Indiana Michigan Power:

2021 Integrated Resource Plan

Public Stakeholder Meeting #3A

July 27, 2021

Presented via GoToWebinar --> https://attendee.gotowebinar.com/register/24556909132799244

BOUNDLESS ENERGY℠

Agenda

Time		
9:30 a.m.	**WELCOME AND SAFETY MOMENT**	**Toby Thomas**, President and COO I&M, **Andrew Williamson**, I&M Director Regulatory Services
9:40 a.m.	**MEETING GUIDELINES AND AGENDA**	**Jay Boggs**, Siemens PTI
9:45 a.m.	**IRP PROCESS AND TOOLS**	**Peter Berini,** Siemens PTI
10:00 a.m.	**INFORMATIONAL RFP'S**	**Angelina Martinez,** Siemens PTI
10:15 a.m.	**REFERENCE CASE DEVELOPMENT**	**Peter Berini,** Siemens PTI, **Thijs Everts,** Siemens PTI
10:45 a.m.	**BREAK**	
11:00 a.m.	**RESOURCE OPTIONS – SUPPLY SIDE**	**Thijs Everts**, Siemens PTI
11:30 a.m.	**LUNCH**	
12:30 p.m.	**RESOURCE OPTIONS – DSM**	**Thijs Everts**, Siemens PTI, **Chad Burnett**, AEP Load Forecasting, **Jeffrey Huber**, GDS Associates
1:15 p.m.	**SCENARIOS**	**Peter Berini,** Siemens PTI
1:30 p.m.	**STAKEHOLDER INTERACTION**	**Art Holland**, Siemens PTI, **Jay Boggs**, Siemens PTI
2:00 p.m.	**ADJOURN**	

WELCOME AND SAFETY MOMENT

Safety Moment

MEETING GUIDELINES

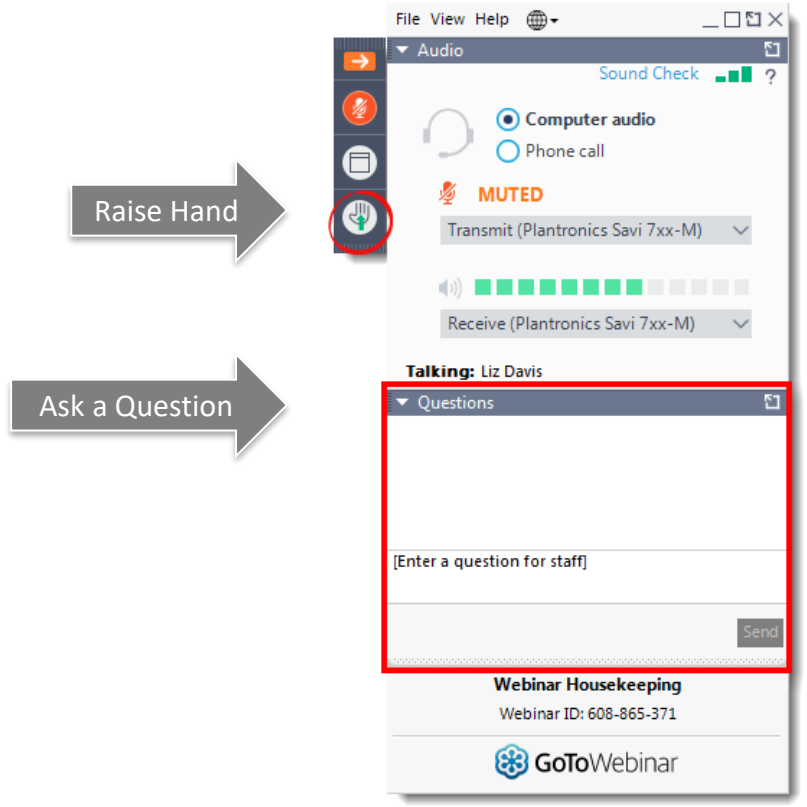
JAY BOGGS | SIEMENS PTI

Questions and Feedback

The purpose of today's presentation is to explain the IRP process and collect feedback from stakeholders. Stakeholder feedback will be posted on the I&M website IRP portal and will be considered as part of the Final IRP.

If you have a question about the IRP process during this presentation:

- Type your question in the Questions area of the GoToWebinar panel
- During the feedback and discussion portions of the presentations, please raise your hand via the GoToMeeting tool to be recognized
- Time permitting, we will address all questions and hear from all who wish to be heard
- Any questions that cannot be answered during the call will be addressed and posted on the website above



If you would like to make a comment or ask a question about the IRP process after the presentation has concluded:

- Please send an email to I&MIRP@aep.com
- Stay informed about future events by visiting the I&M IRP Portal located at www.indianamichiganpower.com/info/projects/IntegratedResourcePlan

Guidelines

1. Due to the number of participants scheduled to join today's meeting, all will be in a "listen-only" mode by default.

2. Please enter questions at any time into the GoToWebinar portal. Technical questions related to the GoToWebinar tool and its use will be addressed by the support staff directly via the chat feature.

3. Time has been allotted to answer questions related to the materials presented. Unanswered questions will be addressed after the presentation and posted in accordance with the Questions and Feedback slide.

4. At the end of the presentation, we will open-up the floor for "clarifying questions," thoughts, ideas, and suggestions.

5. Please provide feedback or questions on the Stakeholder Meeting #3A presentation within ten business days of the conclusion of the meeting.

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I&M 2021 IRP PROCESS AND TOOLS

Definitions

Term	Definition
AURORAxmp	Electric modeling forecasting and analysis software. Used for capacity expansion, chronological dispatch, and stochastic functions
Condition	A unique combination of a Scenario and a Sensitivity that is used to inform Candidate Portfolio development
Deterministic Modeling	Simulated dispatch of a portfolio in a pre-determined future
Renewable Portfolio Standards	Renewable Portfolio Standards (RPS) are policies designed to increase the use of renewable energy sources for electricity generation
Portfolio	A group of resources to meet customer load
Preferred Portfolio	The portfolio that management determines will perform the best, with consideration for cost, risk, reliability, and sustainability
Probabilistic modeling	Simulate dispatch of portfolios for several randomly generated potential future states
Reference Scenario	The most expected future scenario that is designed to include a current consensus view of key drivers in power and fuel markets (reference case, consensus case)
Scenario	Potential future State-of-the-World designed to test portfolio performance in key risk areas important to management and stakeholders alike
Sensitivity Analysis	Analysis to determine the impact of early retirements and other inputs portfolios are most sensitive to

Integrated Resource Plan Overview

The purpose of the IRP is to provide a roadmap at a point in time that AEP I&M can use as a planning tool when evaluating resource decisions necessary to meet forecasted electric energy demand. The approach is meant to balance affordability, reliability, and sustainability for customers and stakeholders in the development and selection of the **Preferred Portfolio**.

Development of Reference and Candidate Portfolio

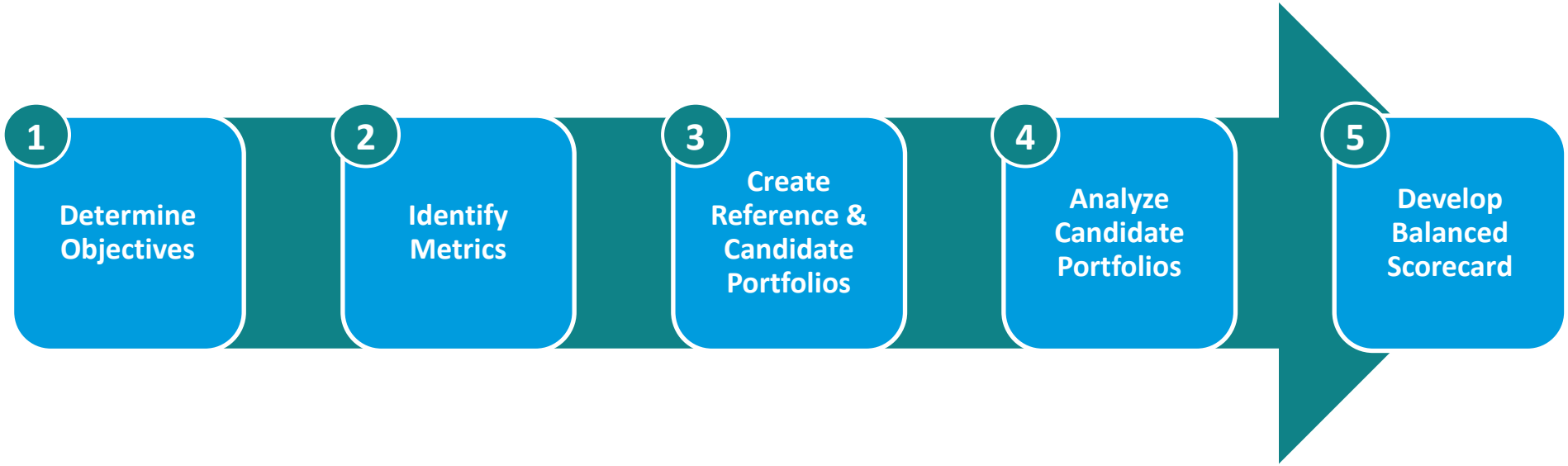
- The end goal of the IRP is to develop a **Preferred Portfolio** (set of supply- and demand-side resources) that can be used as a planning tool to inform future resource actions for electric energy demand to serve load
- I&M has partnered with Siemens PTI to create a **Reference Portfolio** and a set of **Candidate Portfolios** based on a series of inputs that are informed by various **Scenarios** and **Sensitivities**
- The **Reference Portfolio** and the **Candidate Portfolios** will be tested, analyzed and used by I&M management to identify the **Preferred Portfolio**

The discussions today will be focused on the approach and progress for developing the **Reference Portfolio**.

IRP 5-Step Process

Siemens PTI applies the following 5-Step process for modeling, analyzing, and reporting the **Reference Portfolio** and **Candidate Portfolios** related to the AEP I&M IRP. The process, detailed below, provides a holistic approach to identifying the **Preferred Portfolio** that best meets I&M's defined **Objectives** and **Metrics** over a wide range of potential future conditions.

Siemens PTI: Approach to Integrated Resource Plan Modeling



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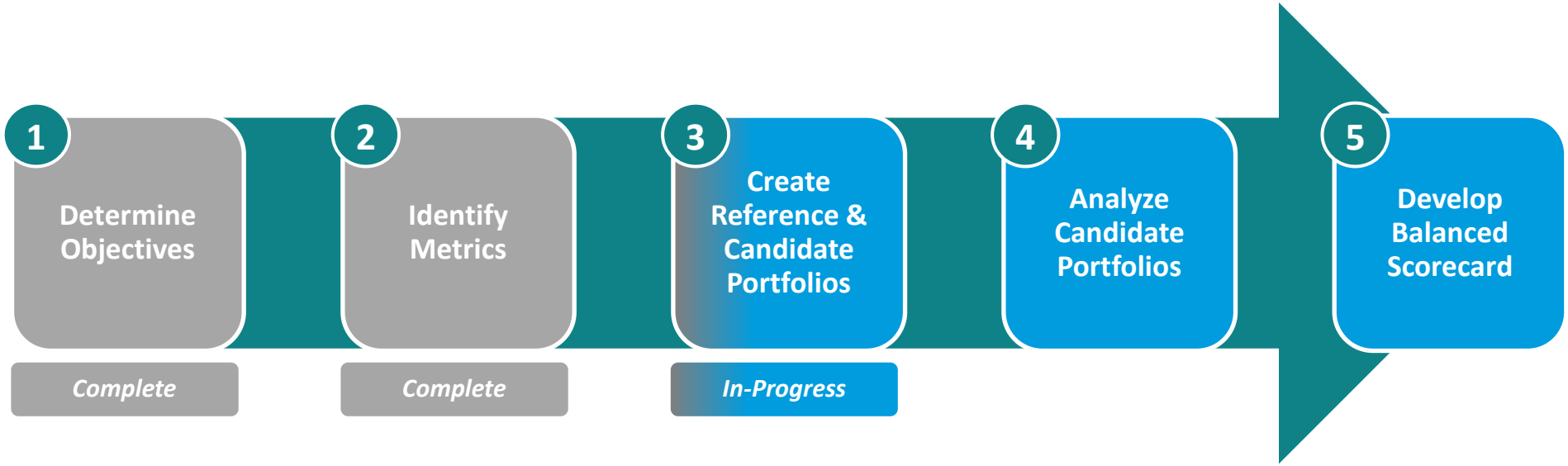


Step 1: Determine Objectives

The purpose of the IRP is to evaluate I&M's current energy resource portfolio and a range of alternative future portfolios to meet customers' electrical energy needs in an affordable and holistic manner. The process evaluates **Candidate Portfolios** in terms of environmental stewardship, market and price risk, reliability, and resource diversity.

IRP Objectives
Affordability
Rate Stability
Sustainability Impact
Market Risk Minimization
Reliability
Resource Diversity

Each **Objective** is important and worthy of balanced consideration in the IRP process

Step 2: Assign Metrics

For each **Candidate Portfolio**, the **Objectives** are tracked and measured through **Metrics** which evaluate portfolio performance across a wide range of possible future market conditions. All measures of portfolio performance are based on probabilistic modeling of 200 futures and addressed in Step 4: Analyze Candidate Portfolios.

