The Duke Energy Indiana 2018 Integrated Resource Plan

July 1, 2019

Volume 2

2018 Duke Energy Indiana
Integrated Resource Plan
7.1.2019

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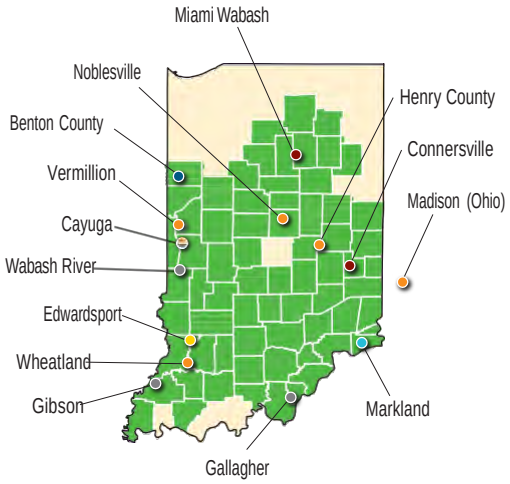
Duke Energy Indiana: an overview



SERVICE TERRITORY (counties served)

Duke Energy Indiana

TYPE OF POWER FACILITY

- Coal
- Syngas/Gas
- Gas CC/CT
- Oil CT
- Hydro
- Wind

As the state's largest electric utility, Duke Energy Indiana provides affordable, reliable and cleaner energy to approximately 840,000 residential, commercial and industrial electric customers.

- Serving customers in 69 of Indiana's 92 counties
- Service area spans 22,000 square miles across north central, central and southern Indiana
- Supporting cities such as Bloomington, Terre Haute and Lafayette
- Also serving suburban areas near Indianapolis, Indiana, Louisville, Kentucky and Cincinnati, Ohio
- Generating facilities capable of producing 7,188 megawatts of electricity
- Bringing power to our customers through 3,064 miles of transmission lines

Duke Energy Indiana is dedicated to strengthening the communities we serve. We work hard to develop clean and efficient energy sources and to help create jobs that bolster the local economy – helping to make this state a great place to live, work and play.

What is an IRP?

An IRP summary document, such as this one, helps our customers understand how we supply and deliver energy today – and how we will continue to enhance our service in the future.

Duke Energy Indiana's Integrated Resource Plan is a comprehensive planning document used to forecast customer demand for electricity and our response to those needs. Our goal is to provide affordable, reliable and cleaner energy for our customers today and in the future. The IRP is updated and submitted every three years with the Indiana Utility Regulatory Commission (IURC), and it outlines the processes, methods and forecasting models used to create the 20-year plan. The company's next IRP will be submitted in 2021.

With each IRP, we use current information to keep our long-term plan updated. When it is time to make a near-term decision, we gather the best available information to analyze for that specific decision in detail at that time. This two-level approach enables us to make the best decisions today and prepare for meeting customers' needs in the future.

Our public advisory process

Engagement process overview

- Involving stakeholders from the beginning of the IRP development
- Six stakeholder workshops
- Informative presentations and interactive workshop exercises
- Summaries on public IRP website at duke-energy.com/indiana/in-irp-2018.asp

As part of the public advisory process with our customers, Duke Energy Indiana conducted four stakeholder meetings to gather feedback and discuss the IRP process with interested parties. The four meetings and related activities are summarized below:

Stakeholder Meetings:

Meeting #1
- Review of 2015 stakeholder process and plan for 2015 process
- Modeling Energy Efficiency (EE) & Scenario planning

Meeting #2
- Resources discussion
- Modeling EE & Scenario planning

Meeting #3
- Scenario review
- Forecasted variables

Meeting #4
- Scenario discussion
- Portfolio development

Meeting #5
- Candidate portfolios
- Modeling results

Meeting #6
- Present Preferred Portfolio
- Lessons learned from 2018 stakeholder process

Materials covered and meeting summaries are posted on the company's website at **duke-energy.com/indiana/in-irp-2018.asp**

Forecasting future energy demand

To address future uncertainty, Duke Energy Indiana develops a comprehensive plan that includes development and analysis of different future scenarios. At the same time, the company must be flexible to adjust to evolving regulatory, economic, environmental and operating circumstances.

We used scenario analysis as part of this year's IRP planning process. Once we identified some key driving forces, including carbon pricing, environmental regulations and fuel prices, we discussed those pressures in our stakeholder meetings. The feedback gathered helped us develop five separate scenarios:

The first set of scenarios reflects the Core Scenarios:

Slower Innovation

- Technology progress more slowly than in the Reference case
- Extraction costs do not fall as quickly and as a result, coal and gas prices are higher than in the Refence case
- Higher fuel dampens economic growth
- No carbon tax/price or regulation

Reference Case with Carbon Tax

- Baseline forecasts for load, gas, coal and power
- Carbon tax $5/ton in 2025, rising $3/ton per year

High Technology

- Technology progress more quickly than in the Reference case
- Extraction costs fall more quickly and as a result, coal and gas prices are lower than in the Refence case
- Lower fuel increases economic growth
- Carbon tax $10/ton in 2025, rising $3/ton per year

The second set reflects the Stakeholder Inspired Scenarios:

Reference Case without Carbon Tax

- Reference Case with Carbon Tax assumptions except without CO2 tax

Current Conditions Continue

- Extrapolations of market curves for gas, coal and power
- Reference case load forecast
- No CO2 tax or regulation

Energy supply and capacity

Energy planning

We carefully consider which types of generating options we use because each source has its own set of advantages and disadvantages, ranging from costs and environmental attributes to reliability.

Because customers demand different amounts of energy depending on time of day and season, our generation portfolio requires a mix of resources that provides the flexibility needed to meet varying loads. These options include:

- Natural gas
- Renewable energy
- Hydroelectric power
- Biomass energy
- Nuclear
- Energy efficiency
- Demand-based service
- Customer-generated power

Ultimately, our energy portfolio includes a diverse mix of options to provide the most reliable, affordable and clean energy available to our customers.

Once the specific modeling assumptions for each scenario were determined, a capacity expansion model was used to optimize a portfolio for that scenario. Nine portfolios, organized in three groups, were evaluated to further increase the robustness of the planning analysis.

The first group of portfolios was developed as part of the optimization of the assumptions defined by the five scenarios.

Optimized Resource Plans:

1. Slower Innovation Portfolio- minimal near-term changes to fleet
2. Reference Case with Carbon Tax Portfolio- carbon tax drives a couple of coal retirements in 2020s; a CT and solar are added starting in the mid-2020s
3. High Technology Portfolio- a higher carbon tax and lower renewables cost cause a number of coal retirements in 2020's; a CC and solar are added starting in the mid-2020s
4. Reference Case without Carbon Tax Portfolio- minimal near-term changes to fleet
5. Current Conditions Continue Portfolio- minimal near-term changes to fleet

Energy supply and capacity

The second group was developed by evaluating the optimized portfolios for lessons learned as well as those from several key sensitivities.

Alternate Resource Plans:

6. Moderate Transition Portfolio- includes 3 coal unit retirements in the 2020s as well as a CC with solar and wind additions occurring in the mid/late 2020s
7. Aggressive Transition Portfolio- retires Cayuga and Gibson stations (3800 MW) by mid-2030s; adds 3 CCs and solar and wind over time
8. Rapid Decarbonization: CT Portfolio- alters Aggressive Transition portfolio by replacing 2 CCs (2480 MW) with more wind, solar and CT's
9. Rapid Decarbonization: Storage Portfolio- alters Aggressive Transition portfolio by replacing 2 CCs (2480 MW) with more wind, solar and storage

The short-term action plan for several portfolios is very similar. Over the next five years, we expect to:

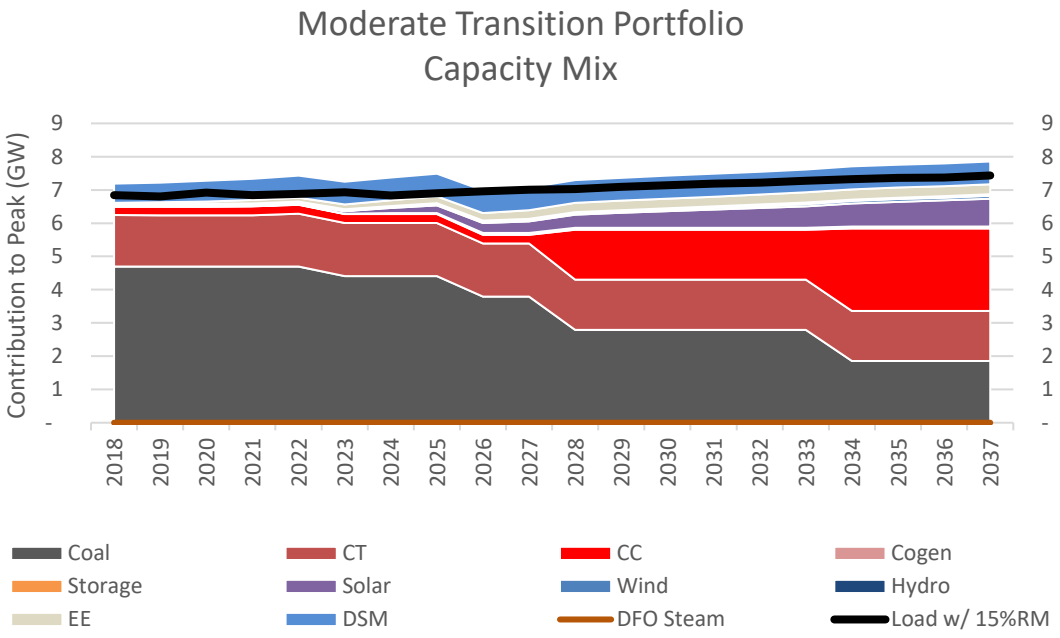
- Retire two older coal units
- Evaluate renewable generation
- Evaluate new natural gas generation
- Implement energy efficiency programs

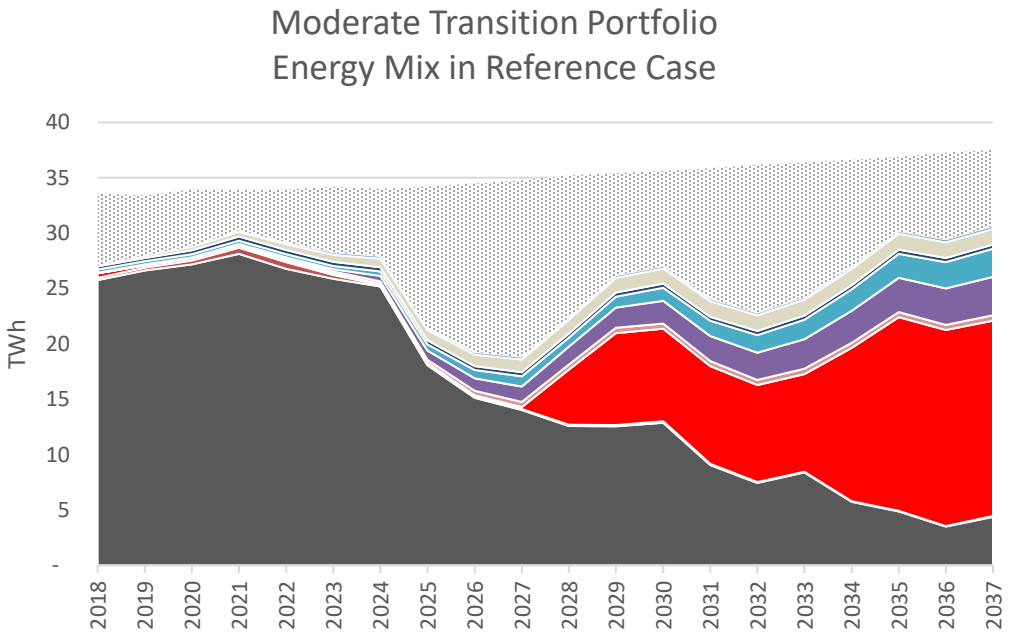
New environmental regulations will likely result in the retirement of some additional coal units beyond those previously announced. This capacity will be replaced with the most cost-effective option. Depending on the time and scenario, that could be gas, renewables, nuclear or greater application of energy efficiency methods.

After comparing the expected cost of each portfolio under a variety of scenario assumptions, we selected the Moderate Transition portfolio for the 2018 IRP. This portfolio benefits from a diverse generation mix as well as the ability to respond to emerging regulations. The generation resource mix of the selected portfolio is shown in the chart below.

Energy supply and capacity

Current and Projected Capacity and Energy Mix





Great strides in energy efficiency

At Duke Energy Indiana, we think of energy efficiency as the “fifth fuel”, joining coal, natural gas, nuclear and renewables as a critical resource needed to serve the growing energy needs of the communities we serve. We are committed to working with Indiana regulators to develop energy efficiency programs that save our customers money and improve our environment.

We offer residential and business customers many tools, programs and incentives to help save money and energy including:

- Free and discounted bulbs
- Home energy house call
- My home energy report
- Smart $aver®
- Power Manager®
- Appliance recycling

These are only a few of the programs our customers can participate in throughout the Duke Energy Indiana service territory. To learn more about how to earn rebates to help increase energy efficiency in your home or business, visit duke-energy.com.

Environmental stewardship

Duke Energy as a company continues to move toward a lower- carbon future through an aggressive power plant modernization program. By retiring older coal plants, deploying clean energy technologies and improving energy efficiency, the company is reducing the amount of carbon emitted per unit of electricity generated – a measure known as “carbon intensity.”

With the latest developments in renewable energy, such as wind and solar power, and our use of new, advanced-technology coal and natural gas plants, Duke Energy is delivering on its promise to provide cleaner energy from a diverse mix of fuel sources.

Partnering to deliver energy

Duke Energy Indiana is a member of the Midcontinent Independent System Operators (MISO) network, along with electric utilities across 15 U.S. states and the Canadian province of Manitoba. As a member, Duke Energy Indiana can supplement its existing energy resources with short-term purchases of energy from the markets operated by MISO.

Duke Energy Indiana participates in MISO’s transmission planning processes and is subject to MISO’s overview and coordination requirements. Duke Energy Indiana performs internal and MISO coordinated analyses of the transmission system to determine whether new or upgraded facilities are needed to maintain near and long-term system reliability. This process has identified several projects that are planned for completion over the next few years.

2018 Integrated Resource Plan

Stakeholder Workshop #1





November 9, 2017
Plainfield, IN

Welcome

- Safety message
- Conference call
  - Call-in # 866-385-2663;
  - Participant Code 8863708
- Introductions

Why are we here today?

- Kick off stakeholder process with a review of the 2015 IRP
- Gather stakeholder feedback and suggestions
- Discuss IRP & Stakeholder process goals and measurement
- Provide overview of anticipated meetings and topics
- Provide initial thoughts on modeling EE and scenarios in the 2018 IRP

Agenda

8:30	Registration & Continental Breakfast
9:00	Welcome, Introductions, Agenda
9:30	Review of 2015 Stakeholder Process and IRP
10:00	Break
10:15	Stakeholder Feedback on 2015 IRP
10:45	Goals of IRP & Stakeholder Process
11:15	Overview of 2018 Stakeholder Meeting Schedule
11:45	Lunch
12:30	EE Modeling
1:30	Scenario Development
2:30	Closing Comments

Scott Park, Director IRP Analytics - Midwest

Review of 2015 Process and IRP

Meetings 1 and 2

Meeting 1

- Overview of Duke Energy Indiana
- Review of 2013
  - Stakeholder Process
  - IRP
- Lessons Learned
- Scenario Discussion

Meeting 2

- Meeting 1 Comments and Response
- Scenario Discussion
- Resource Discussion
- Portfolio Development Exercise

Meetings 3 and 4

Meeting 3

- Meeting 2 Comments and Response
- Scenario Review
- Portfolio Review
- Modeling Results
- Sensitivity Exercise

Meeting 4

- Meeting 3 Comments and Response
- Scenario Review
- Portfolio review
- Modeling & Sensitivity Results
- Decision Making
  - Preferred Portfolio
  - Short Term Implementation Plan

Meeting 4 – Modeling Results

		PORTFOLIOS								
		No CO2 Opt	CO2 Opt	CPP Opt	No CO2 Opt w/ CC	CO2 Opt w/ CC	CPP Opt w/ CC	Stakeholder Dist Gen	Stakeholder Green Utility	High Renewables
SCENARIOS	No CO2 Tax	20,297	20,655	20,891	20,379	20,677	20,931	27,465	22,623	21,219
	CO2 Tax	27,549	27,186	27,209	27,617	27,243	27,334	31,559	28,131	27,611
	CPP	23,699	23,173	22,960	23,419	22,977	22,645	26,864	23,397	23,715
	Delayed CO2 Reg	25,443	25,513	25,606	25,667	25,569	25,662	30,292	26,586	25,901
	Repealed CO2 Reg	22,136	22,092	22,335	22,236	22,137	22,401	28,732	24,183	22,683
	Inc Cust Choice	30,882	30,505	30,824	31,009	30,561	30,642	34,799	31,316	30,937
	Climate Chg	28,060	27,752	27,800	28,052	27,760	27,758	31,840	28,575	28,082

Preferred Portfolio (CO2 Opt w/CC)

- Retires 1258 MW of Coal by 2031
- Builds 1119 MW of Gas by 2033
- Adds 754 MW of Renewables by 2035

DUKE ENERGY

Heather Quinley, Director Energy Affairs & Stakeholder Engagement

Stakeholder Feedback on 2015 IRP & Goals Discussion

Activity

- Purpose: Debrief and Understand Stakeholder Feedback on the 2015 IRP process
- Activity: Discuss at your table the following questions (15 minutes)
  - Why are you here and/or why did you return?
  - What did you like about the 2015 IRP process?
  - What do you want to see change/see more of/never see again?
- Have table spokesperson summarize thoughts and suggestions to the group

Goals for the IRP & Stakeholder Process?

EXAMPLE GOAL	METRIC
Minimize Cost	Present Value of Revenue Requirement (PVRR)
Minimize Risk	Variability of Costs
Decrease CO2 emissions	Tons of CO2 emitted
Increase Generation Diversity	Energy Mix
Maximize Jobs	Net change in jobs created

Nate Gagnon, Lead Planning Analyst

Overview of 2018 Stakeholder Meeting Schedule

Six Stakeholder Meetings

Meeting	Approximate Date	Topic
1	Nov 9, 2017	Stakeholder Feedback & Process Goals; Discussion on modeling EE & Scenario Planning
2	Feb 2018	Resources including discussion on modeling EE; Scenario discussion
3	Apr 2018	Scenarios
4	June 2018	Portfolios
5	Aug 2018	Portfolios & Modeling Results
6	Oct 2018	Modeling Results & Selection of Preferred Portfolio

Lunch

Tom Wiles, Director EE Analytics

EE Modeling

Modeling EE for 2018 IRP

- Market Potential Study (MPS) performed by Nexant scheduled to be completed early November
- What is in the MPS?
  - Assessment of Technical, Economic and Achievable potential for EE and DR within DEI service territory
- Timeline of MPS, IRP and EE filings

2017 MPS → 2018 IRP → 2019 EE filing

Modeling EE for 2018 IRP

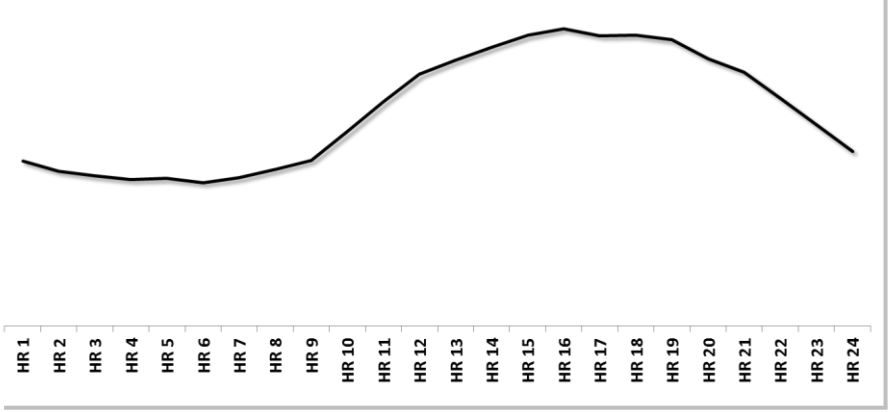
- In the 2015 IRP
  - Based on most recently approved EE filing as starting point with expectation that future years would look like year 5
  - Included Incremental bundles that were similar to Base bundles but more expensive
  - 10 total EE bundles

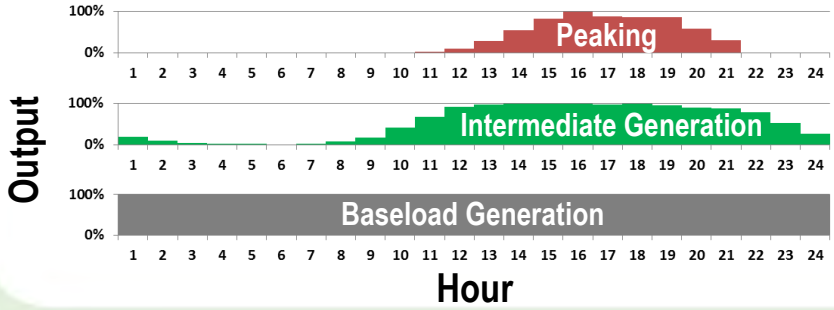
- In the 2018 IRP, we are thinking about
  - First two years (2018-19) based on most recently approved EE filing
  - Subsequent bundles, including Incremental bundles, based on MPS results and grouped by savings shape
  - 20+ total EE bundles, including multiple incremental bundles per time period

- Examples of anticipated EE bundles (Daytime, Night time, 7x24, Seasonal HVAC, etc.)

