MI POWER GRID

Making the Most of Michigan's Energy Future

Integration of Resource, Distribution, and Transmission Planning

Advanced Planning Stakeholder Meeting

November 6, 2020

MPSC

Michigan Public Service Commission

Workgroup Instructions

1. This meeting is being recorded.

2. Please be sure to mute your lines.

3. There will be opportunities for question/comments after each of the sections identified in the agenda. Please type questions into the chat function or use the “raise hand” function during this time. We will open it up to those on the phone after those using the chat function.

4. Questions will be addressed at the end of each presentation segment.

5. We will be requesting comments after all of the meetings which will be posted to the webpage.

6. The presentations for all the meetings are posted to the Advanced Planning webpage.

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Making the Most of Michigan's Energy Future

Agenda Items		
10:50 pm	Welcome/Introductions	MPSC Staff
11:00 am	Aligning Planning Processes: Lessons Learned in Practice	Adam Diamant (EPRI)[1] Bob Thomas (Dominion) Michael Rib (Duke Energy)
12:30 pm	Lunch Break	
1:00 pm	Stakeholder Presentations on Executive Directive 2020-10 Proposals	Indiana Michigan Power, Joint Commenters[2], Others
1:45 pm	Review Stakeholder Feedback from October 21 Meeting	MPSC Staff
2:15pm	Closing/Adjourn	MPSC Staff

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Making the Most of Michigan's Energy Future

Adam Diamant

Electric Power Research Institute (EPRI)

MPSC

Michigan Public Service Commission

Resource Planning for the Next Generation

Developing a Framework for More Integrated Energy System Planning

Adam Diamant
Technical Executive
Manager, Resource Planning for Electric Power Systems (P178)

Presentation to Michigan Public Service Commission
Phase II Advanced Planning Processes: Integration of Resource/Distribution/Transmission Planning

November 6, 2020
via Webcast

www.epri.com

Key Aspects of the Electric Power Research Institute (EPRI)

Independent

Objective, scientifically based results address reliability, efficiency, affordability, health, safety, and the environment

Nonprofit

EPRI is a non-profit "501(c)3 organization, chartered to serve the public benefit.

Collaborative

Bring together scientists, engineers, academic researchers, and industry experts

Our Mission

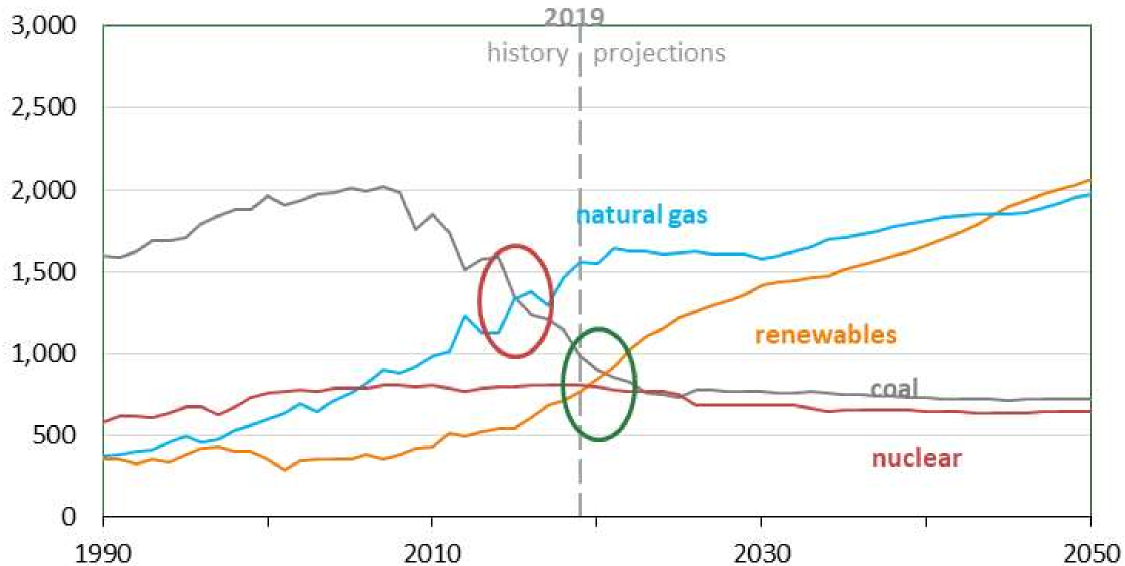
"Advancing safe, reliable, affordable and environmentally responsible electricity for society through global collaboration, thought leadership and science & technology innovation."

*Learn more about the Electric Power Research Institute at www.epri.com .

The Electric Power Industry is Rapidly Transforming

- **Rapidly changing power generation resource mix**
- **Rapidly changing system characteristics**
  - Loss of synchronized, rotating mass
  - Uncertainty and variability of renewable generation
  - Rapid DER deployment and changing load profiles
- **Changing interaction of system resources**

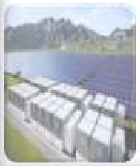
Electricity generation from selected fuels
billion kilowatthours



Source: U.S. Energy Information Agency, Annual Energy Outlook 2020

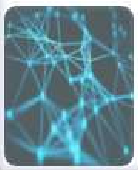
Ongoing transformation requires evolution of resource planning

Emerging Technologies Raise New Complex Questions; Answering These Requires More Integrated Analyses



Energy Storage

- What role does storage play in low carbon, high renewables power systems?
- What types of storage systems are likely to be deployed?
- How does it contribute across G, T and D systems?



Distributed Energy Resources (DERs)

- Can DERs support system reliability?
- Can the system support a network of aggregated DERs?
- How does it all work together?

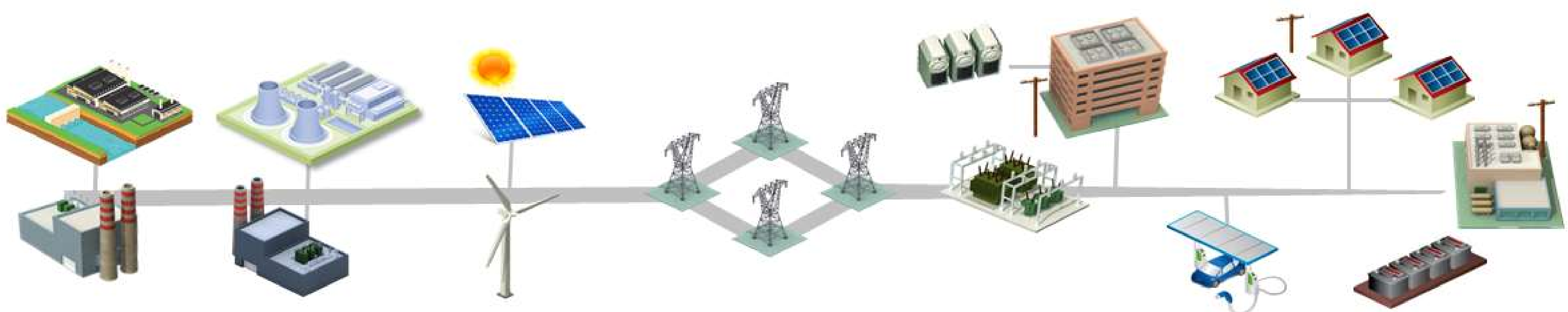
High Deployment Renewable Systems

- How can we balance cost-effectiveness and environmental performance in high renewable systems?
- What types of renewables are likely to be deployed and where?
- Can future high renewable systems be operated reliably?

We need to **improve existing analytical tools — and develop links between them —** to answer these new questions. No one tool, nor several isolated tools, will answer them!

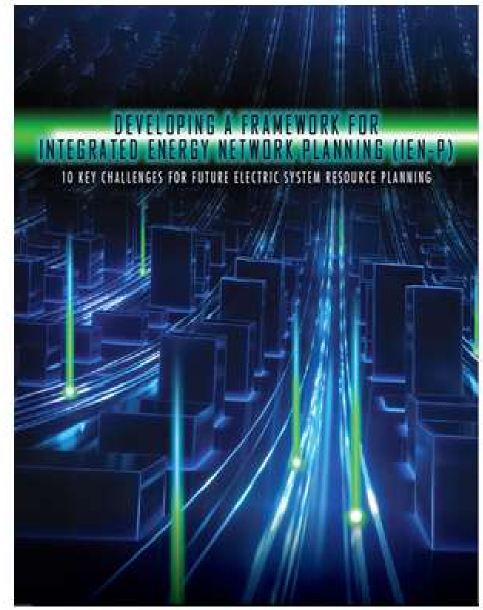
Planning for Climate Resiliency Requires Integrated Analyses

	1 Global Climate Changes	2 Demand & Device Impact	3 Resource Assessments	4 Grid Evaluation	5 End User
Modeling and System Impact	Climate Projections & Extreme Events	Changes in Heating and Cooling Demand	Adequacy, Operations & Capacity Expansion	T&D Reliability and Resiliency	Consumers Impacts & Options (Microgrids & DERs)
			System Impact and Investment Option Assessment		
Infrastructure and Land Use Assessment	Land Use, Vegetation Mgmt. & Managed Ecosystems	Component Performance Impacts & Design Basis	Transmission & Distribution		End Use Devices
			Generation		



Integrated Energy Network Planning (IEN-P)

- **Integrated**
  - Includes all electricity supply and demand-side resources, like traditional IRP
  - Also includes coordinated generation, transmission and distribution planning
  - Spans other resources & infrastructure (e.g., natural gas)
- **Energy**
  - Focused primarily on the electric sector, but also includes related fuels, energy resources and infrastructure
- **Network**
  - Includes the electric grid (i.e., transmission <u>and</u> distribution) and the broader energy network and associated infrastructure
- **Planning**
  - Strategic framework to enhance long-term electric sector investment planning



Online here:
http://integratedenergynetwork.com/wp-content/uploads/2018/07/3002010821_IEN-P_White_Paper.pdf

10 Critical Resource Planning Challenges[1]

1. Incorporating operational detail
2. Increasing modeling granularity
3. **Integrating generation, transmission & distribution planning**
4. Expanding analysis boundaries and interfaces
5. Addressing uncertainty and managing risk

Modeling the Changing Power System

6. Improving forecasting
7. Improving modeling of customer behavior and interaction

Integrating Forecasts

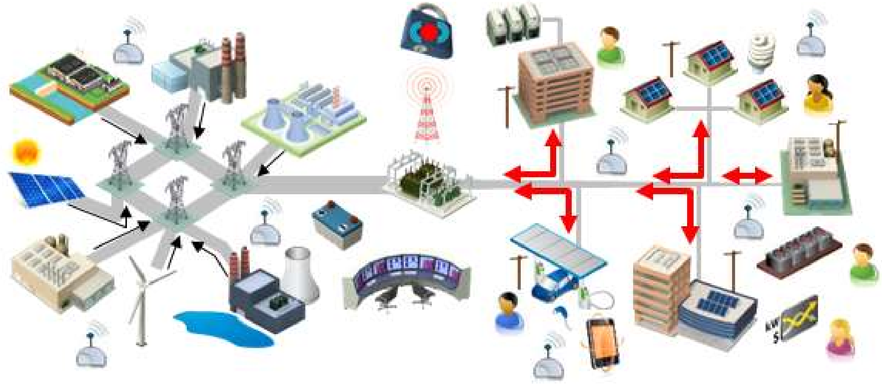
8. Incorporating new planning objectives and constraints
9. Integrating wholesale power markets
10. Supporting expanded stakeholder engagement

Expanding Planning Boundaries

1. For more information about these 10 challenges, see *Developing an Integrated Energy Network Planning (IEN-P) Framework EPRI Palo Alto, CA. 2018. 3002010821*.

Planning Challenge #3: Integrating G, T, and D Planning

- Interactions between transmission system operators (TSOs) and distribution system operators (DSOs) are becoming increasingly important.
  - This will accelerate as the distribution system continues to offer more services.
  - FERC Order 2222 re: DER Aggregation

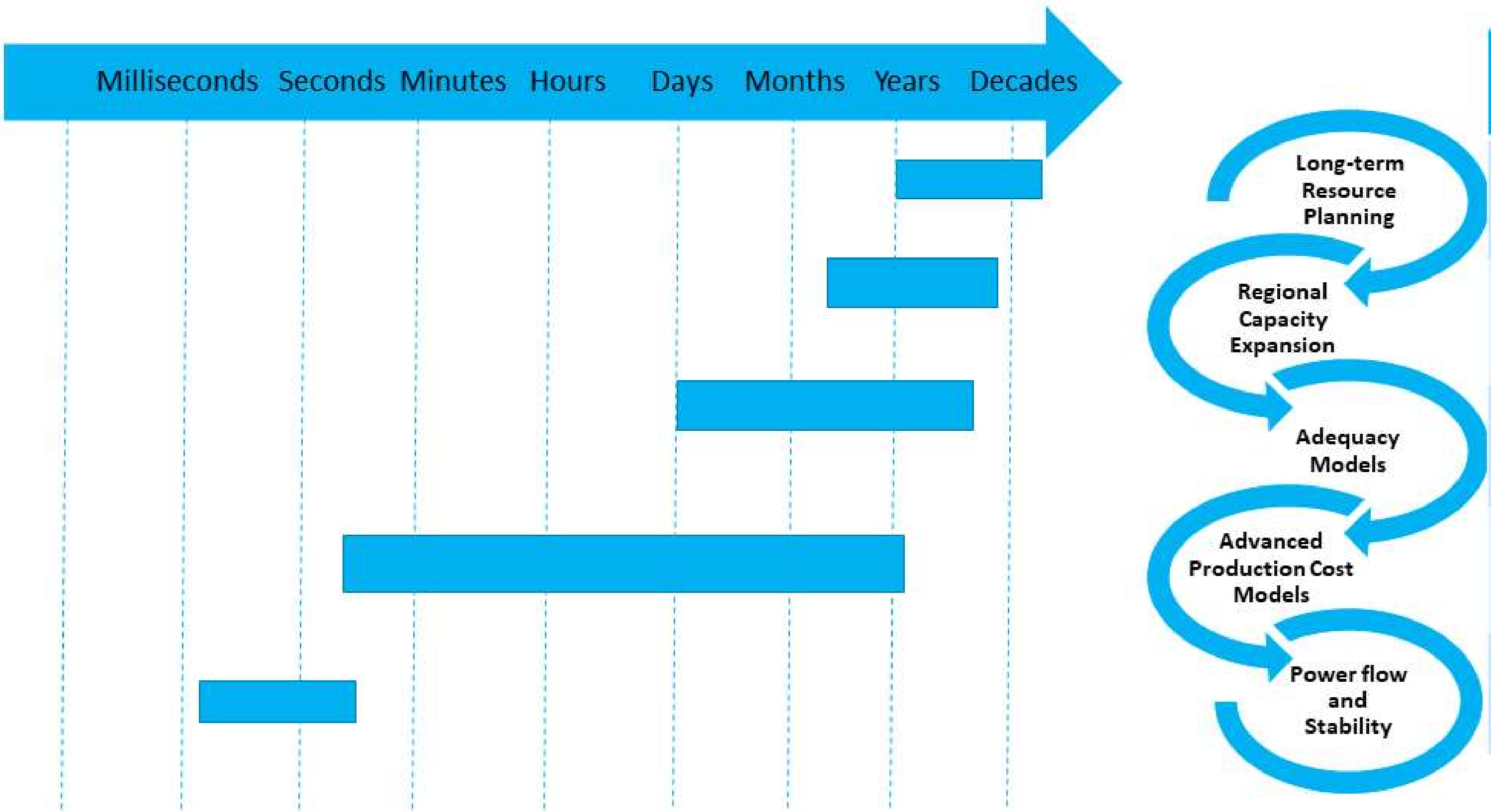


- Integrated planning can make it easier to evaluate and compare *"non-wires alternatives" (NWA)* to new G, T and/or D investments
- Facilitates improved DER valuation and targeting, including locational attributes
- Growing need to improve communications and "handshakes" between different planning functions within vertically-integrated utilities to create more holistic planning
- Important to consider connections to other infrastructure, particularly infrastructure that interacts directly with power generation or consumption (e.g., natural gas, EVs, H_2O)