IRP Objectives	IRP Metric	Unit
Affordability	NPV-RR	$
Rate Stability	95th percentile value of NPV-RR	$
Sustainability Impact	CO_2 Emissions	tons
Market Risk Minimization	Spot Energy Market Exposure (Purchases/Sales)	%
Reliability	Reserve Margin Exposure	%
Resource Diversity	Mix of Baseload Resources	MW

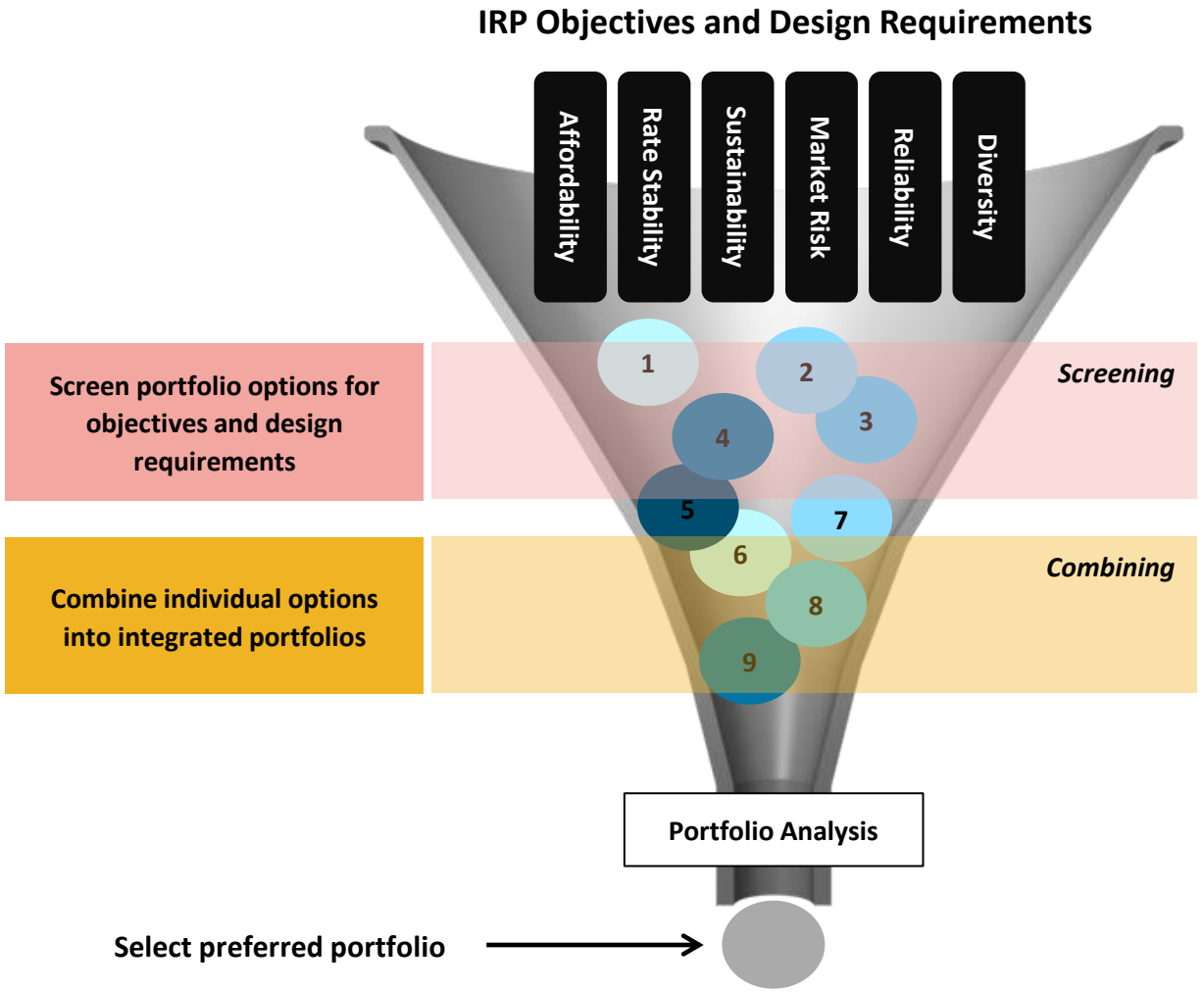
Objectives will be tracked through identified **Metrics** that will be used to measure and evaluate performance of the Candidate Portfolios

Step 3A: Create Reference and Candidate Portfolios

I&M and Siemens have developed **a Reference Case**, two alternative **Scenarios**, and a handful of **Sensitivities** to implement a scenario- and sensitivity-based approach to inform **Candidate Portfolios**. Each **Candidate Portfolio** will be developed from the **Scenarios** and/or the **Sensitivities** below.

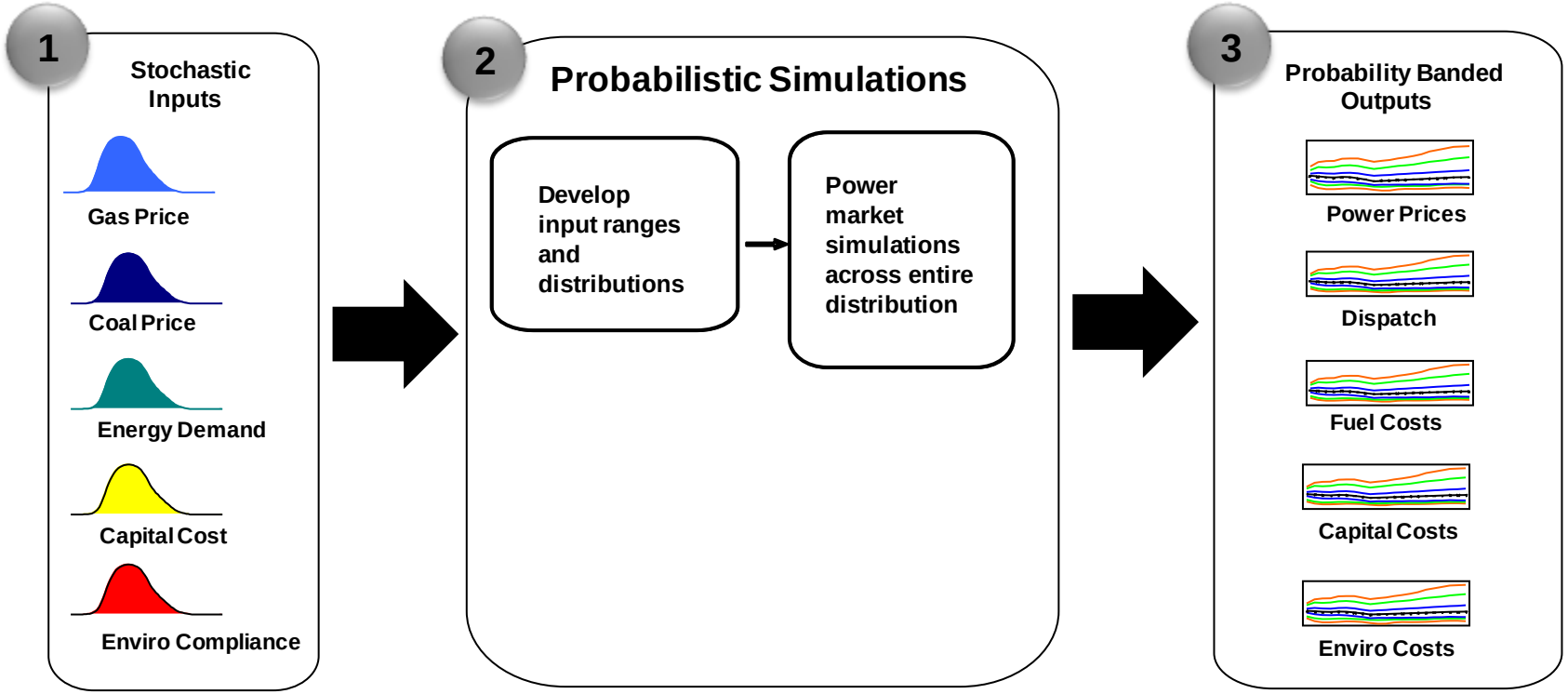
#	Group	Portfolio	Notes
1	Reference	Reference Case	Rockport (2028) and Cook (2034, 2037) Retire as Planned
2	R-A Sensitivity	Reference with Rockport Sensitivity	Rockport Unit 1 Early Retirement (2025)
3	R-B Sensitivity	Reference with Rockport Sensitivity	Rockport Unit 2 Early Retirement (2026)
4	R-C Sensitivity	Reference with Rockport Sensitivity	R-A Sensitivity : 50% of Rockport 2 Capacity
5	R-D Sensitivity	Reference with Rockport Sensitivity	R-B Sensitivity : 50% of Rockport 2 Capacity
6	C-A Sensitivity	Reference with Cook Sensitivity	Cook Unit 1 and Unit 2 License Extensions
7	Scenario	Rapid Technology Advancement	Low Renewable, Storage and EE/DR Costs
8	Scenario	Enhanced Regulation	High Commodity Prices, such as Gas, Coal and CO2

Step 3B: Screen Candidate Portfolios



Step 4: Analyze Candidate Portfolios

Candidate Portfolios are then subjected to **Probabilistic Simulations** (stochastic risk analysis) to measure performance across many future scenarios. The stochastic process will produce hundreds of internally consistent simulations that can provide a more realistic understanding of the potential variation in future scenarios.



Step 5: Develop Balanced Scorecard

Detailed portfolio results will be included for each **Candidate Portfolio** in the report write-up filed with the Commission. The **Candidate Portfolios** will be summarized in terms of each **Objective** and **Metric** through a balanced scorecard.

Balanced Scorecard (Illustrative)

	Affordability	Rate Stability	Sustainability Impact	Market Risk Minimization	Reliability	Resource Diversity
Candidate Portfolios	NPV RR	95th Percentile Value of NPV RR	CO2 Emissions	Purchases as % of Generation	Reserve Margin	Mix of Resources
Reference Case	$92.0	$115.0	-62.0%	10.0%	15%	5
Portfolio #1	$94.0	$138.0	-39.0%	15.0%	15%	4
Portfolio #2	$108.0	$145.0	-50.0%	18.0%	15%	6
Portfolio #3	$81.0	$123.0	-38.0%	24.0%	15%	4
Portfolio #4	$97.0	$146.0	-42.0%	42.0%	15%	4
Portfolio #5	$101.0	$167.0	-54.0%	34.0%	15%	5
Portfolio #6	$87.0	$113.0	-64.0%	41.0%	15%	3
Portfolio #8	$102.0	$172.0	-40.0%	34.0%	15%	5
Portfolio #9	$120.0	$198.0	-90.0%	24.0%	15%	6
Portfolio #10	$99.0	$210.0	-84.0%	12.0%	15%	5

FEEDBACK AND DISCUSSION

INFORMATIONAL RFP'S

All-Source Informational RFP Process

Issue All-Source Informational RFP	Collect and Analyze Responses	Evaluate how will the information will Inform the IRP	Provide resource options to Siemens IRP Modeling team
• March 26, 2021: Draft RFP available to Stakeholders • April 9, 2021: Stakeholder review meeting • April 23, 2021: Issue RFP	• May 21, 2021: collect Responses • Siemens' evaluation incl. Q/A with respondents • Receive I&M 2020 Renewables RFP • RFP results review with I&M	• Create price curves for all technologies based on Siemens internal forecasts • Discuss feedback on the use of All-Source data and confirm approach	• Provide resource options to Siemens IRP Modeling team

Responses Visualization

- All responses for the All-Source Informational RFP are for projects located in Indiana or Michigan, interconnected to PJM with a COD between 2024-2025
- The pricing range between the 2021 All-Source Informational RFP and the I&M 2020 Renewables RFP are similar.
- Both RFPs responses were utilized as a key input for I&M's 2021 IRP process.
- Total data points analyzed 66.