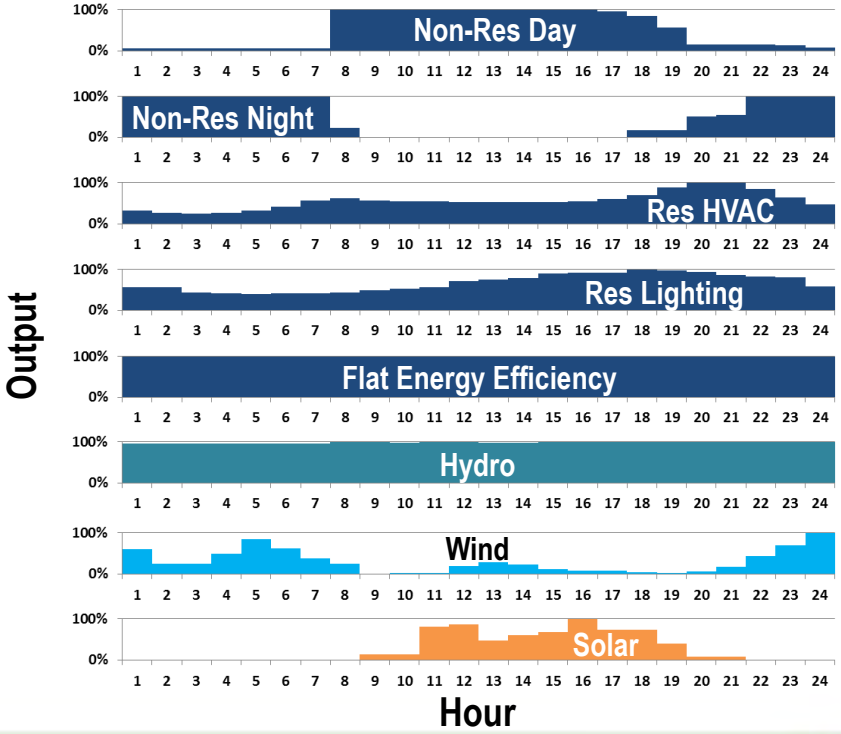
Serving the Load

Load Curve





Resource Options



Scott Park, Director IRP Analytics - Midwest

Scenario Development

Scenario Planning

- Focus on key drivers that are difficult to forecast with confidence
- Should be plausible, internally consistent and sufficiently different
- Address a wide range of possible outcomes
- Uncertainty increases over time, scenarios diverge accordingly

Identifying Key Uncertainties

- Should significantly affect resource planning
- Outcomes should be difficult to predict with a wide range of possibilities
- Many factors that affect resource planning are difficult to predict
- Factors that are less impactful or less uncertain should be addressed in sensitivity analysis

Identifying Key Uncertainties

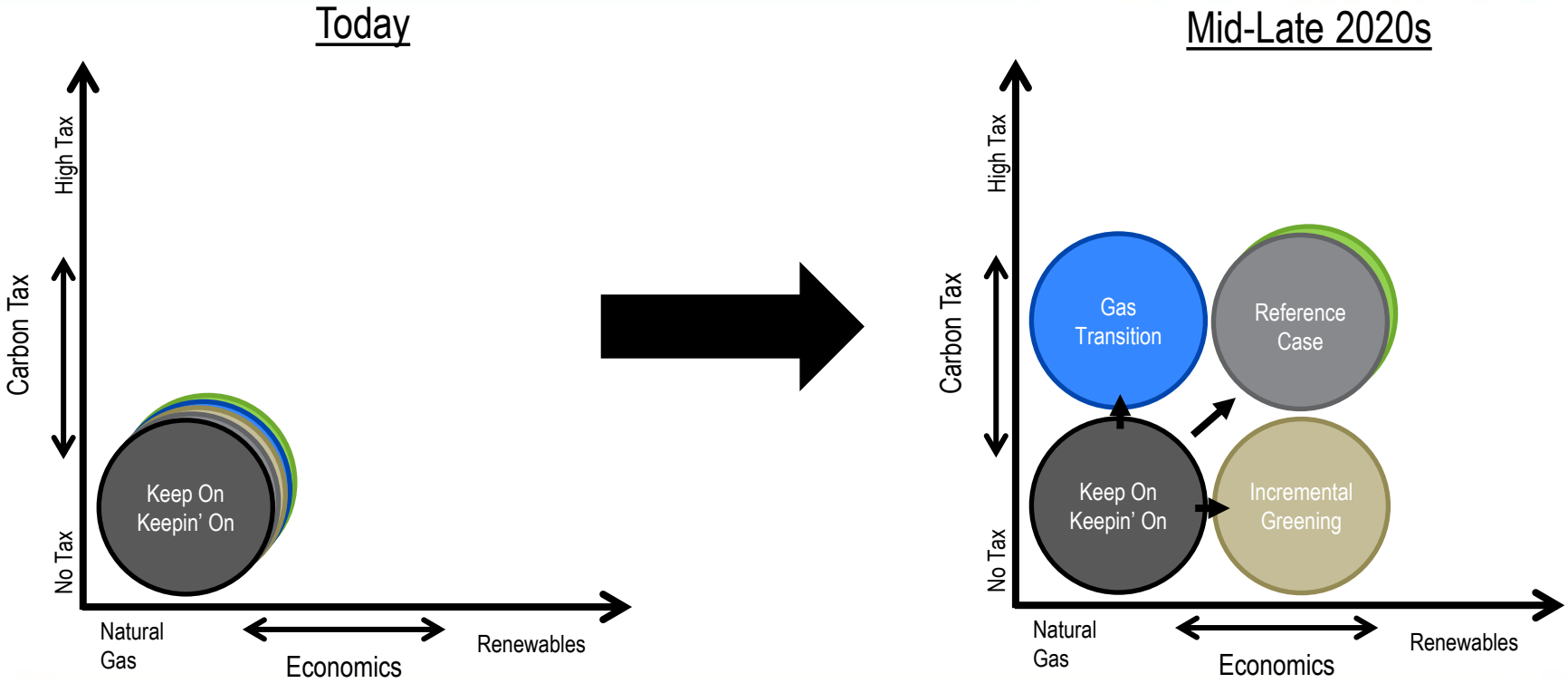
Factor	Impact on Resource Plan	Variability / Uncertainty
Gas Price	High	High
Coal Price	Low	Low
Cost of Wind	High	High
Cost of Solar	High	High
Cost of Energy Storage	High	High
EE Adoption Rates	Low	High
Load	Low	High
Carbon Tax	High	High
Other Regulatory Changes	Low	Low

Identifying Key Uncertainties

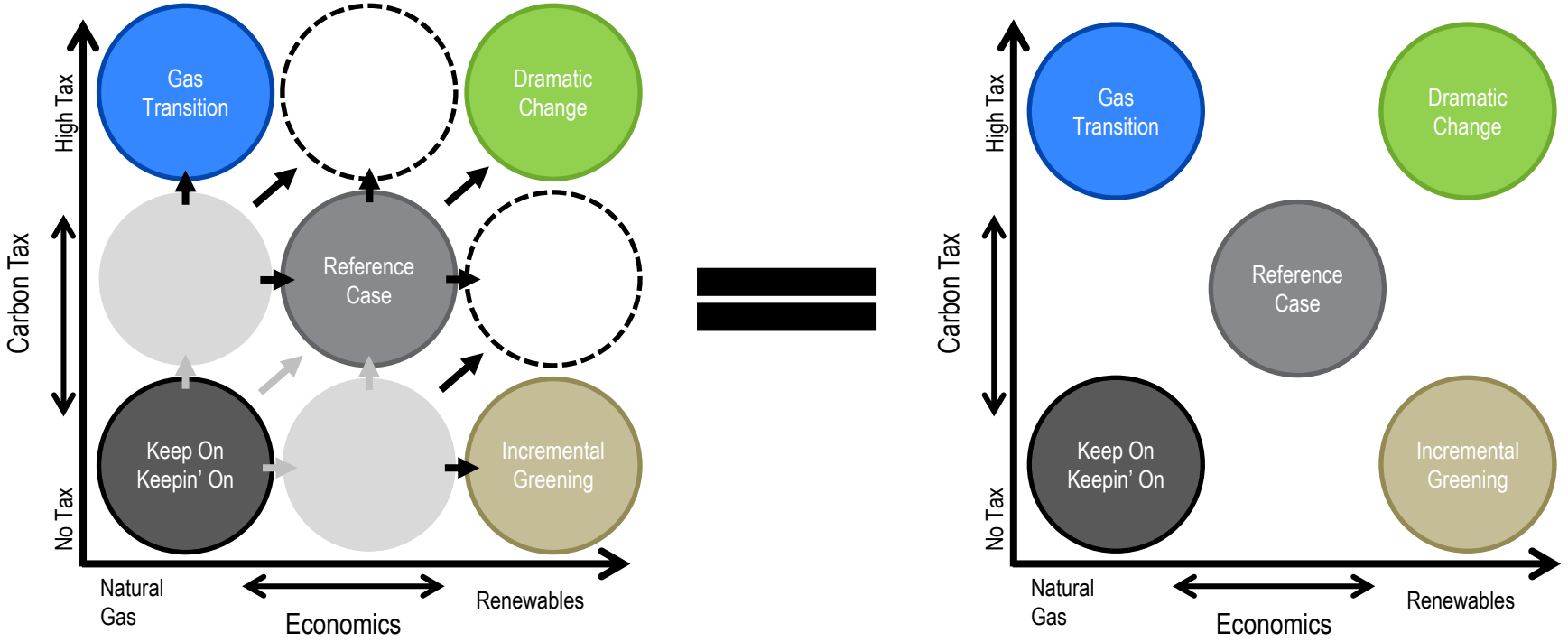
Grouped as "Renewables"

Factor	Impact on Resource Plan	Variability / Uncertainty
Gas Price	High	High
Coal Price	Low	Low
Cost of Wind	High	High
Cost of Solar	High	High
Cost of Energy Storage	High	High
EE Adoption Rates	Low	High
Load	Low	High
Carbon Tax	High	High
Other Regulatory Changes	Low	Low

Scenario Evolution



Scenario Evolution (Mid-Late 2030's)

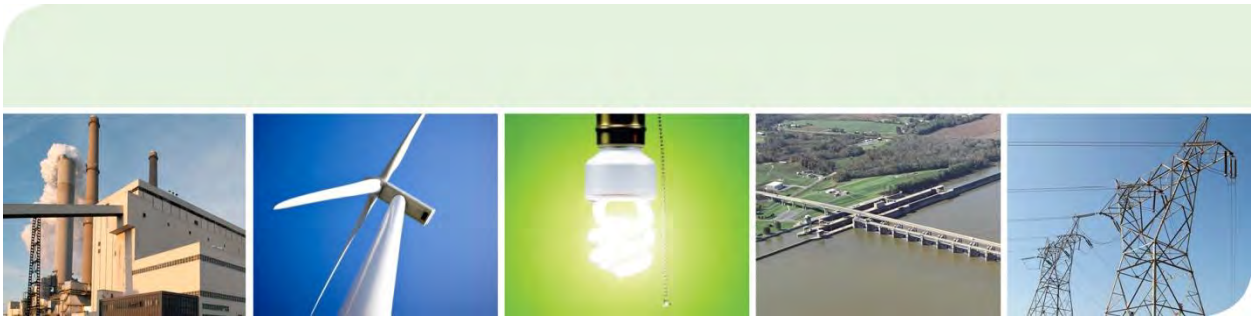


Heather Quinley, Director Energy Affairs & Stakeholder Engagement

Closing Comments, Stakeholder Comments

Next Steps

- Please complete comment cards or send by Nov 16 to Scott at: scott.park@duke-energy.com
- Meeting summary and other materials will be posted on website by Nov 17 (http://www.duke-energy.com/indiana/in-irp-2018.asp)
- Next workshop tentatively scheduled for February 2018



Duke Energy Indiana 2018 Integrated Resource Plan

Stakeholder Meeting 1 Summary
November 9, 2017

Welcome and Introductions
Scott Park, Director IRP Analytics – Midwest
Melody Birmingham-Byrd, State President – Indiana

Scott welcomed everyone and thanked everyone for coming. He confirmed the conference call was working and discussed how to get logged onto the wireless internet. He briefly discussed safety and how to evacuate in case of emergency. He started off introductions and everyone in the room and on the phone introduced themselves with their names, company, and position. He then introduced the Duke Energy Indiana President, Melody Birmingham-Byrd.

Melody welcomed everyone and thanked everyone for coming. She briefly explained that she wasn't a part of the stakeholder meeting process in the past, but she looks forward to these meetings and upcoming interactions with the stakeholders. She encouraged the participants to continually give constructive feedback throughout the process and Duke Energy will listen to their inputs. She concluded by thanking everyone for their time and thoughts. She introduced Heather Quinley, Director of Energy Affairs and Stakeholder Engagement.

Why are we here today?
Heather Quinley, Director of Energy Affairs & Stakeholder Engagement

Heather walked through slide 3 of the presentation. She told the stakeholders why we are here today. She mentioned we were going to kick off this meeting with a review of the 2015 IRP. She also mentioned she wanted to gather feedback and suggestions, discuss the IRP process goals, provide a brief overview of the upcoming meetings, and provide initial thoughts on modeling EE and scenarios in the 2018 IRP.

A stakeholder during this section asked why Duke Energy got rid of the independent facilitator (Marty Rozelle) from the previous process. Scott Park answered this question by saying that after reviewing the process from last IRP, and looking at the cost and the resources available to him this IRP, he did not feel the need to hire a 3rd party facilitator. He feels Duke Energy has the resources and is capable to facilitate the meeting in an organized and fair manner.

Agenda and Review of 2015 Process and IRP
Scott Park, Director IRP Analytics – Midwest

Scott walked through the agenda timeline provided on slide 4. He mentioned that he expects good conversation through this meeting and that he intends to be respectful of everyone's time and will conclude the meeting as close to 2:30pm as possible. There were no questions about the agenda.

Scott then started on slide 6 and began with an overview of the previous IRP meetings and reviewed a high level agenda of previous IRP stakeholder meetings. He mentioned that he thought this process went well during the last IRP and he plans to keep a similar process for this IRP. One change to this IRP is that there are going to be two additional meetings to discuss foundational issues and resources with an emphasis on EE. He referenced that Nate Gagnon will talk about this in further detail later on in the presentation.

Stakeholder questions during this section included the following:

- A question was asked about the modeling files and if there would be time to have experts review and provide feedback during the process. She also asked specifically about the stakeholder scenarios and if/when there would be time allowed for comments on these.
    - Scott Park answered this question by mentioning how the model is very complex and that the data itself is many GBs. He mentioned that once the April/May/June timeframe comes around, he will have a better idea on specific scenarios and then at this time there could be a time for collaboration on reviewing of the basic assumptions Duke Energy is making and reviewing some model files. He reiterated that most likely the timeframe for the stakeholder questions is in the second quarter.
- A comment about the wireless internet privacy policy was brought up by a stakeholder. The "Terms and Conditions" mentions that, if necessary, Duke Energy can see the actions done by the stakeholders when using the wifi. He believes that should be disclosed to the stakeholders at the meeting and doesn't think that is entirely fair to the privacy of the stakeholders.
    - Scott Park mentioned he did not realize what the fine print had in the "Terms and Conditions" and he mentioned that if anyone is concerned, that they should read the privacy agreement and if they did not agree, to use cellular data at this time. Scott would look into this point for the next meeting.
- A comment was brought up that we should host meetings at an offsite and public location. She believes Duke Energy should reconsider having the meeting at the DEI campus, but instead at an offsite location.
    - Scott Park addressed this concern by saying he will look into the possibility of moving to an offsite location for the future meetings, but he does have to be mindful of the financial implications of this change.

Scott continued onto slide 8, by showing the IRP modeling results discussed in the previous meeting 4 from the 2015 IRP process. He walked through each of the different portfolios and the 6 different Duke Energy designed portfolios, as well as the 3 stakeholder provided portfolios. He also discussed the 7 different scenarios ranging from the impacts of a carbon tax to the impacts of climate change scenario. He mentioned that from the portfolios analyzed, the CO2 Opt w/ CC was the overall best option and it was the portfolio that was chosen by Duke Energy in the 2015 IRP. This portfolio would retire 1258 MW of Coal by 2031, build 1119 MWs of gas by 2033, and add 754 Mw of renewables by 2035.

Stakeholder questions included the following:

- A stakeholder mentioned she would prefer the modeling files as early as possible so she can have her experts review the files. She also mentioned she thought the color coding on slide 8 was showing bias and that she would like the information not to have those colors to better present the information in an unbiased way.
    - Scott explained the colors for the graph on slide 8. How the green was the top 3 performers, yellow the middle 3 performers, and orange the bottom 3 performers. He wants the portfolios to perform well over the entire range of scenarios.
- A stakeholder mentioned she would like more detail on the preferred portfolio such as time frames on retirements.
    - Scott answered that the detailed information is in the public IRP and can be viewed online or in the IRP that Duke Energy published.
- A stakeholder mentioned she would like the scenarios and portfolios to remain constant as you go across the rows and columns.
    - Scott answered comparisons are made across the rows. But there are slight changes because the scenarios dictate change. He said we can continue to talk about that in future meetings.
- A stakeholder mentioned she would like a legend/code when the table is presented.
- A stakeholder asked a question about how we are addressing the Director's report and if we are presenting data that reflects changes due to the Director's report.
    - Scott Park answered that this data doesn't reflect the director's report, this data is directly from the 2015 IRP.

Stakeholder Feedback on 2015 IRP & Goals Discussion
Heather Quinley, Director of Energy Affairs & Stakeholder Engagement

Heather began on slide 10 and discussed the purpose of the upcoming group activity. She wants people to talk at their tables and answer the 3 questions presented on slide 10. The purpose of this group activity is to help gather stakeholder feedback from the 2015 IRP process so that Duke Energy can use their to help with the 2018 IRP process. Heather mentioned the groups will have about 15 minutes to discuss their answers and then will have one spokesperson represent each group. The three discussion questions were: Why are you here and/or why did you return? What did you like about the 2015 IRP process? What do you want to see change/see more of/never see again?

The stakeholders had the following input:
<u>Group 1:</u>
They are here to be involved with the process at the start. They are interested in making sure the assumption costs are accurate. They liked getting involved during the process last IRP and liked the employee engagement during the process. They want more connections in modeling results, more accurate assumptions and renewable costs, to avoid bias in presenting results, and an opportunity to discuss changing assumptions when they don't agree.
<u>Group 2:</u>
They are here to see Duke Energy's direction and give input and learn about the process. They liked the conversation with Duke, location, parking, lunch and color coding of data. They have good feedback on portfolio design. The changes they would like to see: lowest portion of energy generated (EE) was talked about the longest time vs. CC was talked about less amount of time, a better game plan for folks to move on during the meeting, 2015 process had some technical issues (microphones, IT issues) they would like resolved. They liked having the materials/presentations in advance and liked having stakeholder portfolios, but want them more realistic.

Group 3:
They appreciated the time to all be in the room at the same time. They would like to have better transparency for stakeholders to share (how IRP may/may not be the same as the business plan). They liked the Duke staff engagement inside and outside of the meeting.
Group 4:
They are here to learn about the IRP process and wanted to make sure Duke had more up to date renewable technical information. They liked how Duke wanted/listened to feedback and how Duke let the stakeholders create scenarios/portfolios. They want to figure out how to have a better 2-way conversation now, so there may be less criticism later in the process when filing occurs.

After the groups presented, Heather continued onto slide 11 which brought up the discussion of goals for the IRP and stakeholder process. Heather mentioned the 5 goals listed on slide 11 and asked the stakeholders for any additional goals and metrics that Duke Energy should consider.

- A stakeholder mentioned the goal of Market Purchases and Sales.
- A stakeholder made the comment that he has never seen maximize jobs as a goal (slide 11). Utility jobs or economic development? He also asked about the utility relationship between customers and competitors (Business model)? He also mentioned that Generation Diversity needs to include adapting to the technological change. He wants Duke to have to goal to try to capture the range of different alternative future and try to integrate that into the IRP. He thinks Duke is too heavily dependent on coal. He says 90% of energy in 2016 was on coal. He wants to focus on energy mix over time (wants less coal).He wants to have a goal for future energy mix. He wants a plan to change future generation. Ex. He wants a plan to have X% of coal by X date.
- A stakeholder mentioned one of the goals needs to address customer choices/empowerment. Mechanisms to allow customers to organize projects. Ex. Community solar.
- A stakeholder mentioned he wants to see the changes in load forecasts/growth/demand and how Duke will deal with that. I.e. How does our portfolios respond to lower/higher load growth.
- A stakeholder mentioned the goal of designing portfolios to encourage economic development.
- A stakeholder mentioned the goal to considering the impact on low income ratepayers.
- A stakeholder mentioned that he seconded another stakeholder and a goal should be the consideration of community solar opportunities.
- A stakeholder had a question about these goals. She commented and concluded that the goals would be after the fact to the modeling to help with the decision making process at the end.

Overview of 2018 Stakeholder Meeting Schedule
Nate Gagnon, Lead Planning Analyst

Nate walked through the high level overview of the six planned stakeholder meetings and the tentative dates. He walked through each of the 6 meeting's planned topics and asked the stakeholders if there were any questions.

