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The Duke Energy Indiana
2015 Integrated Resource Plan

November 1, 2015

Volume 2:
Summary Document and
Stakeholder Meetings

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2015 Duke Energy Indiana

Integrated Resource Plan

11.1.2015

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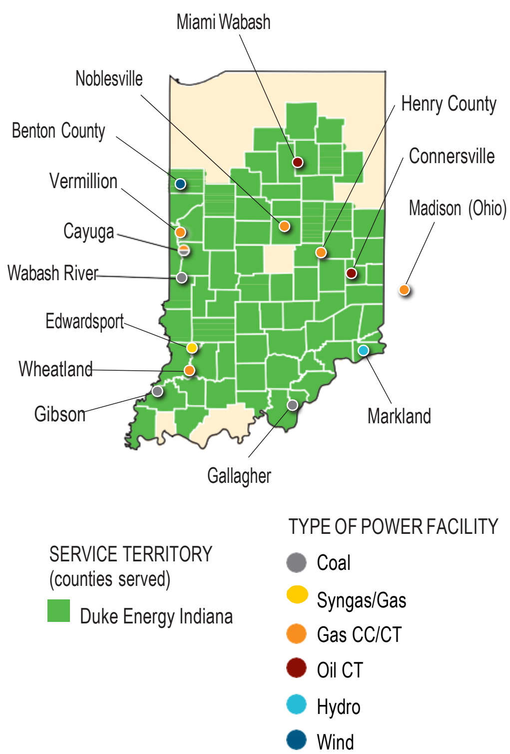
Duke Energy Indiana: an overview



As the state's largest electric utility, Duke Energy Indiana provides affordable, reliable and cleaner energy to approximately 800,000 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 7,507 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 also 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 filed every two years with the Indiana Utility Regulatory Commission (IURC), and it outlines the processes, methods and forecasting models used to create the 20-year plan.

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. 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

- Third-party, unbiased facilitator
- Involving stakeholders from the beginning of the IRP development
- Four stakeholder workshops
- Informative presentations and interactive workshop exercises
- Summaries on public IRP website at duke-energy.com/indiana/in-irp-2015.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:

Mar. 17, 2015

- Review of 2013 stakeholder process and plan for 2015 process
- Scenario planning overview and discussion of driving forces
- Stakeholder scenario planning exercise

Jun. 4, 2015

- Presentation of proposed scenarios
- Discussion of resource options for portfolio development
- Stakeholder portfolio development exercise

Aug. 4, 2015

- Scenario and portfolio review
- Discussion of preliminary modeling results
- Stakeholder sensitivity analysis exercise

Oct. 16, 2015

- Discussion of final modeling results
- Decision and risk management discussion
- Presentation of preferred portfolio
- Discussion of short-term implementation plan

Materials covered and meeting summaries are posted on the company's website at **duke-energy.com/indiana/in-irp-2015.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 seven separate scenarios:

The first set of scenarios is the "Core" Scenarios:

No Carbon Regulation
- No carbon tax/price or regulation
- Moderate levels of environmental regulation
- No Renewable Energy Portfolio Standard (REPS)

Carbon Tax
- Carbon tax $17/ton in 2020, rising to $57/ton by 2035
- Increased levels of environmental regulation
- 5% REPS

Clean Power Plan (based on CPP Proposed Rule)
- Carbon emissions reduced 20%
- Increased levels of environmental regulation
- 5% REPS

The second set is the "Change of Outlook" Scenarios:

Delayed Carbon Regulation
- No Carbon Regulation scenario for the early years of the IRP planning period
- Change to the Carbon Tax scenario for latter part
- Demonstrates impact of delayed carbon regulation

Repealed Carbon Regulation
- Carbon Tax scenario initially
- Change to No Carbon Regulation scenario for latter part
- Demonstrates impact of repeal of carbon regulation

The third set is the "Stakeholder-inspired" Scenarios:

Increased Customer Choice
- Carbon Tax scenario basis
- Roof top solar serves an additional 1% of customer load per year beginning in 2020
- Customers adopt higher levels of Energy Efficiency
- New utility-scale generation served by merchant generators

Climate Change
- Higher summer temperatures increase demand and prices for power and fuel
- Carbon tax same as the Carbon Tax scenario
- Even hotter summer in 2019 and "polar vortex" in 2020, and every 5 years thereafter, causing higher prices and peak energy demand

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.

Since 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 first three scenarios (No Carbon Regulation, Carbon Tax and Proposed Clean Power Plan).

Optimized Resource Plans:

No Carbon Regulation Portfolio

- Assumes retirement of Wabash River units 2-6 in 2016 and the Miami-Wabash and Connersville CTs in 2018
- Most of the resource additions are natural gas fueled Combustion Turbines (CTs)
- Assumes a significant amount of energy purchased from the market

Carbon Tax Portfolio

- Assumes retirement of Wabash River units 2-6 in 2016, Miami-Wabash and Connersville CTs in 2018, Gallagher 2&4 in 2019, and Gibson unit 5 in the 2030s
- Resource additions are primarily renewables and CTs
- Assumes a significant amount of energy purchased from the market

Proposed Clean Power Plan (P-CPP) Portfolio

- Assumes retirement of Wabash River units 2-6 in 2016, Miami-Wabash and Connersville CTs in 2018, Gallagher 2&4 in 2019, and Gibson unit 5 in 2020
- Resource additions are primarily renewables and CT generation
- Assumes a significant amount of energy is purchased from the market

Energy supply and capacity

The second group of portfolios was developed by substituting natural gas fueled combined cycle (CC) power plants in lieu of some of the new combustion turbines (CT) in the portfolios above. This was done to evaluate the impact of adding additional gas generation on cost, carbon emissions and power market interaction.

Combined Cycle Resource Plans:

No Carbon Regulation Portfolio with additional CC

- Assumes retirement of Wabash River units 2-6 in 2016 and the Miami-Wabash and Connersville CTs in 2018
- Resource additions are primarily CCs and a few combined heat and power (CHP) projects
- Additional CC generation lessens the amount of energy purchased from the market

Carbon Tax Portfolio with additional CC

- Assumes retirement of Wabash River units 2-6 in 2016, Miami-Wabash and Connersville CTs in 2018, Gallagher 2&4 in 2019, and Gibson unit 5 in the 2030s
- Resource additions are primarily CCs and renewables
- Additional CC generation lessens the amount of energy purchased from the market

Proposed Clean Power Plan Portfolio with additional CC

- Assumes retirement of Wabash River units 2-6 in 2016, Miami-Wabash and Connersville CTs in 2018, Gallagher 2&4 in 2019, and Gibson unit 5 in 2020
- Resource additions are primarily CCs and renewables
- Additional CC generation lessens the amount of energy purchased from the market

The third portfolio group was based on input from stakeholders as part of the IRP stakeholder process.

Stakeholder-Inspired Resource Plans:

Stakeholder Distributed Generation Portfolio

- Developed by stakeholders in IRP stakeholder meetings
- Assumes retirement of Wabash River units 2-6 in 2016, Miami-Wabash and Connersville CTs in 2018, Gallagher 2&4 in 2019, both Cayuga units, and Gibson units 1-3 & 5
- Resource additions include CTs and CCs with significant additions of CHP, battery storage and renewables

Stakeholder Green Utility Portfolio

- Developed by stakeholders in IRP stakeholder meeting
- Assumes retirement of Wabash River units 2-6 in 2016, Miami-Wabash and Connersville CTs in 2018, Gallagher 2&4 in 2019, both Cayuga units, and Gibson units 1 & 5
- Resource additions include CT and CC generation as well as significant additions (although less than the Stakeholder Distributed Generation Portfolio) of CHP and renewables

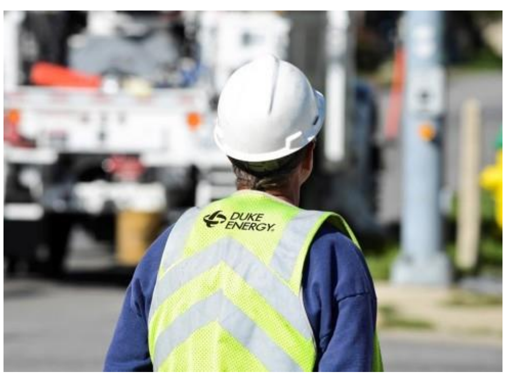
High Renewables Portfolio

- Assumes retirement of Wabash River units 2-6 in 2016, Miami-Wabash and Connersville CTs in 2018, Gallagher 2&4 in 2019, and Gibson unit 5 in the 2030s
- Resource additions are significantly higher levels of renewables and CTs
- Assumes a significant amount of energy purchased from the market

Energy supply and capacity

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

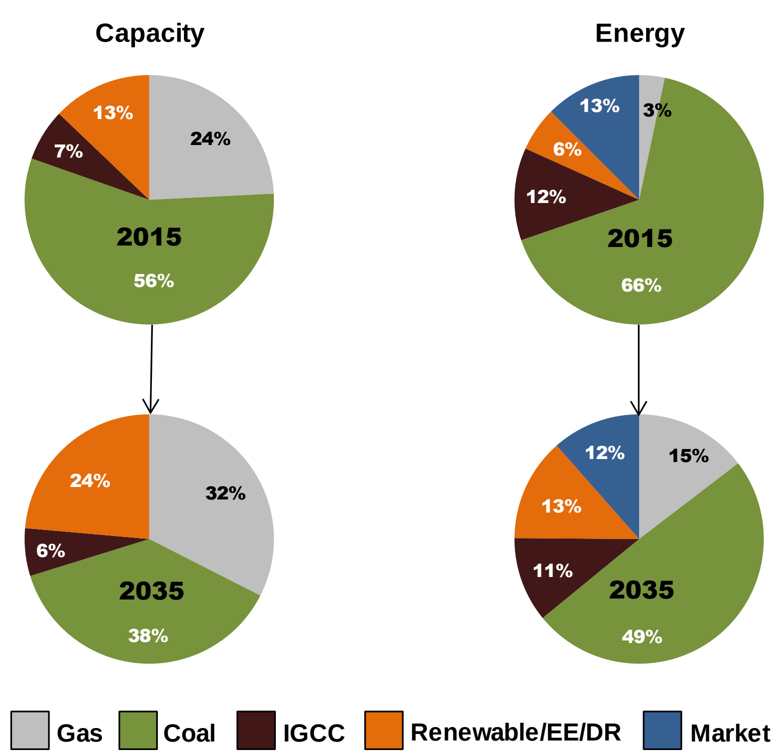
- Retire several older coal and oil-fired units
- Potentially convert Wabash River 6 to natural gas
- Evaluate renewable generation
- Evaluate new natural gas generation
- Implement energy efficiency programs



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 Carbon Tax Portfolio with additional CC for the 2015 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.

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 old 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 is able to 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.

2015 Integrated Resource Plan

Stakeholder Workshop #1

March 17, 2015
Plainfield, IN

Doug Esamann, State President- Indiana, Duke Energy

Welcome

Welcome

- Safety message
- Why are we here today?
- Objectives for stakeholder process
- Introduce the facilitator

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The Facilitator

- Duke Energy Indiana hired Dr. Marty Rozelle of The Rozelle Group and her colleagues to:
  - Help us develop the IRP stakeholder engagement process
  - Facilitate and document stakeholder workshops

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Why are we here today?

- Duke Energy Indiana developing 2015 Integrated Resource Plan (IRP)
- Proactively complying with proposed Commission IRP rule
- Today is the first of four stakeholder workshops prior to filing the IRP by November 1, 2015

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Objectives for Stakeholder Process

- **Listen:** Understand concerns and objectives
- **Inform:** Increase stakeholders' understanding of the IRP process, key assumptions, and challenges we face
- **Consider:** Provide a forum for productive stakeholder feedback at key points in the IRP process to inform Duke Energy Indiana's decision-making
- **Comply:** Comply with the proposed Commission IRP rule

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Agenda

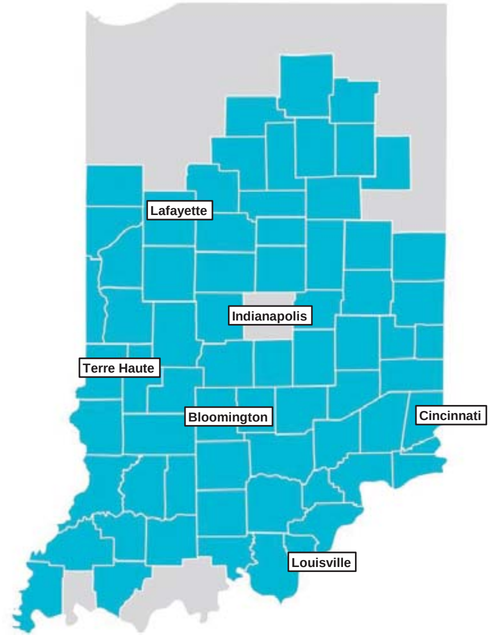
08:30	Registration & Continental Breakfast
09:00	Welcome, Introductions, Agenda
09:30	Overview of Duke Energy Indiana
09:45	Review of 2013 Stakeholder Process and IRP
10:15	Break
10:30	Lessons Learned
11:00	Overview of 2015 Stakeholder Process and IRP
11:45	Lunch
12:30	Scenario Planning Overview
12:45	Scenario Discussion
02:00	Closing Comments

Brian Bak, Lead Planning Analyst

Overview of Duke Energy Indiana

Duke Energy Indiana: Overview

- Indiana's largest electric utility
  - 790,000 customers
  - 22,000 square miles
  - Portions of 69 counties including cities of Bloomington, Terre Haute, Lafayette, and suburban areas near Indianapolis, Louisville and Cincinnati
  - 2,800 miles of transmission lines
  - 30,900 miles of distribution lines



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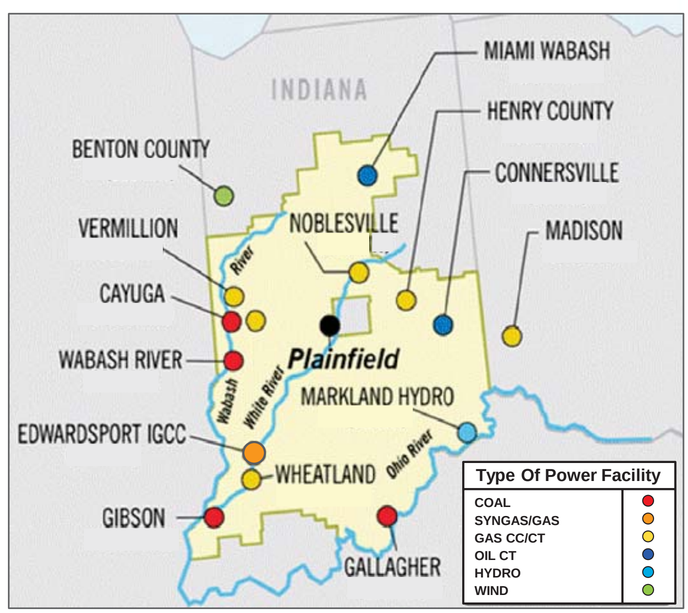
Existing generation resources

- Coal (4,765 MW)
  - Cayuga 1 & 2
  - Gallagher 2 & 4
  - Gibson 1-5
  - Wabash River 2-6 (668MW)
- IGCC (595 MW)
- Combined Cycle (285 MW)
- Combustion Turbine
  - Gas Fired (1619MW)
  - Oil Fired (166MW)
- Hydro (45 MW)
- Wind (100 MW PPA)
- Solar (20 MW PPA)