Project Type	2021 All-Source Informational RFP	2020 Renewables RFP
Solar PPA	10	13
Solar BOT	8	10
Solar + Storage PPA	4	4
Solar + Storage BOT	3	7
Wind PPA	1	2
Wind BOT	-	2
CCGT/CT Capacity PPA	1	-
CT Energy PPA	1	-
Stand-alone Storage PPA	2	-
Demand Response	1	-
Not compliant	4	-
Total Data Points Analyzed (excluding not compliant)	**31**	**35**

All-Source Informational RFP Results

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RFP Responses Summary

Plant Parameters

Plant Parameters	Renewables									Dispatchable				Demand Response
Technology	Medium Solar 20-yr PPA	Medium Solar 30-yr PPA	Large Solar 20-yr PPA	Large Solar 30-yr PPA	Solar + Storage	Wind	Solar	Solar + Storage	Wind	CCGT/ CT Capacity	CT Energy	Stand-alone Storage 2-hr	Stand-alone Storage 4-hr	Demand Response
Commercial Structure	PPA	PPA	PPA	PPA	PPA	PPA	BOT	BOT	BOT	PPA	PPA	PPA	PPA	PPA
Capacity Range (MW)	50-200	60	300-600	245-350	10-100	200-300	100-350	100/ 20-50	200	100-200	236	200	200	5 MW first year (+3MW/yr)
Storage Hours (hrs)	NA	NA	NA	NA	4 hr	NA	NA	4 hr	NA	NA	NA	2-hr	4-hr	NA
Capacity Factor Average (%)	24%	24%	24%	24%	24%	38%	24%	24%	38%	NA	NA	NA	NA	NA
Capacity Factor Min-Max (%)	23%-25%	21%-25%	24%-24%	24%-25%	23%-25%	34%-43%	21%-25%	24%-25%	34%-43%	NA	NA	NA	NA	NA
COD Range	2024-2025	2024-2025	2024-2025	2024-2025	2024-2025	2024-2025	2024-2025	2024-2025	2024-2025	Operational	Operational	2023	2023	2022
PPA Term	15-25	30	15-25	30	15-30	12	NA	NA	NA	10	10	15	15	20

All-in Capex/ PPA Price, Nominal$/kW	Medium Solar 20-yr PPA	Medium Solar 30-yr PPA	Large Solar 20-yr PPA	Large Solar 30-yr PPA	Solar + Storage PPA ($/kW-m)	Wind PPA	Solar BOT	Solar + Storage BOT	Wind BOT	CCGT/CT Capacity ($/kW-m)	CT Energy ($/kW-m)	Stand-alone Storage 2-hr	Stand-alone Storage 4-hr	Demand Response (Real 2021$/kW-m)
Min	43	43	33	45	6.5	48	1,245	1,674						
Average	48	43	37	46	7.3	48	1,475	1,914		3.95	1.75	5.98	8.96	3.53
Max	54	43	41	47	8.5	48	1,600	2,310						
Data Points	5	1	2	2	4	1	8	3	0	1	1	1	1	1

Renewable RFP Results

Renewable RFP Responses Summary

Plant Parameters

Plant Parameters	Renewables						
Technology	Medium Solar	Large Solar	Solar + Storage	Wind	Solar	Solar + Storage	Wind
Commercial Structure	PPA	PPA	PPA	PPA	BOT	BOT	BOT
Capacity Range (MW)	85-163	200-353	120-183/ 24-32	200	100-353	100-163/ 20-32	200
Storage Hours (hrs)	NA	NA	4 hr	NA	NA	4 hr	NA
COD Range	2023	2023	2023	2023	2023	2023	2023
PPA Term	30	30	15-30	12-30	NA	NA	NA

All-in Capex/ PPA Price, Nominal$/kW	Medium Solar 30-yr PPA	Large Solar 30-yr PPA	Solar + Storage PPA ($/kW-m)	Wind PPA	Solar BOT	Solar + Storage BOT	Wind BOT
Min	43	41	8.6	45	1,431	1,666	1,953
Average	50	44	8.7	45	1,525	1,781	2,060
Max	59	50	9.0	46	1,592	1,842	2,168
Data Points	10	3	4	2	10	7	2

FEEDBACK AND DISCUSSION

I&M 2021 IRP REFERENCE CASE

Reference Scenario Inputs

I&M and Siemens PTI developed a set of base case assumptions. In Stakeholder Workshop #1, the team presented illustrative inputs. The inputs included herein are meant to represent the planned reference case inputs being used to construct the Reference Case, including the following key drivers:

Key Market Drivers:

- I&M and PJM energy and demand
- Henry Hub natural gas prices
- PRB Coal Prices
- Capital Costs for various generation technologies

Fundamentals Forecast

- Base Case: Reflects EIA Reference scenario
- Base Carbon Case: Includes a $15/metric ton carbon price beginning in 2028, escalating at 3.5% annually thereafter

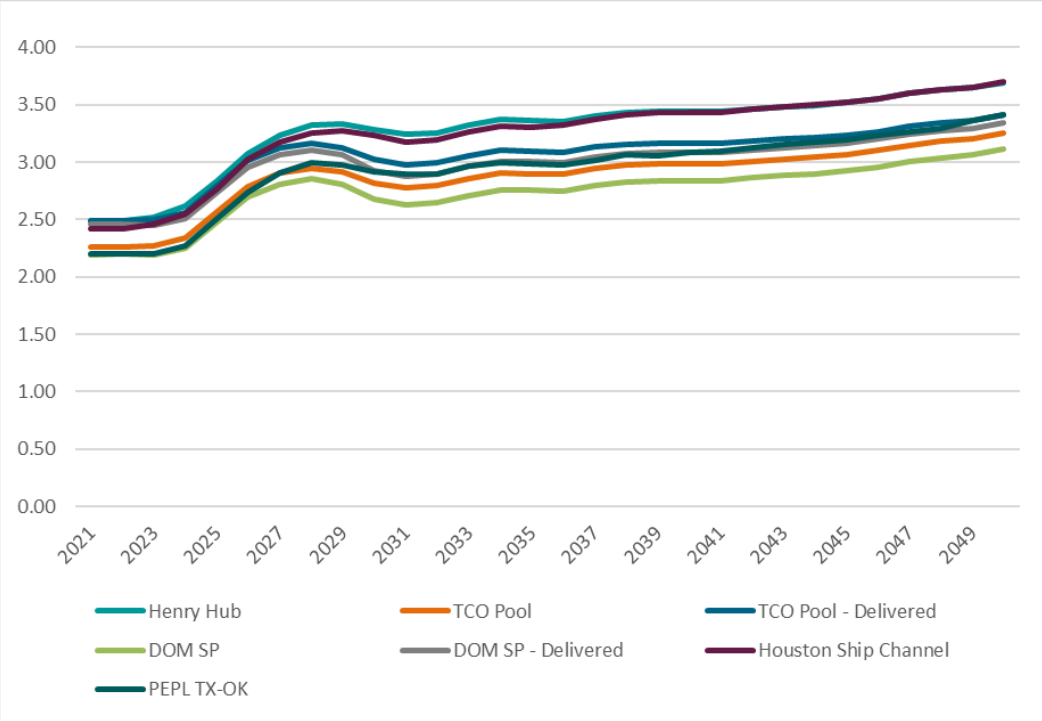
AURORAxmp and other model and tools

AURORAxmp (AURORA) is an industry standard model for electricity production costing, resource valuations, market risk analysis and market simulations.

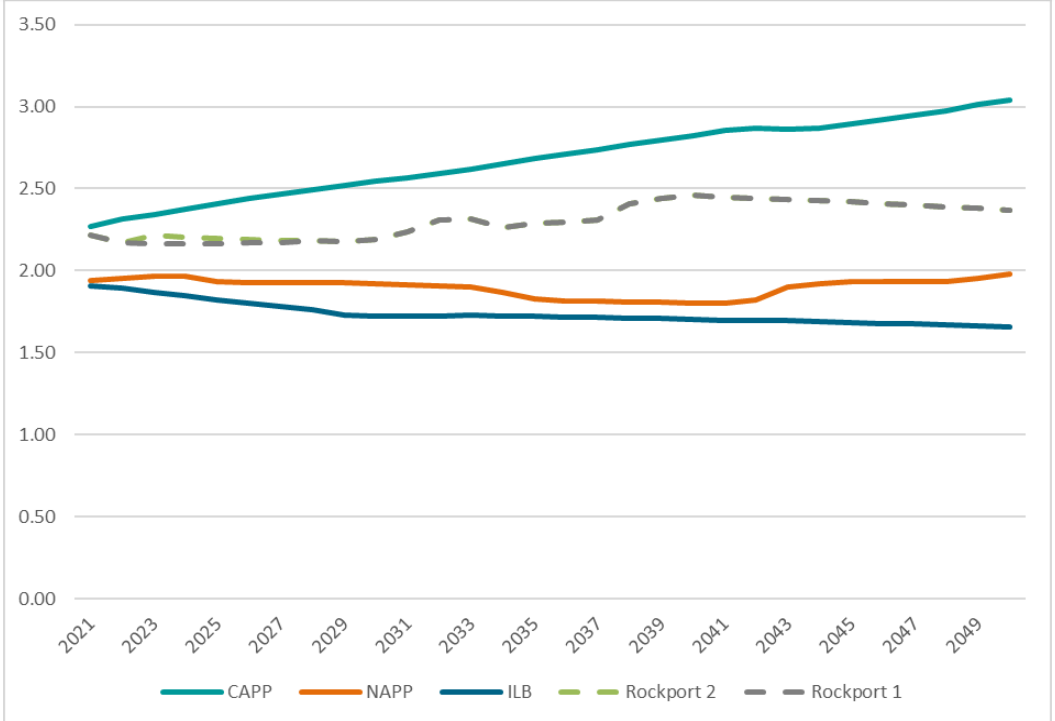
- AURORA is licensed by hundreds of clients in North America, ranging from consultants to utilities to regulatory bodies
- AURORA is accepted in many regulatory jurisdictions
- AEP I&M and Siemens PTI will use the AURORA model in the IRP to provide the following analysis:
  - Commodity forecasts and base case assumption development
  - Least cost optimization of different portfolios
  - Simulation of the performance of different portfolios under a variety of market conditions
  - Production cost modeling to provide market prices for energy
  - Emissions tracking based on unit dispatch
  - An analysis of various regulatory structures such as reserve margins, RPS requirements, others
  - Risk analysis based on stochastic simulation of key inputs

Reference Case: Fuel Prices

Natural Gas Forecast (2019$/MMBtu)

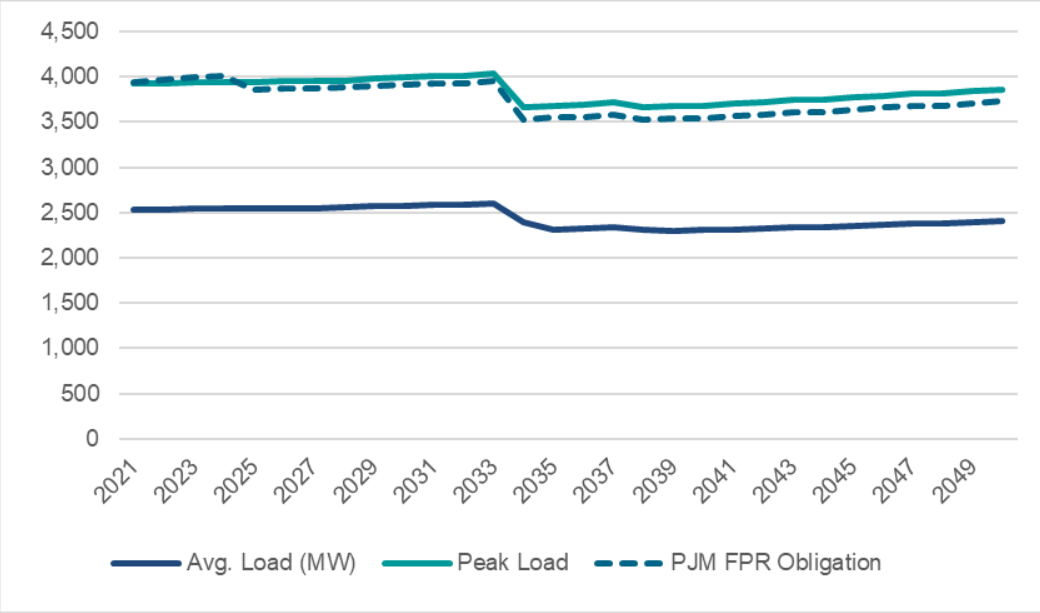


Coal Basin Price Forecast (2019$/MMBtu)

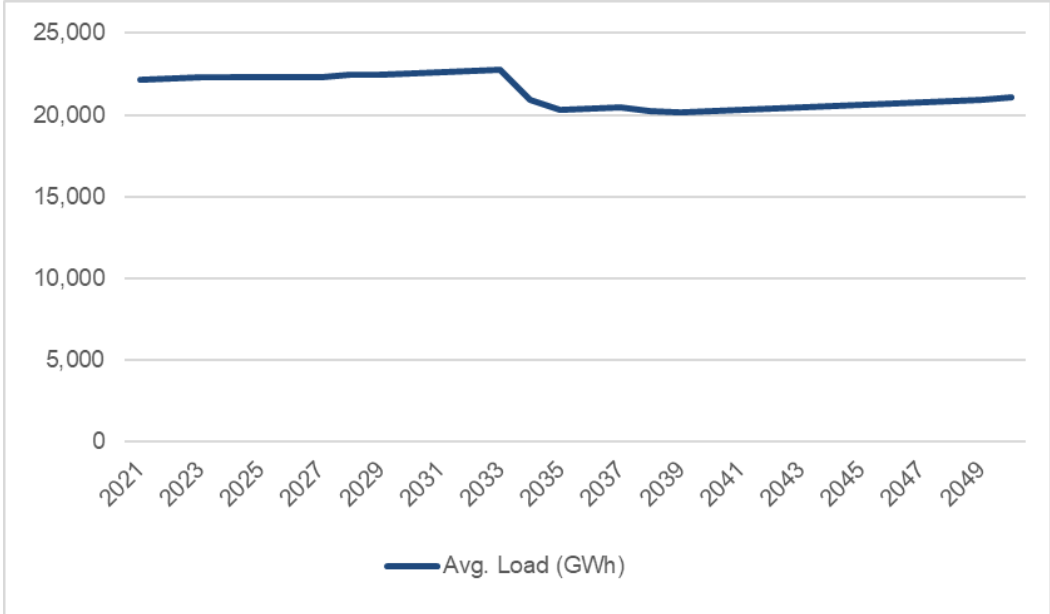


Reference Case: Load Forecast

I&M Load (MW)



I&M Energy (GWh)