Some Key Challenges Will Need to be Overcome to Implement More Fully Integrated / Aligned Power System Planning

- Need for temporally and geographically granular data (e.g., load data & renewable resource production profiles) that can be aggregated and disaggregated easily and shared among different planning and strategy groups
- Electric companies and state regulatory agencies are likely to need to reorganize planning functions, internal structures and incentives
- The overall planning process in companies and regulatory agencies will need to be revised along with important feedback loops
- The quantitative modeling techniques needed to integrated GTD planning have not yet been developed. There is an urgent need for enhanced analytic tools and ways to "link" tools, and enhanced computer infrastructure to support quantitative modeling.
- G, T & D planning typically focus on different timeframes (e.g., 3-10+ years) and usually include different levels of fidelity for key transmission details

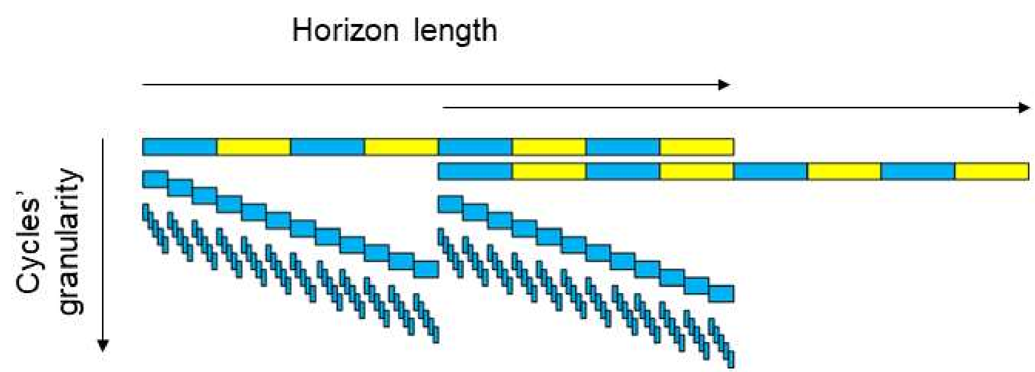
G, T and D Planning Analyses Vary Across Time Scales and Transmission Details



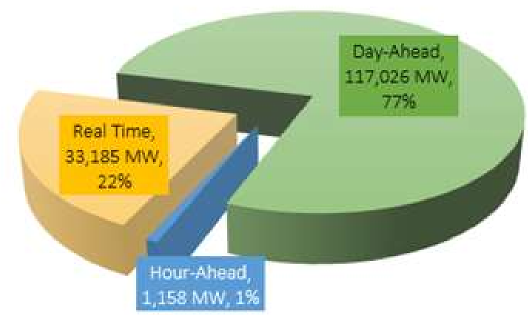
Transmission	Distribution
X	
X	X
X	
X	
X	X

Bridging the "Gap" Between Capacity Expansion and Production Cost Modeling Tools

- CapEx models do not capture short-term net-demand variations; expansion plans are driven by investments cost and other factors but do not include detailed operating needs
- By "closing the loop" between the CapEx and PCM tools, expansion plans would be able to capture and be responsive to system operational needs too.



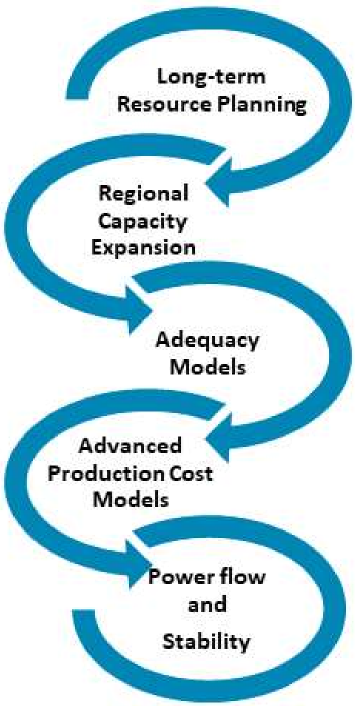
COMMITMENT CAPACITY BY CYCLES



Capacity that must be committed by different scheduling processes in WI

EPRI, "Dynamic Operating Reserve and Advanced Scheduling Techniques to Support Variability and Uncertainty in Power Systems", 3002008366, Dec. 2016.

Key Modeling and Analytic Challenges



- How do different analyses fit together?
  - Which steps produce outputs that become inputs for the next steps
  - Where are the feedback loops
  - How can constraints be enforced across all timescales
- How to ensure consistency between analyses?
  - Can the same dataset feed multiple analyses
  - Do the analyses use consistent mathematical approaches
- How to capture changing power systems?
  - Clean energy policies
  - Emerging technologies
  - Increased DER
  - Increased demand side participation
  - Changing regulatory landscapes
  - Changing Climate
- Where are the gaps?
  - Can current tools fill the gaps
  - Are completely new tools needed
- What overall analytic flow will ensure an economic, reliable, and clean power system?

New EPRI Integrated System Planning Initiative

What

Develop an industry-leading modeling framework/tool(s) to analyze system integration challenges the industry faces.

Who

EPRI staff engaged in transmission, distribution, energy system & climate analysis, and storage/DER plus EPRI Member engagement from all planning areas

How

Improve the integration of G/T/D planning tools including evolving climate Impacts and evolving customer considerations for comprehensive analysis

Deliverable

Tool and/or framework enhancements for EPRI and the industry to conduct assessment studies with comprehensive components ensuring robust solutions.

Funding & Timing

$1.8 million; 3-yr effort

Questions?

Together...Shaping the Future of Electricity

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MI POWER GRID

Making the Most of Michigan's Energy Future

Bob Thomas

Dominion

MPSC

Michigan Public Service Commission

Integrated G, T, & D Planning

November 2020

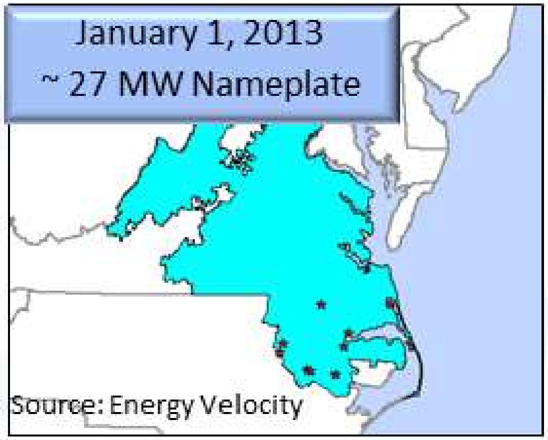
Historical Integrated Electric Planning at Dominion Energy

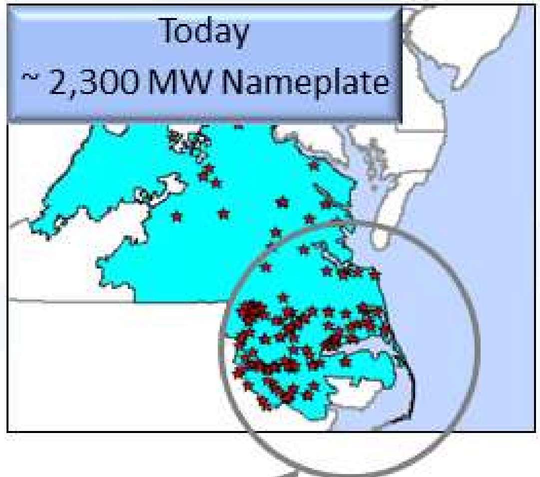
- *Close interface between IRP and Generation Planning.*
- *No interface between IRP and Distribution Planning.*

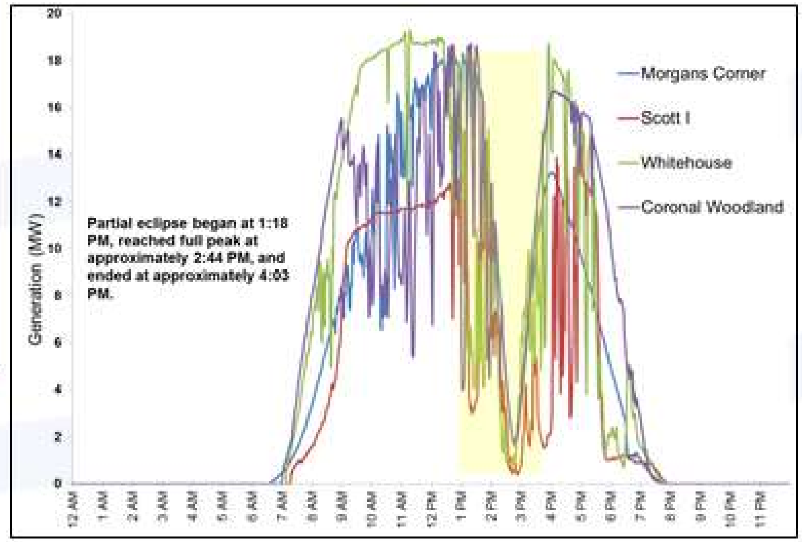
So why does this need to change?

...This is why

Dominion Zone Operational Solar Generation Facilities







Most of these facilities are interconnected to the Distribution System

Future Expansion Plans

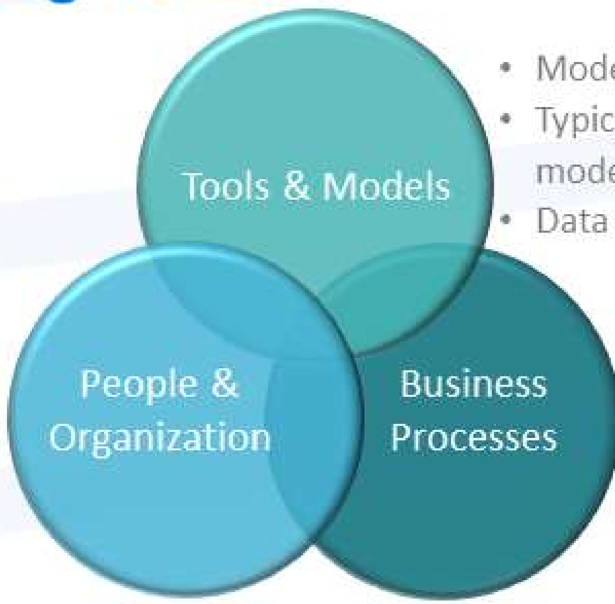
2020 Dominion Energy Virginia IRP Alternative Plans

Executive Summary Table: 2020 Plan Results

	Plan A	Plan B	Plan C	Plan D
NPV Total ($B)	$44.3	$66.2	$78.6	$80.8
Approximate CO_2 Emissions from Company in 2045 (Tons)	24 M	10 M	0	0
Approximate CO_2 Emissions Regionally in 2045 (Tons)	34 M	4 M	4 M	5 M
Solar (MW)	6,720 15-year 11,520 25-year	15,920 15-year 31,400 25-year	15,920 15-year 32,480 25-year	18,800 15-year 40,640 25-year
Offshore Wind (MW)	--- 15-year --- 25-year	5,112 15-year 5,112 25-year	5,112 15-year 5,112 25-year	5,112 15-year 5,112 25-year
Storage (MW)	--- 15-year --- 25-year	2,714 15-year 5,114 25-year	2,714 15-year 9,914 25-year	2,714 15-year 9,914 25-year
Natural Gas-Fired (MW)	1,940 15-year 3,531 25-year	970 15-year 970 25-year	970 15-year 970 25-year	970 15-year 970 25-year
Import / Export Capability (MW)	5,200 15-year 5,200 25-year	5,200 15-year 5,200 25-year	5,200 15-year 10,400 25-year	5,200 15-year 10,400 25-year
Retirements (MW)	3,030 15-year 4,651 25-year	3,183 15-year 5,414 25-year	3,183 15-year 13,978 25-year	3,183 15-year 13,978 25-year

Integrated GT&D Planning is not just models and tools - the processes and organization must also align with the evolving planning needs

- Models don't talk to each other
- Typical routine analysis requires multiple models and spreadsheets
- Data requirements, formats different



- Organizational and mental silos
- Performance targets not shared or aligned
- No shared ownership of the consolidated plan

- Different data sources and planning horizons
- Limited few have view of the "forest"
- Time horizons differ across planning domains
- Objective differ across planning domains

Planning must evolve to meet future needs:

- ***Integrated GT&D Planning Elements:***
  - ✓ Common data sources & forecasts
  - ✓ Common planning horizons
  - ✓ Sub-hourly and Stochastic Supply Analysis
  - ✓ Locational and feeder level supply planning
  - ✓ Iterative results passed between models

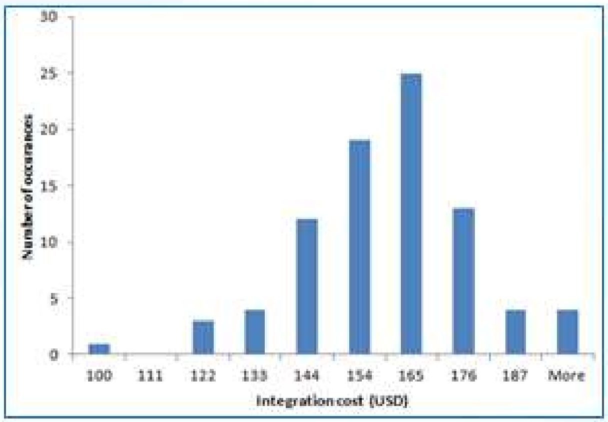
Step 1: Electric Planning Re-Organization

Newly formed Corporate Strategic Planning Group

- Charter Includes:
  - ✓ Planning consistency
  - ✓ G,T, & D integration
  - ✓ Policy guidance