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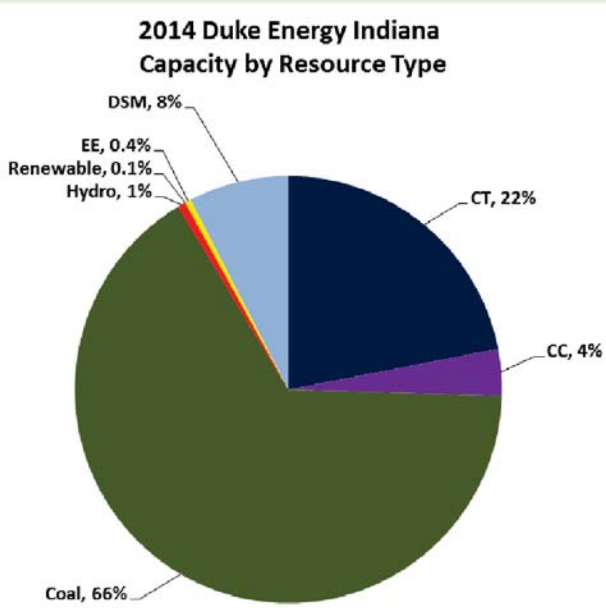
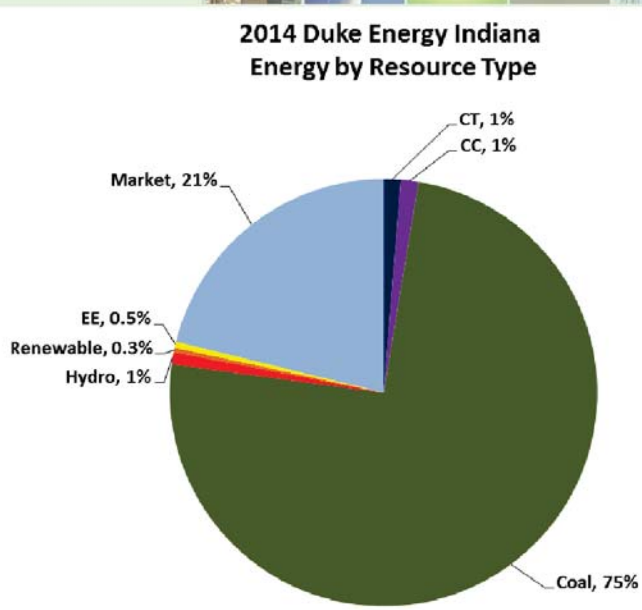
Planned Near-term Retirements & Additions

- Retirement of Wabash River 2-5
- Suspension of Wabash River 6
- Retirement of oil-fired CTs
- Additional environmental controls:
  - Gibson: Precipitator refurbishments, monitoring
  - Cayuga: SCR addition, monitoring

Existing Generation Mix: Capacity and Energy





Jim Hobbs, Lead Engineer

Review of 2013 Process and IRP

5 Meetings

Meeting 1 – December 5, 2012

Meeting 2 – January 30, 2013

Meeting 3 – April 4, 2013

Meeting 4 – July 19, 2013

Meeting 5 – October 9, 2013

IRP Filing – November 1, 2013

Meetings 1 and 2

Meeting 1

- Process Overview
- Scenario Development
- Driving Forces Exercise

Meeting 2

- Energy Efficiency and Renewable Energy
- Scenario Development Exercise

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Meetings 3 and 4

Meeting 3

- Load and Energy Forecasting
- Fundamentals Forecasting
- Scenario Consolidation
- Exercise: Range of Assumptions

Meeting 4

- Portfolios
- Sensitivities

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Meeting 5 – Three Scenarios and Three Portfolios

Low Regulation Scenario: Traditional Portfolio

- Carbon Emissions Price: $0/ton
- Lower Environmental Requirements
- Higher Fuel Prices

Reference Case Scenario: Blended Approach Portfolio

- Carbon Emissions Price: $17/ton in 2020, $50/ton in 2033
- Internal Assumptions for Environmental Requirements

Environmental Focus Scenario: Coal Retires Portfolio

- Carbon Emissions Price: $20/ton in 2020, $75/ton in 2033
- Stricter Environmental Requirements
- Lower Fuel Prices

Meeting 5 – Modeling Results

TRADITIONAL PORTFOLIO (Optimized for Low Regulation Scenario)

	2014-2033	Energy Efficiency (% of Retail Sales)	Renewable Energy (% of Total Sales)
Retirements	Coal (948 MW) Oil CTs (166 MW)	6% in 2020 12% in 2033	2% in 2020 4% in 2033 672 MW in 2033
Additions	WR 6 NG Conversion New CT (1400 MW) New CC (680 MW)		

BLENDED APPROACH PORTFOLIO (Optimized for Reference Case Scenario)

	2014-2033	Energy Efficiency (% of Retail Sales)	Renewable Energy (% of Total Sales)
Retirements	Coal (948 MW) Oil CTs (166 MW)	12% in 2020 12% in 2033	3% in 2020 14% in 2033 2344 MW in 2033
Additions	WR 6 NG Conversion New CT (800 MW) New CC (680 MW) New Nuclear (280 MW)		

COAL RETIRES PORTFOLIO (Optimized for Environmental Focus Scenario)

	2014-2033	Energy Efficiency (% of Retail Sales)	Renewable Energy (% of Total Sales)
Retirements	Coal (4765 MW) Oil CTs (166 MW)	12% in 2020 15% in 2033	4% in 2020 15% in 2033 2606 MW in 2033
Additions	New CT (1370 MW) New CC (2720 MW) New Nuclear (1120 MW)		

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Lessons Learned

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Lessons Learned

Feature	2013	We heard/observed…	2015
Scenario Development	Exercise considered driving forces to define a scenario	Appeared to be too much information to process in a short period of time	Participant exercise to focus on driving forces that will be used to develop scenarios
Scenarios	Three	Need more scenarios to cover wider range of potential futures	We plan on using approximately 5 scenarios this year

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Lessons Learned

Feature	2013	We heard/observed…	2015
Portfolios	Optimized portfolios evaluated	Participants want to propose portfolios for consideration	Portfolio attributes will be solicited from participants and included in portfolio development
CHP	Not modeled due to customer choice	Need to include	We are working to get relevant CHP input assumptions and plan on including CHP as a potential resource

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Lessons Learned

Feature	2013	We heard/observed…	2015
Energy Efficiency	Modeled as a load reduction	Model as a resource	We are planning to model EE as a resource
Confidentiality of Inputs	Trends, ranges, and publicly available info shared	Access to confidential information requested	Specific data will be shared in-person at the DEI-Plainfield office on an individual basis after signing confidentiality agreement

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Lessons Learned

Feature	2013	We heard/observed…	2015
Remote participation	Live Meeting	Difficult for in-person attendees to hear callers questions/comments	Presentation slides will be web-posted and callers will be provided a dial in number to participate
Presentation slides	Significant revisions made after initial posting ahead of meetings	Advance slides needed to prepare for meeting	Near-final version of slides will be posted at least 1 week before meetings
One-on-one meetings		This appeared to be a useful effort for the 2014 utilities	We will make one-on-one meetings available as needed

Scott Park, Director IRP Analytics - Midwest

IRP Overview

Overview of IRP Process

- Meeting 1- Process Overview & Scenario Development **(Today)**
- Meeting 2 - Resource discussion & Portfolio Development **(early June)**
- Meeting 3 - Preliminary Modeling Results **(August)**
- Meeting 4 - Final Modeling Results **(early October)**

Note- The scenarios and sensitivities are not to be interpreted as predictions of the future but rather as tools used to evaluate possible futures. This is done in order to compare costs and risk profiles of various portfolios.

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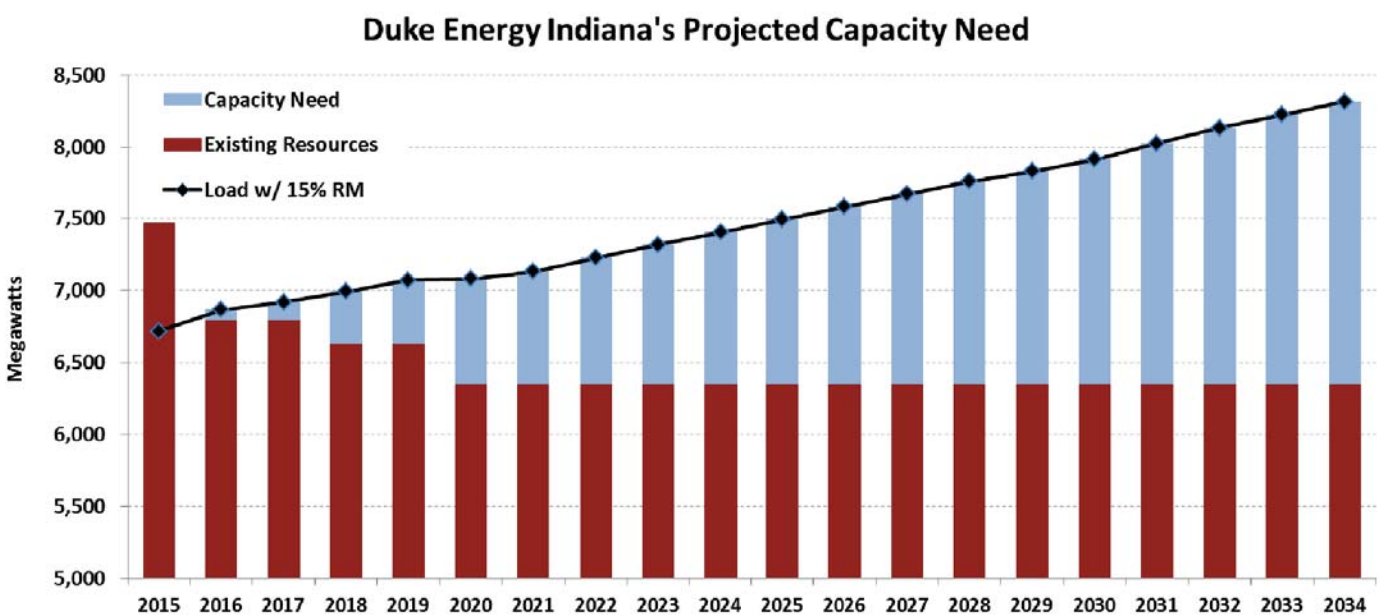
IRP is about "filling the gap"



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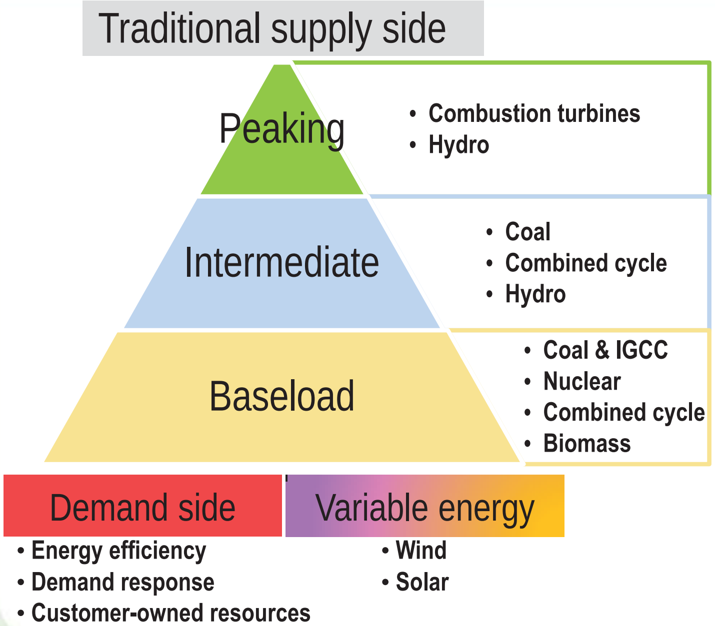
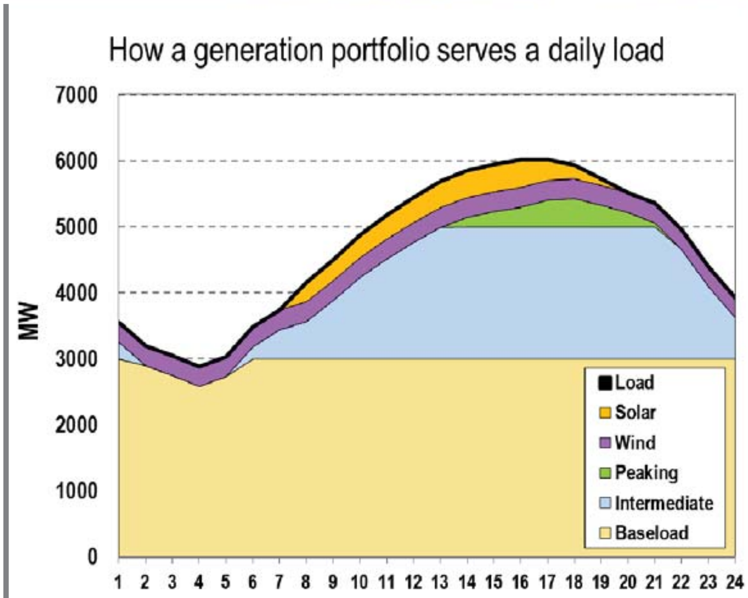
Serving load requires a variety of resource types





How does the IRP process work?

- Complex process involving input from many internal and external groups
- Some components mandated (e.g. MISO reserve margin requirement)
- Requires extensive modeling and analysis

Step 1: Data, assumptions, technology screening and scenarios

Step 1 › Step 2 › Step 3 › Step 4

Gather data

- Gather data such as:
  - Operational characteristics of existing generation
  - Anticipated retirement dates
  - Environmental regulations
  - Energy efficiency potential and costs

Create scenarios

- Identify range of driving forces and input assumptions
- Create and refine scenarios to use in Steps 2 and 3

Develop input assumptions

- Develop input assumptions including:
  - Fundamentals (commodity prices)
  - Load forecast
  - Capital costs
  - Environmental compliance costs

Screen technologies

- Screen technologies to determine
  - Feasibility in service area
  - Technical limitations
  - Commercial availability

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Step 2: Develop portfolios

Step 1 › Step 2 › Step 3 › Step 4

Review scenarios

- Review scenarios and impact on fuel costs, energy and capacity markets, and load growth
- Determine range of sensitivities to consider

Develop Optimized Portfolios

- Use model to develop portfolios optimized for each scenario

Develop Stakeholder Portfolios

- Create portfolios that reflect stakeholder's preferred portfolio attributes

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Step 3: Analyze Portfolios & Identify Preferred Portfolio

Step 1 › Step 2 › **Step 3** › Step 4

Analyze portfolios

- Evaluate portfolios in each scenario
- Stress portfolios via sensitivity analysis

Risk assessment

- Consider portfolio risks
  - Variability of costs
  - Flexibility

Identify preferred portfolio

- Identify the portfolio that performs best overall
  - Costs
  - Risk profile

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Step 4: Develop IRP report

Step 1 › Step 2 › Step 3 › **Step 4**

Develop draft report

- Work with internal groups to write sections of report
- Develop tables and appendices

Management approval

- Gain approval and ensure the proposed plan meets all regulatory requirements

File report

- File 2015 IRP by Nov. 1, 2015

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Lunch

Scott Park, Director IRP Analytics - Midwest

Scenario Planning

What are scenarios?

A scenario is a well reasoned story that defines a plausible future worth considering in long term planning. When combined, several scenarios can describe a range of futures that add to the breadth and depth of the analysis.