- A stakeholder had the question on the exact February date.
    - The February date is tentatively scheduled for February 13, but will be solidified in the upcoming weeks and a confirmation will be sent out.
- A stakeholder had a question about when would she be able to see the assumptions?
    - Answer: April/June timeframe.
- A stakeholder had a question on MPS: Can she get it when available?
    - Answered by Tom Wiles: Once we have the final published version, we can make the files available to the list of people here. The November date on the slides in not correct, and it will most likely be at the end of December when the final version comes out.

- A staked had a question: She would like a meeting to dive further into the modeling files.
    - Answer by Scott Park: Yes, we will eventually set one up with a smaller group.
- A stakeholder had a question on reviewing and getting the modeling files. Encourages Duke to reveal more things in the modeling files because most aren't confidential.
    - Answer: Duke of course had to abide by the legal restrictions but will look into this further when the time comes for the data sharing.
- A stakeholder had a question on load forecast. She would like to see the actual documentation on the load forecast.
    - Answer by Scott: We will need to address the technical details on the load forecast offline and the information will be available.

At this time, there was an hour for lunch to be served. The meeting would start back at 1230.

EE Modeling
Tom Wiles, Director EE Analytics

Tom Wiles started on Slide 16 and reiterated what he said earlier in the meeting that the final form of the MPS is expected around the end of December and it will be sent out to the group. Tom continued by briefly talking about how the MPS should provide an assessment of technical, economic, and achievable potential for EE and DR within the DEI service territory. He mentioned that after the 2018 IRP the EE filing will be sometime in 2019, due to the 3 year EE cycle.

Tom walked through slide 17 on how EE was modeled in the 2015 IRP and what Duke Energy is thinking for the 2018 IRP. In the 2015 IRP there was a total of 10 EE bundles and the bundles were split into incremental bundles and base bundles. For the 2018 IRP, Duke is thinking 20+ bundles based on time period. There would still be base bundles and incremental bundles. Tom then went through a few examples of each the time period bundles.

Tom continued with the EE bundle explanations onto slide 18. He reminded the stakeholders that these numbers are not exact and only show a typical output of the resources. He walked through each of the example resource options and mentioned there are more resources that aren't shown.

Stakeholders had the following questions and inputs:
- One stakeholder mentioned he doesn't want to plateau energy efficiency in future years due to saturation.
    - Tom's answer: He agrees, but it depends on the program and it really depends on the MPS and the future.
- A stakeholder had a question on the effect on storage? Such as combining storage with solar and wind.
    - Tom's answer: Storage will be part of the analysis but just doesn't impact solar or wind but it has multiple impacts that the analysis will try to capture.
- A stakeholder question dealt with looking at the customer side of the meter resource. How does Duke capture customer side of the meter options (storage/batteries)?
    - Answer: We haven't quite figured out how we are exactly going to do that, will have to look into that and into load forecasts, we will need to get into it more as we go through the process. It is already occurring in the load forecasting side.
- A stakeholder question was on grouping energy efficiency by load shape. The question asked about Capacity Expansion and how we are going to model a load shape and if CE was even capable of

modeling this correctly and would it work effectively by having the bundles by load shape. She thinks the bundles should be based on cost because that is how the models will choose the bundles.
    - Answer by Tom and Scott: We will have to discuss with modelers because the stakeholder is correct in that the model doesn't model 8760 and does take some shortcuts. Duke will have to confirm that we can accurately model the load shapes correctly. Duke will look into if the model algorithms capture what we need it to.
- A stakeholder commented on the difficulty of the cost of EE. Her suggestion was to look at the avoided cost runs and "zero cost energy efficiency" .
    - Scott will follow up with the stakeholder can discuss this topic further with Scott during their upcoming one-on-one meeting.

Tom Wiles concluded his presentation by asking for any further questions and said he will follow up with other utilities on how they modeled it based on the Director's Report.

Scenario Development
Scott Park, Director IRP Analytics – Midwest
Nate Gagnon, Lead Planning Analyst

Scott started the Scenario Development section by going through slides 20 and 21 and going over the scenario planning points. He mentioned Duke wants to focus on key drivers that are difficult to forecast with confidence. The scenarios should be plausible, internally consistent, and sufficiently different while addressing a wide range of possible outcomes. He reminded that uncertainty increase over time and scenarios should diverge accordingly.

Stakeholders had the following questions:
- Stakeholder question: Is there an opportunity for the stakeholders to create scenarios? As well as the portfolios.
    - Scott's answer: Hopefully we will come together and we can all weigh in on the scenarios and come up with common scenarios that everyone can basically agree on.
- Stakeholder question: How does load forecasting play into this? Ex. Temperature. Will temperature vary into in the scenarios?
    - Answer: We will continue to revisit this, but typically load forecasting remains constant through scenarios.

Nate then began the discussion on key uncertainty drivers, beginning on slide 22 and going through slide 25. Nate showed on slide 22 Duke Energy's identified key uncertainties and Duke's rating of "High" or "Low" impact on the resource plan and uncertainty. He continued onto slide 23 which had Duke Energy's grouping of the 3 highest impact of uncertainties: Gas Price, Renewables, and Carbon Tax. Nate walked through the scenario evolution that Duke Energy has been thinking about. The graphs show Duke's 3 highest impact uncertainties on the axis and how the portfolios might develop through the years (10 year increments). In slide 25, Nate detailed the future bubbles that could occur (Ex. Gas Transition would have a high carbon tax, cheap natural gas, and renewables would not get much cheaper).

There were multiple questions/comments by the stakeholders during these slides:
- A stakeholder question asked how can the cost of coal, when you are entirely relying on coal for generation, be a "low" impact?

    - Nate's answer: We are looking at a relative comparison mainly between gas vs coal. We believe gas will have more influence on the power market and will be more impactful than coal.
- A stakeholder commented that it is frustrating on the bias of high vs. low. She wants to see the data to how we get the "high" and "low". She believes the "Load" factor should be "High".
    - Scott's answered by saying it is the scenario that determines the data and that the high vs low was initially just used by industry experience but he wants to hear input from the stakeholders.
- A stakeholder commented saying it matters a great deal what the assumptions are and would like to further discuss this.
- A stakeholder question: How is natural gas and renewable on the opposite side of the axis?
    - Answer: We are getting at the comparison of new generation competitiveness.
- A stakeholder question: Are we talking about developing different portfolios or scenarios?
    - Answer: Today we are only talking about future scenarios that might favor certain type of portfolios.
- A stakeholder question: How do we choose the High/Low?
    - Answer by Scott: No data behind it, just based on current experience but we can further discuss this in a future meeting.

After the stakeholder discussion between Nate, Scott, and the stakeholders on slides 22-25 Scott Park made the following points:

- Duke will further hit on this point in the next stakeholders meeting in February to hopefully clear this up further. Duke might need to craft what the data will look like in the scenarios on slide 25 to help give any basic assumptions made.
- He is thinking for February: Duke would layer a sensitivity analysis into the scenarios. With basic assumptions and sensitivities run. Duke would have narratives that would drive the assumptions of the portfolios to help bring clarity.

Scott then asked the stakeholders are there other scenarios that you think we need to look at? No stakeholders had any additional scenarios.

A question was brought by the stakeholders: How does Duke's must run instructions to MISO work? Edwardsport and other fossil plants are "Must-Run".

- A stakeholder on the phone answered how at least part of fossil/nuclear plants are "Must-Run". Her answer was cut short by further questions by the stakeholders asking how Duke is dealing with how "Must-Run" impacts future retirements and they wanted Duke Energy to answer the question. Scott said he will have to do further research on this topic and get back to the stakeholders at the next meeting.

Closing Comments

Scott Park, Director IRP Analytics – Midwest
Heather Quinley, Director of Energy Affairs & Stakeholder Engagement

Scott Park thanked everyone for coming and mentioned in the next stakeholder meeting, he will give an update on the 1-on-1 meeting with Jennifer and Anna. He also mentioned he owes a confirmation of next stakeholder meeting date of Feb 13th within a couple of weeks.

Heather thanked everyone for their time and went over slide 27 of the presentation. She asked the stakeholders to complete the comment cards by November 16 and send them to Scott. She mentioned the summary notes will be available online within 7-10 days. She hopes everyone travels safe and looks forward to the next meeting and with working with everyone throughout the process.

2018 Integrated Resource Plan

Stakeholder Workshop #2





February 13, 2018
Plainfield, IN

Welcome

- Safety message
- Technology
  - Call-in # 866-385-2663
  - Wi-Fi provided as in previous meetings
- Melody Birmingham-Byrd Opening Comments
- Introductions

Why are we here today?

- Recap November 2017 stakeholder meeting and respond to comments/questions
- Discuss desired characteristics of preferred resource plan
- Discuss resource types
  - Fossil Fuels
  - Renewables
  - Energy Efficiency
- Discuss scenario planning process in preparation for April stakeholder meeting

Agenda

8:30	Registration & Continental Breakfast
9:00	Welcome, Introductions, Agenda
9:20	Review of November 2017 Meeting, Responses to Questions
9:45	Break
10:00	Characteristics of Preferred Portfolio
10:30	Traditional Resources
11:00	Renewable & Demand Side Resources
11:30	Lunch
12:30	EE Modeling
2:00	Scenario Development
2:30	Closing Comments

Scott Park, Director IRP Analytics - Midwest

Review of November 2017 Meeting

Recap of November Meeting

- Review of 2015 Stakeholder Process and IRP
- Stakeholder Feedback on 2015 IRP
- Goals of IRP & Stakeholder Process
- Overview of 2018 Stakeholder Meeting Schedule
- EE Modeling
- Scenario Development

Comments from November Meeting

STAKEHOLDER QUESTIONS	RESPONSE
When will modeling inputs be made available to stakeholders?	After scenarios are developed; April/May time frame
How will comments in Director's Report from 2015 be addressed?	Incorporate as we go through the 2018 IRP process
When will the Market Potential Study be made available to stakeholders?	Posted to website on Feb 9th
What about the proposal by CAC to model EE bundles as zero-cost resources?	Open to hearing new ideas
Have any one-off meetings with stakeholders taken place?	No one-off meetings with stakeholders took place

Must Run Units

- Submitting low cost resources, such as coal plants, to MISO as Must Run Units is a mechanism that saves customers money

- Consider a plant that generates power at $25/MWh, but prices over night are $24/MWh. *Should the plant be turned off over night?*

Turn Off Plant	Turn Down Plant
▪ Avoid $1/MWh operating loss ▪ Incur start-up cost	▪ Incur $1/MWh operating loss ▪ Avoid start-up cost

Nate Gagnon, Lead Planning Analyst

Heather Quinley, Director Energy Affairs & Stakeholder Engagement

Characteristics of Preferred Portfolios Exercise

Stakeholder Exercise

- The purpose of the IRP process is to arrive at a preferred resource portfolio. What do we mean by preferred?

- The proposed IRP rule defines the preferred portfolio as one that "reliably, efficiently, and cost-effectively meets the electric system demand, taking cost, risk, and uncertainty into consideration"

- Small group exercise: brainstorm short list of important qualities/characteristics you think the preferred portfolio should have

Scott Park, Director IRP Analytics - Midwest

Resource Options: Traditional Generation

Resource Comparison Key

- Resources are compared using a combined-cycle facility as the baseline
- Attributes are presented using the following indicators

= similar to combined-cycle

or = greater than combined-cycle

or = less than combined-cycle

A **GREEN** arrow indicates a favorable comparison (e.g. lower cost is desirable)

A **RED** arrow indicates an unfavorable comparison (e.g. higher cost is undesirable)

Combined Cycle Gas Turbine (CC)

Capital Cost	
Operating Cost	
Carbon Emissions	
Flexibility	
Capacity Share Today	4%
Energy Share Today	4%

59

DUKE ENERGY

Gas Combustion Turbine (CT)

Capital Cost	↓
Operating Cost	↑
Carbon Emissions	↑
Flexibility	↑
Capacity Share Today	22%
Energy Share Today	1%

60

DUKE ENERGY

Combined Heat & Power (CHP)

Capital Cost	↑
Operating Cost	■
Carbon Emissions	■
Flexibility	↓
Capacity Share Today	0%
Energy Share Today	0%

Coal

Carbon Capture	No	Yes
Capital Cost	↑	↑
Operating Cost	↓	↑
Carbon Emissions	↑	↓
Flexibility	↓	↓
Capacity Share Today	66%	0%
Energy Share Today	70%	0%

62

DUKE ENERGY®

Nuclear

Capital Cost	↑
Operating Cost	↓
Carbon Emissions	↓
Flexibility	↓
Capacity Share Today	0%
Energy Share Today	0%

63

DUKE ENERGY

Nate Gagnon, Lead Planning Analyst

Resource Options: Renewables and Energy Storage

Solar Photovoltaic (PV)

Capital Cost	↑
Operating Cost	↓
Carbon Emissions	↓
Flexibility	↓
Capacity Share Today	< 1%
Energy Share Today	< 1%

65

DUKE ENERGY®

Wind

Capital Cost	↑
Operating Cost	↓
Carbon Emissions	↓
Flexibility	↓
Capacity Share Today	< 1%
Energy Share Today	1%

66

DUKE ENERGY

Energy Storage - Batteries

Capital Cost	↑
Operating Cost	↓
Carbon Emissions	N/A
Flexibility	↑
Capacity Share Today	0%
Energy Share Today	0%

67

DUKE ENERGY

Other Renewables

Capital Cost	↑
Operating Cost	↓
Carbon Emissions	↓
Flexibility	↓
Capacity Share Today*	< 1%
Energy Share Today*	< 1%

*Markland hydro

DUKE ENERGY

Nate Gagnon, Lead Planning Analyst

Resource Options: Demand Side

Energy Efficiency

Up-Front Cost	↓
Operating Cost	↓
Carbon Emissions	↓
Flexibility	↓
Capacity Share Today*	< 1%
Energy Share Today*	< 1%

*2018 EE programs only

Demand Response & IVVC

Capital Cost	↓
Operating Cost	↓
Carbon Emissions	↓
Flexibility	↑
Capacity Share Today	8%
Energy Share Today	< 1%

71

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Resource Summary

Resource	Capital Cost	Operating Cost	CO2 Emissions	Flexibility
CC	■	■	■	■
CT	↓	↑	↑	↑
CHP	↑	■	■	↓
Coal	↑	↓	↑	↓
Nuclear	↑	↓	↓	↓
Solar	↑	↓	↓	↓
Wind	↑	↓	↓	↓
Batteries	↑	↓	N/A	↑
Energy Efficiency	↓	↓	↓	↓
DR / IVVC	↓	↓	↓	↑

DUKE ENERGY®

Lunch

Tom Wiles, Director EE Analytics

Energy Efficiency

Modeling EE for 2018 IRP

- Market Potential Study (MPS) performed by Nexant and presented to Oversight Board on February 8th
- What is in the MPS?
  - Assessment of Technical, Economic and Achievable potential for EE and DR within DEI service territory
- Timeline of MPS, IRP and EE filings

2017 MPS → 2018 IRP → 2019 EE filing

Summary of Market Potential Study

- The Market Potential Study estimates the following levels of Energy Efficiency:

Potential	25-Year EE Energy – GWh	25-Year EE Demand – MW
Technical	11,080	3,569
Economic	6,703	2,400
Base Achievable – No Opt Outs	4,992	1,224
Base Achievable – Opt Outs	2,949	698

- Additional data is provided in the MPS regarding
  - Recommended types of Achievable Potential programs
  - Estimated Program Cost
  - Estimated Cost Effectiveness Scores
  - Demand Response Potential

Using the MPS to Create EE Bundles

Data from the MPS will be used to create different EE tiers

		TIME BUCKETS				
		18-19	20-22	23-25	26-31	32-37
TIERS	TECHNICAL					
	ECONOMIC					
	ACHIEVABLE (No Opt Outs)					
	ACHIEVABLE (Opt Outs)					

Each tier will also be divided into bundles:

Res - Flat Year Round
Res - Weather - Summer Only
Res - Weather - Year Round
Res - Lighting
Res - Behavior
NonRes - Flat - Daytime
NonRes - Flat - Nightime
NonRes - Flat - Year Round
NonRes - Weather - Summer Only
NonRes - Weather - Year Round
NonRes - Lighting
NonRes - Behavior

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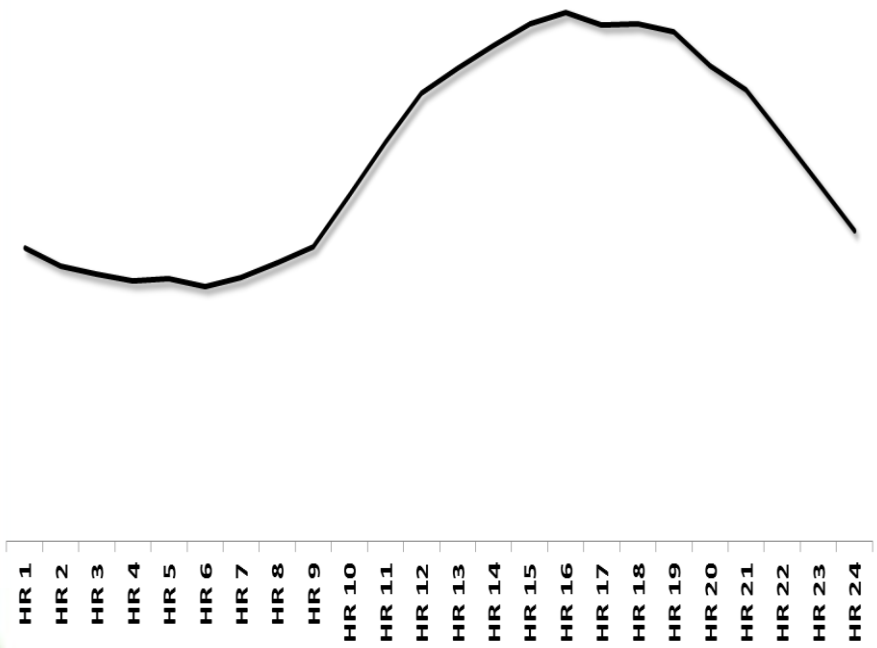
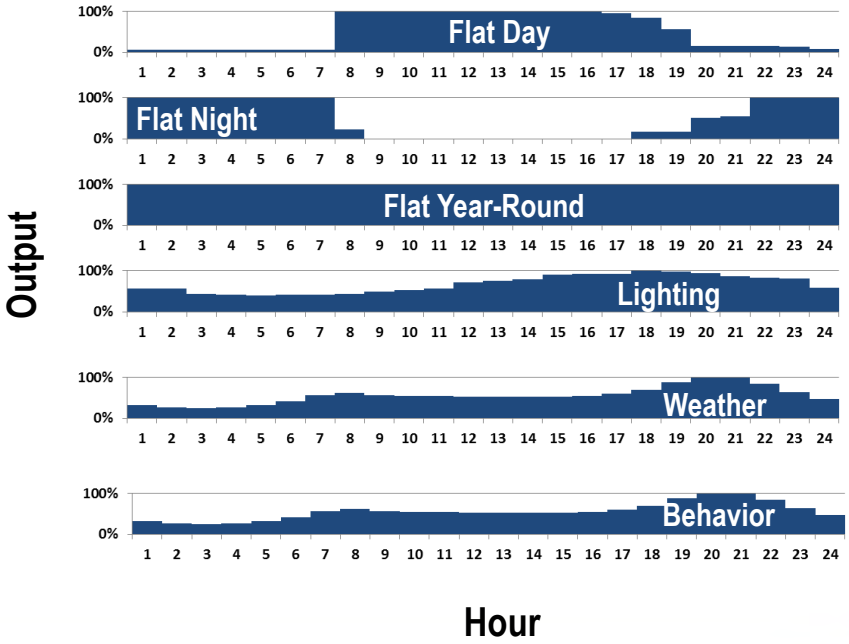
EE Bundle Hourly Savings Shapes

Example Summer Load Curve



Examples of Summer EE hourly Savings Shapes



Cost of EE bundles

- Because the cost of future EE programs is uncertain, the growth in annual cost will be treated as a sensitivity on three trajectories

Res - Flat Year Round
Res - Weather - Summer Only
Res - Weather - Year Round
Res - Lighting
Res - Behavior
NonRes - Flat - Daytime
NonRes - Flat - Nightime
NonRes - Flat - Year Round
NonRes - Weather - Summer Only
NonRes - Weather - Year Round
NonRes - Lighting
NonRes - Behavior

Costs increase at inflation plus a factor for increased penetration (~4%) (Rising Real Costs)

Costs increase at inflation (~2.5%) (Constant Real Costs)

Innovation offsets inflation and factor for increased penetration (~0%) (Declining Real Costs)

How EE is handled in the model?