Step 2: Develop New Analytical Techniques

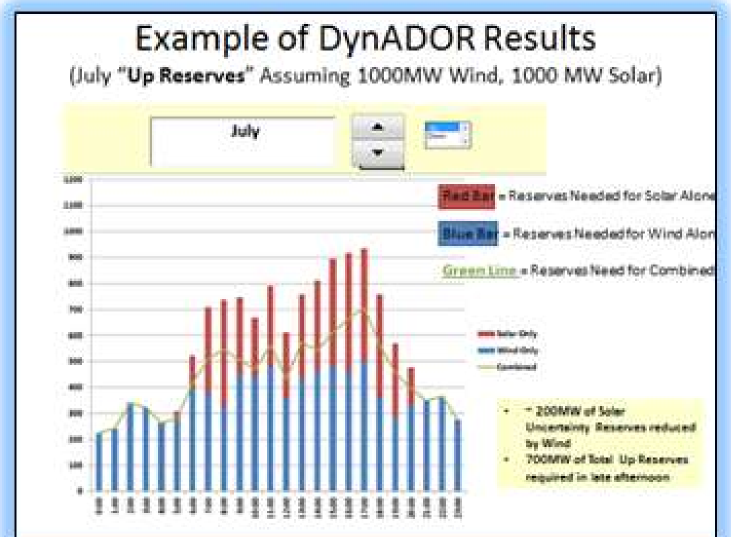
Transmission Planning Example

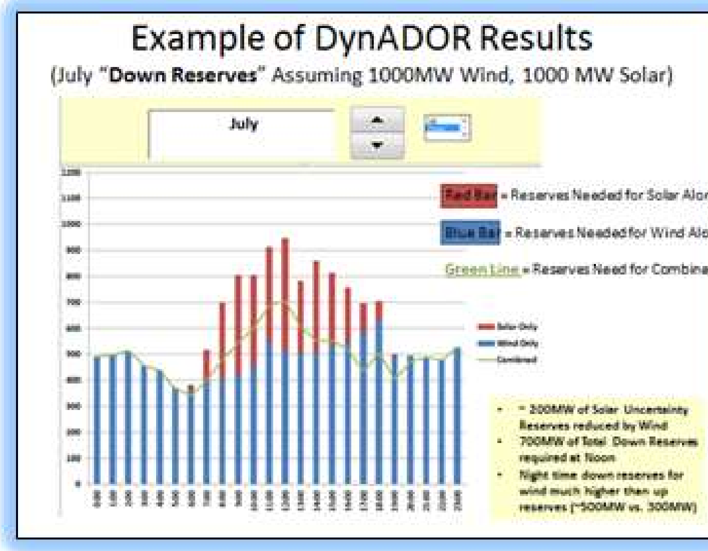


- *Stochastic load flow analysis that varied solar PV sites within DE's service territory.*
- *Peak Load – High Solar.*
- *Low load – High Solar.*
- *Generation unit retirements.*

Develop New Analytical Techniques

Ancillary Services Example – Regulating Reserves

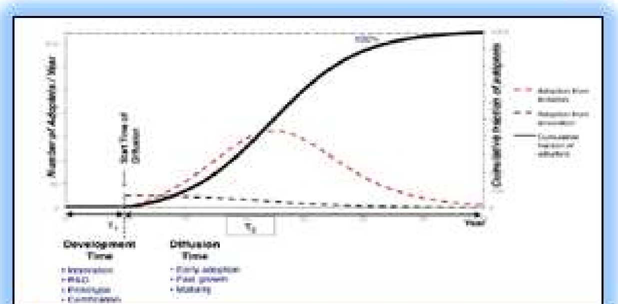




- *EPRI DynADOR model provides Regulation Service Volume estimate.*
- *PJM Regulation Market price as a function of DOM Zone power prices.*

Develop New Analytical Techniques

DER Forecasting Example - Net Metering Solar PV Customers



Objective: forecast commercial and residential class net metered solar program participation and kW capacity by circuit for each of the next 25 years.

Methodology

- Base forecasts on a feeder circuit level using 3-parameter Bass Diffusion Models of net metering solar participation.
- Use a hierarchical "bottom-up" approach to best reflect geographic variation in participation rates and potentials:
  - ✓ *Where feasible, estimate diffusion parameters at the circuit level then calculate their average values at the corresponding district office and regional levels as well as at the overall system level.*
  - ✓ *For circuits for which diffusion curves could not be estimated (e.g., insufficient or non-existent historical data), apply average parameters at the lowest feasible level in the hierarchy.*

Develop New Analytical Techniques

Distribution Planning Example

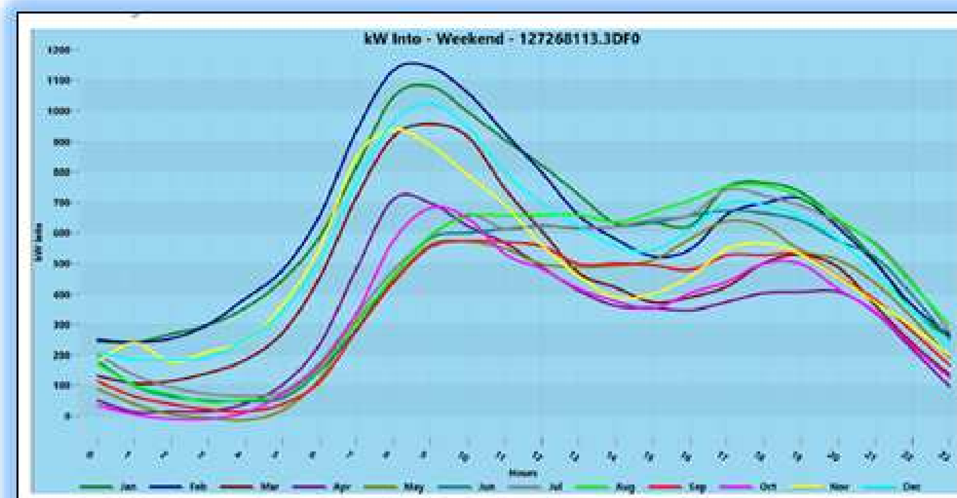


Figure 15: Load profile of section responsible for thermal overloads

Non-Wires mitigation analysis of thermal overload.

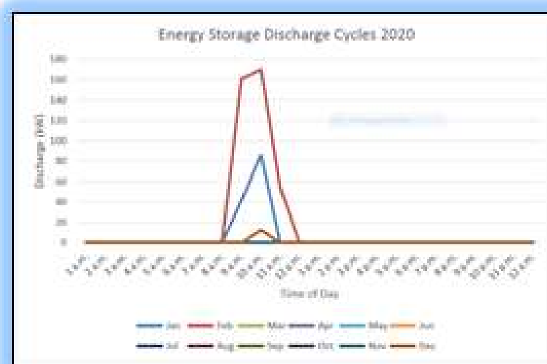


Figure 16: Energy storage discharge required to mitigate thermal overload in 2020

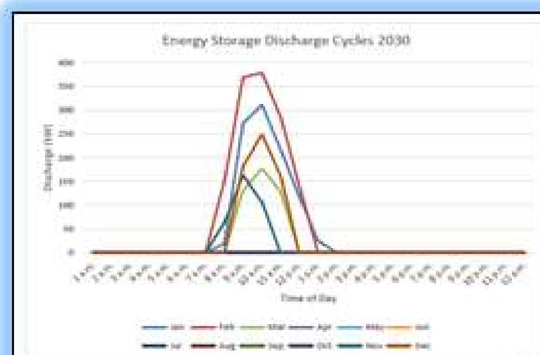
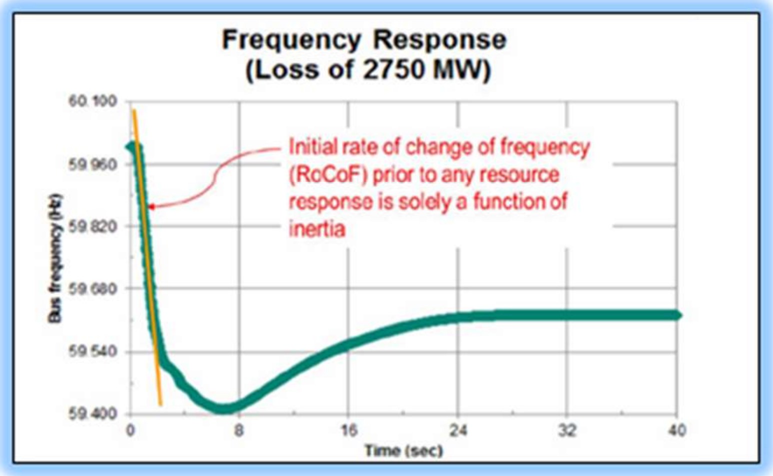


Figure 17: Energy storage discharge required to mitigate thermal overload in 2030

Develop New Analytical Techniques

In the Works…



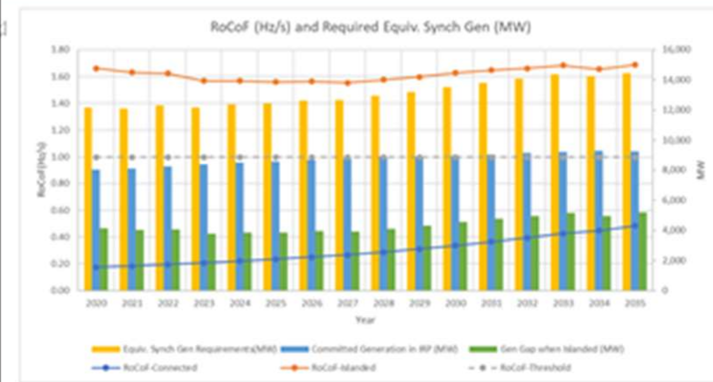


Figure 6-8: RoCoF, Installed Generation MW, and minimum Required Equivalent Generation Resources by Year for Islanded and Interconnected Dominion System – Fall Early Afternoon – 15% Spinning Reserves

Currently developing analytical techniques to assess:

- System Inertia and Frequency Control.
- System Short-Circuit Strength.

Key Insights

- *The electric grid is transforming:*
  - ✓ From _dispatchable rotating synchronous_ based generation resources at the T level;
  - ✓ To _intermittent inverter-based_ generation resources at both the T&D level.
- *Therefore, system planning must:*
  - ✓ Recognize this transformation.
  - ✓ Re-organize planning personnel to accommodate this transformation.
  - ✓ Develop new analytical tools and processes to properly evaluate the entire GT&D system under various conditions in order to assure future reliability.

Questions?

MI POWER GRID

Making the Most of Michigan's Energy Future

Michael Rib

Duke Energy

MPSC

Michigan Public Service Commission

Presentation to Michigan Public Service Commission

An Overview of Duke Energy's Integrated System & Operations Planning Development Efforts

November 6, 2020

DUKE ENERGY®

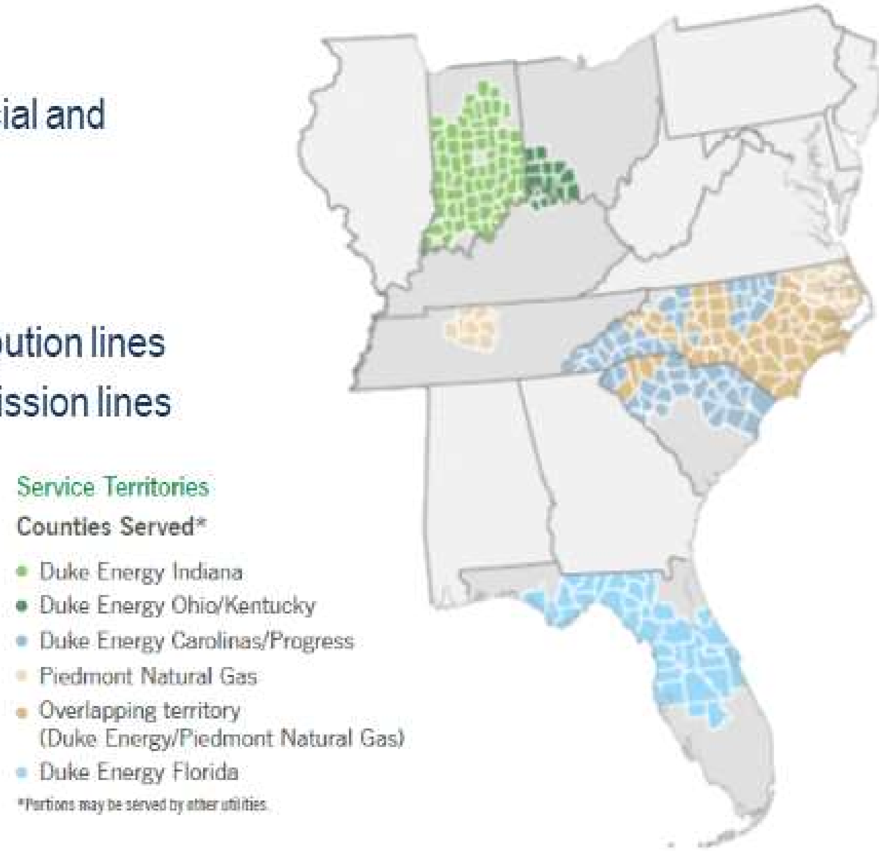
Intro to Duke Energy

Regulated Electric Utilities

- Serve 7.8 million residential, commercial and industrial customers
- Serving in 6 states
- 51,144 MW generation
- Approximately 280,000 miles of distribution lines
- Approximately 31,000 miles of transmission lines

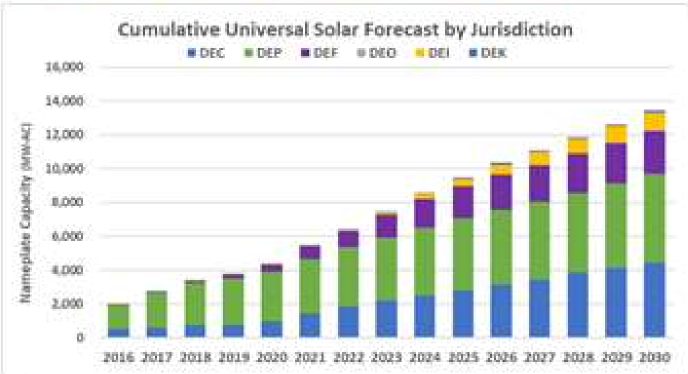
Commercial Renewables

- 2,282 MW generation (wind, solar, fuel cell & battery)
- Serving in 19 states

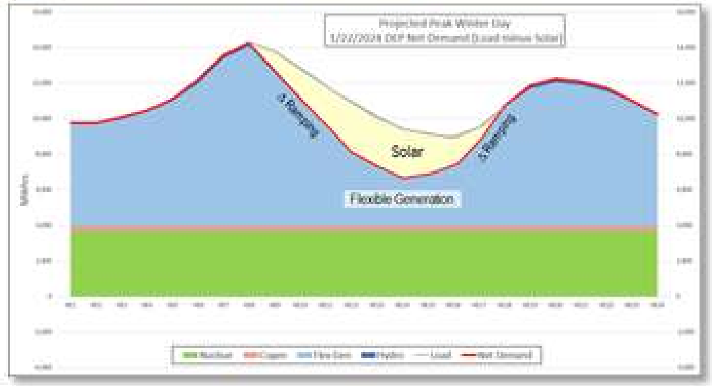


What are some of the challenges that we are addressing?