Reference Case: Emissions Price Forecast

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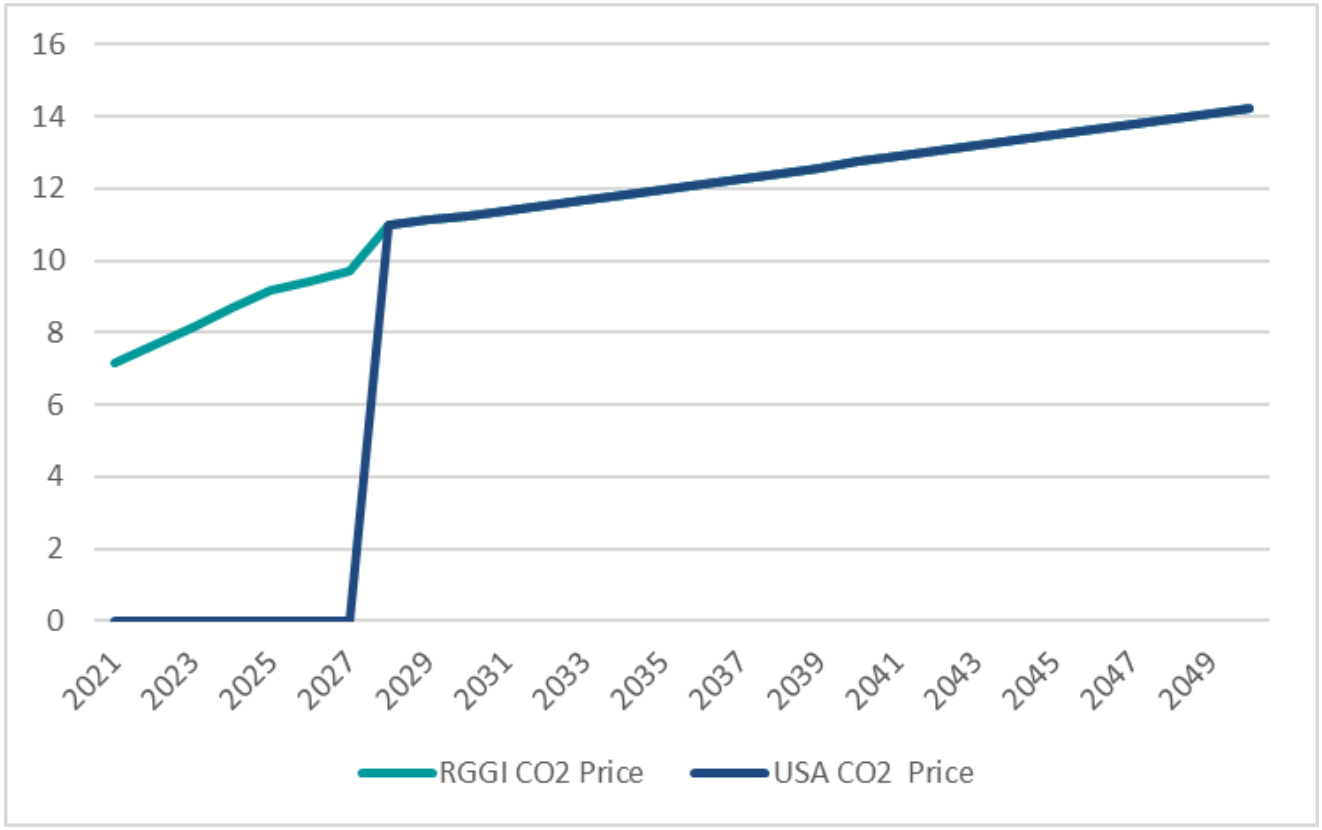
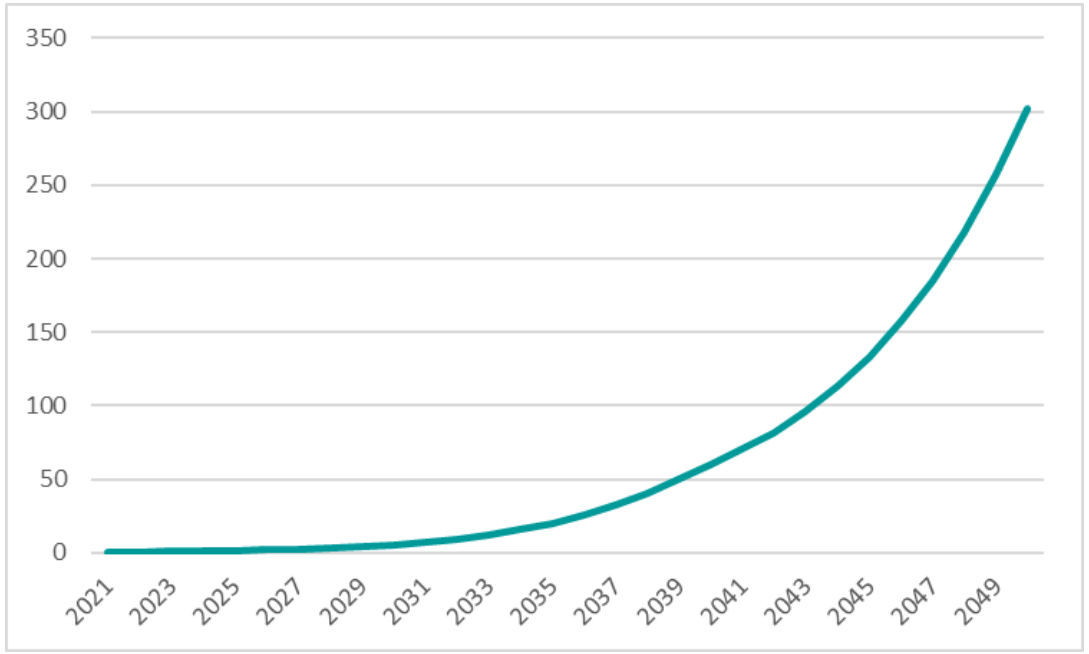
CO2 Price Forecast (2019$/Ton)

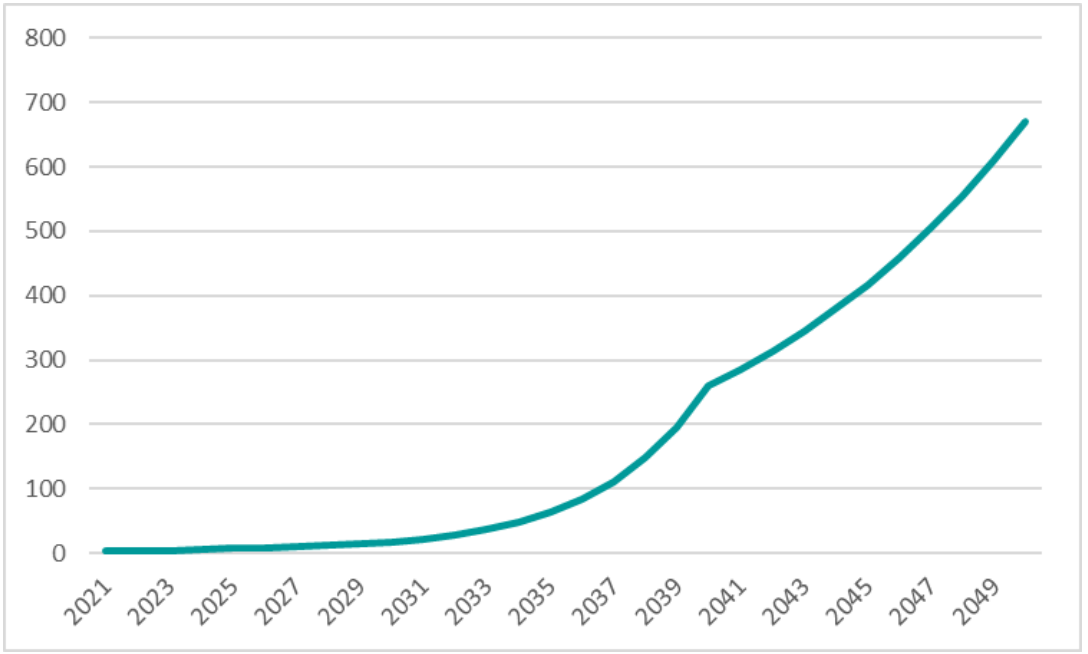


Reference Case: Solar & EV

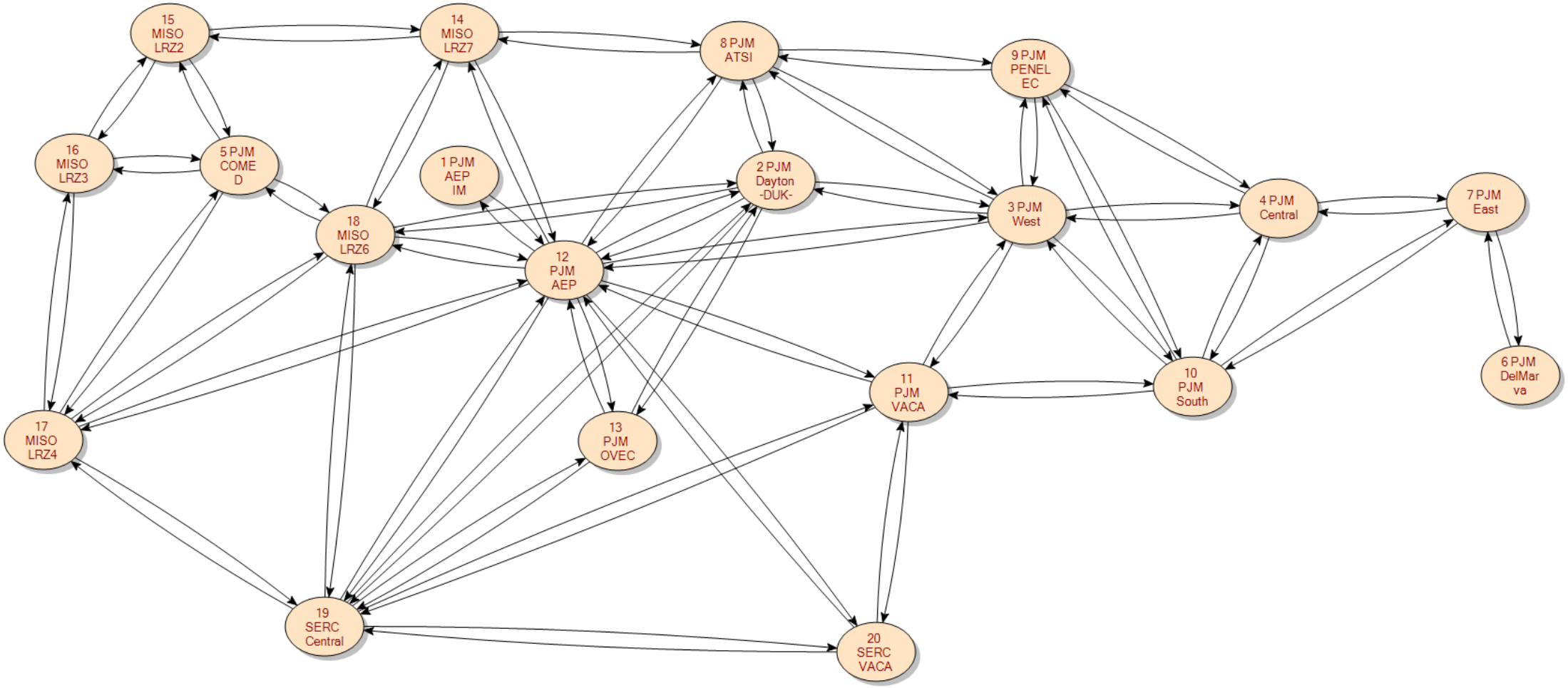
I&M DG Solar Capacity (MW)



I&M Electric Vehicle Demand (MW)