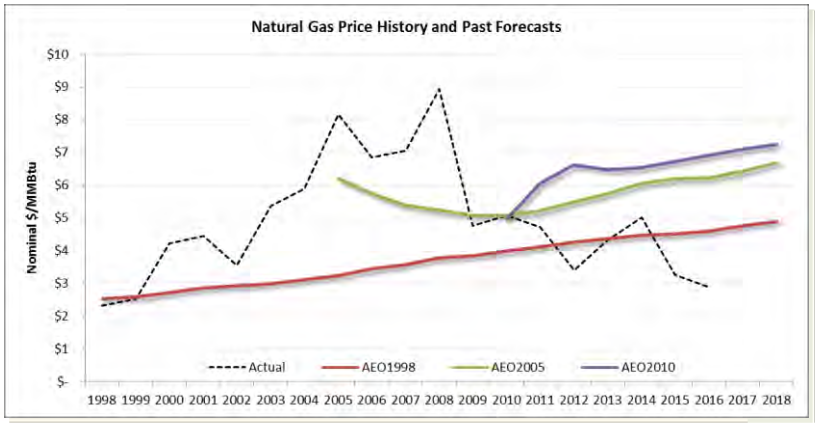
- EE bundles are entered into the resource planning model the same as any other non-dispatchable resource
- The model then looks among all possible resources and calculates the lowest cost to serve the load under that scenario's set of assumptions
- Even though the model evaluates EE bundles as discrete resources, actual administration of an EE program may make starting and stopping programs problematic
- It is expected that the optimized portfolio for each scenario is likely to select different levels of Energy Efficiency

Nate Gagnon, Lead Planning Analyst

Looking Ahead to April: Scenario Analysis

Scenario Planning: Purpose

- Develop a plan when facing uncertainty across multiple dimensions
- Address the full range of plausible outcomes
- Group possible outcomes around central themes; eliminate unlikely combinations
- Formalize assumptions about variables that cannot be reliably modeled



Looking to the future:

- Carbon regulation
- PV import tariffs

What else will surprise us?

Scenario Planning: Process

Scenarios

- Define Scope & Purpose
- Identify Sources of Uncertainty
- Define "Key" Uncertainties
- Construct Scenarios Around Themes
- Check for Consistency and Completeness

Portfolios

- Develop Quantitative Models
- Sensitivity Analysis
- Select Preferred Portfolio

Preview of April Scenario Exercise

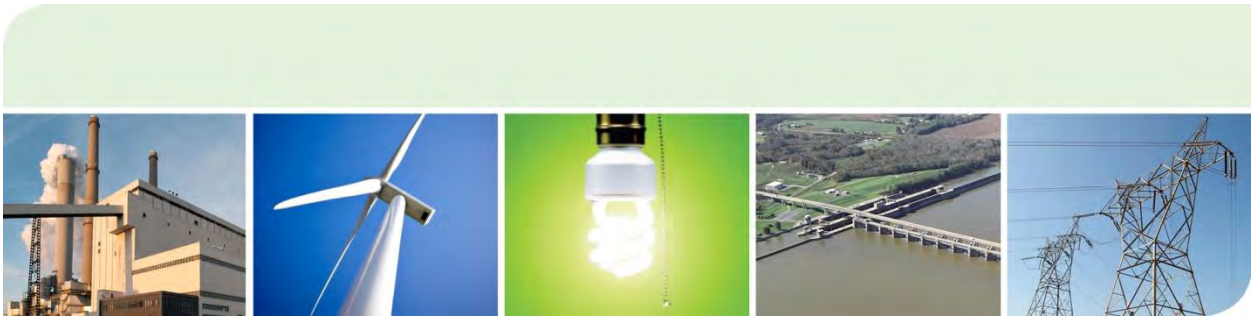
- Our April meeting will be focused on constructing plausible scenarios for the future of the Indiana energy market over the next 20 years
- At the April meeting, we will hold a brainstorming session to identify relevant areas of uncertainty that prevent us from perfectly predicting that future
- We will then narrow that list down to a handful of items that we think will be most impactful
- Between now and then, please give some thought to the factors that you think it will be important for us to address. To get started, it might be helpful to look back over the past 20 years and consider what a planner in 1998 would want to know was coming

Heather Quinley, Director Energy Affairs & Stakeholder Engagement

Closing Comments, Stakeholder Comments

Next Steps

- Please complete comment cards or send by Feb 20 to Scott at: scott.park@duke-energy.com
- Meeting summary and other materials will be posted on website by Feb 21 (http://www.duke-energy.com/indiana/in-irp-2018.asp)
- Next workshop tentatively scheduled for April 17th, 2018



Duke Energy Indiana 2018 Integrated Resource Plan

Stakeholder Meeting 2 Summary
February 13, 2018

Meeting Begins at 9:00am

Welcome and Introductions
Scott Park, Director IRP Analytics – Midwest
Melody Birmingham-Byrd, State President – Indiana

Scott welcomes everyone to the second stakeholder meeting that will be focused primarily on resources. He goes over safety and how to evacuate in case of emergency. He goes over Wi-Fi and instructions on how to get logged in correctly.

Melody welcomes everyone and thanks everyone for coming. She acknowledges the importance of this process and welcomes input and healthy dialogue throughout the entire process. She wants to respect everyone's time and intends to keep to the agenda timeline. Lastly, she thanks everyone again for attending and turns it over to Heather Quinley for introductions and to state why everyone is here today.

Why are we here today?
Heather Quinley, Director of Energy Affairs & Stakeholder Engagement

Heather welcomes everyone to the second of six stakeholder meetings. She then starts introductions going around the room allowing everyone to introduce themselves and tell the organization they are representing. She then allows the participants on the phone to introduce themselves.

Heather reflects on why we are here. The agenda includes recapping the November 9th meeting and responding to the comments/questions from the last meeting. The agenda also includes discussion on desired characteristics of a preferred resource plan. This will be followed by discussing resource types, EE, and then look ahead and discuss scenario planning process in preparation for the April stakeholder meeting.

Agenda and Review of 2015 Process and IRP
Heather Quinley, Director of Energy Affairs & Stakeholder Engagement

Heather goes over the agenda on slide 4 and the timeline of the day. She asks for any questions. The stakeholders do not ask any questions. Heather turns the meeting over to Scott to recap the November Stakeholder Meeting.

Recap of November Meeting
Scott Park, Director IRP Analytics – Midwest

Scott recaps the first stakeholder meeting held in November. He reminds the stakeholders the goal of these meetings is for open and healthy conversation throughout the entire process. He wants everyone to feel that they are heard and welcomes comments and feedback at any time.

The primary focus of today's meeting is on resources. Tom Wiles will present slides on modeling EE as a resource later in the meeting. He reminds stakeholders that the topic in April will be scenario development and in June the topic will be portfolios. In August, Duke will present some of the results and get stakeholder feedback. Then, in the October meeting, discussion will focus on the final IRP plan that will be submitted.

Comments from November Meeting
Scott Park, Director IRP Analytics – Midwest

Scott goes to the presentation slides 7 and 8 that answer the November stakeholder questions. On slide 8, Scott goes in depth on the Must Run terminology and the reasoning why Duke Energy classifies some of generation plants as Must Run. After going through the November stakeholder questions, Scott asks for any questions/comments:

Stakeholder question/comment: His opinion was that slide 8 was too simple. It didn't include some of the additional costs including O&M, line losses, LMPs, etc. He mentioned that it is costing 100 million dollars per year to run the must run units and thinks this is something resource planning should be looking at throughout the years, the accumulation of these costs.
Response: He states that slide 8 was for a specific question. We do have models that look at these type of factors, such as transmission power flows, but for long term IRP planning not all these factors are considered.

Stakeholder comment: He thinks the question should be "At what price differential should we turn the plant off?"
Response: That is the analysis we do in the model. The model figures out what is the best way to operate the system at the lowest cost to the customer. This calculation is also done by the real world dispatchers.

Stakeholder question: She asks if the "Must Run" term dictates the load that the unit operates at, or does the unit still operate within a "economic minimum" or "economic maximum" range.
Response: Duke's Must Run commitment is to ensure the unit stays online, to avoid a short term cycle that would accrue additional startup costs and component fatigue, but MISO still has a range of

generation limits between the minimum and maximum to dispatch the units that are driven by the MISO market.

Stakeholder question: Shouldn't the calculation look at how long the plant will operate with these must run losses instead of just retiring the unit all together?
Response: Duke looks at all of this including when it makes sense to retire, build, and upgrade units. The System Optimizer model determines this, and the Prosym model determines the lowest cost operation of the portfolio.

Stakeholder question: She asked how coal contracts factor into the decision to run the coal plant overnight.
Response: The plants have coal piles that allow flexibility in dispatching the units in relation to the inventory to the fuel.

Morning Break from 9:45am – 10:00am

Characteristics of Preferred Portfolios
Heather Quinley, Director of Energy Affairs & Stakeholder Engagement
Nate Gagnon, Lead Planning Analyst

Heather welcomes everyone back from break and reminds people of the safety concerns when walking around the room during the following exercise. She hands it over to Nate to go over the stakeholder characteristics of preferred portfolio exercise.

Nate gets everyone into groups and gives them about 10 minutes to develop a list of characteristics they want to see in a preferred portfolio. Nate explains the purpose of this IRP stakeholder process is to develop a preferred action plan over the planning horizon. 2018 IRP is an update of the 2015 IRP, based on the new information over the last three years. This exercise is intended to come up with a list of the characteristics stakeholders want to see in Duke's preferred portfolio. The model is optimizes costs while adhering to regulations and constraints. This lists establishes the goal of developing that ultimate preferred portfolio constraints.

After 10 minutes all the groups present their ideas and a list is compiled. This list will be continually reviewed throughout the following stakeholder meetings. Each group presented the following characteristics:

Group 1:
Low carbon; Low cost/affordability; focus on customer bills over rates; local based generation; investments that benefit customers (fuel cost, water use, local jobs); preserving flexibility by adding resources incrementally; controlling load growth with EE (long and short term); taking advantage of cost reductions (tax credits); taking advantage of including demand side resources; taking advantage of Indiana based renewables; including comprehensive set of supply and demand side resources in modeling

Group 2:

Reliable; diverse (robust, flexible options); cost effective (lease cost options with environmental aspects and other rules regulations included); reduces environmental impact; plan flexibility (both dispatching flexibility and long range planning flexibility); incorporates customer facing options; time-of-use billing; and appropriate weighting of evaluations that should include emerging technologies

Group 3:
Cost effective; flexible; resilient; minimizes stranded costs; comparing portfolios objectively; the plan should be transparent; considers societal concerns (climate change); having a contingency plan to the preferred plan in case of major event (legislation, emerging technology, fuel supply, etc.)

Group 4:
Minimizing risk (fuel cost risk, future environmental risks); low cost; reliability; efficient generation (in relation to proximity to load centers)

Phone Group:
Low cost and stability of cost (stable power prices); consideration of impact on states economy; maximum flexibility; maximizing self-determination by customers

Nate ended the characteristics exercise by mentioning one of the common characteristics in all groups was cost (rates, rate volatility, bills, etc.) and said that it is a very important and key characteristic. He then asked for any questions.

Stakeholder question: What scope are we looking at this? Is this corporate or state or what kind of level is this exercise?
Response: This is Duke Energy Indiana level and a DEI exercise. This is echoed by Melody.

Resource Comparison
Scott Park, Director IRP Analytics – Midwest

Scott introduces the next section where all potential resources that are available in the model will be presented. The resource comparison is for informational and educational purposes. He mentions the reference point chosen was a combined cycle (CC) because it is well grounded in a significant base for new central resources and not because it is some preferred option. He is not trying to bias towards one type of generation or another or show any bias using colors. Scott goes through the traditional generation slides (CC, CT, CHP/Cogen, Coal with and without CCS, and Nuclear) and explains the unit comparisons compared to the baseline CC. The following questions/comments came from this section:

Stakeholder question: In this resource comparison, what does Duke mean with the term “flexibility”? She prefers to see actual data in the comparison instead of showing based color coding.
Response: Duke means dispatch flexibility to meet the operations of the grid.

Stakeholder question/comment: For the resources, is the comparison a new resource versus a new combined cycle? Duke should use different colors yellow and purple instead of red and green.
Response: The comparison is a new resource versus a new combined cycle to determine the direction of the arrow.

Stakeholder comment: Concern over storage information that will be presented and what is charging them and comparing them.

Stakeholder comment: Concern over the color coding bias and expresses her frustration with the lack of data to compare the resources themselves. The capital costs for example, she prefers the data instead of the boxes and arrows. She also objects to the combined cycle as the baseline. She believes the selection of a baseline unit could have been opened to the stakeholders. She wants more data instead of figures and colors.
Response: Scott thought the CC is a well understood generator that is the middle of the generation cost. He is not trying to show bias, but chose a CC as a baseline due to the resource type generally being in the middle of all of resources in each of the parameter. He could have chosen a different baseline. The capital costs comparisons are on $/kW bases.

Stakeholder comment: Operating cost of a CC. He wishes Duke to disclose the range of cost for the fuel gas price. The fuel price could change the color of the operating cost.
Response: Scott says if you start assigning all the costs, you start getting into sensitivities and scenarios. We will get to that in future meetings/scenarios/sensitivities, but this exercise is high level.

Stakeholder comment: Questioning why just limiting to carbon emissions instead of potentially Greenhouse Gas emissions since that is potentially more harmful.
Response: Scott mentioned that is a good point and if the stakeholder has any data on this, it would be interesting to see it so he could look at how to potentially incorporate this information.

Stakeholder comment: Question on cost associated with how often the unit is run.
Response: We consider the capital cost and production cost when we do our studies. We are comparing $/MWhr in the production cost comparison.

Stakeholder comment: It would be helpful to see the data and numbers for all of this data.
Response: We work with Burns & McDonnell to come up with some of our numbers. We will be providing more data from our modeling efforts in future meetings/data request when that time comes.

Stakeholder comment: She wishes to have the data. It is frustrating to not have the data. She wants to know assumptions and more numbers.
Response: When the data is available and Duke will provide the data in the appropriate context. This portion of the process is addressing resources at a high level for educational and informational purposes. More numbers will be available later in future stakeholder meetings.

Stakeholder comment: Suggestion for comparisons on a lifecycle analysis on a greenhouse gas perspective.
Response: Scott understands his comment and suggestion, but the data is very hard to get. If anyone has information on this, Scott would like to see the data.

Stakeholder comment: How are we comparing capital costs of building theses resources in the future? If more are being built, the cost will go down.
Response: We get our cost information from Burn & McDonnell and Navigant. During modeling, we consider construction scheduling and consider that when building resources. An emerging technologies scenario maybe be useful to determine impact of this.

Stakeholder comment: He sees bias when comparing CC and CHP. It depends on how you are evaluating CHP. He thinks Duke is showing bias against CHP because it is owned and based.
Response: Scott does not agree and states that DEI is actively pursuing CHP in the state. He reiterates that this is for educational purposes, not for how the resources will be picked or bias in the selection. The presentation shows the tradeoffs offs of each resource. Model evaluation will have other factors, including size, flexibilities, cost, etc. and Duke will share data when industry experts data is available.

Resource Options: Renewable and Energy Storage
Nate Gagnon, Lead Planning Analyst

Nate reviews the four slides for different renewable and energy storage resource options (Solar, Wind, Storage – Battery, and Other Renewables). He walks through each four of the options and walks through the cost, emissions, flexibility, etc. He explains the capacity credits given for each resource by MISO. He highlights resource options flexibilities. The following questions/comments come from this section:

Stakeholder comment: Pertaining to grid support characteristics, are they being considered.
Response: Yes, grid support is being considered and considerations depend on the type of resource.

Stakeholder comment: What are the assumptions for ITC and PTC? Are you assuming continuation of regulation? How are you dealing with the solar tariff.
Response: For this activity, we are using current state, scenario development will consider ITC and PTC changes and considerations.

Stakeholder Comment: What is the assumption with the rules of MISO and PJM? Do the rules of MISO and PJM change/remain the same of the next 25 years?
Answer: We haven't made any assumptions yet, but we will rely on this group to help make scenario assumptions for our planning horizon.

Lunch Break from 11:30am – 12:30pm

Energy Efficiency
Tom Wiles, Director EE Analytics

Tom welcomes everyone back from lunch and reminds everyone that this part of the presentation is high level. He will discuss the methodology that will be used and is looking for feedback on the approach. He doesn't have many numbers, but with the market potential study (MPS) was released and will be posted to the website. Duke will begin to assign numbers to the methodology in the future.

Tom informed the stakeholders that the MPS was presented to the oversight board on February 8th. He proceed by going over slide 29 and reviewed the MPS, IRP, and EE filing schedule and the timeline of how the information flows and is used.

Tom shows some of the results from the MPS. He reviewed the terminology of the "Technical", "Economic", "Base Achievable – no opt outs", and "Base Achievable – opt outs". Addition data provided

in the MPS recommended different achievable programs, estimated costs, cost effectiveness scores, and demand response potential.

Stakeholder comment: Stakeholder wanted to confirm that the report has the "Enhanced Portfolio Achievable" and that Duke will be using that information. She also wanted to confirm that the MPS does not include emerging technologies. She wants the model to include emerging technologies that haven't been developed yet.
Response: Correct, the enhanced portfolio achievable will still be used. Correct, the MPS does not include emerging technologies, but that is something that could be considered. Tom said the model will be provided different buckets and have different tiers of adoption rates and sensitivities.

Tom explains slides 30, 31, and 32 of how EE modeling will work. He gives examples of programs for some of the EE bundles. The way Duke is thinking about modeling is based on savings shapes and the influence they have on customer load. On slide 33 Tom highlights more on the cost of the bundles.

Stakeholder question/comment: The bundles will have different programs that have different costs. There is concern that the programs should also be grouped together based on cost or at least try to consider how to group expensive and cheap programs that have the same load shapes.
Response: Tom understands the question and thinks that sensitivity analysis will help address her question. Duke will continue to keep an eye on the programs in each bucket. The bundles of measures may be tiered separated by cost, so certain measures will not raise the cost of a complete bundle that will make it uneconomic for the model to select.

Stakeholder question: Is there a way to look back and see the EE assumptions and see a benchmark from the previous IRP. Is there a way to look back and see how the programs performed? Example: He wants to look at the load curve of previous IRP compared to the current IRP load curve and see EE impacts.
Response: The question is good, no answer right now because that is tough to answer. There are more factors going in to load shape changes than just the EE implementation. Tom said we will think about this further and get back to you. The quarterly EE scorecard might be a good to resource to review as well.

Stakeholder comment: This MPS is based on the spring 2017 load forecast, we don't have the IRP load forecast yet. She would like to see the comparison of the two load forecast.
Response: There might be a way to ratio the two. But in a future meeting we can look into showing the two different load forecasts and showing how different they are.

Stakeholder question: How is the EMI going to fit on how we measure EE programs?
Response: Good question, no specific answer. But Tom doesn't think it impacts the forecasting methodology, but could incorporate after the fact.

Stakeholder question: Where do smart thermostats fit into this? How about smart homes?
Response: Smart Thermostats are part of the studied portfolio and are being looked into for demand response purposes. We have about 500,000 dollars in 2018 budget for BYOT and we will continue to invest more and look more into those programs.

Stakeholder comment: DEI hit new historic winter peak this year. Advanced Energy Economics released a Demand Response article on energy in Indiana and wanted to make everyone aware of that.

After the stakeholder questions/comments, Tom then handed the presentation over to Scott Park to discuss slide 34 and how EE is handled in the model. Scott apologizes for the technical difficulties (the projector went out during Toms portion of the presentation). He mentions that with the number of bundles we are modeling, he thinks modeling of energy efficiency will be very transparent and will increase possibility of grouping EE bundles correctly with consideration to the cost. The model will choose the optimized portfolio for each scenario.

Stakeholder question/comment: Are you planning on using the customer's smart phone and empowering them to make their own decisions on how to save money.
Response: That is where technology is taking us. We are trying to stay ahead of the market with the smart meter usage app to allow consumers to make better decisions and show they usage behaviors.

Stakeholder question/comment: Comments on factors that affect selection of portfolio. Should consider considering a sensitivity at doing EE as zero cost (avoided costs). Could use this type of methodology for EE program screening. This would be a complimentary study.
Response: This is definitely something that we can discuss further and please reach out to Scott to set up a meeting.

Looking Ahead to April: Scenario Analysis
Nate Gagnon, Lead Planning Analyst

Nate informed the stakeholder that the next meeting in April will be on construction of scenarios in IRP . It is hard to accurately predict future, but we can come up with multiple possible scenarios to come up with a robust portfolio to be successful across multiple different futures.

On slide 36, Nate went over the scenario planning process. The scope of the IRP is the DEI service territory and factors that impact that territory. The factor that cannot be predicted (fuel prices, legislation, etc.) must be considered. From that list, "key" factors need to be identified. Then scenarios can be constructed using themes, where external factors are not in conflict. These scenarios are then used to develop portfolio, perform sensitivity analysis of other non-"key" factors, and then select preferred portfolio.

Stakeholder question: Are you going to incorporate any stochastic modeling in our forecast?
Response: IRP models are deterministic. As far as the forecast, even though it would be great to try to use them, due to the difficulty and large number of variables that need to be estimated, we aren't going to do stochastic modeling.

Stakeholder comment: Stakeholder would like to suggest an alternative approach. A financial disclosure model. Duke would disclose and report how we are doing with a 2-degree scenario voluntarily. This way investors/customers/supporters can make their own decisions and see the data on the risk of the company's portfolio in a carbon constrained future. Additionally, a utility of the future scenario that reflects a different business/regulatory model would be beneficial. Given that the planning period for this IRP extends through 2038, both of these alternative scenarios are of sufficient probability of occurrence and significance of impact during that time horizon to warrant beginning development of related planning and analysis frameworks (individually and/or jointly) at this time.

Response: The purpose of this process is to develop a plan that performs well in multiple futures. This process will hopefully prepare us best for multiple different futures.