Rapid growth of renewables in our regions ...

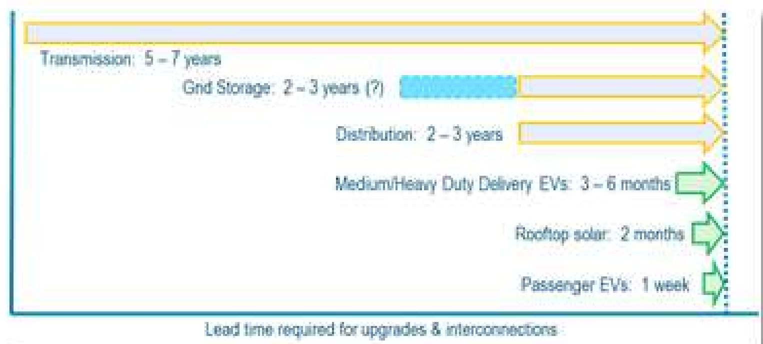


Increasing system resource flexibility needed ...



Addressing dynamic loading on the grid ...

Aligning planning timeframes with customer needs ...



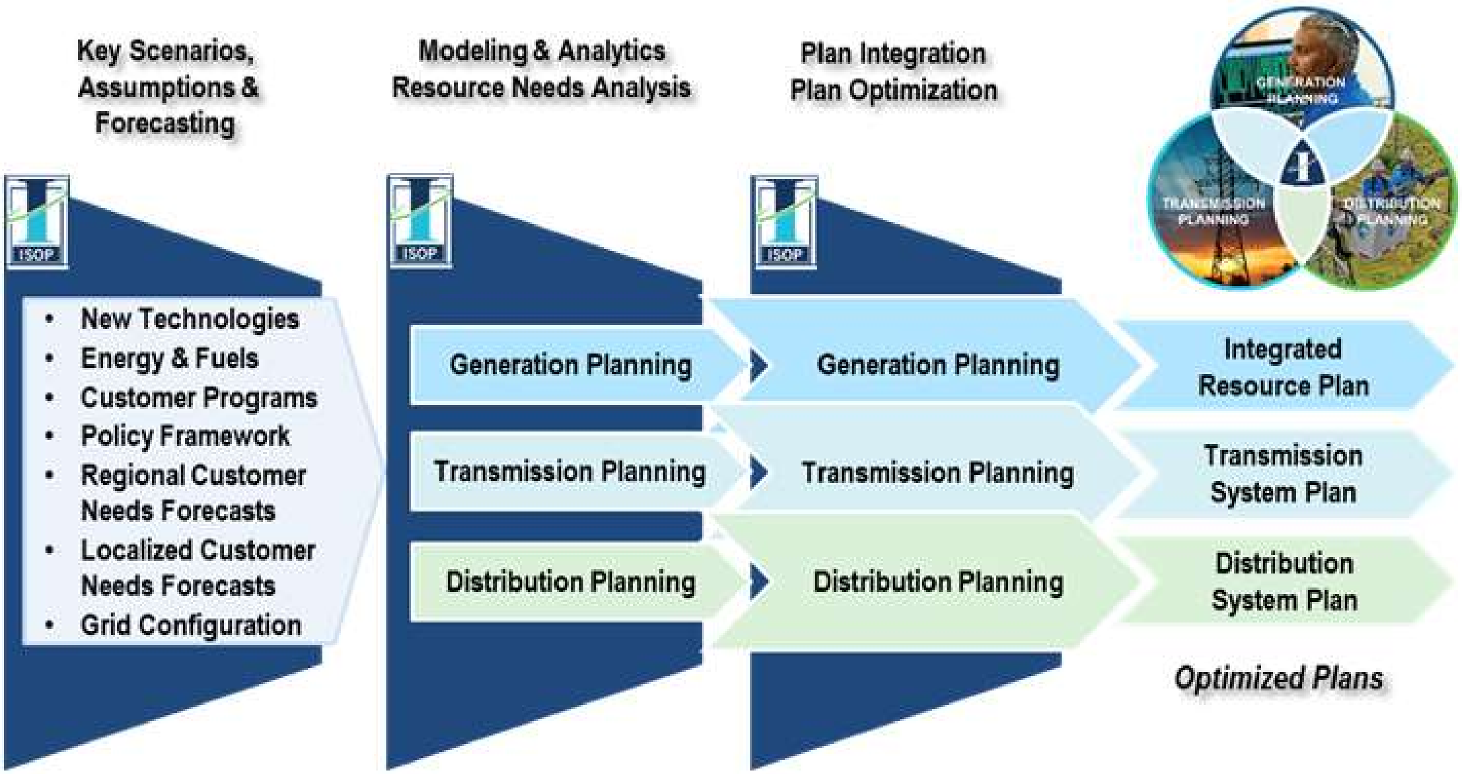
ISOP Vision

The Integrated System & Operations Planning (ISOP) vision is a planning framework* that optimizes capacity and energy resource investments (MW/MWh) across Generation, Transmission, Distribution and Customer Solutions. The framework will address:

- **Operationally feasible plans** while accommodating rapid renewable growth
- **Enhanced modeling and analytics** to value new technologies such as energy storage, electric vehicles, intelligent grid controls and customer programs (non-traditional solutions for T&D)
- Ability to evaluate different asset portfolios across a **broader range of potential future scenarios**

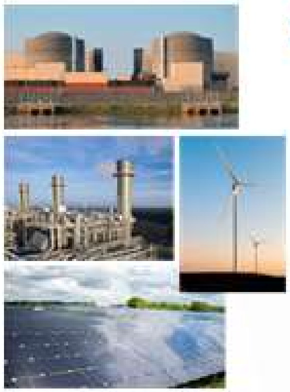
* Initial ISOP Focus: Carolinas Region

Establishing the framework for ISOP



ISOP drives optimization through collaboration and integration

Framing the long term vision and objectives …



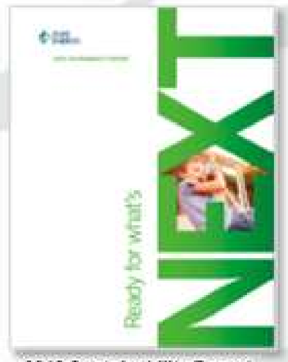
Supply Side

- New generation technologies
- Resource mix (central, distributed and external resources)
- Insights on locations for resources

Demand Side

- Evolving customer needs and expectations
- Future perspective on load-modifying resources and programs
- Insights on locations for resources

ISOP scenarios leverage IRP, ESG and Sustainability work to help frame the future for integrated planners …



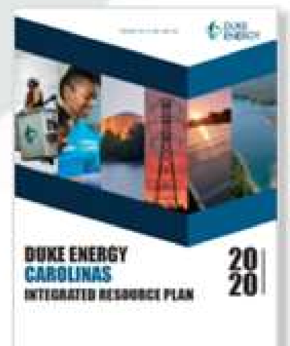
2019 Sustainability Report

➡ *Vision Statement …*

Net Zero Carbon by 2050

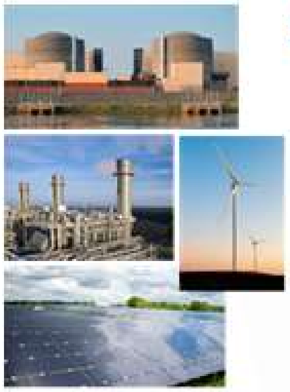
➡ *Integrated Planning …*

Pathways to Net Zero



2020 Integrated Resource Plan

Framing the long term vision and objectives …



Supply Side

- New generation technologies
- Resource mix (central, distributed and external resources)
- Insights on locations for resources

NTS/Storage Potential

- Storage needs and potential on the system
- Storage use cases for energy network support

ISOP is integrating our planning efforts to define future system needs

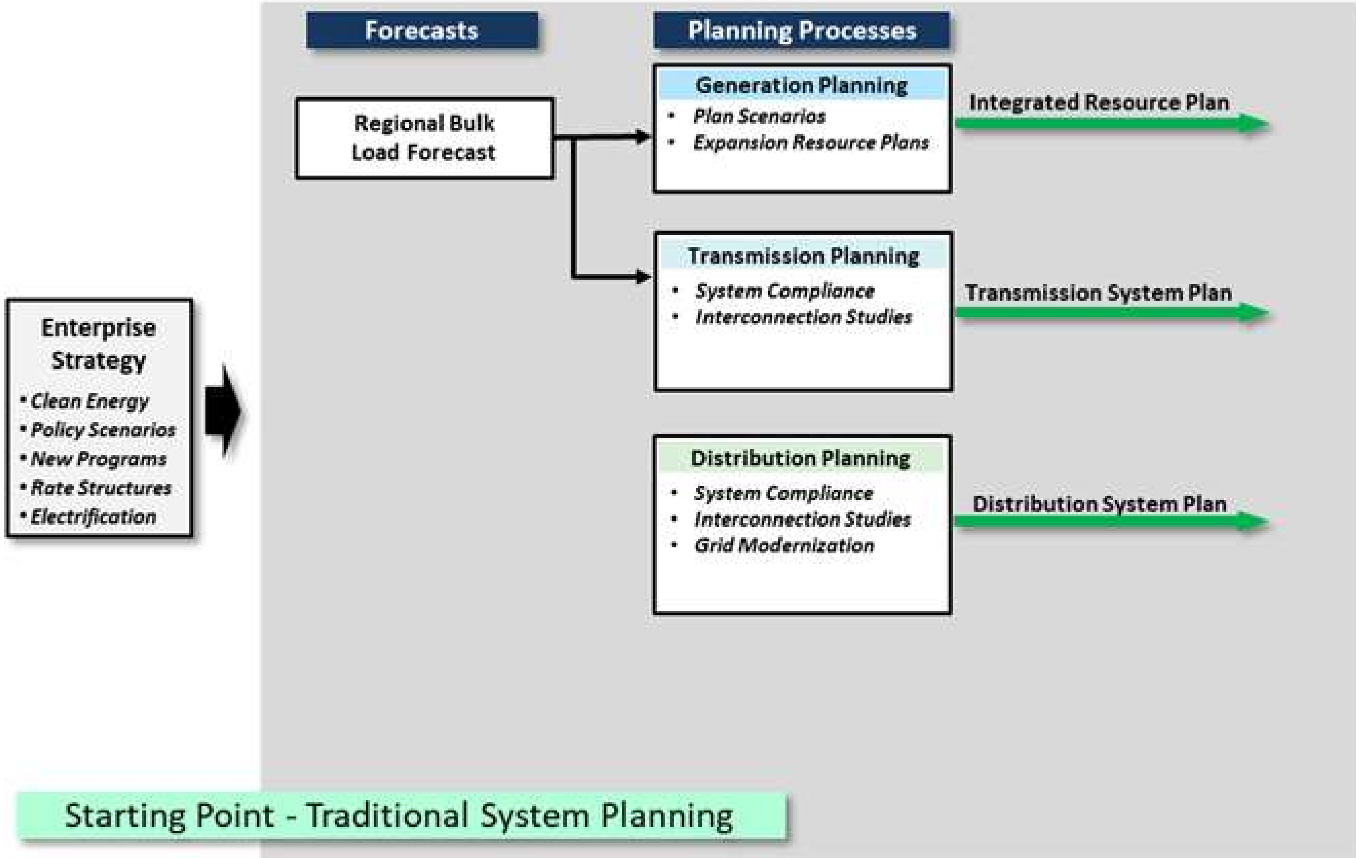
Demand Side

- Evolving customer needs and expectations
- Future perspective on load-modifying resources and programs
- Insights on locations for resources

Grid Implications

- Informed view of distributed resources and capabilities operating on the system
- Grid configurations and capabilities needed to support envisioned fleet transition and future operations

ISOP - Aligning and Linking Process, Tools and Data



Traditional Planning

Integrated Resource Planning

- System load forecasts
- System resource needs
- DSM/EE programs
- Retirement Studies