Reference Case: Transmission Topology



FEEDBACK AND DISCUSSION

RESOURCE OPTIONS – SUPPLY SIDE

Resource Overview – Self-Build Baseload and Peaking Options

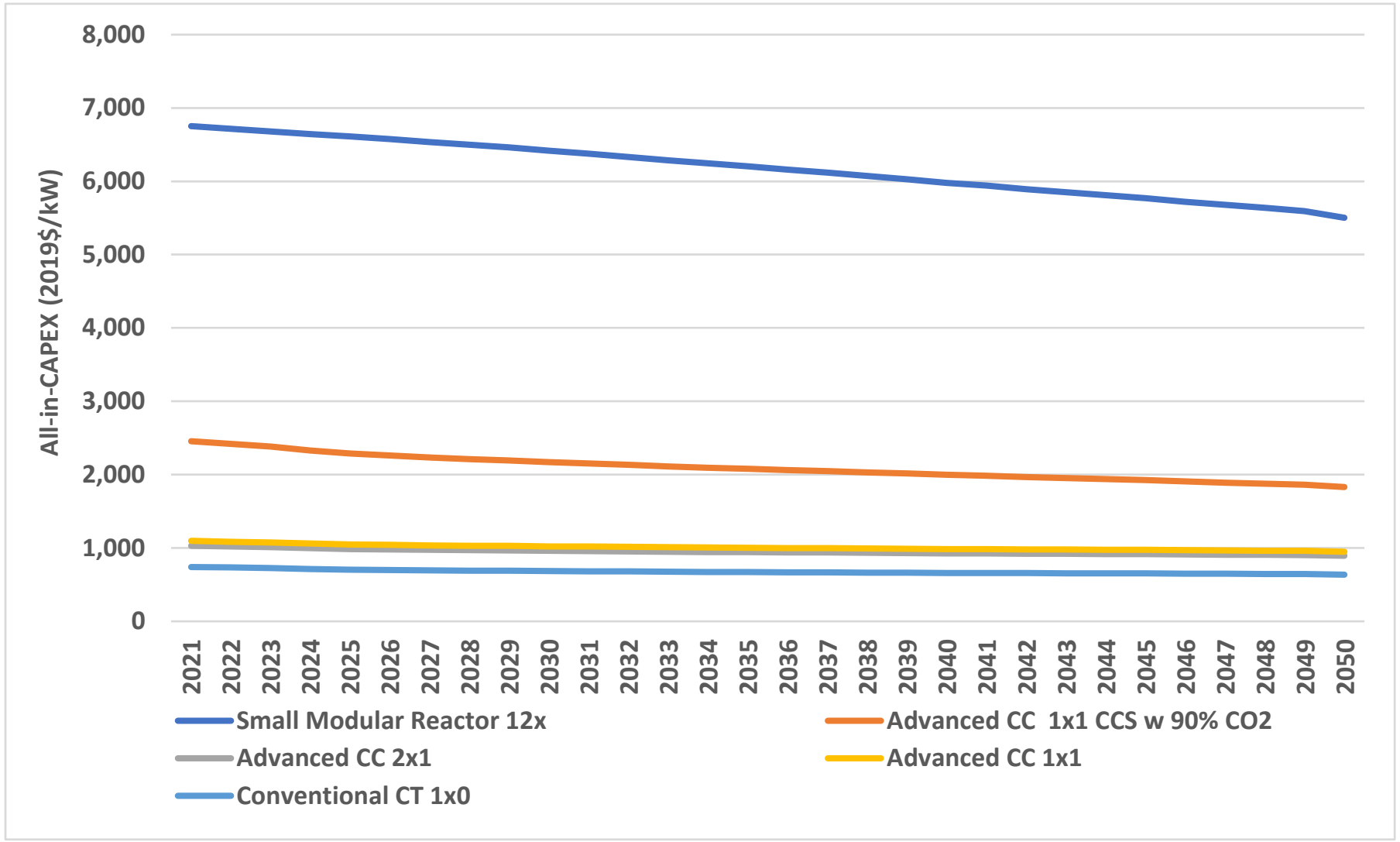
Sources: EIA, Siemens

Technology	Small Modular Reactor	Advanced CC	Advanced CC	Advanced CC	Conventional CT
	12x	1x1 CCS w 90% CO2	2x1	1x1	1x0
Fuel	Uranium	Nat. Gas.	Nat. Gas.	Nat. Gas.	Nat. Gas.
Construction Time (Yrs)	10	7	6	5	5
Book Life (Yrs)	40	40	30	30	30
Size (MW)	600	380	1030*	420	230
Average Heat Rate (Btu/kWh), HHV	10,046	6,431	6,370	6,431	9,905
VOM (2019$/MWh)	3.03	5.84	1.87	2.55	0.60
FOM (2019$/kW-yr)	96.14	27.58	11.26	14.10	6.99

* The Optimization routine can select the Gas CC 2x1 Configuration in smaller increments

Resource Overview – Self-Build Baseload and Peaking Options

Sources: EIA, Siemens



Resource Overview – Renewable and Storage Options

Sources: EIA, Siemens, AEP

Technology	BESS	Onshore Wind	Solar	Solar	Solar + Storage
	50MW/ 200 MWh	with PTC	Tier 1 w ITC	Tier 2 w ITC	20MW/80MWh w ITC
Fuel	NA	Wind	Sun	Sun	Sun
Construction Time (Yrs)	1	2	2	2	2
Book Life (Yrs)	30	10	35	35	35
Size (MW)	50	200	50	50	100
Average Heat Rate (Btu/kWh), HHV					
VOM (2019$/MWh)	0.00	0.00	0.00	0.00	0.00
FOM (2019$/kW-yr) *	20.67	31.72	16.70	16.70	37.55

* The FOM costs are based on levelized FOM assumptions provided by AEP IM

Resource Overview – Renewable and Storage Options – ITC and PTC

Siemens included Investment Tax Credit (ITC) and Production Tax Credits (PTC) for solar and wind resources, respectively.

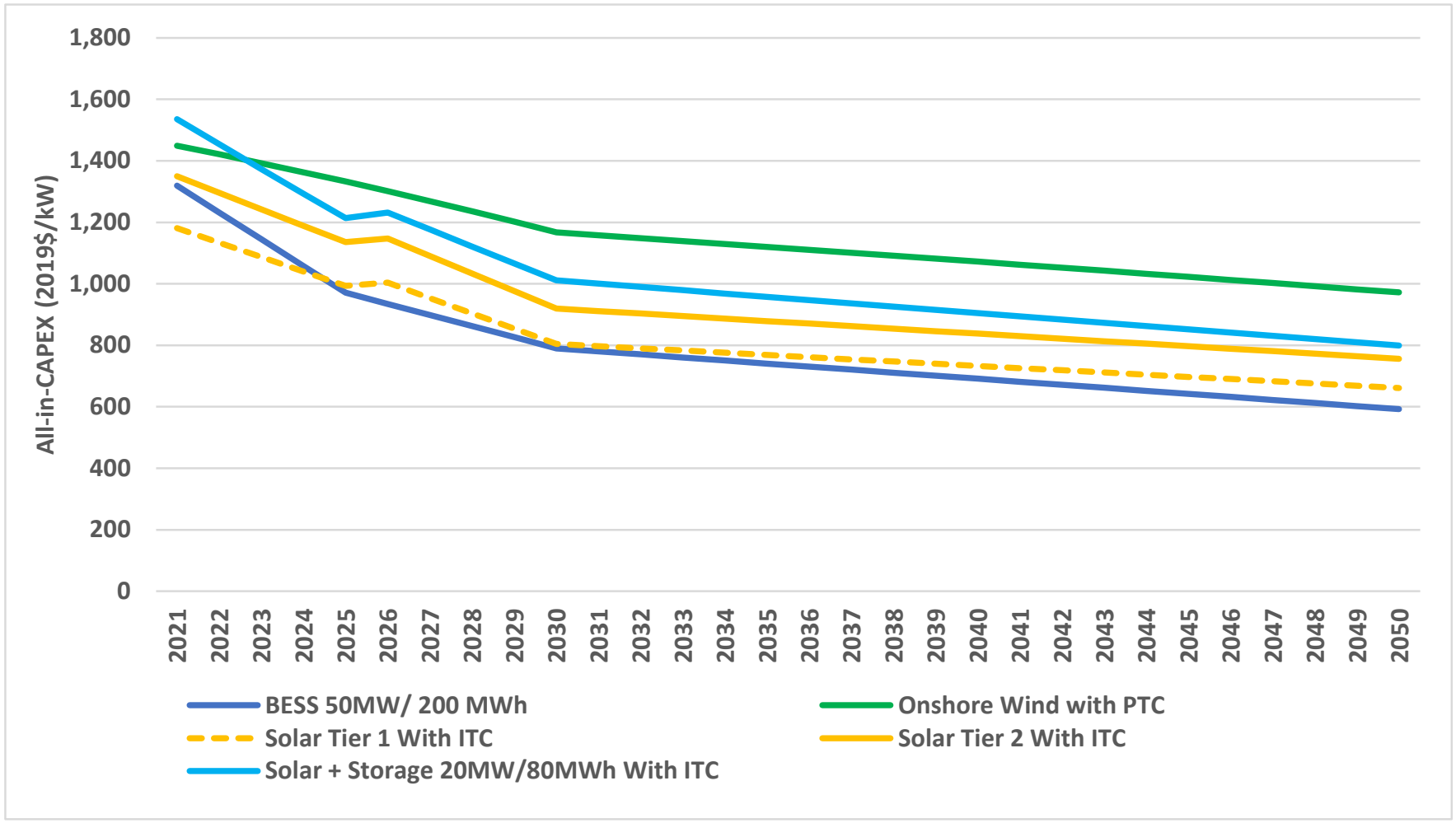
- The ITC is assumed to be available for solar resources coming online through the forecast horizon according to the following schedule:
  - 26% for resources coming online before the end of 2025
  - 10% for resources coming online after January 1st, 2026

- The PTC is assumed to be available for wind resources coming online before the end of 2025.

*AEP I&M solar and wind tax credits assumes ability to leverage safe harbor clause for projects

Resource Overview – Renewable and Storage Options

Sources: EIA, Siemens, AEP



Feedback and Discussion

RESOURCE OPTIONS – DSM/EWR

Demand Side Management Resource Options

Siemens PTI, GDS and the I&M IRP team collaborated on the development of the forecasted inputs needed to include Demand Side Management (DSM) Resources in the analysis.

The AEP I&M IRP included the following DSM options:

- Energy Efficiency (EE)
- Demand Response (DR)
- Distributed Energy Resources (DER)

Resource Overview

DSM resources act as a load reducing resource and decrease the need for capacity and/or generation from new resource options

- **Energy Efficiency** has become an increasingly important measure in Integrated Resource Planning since it reduces the generation needs and can be an effective tool in carbon reduction strategies.

- **Demand Response** provides a reduction in Peak Capacity needs which can act as a carbon reduction strategy decreasing the operating time of less efficient Peaking resources.

- **Distributed Energy Resources** are drastically increasing in the US as renewable energy, specifically solar, has significantly decreased in costs due to policy incentives and learning curves. This allows homeowners or commercial and industrial entities to generate their own energy, decreasing the need for energy generation from utilities.

DSM Resource Treatment

Measure	Program	Treatment	# of Programs
Energy Efficiency	Conservation Voltage Reduction (CVR)	Going-In	4
	Low Income Qualified (IQW)	Going-In	3
	Long-Term Vintages	Optimized	39
Demand Response	Residential	Non-Optimized	1
	Commercial & Industrial	Non-Optimized	1
Distributed Energy Generation	Rooftop Solar (DG)	Going-In	2
	Combined Heat & Power (CHP)	Going-In	1

Optimized: These programs will be exposed to the optimization routine, and the capacity and generation impact will be determined by the economic need for these programs.

Non-Optimized: The capacity included in the analysis; however, the actual impact to each Portfolio may depend on the economic dispatch of the program.

EE Bundle Development For IRP

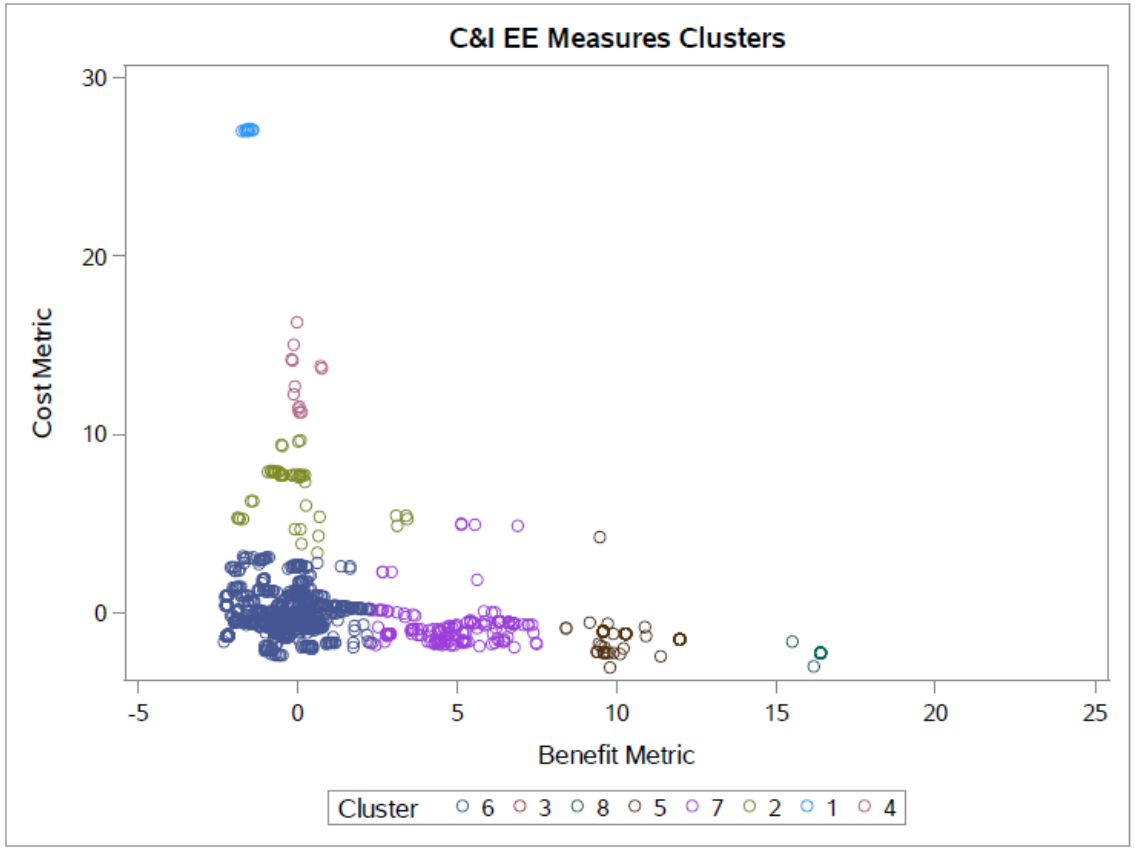
GDS produced value-based bundles based on statistical cluster technique