Stakeholder question: What variables other than natural gas can't be reliably modeled? Also, will we see assumptions of various themes.
Response: Gas prices can be modeled, but very hard to predict. The themes, based on uncertainties, will be developed with the stakeholders input. Consider key uncertainties for future for the next meeting.

Stakeholder question: How many scenarios and sensitives would Duke like to run?
Response: Maybe 5 scenarios and different sensitives for every scenario.

Closing Comments
Scott Park, Director IRP Analytics – Midwest
Heather Quinley, Director of Energy Affairs & Stakeholder Engagement

Heather thanks everyone for active participation. April 17th is the date of the next stakeholder meeting. Please send comments/feedback to Scott and we will have meeting notes out by 2/21. Scott hopes we will continue have good conversation. In April we will look further at scenarios and he looks forward to working together at the next meeting. Scott then goes over the stakeholder plans for the upcoming meeting with the final meeting being in October.

Stakeholder question: Will you be giving us data of the fuel forecast and other forecast?
Response: Not for the next meeting. The data is a bi-product of the scenarios which will be developed by the stakeholders at the next meeting. That kind of data will be after April, but before the June meeting.

Stakeholder question: Can we get some of the base spring load forecast? Or see the other load forecast ahead of the April meeting?
Response: The load forecast will be scenario dependent. And the spring load forecast will probably not be done by April.

Meeting Ends at 2:15pm

2018 Integrated Resource Plan

Stakeholder Workshop #3





April 17, 2018
Plainfield, IN

Welcome

- Safety message
- Technology
  - Call-in # 866-385-2663
  - Wi-Fi provided as in previous meetings
- Melody Birmingham-Byrd Opening Comments
- Introductions

Why are we here today?

- Recap February stakeholder meeting and respond to comments/questions
- Review desired characteristics of preferred resource plan
- Update on EE modeling
- Discuss sources of uncertainty over planning horizon
- Present reference case and alternative scenarios for IRP
- Discuss stakeholder developed scenarios

Agenda

Time	Topic
8:30	Registration & Continental Breakfast
9:00	Welcome, Introductions, Agenda
9:20	Review of February Meeting & Responses to Questions/Feedback
9:45	Characteristics of Preferred Portfolio
10:00	Scenario Planning Process & Sources of Uncertainty
10:30	Break

Time	Topic
10:45	Forecasts of Select Variables
11:15	Update on Modeling EE
11:30	Lunch
12:30	Reference Case Scenario & Alternative Scenarios
1:30	Stakeholder Scenarios
2:30	Scenario Review
2:50	Closing Comments

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Scott Park, Director IRP Analytics - Midwest

Review of February Meeting & Characteristics of Preferred Portfolio

Recap of February Meeting

- Review of November 2017 meeting
- Desired portfolio characteristics
- Review of resource types
- EE modeling
- Prep for scenario development

Comments from February Meeting

STAKEHOLDER QUESTIONS/COMMENTS	RESPONSES
Have any one-off meetings with SH taken place?	No
What about the proposal by CAC to model EE bundles as zero-cost resources?	We have expressed openness to a sidebar meeting
How does the MPS load forecast compare to the IRP load forecast?	The MPS forecast was prepared in 2017 and based upon the Spring 17 forecast; the IRP will be based on the Spring 18 forecast
How did the EE assumptions in the 2015 IRP play out in reality?	Total actual kWh savings during the 2015-2017 period exceeded the 2015 IRP projections by 15%
How will yet-to-be-developed EE technologies be considered in IRP?	Similar load shapes as in the near term will be used along with future cost sensitivities

Comments from February Meeting

STAKEHOLDER QUESTIONS/COMMENTS	RESPONSES
Will stakeholders be allowed to present at meetings?	• Yes but subject to time availability • Case by case basis • Need advance notice
Less education; more opportunity for feedback	Understand concerns of some stakeholders, but not everyone is at the same level of knowledge; early meetings more foundational; later meetings will include more opportunities for input
Will stakeholders have an opportunity to develop scenarios?	Yes - similar to the 2015 IRP process, stakeholders will be allowed to develop scenarios & portfolios
Will stakeholders have an opportunity to develop portfolios?	
How will confidential data be handled?	To be updated at April 17th meeting

Characteristics and Metrics

CHARACTERISTIC	METRIC
Low Cost	5-yr PVRR, 20-yr PVRR
Low Risk	Cost Variability Across Scenarios & Sensitivities
Flexible	Frequency, Size, Timing of Irreversible Decisions
Low Environmental Impact	Annual CO_2 Emissions
Reliable	Meets Long-Term Planning Reserve Margin Each Year

Note: It is important that, regardless of the ultimate composition of the preferred portfolio, resources are selected through a transparent process in which a comprehensive set of supply- and demand-side resources is considered and resources are assessed on an even playing field

Nate Gagnon, Lead Planning Analyst

-Scenario Analysis Process
-Sources of Uncertainty
-Representative Forecasts for Select Variables

Scenario Planning: Process

Scenarios

- Define Scope & Purpose
- Identify Sources of Uncertainty
- Define "Key" Uncertainties
- Construct Scenarios Around Themes
- Check for Consistency and Completeness

Portfolios

- Develop Quantitative Models
- Sensitivity Analysis
- Select Preferred Portfolio

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Sources of Uncertainty

Market

- Gas Price
- Coal Price
- Fuel Oil Price
- Power Price
- Load

Policy

- Carbon Cost/Limit
- Tax Credits
- MISO Market Design
- Other New Compliance

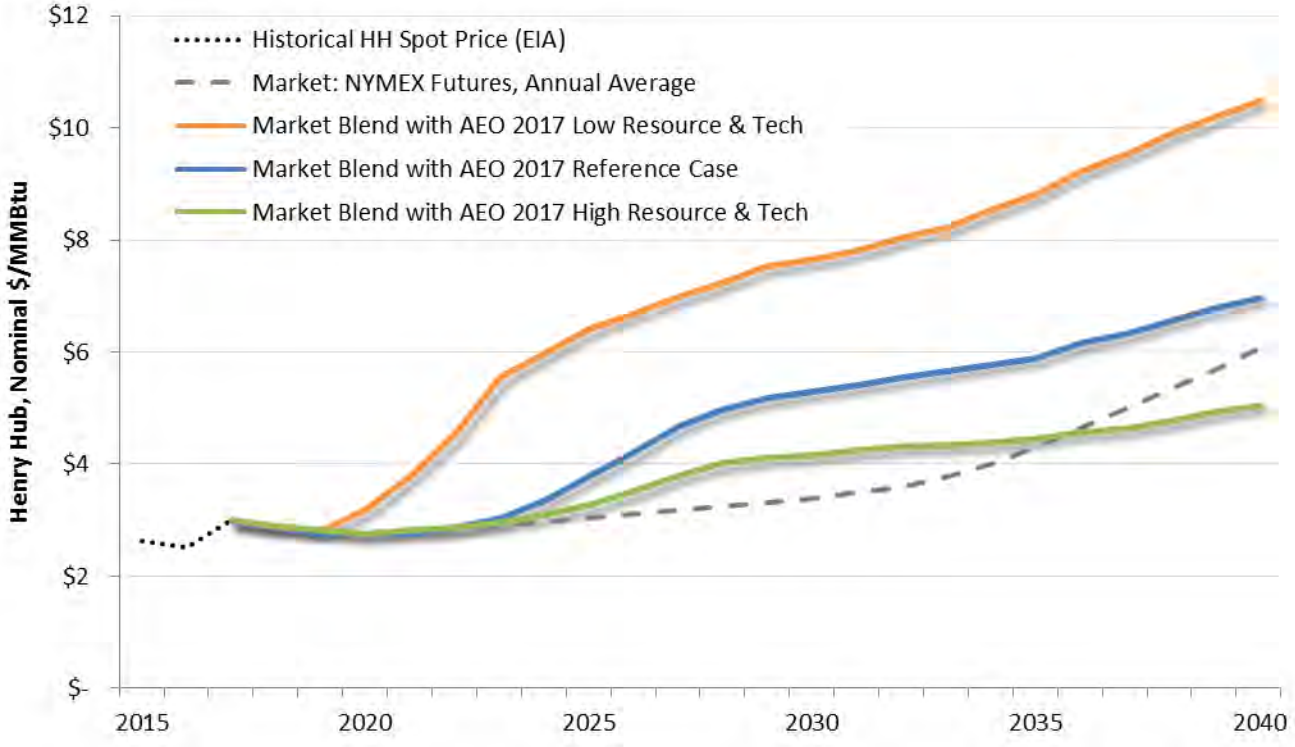
Technology

- Cost of Wind
- Cost of Solar
- Cost of Storage
- Cost of CC/CT
- Heat Rates
- Emissions Rates
- Cost of CCS
- EE Efficacy
- BTMG Adoption
- EV Adoption

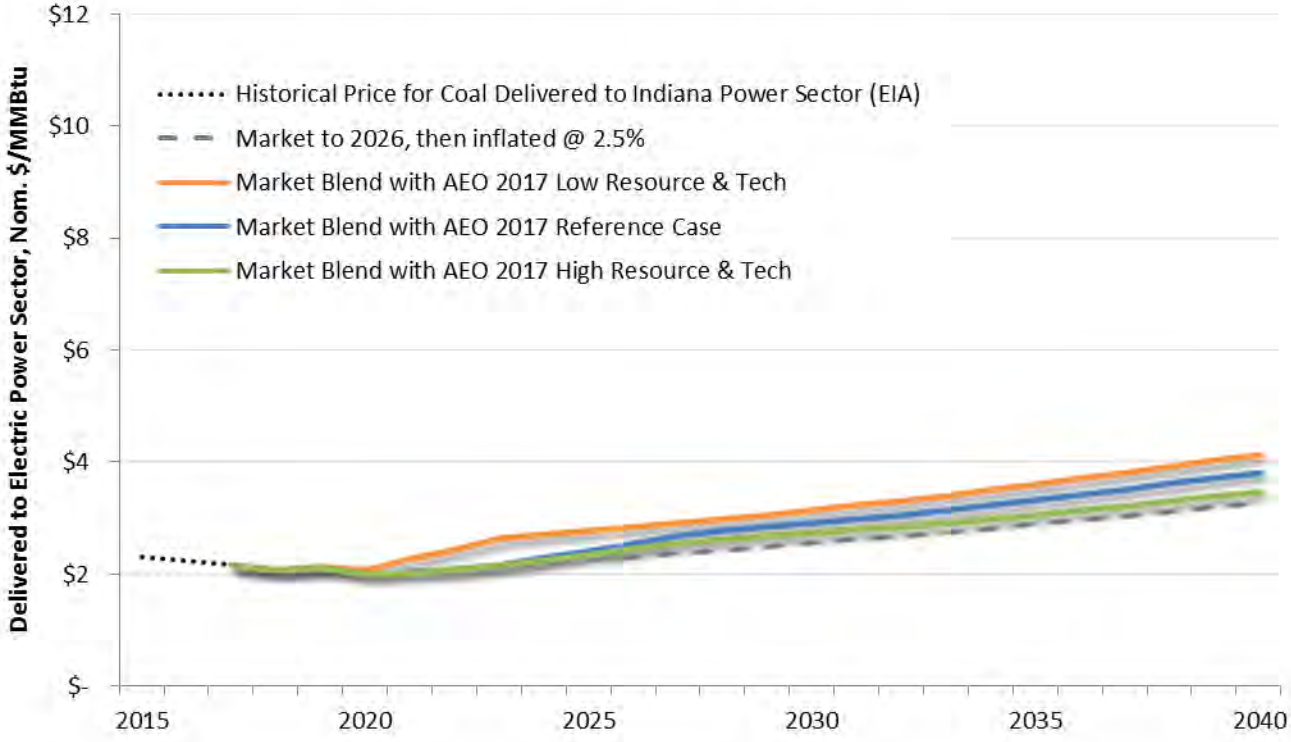
Sources and Methods

- Forecasts in the following slides are representative of those we expect to use in the IRP analysis, but should not be considered final and do not exactly match certain proprietary forecasts
- **Fuel Price Cases:** We plan to use derivatives of the coal and gas price forecasts in the EIA's 2018 Annual Energy Outlook (AEO) for our alternative scenarios. Low price cases are based on the AEO "High Oil and Gas Resource and Technology" scenario, and high price cases are based on the AEO "Low Oil and Gas Resource and Technology" scenario
- **Market Blending:** All fuel price forecasts reflect market prices for the first 2 to 5 years, followed by 3 to 5 years of blended market and fundamental forecast prices, before transitioning fully to the fundamental forecast. Because we adjust the starting point, our forecasts are not exactly equal to those in the AEO, but the shapes of the curves are the same after the blending period
- **Power Price Cases:** Final power price curves will be developed based on the final fuel and carbon price assumptions using an iterative process that accounts for changes in the makeup of the MISO generating fleet. Curves shown here are based on the fuel and carbon price forecasts in this presentation but do not account for changes in the MISO fleet
- **Load:** The load forecasts shown here are internal Duke Energy forecasts and represent weather-normal gross load before adjusting for utility-sponsored energy efficiency programs
- **Carbon Prices:** The carbon price forecasts shown here are internal Duke Energy forecasts
- **Renewable Energy Costs:** Based on the NREL *2017 Annual Technology Baseline* converted to nominal dollars using inflation of 2.5% per year and, in the case of the solar forecast, converted to AC capacity at a 1.2 ILR and adjusted to reflect fixed tilt systems based on the NREL *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017*

Gas Price History and Forecasts



Coal Price History and Forecasts



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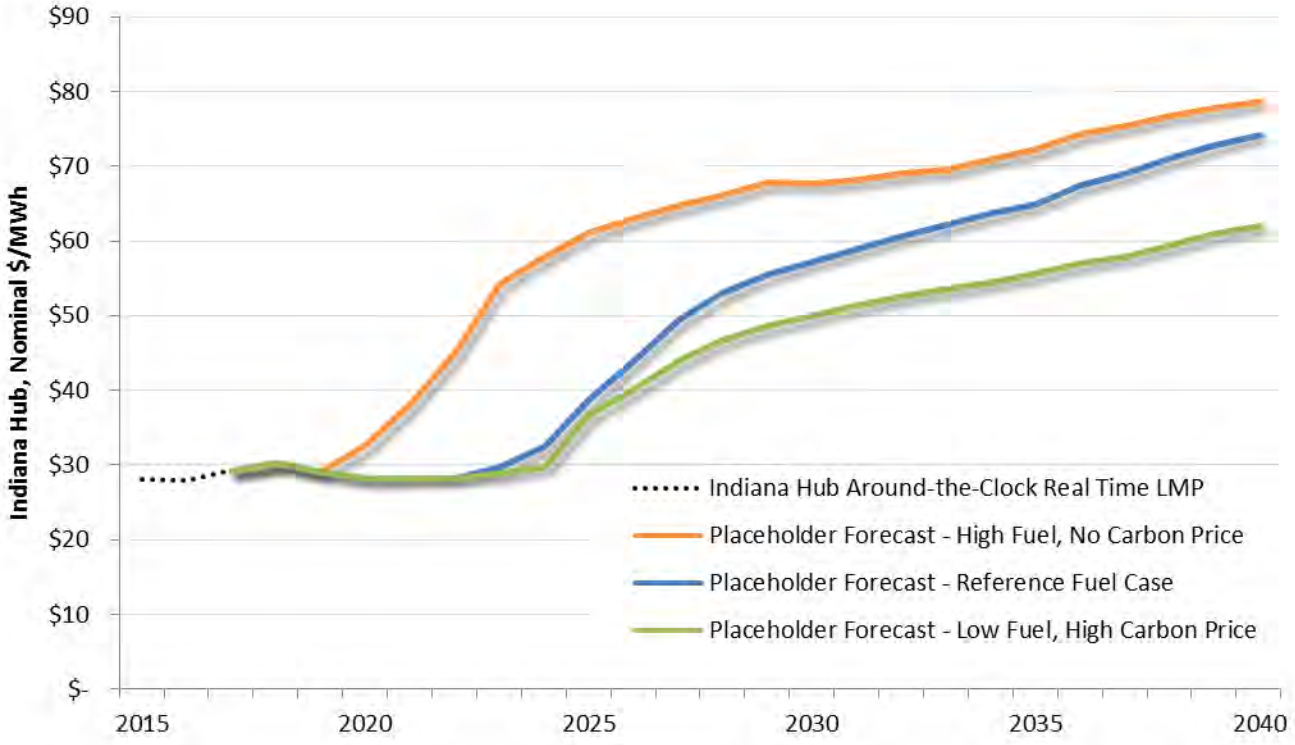
Power Price History and Forecasts



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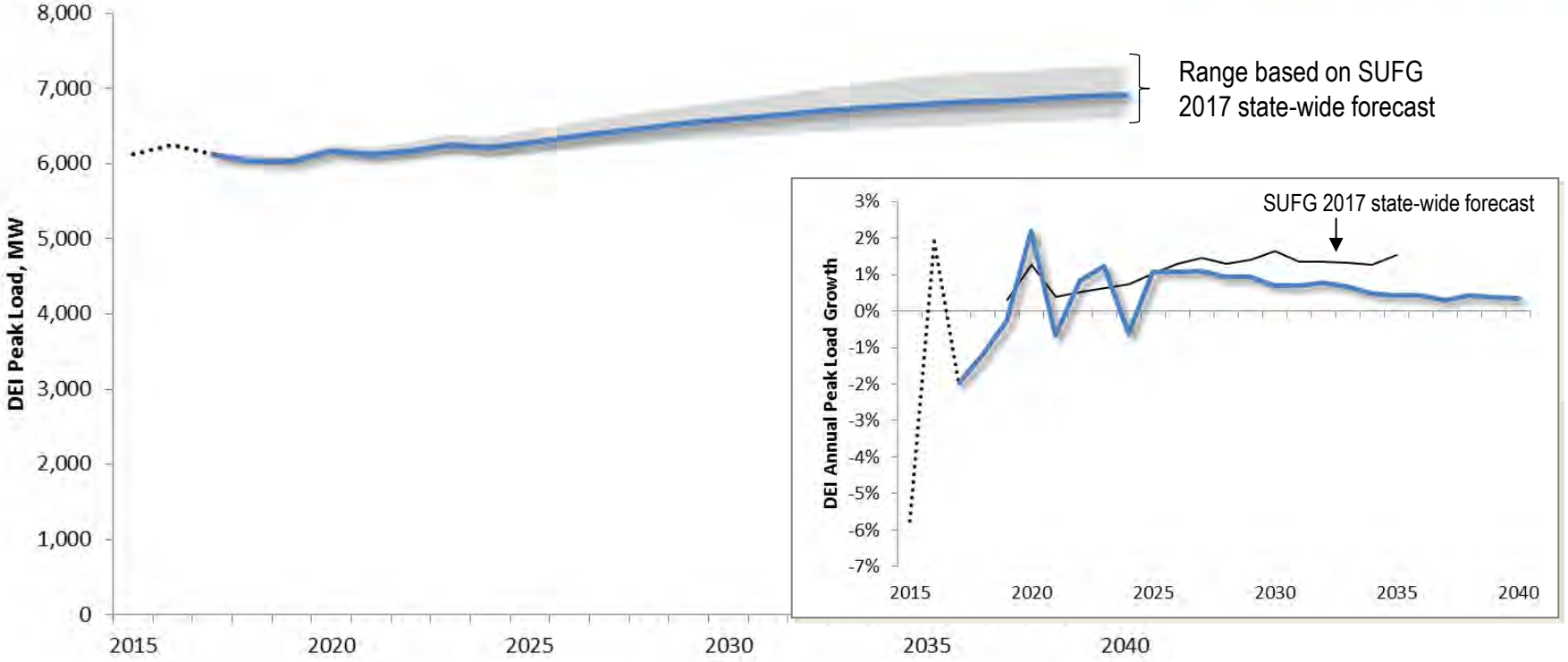
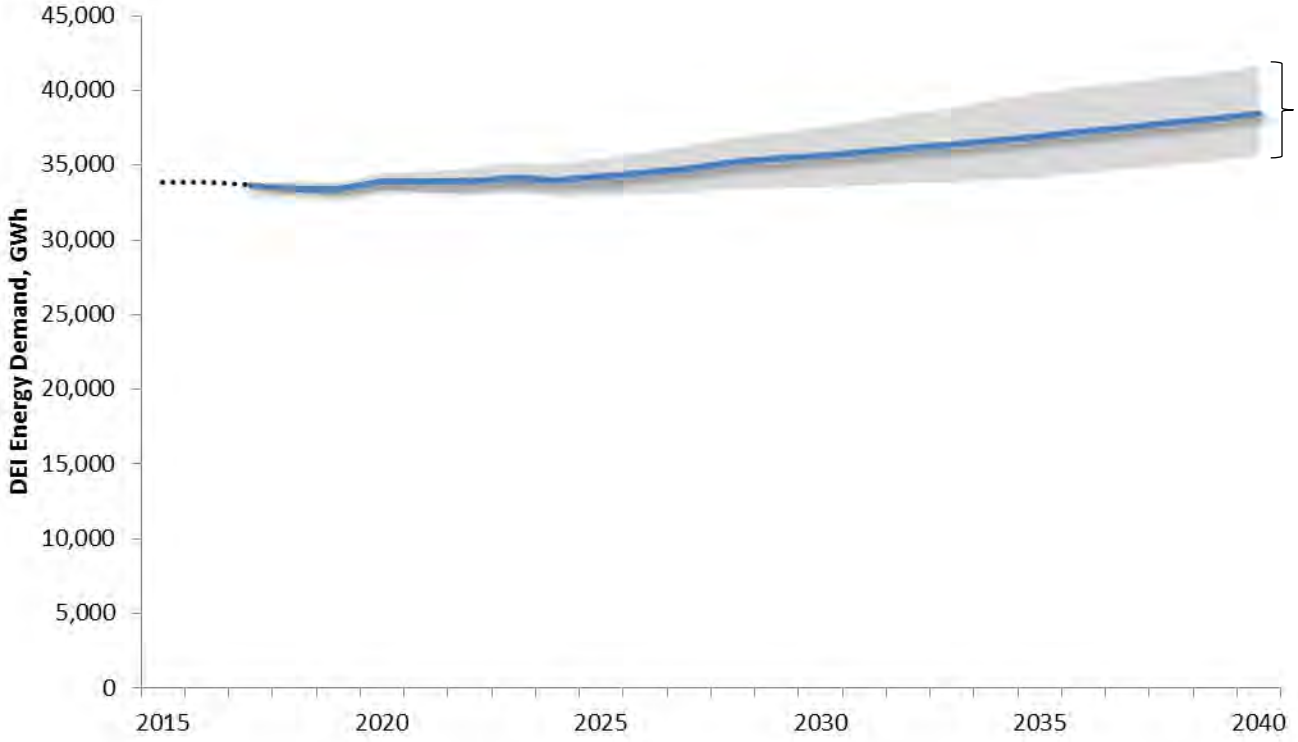
Peak Load History and Forecast