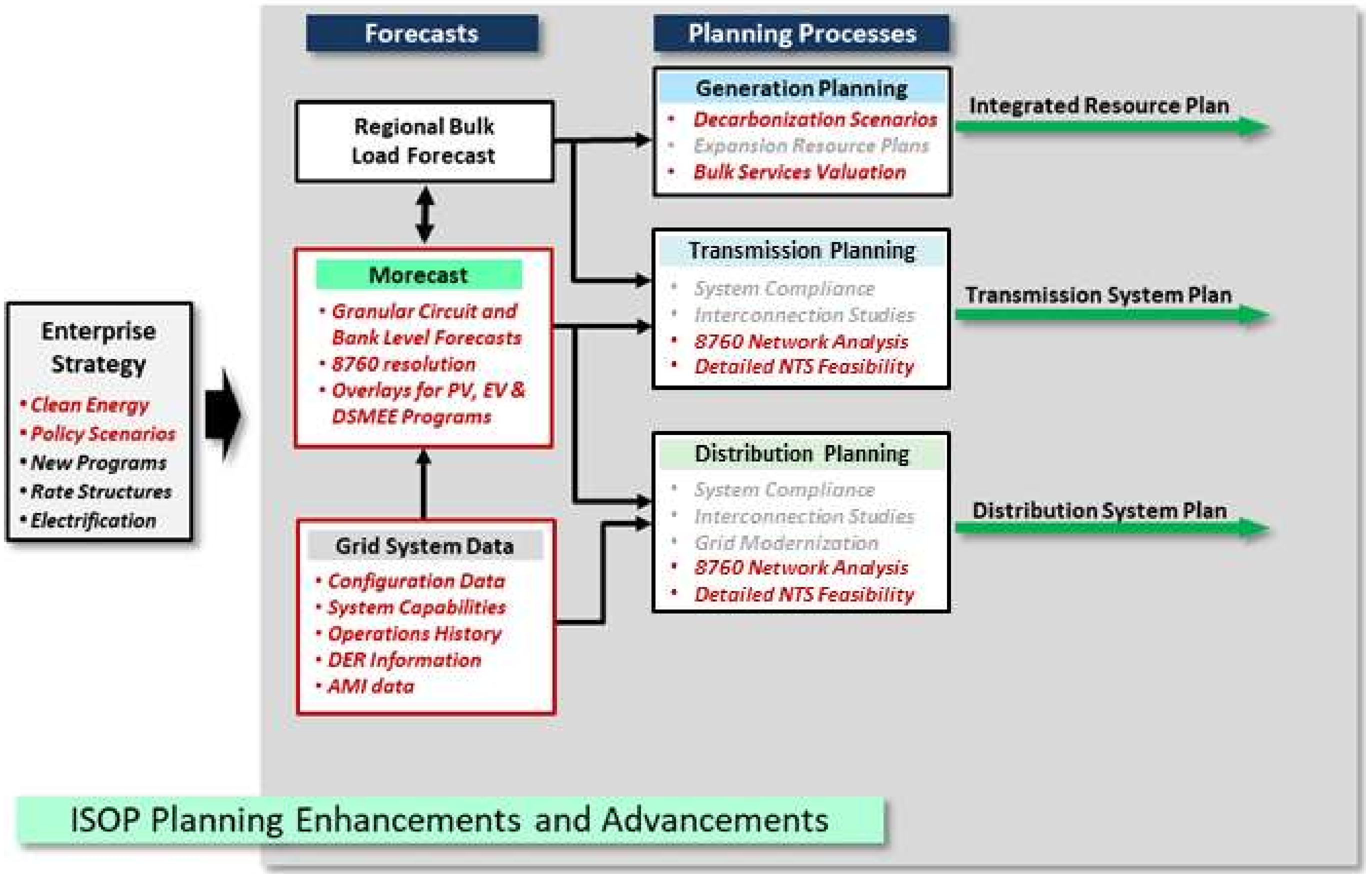
Transmission Planning

- TPL Compliance
- Interconnection
- Retirement Studies
- Operational Needs

Distribution Planning

- System peak analysis
- Interconnection
- Grid modernization

ISOP - Aligning and Linking Process, Tools and Data



Planning Enhancements

Integrated Resource Planning

- Decarbonization Scenarios
- Operational Detail
- Valuation of Bulk Services

Grid System Data

- Critical Configuration Data
- GIS, Ratings, Ops History

Morecast Circuit Level Forecast

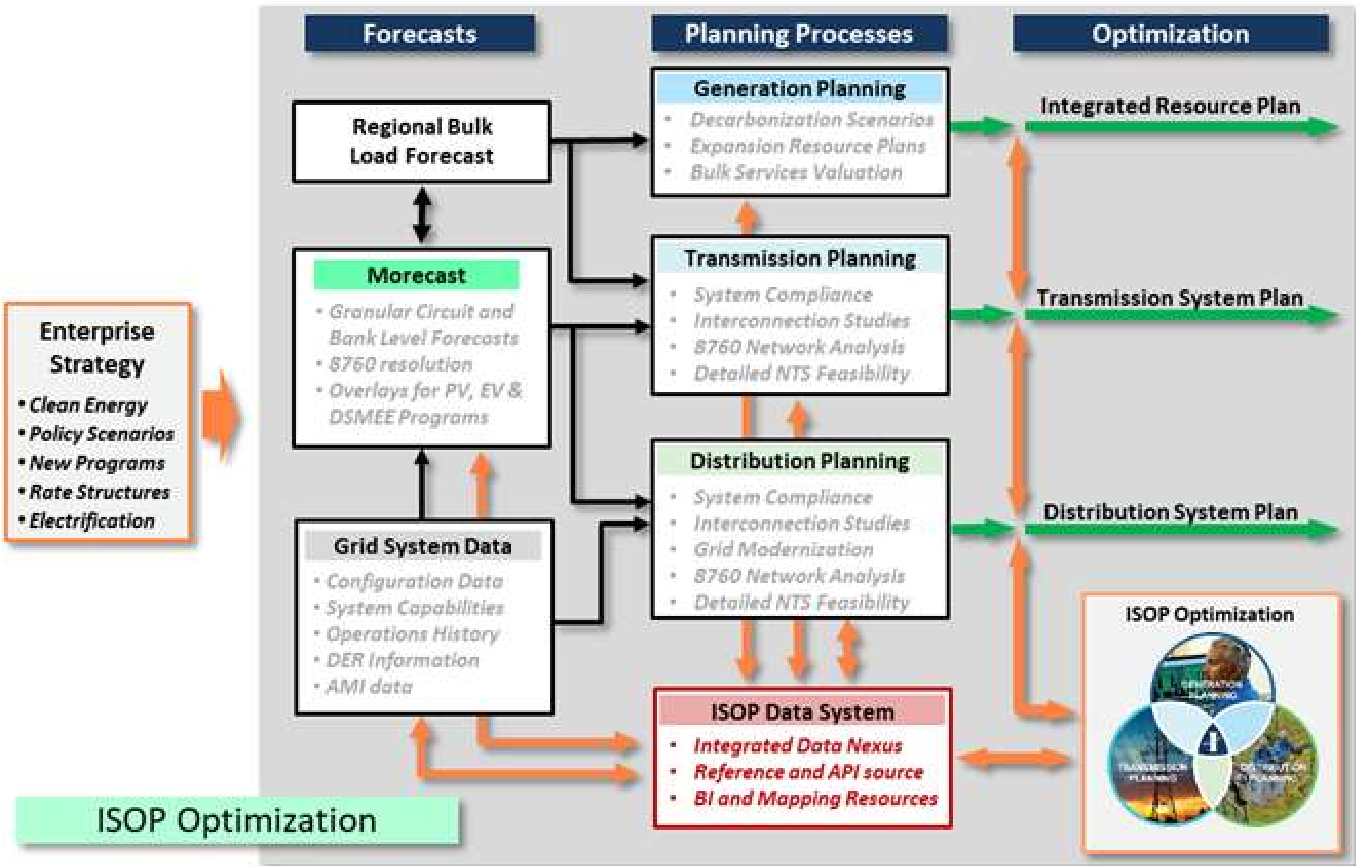
- 8760 Load Forecasts
- Scenarios, DER Overlays

Enable Advancements

Transmission Planning
Distribution Planning

- 8760 Load Flow Analysis
- NTS Screening, Studies

ISOP - Aligning and Linking Process, Tools and Data



ISOP Optimization

- *ISOP = Collaboration*
- Data infrastructure to support integration

Also addressing ...

- Tools for Screening & Visualization
- Tabletop Learning Process
- Performance metrics and comparative measures
- Synchronizing timelines

ISOP Development - Granular Load Forecasting

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Weather
Historical and "normal" temperatures

Economic Variables
GDP, Business GDP, Population, Housing, Income, Employment

Load History
Metered Circuit data with adjustments for impacts from DR, EV & PV

Customer Demographics
Types of customers, number of customers, etc.

Energy Dynamics Segments
Customer's attitude towards energy

Morecast: New internal tool being developed to provide 10-year hourly (8760) forecasts at the circuit level

- *Morecast is a critical input to the advanced distribution planning tools being developed*
- Bottom-up feeder-level forecasts inclusive of DERs, EVs and customer programs (gross and net load)
- Load forecasters and distribution planners collaborating to produce informed forecasts
- Increasing availability of AMI data will influence and enhance the process

Morecast – Carolinas System

Model Development
Critical Data Integration

Oct'20
Testing & Partial Scale Release

Sep'21
Full Release

2022+
Upgrades & Future Releases

ISOP Development – Advanced Distribution Planning (ADP)

Integrating sophisticated granular load forecasts

- Current 3-5 year window evolving to 10 years
- New capabilities for multiple planning scenarios

New power flow resolution

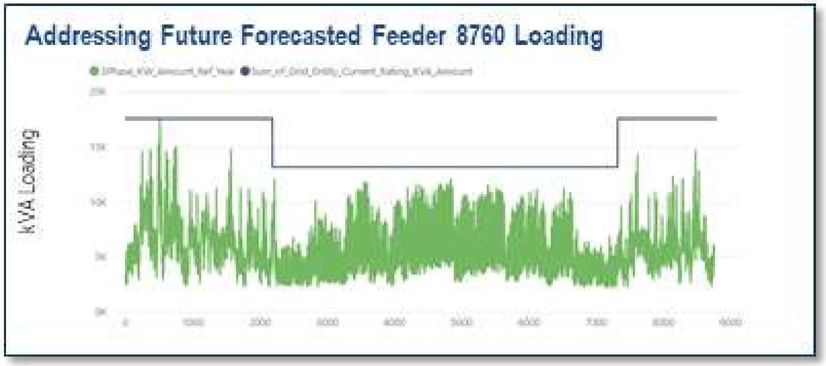
- From peak hour assessment to 8760 assessment

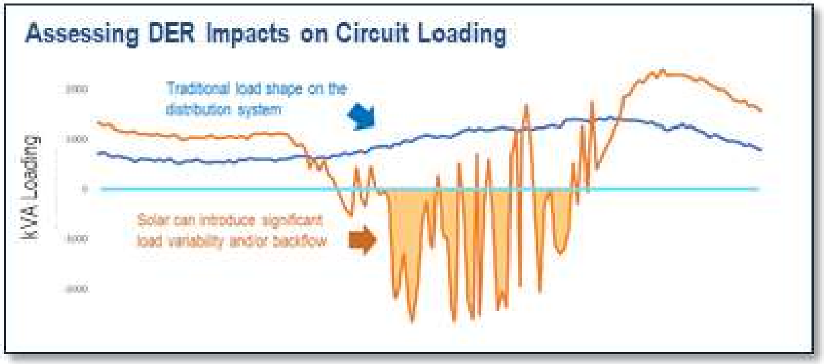
Assessment of new solutions

- DERs including battery storage systems
- Capture benefits of D-sited options for G and T

Integration and automation of new tools and data

- New server based power flow models and integration
- Supports more complex planning for a dynamic grid
- Tools and processes will evolve as planning needs change

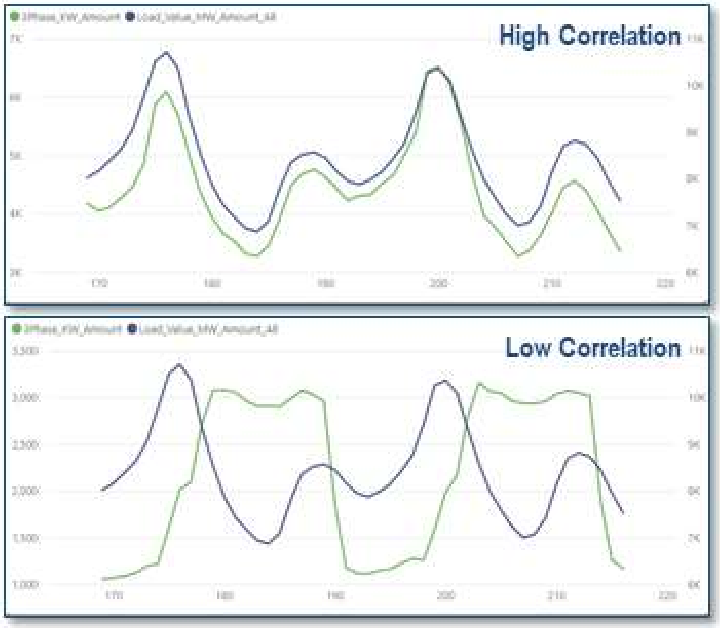




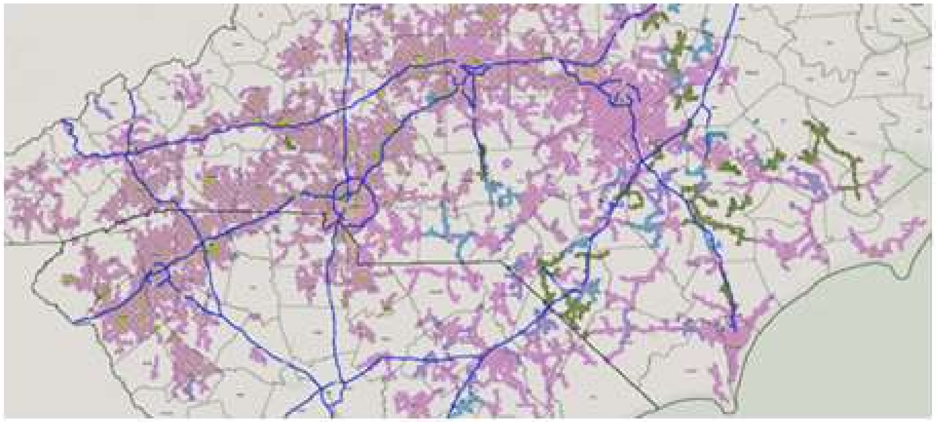
New Advanced Distribution System Planning Applications

ISOP Data System Applications

Circuit Correlation for NTS Screening



Circuit Headroom *(Illustrative view for Carolinas)*



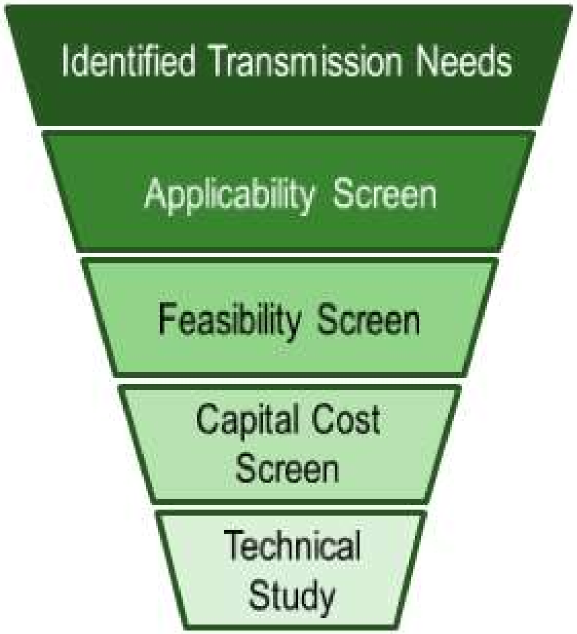
Distributed Generation (DG) Guidance Map

Provides a geographical visualization of the distribution system in a manner consistent with the "Method of Service Guidelines" to inform siting of future distributed generation.