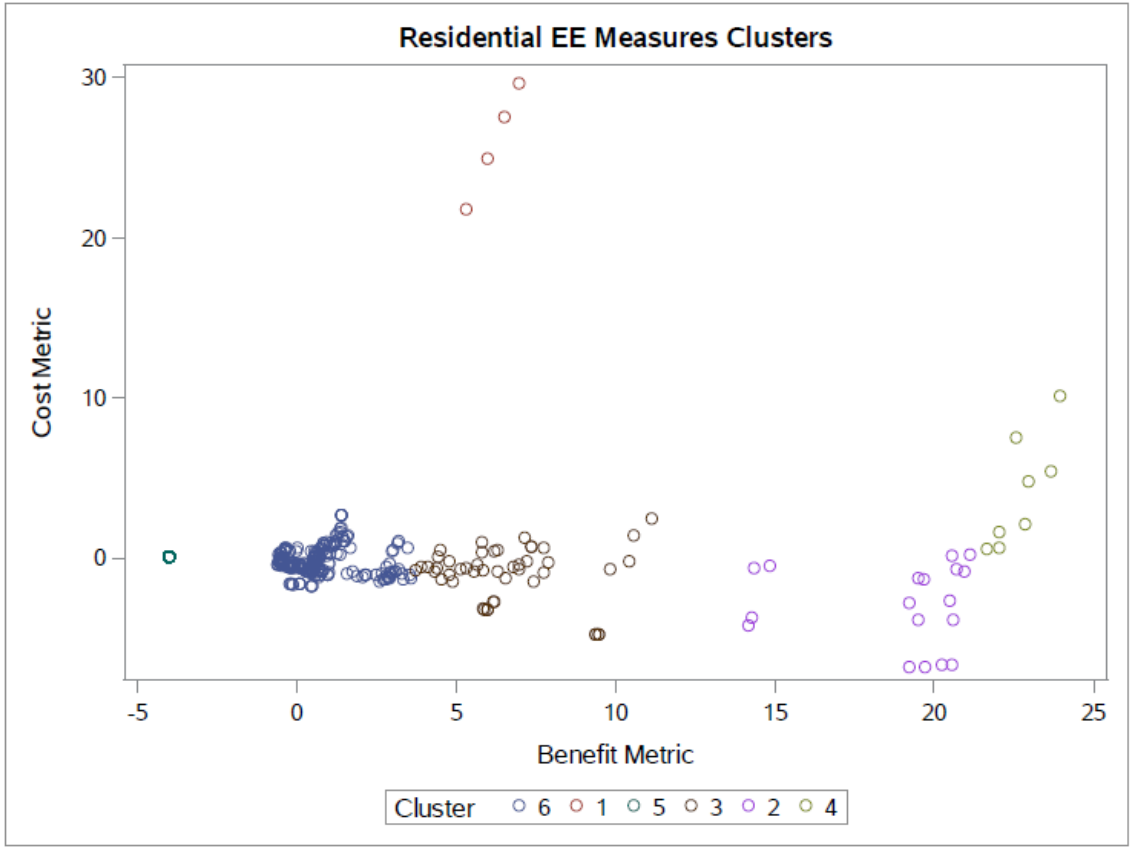
- k-means clustering is a way to group data points together based on some user defined metric(s)
- Data is grouped together by minimizing the Euclidean distance between data points and a randomly selected centroid (single point) within the data
  - Of course, but what does that mean??
- Essentially, data points that are the most similar are grouped together within a cluster
  - The number of clusters affects the groupings
  - Iterative process to get the closest/most similar group of data points in each cluster

EE Measures clustering

- **Residential and Non-Residential measures were kept separate**
  - Cluster process was developed separately for each
- **NPV $ Benefits (and costs)/lifetime kWh were used as the metrics to determine clusters**
  - Both metrics were used to determine cluster groupings
- **Clustering process was analyzed using 2 through 20 clusters**
  - There is no “correct” answer, rather a range of clusters that provide the best results based on the various metrics the analysis provides

EE Measures clustering





EE Measure BUNDLES

- Measure cluster assignment was used to create bundles
- EE bundles are based on the *gross* Realistic Program Potential Determined from the IRP
- Bundles are *not* equal in total savings
- Costs were adjusted to reflect the T&D benefits of each bundle
- Each bundle has unique 8,760 hourly shape

Residential

Five bundles

1 bundle represents ~ 85% of savings

Income-Qualified

Single bundle (non-optimized)

Savings modified from MPS to align with historical spending

C&I

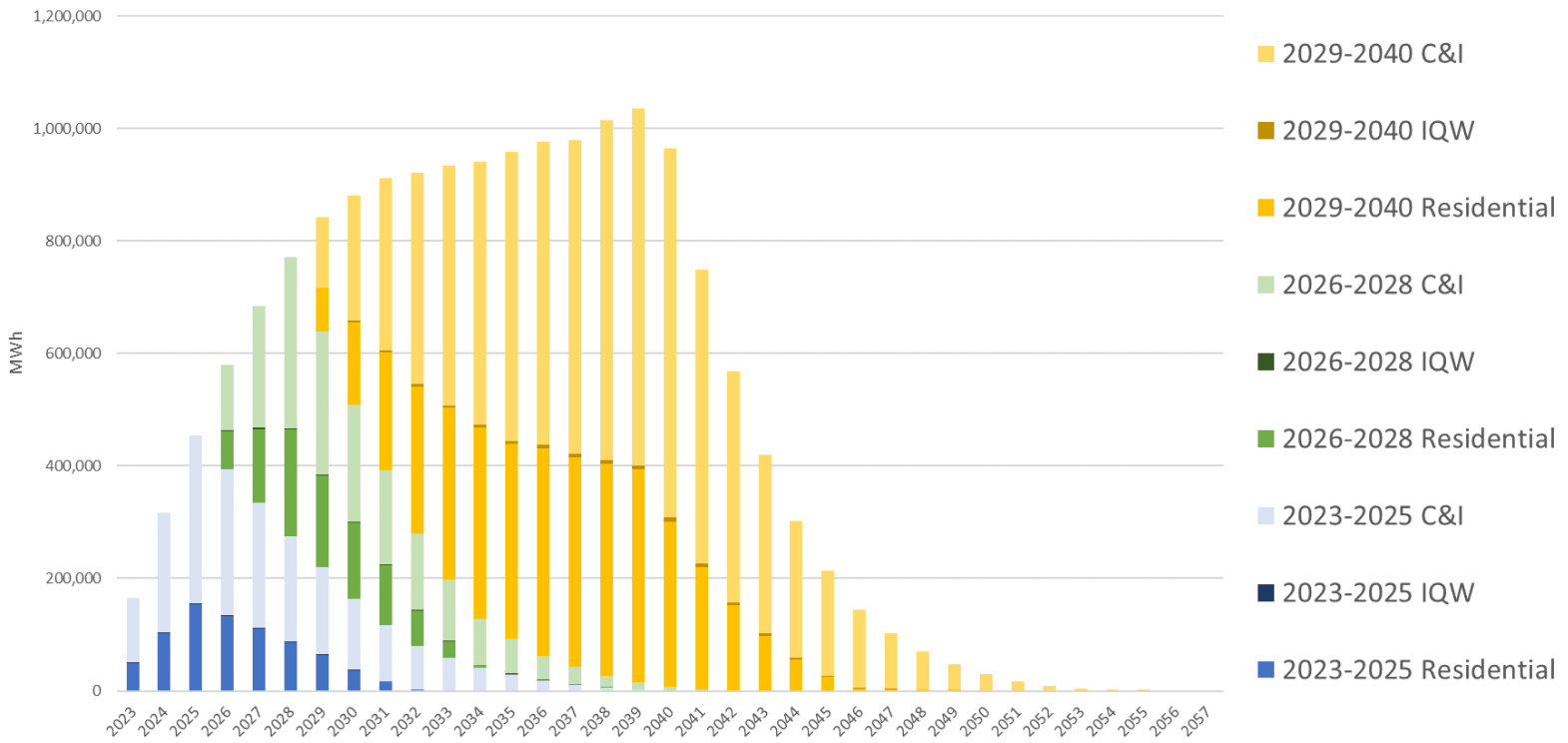
8 bundles

1 bundle ~ 55% of savings

2 additional bundles ~ 30% of savings

EE Measure BUNDLES

Annual costs and savings (inclusive of line losses) are incorporated
Shown below are sector level impacts only ***(actual sectors had additional bundles as indicated on the prior slide)***

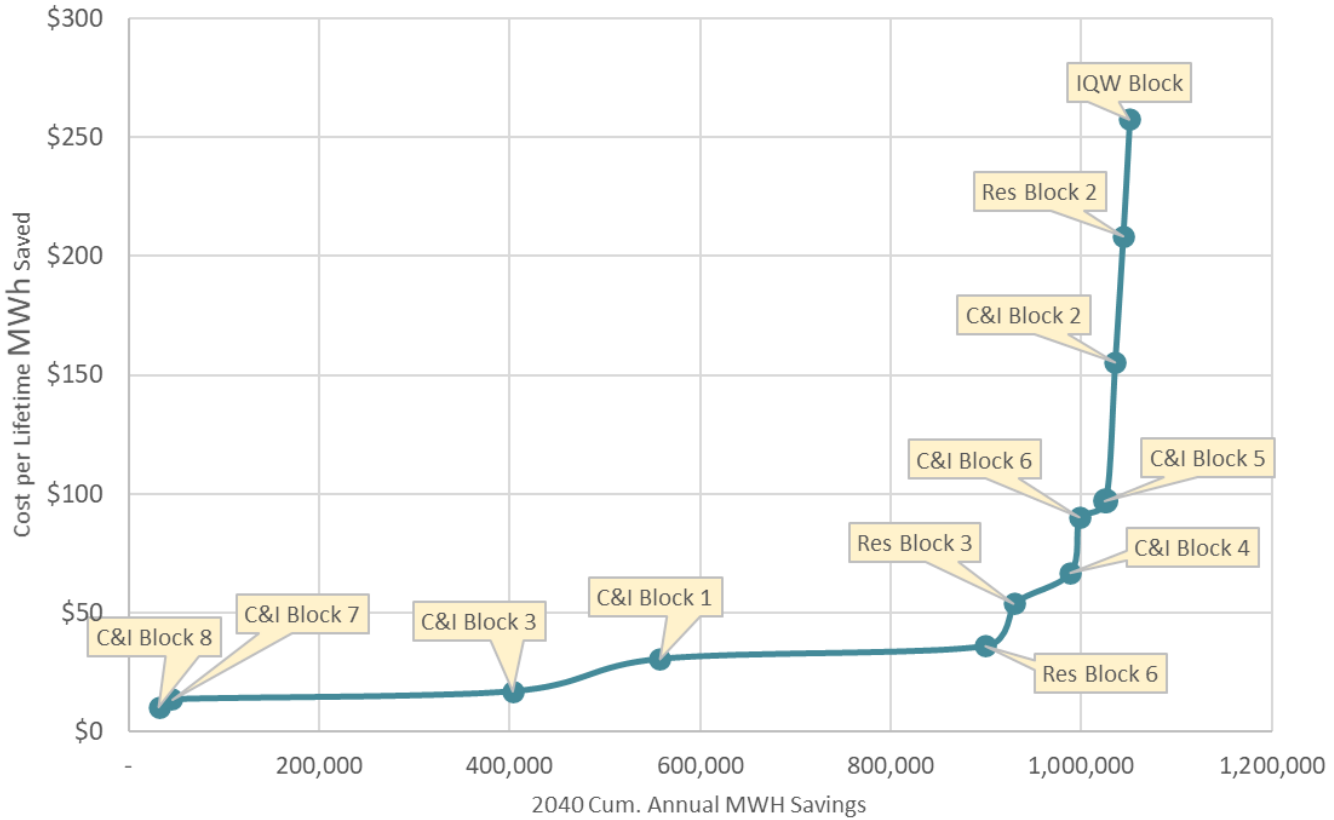


Levelized Cost ($/MWh)

	Range	Mean
Vintage #3	$13-$155	$34
	$298	$298
	$36-$798	$43
Vintage #2	$12-$154	$29
	$267	$267
	$35-$793	$42
Vintage #1	$10-$155	$24
	$258	$258
	$36-$792	$42