"Each scenario….tells a logical "story" about the future that includes important trends and events, describes the key players and their actions, and explains the dynamics of the system… The aim is not to predict a precise order of events and outcomes, but rather to enable development of robust strategies that will stand up no matter what happens. Scenarios force us to explicitly identify and question our assumptions about the future." – CERA/IHI

"Scenarios are intended to form a basis for strategic conversation – they are a method for considering potential implications of and possible responses to different events. They provide their users with a common language and concepts for thinking and talking about current events, and a shared basis for exploring future uncertainties and making more successful decisions." – Shell

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Scenarios should…

- Help us find an "always acceptable" solution across a range of possible futures instead of an "optimal" solution for one potential future
- Force us to consider a robust range of possible futures
- Focus on key drivers and input variables that drive action and change outcomes
- Incorporate quantitative and qualitative data
- Be internally consistent

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Why do we use scenarios?

- Future is uncertain
- Scenarios are plausible views of what the world might look like over the next 20 years
- Scenario planning intended to make decision-making process more robust
- Preferred portfolio performs best overall across the multiple scenarios and sensitivities

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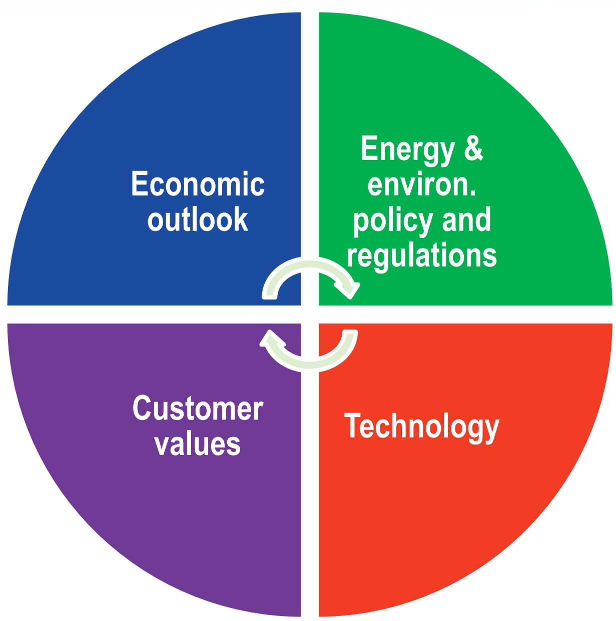
What are the key driving forces?

Economic outlook
•Fiscal policies
•Economic growth
•Interest rates
•International trade policies

Energy & environmental policy and regulations
•Renewable energy
•Energy efficiency
•Air emissions
•Water & waste
•Nuclear



Customer values
•% income spent on electricity
•Usage per customer
•Environmental, health, and safety concerns
•Use of customer-owned resources

Technology
•Capital & construction costs
•Efficiency of existing technologies
•New technology development

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Driving Forces Determine Key Input Variables

Driving Forces

Scenarios

Key model input variables

Load growth	Coal prices	Natural gas prices	Price of carbon	Capital & construction costs

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Clean Power Plan

- What is the Clean Power Plan (CPP)?
  - EPA's proposed rule for regulating CO_2 emissions from existing fossil fuel-fired power plants
  - As proposed, the rule is intended to reduce power sector CO_2 emissions by 30% from 2005 levels by 2030
- Emission reduction "building blocks"
  - Block 1: "Make existing fossil fuel power plants more efficient" (invest in plant heat rate improvements)
  - Block 2: "Use lower-emitting power sources more" (run NGCC units at 70% capacity factor to displace coal-fired units)
  - Block 3: "Build more zero/low emitting energy sources" (Renewables, add/retain nuclear, build new NGCC)
  - Block 4: "Use electricity more efficiently" (increase energy efficiency and demand side measures)
- Implementation Timeline:

Summer 2015 Final Rule Issued

Summer 2016 State Implementation Plans (SIP) Due

Summer 2017 Final SIPs due if granted extension

Summer 2018 Due date for multi-state plans

EPA has 1 year to review and approve or disapprove SIPs

2020 Compliance period begins

2020-2029 Interim goal period

2030 Emission reduction goal deadline

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Clean Power Plan (continued)

- Proposed Indiana reduction goal:

2012 Baseline (lbs CO2/MWh)	After Applying Building Block 1	After Applying Building Block 1 & 2	After Applying Building Block 1 - 3	After Applying Building Block 1 - 4	Total Percentage Reduction
1923	1817	1772	1707	1531	-20%

- How is Duke Energy Addressing the CPP?
  - Conducting extensive study of impacts to current system and future resource plans
  - Engaging with EPA on refinement and clarification of proposed rule
  - Continued monitoring of final rulemaking process
- 2015 IRP Impacts
  - Modeling will include both CPP (as proposed) and traditional carbon tax scenarios
  - Will refine modeling where possible as details of final rule are released

Scott Park, Director IRP Analytics - Midwest

Driving Force & Scenario Discussion

Overview of driving forces and scenario discussion

Purpose

- Gather a range of information and perspectives on the driving forces that will inform the development of scenarios

Things to remember

- Consider the range and plausibility of input
- Consider various/other stakeholder perspectives for each driving force

Follow-up

- Information will be collected and incorporated into scenarios that will be reviewed and discussed in the second meeting

Driving Forces: Economic, Regulation, Customer Values and Technology (others?)

Stakeholder views: Residential, Low Income, Environmental Focused, Businesses (others?)

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Wrap up

- Combine stakeholder feedback that we heard today and from any post meeting comments
- Develop a number of scenarios that reflect the themes of the discussion and comments
- Specify details of scenarios that will be used for analysis
  - Manageable number of scenarios
  - Quantifiable
  - Plausible
  - Impactful
- Scenarios will be presented in the next stakeholder meeting.

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Marty Rozelle, President, Rozelle Group

Closing Comments, Stakeholder Comments

Next Steps

- Please complete comment cards or send by March 24 to Marty at: RGL97marty@rozellegroup.com
- Meeting summary and other materials will be posted on website by March 31 (http://www.duke-energy.com/indiana/in-irp-2015.asp)
- Next workshop tentatively scheduled for June 4

Duke Energy Indiana 2015 Integrated Resource Plan

Stakeholder Workshop 1 Summary
March 17, 2015

Welcome
Doug Esamann, State President- Indiana, Duke Energy

Mr. Esamann welcomed participants, both those who have returned from the last Integrated Resource Plan (IRP) process and those attending for the first time. For his safety message, he pointed out the emergency exits, and cautioned participants to be aware of the electric cords in the room. Mr. Esamann explained the purposes of the meeting. He introduced the facilitator, Dr. Marty Rozelle, as well as the Duke Energy IRP group including Brian Bak, lead planning analyst, Jim Hobbs, lead engineer, and Scott Park, the IRP director for the Midwest. He mentioned that Diane Jenner, Director of Regulated Strategy for Duke Energy Indiana, has retired.

Mr. Esamann emphasized that the company values the thoughts and opinions of its stakeholders, and finds the input helpful in developing the IRP. He thanked participants for their time.

Introductions and Agenda Overview
Dr. Marty Rozelle, The Rozelle Group Ltd.

Dr. Rozelle said that this workshop is the first of four to be held during development of the 2015 IRP, which will be filed by November 1. She reviewed the objectives for the Duke Energy Indiana (DEI) stakeholder process. These include understanding the concerns of stakeholders, providing information to help stakeholders understand the IRP process, listening and considering participant suggestions, and complying with the proposed public consultation rule of the Indiana Utility Regulatory Commission (IURC). She provided an overview of the agenda for today’s meeting, and asked those in the room and on the telephone to introduce themselves.

Overview of Duke Energy Indiana
Brian Bak, Lead Planning Analyst

Brian Bak gave a brief overview of the Duke Energy Indiana system and its generating resources. DEI is the largest electric utility in the state, serving nearly 800,000 customers including several very large employers, some of whom are represented here today. Generation assets include coal units, integrated gasification combined cycle (IGCC), combined cycle (CC) and combustion turbine (CT) generators, as well as small amounts of hydropower, wind, and solar generation (coming online at the end of 2015 and early 2016).

Mr. Bak explained planned near-term retirements and additions to the system including retirement of Wabash River units 2 - 5, retirement of oil-fired CTs, and addition of environmental controls at several facilities. He noted that coal still makes up the majority of capacity and energy resources for DEI, supplemented with CT, CC, market purchases, and renewable resources.

Participant questions included the following:

- Is the 100 megawatts (MW) at the Benton County wind farm under litigation, putting Duke's purchase in question?
    - Yes, it is being litigated; however, Duke is purchasing it.
- What is DEI's total MW of capacity and energy?
    - Approximately 7500 MW
- Please clarify where the Edwardsport plant is included in the chart on slide 12. It would be helpful to see it broken out, since it is sometimes fired with natural gas.
    - It is included with coal resources. We don't have the specific data available here today to break it out.

Review of 2013 Stakeholder Process and IRP
Jim Hobbs, Lead Engineer

Jim Hobbs observed that some of the stakeholders here today are returning from last time, and several industrial customers are also attending. He reviewed the five individual meetings that were conducted during the 2013 IRP process, noting that this year's process will be similar. He summarized the three scenarios and three portfolios that were included in the 2013 IRP, including low regulation, reference case, and environmental focus scenarios that made varying assumptions about carbon emissions prices, fuel prices, and environmental regulations. The portfolios included retirements of specific units and proposed additions of generating capacity.

He invited people to look at the "*IRP 101*" document that Duke has posted on its website that explains the planning process and components.

Lessons Learned
Scott Park, Director IRP Analytics - Midwest

Scott Park discussed several features of the last 2013 planning process on which stakeholders provided comments and observations, along with Duke's response to those comments.

At this meeting we will focus on development of driving forces to define scenarios for the next workshop. This year, we plan to develop approximately five scenarios rather than three, in response to stakeholder suggestions. This will be largely defined by what we discuss in the exercise this afternoon.

Mr. Park explained how “optimized portfolios” for each scenario were defined in the previous process, and noted that stakeholders wanted to be more involved in developing portfolios. This year, Duke will discuss portfolio attributes with stakeholders and may evaluate several additional portfolios if suggested by participants.

He explained that combined heat and power, or ‘co-generation’ (CHP), was not modeled in the previous IRP because it was considered a customer choice. In the current process, Duke is working to develop relevant CHP input assumptions to include CHP as a potential resource in the IRP models.

He reminded participants of the definitions of key planning elements:

- Scenario – set of external assumptions used to define a possible, plausible future
- Portfolio – the mix of resources of the utility to meet future generating needs

Regarding energy efficiency (EE), the 2013 plan assumed compliance with the current State of Indiana requirements. Now the state requirements have been suspended, Duke is planning to model EE as a resource in the 2015 plan. However, it is very complex to define and develop assumptions for EE. We will try to create bundles of EE resources that could be included in the models.

Addressing the issue of confidential data, Mr. Park said that this data will not be made public in this process. Consequently, similar levels of data, proxies, and trends will be shown this year in the IRP workshops; however, those who would like to view confidential data may sign a confidentiality agreement at the Plainfield office. (This may also be made available to consultants, at the request of some stakeholders.)

He discussed changes to remote participation, advance posting of presentation slides, and expansion of one-on-one stakeholder meetings if desired.

Group comments and questions included the following:

- Will DEI be looking at the Clean Power Plan this year, and will it be part of the scenarios?
    - Yes. This will be explained more in the following presentations.
- Do you have a timeline for 2015 for implementing a CHP decision?
    - Not at this time
- Will you be limiting the size parameter of CHP for the plan? For example, will it be only for larger size units? Some states (Massachusetts) encourage residential- sized CHP.
    - We don’t plan to cap the size at some arbitrary number, but there will probably be a minimum size that can be captured in a model.
- As was mentioned during the last process, competition and deregulation is a huge underlying risk factor for IRP processes, and assumptions about this should be developed for the current plan.

  - Mr. Park acknowledged that deregulation could be a potential in the long-term future, and we can explore this further in the discussion this afternoon.
- What assumptions will you make for commercial and industrial (C&I) customers regarding EE for this plan?
  - We don't know that yet. The opt-out ability of the new requirement is something we'll need to look at, and we can also look at historical evidence.
- How many MW have been opted out?
  - About 80% of the eligible load has opted out so far.
- In one-on-one meetings, other parties are left out. OUCC suggested that a method be developed for sharing information discussed with other stakeholders.
  - Duke said they would consider a way to do this.

Overview of 2015 Stakeholder Process and IRP
Scott Park, Director IRP Analytics - Midwest

Mr. Park noted that the IURC (Mr. Brad Borum) issued its draft report on the previous IRP stakeholder processes recently; DEI is not able to respond to that at this time but will review the final report when issued and consider it as needed.

He gave an overview of upcoming meetings for this process, noting that the next one in June will include a resource discussion and portfolio development. The third meeting will be in August to show preliminary modeling results, and the final meeting in October will present the final results.

In expanding the number of scenarios evaluated this year, he emphasized that these are not predictions, but tools to evaluate a wider range of possible futures. Scenarios are developed to compare costs and risk profiles of various portfolios.

He showed illustrations of DEI's projected capacity need over the next 20 years, comparing needs to existing resources with predicted load growth and required reserve margin (15%). He described the supply-side resources that are used to fill the demand, including base load (coal and IGCC, nuclear, combined cycle, biomass) that are expensive to build but relatively low cost to operate. Intermediate resources are more expensive to operate and are used as needed (coal, combined cycle, hydro), and peaking resources are used to supplement energy in peak and limited times (CTs, hydro). More recently, demand-side supply includes EE, demand response, and customer-owned resources. Variable energy includes wind and solar generation.

Mr. Park noted that solar has unique attributes such as pushing the peak later in the day as well as intermittency, which make it more taxing on the overall distribution system. Duke is studying these phenomena because solar has quite complicated effects.

He showed another graphic illustrating a summer load and how it might be typically filled using the range of available resources. He said that generally the least-expensive units are turned on first. When economic, excess power can be sold on the market. Similarly, DEI can also make spot power purchases when that is economic. He noted that winter daily profiles would be different. Also, some types of units perform differently in hot and cold weather, and solar is less effective in the winter.

Mr. Park provided an overview of how the IRP process works. It is a complex process involving input from many internal and external groups, and requires extensive modeling and analysis. He showed the specific steps involved. Step 1 includes data gathering, estimating driving forces, scenario development, development of input assumptions, and screening of technologies for viability. A challenge here is that the efficiency gains of some emerging technologies are unknown, so it's risky to commit major costs to them in the planning process.

Step 2 is portfolio development. This includes reviewing scenarios considering fuel costs and other factors and determining a range of sensitivities to consider. Sophisticated computer models are then used to develop portfolios optimized for each scenario. In 2013, DEI identified an optimized (least-cost) portfolio for each scenario; this year we will include additional stakeholder-identified portfolio attributes.

Step 3 includes evaluating portfolios using sensitivity analysis, conducting a risk assessment (e.g. cost, flexibility), and identifying the preferred portfolio that performs best in all scenarios.

The last, step 4 is to prepare and file the Integrated Resource Plan report to the IURC by November 1, 2015.