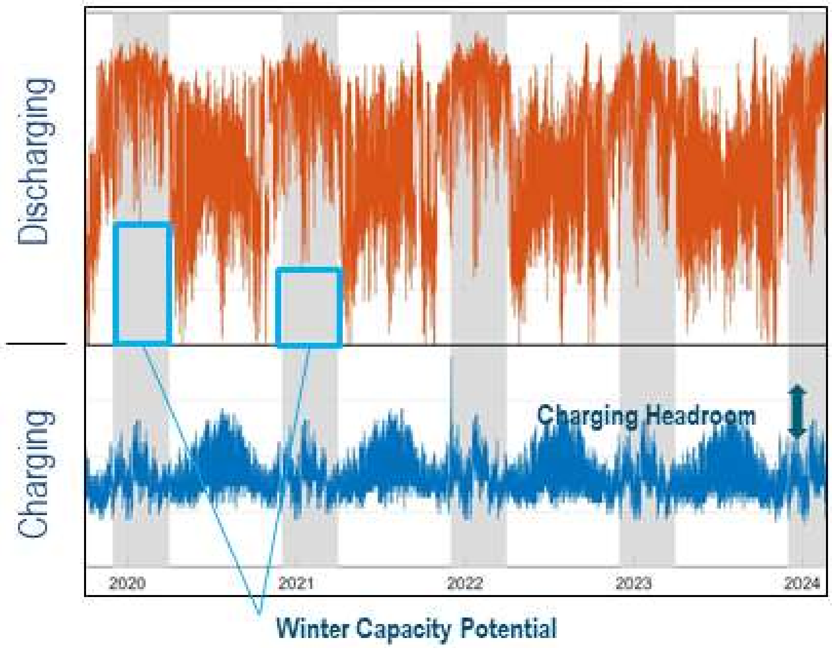
Advanced applications for Distribution Planning to assess dynamic grid operations and increasing DER saturation

New Transmission System Planning Applications

Screening for NTS Opportunities



8760 Power Flow Modeling *(Illustrative Battery Analysis)*



Advanced applications for Transmission Planning to assess dynamic grid operations and storage potential

ISOP Applications – Portfolio Screening Tool (PST)

Design Objectives

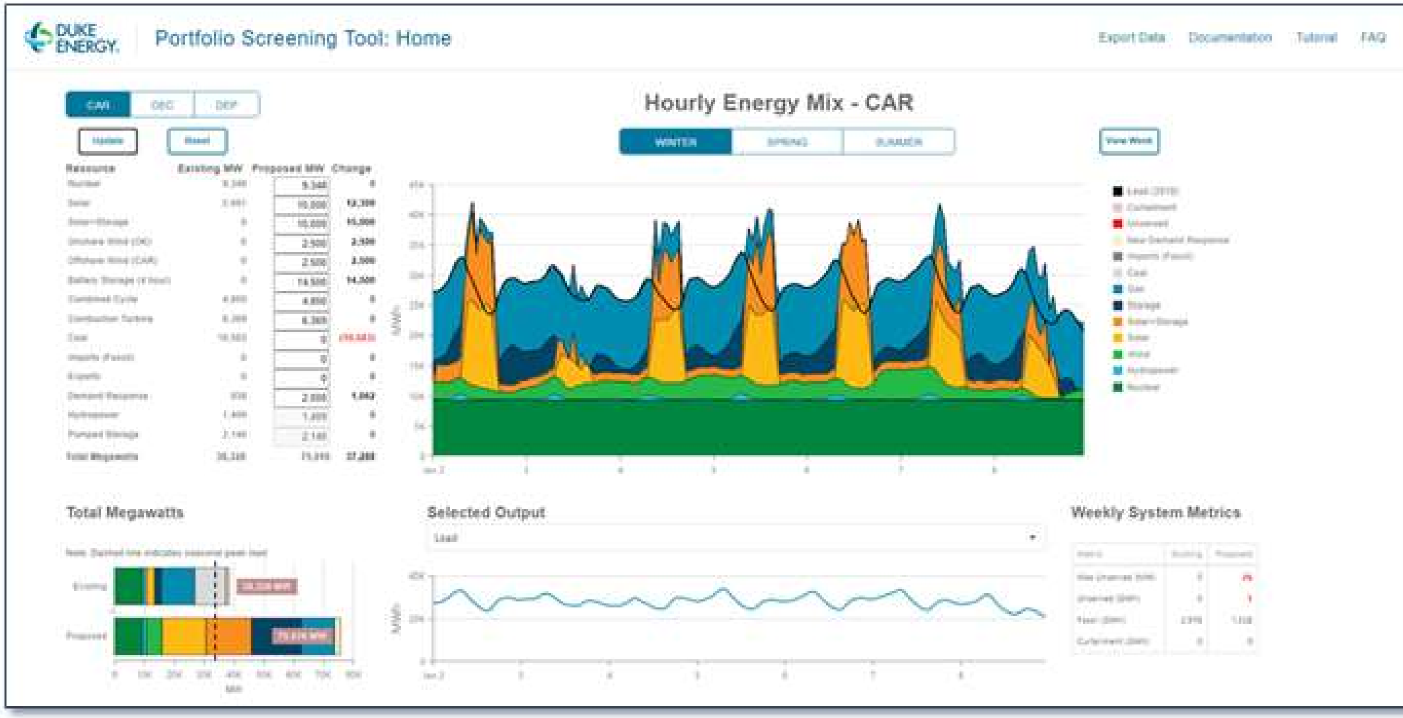
Simplicity, clarity, transparency

- *No economics*
- *Few operational constraints*
- *Historical data*
- *Full documentation of inputs, outputs, methods*

User-defined resources

Load being served over challenging 7 day periods

Note: The PST is not a planning model



PST is a stakeholder focused application for visualizing future energy portfolio mixes which is being shared publicly

Notes on ISOP's path forward

- Introduce ISOP elements to complement the 2022 IRP process in the Carolinas
- Continue to engage stakeholders in the Carolinas on development progress (https://www.duke-energy.com/our-company/isop)
- Continue to engage with industry peers and SMEs and benchmark against new practices in other regions
- Implement new components of the planning framework as capabilities mature
- Expand ISOP into other regions as our capabilities evolve
- Support regulatory policy initiatives in the regions we serve

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Integrated System & Operations Planning
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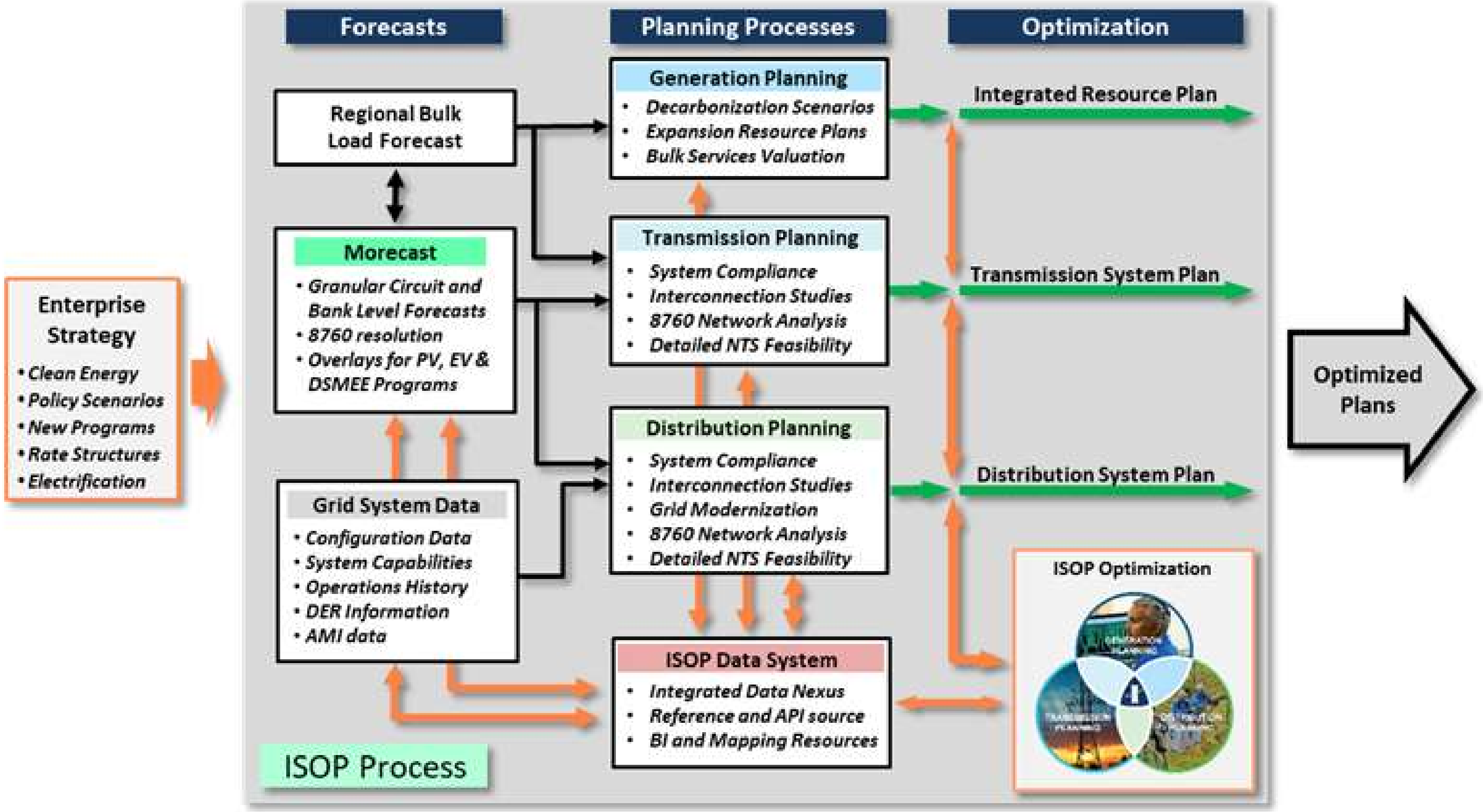
Duke Energy ISOP Portal: https://www.duke-energy.com/our-company/isop

ISOP Overview



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Making the Most of Michigan's Energy Future

30 Minute Lunch Break

Please mute your microphone and turn off your camera during break.

Michigan Public Service Commission

MI POWER GRID

Making the Most of Michigan's Energy Future

Andrew Williamson

Indiana Michigan Power Company

MPSC

Michigan Public Service Commission

Indiana Michigan Power
Michigan Executive Directive 2020 – 10

November 6, 2020

Andrew J. Williamson
I&M Director of Regulatory Services



BOUNDLESS ENERGY™

INDIANA MICHIGAN POWER
An AEP Company

Overview

- Fully integrated, multi-jurisdictional utility energy company
- ~ 600,000 retail customers in Michigan and Indiana
  - Indiana: ~472,000
  - Michigan: ~130,000
- ~390 MW of long-term full requirements wholesale contracts
- Part of the American Electric Power system
- Member of PJM Interconnection, LLC (PJM)
- Total-company Integrated Resource Planning process
  - Supports resource transformation, diversity, adequacy, and economies of scale
- 100% carbon-free generation in Michigan

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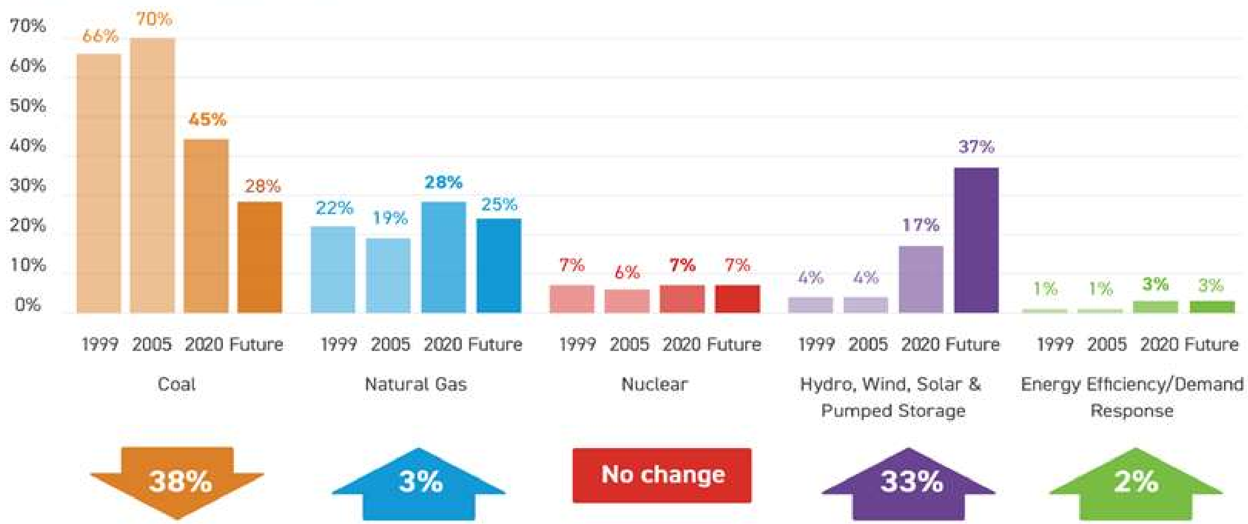
MPSC

INDIANA MICHIGAN POWER

An AEP Company

AEP Alignment with ED 2020-10

TRANSFORMING OUR GENERATION FLEET— AEP'S GENERATING RESOURCE PORTFOLIO



As of March 31, 2020. Future includes IRP forecasted additions and retirements through 2030.
Energy Efficiency/Demand Response represents avoided capacity rather than physical assets.