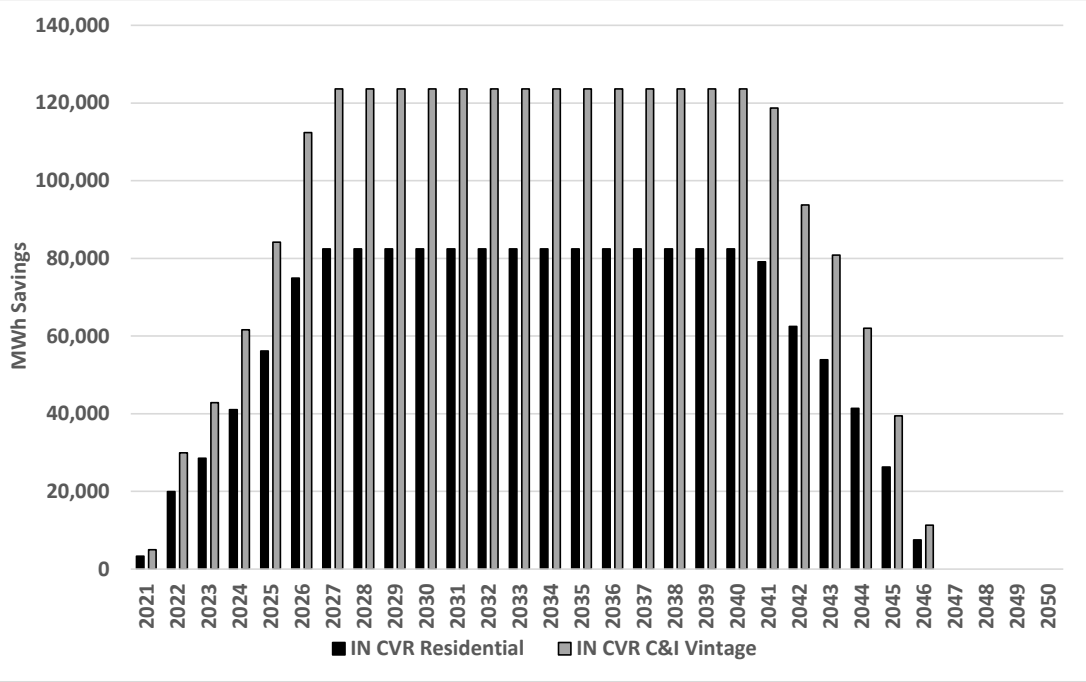
EE Measure Bundles

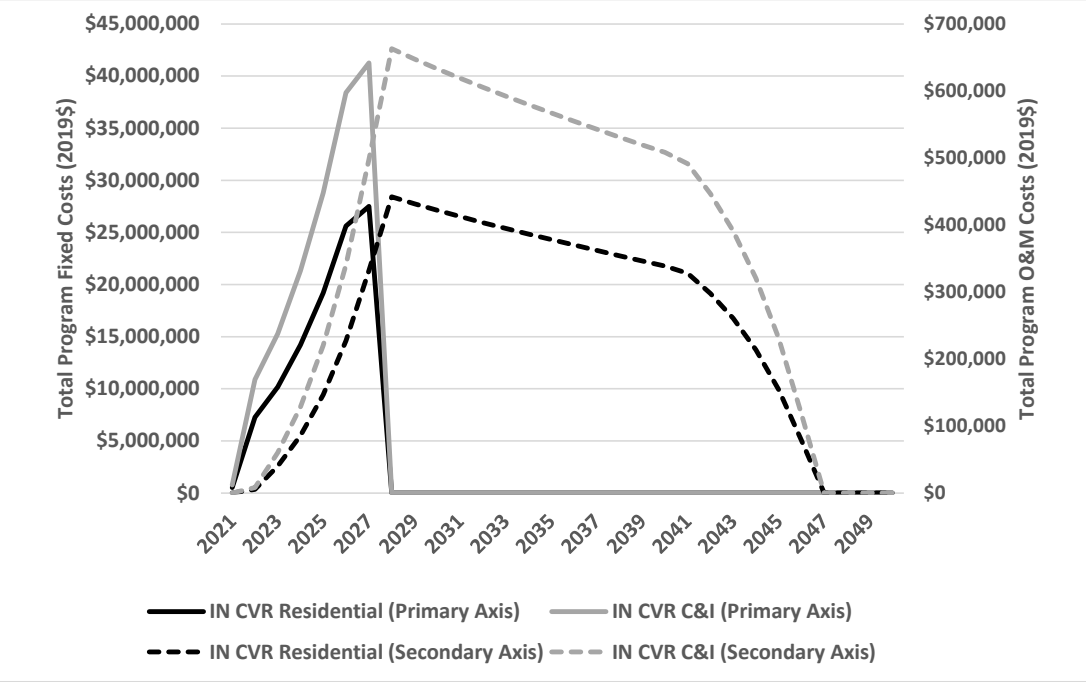
- Supply Curve demonstrates the breakout of the individual DSM bundles and their relative contribution to the cumulative annual impacts in 2040.
- The largest C&I block is 3rd on the supply curve (~$18/lifetime MWh).
- The largest residential block is 5th on the supply curve (~$36/MWh)



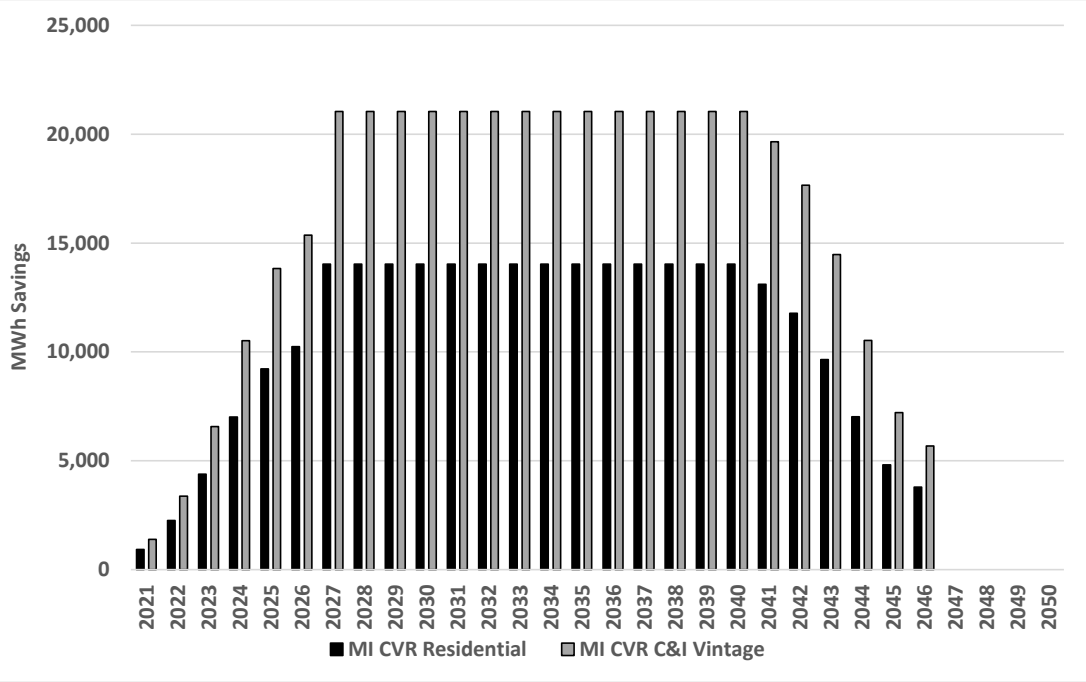
** Two additional residential blocks, with a cost per lifetime MWh saved $300 were omitted from the supply chart. They represent less than 0.1% of the 2040 Cumulative Annual MWh savings in 2040.*

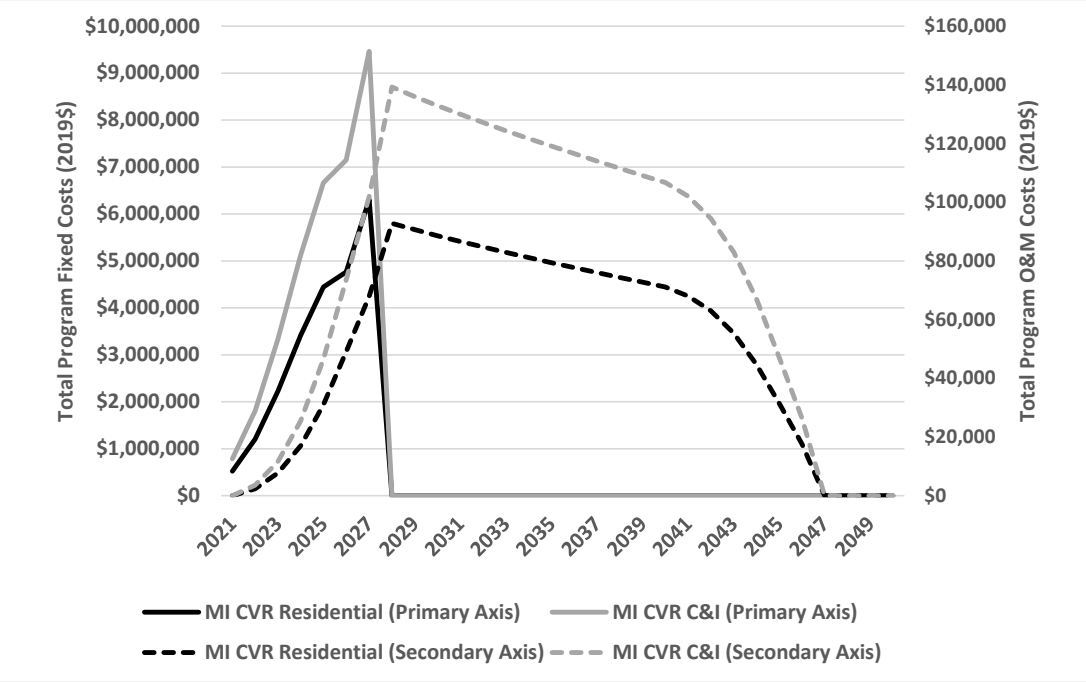
Siemens Parametrization of EE “Going-in” Data
Indiana CVR



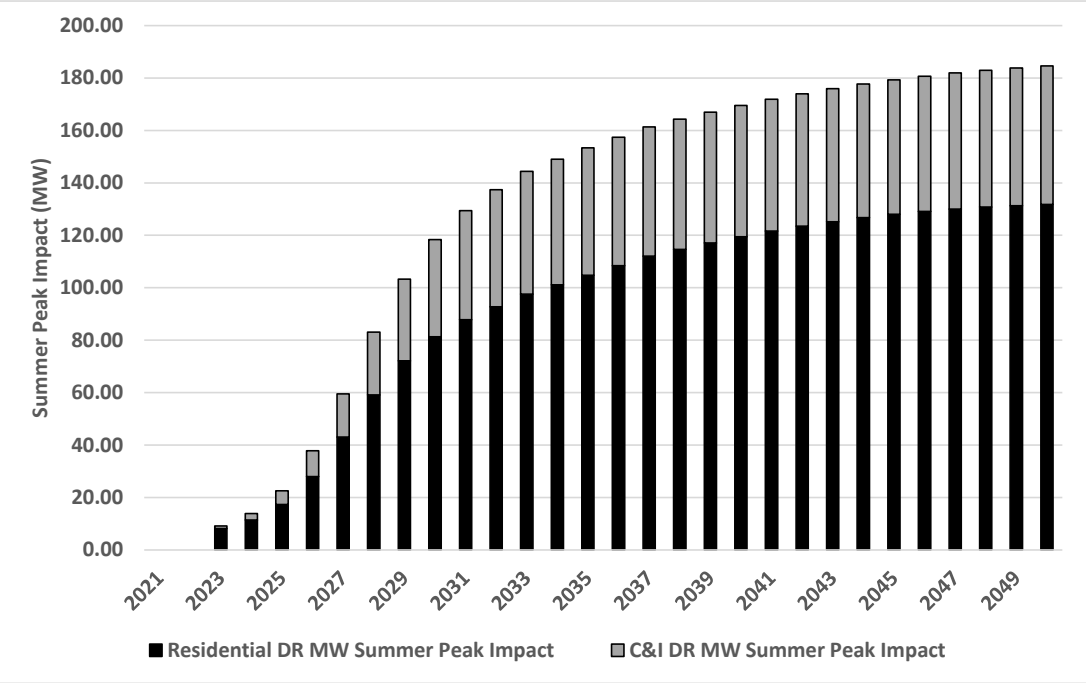


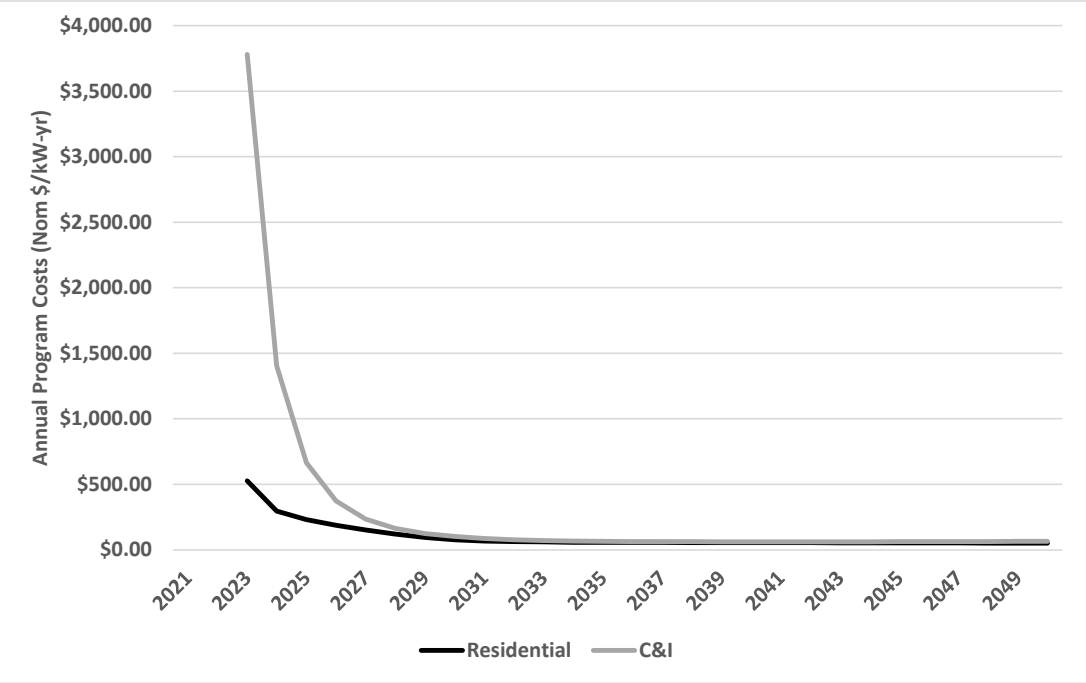
Siemens Parametrization of EE “Going-in” Data
Michigan CVR





Reference Case: Realistic Achievable Potential Demand Response Data





Peer Utility Review

In response to Stakeholder comments after the 2nd Stakeholder meeting, I&M reached out to multiple Investor-Owned Utility (IOU) in the states of Indiana and Michigan to see how they were accounting for energy efficiency in their IRPs and load forecast models.