Stakeholder questions, comments, and suggestions included the following:

- What load are you assuming?
    - This would be specific to each scenario. In the past, it has been between 1% and 3%.
- Does DEI have any time-of-use tariffs?
    - No
- For renewable and solar energy, time-of-use rates can help to reduce the peak, particularly when solar PV units face to the south.
    - We do not have time-of-use, but we've looked at piloting such rates in prior smart grid proceedings that were not approved.
- Regarding treating EE as a resource this time, rather than as an off-model adjustment, will you be talking about that more?
    - Yes, at the next meeting. You need to take EE out of the load forecast in order to add it to the resource base. It's not a homogeneous resource but is a set of programs that vary widely.
- How will the proliferation of products in the energy marketplace be reflected in the process? For example, Germany and California are looking seriously at solar storage as strategies; a company in Hawaii has an inverter that has the capability to regulate voltage island-wide.
        - Adding intermittent resources like wind and solar requires that the system be able to respond to that. DEI may not be able to fully examine adding more variability in this IRP because it takes a great deal of planning to determine how to make the system more flexible. Storage is still very expensive, since the storage needs to be about equal to the generation (e.g., 1 MW generation = 1 MW storage). Scott noted that rates in

    - Germany have gone up dramatically while carbon emissions have not been reduced significantly.
- Do you have comparable charts for peaks in other seasons? Please revise this slide to indicate that this is a “summer” profile.
    - Yes, seasonal profiles would vary. This was meant to be used for illustrative purposes.
- Different customers have different load profiles. One participant noted that his use is winter-peaking, and solar still generates even in winter and when cloudy.
- What is the MISO reserve margin (not 15%)? Lower margins mean lower costs, of course. Also, you can replace capacity with energy if you purchase from the open market as needed.
    - MISO requires a reserve margin of about 7 to 7.5%, depending on the more sophisticated method that they use. Also, the joint dispatch of energy resources by MISO helps to contain costs. The 15% represents installed capacity.

Lunch

Scenario Planning Overview
Scott Park, Director IRP Analytics - Midwest

Mr. Park provided a description of what the utility means by “scenarios”. These are, essentially, ‘stories’ that describe a reasonable range of futures. Scenarios should help find a solution that works across all possible futures, focus on ‘key drivers’ that can change outcomes, and be internally consistent. The purpose of developing scenarios is to make the decision-making process more robust.

He explained the concept of driving forces that may shape the future. These have been grouped into the main categories of economic outlook, energy and environmental policy and regulations, technology, and customer values. Variations in these can have major effects on the way the industry responds to future conditions. Driving forces provide a framework for defining scenarios. Then, key model input assumptions are developed for factors including load growth, coal and natural gas prices, price of carbon, and capital and construction costs.

Mr. Park noted that one of the scenarios developed for this plan will probably be a “Clean Power Plan” scenario, and explained the current status of the EPA’s proposed rule for regulating CO2 emissions from existing fossil fuel power plants, with the goal of reducing emissions by 30% from 2005 levels by 2030. He talked about the four emission reduction “building blocks”. He showed the implementation timeline, with summer 2016 being the deadline for state implementation plan submittal, and compliance beginning in 2020. Indiana reduction goals were shown per phase of applying the four building blocks, with a total percentage reduction over time of 20%. Duke will model the proposed rule as if it is the final rule, even though there is a great deal of uncertainty about the regulations at this time as well as possible litigation.

Discussion included the following:

- What percent of national carbon emissions are due to power generation?
    - We don't know for sure, but probably about 40 to 50%.
- If Indiana does not adopt a state implementation plan, will DEI still plan as if the regulations are in place, on a voluntary basis, or at least have a contingency plan? Will you try to meet the 20% reduction goal?
    - We will develop a clean power plan scenario for this IRP based on reasonable assumptions, and at least one other scenario assuming a carbon tax. We will need to see what level of emissions reduction can be achieved using certain assumptions.
- What is your CO2 rate for 2012?
    - There were a substantial amount of market purchases, and we can't really know what the emissions were from these sources, so it's difficult to account for this. We will try to provide cost data for the "buckets" in the various scenarios.
- How does Edwardsport fit into this program? If it is in, would the Clean Power Plan scenario include carbon capture and sequestration?
    - Mr. Park was not sure how Edwardsport would be treated since the rule is only proposed. He also did not want to speculate about sequestration.
    - OUCC said that they included Edwardsport in the calculation for Indiana.
    - It appears that clarification is needed on this point.

Driving Force & Scenario Discussion
Scott Park, Director IRP Analytics - Midwest

Mr. Park introduced a participant exercise to discuss a range of driving forces to be used in shaping scenarios. He said that the purpose of this exercise is to gather a range of information and perspectives that will help Duke to develop scenarios.

Driving Forces Participant Exercise
All

Marty Rozelle explained the worksheets that were distributed. She asked the groups to pick someone to keep notes for each table. Each of the four tables will initially work on one driving force topic, and move on to the others as time allows. Groups will share their thoughts with the larger meeting at the end, and DEI will use the results in developing scenarios.

The results of the group exercise are attached to this summary.

Closing Comments

A participant noted:

- Climate change is the "elephant in the room" that does not directly appear in any of these materials. She suggested that climate change might be a good scenario to include. She referenced four scenarios developed by the Rocky Mountain Institute that represent what should be looked at, and said that she will provide an internet link to this information. The scenarios are:

Maintain – business as usual
Migrate – current system changes to reduce GHG emissions
Renew – utility scale renewables provide 80% of 2050 system
Transform – large capacity of distributed resources, compatible grid

In an email following the meeting this same participant clarified her point by saying that the construct for today's discussion of future scenarios was missing a large component -- and that is the natural world in which Duke operates and its customers live and do business.

She believes that future scenarios should include some that would address the risks of changes in the natural world, such as:

- Drought that would affect the supply of water for electricity generation
- Warm water that would affect the use of water for cooling
- High temperatures that would impact the efficiency of power plants or the demand on the system during the summer
- Damage to infrastructure that could be caused by increasingly severe storms

At least one of the scenarios should be crafted to test portfolios against the risk of changing weather patterns that are already occurring and projected to continue to occur in the coming years in Indiana.

The facilitator reminded participants to please fill out comment forms about the meeting. Additional comments can be emailed to Dr. Marty Rozelle at rgl97marty@therozellegroup.com. The next meeting will likely be on June 4.

2015 Integrated Resource Plan

Stakeholder Workshop #2

June 4, 2015
Plainfield, IN

Welcome

Welcome

- Safety message
- Why are we here today?
- Objectives for stakeholder process
- Introduce the facilitator

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The Facilitator

- Duke Energy Indiana hired Dr. Marty Rozelle of The Rozelle Group and her colleagues to:
  - Help us develop the IRP stakeholder engagement process
  - Facilitate and document stakeholder workshops

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Why are we here today?

- Duke Energy Indiana developing 2015 Integrated Resource Plan (IRP)
- Proactively complying with proposed Commission IRP rule
- Today is the 2nd of 4 stakeholder workshops prior to filing the IRP by November 1, 2015

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Objectives for Stakeholder Process

- **Listen:** Understand concerns and objectives
- **Inform:** Increase stakeholders' understanding of the IRP process, key assumptions, and challenges we face
- **Consider:** Provide a forum for productive stakeholder feedback at key points in the IRP process to inform Duke Energy Indiana's decision-making
- **Comply:** Comply with the proposed Commission IRP rule

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Agenda

08:30	Registration & Continental Breakfast
09:00	Welcome, Introductions, Agenda
09:20	Meeting 1 Comments and Response
09:40	Updates Since Meeting 1
10:00	Break
10:15	Scenario Discussion
11:30	Lunch
12:15	Resource Discussion
01:30	Portfolio Development Exercise
03:00	Closing Comments

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Scott Park, Director IRP Analytics - Midwest

Meeting 1 Comments and Response

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Meeting 1 Comments and Response

Topic	We heard/observed…	Response
Wi-Fi	Overloaded Wi-Fi hot spot	Individual guest accounts were created to access vendor network
Scenarios	More information on environmental scenarios	Scenario specifics will be discussed in June 4th meeting
DSM/EE	How will DSM/EE be modeled?	Resources including DSM/EE will be discussed in June 4th meeting
Retirements	Analysis of extending the life of older generating units	The process used to evaluate the economics of retiring generating units will be discussed in meeting #3 (early August)
Health impacts of CO2	Are the health benefits of lower CO2 emissions associated with renewables factored into the analysis?	No; our analysis is directed toward serving customers in the most cost effective manner that complies with laws and regulations.

Scott Park, Director IRP Analytics - Midwest

Updates Since Meeting 1

Updates Since Last Meeting

<u>Deregulation call report out</u>

- On May 14th, Duke hosted a call to further discuss with stakeholders ideas about deregulation and customer choice.
- Themes from that call were used to develop a Customer Choice Scenario
  - Will be discussed in more detail in the Scenario section of this morning's meeting
  - Additional information can be found on slide 22

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Break

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Jim Hobbs, Lead Engineer

Scenarios Part 1

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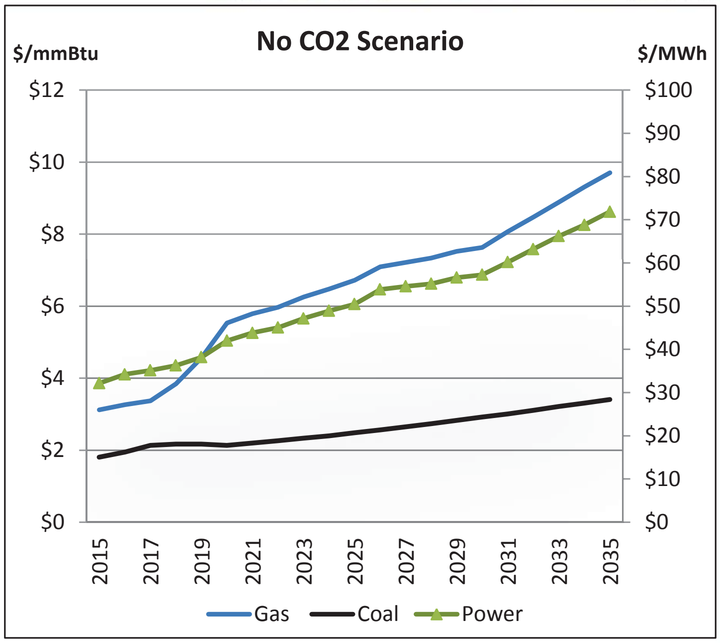
No CO_2 Regulation

- Scenario Narrative
  - No carbon tax/price or regulation
  - Moderate environmental levels of regulation
  - No renewable energy portfolio standard
- Average annual load growth rate: 0.9%



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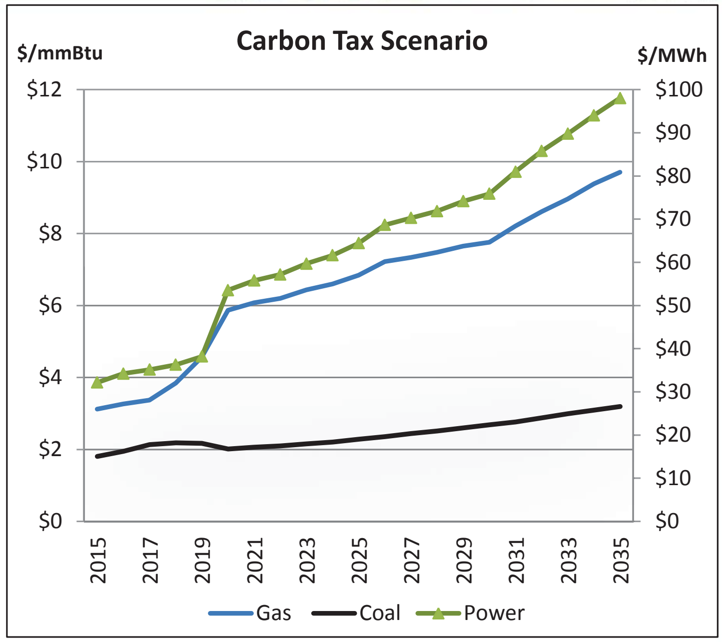
CO_2 Regulation by Price

- Scenario Narrative
  - Carbon tax: $17/ton in 2020, rising to $50/ton
  - Increased environmental levels of regulation
  - 5% renewable energy portfolio standard
- Average annual load growth rate: 0.8%



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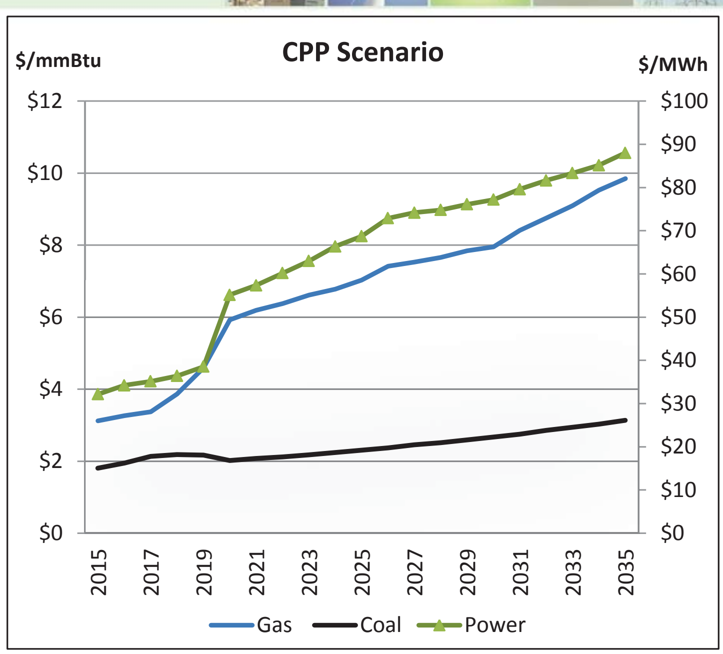
Clean Power Plan (CPP)

- Scenario Narrative
  - Carbon reduced 20%
  - Increased environmental levels of regulation
  - 5% renewable energy portfolio standard
- Average annual load growth rate: 0.8%



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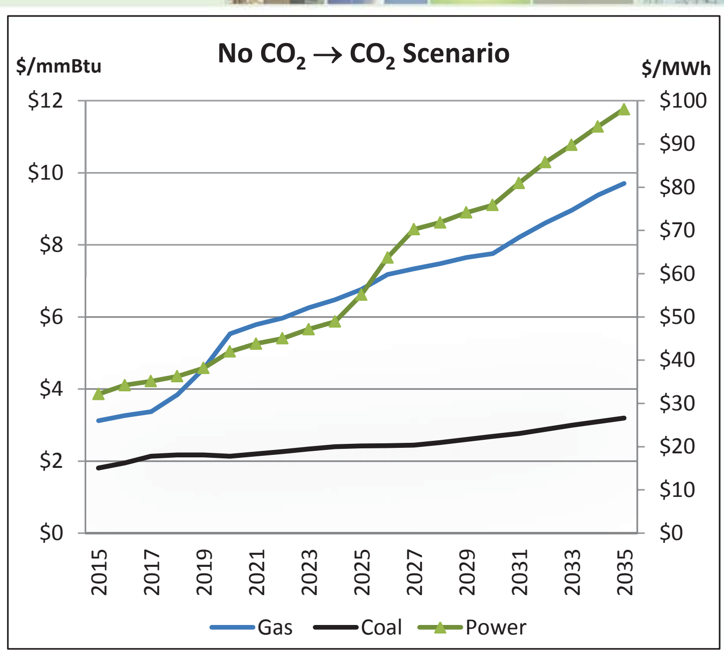
Brian Bak, Lead Planning Analyst

