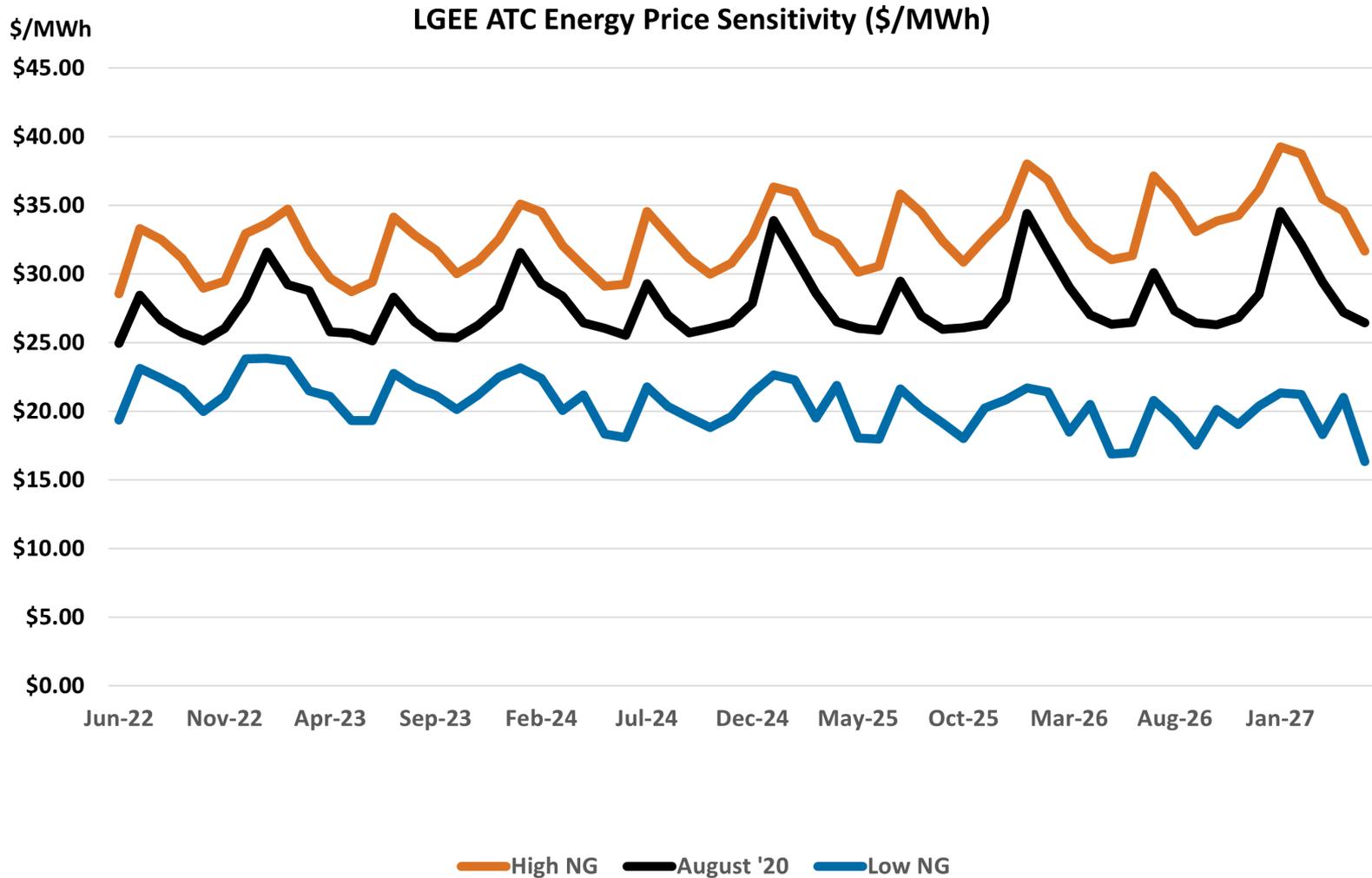
- Evaluation Period: 20 Years
- Risk Analysis Quadrant: Scenarios