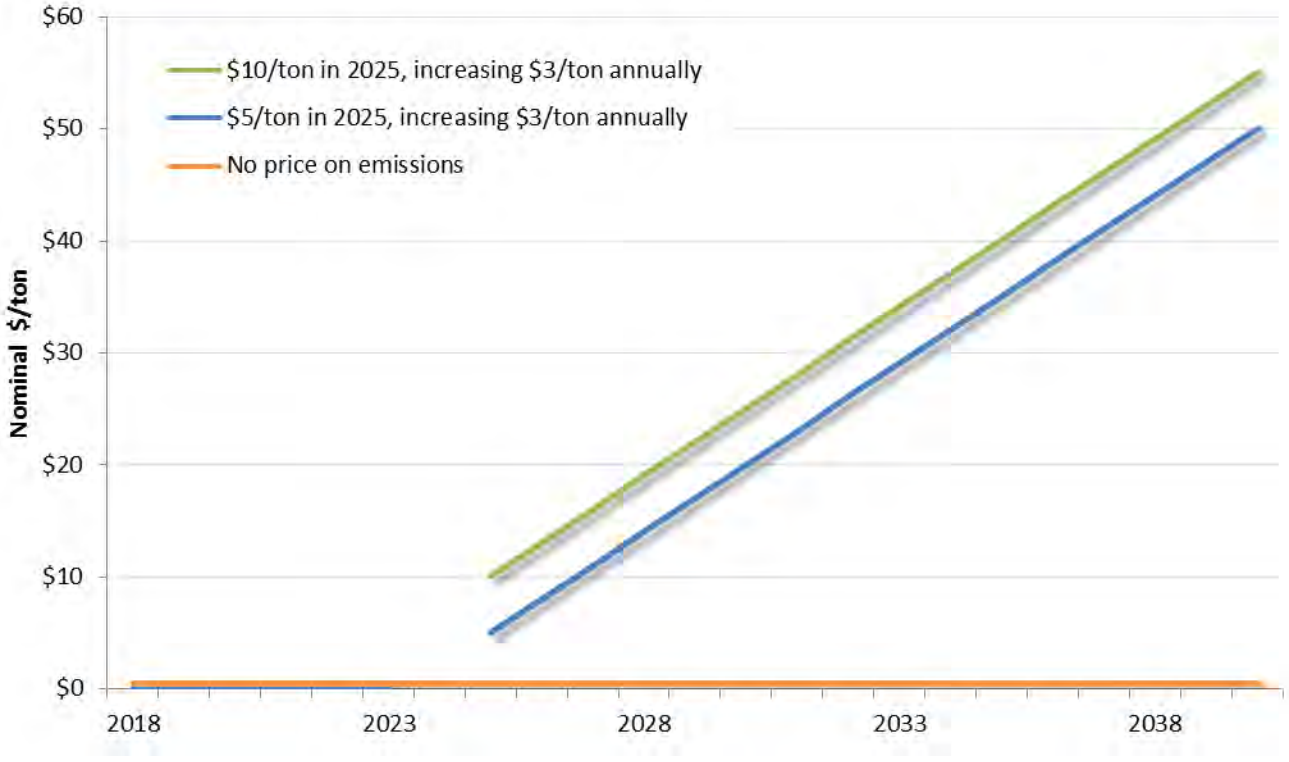
Note: Peak load forecast shown here is before accounting for utility-sponsored energy efficiency and demand response

Energy Demand History and Forecast



Note: Energy demand forecast shown here is before accounting for utility-sponsored energy efficiency

Carbon Price Forecasts



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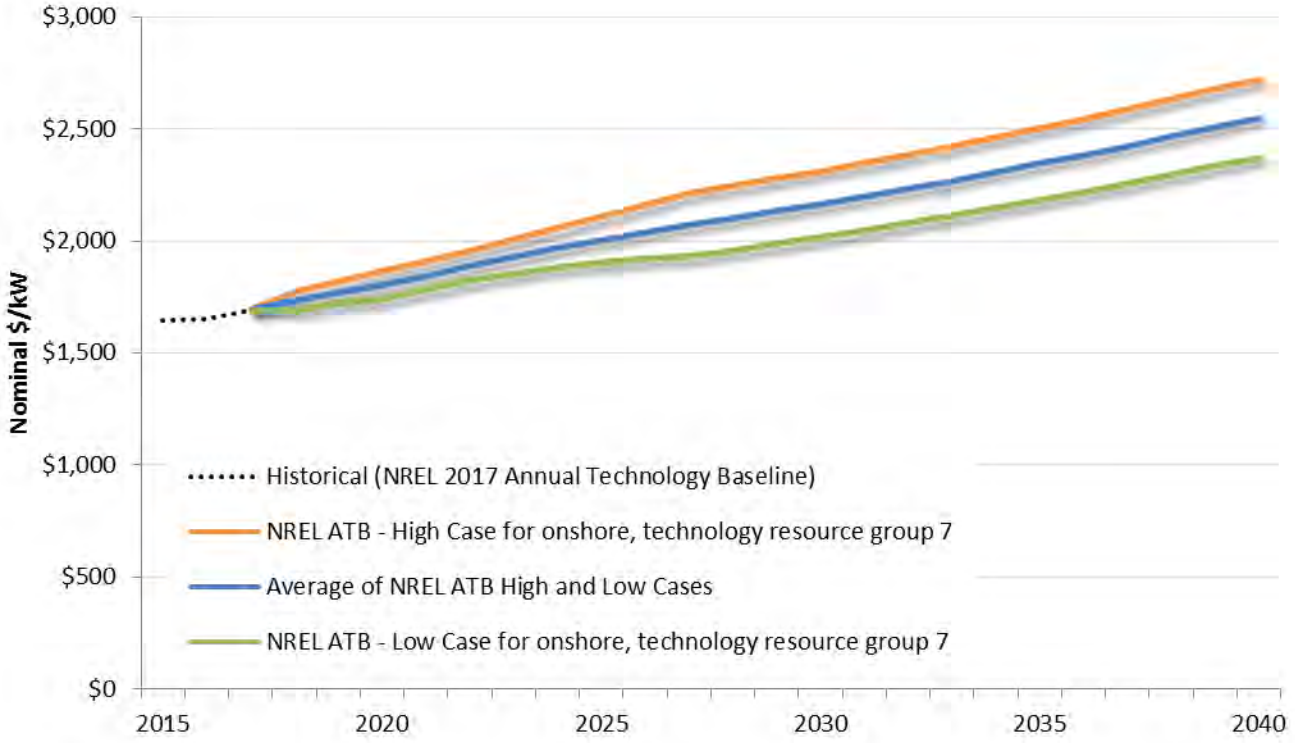
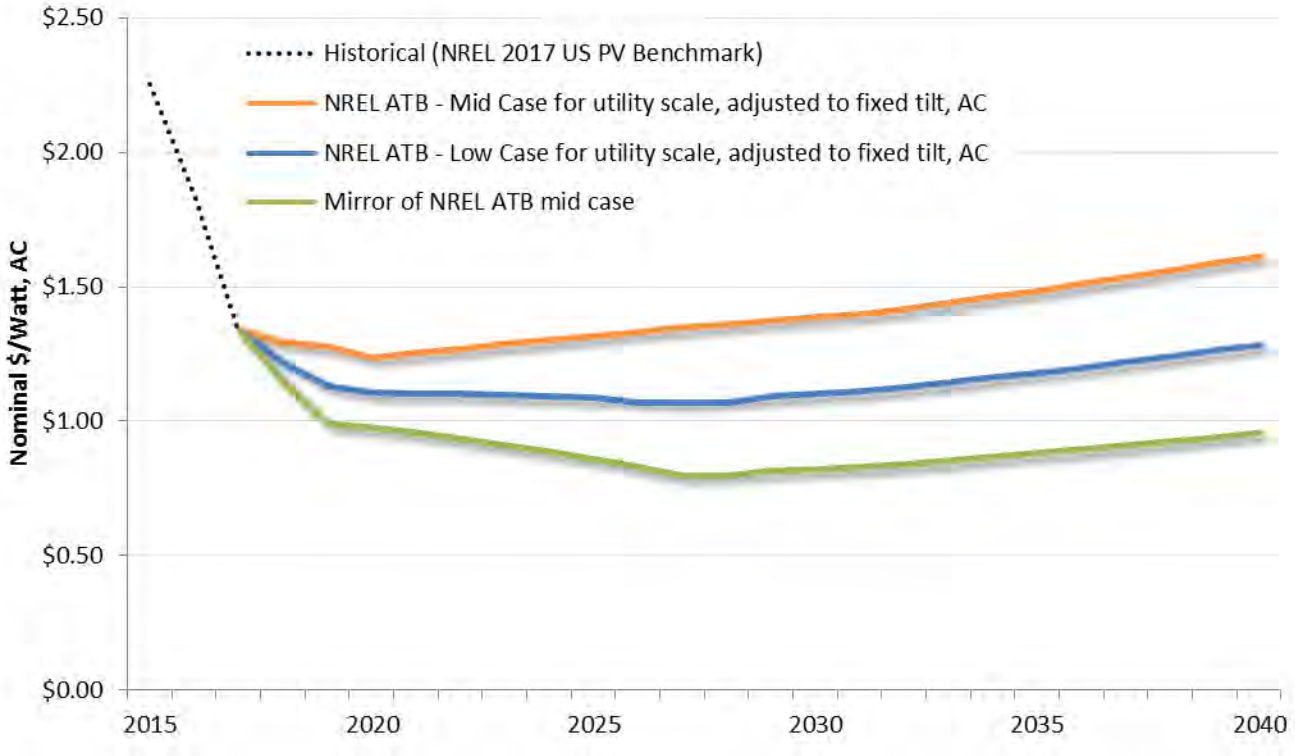
Overnight Capital Cost, Wind



Note: Costs shown here exclude interconnection and owner's costs

Overnight Capital Cost, Solar



Note: Costs shown here exclude interconnection and owner's costs

Brian Bak, Lead Planning Analyst

Energy Efficiency

Modeling EE Update

- The MPS shows different levels of EE savings potential under different sets of assumptions
  - Achievable: overall portfolio is cost effective and comports with historical customer behavior
  - Economic: each measure is cost effective but assumes full customer adoption
  - Technical: physically possible regardless of economics and assumes full customer adoption
- The challenge for the IRP is to develop EE bundles that are feasible
  - Achievable
  - Enhanced: greater EE savings from existing and new measures/programs
  - Technical Sub-set: even greater savings from measures not included in Enhanced but part of Technical Potential in MPS

Using the MPS to Create EE Bundles

Data from the MPS will be used to create different EE tiers

Potential Tiers	Time Buckets				
	2018-19	2020-22	2023-25	2026-31	2032-37
Achievable					
Enhanced					
Technical Sub-set					

Each tier will also be divided into bundles:

- Res - Weather - Summer Only
- Res - Weather - Year-Round
- Res - Lighting
- NonRes - Flat - Daytime
- NonRes - Flat - Nightime
- NonRes - Flat - Year-Round
- NonRes - Weather - Summer Only
- NonRes - Weather - Year-Round

Cost of EE bundles

- Because the cost of future EE programs is uncertain, the growth in annual cost will be modeled as three trajectories consistent with a scenarios narrative

Res - Weather - Summer Only
Res - Weather - Year-Round
Res - Lighting
NonRes - Flat - Daytime
NonRes - Flat - Nightime
NonRes - Flat - Year-Round
NonRes - Weather - Summer Only
NonRes - Weather - Year-Round

Costs increase at inflation plus a factor for increased penetration (~4%) (Rising Real Costs)

Costs increase at inflation (~2.1%) (Constant Real Costs)

Innovation offsets inflation and factor for increased penetration (~0%) (Declining Real Costs)

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Lunch

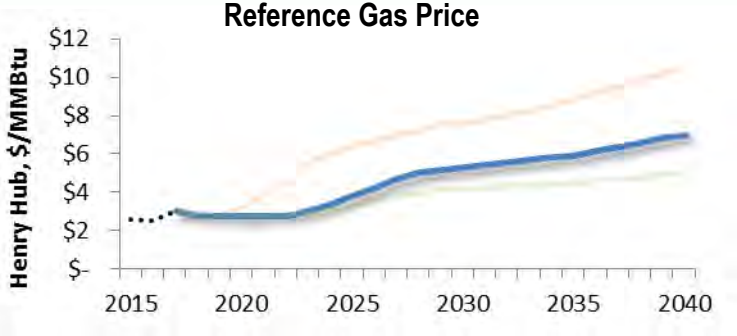
Brian Bak, Lead Planning Analyst

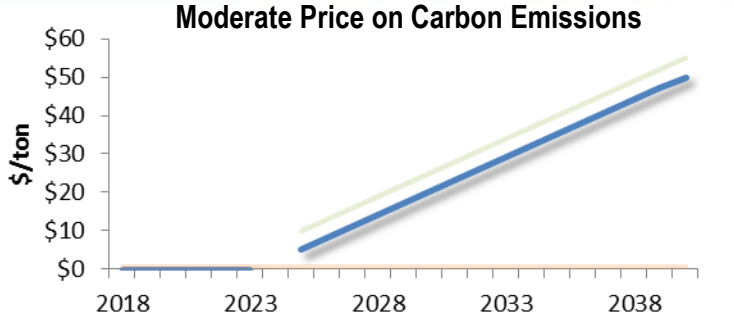
Three Duke Scenarios
- Reference
- High Technology
- Slower Innovation

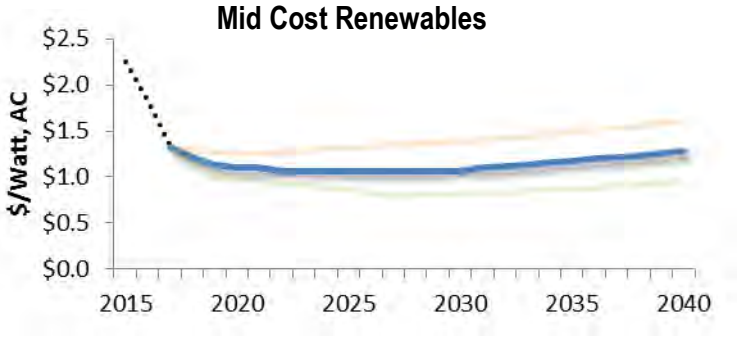
Reference Case Scenario

The Reference Case envisions many aspects and trends of the present persisting into the future. Load growth is moderate at approximately 0.5% per year. Innovation continues to drive down the cost of renewable resources and energy efficiency measures, and increases in the cost of oil, gas and coal extraction are moderate. Public opinion shows support for a response to climate change and a price on carbon emissions is imposed starting in 2025. Lower capital costs for renewable projects and the presence of a carbon price obviate any push to extend federal tax incentives for renewables.

Reference Case Scenario







- Reference coal prices
- Reference load
- Reference EE cost trajectory
- ITC reduced to 10% by 2022
- PTC expires in 2020

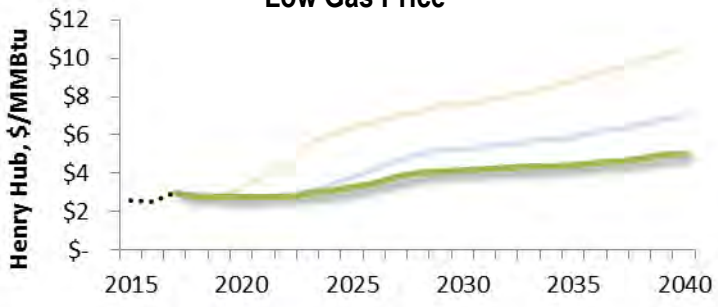
Note: Solar cost shown for illustrative purposes

High Tech Future

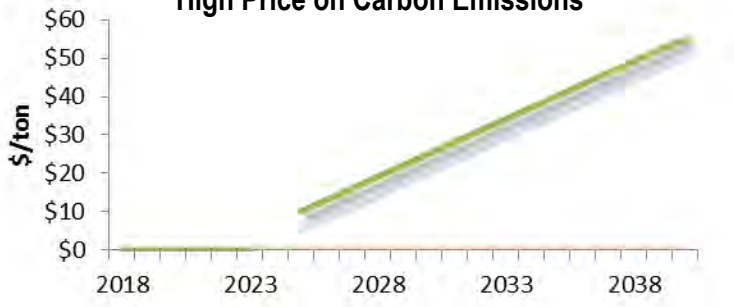
The High Tech Future features increased levels of innovation that hasten the reduction in the cost of renewable resources and energy efficiency measures while also holding down the cost of oil, gas and coal extraction. Load growth is higher than the Reference Scenario as technology gains and lower cost energy spur economic growth. As in the Reference Case, public opinion shows support for a response to climate change which, coupled with lower energy prices, leads to the imposition of a more aggressive price on carbon emissions starting in 2025. Lower capital costs for renewable projects and the presence of a steep carbon price eliminate discussion of extending federal tax incentives for renewables.

High Tech Future

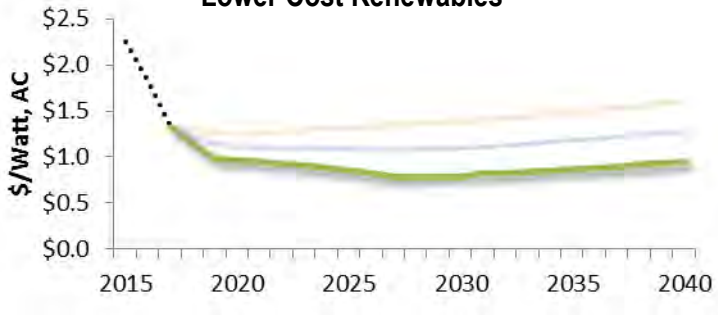
Low Gas Price



High Price on Carbon Emissions



Lower Cost Renewables



Note: Solar cost shown for illustrative purposes

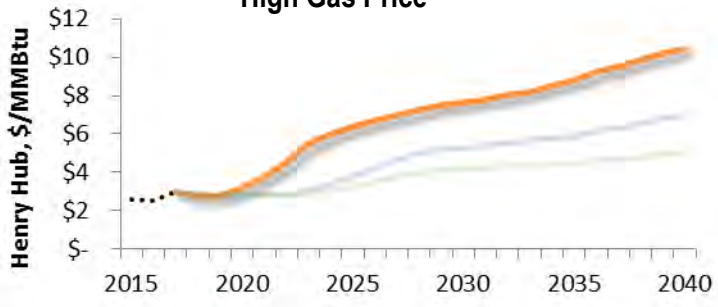
- Low coal prices
- Higher load forecast
- Flat EE cost trajectory
- ITC reduced to 10% by 2022
- PTC expires in 2020

Slower Innovation

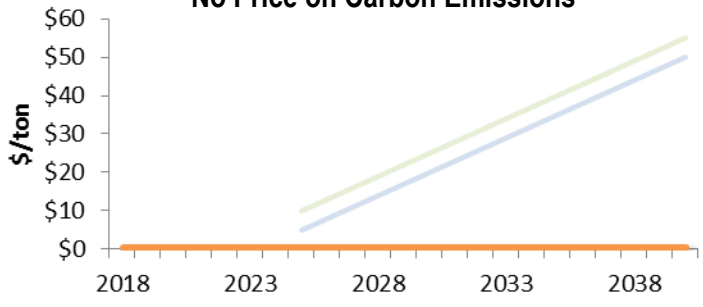
The Slower Innovation case features a reduction in the pace of technological advancement that moderates cost declines for renewable resources and energy efficiency measures. Continued dependence on fossil fuels for generation and transportation, combined with higher resource extraction costs, puts upward pressure on fuel prices. Load growth is lower than the Reference Scenario being moderated by slower technology gains and higher energy prices, which also make a price on carbon politically unpalatable. Slower reductions in the capital costs for renewable projects lead to calls for the extension of federal tax incentives for renewables, which are extended through 2022.