I&M also reached out to Itron (the developer of the SAE models) to review I&M's approach to modeling energy efficiency in the SAE load forecast models.

Utilities Surveyed

Indiana Utilities	Michigan Utilities
AES (IP&L)	Consumers Energy
Centerpoint (Vectren)	DTE Electric
Duke Energy	
NIPSCO	

Benchmark to Other Utilities in IN & MI

	I&M	Utility A	Utility B	Utility C	Utility D	Utility E	Utility F
Itron SAE Models?	Yes	Yes	Yes (use Itron)	No (traditional econometric model)	No (Use External Consultant)	Yes	Yes
DSM Optimized?	Optimized	Target	Optimized	Target	Optimized	Optimized	Target
DSM Model Approach	Supplemental Efficiency Adjustment Matrix based on measure life	Regress DSM as independent variable	Regress DSM as independent variable	Model programs base on measure life. Assume no savings after measure life expires	Use Add-back method with Aurora	Regress DSM as independent variable	Use Add-back method with MPS EE targets
Adjusting DSM savings in Load Forecast?	Supplemental Efficiency Adjustment used in conjunction with SAE model to prevent double counting EE	DSM coefficient used to discount future DSM savings in forecast	DSM coefficient used to discount future DSM savings in forecast	Load forecast is standard econometric model that doesn't attempt to account for future EE. As a result, no adjustment needed for future DSM savings.	Load forecast is standard econometric model that doesn't attempt to account for future EE. As a result, no adjustment needed for future DSM savings.	DSM coefficient used to discount future DSM savings in forecast	Add back historical savings, and assume MPS savings for future EE savings.

Benchmarking Observations

- 5 out of the 7 IOUs surveyed in IN and MI use Itron's SAE model.
- Utilities that operate exclusively in MI are assuming a target for DSM/EWR whereas most IN and multi-state utilities are optimizing DSM as a supply side resource.
- The majority of IOU's using Itron's SAE model are modeling the DSM series as an independent variable in the regression.
- I&M's Supplemental Efficiency Adjustment (SEA) gets to the same levels as using DSM variable as a independent variable in the regression. In future IRP cycles, I&M will replace the SEA approach by modeling DSM series as an independent variable in the regression equation.
- Many IOU's are using a different load forecast methodologies for their IRP than they use in base rate case, fuel, and/or rider filings. This is not the case for I&M.

SEA vs DSM as an Independent Variable

I&M Indiana												
	Residential Lighting											
5 / 10	900,000	19,899,654	15,515,989	15,306,274	19,651,372	15,067,351	15,169,832	11,939,913	1,070,007	609,626	-	-
	2008	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
2008	900,000											
2009	688,574											
2010	440,204											
2011	207,749											
2012	49,670											
2013												
2014												
2015		19,899,654										
2016		15,224,867	15,515,989									
2017		9,733,237	13,818,033	15,306,274								
2018		4,593,477	11,871,004	13,631,267	19,651,372							
2019		1,098,246	9,759,036	11,710,554	17,500,870	15,067,351						
2020			7,589,116	9,627,132	15,034,911	13,418,490	15,169,832					
2021			5,485,731	7,486,541	12,360,053	11,527,759	13,509,757	11,939,913				
2022			3,581,587	5,411,585	9,611,798	9,476,858	11,606,165	10,633,296	1,070,007			
2023			2,003,944	3,533,178	6,947,809	7,369,680	9,541,315	9,135,012	952,914	609,626		
2024			856,315	1,976,859	4,536,165	5,327,113	7,419,806	7,509,804	818,643	542,913	-	
2025			195,335	844,741	2,538,043	3,478,027	5,363,346	5,840,001	672,999	466,414	-	-
2026				192,695	1,084,543	1,946,001	3,501,682	4,221,397	523,358	383,434	-	-
2027					247,396	831,555	1,959,237	2,756,124	378,305	298,178	-	-
2028						189,687	837,211	1,542,081	246,992	215,535	-	-
2029							190,977	658,954	138,195	140,721	-	-
2030								150,315	59,053	78,735	-	-
2031					Total to Subtract from LF		69,099,327		13,471	33,645	-	-
2032					Total Savings w/ no adjustment		151,698,321			7,675	-	-
					Supplemental Efficiency Adjustment Impact		46%				-	-

JURIS	CLASS	DSM Variable Coefficient	T-Stat	P-Value
IM-IN	Residential	-0.51	(2.88)	0.43%
	Commercial	-0.47	(5.70)	0.00001%
I&M-MI	Residential	-0.52	(4.42)	0.0018%
	Commercial	-0.39	(1.88)	6.12%
	Average	**-0.47**		

FEEDBACK AND DISCUSSION

SCENARIOS

Overview of Proposed Scenarios

I&M will use a scenario- and sensitivity-based approach to construct future market and regulatory environments. The Reference scenario is the most expected future scenario and includes the base case inputs provided by AEP I&M. The changes in the alternative scenarios are shown relative to the Reference scenario.

All Portfolios in each proposed scenario will achieve a Net Zero by 2050 Carbon Reduction goal which aligns with the AEP Corporate Goal.

Scenario	Load	Gas Price	Coal Price	CO2	Renewable and Storage Costs	EE / DR Cost
Reference	Base	Base	Base	Base	Base	Base
Rapid Technology Advancement	Base	Base	Base	Base	Low	Low
Enhanced Regulation	Base	High	High	High	Base	Base

The directional basis of the Scenario drivers are as compared to the Reference scenario.

Scenario Narrative: Reference Scenario

Scenario	Load	Gas Price	Coal Price	CO2	Renewable and Storage Costs	EE / DR Cost
Reference Scenario	Base	Base	Base	Base	Base	Base

The Reference Scenario

The Reference scenario is the most expected future scenario that is designed to include a consensus view of key drivers in power and fuel markets. The existing generation fleet is largely unchanged apart from new units planned with firm certainty or under construction. An increased carbon reduction is assumed to achieve net zero in the electric sector.

In the Reference scenario, major drivers include:

- Coal prices remain relatively flat over the forecast horizon in constant dollars consistent with EIA reference
- Natural gas prices move upward in real dollars to 2050 consistent with EIA reference
- Capital costs are downward sloping for fossil and wind resources, and decline significantly for solar and storage resources
- Carbon regulations limiting CO2 emissions will commence in 2028 and remain in effect throughout the forecast horizon
- Portfolio achieves Net Zero by 2050 without any incremental goals and assuming an $100/ton (nominal) offset is available

Scenario Narrative: Rapid Technology Advancement

Scenario	Load	Gas Price	Coal Price	CO2	Renewable and Storage Costs	EE / DR Cost
Rapid Technology Advancement	Base	Base	Base	Base	Low	Low

Rapid Technology Advancement

The Rapid Technology Advancement scenario assumes technological advancements, favorable regulation and overall economies of scale that impact renewable resources. The scenario assumes technology costs for supply- and demand-side renewable resources decline over time, resulting in up to 35% reductions in technology costs; significantly faster than in the Reference scenario.

In the Rapid Technology Advancement scenario, major drivers include:

- Technology cost reductions for renewables and storage result in lower capital costs
- Technological advancement and economies of scale contribute to greater potential for energy efficiency and demand response
- Carbon regulations limiting CO2 emissions will commence in 2028 and remain in effect throughout the forecast horizon
- Thermal generation retirements are driven by unit age-limits and announced retirements, consistent with Reference scenario
- Fundamental drivers (load, commodity prices, net zero requirement by 2050) remain constant to the Reference scenario

Scenario Narrative: Enhanced Regulation

Scenario	Load	Gas Price	Coal Price	CO2	Renewable and Storage Costs	EE / DR Cost
Enhanced Regulation	Base	High	High	High	Base	Base

Enhanced Regulation

The Enhanced Regulation scenario assumes increased environmental regulations covering natural gas, coal and CO2. Illustrative examples include a potential fracking ban and increases of carbon reduction targets.

In the Enhanced Regulation scenario, major drivers include:

- Natural gas, coal prices and CO2 prices are increased to reflect enhanced regulation
- Technology costs for thermal and renewable units remain consistent with the Reference scenario
- Thermal generation retirements are driven by unit age-limits and announced retirements, consistent with Reference scenario
- Carbon regulations limiting CO2 emissions will commence in 2025 and remain in effect throughout the forecast horizon
- Portfolios achieves Net Zero by 2050 without any incremental goals and assuming an $100/ton (nominal) offset is available

FEEDBACK AND DISCUSSION

INDIANA MICHIGAN POWER
An AEP Company

STAKEHOLDER SESSION

Stakeholder Session

- The purpose of this session is to allow stakeholders to discuss and propose different strategies to meet load obligations over the next 20 years.
- We won't be able to run a least-cost portfolio run for each strategy, but we will optimize several different strategies.

Process:

1. Open Discussion
2. Poll – based upon the discussion, what additional strategy would you like to see included in the IRP process.
3. In the next meeting, strategies will be defined as model structures
4. Structures will be consolidated into several portfolios for further evaluation

Questions to Facilitate the Discussion

1. When you consider our IRP objectives of Affordability, Sustainability, and Reliability, is there an alternative strategy that would emphasize a particular objective?

2. In the short-term, what alternative option would you like to see added to the analysis?

3. Over the long-term, should a different strategy be introduced into the analysis?

STAKEHOLDER PROCESS

Stakeholder Timelines

INDIANA MICHIGAN POWER
An AEP Company

March 9, 2021 ✓
- 2021 IRP Process
- Objectives and Metrics
- Proposed Scenarios
- Base Case Inputs

April 14, 2021 ✓
- DSM IRP Inputs and Modeling
- EE/EWR, DR and DER Results
- 2021 IRP Update

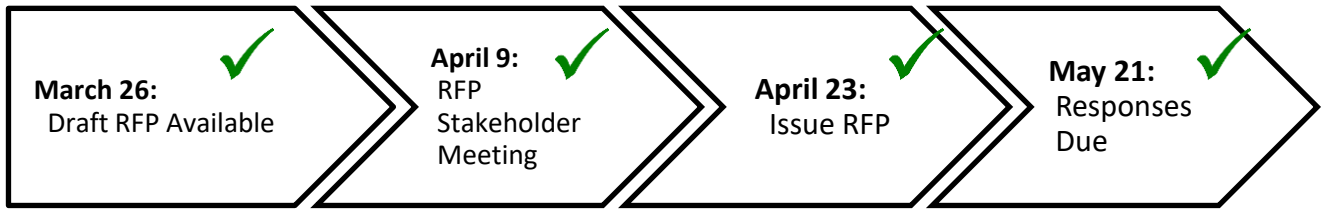
June 24, 2021 ✓
- AURORA Technical Workshop

July 27, 2021
(this session)
- IRP Process – Inputs, Scenarios and Sensitivities
- All-Source RFP Results

August 24, 2021
- Candidate Portfolio Review
- Stochastic Modeling Approach and Assumptions
- Stochastic Modeling

September 21, 2021
- Probabilistic Modeling Results
- Review of Preferred Portfolio
- Other(s)

All-Source RFP Timeline



AURORA Licensing and Data Provision

Licensing of Aurora Application

- As part of the Stakeholder engagement, I&M executed an agreement to extend licenses of Energy Exemplar's AURORA application to the parties in Case No. U-20591 and to the stakeholders in Indiana that are highly involved in the technical aspects of the IRP.
- As of this meeting, licenses have been issued. Any licensing issues should be reported to Jay Boggs (jay.boggs@siemens.com) or Christen Blend (cmblend@aep.com)
- Online help manuals are available within the Aurora application - the model's Help menu features material like a user manual.

AURORA Licensing and Data Provision (continued)

Data Provision

- Consistent with prior I&M Integrated Resource Planning processes, we will continue to provide access to data to support stakeholder review of the IRP process.
- Siemens will host a confidential and secure site for stakeholders to access the information.
- IRP databases would include input and output tables used in the modeling and will require an NDA with Siemens.
- The model database will be available for review, but Siemens will not provide any review support beyond clearly-defined naming conventions (data key).
- Process for signing up to access the data will be shared by the Stakeholder Meeting #3B in August.

FEEDBACK AND DISCUSSION

CLOSING REMARKS