Near-Term Plan Risk Evaluation

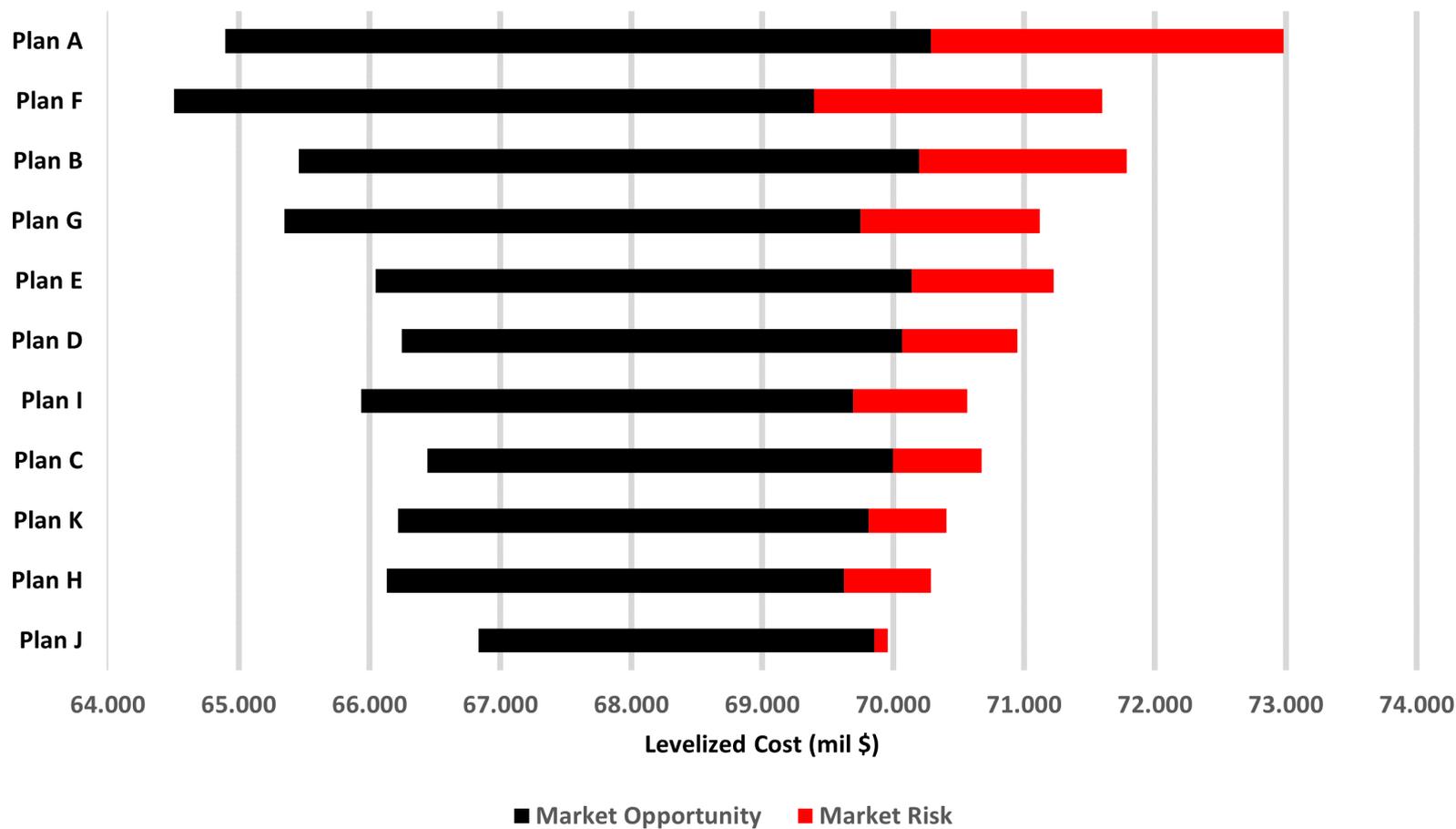


Near-Term Energy Price Sensitivity



Near-Term Plan Market Risk

Expected Value and Market Risk

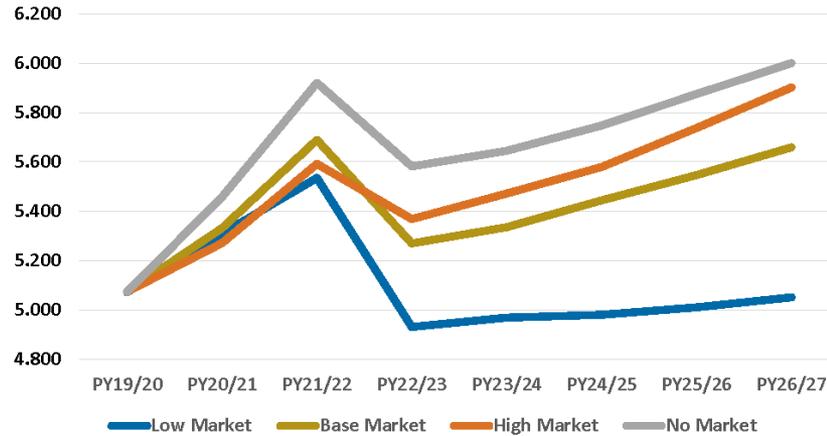


KYMEA Board Approval – December 29, 2020 (6 months ago)

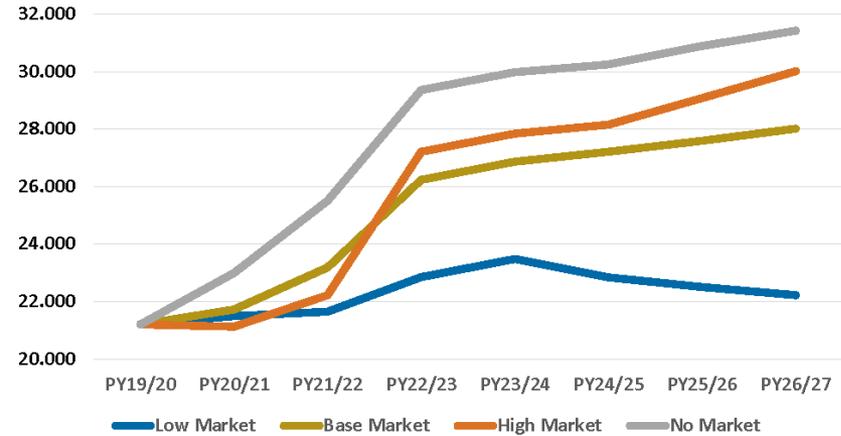
1. Board approval to select Plan E and direct KYMEA CEO to implement elements of the Plan subject to as needed subsequent Board approval(s).
2. Board approval to nominate the PPS Peaking Capacity to 60 MW beginning June 1, 2023.
3. Board approval to waive KYMEA's right of first refusal (ROFR) to take an additional 32.25 MW from the Ashwood Solar I Project.
4. Board directed the CEO to develop a term sheet and negotiate a purchase power agreement for 30 MW of intermediate capacity and energy with one or more identified parties from the indicative RFP responses received August 19, 2020. CEO will seek Board approval of the final PPA when contract terms have been completed.
5. CEO Action (No further Board action required): Based on selected Plan E, CEO will move forward with the necessary LG&E/KU and MISO System Impact Studies which have been previously approved by the Board at the September 24, 2020 Board meeting for 15 MW of additional MISO transmission.

Plan E - Market Exposure

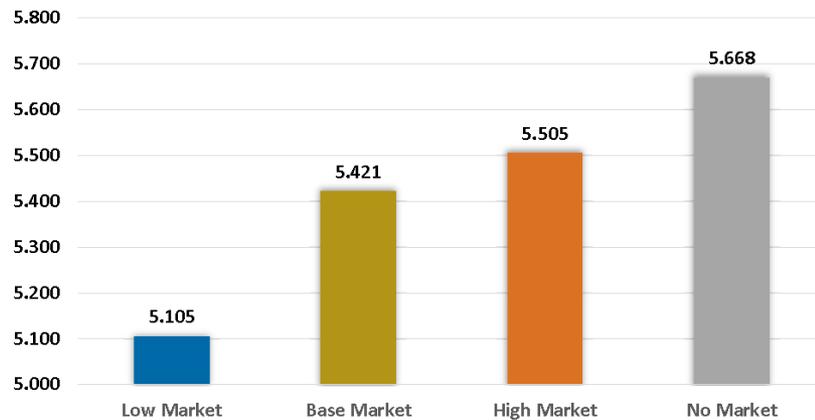
Average Production Cost (¢ per kWh)