Slower Innovation

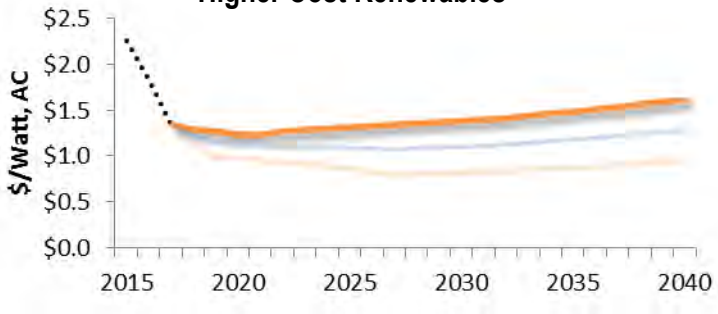
High Gas Price



No Price on Carbon Emissions



Higher Cost Renewables



- High coal prices
- Lower load forecast
- Higher EE cost trajectory
- ITC of 30% through 2022, 10% thereafter
- PTC extended at $10/MWh through 2022

Note: Solar cost shown for illustrative purposes

Scenario Summary (DEI)

Scenario	Gas Prices	Coal Prices	Load Forecast	Carbon Price	Cost of Solar & Wind	Cost of EE	Federal Tax Credits
Reference Case	Mid	Mid	Mid	Mid	Mid	Mid	Current Law Unchanged
High Tech Future	Low	Low	High	High	Low	Low	Current Law Unchanged
Slower Innovation	High	High	Low	None	High	High	Extended Through 2022

Presentation of Stakeholder Scenarios

Current Conditions (CAC)

Uses reference case forecasts for load growth, fuel, wholesale prices, wind, solar, etc.

Natural Gas Price, Henry Hub	NYMEX futures
Coal Price, Delivered	CME futures plus delivery charge
Carbon Price	
Solar All-In Overnight Capital Cost, Fixed Tilt, 20 MW AC	Pegged to Bloomberg New Energy Finance or GTM research forecast
Wind All-In Overnight Capital Cost, Onshore, 100 MW	Pegged to NREL ATB forecast
Peak Summer Load Before Utility-Sponsored EE	Duke reference case
Annual Energy Consumption Before Utility-Sponsored EE	Duke reference case
Power Price	OTC forwards for the Indiana Hub

Social Cost of Carbon (CAC)

Uses reference case forecasts for load growth, fuel, wholesale prices, wind, solar, etc, with a carbon price imposed in line with the social cost of carbon as estimated by EPA.

Natural Gas Price, Henry Hub	NYMEX futures
Coal Price, Delivered	CME futures plus delivery charge
Carbon Price	Social Cost of Carbon from EPA TSD
Solar All-In Overnight Capital Cost, Fixed Tilt, 20 MW AC	Pegged to Bloomberg New Energy Finance or GTM research forecast
Wind All-In Overnight Capital Cost, Onshore, 100 MW	Pegged to NREL ATB forecast
Peak Summer Load Before Utility-Sponsored EE	Duke reference case
Annual Energy Consumption Before Utility-Sponsored EE	Duke reference case
Power Price	OTC forwards for the Indiana Hub

Beneficial Electrification (CAC)

Customer preferences push adoption of distributed solar, electric vehicles, and "smart" thermostats. Storage costs are pegged to Wood Mackenzie forecasts, EV adoption rates from BNEF, and appropriate vendor commodity prices will be utilized in order to maintain consistency with this new paradigm.

Natural Gas Price, Henry Hub	Vendor Supplied
Coal Price, Delivered	Vendor Supplied
Carbon Price	
Solar All-In Overnight Capital Cost, Fixed Tilt, 20 MW AC	Pegged to Bloomberg New Energy Finance or GTM research forecast
Wind All-In Overnight Capital Cost, Onshore, 100 MW	Pegged to NREL ATB forecast
Peak Summer Load Before Utility-Sponsored EE	Duke reference case adjusted for DER, EV, and thermostat adoption.
Annual Energy Consumption Before Utility-Sponsored EE	Duke reference case adjusted for DER, EV, and thermostat adoption.
Power Price	Vendor Supplied

Load Growth and Economy Decouple (CAC)

Electricity consumption and economy growth continue to decouple from each other such that electricity consumption remains stagnant even as the economy improves. The commodity prices would have be developed with vendor support under the presumption that load growth remains stagnant through the U.S.

Natural Gas Price, Henry Hub	Vendor Supplied
Coal Price, Delivered	Vendor Supplied
Carbon Price	
Solar All-In Overnight Capital Cost, Fixed Tilt, 20 MW AC	Pegged to Bloomberg New Energy Finance or GTM research forecast
Wind All-In Overnight Capital Cost, Onshore, 100 MW	Pegged to NREL ATB forecast
Peak Summer Load Before Utility-Sponsored EE	Based on 10-year trend of sales in DEI territory.
Annual Energy Consumption Before Utility-Sponsored EE	Based on 10-year trend of sales in DEI territory.
Power Price	Vendor Supplied

Global Carbon Constraint (Mullett)

This scenario is based on the IPCC 2011 Report which considers constraining cumulative global carbon emissions to no more that one trillion metric tons by 2050 in order to have any meaningful chance (25%) of constraining global temperature rise to below two degrees centigrade.

In this context, it should be noted that approximately half of those emissions had already been made by 2011, meaning that future carbon emissions between 2011 and 2050 needed to be constrained to between 250 and 500 million tonnes.

This analytical construct was then used in the Paris Climate Accords of 2015 to elicit "fair share" National Determined Contributions (NDCs) intended to make a reasonable start on meeting that global constraint.

Global Carbon Constraint (Mullett)

Of late, major investors and financial standards organizations have extended this analytical framework to major corporations in the energy, oil and gas industries as a financial disclosure framework designed to better inform management, boards of directors, investors and the consuming public at large of the relative climate-related "stranded investment risk" of current corporate policies and conceivable alternatives to those policies.

Duke Energy is one of those major corporations, with climate-related stranded investment risk being estimated at eight to ten billion dollars.

Utility of The Future (Mullett)

Indiana utilities face unavoidable and significant financial and operational risks in the current IRP planning horizon from 2018 through 2037 associated with technological innovation and electricity market transformation. This scenario is intended to reflect the evolution of the traditional Indiana utility business and regulatory models into "the utility of the future" required to address these risks. Rather than "re-invent the wheel" to describe the conceptual nature of this scenario, I am instead providing a recent report prepared by the Rocky Mountain Institute to summarize its ongoing Utility of the Future project combining research, analysis and collaborative discussion among representative stakeholders which is being facilitated by the Institute.

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Scott Park, Director IRP Analytics - Midwest

Overall Scenario Discussion & Next Steps

Evaluation of Scenarios in Aggregate

- Do we have a comprehensive set of scenarios?
  - What major potential futures have we overlooked?
  - How can we address significant gaps (if any)?
- Have we avoided redundancy?
  - Delete/merge redundant scenarios
- What possibilities remain to be addressed in sensitivity analysis?

Scenario Summary

Scenario	Gas Prices	Coal Prices	Load Forecast	Carbon Price	Cost of Solar & Wind	Cost of EE	Federal Tax Credits
1) Reference Case	Mid	Mid	Mid	Mid	Mid	Mid	Expire
2) High Tech Future	Low	Low	High	High	Low	Low	Expire
3) Slower Innovation	High	High	Low	None	High	High	Renewed
4) Current Conditions	Extrapolate Market	Extrapolate Market	Mid	None	Mid Navigant	Mid	Expire
5) Social Cost of Carbon	Extrapolate Market	Extrapolate Market	Mid	SCC(EPA)	Mid Navigant	Low	Expire
6) Beneficial Electrification	Vendor (Mid?)	Vendor (Mid?)	Adjusted for DER, EV, etc	None	Mid Navigant	Low	Expire
7) Load Growth and Economy Decouple	Vendor	Vendor	Extrapolate 10 yr. trend	None	Mid Navigant	Low	Expire
8) Global Carbon Constraint	Low	Low	Low	CO_2 Cap DEI share	Mid Navigant	Low	Expire (+sensitivity)
9) Utility of the Future			High (Gross) Low (Net)	SCC	Mid Navigant	Low	Expire (+sensitivity)

Next Steps

- April/May – Finalize model inputs
- May/June – Inputs to be made available to stakeholders
- June – Develop optimized portfolios for each scenario
- June – Develop hybrid portfolios as needed
- Stakeholders will be asked to propose alternative portfolios at the June 29th meeting

Heather Quinley, Director Energy Affairs & Stakeholder Engagement

Closing Comments, Stakeholder Comments

Closing Comments

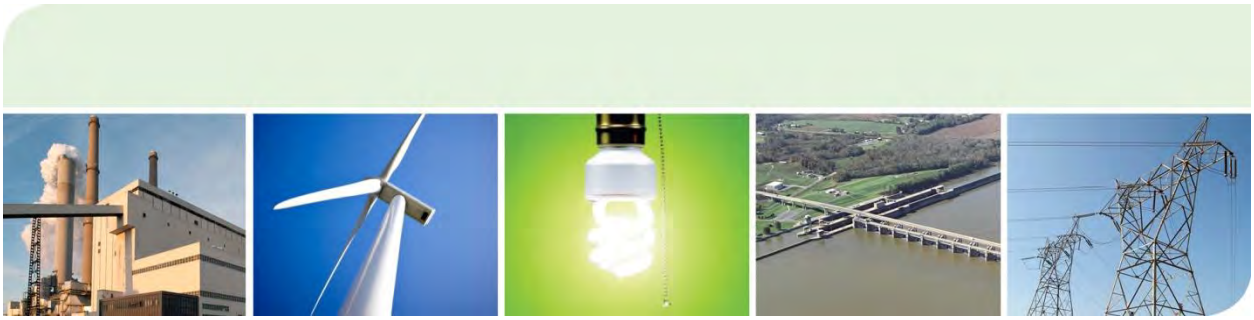
- Please complete comment cards or send by April 24 to Scott at:

  scott.park@duke-energy.com

- Meeting summary and other materials will be posted on website by April 25

  (http://www.duke-energy.com/indiana/in-irp-2018.asp)

- Next workshop scheduled for June 29th, 2018



Duke Energy Indiana 2018 Integrated Resource Plan

Stakeholder Workshop #3 Summary
April 17, 2018

Meeting Begins at 9:00am

Welcome and Introductions
Heather Quinley, Director of Energy Affairs & Stakeholder Engagement
Scott Park, Director IRP Analytics – Midwest
Melody Birmingham-Byrd, State President – Indiana

Scott welcomes everyone to the third stakeholder meeting that will be focused primarily on scenario development. He goes over safety and how to evacuate in case of emergency. He goes over Wi-Fi and instructions on how to get logged in correctly.

Melody welcomes everyone and thanks everyone for coming. She acknowledges the importance of this process and welcomes input and healthy dialogue throughout the entire process. She thanks and recognizes the Duke energy Team and participants for their collaboration in this process. Melody reiterates the importance of safety and recaps the safety expectations. Lastly, she thanks everyone again for attending and turns it over to Heather Quinley for introductions and to state why we are here today.

Heather welcomes everyone to the third of six stakeholder meetings. She asks the participants on the phone to introduce themselves, followed by introductions in the room. Attendees introduce themselves and state the organization they are representing.

Why are we here today?
Heather Quinley, Director of Energy Affairs & Stakeholder Engagement

Heather moves to slide 3 to go over the reasons we are here today. The topics for day include recapping the February 13th meeting and responding to the comments/questions. There will be a review of the main topic from the last meeting, desired characteristics of a preferred resource plan. There will also be an update on EE modeling. The main topics to be covered during this meeting are sources of

uncertainty and scenario development including the Duke Energy reference case, the Duke Energy alternative scenarios, and stakeholder developed scenarios.

Agenda
Heather Quinley, Director of Energy Affairs & Stakeholder Engagement

Heather goes over the agenda on slide 4 and the timeline of the day. She acknowledges a longer meeting for this third workshop, so she stresses the importance to stay focused and on task. Heather turns the meeting over to Scott to recap the February Stakeholder Meeting. Before moving to slide 6, Scott notes that the scenario development portion will require discussion to narrow down the selection of scenarios and may require ample time to complete. He asks if there are any questions at this time. There are no stakeholder questions at this time.

Review of February Meeting & Characteristics of Preferred Portfolio
Scott Park, Director IRP Analytics – Midwest

Scott recaps the second stakeholder meeting held in February on slide 6. Scott goes through the questions from the previous meeting on slides 7 and 8 and the responses from Duke Energy. On confidential data, Scott asks for a sense of what stakeholders would like to see and if they have any other questions.

The stakeholders state they would like to see the confidential data with regards to the load forecasts, commodity pricing for fuels and wholesales market capacity energy, inputs for cost of new resources. The stakeholders would also like information from Duke Energy on the models that are being used, constraints placed on resources in the model, and other financial calculations being used, i.e. economic carry charge, etc.

Stakeholder question: She would like to see modeling of zero cost EE. Her organization has put their argument for this approach into a document and will provide to Duke Energy, with a request to discuss. On the topic of yet-to-be EE technology, she would like to see that modeled as an option in this IRP, and would like to discuss further. Using the Technical Potential level will capture some of these yet-to-be technologies.
Response: We are happy to discuss approaches to modeling EE. The presentation will cover more about the Technical Potential level of EE modeling later this morning.

Stakeholder question: On the external stakeholder website, they were not able to find the third stakeholder meeting agenda, meeting slides, nor could they find notice of this meeting or future meetings.
Response: The slides had not posted there yet. The slides were not posted earlier because they were still being updated until the last minute due to stakeholder scenario submissions. Scott will check on why they couldn't find notice of the meeting.

On slide 9, Scott covers the characteristics and metrics of preferred portfolios. He covers in detail the meaning of Low Cost (PVRR, impact to customer bill), Low Risk (cost variability across scenarios and sensitivities), Flexible (frequency, size, time of irreversible decisions), Low Environmental Impact (annual CO2 as proxy for others), and Reliable (meetings long term planning reserve margin each year) with

respect to the IRP process and preferred portfolios. After going through the descriptions of these characteristics and the metrics used to measure portfolio performance, Scott asks for additional questions/comments.

Stakeholder statement: With regards to the impact to customer bill, NIPSCO had a bill impact section as part of their stakeholder engagement meeting. He would like to know how the PVRR will impact the customer bill, perhaps looking at incremental impact of the preferred portfolio with all other things (transmission, distribution, etc.) held equal.
Response: Scott will look into this, but rates structure and recovery is an important factor for impact to overall customer bill. Scott will also reach out to NIPSCO on this topic.

Stakeholder question: Could Duke Energy use a cost of service study rather than PVRR?
Response: This method still gets into rate design aspect. Current cost of service has embedded system costs. We can look into incremental impact due to generation costs.

Stakeholder question: Natural gas is becoming much cheaper, and in hand methane emissions from fracking is also increasing due to the demand. This stakeholder would like to see how production and transportation emissions can be reflected in this IRP
Response: The question becomes how far do we draw the bubble. This becomes the challenge. We've looked at it and are willing to talk about life cycle emission more, but gets away from the emissions of the generating assets themselves which the company is responsible for.

Stakeholder question: What will be the approach to CO2? Will it be treated as an internality or as an externality. Indiana is a ball of externality and still this needs to be taken into consideration. But how will the IRP reflect internalities? He does not believe power purchases are easily distinguishable and we can't use average emission per MW purchased. How does duke consider PPAs for wind and solar and resource specific generation versus spot MISO purchases?
Response: Different portfolios will have different amounts of purchases and different proportions of CO2 per MWh purchase based on what the purchase amounts are. PPA are dispatched in the model as "owned" asset and we will have their CO2 emissions tracked according to purchase. The spot market purchases would then fall into this average CO2 per purchase rate

Stakeholder question: On the topic of Life cycle emissions, Carnegie Mellon and government agencies have done studies on life cycle CO2 emissions. The stakeholder suggests we read this literature and look at the life of the investment over more than just the study of the period.
Response: CO2 emissions in this context only refers to the emission of the portfolio, with respect to complying with the law or running the economic analysis on the taxes on carbon. Duke will determine through the model, how much CO2 emissions each portfolio emits in each of the different scenarios. Life effects of the assets can be difficult to capture.

Stakeholder question: This stakeholder is concerned with only using CO2 emissions. She would like extra documentation in the IRP for land and water impacts. She does not want us to ignore those.
Response: The IRP document itself has CO2, SO2, NOx, and water. The IRP does include all of those components for which the stakeholder is concerned.

Stakeholder comment: The water rules can be the last and final straw to shut down a facility. In the retirement analysis, focusing on only CO2 could be a big oversite.

Response: We are mostly just talking about for modeling purposes. 316b is captured in the IRP document. CO2 is just a good proxy in the modeling process for stack emission.

Stakeholder question: With regards to the planning reserve margin, what's in place now is a decent assumption going forward, but wants to acknowledge that plant outages should also be kept in mind. The stakeholder proposes the IRP process should evaluate the system on a MISO UCAP basis. UCAP is installed capacity less the EFOR of those units. Is resource adequacy (UCAP) for MISO a better measure instead of ICAP. For the model, Duke could use the same UCAP going forward with the same unit outage rates. The stakeholder suggests this will help by understanding where Duke is based on MISO capacity needs.
Response: MISO UCAP uses a yearly projected outage rate which can vary year to year. There is not much difference between evaluating using an ICAP with higher reserve margin opposed to UCAP with lower reserve margin, other than additional uncertainties in projecting future forced outage rates which can be problematic.

Scenario Analysis and Sources of Uncertainty

Nate Gagnon, Lead Planning Analyst

Nate covers slide 11, Scenario Planning: Process. The scenario development process feeds portfolio development. Scenarios are a combination of external conditions that impact Duke Energy business and operations. Portfolios are internal Duke Energy selections that respond to the external conditions.

Today will cover the scenario development side of the process. The scope for the IRP process is the geography – the Duke Energy Indiana territory – and the time is bound by the planning period. The purpose this process is done is to comply with law by filing the IRP. Uncertainty of variable is based on not knowing the future, so identifying and developing the potential variables that can impact our performance over the planning period. To make the modeling manageable, you want to narrow those to the key factors that will drive the performance over time. Thoughtfully constructing the scenarios based on common themes is the next step, ensuring key interdependent factors make sense together. The final processes is to check for the scenarios for consistency and completeness.

Nate reads out and explains the list of uncertainties on slide 12. Nate asks if the stakeholder thing were missing anything.

Stakeholder question: AMI technology should be included in the technology bucket. AMI will enable us to validate how EE is truly impacting load in field and verify those energy efficiency programs. The technology of AMI will inject uncertainty into how we look at resource planning. Is cost of storage the same as the cost of batteries?
Response: Yes storage also includes the source of battery costs. Ami is probably covered with EE Efficacy and usage programs. We can add AMI to this list.

Stakeholder question: Power Price is not an input?
Response: Power price is more of a dependent variable based on the other variables that we use.

Stakeholder question: Smart grid development with its connection to energy management should be added to the list. Smart grid technologies will enable Duke to increase data collection and use that

information to manage electric service. Ancillary services development should also be under technology. Technology feedback is crucial going forward. Technologies like cellphone control to manage load energy generation.
Response: We agrees those are important sources of uncertainty. As they pertain to load and DSM.

Stakeholder question: Does EE efficacy include price of EE?
Response: Yes.

After the additional sources of uncertainty have been discussed, Nate announces that will take a short break and we will next cover commodity, regulation, technological development data.

Before break Melody wants to recognize some distinguished participants along with those who are attending their first stakeholder meetings: Jim Houston – Chairman and Commissioner of the IURC; David Ober - Commissioner of the IURC; Greg Goodnight - Mayor of Kokomo. Melody reminds the participants that we welcomes question about the IRP and Stakeholder Meetings now or throughout the process.

Morning Break from 10:15am – 10:32am

Representative Forecasts for Select Variables
Nate Gagnon, Lead Planning Analyst

The meeting is reconvened and Nate discusses on some of the forecasts on slide 13. Not all sources were cover in detail, but they are explained in general as the sources and methodologies used to get to the curves seen on the following charts. Nate points out that this data is representative of the data that will be use in the IRP, but not necessarily equal to the data we will use. The reason for this is that some are dependent on one another, some are not determined, and some are proprietary.

Stakeholder questions: For the source of the renewable energy sources, is Duke using anything other than NREL?
Response: Duke will be using a combination of consultants data, NREL public data, and company experience for renewables prices. This specific information will be available in late May during the confidential data day.

Stakeholder questions: Is Duke using current market data on solar PV? The MISO website shows 1394 MW in the que with Duke connection with in service dates from 2019 through 2021.
Response: Duke Energy does have some solar that we have put into service already. Costs vary by system size and technology. There is a range of sources are used to develop our cost assumptions. The near term forecast are in-line with current market assumptions on renewables costs.

Stakeholder questions: With respect to carbon price, will this be treated as an internality and externality. Externality is very important in Indiana.
Response: Carbon prices here are being imposed. Anything above and beyond what is being imposed on use would not be optimal in terms of price, so therefore would be covered in portfolio discussions.

<u>Gas Prices</u>

Nate discusses how the different scenarios are derived from the EIA 2018 AEO.

Stakeholder questions: How are basis differentials factored in? How are peak and off peak pricing factored in? How are seasonal gas prices factored in?
Response: Gas prices are available on a monthly schedule. Basis adders and transmission adders are less volatile and small portion of the commodity and will be factored in across all scenarios the same.

Coal Price
Forecasts are based on AEO Curves as well. Nate notes there is less cost divergence in the coal prices compared to gas prices from the AEO.