Scenarios Part 2

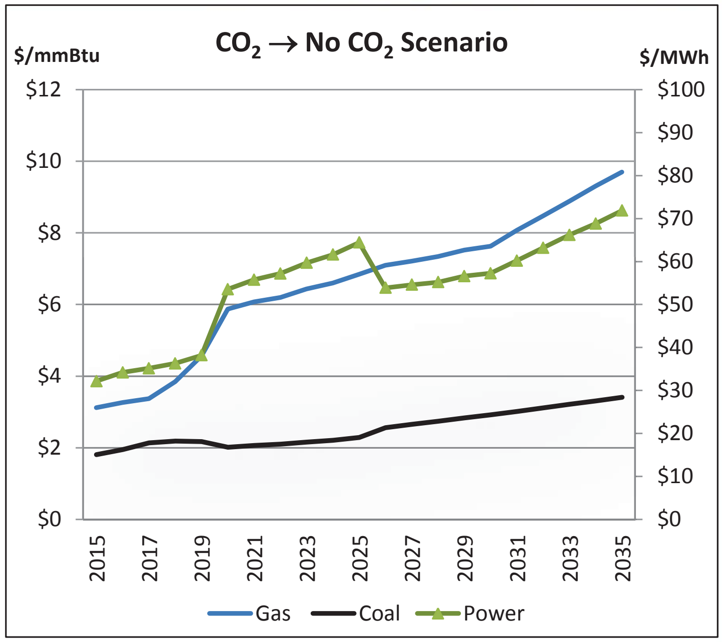
No CO_2 Regulation followed by CO_2 Regulation

- Scenario description:
  - Follows No CO_2 scenario pricing, load growth and regulatory policy for 10 years followed by a gradual shift to CO_2 scenario pricing, load and regulatory policy for remainder of the 20 year planning period
- Average annual load growth rate: 0.8%.
- Value to IRP process:
  - Demonstrates level of resource/portfolio flexibility
  - Adds depth and breadth to portfolio risk analysis



CO_2 Regulation followed by No CO_2 Regulation

- Scenario description:
  - Follows CO_2 scenario pricing, load growth and regulatory policy for 10 years followed by a sudden shift to No CO_2 scenario pricing, load and regulatory policy for remainder of the 20 year planning period
- Average annual load growth rate: 0.8%
- Value to IRP process:
  - Demonstrates level of resource/portfolio flexibility
  - Adds depth and breadth to portfolio risk analysis



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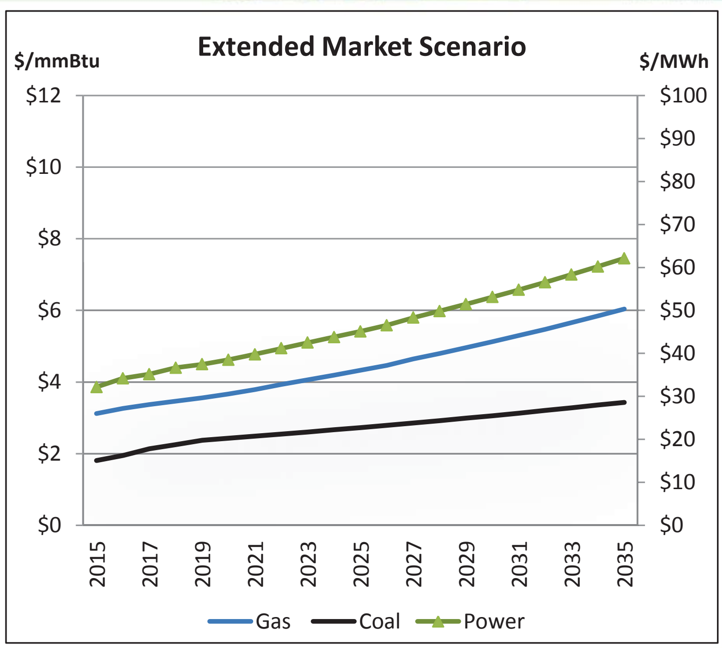
Extended Market Pricing

- Scenario description:
  - Maintains market fuel and power prices for full planning period – no fundamental forecast data
- Typical transition from Market to Fundamental
  - Market pricing for 3 years
  - Transitional 'blend' of market and fundamental forecast pricing for 2 years
  - Fundamental forecast for remaining 15 years
- Extended Market Pricing
  - Market pricing out to limit of visibility/liquidity
  - Extrapolate pricing for remainder of planning period using observed growth rate (CAGR)
- Average annual load growth rate: 0.9%



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Scenarios Part 3

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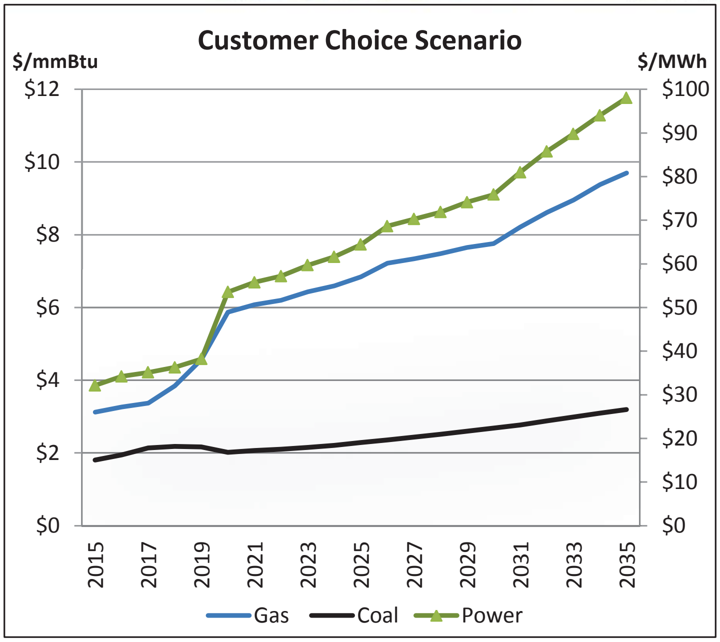
Increased Customer Choice

- Increased roof top solar is installed and a growing number of customers make this decision.
  - Every year, starting on 2020, an additional 1% of load is served with solar at the average cost of rooftop solar for residential and commercial installations
- Customers elect to adopt higher levels of EE
- Carbon tax: $17/ton in 2020, rising to $50/ton
- New generation will primarily be built by merchant generators (e.g. Dynegy or Calpine).
- Average annual load growth rate: 0.8%



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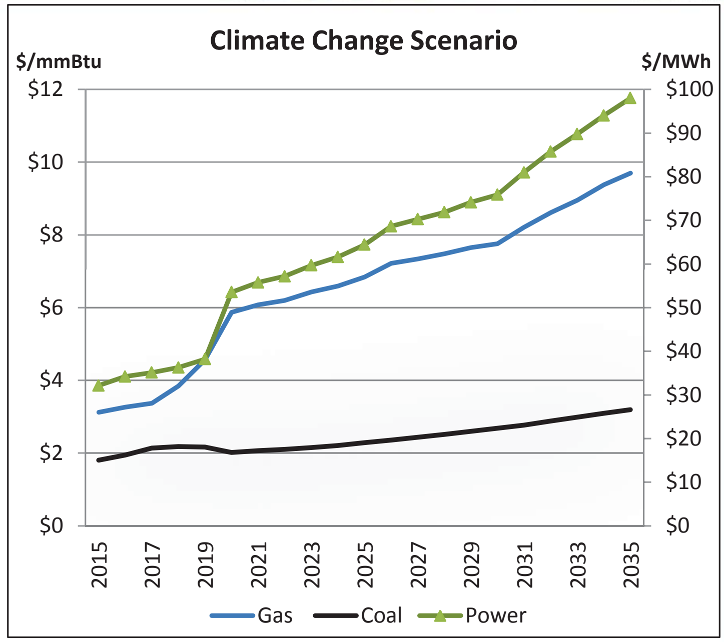
Climate Change Scenario

- The Climate Change Scenario is characterized by higher summer temperatures that drive increased electricity consumption. Increased fuel and power prices as well as a carbon tax of $17/MWh starting in 2020 benefit alternative resources such a renewables, energy efficiency and CHP.



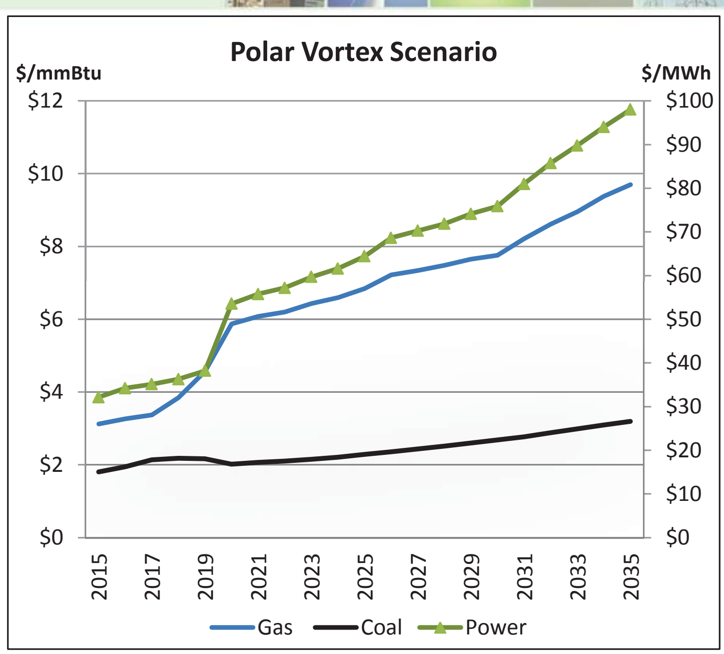
One Year Stress Scenario: Polar Vortex

What is a One Year Stress Scenario?

These scenarios were developed to stress the various portfolios to extreme events. While not frequent enough to warrant a long term scenario, we expect them to be insightful and primarily used for comparative risk analysis.

Description of Polar Vortex Stress Scenario

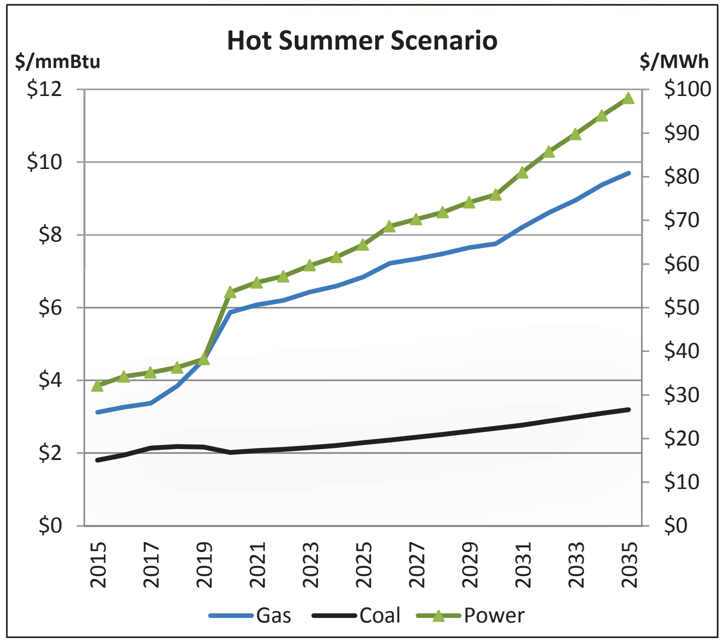
This scenario will mimic calendar years 2013 and 2014 and will include higher winter peaks and higher prices for fuel and power. A carbon tax of $17/MWh starting in 2020 will be assumed.



One Year Stress Scenario:
Hot Summer (Low Water and High Load)

Description of Hot Summer Stress Scenario

This scenario will feature higher summer temperatures which drive increased demand for electricity. Due to lower river levels, riverside generation will be de-rated. Both of these factors contribute to higher prices for fuel and power. A carbon tax of $17/MWh starting in 2020 will be assumed.



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Lunch

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Jim Hobbs, Lead Engineer

Resources Part 1

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Simple Cycle Combustion Turbines (CTs)

Resource Description
- Natural Gas primary, Fuel Oil backup
- 210 MW Nameplate
- Heat Rate 10 MMBtu/MWh
- Capital $31/MWh @ 30% Capacity Factor
- Fuel/O&M $73/MWh @ 30% Cap Factor
- CO2 emissions rate 1200 #/MWh

Advantages
- Low capital cost
- Fast install vs. other conventional options
- Fuel abundant/cheap for now

Disadvantages
- Less efficient than combined cycle
- Fuel price historically volatile

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Combined Cycle Combustion Turbines (CCs)

Resource Description

- Natural Gas primary, Fuel Oil backup
- 2 CTs with steam generator (2 on 1 or 2x1)
- 620 MW Nameplate
- Heat Rate 7 MMBtu/MWh
- Capital $16/MWh @ 87% Capacity Factor
- Fuel/O&M $51/MWh @ 87% Cap Factor
- CO_2 emissions rate 840 #/MWh

Advantages

- High efficiency
- Versatile - baseload or intermediate service
- Fuel abundant/cheap for now

Disadvantages

- Requires firm gas transportation for reliability
- Fuel price historically volatile

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Nuclear

Resource Description

- Uranium fuel
- 1117 MW Nameplate
- Capital $72/MWh @ 90% Capacity Factor
- Fuel/O&M $24/MWh @ 90% Cap Factor
- CO_2 emissions rate 0 #/MWh

Advantages

- Low variable cost
- Reliable baseload service
- Fuel supply reliability
- No air emissions

Disadvantages

- High construction cost
- Long lead time
- High water use
- Spent fuel storage

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Screened Out Resources

- Geothermal – No local resource
- Advanced Storage – Expensive; Duke R&D efforts continuing.
  - Battery Innovation Center near Crane Naval Surface Warfare Center, $1M funding
- Compressed Air Storage – Expensive, limited experience, high capital, scarce sites
- Small Modular Reactors – Conceptual design and development state
- Fuel Cells – Utility scale application not commercially available
- Animal Waste Digesters – Expensive, operational and permitting hurdles
- Woody Biomass – Expensive, limited by fuel availability, access, and proximity
- Coal-based generation – Potentially risky depending on outcome of carbon regulation

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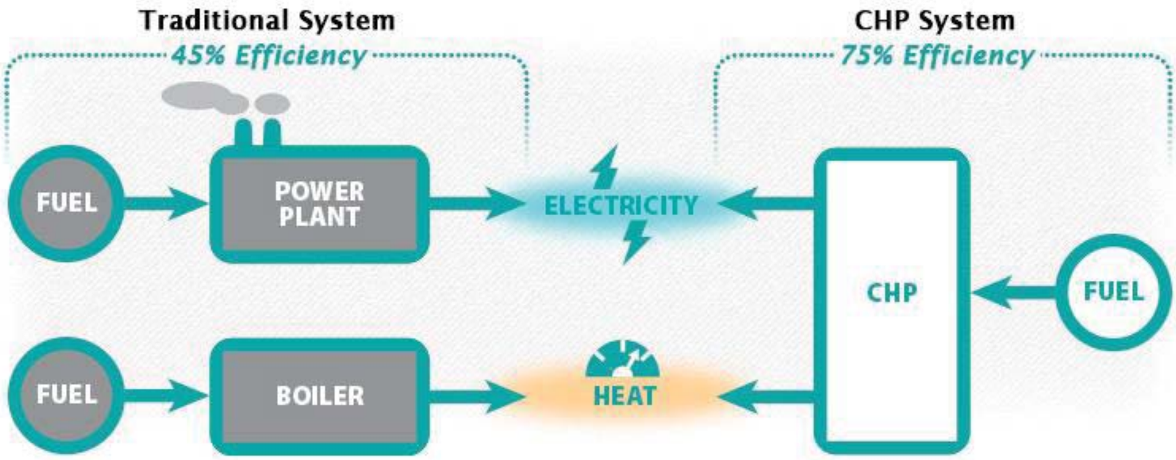
Battery Storage R&D

Project Name	Location	Technology	Capacity	Interconnection
Notrees	Ector and Winkler counties, TX	Xtreme Power advanced lead acid	36 MW/24 MWh	153 MW Wind Project
Rankin	Gaston County, NC	FIAMM sodium nickel	402 kW/282 kWh	1 MW Solar Project
Marshall	Catawba County, NC	Kokam superior lithium polymer	250 kW/750 kWh	1.2 MW Solar Project
McAlpine Community	Charlotte, NC	Kokam	24 kW/24 kWh	Transformer
McAlpine Substation	Charlotte, NC	BYD lithium iron phosphate	200 kW/500 kWh	50 kW Solar Project
Clay Terrace	Carmel, IN	Toshiba lithium titinate	75 kW/48 kWh	Clay Terrace Micro-grid

DUKE ENERGY.