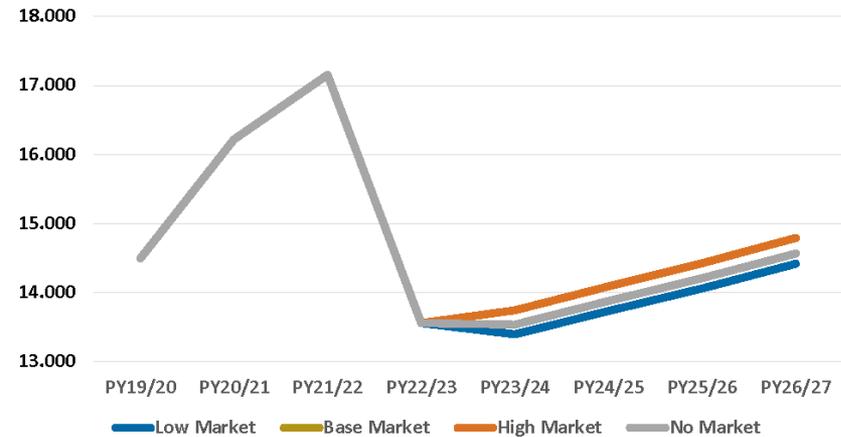
Native Load Energy Cost (\$ per MWh)



PY22/27 Levelized Ave Cost (¢ per kWh)



Production Fixed Cost (\$ per kW-MO)

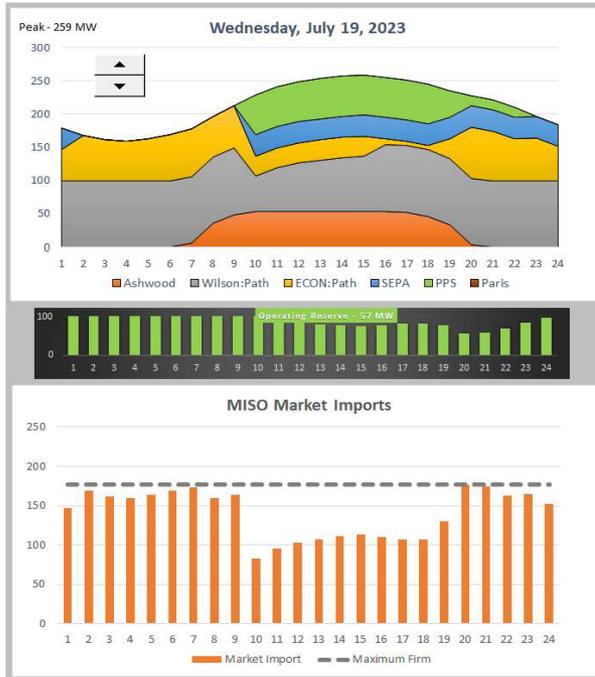


Plan E - Summer Operating Reserves

Summer Season - 2023

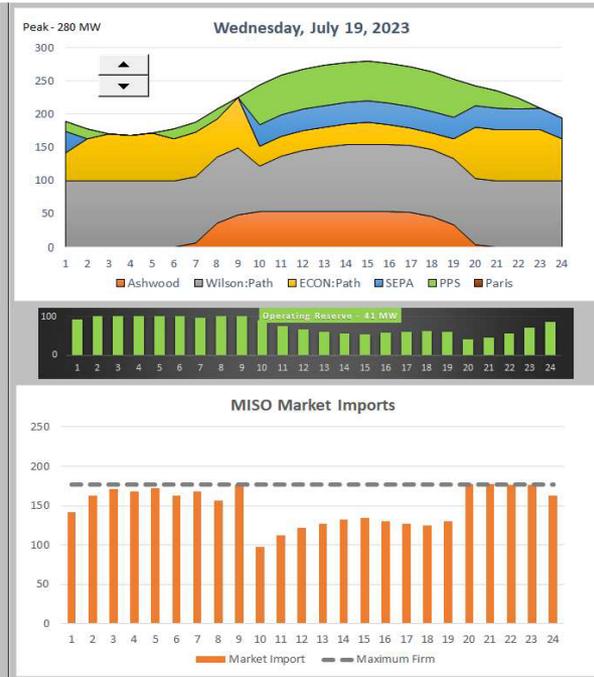
Operating Reserves: 57 MW
Peak Summer Day

All Units Available



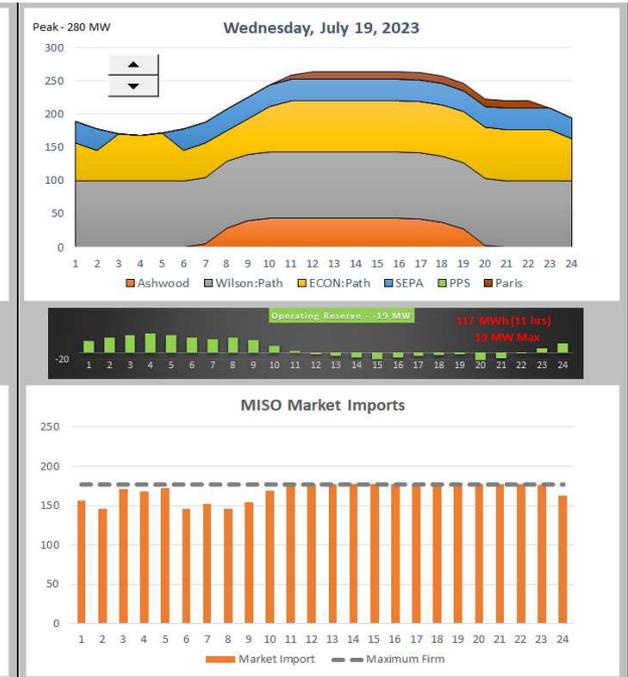
Operating Reserves: 41 MW
1-in-10 Peak Summer Day