Power Price History and Forecasts
Power prices are dependent in nature. Once final commodity and carbon prices are required before power prices can be finalized.

Stakeholder questions: Does Duke factor in changes to MISO pricing methodology?
Response: No, not at this time. We are open to discussion if you think so.

Stakeholder questions: Can you explain the earlier divergence in power prices for the high case compared to the reference and low? There is a stepper incline for the reference and low in the later years.
Response: Gas prices diverge from the reference and low case earlier and this is reflected in the power pricing in the high commodity price scenarios. Carbon prices putting upward pressure on power prices in later years.

Peak Load Energy Demand
Shown on the screen is our spring 2018 forecast. The band is a range based on SUFG's Indiana forecast. Duke energy has not created our high and low cases yet, and will replace the SUFG's range once they have been developed.

Stakeholder questions: Can we see a historical chart that goes back (slide 36 from the February meeting) for peak load? Can we have a look back to get a healthy reference going forward?
Response: We don't have that on hand for this meeting, but can provide it.

Stakeholder questions: For peak load growth, is that just residential?
Response: Peak load growth includes everything including Wholesale and Residential.

Stakeholder questions: Low load forecast is not reasonably low enough. 2008-2017 has been pretty steady in low load growth. The stakeholder thinks the low should actually be flat to declining.
Response: This could be addressed in scenario analysis or perhaps in additional sensitivity analyses.

Energy Demand History and Forecast

Stakeholder questions: Similarly to peak demand, the stakeholder believes the low energy forecast is not reasonably low enough.
Response: We can definitely look at this closer is scenario and sensitivity once the final high low cases are finalized.

Stakeholder questions: Load served by behind the meter resources are not reflected here, correct?
Response: Correct, this is just load served by Duke.

Carbon Prices
Reference case gets to sustainability goals by 2030.

Stakeholder questions: For carbon regulation, is this an internal or regulatory construct? What is regulatory assumption congress passes tax? Don't see why 2025 makes sense. The stakeholder would like to see the justification for a 2025 start to carbon taxing. The stakeholder finds it hard to imagine 2025 based on past experience with getting carbon legislation passed.
Response: Carbon prices implied are external tax and 2025 represents the earliest carbon legislation could begin impacting the country. A carbon tax could be implemented later and seeing the results of no carbon tax is important.

Stakeholder questions: This stakeholder believes the 2025 is a reasonable date. Social cost of carbon is internalizing opposed to externalizing carbon regulation as a tax. A tax is a useful proxy under differing levels of policy sensitivities around carbon pricing, internalizing externalities is social cost of carbon.
Response: We will stick to imposed cost of carbon in modeling. Social cost of carbon could be considered in a portfolio preference. We can consider using a social cost of carbon as an upper bound carbon tax because it will include everything.

Wind Pricing
This data is based on NREL's Annual Technology Baseline (ATB). Duke is currently settling on internal numbers. Wind is a more mature technology from procurement and operations perspectives

Solar Pricing
This data is based on NREL's ATB. Duke is currently settling on internal numbers. Solar is a less mature technology, which has more room for improvement for cost, configuration, and operations. This is reflected by more uncertainty with greater separation between curves.

Stakeholder questions: There are several solar advancements going on in Indiana. Can a large solar plant as a baseline? One way is to have the plants modeled in 50MW capacity blocks?
Response: The final forecasts use large 50+ MW blocks as benchmark along with smaller incremental solar blocks.

Energy Efficiency
Brian Bak, Lead Planning Analyst

Brian covers the different adoption and technology set assumptions between the Market Potential Study (MPS) and the IRP. Achievable, economic, and technical were used for the MPS. IRP will use EE bundles the model can select based on load shape savings in the Achievable, Enhanced, and Technical Subset, which that are feasible in terms of adoption.

2015 had 2 bundles (Achievable and Incremental) for 5 time periods for a total of 10 model selections. The 2018 IRP will have 120 selections. There will again be 5 time buckets, but with 24 bundles per time bucket (8 load shape savings for each of the technology/cost/adoption buckets: Achievable, Enhanced, and Technical subset). Brian gave examples of a few of the load savings shapes.

Stakeholder question: Why is the Technical subset in the MPS not equal to Technical Potential in the IRP. This creates an extra cost effectiveness screen that other resources don't face. Technical Potential in its entirety from the MPS be used to account for "yet-to-be" technology.
Response: We don't believe the full Technical Potential is fully deployable. We need to factor in resources that are feasible. 100% adoption for Economic or Technical Potential from the MPS is not feasible in our eyes. 100% adoption even among free EE programs is an unsubstantiated customer behavior. This method is not a prescreening for cost. Enhanced EE has greater cost savings at a greater price. Duke cannot agree with greater participation for advancing technologies which will cost more. How we handle "yet-to-be" technology is through the cost trajectories of EE in sources of uncertainty. EE is flat in nominal terms (decreasing in real terms), which Duke thinks is a reasonable assumption going forward.

Stakeholder question: Current cost or from projections. What would it look like if all that. Customer adoption is more than just cost. Risk thinking MPS can identify adoption as well as costs. Emerging tech is crucial here. This is a different way to look at EE because the MPS is flaw. The decrement??
Response: essentially current. Additional information we would love to see. Additional saving is additional tier; economics is based on cost trajectories. 360 saving price pairs to better capture something that is variable and don't have a great idea of what it looks like in 10 years. Modeling 8 load shapes in 3 cost increase trajectories. Savings, cost, and adoption data is welcomed.

Stakeholder Comment: This stakeholder also disagree with Technical Subset in the IRP compared to the Technical Potential. MPS results should be used for this IRP. The shareholder did receive the discovery request and provided reworked analysis on Friday. The stakeholder will share comments their comments on the MPS this week and dive in deeper later and send in.

Brian continued covering the cost of EE Bundles explained on slide 26.

Stakeholder question: Modeling here does not include EE from appliance standards or efficiency from employed by opt outs, correct?
Response: Correct, those will be captured in load forecast.

Stakeholder question: What is the assumption with opt-out?
Response: They are assumed not to return which is factored into the load forecast/EE.

Stakeholder question: What are the costs assumed? Are they based on Dick Stevie's analysis? Where does the costs from the presentation come from? This stakeholder disagreed with Dick Stevie's analysis and provided numerous comments in a document to Scott.
Response: The costs are based on a corporate inflation number with increasing, decreasing and flat real costs. These cost trajectories, we believe, are more plausible and are more responsive to different technology paths. The way we are projecting the separate levels is consistent with the law of diminishing returns. Declining real costs reflects increase technology. Both increase and constant real costs are in line with Dick Stevie's analysis. We do not know if the inflation rates are consistent with the MPS here today.

Stakeholder question: How are the costs broken into the buckets? Averaging (event weighted averaging) measures together into one buckets can unfairly affect the selection of all the measures by

the more expensive measures driving up the cost of the bucket. Because the IRP levels don't match the MPS, the stakeholder would like to see how the Technical Potential tiers break down into cost parallels.
Response: The granularity used this time around will help capture some of that and drive out and losses in EE selection due to averaging. Instead of 10 selections, we will have 120 in this year's IRP. On average is that load shape savings economic on this granular of a measure is a fair approximation to get fair selection. The measures are put in cost buckets in terms of Achievable, Enhanced, and Technical subset will have costs associated with them according to cost savings and adoption. We can show the specifics of the buckets when they are available. This is a customer adoption screening rather than cost screening.

Lunch Break from 11:42am – 12:30pm

Scott reconvenes the group and introduces the afternoons agenda and reminds the group we will need to stay focused and on task to complete the workshop on time.

Reference Case Scenario and Alternative Scenarios
Brian Bak, Lead Planning Analyst

Nate introduced the key sources of uncertainty this morning. These uncertainties are selected in these scenarios based on the narrative.

Reference Case Scenario
This is our benchmark scenario and most sources of uncertainty are current assumptions carried forward. This scenario includes a 0.5% load growth, a carbon price starting in 2025, and our reference gas curve.

Stakeholder question: Where does Energy Storage come in?
Response: There are 2 options for energy storage in portfolio selection process.

Stakeholder question: 2025 is a hypothetical aggressive date for carbon tax. The stakeholder would like to see a reference case solved without CO2 tax.
Response: This is an externally imposed on Duke, but aligns with our CO2 reduction goals. This is something we can look at as a sensitivity.

High Tech Future
This case assumes lower cost assumptions with further innovations. Lower gas prices, higher CO2 tax, and lower cost of renewables.

Slower Innovation
The Slower Innovation case has moderate cost declines of renewables, lower load growth due to lower economic advancements, high gas prices, no price on carbon emissions, and tax credits continued.

Stakeholder comment: High coal prices in this scenario doesn't seem to make sense. Consider looking into the relationship between rising gas prices and declining coal prices.
Response: Slower innovation, where it affects commodity fuel prices, impacts extraction technologies that fail to produce a cheaper coal cost.

Technical difficulties required all call-ins to the meeting to hang up and call back in. A short break was taken to resolve the call in issues.

Stakeholder Scenarios #1: Current Conditions
Anna Sommer, CAC

This can be considered a "Reference case", which is slightly different from a "Base case" forecast, but rather theses represent current conditions. Relying on public for Natural Gas and Coal Prices – available through NYMEX and extrapolate forward prices out and CME Futures with delivery charges added in. No carbon price because one does not exist in current day. For solar costs, long term projections should be used from the New Energy finance or GTM research. For wind costs, the NREL ATB forecast (ATB is data uses for its own modeling capital costs) would be used. Duke reference case summer load before UEE. Annual energy consumption before UEE. Power prices would use the OTC Forward for the Indiana Hub – wholesale market prices (7-10 year).

After Anna presented the scenario, Scott respond with a series of clarifying questions to determine what the data source will be used that will work with the model.

Commodity prices – Duke can get market data for Gas, Coal, and Power Prices. Extrapolate the trend in these prices, maybe just last 5 years because inflation might overstate the price, because we are not see that currently.

Carbon prices – This will be zero.

Renewables – Per the Anna's suggestion, Scott will check to see if we have access to Bloomberg or GTM data based on our subscriptions through Mackenzie or another preexisting provide. not sure we have those.

Power price – This will be perpetuations of low power prices

EE cost assumption – This will follow current costs, flat real cost assumptions.

Tax Credit assumptions – ITC and PTC will expire.

Stakeholder Scenarios #2: Social Cost of Carbon
Anna Sommer, CAC

This scenario is similar to Current Conditions scenario. The main difference is the carbon price use will be from the EPA's Technical Support document. The reason for this is because there is a broad expectation that there will be some social cost of carbon regulation at some point. What we do know is that there is externality value with GHG which is captured in a social cost of carbon. This is a holistic look at the world from social perspective. What decisions would we make if we included all of the costs of carbon on society.

After Anna presented the scenario, Scott respond with a series of clarifying questions to determine what the data source will be used that will work with the model.

Commodity prices – Duke can get market data for Gas, Coal, and Power Prices. Extrapolate the trend in these prices, maybe just last 5 years because inflation might overstate the price, because we are not see that currently.

Carbon prices – EPA's Technical Support document.

Renewables – Per the Anna's suggestion, Scott will check to see if we have access to Bloomberg or GTM data based on our subscriptions through Mackenzie or another preexisting provide. not sure we have those.

Power price – This will be perpetuations of low power prices

EE cost assumption – This will follow current costs, flat real cost assumptions.

Tax Credit assumptions – ITC and PTC will expire.

Stakeholder question to Presenter, Anna Sommer: What other inputs should change with carbon price? Wouldn't cost of carbon change the demand for load forecast, power prices, natural gas and coal.
Anna's Response: This is an externality costs, So it wouldn't change those.

Stakeholder question to Presenter, Anna Sommer: Scott asks is this a scenario or portfolio decision. Is the social cost of carbon the carbon price in the model?
Response: Anna doesn't know how else to do it. Anna doesn't know how assumptions might change this selection. Internalizing our externality.

Stakeholder question to Presenter, Anna Sommer: Is the carbon price is from the 2016 or 2015 EPA Report? Are you using the table ES-1?
Response: Anna thinks it's the 2016. Can't remember off the top of her head.

Stakeholder question to Presenter, Anna Sommer: If you are going to use the Social cost of carbon for the carbon tax, are you applying it just to Duke Energy. In a scenario you would really have to apply it to everyone and therefore need new forecasts that are consistent with this.
Response: Anna agree that a true scenario would have to impact everything (commodities, power prices, etc.), but the portfolio could be a choice by us.

Stakeholder question to Presenter, Anna Sommer: Scott asks if this more of a means to a portfolio or a scenario in itself. Are we putting other portfolios in this scenario or are we just putting this portfolio in other scenarios?
Response: Anna believe it could be used to get a portfolio.

Stakeholder Scenarios #3: Beneficial Electrification
Anna Sommer, CAC

This scenario attempts to capture a movement to beneficial electrification, mitigating electricity produced. This idea of beneficial electrification is driven by adoption by disturbed solar, EVs, and smart thermostats, mostly changes to load forecast. This scenario would also impact the cost of battery storage, in which a WoodMac curve would be used. EV adoption rates would come from Bloomberg.

Social cost of carbon to get natural gas, coal, and power prices, etc. Current adoption rates of DER (distributed energy resource) would need to be reviewed.

EE cost assumption – This will follow current costs, flat real cost assumptions.

Tax Credit assumptions – ITC and PTC will expire.

Stakeholder question to Presenter, Anna Sommer: Scott asks, is it contemplated that this is a higher or lower load forecast?
Response: This will be dictated by adoption rates. The addition of EVs and DERs have conflicting signs. Depends on which outweighs the other.

Stakeholder question to Presenter, Anna Sommer: With DER, is this primarily primarily rooftop solar?
Response: Distributed solar, yes. Mostly. Maybe some other power methods could be included.

Stakeholder question to Presenter, Anna Sommer: Should we also consider EE grid upgrades?
Response: This depends on what we're putting to the model bundles, voltage reduction could be big impact for beneficial electrification.

Stakeholder question to Presenter, Anna Sommer: Scott states that our load forecast has DER and EVs included in already. How will this be different? And comparing this to continuing conditions, what model inputs would change
Response: Anna would needs to see the adoption rates of DER and EVs in our load forecasts. As for the other model inputs, only solar and wind prices would be the same. The rest of the sources of uncertainty would change from the current conditions case.

Stakeholder question to Presenter, Anna Sommer: Scott follows up with the question, if the EV and DER adoption rates are the same how would it differ from the current conditions cases.
Response: This case could be the same as current conditions if EV and DER net out. If they're not netting out, Anna doesn't know how the commodity prices changes because she don't know what's in the reference cases and how they factored in the EVs and DERs.

Stakeholder comment to Presenter, Anna Sommer: We will want to make sure are not double counting Smart thermostats. Look for this measure potential in EE bundles.

We will have to look at adoption rates for DER and EVs in our load forecast, check with EE bundles for the smart thermostat measure and benefits, check net load change after new rates are applied, and contemplate commodity curve changes WRT load change.

Stakeholder Scenarios #4: Load Growth and Economic Decouple
Anna Sommer, CAC

This scenario intends to get at ongoing trend that electric function and consumption and economic growth continue to decouple. An trend to look at is the increased employment necessarily means increase electricity? That is now in question that is to be studied here. In recent years, electric is stagnant compared to growth. Commodity prices and load forecast will have to be developed. The regression analysis used in the 2015 IRP washed out the more recent trends by using a 30 year economic

growth. This method will capture that near term trend by looking at the most recent 10 years and draw trend lines continue forward.

Stakeholder question to Presenter, Anna Sommer: Economic growth might not impact electric growth, but economic downturn does impact electric growth and consumption.
Response: Anna is anticipating flat demand curve for 10 year extrapolating this data forward.

Stakeholder comment to Presenter, Anna Sommer: Nate states that we used 30 years for weather, but 10 years for economic forecast that goes into load forecasting
Response: This is news to Anna and she would like this to be confirmed.

We will confirm what is being used for economic growth and weather in the load forecasting.

Stakeholder Scenarios #5: Global Carbon Constraint
Mike Mullett, Self-representation

We need to evolve the IRP process based on world trends. In the future utilities will be local carbon constrained. Climate change is holistic regardless of regulatory compliance. This scenario will help inform us for where we stand based on what is necessary to meet a 2-degree scenario. This scenario would be an evolving process over time. Everywhere other than US, this type of analytical process is going on national or international level. The scenario is based on the intergovernmental panel process in 2015 Paris Accords. Whether we like or believe it or not, we will need a meaningfully probable scenario in a carbon constrained or carbon budget emissions world, Astro and Geo-physical. This scenario helps us identify what is need to do what it would takes to achieve that. National commitments, to industry and enterprises levels goals. Because of the size and significance of Duke energy on this stage, we will need to be part of this. This scenario will aslo help us evaluate the risk associated with our portfolios due to climate change imposed on us and stranding our assets.

We can use this as a local benchmark for where we are against where we need to be. It is recognized that this is an aggressive step forward. Benchmarking how much more needs to be done.

Preferred approach would be with a mass cap – We will look into the cap method. How effect is that policy?

Load forecast – Carbon caps as external and internality would suppressing economy and suppresses load. Loads would be down, but don't have a load developed.

Reduction in coal and gas consumption would change the coal and gas prices.

Carbon price – 550-600/ton 2040 price? 250-500B national mass cap

Stakeholder question to Presenter, Mike Mullet: Are you suggesting this mass cap only be applied to just generators or everyone across society?
Response: Allocation should apply to everyone with their portion.

Stakeholder question to Presenter, Mike Mullet: Scott asks to what extent is this close enough to social cost of carbon proposed to CAC?

Duke will follow up to see how is this this could be modeled accurately

Stakeholder Scenarios #6: Utility of the Future
Mike Mullett, Self-representation

This scenario could be separate, but also combinable with Global Constrained Carbon scenario. This scenario changes the regulatory and business model. Pick up on the trends that are happening in Duke service territory with generation, transmission, distribution, and consumption of electricity. Model would look a Duke's service territory, rather than a Duke served load. Any changes in duke requirement to serve would be captured in load forecast. This can be thought of with the concept of grid defection, and/or Duke defection. Freedom to opt out for energy, and privately generate. The use of electricity is not necessarily declining, but the Duke's portion is declining.

Commodity Prices – Mike states that that commodity and electricity demand and energy are unchanged, but Dukes portion is less, even though the net consumption is consistent.

Carbon Scenario – Every scenario/portfolio should have cost of carbon in it. Should be non-zero in every scenario regardless of CO2 tax.

Wind and Solar Costs – No issues with using the best available

PTC/ITC – Sensitivities should be run, but the reference case assumptions should be used here.

Stakeholder question to Presenter, Mike Mullet: Nate states that the IRP is the tool for laying for path forward to utility owned generation under current regulatory construction. Is the IRP the right forum for this discussion this scenario?
Response: The statute in the state still requires a plan. Maybe this becomes a state plan, to the extent to which all the IOUs are added up to get to state plan. The IOUs are the biggest contributor to the state plan and interact feedback loop between the state and energy providers. Whether this is all of the process or end result, he see the DEI IRP are intertwined.

Overall Scenario Discussion and Next Steps
Scott Park, Director IRP Analytics – Midwest

Given that there is a lot to model, and limited time, but in order to maximize time Scott begins distilling the scenarios in to what looks like possible overlap and combination. Scott proceeds to slide 45. Scott points out that Social Cost of Carbon and Global Carbon Constrained scenarios look like they could be a means to a similar portfolio. He also notes that Beneficial Electrification and Load Growth and Economy Decouple could be evaluated as load impact sensitivities.

For the Utility of the Future, Scott identifies that there is more work to do. This could also potentially be a low load forecast sensitivity with a higher cost of carbon attribute.

Will add coal/gas sensitivity.

Stakeholder question: Stakeholder feels strongly that a reference case without carbon is needed. Also need a reference case where coal prices are lower and gas prices are higher.
Response: We will follow up with you specifying these sensitivities

Stakeholder question: With respect to resilience – however you want to define it: diversity of resources; don't put all your eggs in one basket. What are our thoughts here?
Response: These are more of characteristic of a preferred portfolio and evaluation of portfolios. Also looking at UCAP vs ICAP. There are some shock absorbers on system could help with intermittency, have coal units helps with that. More ancillaries will be part of resiliency. The level of intermittent resources and how we think about them as risk attribute will be important to look at our portfolios through that lens.

Scott state the next steps in the IRP and stakeholder process: finalize model inputs, non-disclosure and confidential data. We will clean up table and follow up with folks on specified action items.

Duke will be setting up a meeting late May to answer any questions after confidential data has been made available. We will create optimized portfolios for each scenario selected. In the next meeting stakeholders will have the opportunities to create their own portfolios to evaluate in all of the scenarios.

Stakeholder comment: He would like to recognize that the optimal portfolio maybe not be the optimized portfolio for any one scenario but the best across all scenarios.
Response: Optimal might not be the best across all scenarios, but might be the competitive across the range of scenarios. Also picking a portfolio that is flexible and robust across multiple futures.

Scott then goes over the stakeholder plans for the upcoming meeting with the final meeting being in October.

Closing Comments
Heather Quinley, Director of Energy Affairs & Stakeholder Engagement

Heather thanks everyone for active participation. June 29th is the date of the next stakeholder meeting. Please send comments/feedback to Scott and we will have meeting notes out by 4/27. We will follow with website concerns.

Meeting Ends at 2:41pm