AEP's Carbon Reduction Goals: 70% by 2030; 80% by 2050

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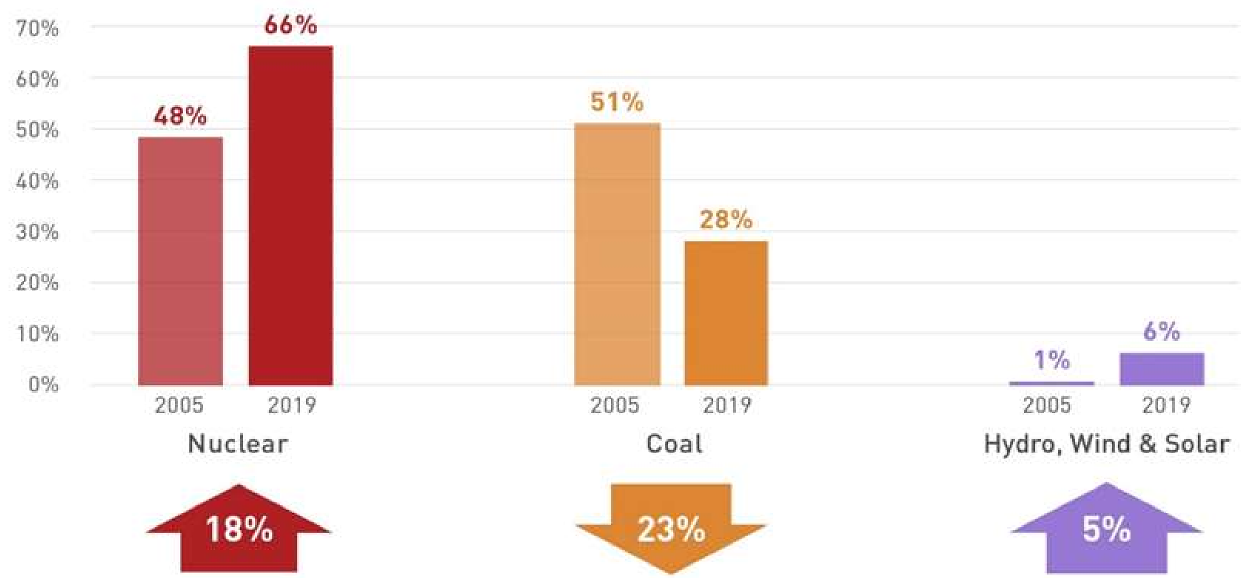
I&M Generation Transformation

I&M's TRANSITIONING GENERATION - MWH ENERGY PRODUCTION



I&M is Undergoing Just Transition of its Generating Resources

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Key Considerations and Recommendations

- Maintain single IRP for multi-state companies
  - Comprehensive stakeholder process in which ELGE can actively participate
  - Consistent scenarios and planning horizon
  - Opportunity for supplemental information in Michigan filing
- Clarify application of ED 2020-10 to the IRP process
  - Only applicable to in-state resources
  - What if goal is already achieved
- Recognize need for future dispatchable generation
  - IRP conducted every three years
  - Potential for changes in technology and fuel sources

Stakeholder Process Appropriate Forum to Consider Input about Healthy Climate Plan

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MI POWER GRID

Making the Most of Michigan's Energy Future

Douglas Jester

Joint Commenters

Ecology Center, ELPC, MEC, NRDC, Sierra Club, UCS, Vote Solar

MPSC

Michigan Public Service Commission

Sketch for Construction of IRP Scenarios Reflecting ED 2020-10

Presented to MPSC "Advanced Planning" Workgroup on behalf of Ecology Center, ELPC, MEC, NRDC, Sierra Club, UCS, Vote Solar

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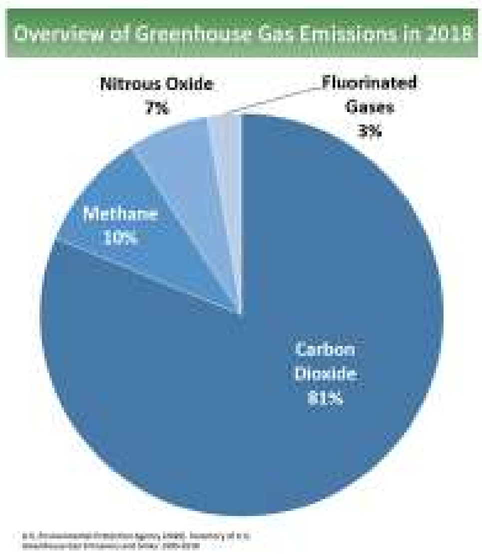
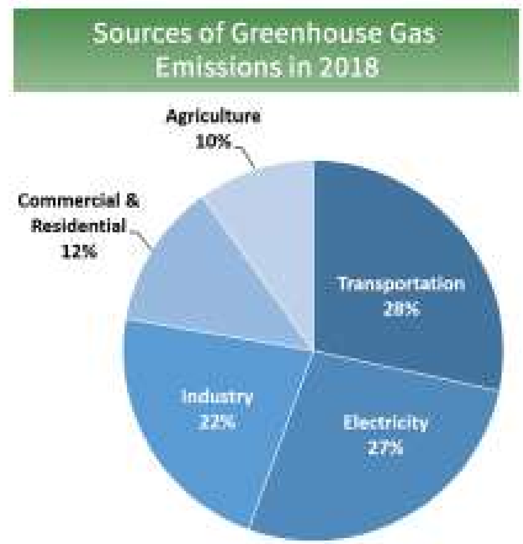
Responsibilities of MPSC and EGLE Under ED 2020-10

- Summarizing,
  - EGLE to support climate council work, which will develop GHG inventory and recommendations to reach economy-wide net zero by 2050. This will take time and can inform future MPSC IRP scenario development. EGLE to consider climate justice in climate plans but also environmental justice in IRP reviews.
  - MPSC to establish IRP scenarios that reflect ED 2020-10 and EO 2020-182. These must reflect economy-wide net zero by 2050. This is NOT explicitly based on EGLE work, but should be informed by it.
  - MPSC to consider environmental justice in reviewing IRP. If IRP decisions are to reflect environmental justice, then it behooves MPSC and utilities to consider environmental justice in IRP analyses. EGLE tool will be available circa January 2020.
  - MPSC should consult EGLE now, but must develop its own IRP guidance and cannot wait for recommendations from EGLE or the Council on Climate Solutions.

GHG Emissions are Mostly from Fossil Fuel Combustion for Energy





Emissions of nitrous oxides and methane from agriculture will be particularly challenging to eliminate. Converting methane to carbon dioxide through energy production may be partial solution. Energy transition to eliminate GHG emissions must be comprehensive to reach net zero emissions by 2050.

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Emissions Scope for Governor's Directive

- Sustainability programs often discuss emissions scope
  - Scope 1: All Direct Emissions from the activities of an organization or under their control. Including fuel combustion on site such as gas boilers, fleet vehicles and air-conditioning leaks.
  - Scope 2: Indirect Emissions from electricity purchased and used by the organization. Emissions are created during the production of the energy and eventually used by the organization.
  - Scope 3: All Other Indirect Emissions from activities of the organization, occurring from sources that they do not own or control. These are usually the greatest share of the carbon footprint, covering emissions associated with business travel, procurement, waste and water.

Emissions Scope for Governor's Directive

- What should MPSC address?
  - When we approach zero net emissions economy-wide, there are no scope 2 or 3 emissions, so it is sufficient to focus on scope 1 emissions
  - Strategies to eliminate emissions from other energy sources inevitably lead to substantial, perhaps complete, electrification that should be included in electricity demand forecasts
  - Governor's directive addresses Michigan, so in some scenarios there may be imports from outside Michigan that produce scope 2 and 3 emissions
  - Electricity is the only form of energy where the location of emissions can substantially differ from the location of energy use
  - Michigan is trying to lead, not control other jurisdictions and trade is inevitable.
  - As a practical but meaningful approach, **we recommend that MPSC address Scope 1 emissions economy-wide within Michigan and Scope 2 emissions for utility imports of electricity and other energy from outside Michigan.**

What is the role of GHG offsets?

- Offsets have traditionally included emissions reductions outside the scope of regulations or voluntary commitments.
- When we approach zero net emissions economy-wide, there are no out of scope emissions reductions.
- In the long run, potential offsets are limited to carbon sequestration. Potential carbon sequestration using known methods is small relative to carbon emissions and should be reserved for offsetting emissions that are truly difficult to reduce. **We recommend that the Commission not consider carbon offsets for electric power generation in IRPs.**

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Michigan Energy-Related CO2 Emissions Baseline

Michigan Carbon Emissions 2005 (million metric tons)	Residential Sector	Commercial Sector	Industrial Sector	Transportation Sector	Electric Power Sector	All Sectors
Coal	0.0	0.3	7.3	0.0	67.8	75.4
Petroleum Products	4.6	0.9	5.8	53.8	0.8	65.9
Natural Gas	19.3	9.4	12.0	1.5	7.0	49.2
Total	23.9	10.6	25.1	55.3	75.6	190.5

Michigan Carbon Emissions 2017 (million metric tons)	Residential Sector	Commercial Sector	Industrial Sector	Transportation Sector	Electric Power Sector	All Sectors
Coal	0.0	0.0	5.0	0.0	42.6	47.6
Petroleum Products	2.3	1.6	3.3	48.4	1.3	56.9
Natural Gas	16.6	9.0	9.7	1.1	11.7	48.1
Total	18.9	10.6	18.0	49.5	55.6	152.7

Michigan Carbon Emissions 2017-2005 (% change)	Residential Sector	Commercial Sector	Industrial Sector	Transportation Sector	Electric Power Sector	All Sectors
Coal		-89%	-32%		-37%	-37%
Petroleum Products	-49%	78%	-43%	-10%	63%	-14%
Natural Gas	-14%	-4%	-19%	-27%	67%	-2%
Total	-21%	0%	-28%	-10%	-26%	-20%
				Further reduction by 2025 (MMT)		-15.5
				% Reduction 2017-2025		-10.2%

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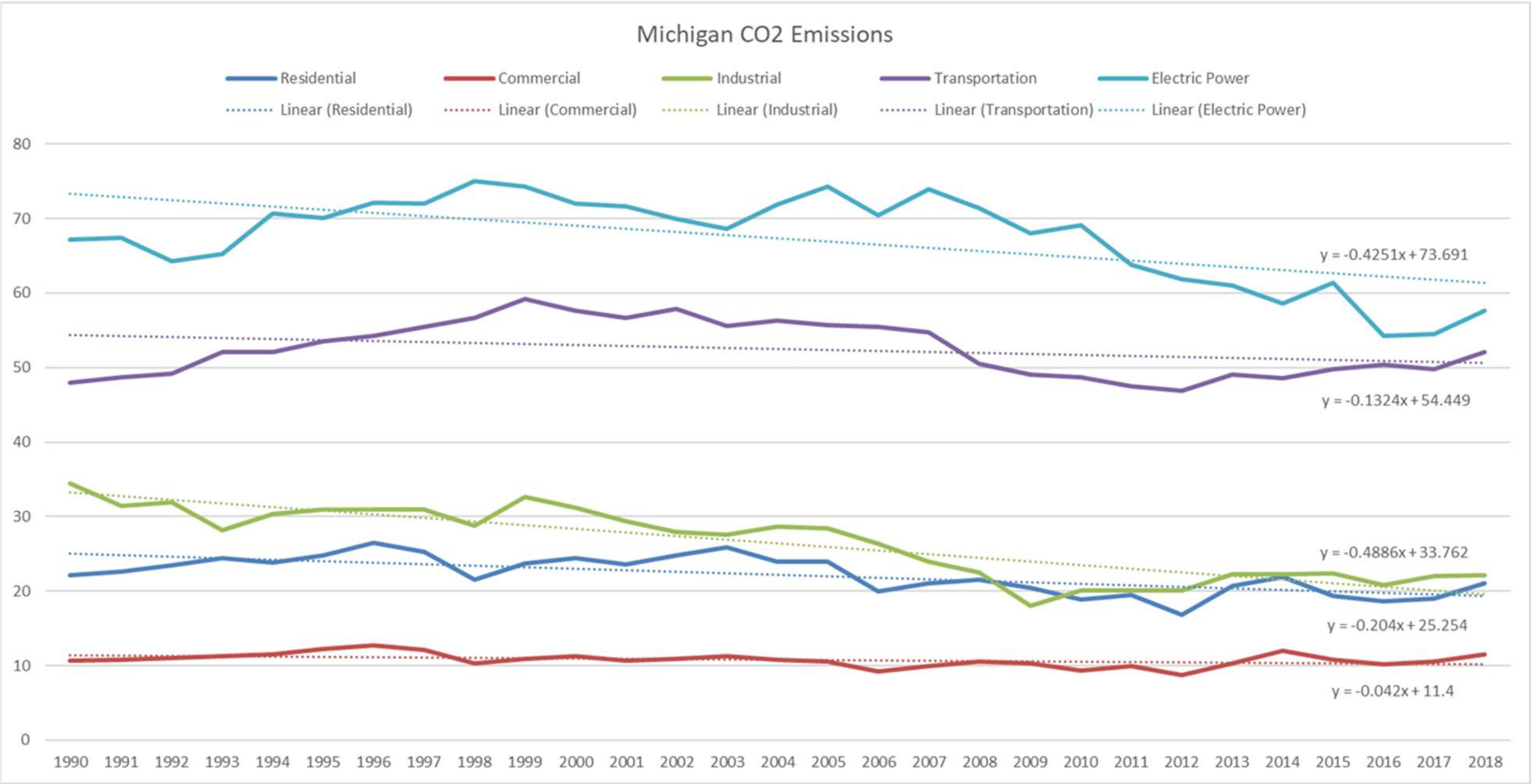
What are the trends?



How do we reach 28% economy-wide CO2 reduction by 2025?

- Although long-term trends are declining CO2 emissions in all sectors, only Electric Power was changing significantly in the last decade.
- Building shell and HVAC equipment, and vehicles are long-lived and turn over slowly, so there is no basis to project significant improvements by 2025 based on new policy.
- If other sectors don't improve over 2018, Electric Power needs to reduce CO2 emissions to about 37 MMT in 2025, a 21 MMT reduction from 2018. If other sectors improve at the rate of long-term trends, Electric Power needs to reduce CO2 emissions to 44.4 MMT, a 13.2 MMT reduction. 2018 Electric Power emissions were 57.6 MMT.*

*These calculations need to be redone, presented and vetted before adoption. There are small differences between data sources that are nonetheless important to resolve.

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How do we reach 28% economy-wide CO2 reduction by 2025?*

- Achieving 8 MMT emissions reductions in non-power sectors by 2025 likely includes:
  - 2% gas EWR programs
  - Restoration of CAFÉ standards
  - 8% of vehicle sales are electric by 2025 (we are currently at about 0.8%)
  - 100% electrification of 1% of buildings
- Achieving a 13.2 MMT carbon emissions reduction from the Electric Power sector likely includes retiring Erickson, Campbell 1 and 2, and one Belle River unit before 2025, replacing them with EWR (at about 1.75%), renewables (at about 25%), and load management/demand response.
- Achieving a 21 MMT carbon emissions reduction from the Electric Power sector likely also requires retiring the other Belle River unit, EWR at 2% and pushing renewables to 30% by 2025.

*These calculations need to be redone, presented and vetted before adoption. There are small differences between data sources that are nonetheless important to resolve.

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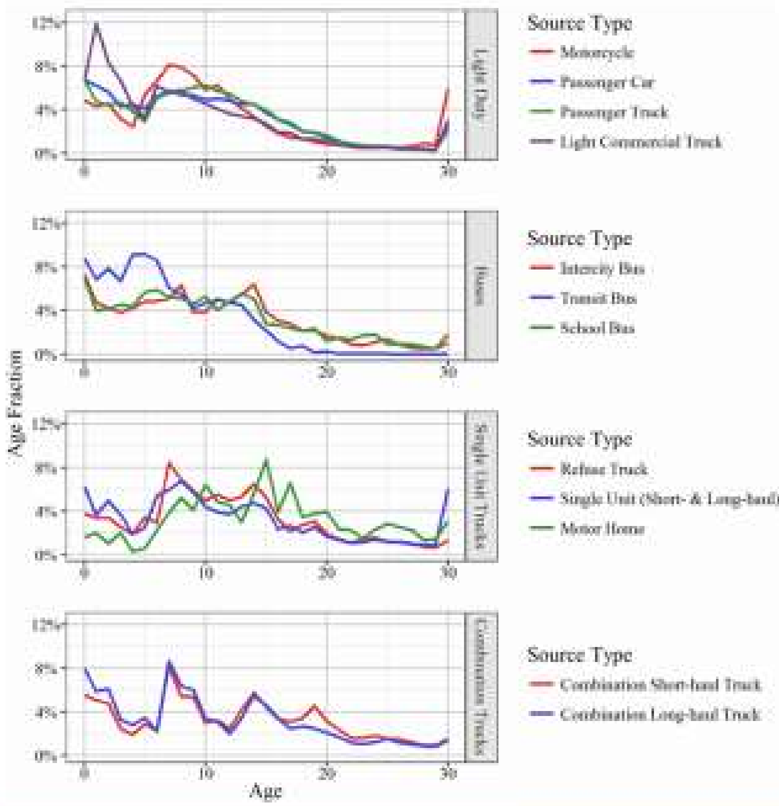
How do we decarbonize power sector by 2050?