All Units Available



Operating Reserves: -19 MW
1-in-10 Peak N-1 Contingency

PPS FO, Ashwood 20% Derate



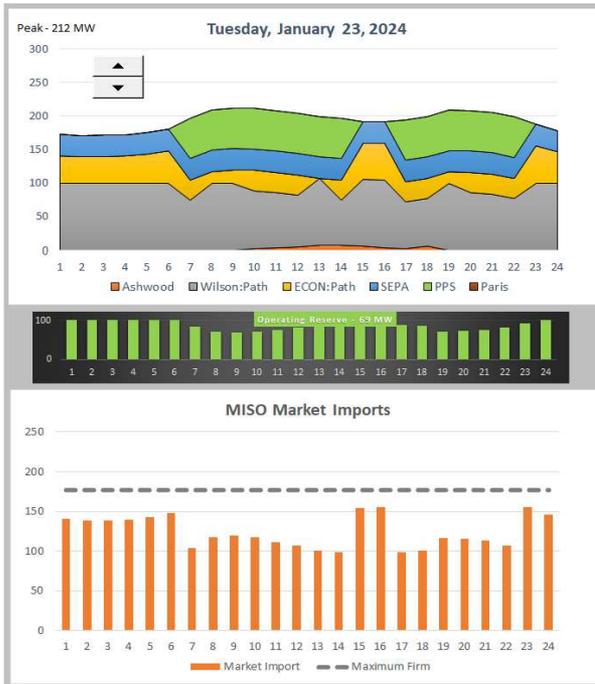
Plan E - Winter Operating Reserves

Winter Season - 2023

Operating Reserves: 69 MW

Peak Winter Day

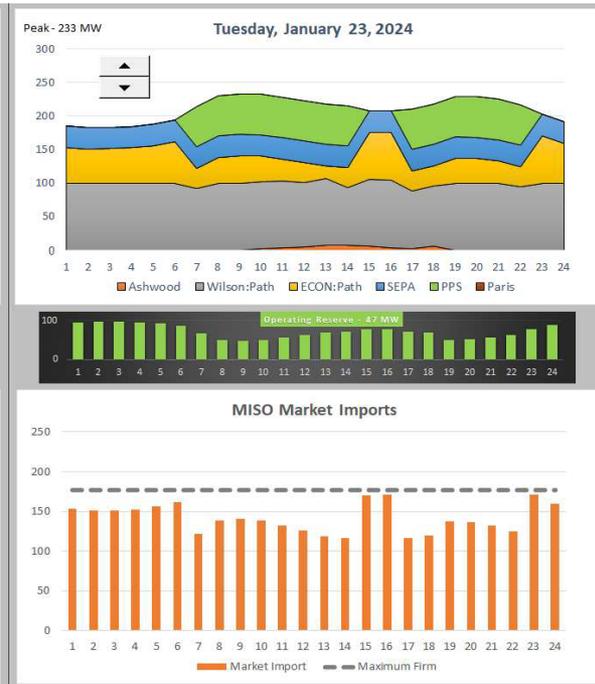
All Units Available



Operating Reserves: 47 MW

1-in-10 Peak Winter Day

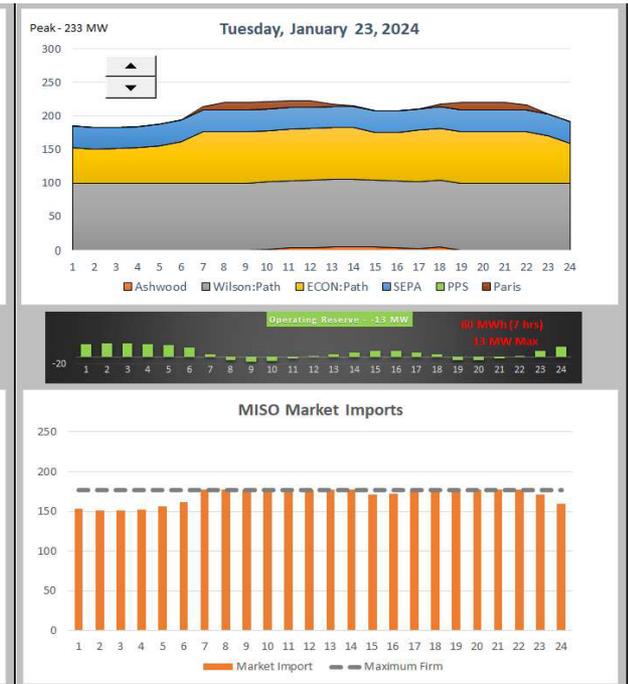
All Units Available



Operating Reserves: -13 MW

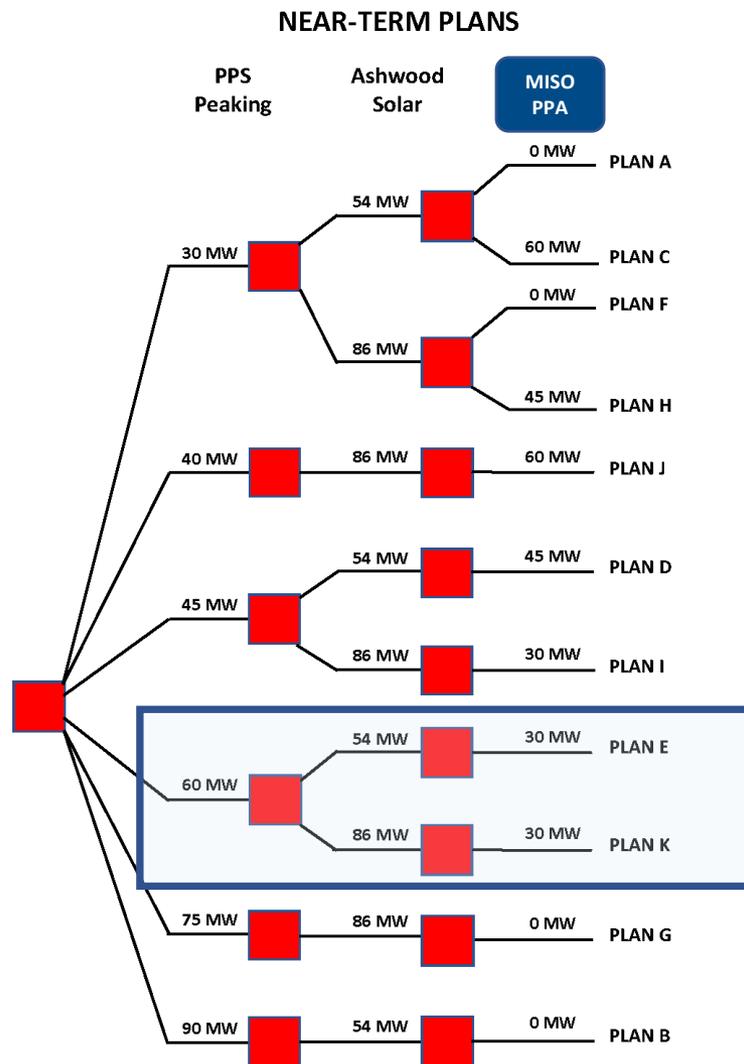
1-in-10 Peak N-1 Contingency

PPS FO, Ashwood 20% Derate



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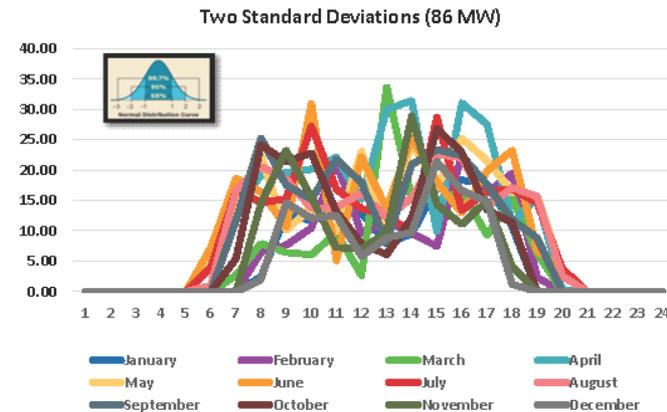
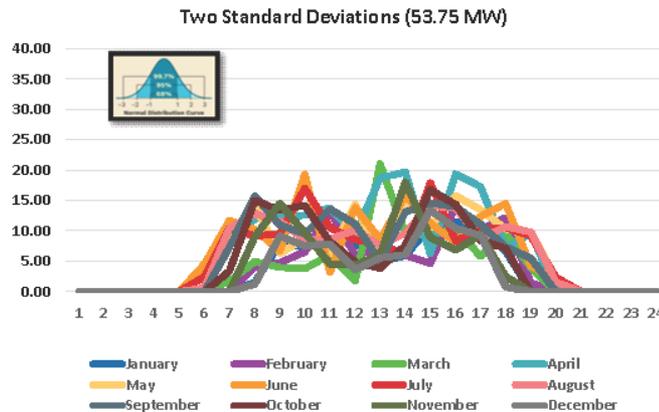
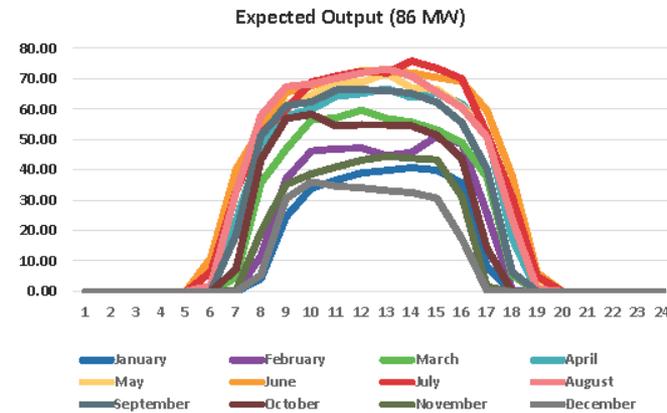
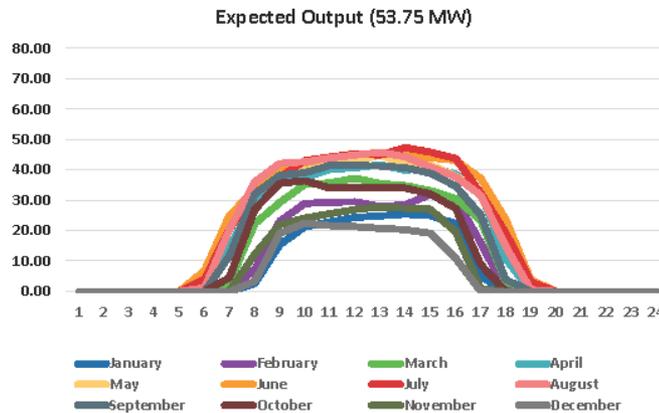
Optional Pivot from Plan E to Plan K



Plan E and Plan K

Ashwood Intermittency

The difficulty associated with integrating Ashwood into KYMEA's portfolio stems from the fact that the LKE transmission system is not in an RTO; therefore, fluctuations in KYMEA's supply and demand balance fall under LG&E/KU's imbalance tariff, which provides a very narrow bandwidth of movement ($\pm 7.5\%$ of hourly demand). This is especially challenging because KYMEA's conventional method for planning the daily balancing operation involves adjustments to its day-ahead, hour-ahead, and real-time operating procedures subject to MISO tags and ramping availability.



KYMEA Board Direction – December 29, 2020 (6 months ago)