Combined Heat and Power (CHP)



CHP Advantages and Challenges

- Advantages
  - High combined efficiency
  - Low combined carbon emissions
  - Smaller scale could enable better matching to reserve margin requirement
  - Economic development incentive
- Challenges
  - Unique, site and customer specific; must have steady steam load
  - Customer must be convinced that project makes economic and operational sense
  - Customer's business must have favorable long-term economic outlook

CHP Prospects

- Up to 500 MW Technical Potential with suitable customers
  - Universities
  - Bio-refineries
  - Pharmaceuticals
  - Other Industrials
- 2 customer installations now operating
  - Purdue (39 MW-coal and gas)
  - Tate and Lyle (7.4 MW-coal)
- CHP may be an economic alternative for meeting small boiler air emission restrictions

Duke Energy

Brian Bak, Lead Planning Analyst

Resources Part 2

Duke Energy

Duke Energy Indiana renewable resources

- Benton County Wind Farm
  - 100.5 MW
  - 20-year power purchase agreement (PPA) signed in 2006
  - Yields approximately 300,000 MWh/year
- Markland Hydro Facility
  - 51.3 MW run-of-river facility owned by Duke Energy Indiana
  - Also yields approximately 300,000 MWh/year
- New Solar Farms in Clay, Howard, Sullivan and Vigo counties
  - 20-year PPAs totaling up to 20MW (4 x 5MW)
  - 3 facilities expected online by year-end, Sullivan in 1Q2016
- In total, renewable resources provide ~1.5% of our annual energy

DUKE ENERGY.

Biomass – Landfill Gas

Resource Description

- Fuel source: Landfill methane emissions
- Internal Combustion Engine
- 5 MW Nameplate
- Capital $65/MWh @ 90% Capacity Factor
- Fuel/O&M: $20/MWh @ 90% Capacity Factor
- Heat Rate: 10.5 MMBtu/MWh
- CO_2 emissions rate: 0 #/MWh (considered carbon neutral due to biomass/MSW source)

Advantages

- Low fuel cost
- Baseload power
- Dispatchable
- Reduces flaring/direct emission of landfill methane

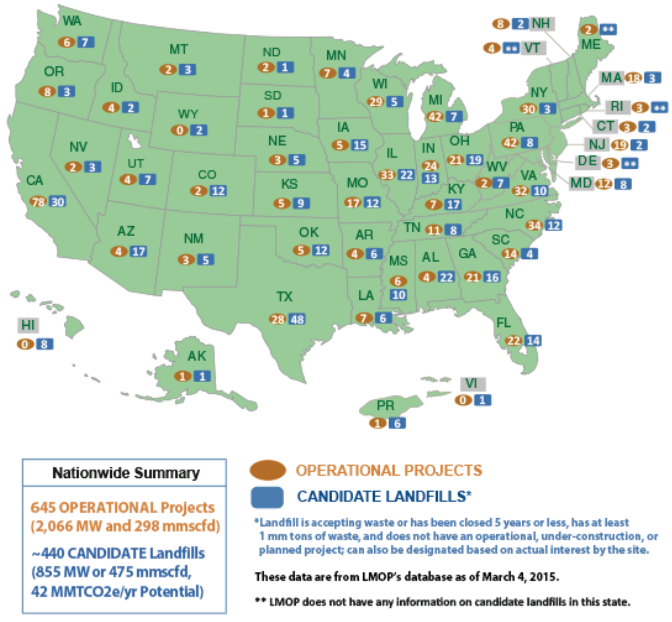
Disadvantages

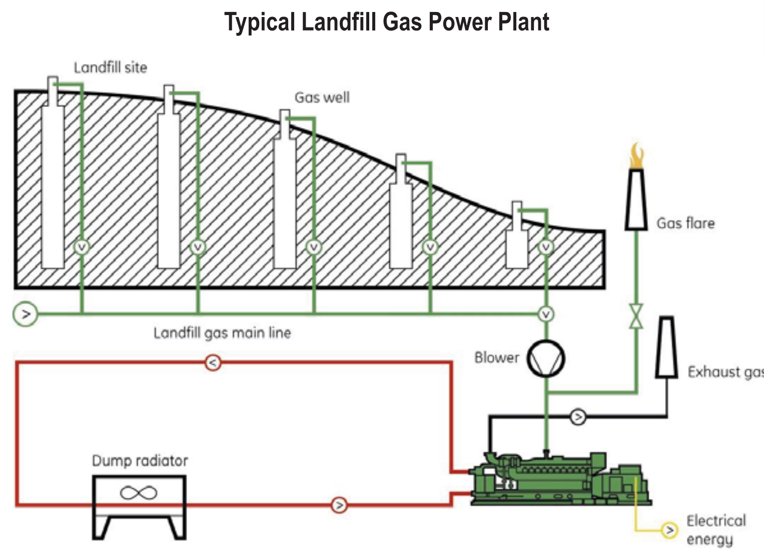
- Limited number of available sites
- Not scalable

Source: EPA Landfill Methane Outreach Program (LMOP) Website and Energy Cost Manual

DUKE ENERGY.

Biomass – Landfill Gas





Wind

<u>Resource Description</u>

- 20-200 MW Nameplate
- Capital: $56/MWh @ 35% Capacity Factor
- O&M: $13/MWh @ 35% Capacity Factor
- Contribution-to-Peak (MISO Capacity Credit)
  - 14.7% average
  - Site specific: 1.4% - 25.5%

<u>Advantages</u>

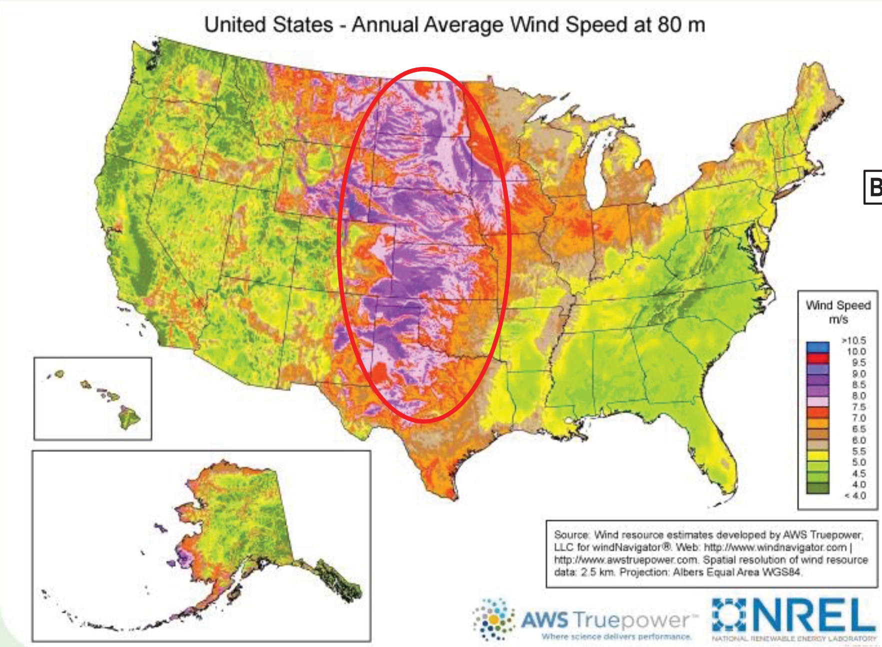
- Zero "fuel" cost
- Zero air emissions
- Renewable resource

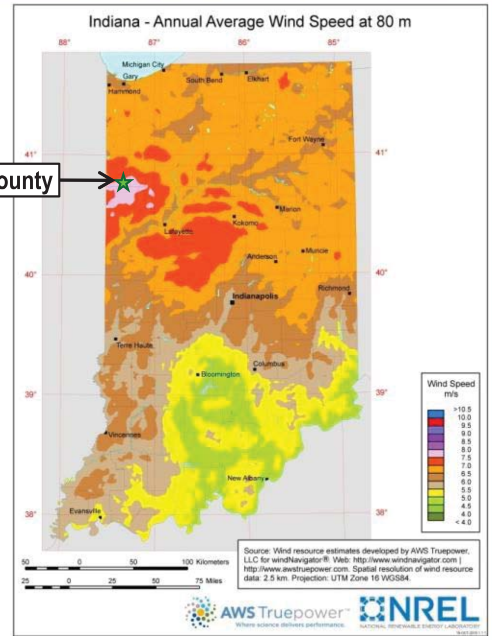
<u>Disadvantages</u>

- Distance from load center
  - Transmission / congestion cost
- Siting difficulties (NIMBY)
- Intermittency
- Low contribution to peak load

Source: Lazard Levelized Cost of Energy Analysis – Version 8.0 (Sept. 2014)

Wind Resource Distribution





Solar

Resource Description

- 5-25 MW Nameplate
- Capital: $79/MWh @ 21% Capacity Factor
- O&M: $7/MWh @ 21% Capacity Factor
- Contribution-to-Peak / Capacity Value
  - MISO Capacity Auction: based on actual metered historical output
  - Time-period based studies can be used to forecast approximate value

Advantages

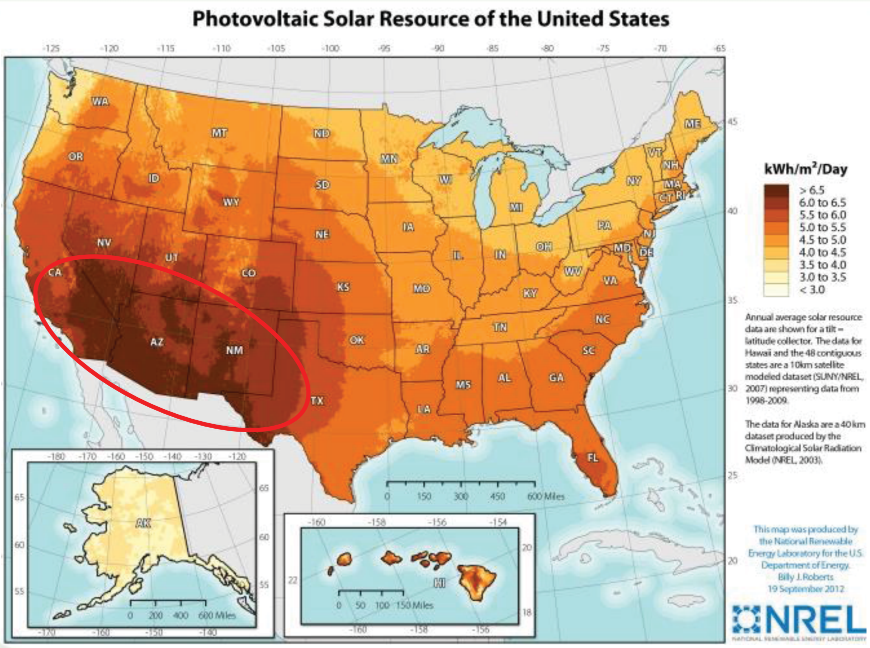
- Zero "fuel" cost
- Zero air emissions
- Renewable resource

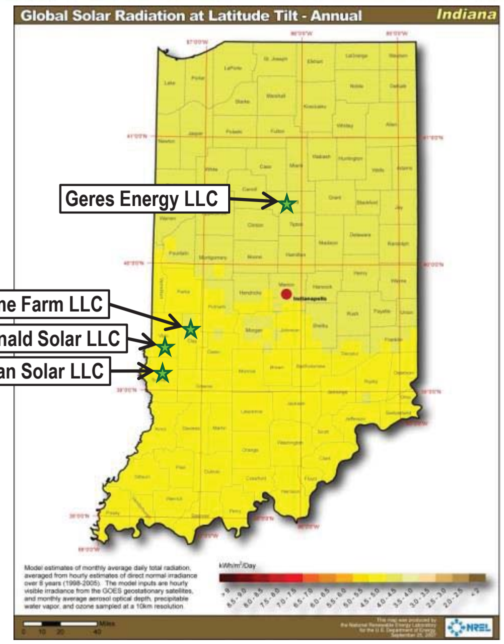
Disadvantages

- Intermittency
- Contribution to serving peak customer load declines as installed MW increase

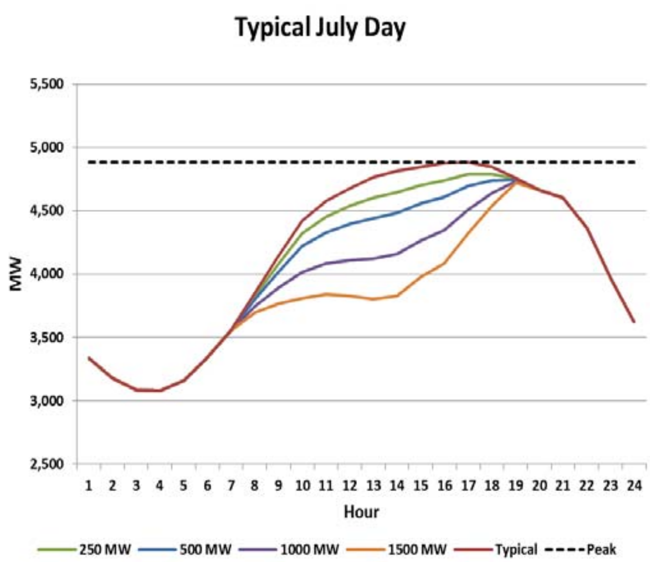
Source: Lazard Levelized Cost of Energy Analysis – Version 8.0 (Sept. 2014)