- Retire all fossil fuel generation by 2050 and replace with carbon-free resources
  - All generation must be carbon-free by 2050.
  - All fossil assets must be considered for retirement in IRP analyses.
  - Revenue requirements for new fossil-fueled generation options in IRP must assume depreciation by 2050
  - Revenue requirements for maintenance investment in existing fossil-fueled generation must assume depreciation by 2050 or projected retirement, whichever is first. Retirement analyses must reflect this.

How do we decarbonize transportation by 2050?

- Fuel efficiency is not sufficient, carbon-free propulsion energy is necessary
- Biomass-based fuels should not be double-counted and quantitatively are limited to small niches
- Carbon-free propulsion using hydrogen or synthetic liquid fuels will based on electric energy or equivalent solar energy
- Recommendation: Assume electrification of all transportation

How do we decarbonize transportation by 2050?



These are age distributions, but you can approximately infer life distributions. Average scrappage age for Light-Duty Vehicles is 15.6 years, for Buses is 14.7 years, for Single-Unit Trucks is 18.2 years, for Combination Trucks is 20.1 years.

Carbon-free vehicles by 2050 requires either fast ramp-up or stranded costs post 2050. Recommendation: Assume all-electric vehicle sales by 2035 with S-curve ramp-up by then.

Transportation Electrification Calculations

Motor Gasoline		
Michigan		
Quantity	Units	Notes
96,214,894,000	miles	Michigan non-commercial VMT (MDOT, 2018)
531.6	tBtu	Michigan motor gasoline consumption excluding ethanol (US EIA, 2
120,286	Btu/gallon	Motor gasoline conversion factor (US EIA)
4,419,466,987	gallons	2018 MI motor gasoline (assuming all non-commercial VMT)
2.50	$/gallon	Assumed average gasoline retail price
20.78	$/MMBtu	
11,048,667,348	$	MI annual spending on gasoline
0.115	$/mile	MI average gasoline cost per mile
0.30	kWh/mile	Assumed EV electricity use per mile
		Note: Roughly 85% of EV charging is residential
3.412	MMBtu/MWH	Conversion factor
42.35	$/MWH	MI average electric G&T $/MWH (DTE and CE PSCR data)
12.41	$/MMBtu	MI average electric G&T $/MMBtu
154.67	$/MWH	MI residential $/MWH (US EIA, 2018)
45.33	$/MMBtu	MI residential $/MMBtu
0.01	$/mile	MI EV cost per mile (at G&T unit cost)
0.05	$/mile	MI EV cost per mile (at residential sales per MWH)
1,222,545,125	$	MI annual spending on EV electricity (at average G&T $/MWH)
4,464,398,932	$	MI annual spending on EV electricity (at average residential $/MWH
3.412	MMBtu/MWH	Conversion factor
28,864,468	MWH	MI annual increment of electricity for EVs
98,485,565	MMBtu	MI annual increment of electricity for EVs
111,571,499	MWH	MI annual electricity sales (US EIA, 2018)
0.259		MI EV increment/electricity sales

This is a sample calculation of the kinds that will be needed for each vehicle class and fuel type. This calculation is for complete electrification of gasoline vehicles but in electricity demand forecasts will need to follow the vehicle fleet makeup.

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How do we decarbonize heating by 2050?

18.9 MMT CO2 in 2017

Residential Heating Fuel Usage	Space heating[3]	Water heating	Other[4]
	77%	19%	4%

Efficiency & Electrification

10.6 MMT CO2 in 2017

Commercial Heating Fuel Usage	Space heating	Water heating	Cooking	Other
	78%	12%	8%	2%

Efficiency & Electrification

18.0 MMT CO2 in 2017

Industrial Sector Heating Fuel Usage	Heating Fuel %	Cumulative Heating Fuel %
Ethyl Alcohol	18.7%	18.7%
Iron and Steel Mills and Products	16.1%	34.8%
Food	14.6%	49.3%
Fabricated Metal Products	10.6%	60.0%
Petroleum Refineries	7.4%	67.3%
Paper and Wood Products	5.7%	73.0%
Nonmetallic Mineral Products	4.9%	77.9%
Transportation Equipment	4.1%	82.0%
Machinery	2.7%	84.7%
Plastics and Rubber Products	2.2%	86.9%
Alumina and Aluminum	2.1%	89.0%
Nitrogenous Fertilizers	2.0%	91.1%
Glass	2.0%	93.1%
Building Materials	1.6%	94.7%
Other	5.3%	100.0%

Efficiency, Recycling, Substitution, & Electrification

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How do we decarbonize building heating by 2050?

- Heat pumps are now the technology of choice for electric heating both space and water. Heat pumps can be geothermal, well water, air source, and can be deployed per building or as district heating or district geothermal
- Average HVAC and water heating equipment life is about 15 years, so as with transportation we should assume 100% electric equipment sales by circa 2035
- Adoption from now to 2035 should begin with switching from propane to electric, then progress to switching from gas. Renewable natural gas and hydrogen are alternative delivery methods but in a decarbonized economy will need to be produced from electricity or equivalent solar technologies
- Efficiency measures such as shell improvements that reduce the need for heat will make electrification cheaper but need not be treated as a prerequisite of electrification

Building Heating Electrification Calculations

Residential Propane		
Michigan		
Quantity	Units	Notes
91,452	Btu/gallon	Propane conversion factor (US EIA)
[illegible]	gallons	MI 2017 residential propane consumption (source: https://www.propane
[illegible]	MMBtu	MI 2017 residential propane consumption
		Note: assume all residential propane is for heating
0.85		Assumed average furnace efficiency
28,528,451	MMBtu	MI annual heating demand
1.74	$/gallon	Assumed average retail price of propane
19.04	$/MMBtu	Average retail price of propane
538,347,000	$	MI annual spending on residential propane
2.0		Assumed heat pump coefficient of performance (COP)
3.412	MMBtu/MWh	Conversion factor
14,264,226	MMBtu	MI annual heating demand, heat pumps
4,180,605	MWh	MI annual increment of electricity for heat pumps
42.35	$/MWh	MI average electric G&T $/MWh (DTE and CE PSCR data)
12.41	$/MMBtu	MI average electric G&T $/MMBtu
154.87	$/MWh	MI average residential $/MWh (US EIA, 2018)
45.33	$/MMBtu	MI average residential $/MMBtu (US EIA, 2018)
177,066,177	$	MI annual spending on heat pump electricity (at average G&T $/MWh)
646,603,615	$	MI annual spending on heat pump electricity (at average residential $/MW
0.30		EE Scenario: heating energy savings from building improvements
19,969,916	MMBtu	MI annual heating demand (EE Scenario)
23,494,019	MMBtu	MI residential propane sales (EE Scenario)
447,282,900	$	MI annual spending on residential propane (EE Scenario)
9,984,958	MMBtu	MI annual heating demand, heat pumps (EE Scenario)
2,926,424	MWh	MI annual increment of electricity for heat pumps (EE Scenario)
123,947,724	$	MI annual spending on heat pumps (at average G&T $/MWh; EE Scenario)
452,622,630	$	MI annual spending on heat pumps (at average residential $/MWh; EE Scen
111,571,489	MWh	MI annual electricity sales (US EIA, 2018)
0.037		MI electricity for heat pumps/total electricity sales
0.026		MI electricity for heat pumps/total electricity sales (EE Scenario)

This is a sample calculation of the kinds that will be needed for each heating fuel and heat pump type. This calculation is for complete electrification of residential propane but electricity demand forecasts will need to track projected adoption.

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How do we decarbonize industrial heating by 2050?

- Electrifying transportation will largely eliminate demand for petroleum products and will likely reduce use of ethanol as a transportation fuel
- Ethanol and other biomass processing may replace petroleum as chemical feedstock (which will largely make biomass unavailable for energy products)
- Recycling primary materials can reduce energy requirement
- Equipment life, process substitution to reduce heating requirement or to electrify will vary by industry
- Recommendation: **Develop industry-specific electrification and electricity demand forecasts**

Summary of Recommendations

- This presentation was only a sketch. IRP scenarios will need vetted calculations and additional details about assumptions, etc.
- Realistically meeting 28% economy-wide carbon emissions reduction from 2025 by 2025 requires power generation to achieve about a 36% carbon emissions reduction from 2018 by 2025.
- Achieving economy-wide net zero GHG emissions by 2050 requires zero-emissions power sector and nearly complete electrification of both transportation and buildings and substantial electrification of industrial heat. Electrification by 2050 requires all-electric equipment sales by about 2035, ramping up to that from 2020.
- MPSC IRP scenarios should incorporate these assumptions about power generation and load growth.

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Making the Most of Michigan's Energy Future

Naomi Simpson

MPSC Staff

Workgroup Timeline for ED 2020-10

MPG Advanced Planning, Integration of GD&T Planning	
October 21	Staff presented Straw Proposal
November 6	Alternative Proposals were presented
November 17	Feedback due on all proposals
December 15	Staff will file its recommendation*
January 12	Stakeholder comments due in Case No. U-20633*

* Per Commission Order in Case No U-20633, October 29, 2020

Stakeholder Discussion

Staff clarification about its response to comments regarding:

The merits and challenges of using benefit-cost analyses to equitably compare resources, distribution and transmission alternatives.

After further review, Staff would like to provide clarification;

After the next round of utility distribution plans have been submitted in August 2021, there will be some additional discussion specifically addressing BCA coming from the MPG Distribution Planning efforts in U-20147.

Summarized Stakeholder Comments from 10/21 Meeting

In what ways could resiliency be addressed and modeled in an IRP?

- Start by clearly defining resiliency, establish the goals to be accomplished, and metrics by which to measure it.
- Quantitative and qualitative measures could be included in an analysis.
- May be best addressed in distribution planning processes.

Stakeholder Discussion

Commenters highlighted the need for a definition of *resiliency*.

- National Infrastructure Advisory Council's definition of resilience, adopted in 2009, is

  "the ability to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient infrastructure or enterprise depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event."

- NARUC defines resilience as

  "the robustness and recovery characteristics of utility infrastructure and operations, which avoid or minimize interruptions of service during an extraordinary and hazardous event."

Information obtained from Statewide Energy Assessment Report

Stakeholder Discussion

Commission's guidance in U-20147, pp 48-49.

- Agrees with DTE Electric on the description of resilience, in terms of the ability to restore power following a major catastrophic event.

- Commission also thinks about this term more broadly:
  - Planning to mitigate more localized, high-impact outages caused by equipment issues, access limitations, or system configurations that inhibit timely restoration or backup capabilities;
  - Resilience should consider the vulnerability of loads that would affect public health, safety, or security under an extended outage, and related mitigation strategies to ensure continuity of service;
  - Commission underscores the importance of robust, risk-based resilience evaluations and mitigation strategies as part of distribution planning efforts.

Stakeholder Discussion

With respect to ***resilience*** regarding aligning planning processes and reflecting that in the MIRPP/Filing Requirements;

- Is resilience accounted for in sensitivities analysis and risk assessment? If not, should it be and if so, how?
- Is resilience accounted for through the MISO planning process by meeting PRMR requirements? If not, should it be and if so, how?
- Is the N-1-1 planning criteria used in transmission planning useful for distribution planning?
- Should resiliency investments be identified in distribution planning feed into IRP or vice versa?
- What are the touchpoints between distribution planning and IRP that will align the processes when addressing resiliency?

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Summarized Stakeholder Comments from 10/21 Meeting

What specific externalities do stakeholders think should be addressed that are not currently addressed in the Michigan Integrated Planning Parameters (MIRPP) document? What specific changes to the MIRPP would address these externalities?

- Current requirements are adequate, and no changes are needed.
- Require an assessment of:
  - system weakness under various DER penetration scenarios;
  - the benefits of enhanced transmission capacity;
  - modeling to optimize system capability and investment.
- Require an *upfront* assessment of externalities in IRPs.

Stakeholder Discussion

Commenters identified the need to include externalities in planning processes.

Stakeholder Discussion

With respect to *externalities* regarding the MIRPP/Filing Requirements;

- To what extent do current scenarios, sensitivities, and risk address externalities?
- Does a probabilistic risk assessment play a role in addressing externalities?
- What externalities best lend themselves to a qualitative analysis?
- To what extent should the analysis of externalities influence the IRP filing? Transmission planning? Distribution planning?

Summarized Stakeholder Comments from 10/21 Meeting

What are appropriate ways to address the disconnect between resource needs in an IRP and future unknown resource locations? Are there studies that need to be performed, communication channels that need to be established, or other possible solutions?

- Flag locations that may no longer be optimal.
- Define scenarios that provide a range of possible outcomes instead of attempting to find the "right answer".
- This is not necessarily a "disconnect" because IRP resources are not definitive to a particular location. If system constrains are the driver, IRPs can identify these locations.
- Hosting capacity analysis (HCA) could be an answer and utilities are working on this through the August 20, 2020 order in U-20147.

Stakeholder Discussion

September 24th and October 21 comments identified the need to address Non-Wires Alternatives more specifically.

Staff Observations

- Utilities include resources that could be NWA's as resource alternatives for the IRP model to select.
- Often these resources are seen by the model as "buckets".
- In error, Staff inadvertantly did not include energy efficiency as a Non-Wires Alternative on October 21.
- NWAs are demand or supply-side resources, but those same resources are not necessarily NWAs unless they are targeted to defer a specific grid investment.

Stakeholder Discussion

With respect to *Non-Wires Alternatives* regarding the MIRPP/Filing Requirements and aligning planning processes;

- Do stakeholders agree that non-wires alternatives includes storage, solar, wind, demand response, CVR and *energy waste reduction*?
- Do stakeholders agree that a non-wires alternative is *location specific* and alleviates some *traditional investment* in a *targeted* geographic area?
- Juliet Homer's presentation identified several types of NWA analyses identifying benefits and costs across planning processes. Do stakeholders feel one planning process drives another when evaluating and selecting NWAs?

Feedback Request

1. Please provide comments about the Staff Straw Proposal and alternative proposals.
   - What is a reasonable path forward? ***Your feedback is critical!***
2. Please provide any comments related to the expert presentations from EPRI, Duke Energy, Dominion.

Stakeholder Feedback Requests

Please submit responses to the stakeholder feedback comments received to Danielle Rogers by **November 17.**

RogersD8@michigan.gov

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Making the Most of Michigan's Energy Future

Thank You

Upcoming Advanced Planning Stakeholder Meetings

November 18

December 16