1. Given KYMEA has not been able to fully investigate and analyze the ability to dynamically schedule energy from MISO, the Board chose not to exercise its right to the additional 32.25 MW during the ROFR period.
2. KYMEA is dependent on other entities (OATI, MISO, MISO LBA, LG&E/KU, and TVA); plus, must address hardware, software, and communications issues to make the dynamic schedule a reality.
3. Depending RWE's remarketing efforts, the KYMEA Board will have an opportunity to take the unremarketed portion of Ashwood (0 to 32.25 MW) at some point in 2021.
4. The Board's decision to waive its ROFR provides the KYMEA staff more time to continue its analysis and feasibility of the MISO dynamic schedule.

Dynamic Schedule Solution

Addressing Solar Intermittency - Dynamic Schedule Solution

In addition to daily fluctuations caused by sunrise and sunset, the output from solar panels can also change suddenly due to clouds. Variability caused by clouds can make it more difficult for KYMEA to predict how much energy to import from MISO during the next hour of the day. Fast fluctuations in output from solar energy does not only disrupt the hourly load-following, but also the second-to-second balance between total electric supply and demand. Today, BA grid operators send a signal to power plants approximately every four seconds to ensure the total amount of power injected into the grid consistently equals the total power withdrawn. KYMEA's strategy to overcome solar variability is to mimic how a grid operator balances load; but, instead of sending a signal to a generator, KYMEA will send a signal to MISO in the form of a dynamic schedule.