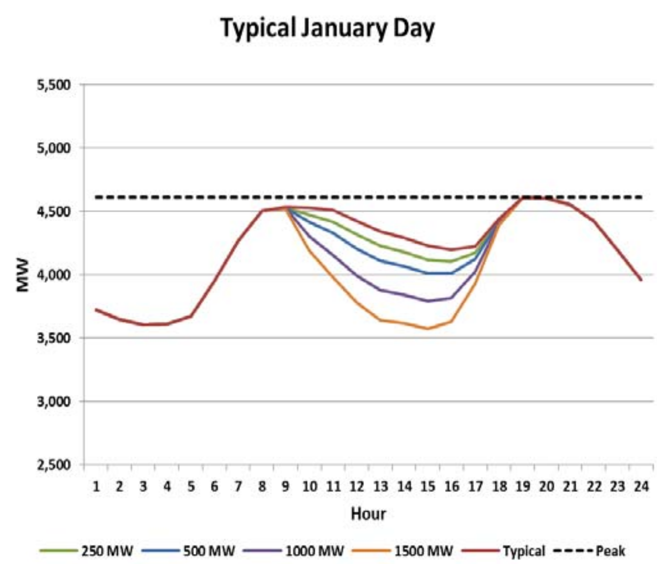
Solar Resource Distribution



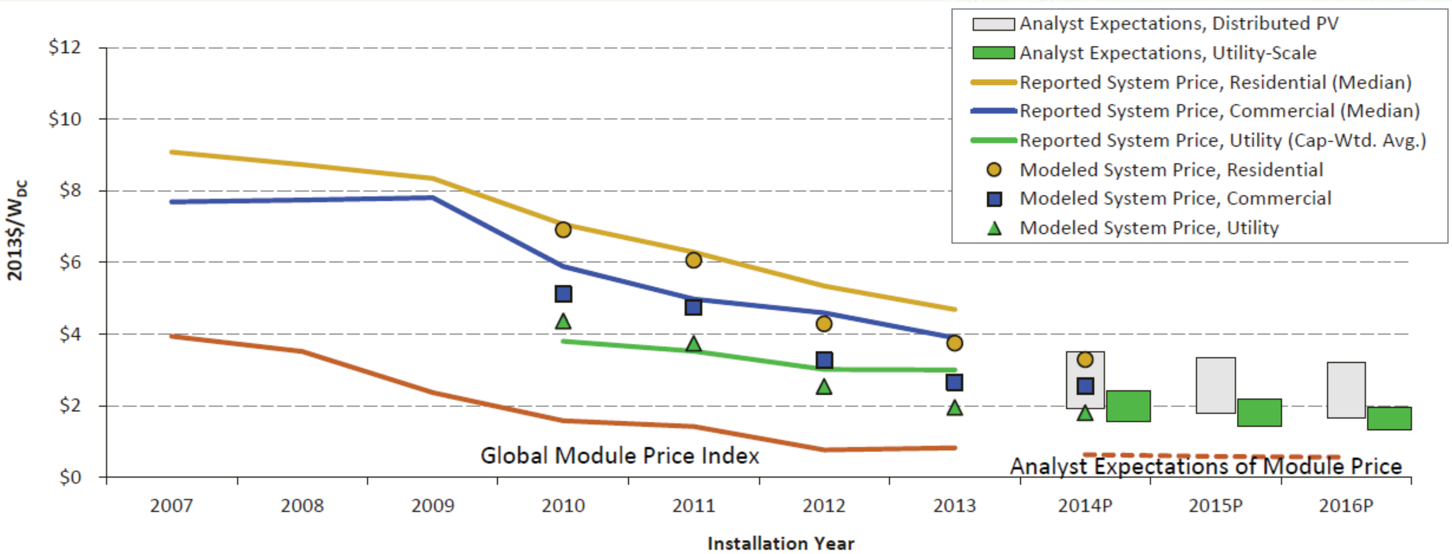


Solar: Contribution to Peak Load – Summer & Winter





U.S. Photovoltaic System Pricing Trends



- All methodologies show a downward trend in PV system pricing
- Reported pricing and modeled benchmarks have historically had similar results, however have recently diverged

Source: US DOE SunShot Initiative; Sept. 2014 (National Renewable Energy Laboratory and Lawrence Berkeley National Laboratory)

Scott Park, Director IRP Analytics - Midwest

Resources Part 3

Demand Response (DR)

Resource Description

- DR is a resource where the company pays customers an option payment to be able to curtail a customers load during periods of high demand.

Advantages

- Opportunity for customers to lower bill in exchange for being interrupted
- Useful in clipping peak

Disadvantages

- Higher use of DR can drive customers away from program
- Incremental DR capacity gets increasingly expensive
  - Higher payments are needed to incent new participants and that higher rate also gets paid to all participants and drives up the cost of incremental DR.

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Energy Efficiency (EE)

Resource Description

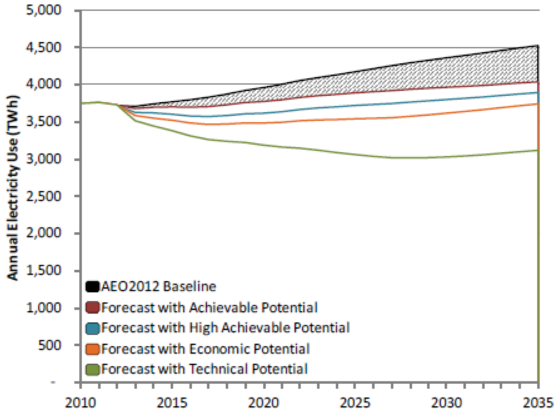
- EE is not a single resource but rather a collection of over five-hundred different measures such as lighting, appliances or motors
- Typically,
  - EE is included in the load forecast implicitly or as a load reduction
  - EE levels are frequently described in terms of
    - Technical potential
    - Economic potential
    - Achievable potential
- In order to model utility sponsored EE as a resource, this portion of EE needs to be removed from the load forecast and put into bundles for economic selection by the resource planning model.

DUKE ENERGY.

Energy Efficiency (EE)

Resource Description

- EE can be incented by the utility, but requires an action by the customer
  - Participation is less than what purely economic behavior would suggest



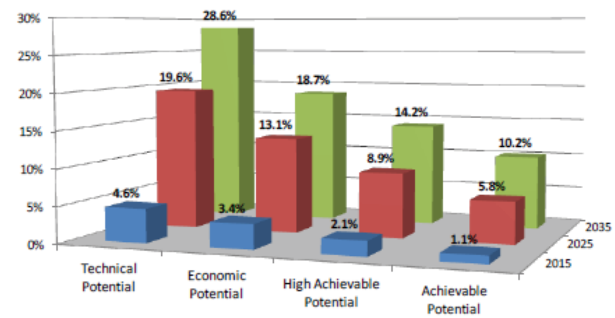
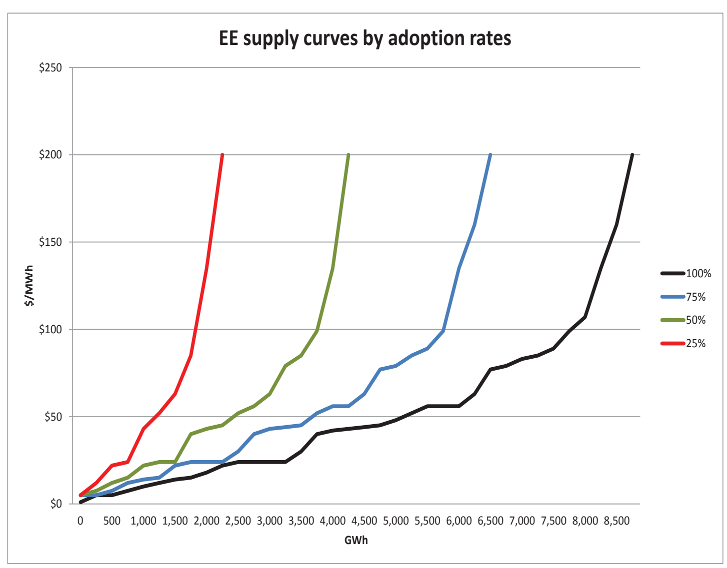


Figure 12
U.S. Summer Coincident Peak Demand Reduction

Energy Efficiency (EE)

- Unlike a traditional generation resource such as a gas plant or windmill, EE does not have a single cost for each MWh, but rather has a supply curve for increasing amounts of energy

- Additionally, the supply curve changes as a function of customers adoption rates



Energy Efficiency (EE)

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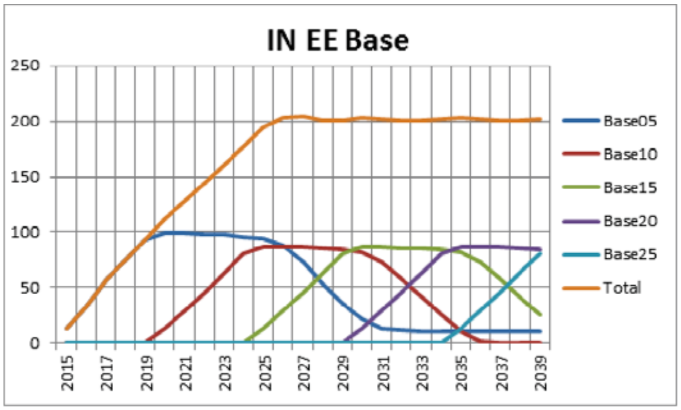

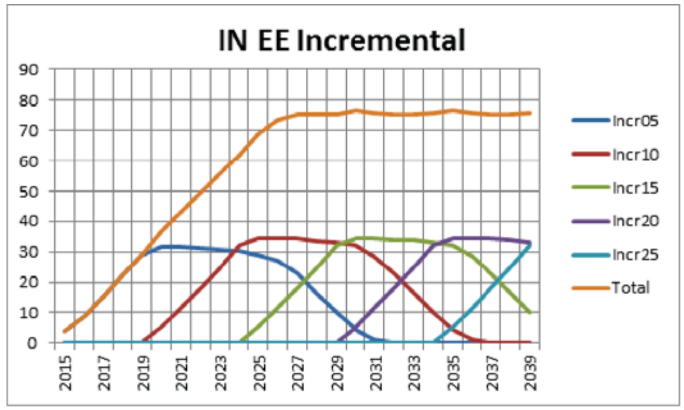

DUKE ENERGY.

Scott Park, Director IRP Analytics - Midwest

Portfolio Development Exercise

DUKE ENERGY.

Portfolio Development Exercise

Purpose

- Give stakeholders an opportunity to describe their respective preferred energy mix of DEI's future portfolio

Things to remember

- Consider other stakeholders (800,000 customers but only 1 system)
- System flexibility and fuel diversity
- Tradeoffs between different technologies

Follow-up

- Stakeholders may provide additional input by June 11th
- Duke Energy will specify resources that match stakeholders' preferred energy mix
- Model results will be presented in meeting #3

Marty Rozelle, President, Rozelle Group

Closing Comments, Stakeholder Comments

Next Steps

- Please complete comment cards or send by June 11 to Marty at: RGL97marty@rozellegroup.com

- Meeting summary and other materials will be posted on website by June 18 (http://www.duke-energy.com/indiana/in-irp-2015.asp)

- Next workshop is scheduled for the Tuesday, August 4th

DUKE ENERGY.

Duke Energy Indiana 2015 Integrated Resource Plan

Stakeholder Workshop 2
Summary
June 4, 2015

Welcome
Doug Esamann, State President for Indiana, Duke Energy

Mr. Esamann welcomed participants. He observed that these meetings have changed over time, and he thinks there have been several improvements. He noted the safety messages regarding emergency egress in case of a tornado or other emergency.

He told the group that he has new responsibilities with the Company, requiring him to relocate to Charlotte where he will be an Executive Vice President. He will be responsible for Ohio, Kentucky, Indiana & Florida. Melody Birmingham Byrd will be taking his place as President of Duke Energy Indiana (DEI). She has been here for several years, having come from another utility. Chuck Whitlock will take on electric distribution operations, replacing Ms. Byrd.

Mr. Esamann said that he thinks the agenda for today is an interesting one, and he will be back later in the afternoon for the group exercise.

Introductions & Agenda Overview
Dr. Marty Rozelle, The Rozelle Group Ltd.

Marty Rozelle introduced herself, thanking participants for attending Workshop 2 in this year's Integrated Resource Plan (IRP) process. She asked everyone to introduce themselves, and noted that there are also people calling in on the phone, so requested that participants please speak clearly and use the provided microphones.

There was discussion about how to access the internet accounts that had been set up, and clarification was provided. Several participants had trouble with this, and technical support was called to help. Further instructions were provided. The telephone connection was also unsatisfactory. DEI staff said they will continue to try to fix these issues. After quite a bit of discussion, Dr. Rozelle decided that if we are unable to solve technical difficulties, we just need to proceed since there is a lot to accomplish today.

Meeting 1 Comments & Responses - Updates Since Meeting 1
Scott Park – Director IRP Analytics, Midwest

Scott Park reviewed some of the comments and suggestions that were made at the previous workshop, and discussed how DEI has addressed them. These included Wi-Fi internet access, the range of scenarios, how demand-side management (DSM) and energy efficiency (EE) will be modeled, analysis of unit retirements, and whether health impacts of CO2 emissions would be addressed.

Mr. Park noted that, at this meeting, DEI will be asking participants to make suggestions about scenarios that have been developed based on suggestions at the last workshop. He discussed the conference call in which a "deregulation scenario" was discussed among DEI staff and several stakeholder representatives; this discussion centered on what assumptions might be made to craft such a scenario.

Participant questions included the following:

- A participant requested that the current operations that Duke is using in the State of Ohio should be considered as a scenario. She thought that there should be data available that could be used to build a scenario.
    - Mr. Park explained that in Ohio the utility is essentially taken apart and is deregulated. There are independent generators, customers purchase from the market, and use the transmission system. A big question is who builds the generation. There are also limitations on the transmission system for imported power. It is difficult to make assumptions about generators in building a model. He wondered if this would this be a meaningful scenario for Indiana, and said that DEI will think about it.
- Is there an expectation in Ohio that Duke will provide power to its customers, even though it doesn't generate any power?
    - Power is now provided through market auctions.
- A suggestion was made that an appropriate role would be to decrease power production and increase grid capacity through smart grid technology.

Scenarios – Part 1
Jim Hobbs, Lead Engineer

Mr. Hobbs told the group that there are 10 scenarios under consideration now, which is quite a few. The first one being considered is "No CO_2 Regulation", which assumes that there would not be a carbon tax or price, and the load growth rate would be 0.9%. He explained the graph that shows changes in cost of gas and coal resources and power over the planning period.

The second scenario is termed "CO_2 Regulation by Price". This includes a carbon tax price of $17 per ton in 2020. Gas prices are slightly higher here, as are coal prices. The load rate assumed is 0.8%, and there is a goal of 5% renewable energy in the portfolio.

The third scenario is a Clean Power Plan (CPP) construct that aims to reduce carbon emissions by 20%.

Group comments and questions included the following:

- As generation expires, what are you replacing it with? Will you stay with coal as a resource till 2035?
    - EVA does modeling for the whole Eastern interconnect; their model uses proprietary costs. In the "No CO_2" scenario, there will still be substantial amounts of coal because there is no penalty for coal.
- On the 3 graphs, the coal prices seem to be the same for all. Does that mean that the scenarios will not affect coal at all?
    - Both fuel prices have a very flat supply curve, so they do not vary much.
- Under the CPP, why a 5% renewable, while Indiana Clean Power Compliance Plan is considering a 7% renewable portfolio? EPA is using 7.5% as a data point.
    - These models are based on economics; 5% was the input, and the model would vary that if economical to meet higher requirements.
- Is there any scenario at which the renewable target is set higher than 5%?
    - Not at this time. We can reevaluate that based on model outputs.
- Is there any scenario that just lets the model select a Renewable Portfolio Standard (RPS)?
    - This might be more appropriate to do as a sensitivity. With carbon assumptions, we could try to run a carbon scenario without any RPS input to see what happens.
- Is the dip at 2019 related to retirement of Gallagher?
    - No, this is just supply and demand in the future, and it's not related to Gallagher at all.
- It seems that there is a constant rise in coal prices. Why is that?
    - Primarily due to mining labor costs. The coal fleet drives demand, but fixed production costs will still exist.
- Have you incorporated demand response?
    - Yes. Demand response has been treated more as a resource, which we will talk about more this afternoon.
- The low growth rate is similar in all scenarios. Would you consider a higher load growth scenario?
    - Yes, we've done this in some of the scenarios that will be explained later.
- Are these average nationwide prices for coal and gas?
    - They are Eastern Interconnect prices.
- A participant suggested that the CPP scenario should have 7.5% RPS and also include energy efficiency, to be consistent with the possible Indiana State Implementation Plan.
    - We'll consider it, and may look at it both ways.

Scenarios – Part 2
Brian Bak, Lead Planning Analyst

Brian Bak explained that the scenarios he will describe were designed to test the level of flexibility in the resource portfolio. They combine both carbon regulation and no carbon assumptions over the planning horizon. First, DEI assumes that there is no CO_2 regulation for 10 years, followed by regulation for the remaining 20 years. The next scenario is the opposite, with regulation followed by no regulation.

The third ‘stress’ scenario is termed “Extended Market Pricing”, which tests fixed market prices (currently low) rising steadily over time, without inputting price assumptions.