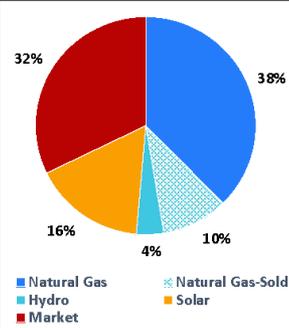
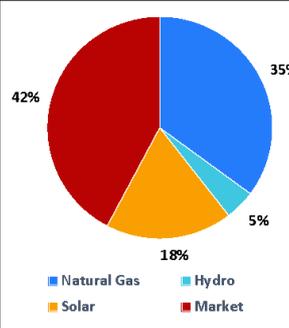
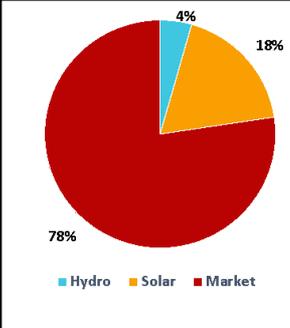
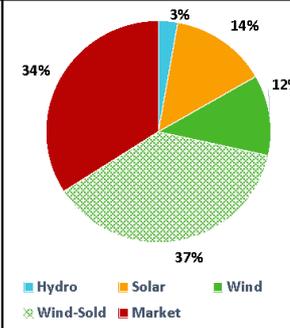
Dynamic Schedule Definition

From a simple perspective, a dynamic schedule is a means of achieving a time-varying exchange of power where traditional block scheduling is not sufficient. The dynamic schedule is a telemetered reading or value that is updated in real time and used as a schedule in the AGC/ACE (automatic generator control/area control error) equation and the integrated value of which is treated as a schedule for interchange accounting purposes.

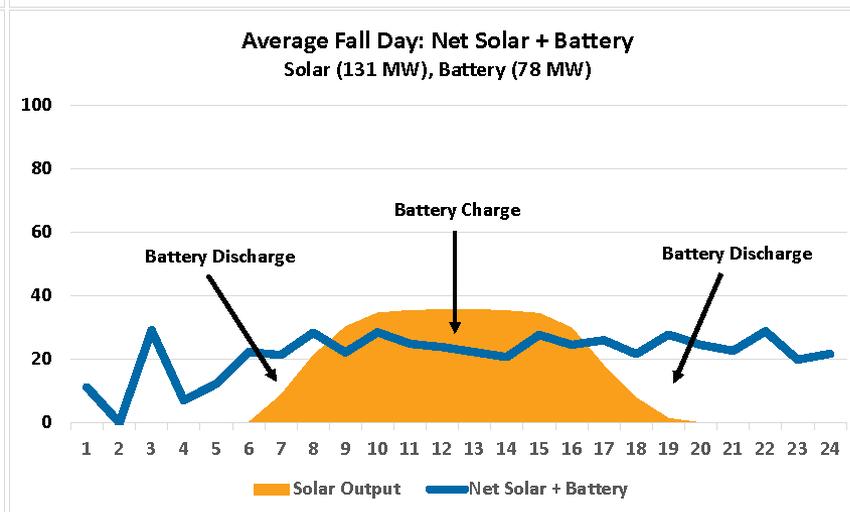
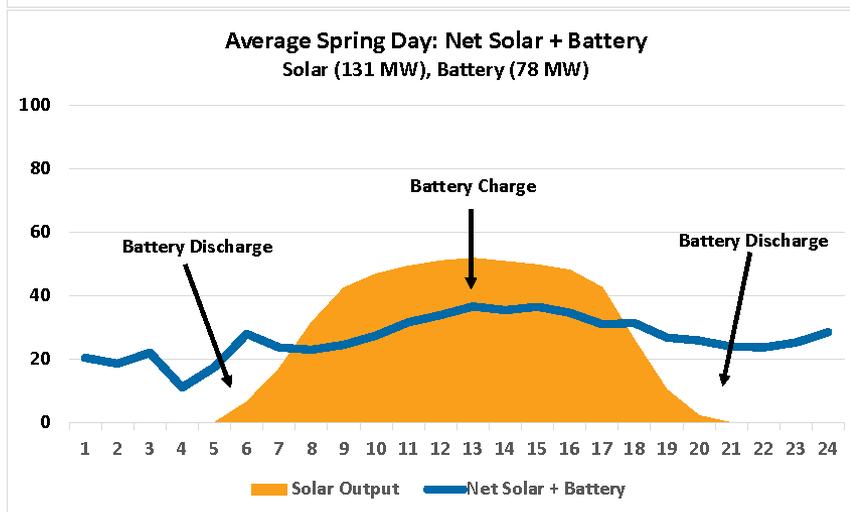
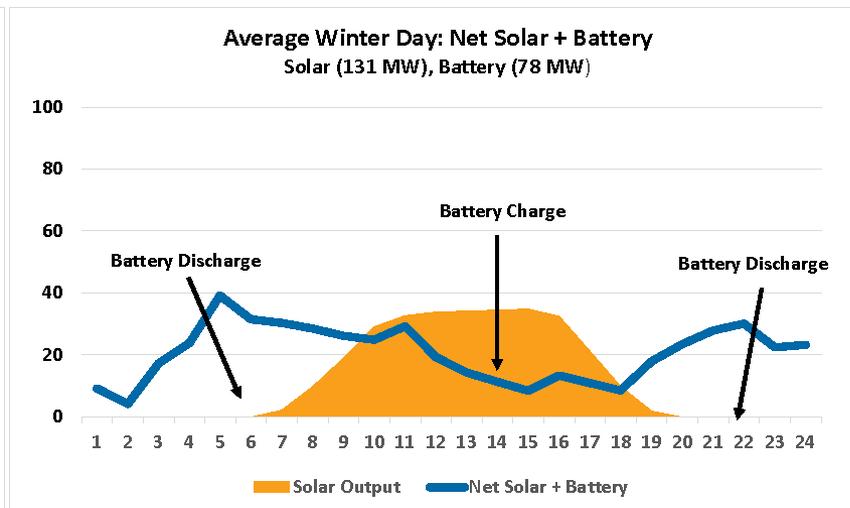
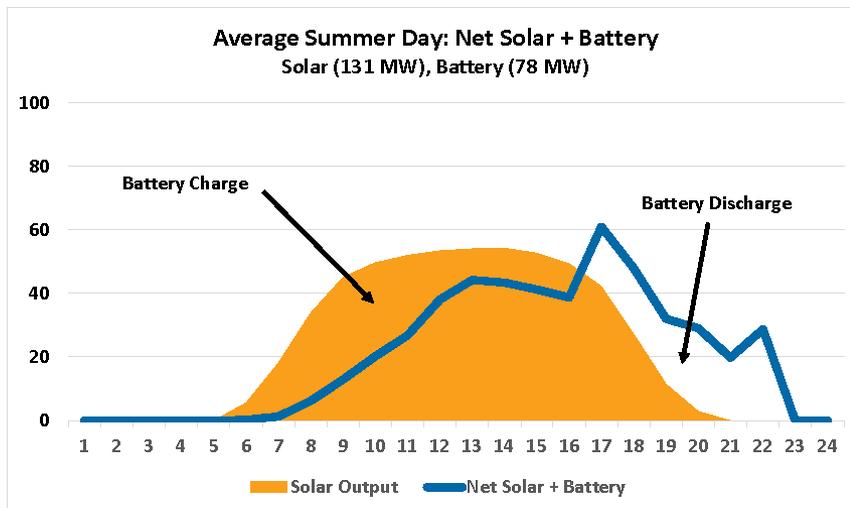
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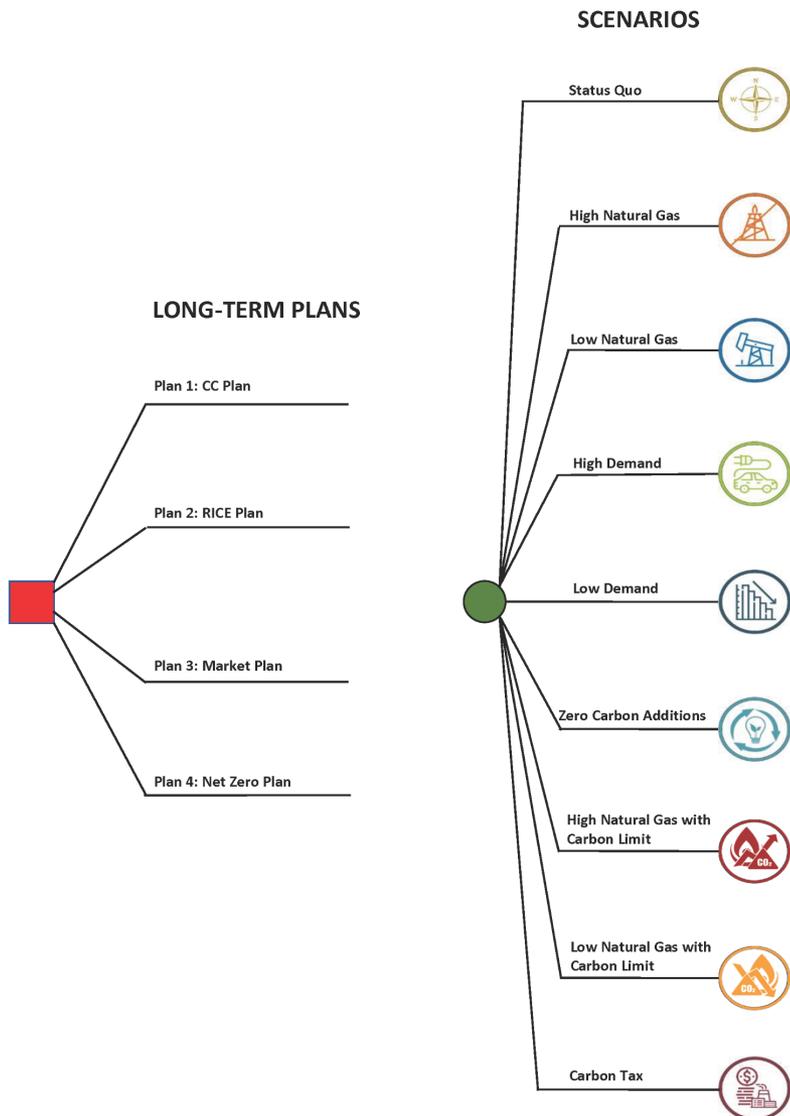
Four Long-Term Plans

	Plan 1: CC Plan	Plan 2: RICE Plan	Plan 3: Market Plan	Plan 4: Net Zero Plan
Plan Description	150 MW Participation in a MISO-Sourced Combined Cycle Unit in 2029, 50 MW Solar in LKE in 2029.	156 MW LKE Reciprocating Internal Combustion Engines (RICE) in 2029, 50 MW LKE Solar in 2029.	Market Purchases. MISO-Sourced Market Bilateral Capacity and Energy. Hedge Products to manage risk.	Net Zero by 2030. 325 MW MISO-Sourced Wind in 2029, 77 MW LKE Solar. New Solar and Ashwood paired with 78 MW 10-hour Battery.
2019-2028	Same Near-Term Plans			
2029	BREC-Wilson expires, PPS-Peakers expires, Paris expires, add 150 MW CC, 50 MW Solar, 237 MW Transmission	BREC-Wilson expires, PPS-Peakers expires, Paris expires, add 156 MW RICE, 50 MW Solar, 81 MW Transmission	BREC-Wilson expires, PPS-Peakers expires, Paris expires, add 237 MW Transmission	BREC-Wilson expires, PPS-Peakers expires, Paris expires, add 327 MW Wind, 77 MW Solar, 237 MW Transmission
2030	 <p>■ Natural Gas ■ Natural Gas-Sold ■ Hydro ■ Solar ■ Market</p>	 <p>■ Natural Gas ■ Hydro ■ Solar ■ Market</p>	 <p>■ Hydro ■ Solar ■ Market</p>	 <p>■ Hydro ■ Solar ■ Wind ■ Wind-Sold ■ Market</p>
2031-2033				
2034	Add 7 MW Transmission	Add 7 MW Transmission	Add 7 MW Transmission	Add 7 MW Transmission
2035-2038				
2039	Add 7 MW Transmission	Add 7 MW Transmission	Add 7 MW Transmission	Add 7 MW Transmission
2040-2042				

Net Zero Plan Battery Utilization



Long-Term Plan Risk Evaluation



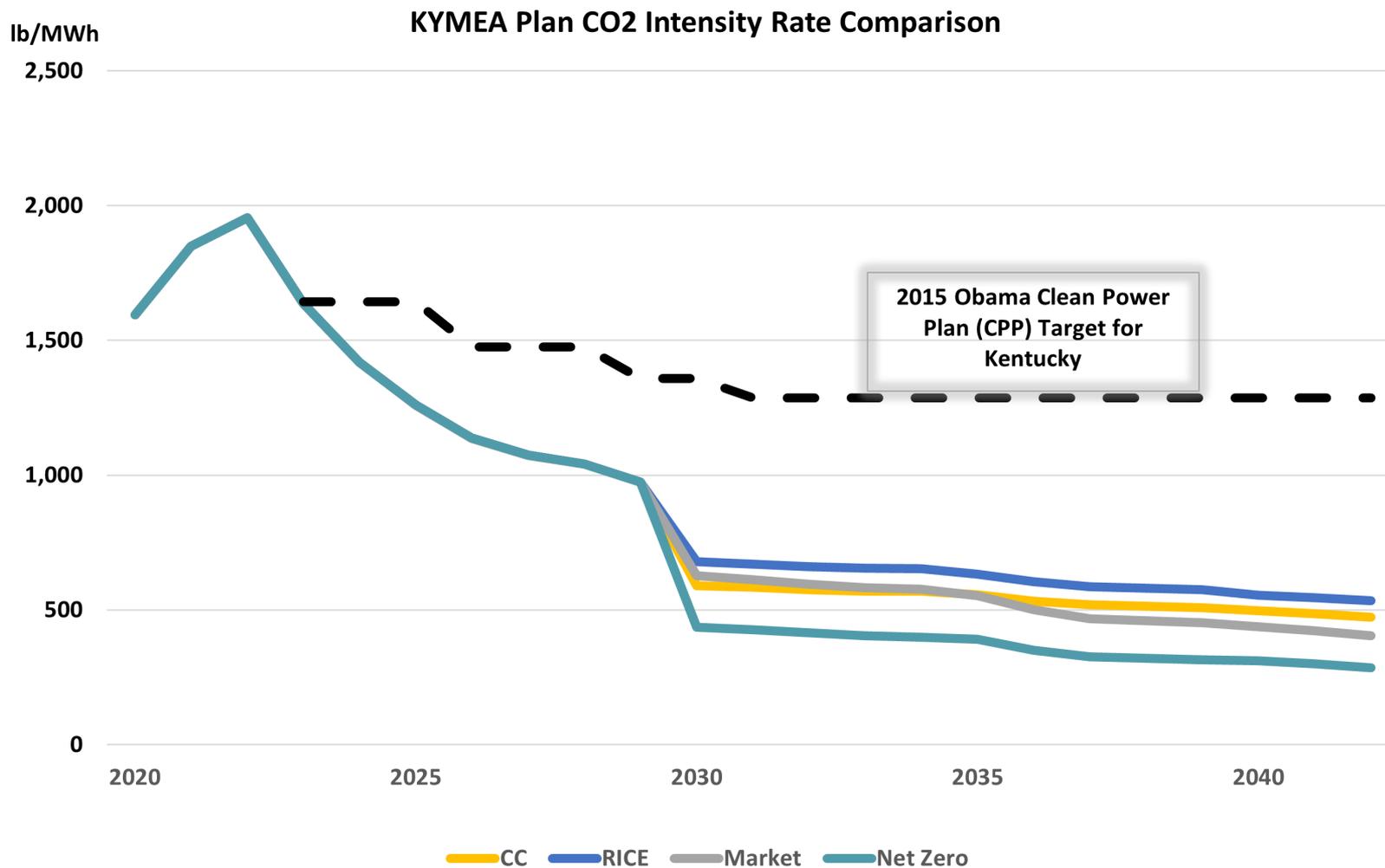
Levelized Average Cost - ¢ per kWh

Scenario	Long-Term Plan			
	Plan 1: CC Plan	Plan 2: RICE Plan	Plan 3: Net Zero Plan	Plan 4: Market Plan
Status Quo	6.504	6.241	7.395	6.309
High NG	7.081	6.838	7.587	6.992
Low NG	5.975	5.646	7.322	5.801
High Demand	6.496	6.225	7.386	6.315
Low Demand	6.512	6.253	7.433	6.336
Zero Carbon Additions	6.625	6.377	7.507	6.568
High NG w/ CO2 Limit	7.382	6.745	7.762	7.351
Low NG w/ CO2 Limit	6.573	5.771	7.400	6.317
Carbon Tax	7.807	7.032	8.032	7.490

Results as a Percentage of Least-Cost

Scenario	Long-Term Plan			
	Plan 1: CC Plan	Plan 2: RICE Plan	Plan 3: Net Zero Plan	Plan 4: Market Plan
Status Quo	4.2%	0.0%	18.5%	1.1%
High NG	3.6%	0.0%	11.0%	2.3%
Low NG	5.8%	0.0%	29.7%	2.7%
High Demand	4.4%	0.0%	18.7%	1.4%
Low Demand	4.1%	0.0%	18.9%	1.3%
Zero Carbon Additions	3.9%	0.0%	17.7%	3.0%
High NG w/ CO2 Limit	9.5%	0.0%	15.1%	9.0%
Low NG w/ CO2 Limit	13.9%	0.0%	28.2%	9.5%
Carbon Tax	11.0%	0.0%	14.2%	6.5%

Long-Term Plan Carbon Intensity



AGENDA

- IRP Process
- Community Involvement
- Identify Resource Needs
- Near-Term Decision Elements
- Near-Term Preferred Plan
- Near-Term Plan Option
- Long-Term Plan Analysis
- **IRP Publication Schedule**

IRP2020 Publication Schedule