Participants had the following questions:

- The natural gas curve is identical for the first two scenarios; why is that?
    - It’s a very flat part of the supply curve, so there is not much variation when you blend them.
- Then, why do the prices go up at all?
    - To account for inflation over time.
- A participant suggested that the second scenario is not realistic, since it is unlikely that regulations would be rescinded. Another participant disagreed, saying this could happen depending on the current political situation.
- A participant noted that the total price of the “Extended Market” scenario is $65 per megawatt hour (MWh) at the end of the period, compared to $72 for the “No Carbon Regulation” scenario.
- Is the average annual load growth Indiana-specific?
    - Yes.

Scenarios – Part 3
Scott Park

These scenarios are derived from stakeholder suggestions at the last workshop. The first is characterized as “Customer Choice”. This incorporates some elements that might be considered aspects of deregulation, as discussed in the previously-mentioned conference call with stakeholders. These include assumptions about increasing use of customer-installed solar, higher levels of EE adoption, a carbon tax on coal, and more merchant generation.

Mr. Park asked the group how this scenario might be improved. They said:

√ Add combined heat and power (CHP)
√ This scenario is reasonable. Increasing the target for ‘rooftop solar’ makes sense because of increased availability and use of battery storage.

Other comments included the following:

- If DEI is only going to assume 1% increase per year of solar, how are you even going to get 1 MW of total generation, given the low measure of efficiency of wind and solar?
    - We are only including customer-generated solar here, not utility scale.
- What’s the utilization factor on rooftop solar?
    - About 45%.
- It takes about 5.5 acres of solar installation to generate 1 MW – “that’s a lot of roofs”.
- Don’t call it ‘rooftop’, call it customer-owned. For example, there are farmers now who have installed solar panels in fields, which they can seasonally adjust.
- Some states have increased their net metering caps from 3% to 6%.
- Is there a scenario that reflects decreased customer choice?

    - Not really; this assumes that customers can adopt distributed generation (rooftop solar) at any time, not factoring in federal subsidies, etc.
- A participant suggested that the power price of $100/MWh would be offset by benefits to society of about $40/MWh, making this scenario cost $60, which is relatively inexpensive.

Mr. Park explained that the next 3 scenarios address climate change issues. He said these may be able to be combined into a single scenario, and asked the group to consider whether this might make sense.

He observed that climate change might include greater volatility in weather, rather than a wholesale change in everything. The “Climate Change” scenario, therefore, is characterized by higher summer temperatures that drive increased electricity consumption as well as increased fuel and power prices and a carbon tax.

Additionally, DEI has developed 2 one-year stress scenarios that test the various portfolios in extreme weather events, mainly as a risk analysis. These include a “Polar Vortex” scenario that mimics conditions of 2013 and 2104 where there were high winter peaks in energy demand, and a “Hot Summer” scenario with high demand in which river levels are lower, resulting in reduced power generation unit output. Both of these factors contribute to higher prices for fuel and power.

Questions, comments, and observations included:

- What years in these charts would reflect the stressors?
    - We would try to mimic recent experiences. The various portfolios would be run through these conditions to allow us to compare costs of portfolios under stress of winter and summer conditions.
- You can’t use the same prices for these scenarios; commodity prices would likely be much higher here.
    - Agreed.
- From a climate standpoint, it is predicted that these events will occur on a more regular basis in future, so these scenarios make sense.
- Are you assuming constant load growth throughout all these scenarios?
- Yes, because some assumption could increase load growth while others could decrease it; we assume it would balance out.
- Please review the charts for these scenarios again; they are not clear to participants.
    - These prices would only vary significantly on a seasonal or even daily basis – we haven’t built in that level of specificity. Historically, changing demand doesn’t necessarily result in cost changes. These are generally based on the previously-described Carbon scenarios.
- If there is a carbon tax and higher demand, it would probably result in a higher adoption of customer solar generation.
- Perhaps you’re assuming too much load growth?
    - The Carbon case would be a proxy for that, starting with .8%. The model can select additional levels of EE, rooftop solar, etc. This could even result in a negative load growth for the utility.

- If we collapse the climate scenarios, the events should be assumed to occur close together, perhaps in concurrent years on several occasions over the planning horizon (but not every year).
    - This seems to be a good approach to use. Thank you.
- Consider that average temperatures will continue to rise regardless of drastic events.
- What effect do hot summers have on the system?
    - The ability of plants to take in cooling water is less, so generation efficiency is reduced (say by 40%). The model can reduce the dispatch of units accordingly.

In summarizing the discussion, Mr. Park said the group seems to agree that DEI should proceed with the following:

√ Include the carbon/no carbon scenarios
√ Extended Market scenario represents low sensitivity
√ Customer Choice scenario is acceptable
√ Climate Change scenarios make sense, and it is agreeable to combine them, using suggestions above

Resources – Part 1
Jim Hobbs

Jim Hobbs noted that this discussion is in preparation for the exercise this afternoon dealing with portfolios. He asked the group if anyone had tried playing the Duke Energy online Planning Game, and several had. He provided a brief overview of the remaining presentations, noting that the statistics presented are from EIA.

The first resource discussed was Simple Cycle Combustion Turbines(CT), essentially jet engines fueled by natural gas. These tend to be peaking units.

Questions included:

- Do the data on capital cost include pollution control equipment?
    - Mr. Hobbs didn't know but assumes so.
- What's the energy efficiency of these units? People took issue with the assumption of 30% capacity factor, believing it's much lower.
    - Megawatt cost ($/MWh) is a function of capacity factor, so if you want to cut capacity back, the cost could be cut back commensurately (e.g. 10% capacity = $10/MWh).
- Characterizing cost as dollars per **kilowatt** ($/KW) would be more understandable to stakeholders.

The next resource described was Combined Cycle Combustion Turbines (CC), which are about 3 times larger than a stand-alone CT and tend to serve as baseload units. They cost about $900/KW and have a much higher capacity factor.

Nuclear units are much larger baseload resources, are very expensive to install, but have no carbon emissions. The cost equates to about $5500/KW.

Mr. Hobbs discussed the resources that were looked at but not used in portfolio development for a number of reasons. These are:

- Geothermal – There are no local resources (Some participants did not agree with this characterization.)
- Advanced storage (batteries) – Still very expensive, although research and development are ongoing (Some participants suggested that this should not be screened out, since costs are coming down all the time. Mr. Park noted that the cost is still very high, and batteries need to be replaced several times over the life of a project, adding significantly to cost-effectiveness.)
- Compressed air storage – Indiana geology does not present suitable sites.
- Small modular nuclear reactors (recyclable) – conceptual only at this point
- Fuel cells – not commercially viable at utility scale
- Animal waste digesters (A participant objected to screening this resource out, and said that there are 14MW already being generated in Indiana with anaerobic digesters. There are also a number of other industrial waste streams that could be suitable for these digesters.)
- Woody biomass – inadequate fuel resource in Indiana due to climate (A participant noted that there are resources in southern Indiana that would accommodate this. Also, although the resource may not be suitable for Duke's use it could be viable on a smaller scale for customer generation.)
- Coal – unlikely to be developed as a new resource in the future

A participant said that this information is very confusing. Another wondered if Duke is trying to predict when some of these resources may become available; Mr. Park said it's not practical to include purely hypothetical resources without reliable data, but the repetition of the IRP process every two years accounts for updates of information and inclusion of new approaches. He noted that Duke has an emerging technologies group that tracks these developments.

Mr. Hobbs provided more information about Duke's battery storage research and development activities. He explained how combined heat and power (CHP) works, saying that this would typically be used by an industrial customer who has a need for both steam and process heat. This approach greatly increases plant efficiency, and has a number of other advantages. The challenge is mainly economic, and depends on individual customer needs and budgets. Both Purdue University and Tate and Lyle now operate CHP units, and other customers may emerge in future.

Participant questions included:

- Would CHP be utility-owned or customer-owned?
    - It could be either one.
- Is there a benefit of CHP to the utility in terms of deferred generation, relieving pressure on the transmission system, etc.?
    - Possibly.
- The increase in efficiency and corresponding reduction of CO_2 emissions make CHP a very important technology for future consideration. Purdue has a 39 MW facility.
- Wastewater treatment plants may also be good candidates. Duke should do a market assessment by sector to evaluate this.

- Why isn't gas conversion of existing coal plants included in the list of resources?
    - Converting coal units to gas is inefficient and inflexible, so it won't do much on an energy basis or a capacity basis; therefore, it hasn't been an attractive option to date. The Clean Power Plan may change that thinking. We may look at Wabash River #6 within the context of this IRP, but would probably limit the analysis to that.

Lunch

Resources – Part 2
Brian Bak

Mr. Bak discussed biomass generation from landfill gas. These are small units with a high capacity factor that can provide baseload power. An advantage is that the fuel cost is low; a disadvantage is that sites are limited.

Questions were:

- Are these costs open for stakeholder discussion?
    - They are confidential costs, but could be made available if participants sign a non-disclosure agreement.
- What's the life expectancy of a landfill unit?
    - We don't know exactly, but it's likely to decrease over time.
- Do they need to be located in DEI's service territory to be used?
    - That would be preferable from a transmission standpoint, but it's probably not necessary.
- Can these units be installed retroactively, or do they need to be built along with the landfill?
    - It's probably more efficient to design them into the facility, but they can be retrofitted (e.g., Marshall County, Argos).

Mr. Bak provided an overview of DEI's renewable energy resources, which provide a total of 1.5% of annual energy. These include wind, hydro, and solar. He noted that there are many more wind generators in the region than previously. Wind farms can range from a single turbine to large arrays. Capital costs are relatively low, but the capacity factor is also quite low (about 35%). The biggest challenge is that the resource is intermittent, and the average contribution to peak (MISO capacity credit) is only 14.7% in the MISO region. Transmission may also be a challenge. Advantages include no fuel costs and no emissions. He showed a map of wind resource quality throughout the United States; Indiana is about in the middle of the range.

Regarding solar, this assessment is limited to photovoltaic, on a utility scale. Capital costs are slightly higher than wind, but the capacity factor is lower (about 21%). Maintenance costs tend to be low, and there is no fuel cost. There are no air emissions. Solar is also an intermittent resource and has effects on peak demand. This is illustrated by looking at a series of graphs showing typical summer- and winter-day demand relative to solar output. In summer, solar contributes significantly to peak demand in the late morning and early afternoon, but not in the evening. In winter, there is a dual peak in morning and evening, while solar produces energy between those times; therefore, solar does not significantly contribute to winter demand at all.

Group questions and comments included the following:

- What is MISO Capacity Credit?
    - MISO (Midcontinent Independent System Operator, Inc.) will calculate credit to utilities for providing energy to customers, while maintaining the required reserve margins. This means utilities don't typically get full capacity credit for some resources.
    - A participant from Indianapolis Power and Light (IPL) noted that IPL approaches solar differently, putting a 7% credit on top of the MISO capacity factor. There is not always a direct exchange, and it does not always involve "real" money.
- A participant suggested that there is evidence showing that orienting solar panels due south instead of west may be advantageous to the utility.
- If the orientation of panels is seasonally adjusted, 4 times per year, efficiency can be increased quite a bit. There seems to be a trend toward this in Indiana, according to a participant.
- Do solar generators get credit for the times of day that solar greatly reduces demand?
    - Yes, but that's offset by the opposite times when they need to obtain power from the grid.
- A participant said that solar is being installed in Bloomington for $2.75 per watt; here we still show a cost of more than $4.
    - This is a function of the data being used as inputs here. A participant in the previous workshop had also suggested that costs were much lower in the German system.

Resources - Part 3
Scott Park

Mr. Park talked about customer-driven resources including Demand Response (DR) and Energy Efficiency (EE). DR presents an opportunity for customers to lower their bills in exchange for having their power interrupted during periods of high demand on the system.

The concept of Energy Efficiency includes hundreds of different programs and approaches, not just a single resource. EE is typically described according to 'achievable potential', 'economic potential', and 'technical potential'. Historically, about 50-60% of customers have taken advantage of some kind of EE opportunity. Mr. Park explained how EE will be evaluated in scenario analysis, by 'bundling' programs so they can be economically selected by the resource planning model.

Questions and comments included:

- Why aren't large customers taking advantage of this? Why haven't the utilities been offering incentives for these customers?

- Mr. Park provided some history of this topic in Indiana, resulting in the current situation whereby the State has taken away EE targets, and industrial users are allowed to opt out of the available programs.
  - Michael Goldenberg of DEI said that the best opportunity at this time may be for the small commercial users, since the large customers have opted out. He noted that this decision is no different from residential customers who don't want to spend a lot of up-front money.
  - A representative of Steel Dynamics, Inc. said that they are the second-largest electricity user in DEI territory. They want a 3-year payback, not a 30-year payback as estimated by the utilities. Although they have opted out, they are still doing what makes economic sense, on their own initiative and not in response to a regulation.
  - A representative from the Office of Utility Consumer Counsel (OUCC) noted that there were probably several reasons for this history. Marketing of the CNI programs at the beginning wasn't very effective. "Energize Indiana" made better sense. Also, along the way there were a number of facilities that made big improvements, and later they resented having to subsidize others who had not made those investments.
- Thank you for including the market potential study in the recent filing. It does seem to be a bit outdated, however.
  - Suggestions and ideas about what should be included in future studies would be welcome.
- Are you accounting for LRAM in the market potential studies?
  - Accounting for lost revenues is part of our analysis of cost-effectiveness.
- Regarding the packaging of EE for modeling, are these bundles of individual programs? Are bundles created by year, incrementally?
  - No, they are an aggregation of a number of programs, which are added incrementally at sequential times in the modeling. We cannot, therefore, evaluate the effects or effectiveness of individual EE programs.
- How are you adjusting reserve margins taking EE into account?
  - We're not; MISO dictates the required reserve margin.

Portfolio Development Exercise
All

Dr. Marty Rozelle explained that the exercise planned was for about 1.5 hours, but we only have about ½ hour left today. She explained the exercise and the worksheets. The goal is to fill in the blank portfolio matrices with a percentage breakdown of resources to be included in a suggested portfolio, taking into account the cost and performance data that's been presented today. She asked participants to please spend a few minutes individually filling out a matrix, and then discuss your ideas with the group at your table to see if you can agree on a shared portfolio. Tables will share their thoughts with the larger group at the end, and DEI will use the results in testing the scenarios.

A participant noted that it would be very helpful to have the information in MW rather than percentages; for example, what does 1% represent? Mr. Park said that that DEI serves about 40 million megawatt hours per year.

After working separately, each table presented their proposals. Group observations about the proposals included the following:

- No one had more than 40% coal in their portfolio in 2035. This will help in reducing emissions.
- Only one included nuclear generation.
- Everyone wants more renewables and EE.
- Combined cycle will also produce some emissions.
- EE and CHP should be taken more seriously, especially by business and industry, since these will ultimately reduce customer costs. These will also help to reduce carbon sources, which is good for all. Duke needs to really help customers reduce energy use.
- Most table groups reduced the level of market purchases. DEI asked why this was suggested; answers were:
  -- There's less financial risk to the company.
  -- As more plants are shut down, there's less power out there to purchase.
  -- It's going to be up to the utility to generate its own power.
  -- Duke needs to show every year that it has enough generating capacity to serve its load. If this is not fully used, customers are still paying for the assets. If we have enough capacity, then why are we buying?

The results of the group exercise are attached to this summary.

Closing Comments

Doug Esamann observed that the various proposals show similar trends, specifically in the suggestions for reduced coal and increased renewables. He promised that DEI will cost these out to see how feasible they may be, and also to evaluate the carbon footprint of the various portfolios. He thanked participants very much for their time today, reiterating that the IRP stakeholder process is very important to DEI and to its customers.

The facilitator reminded participants to please fill out comment forms about the meeting. Additional comments can be emailed to Dr. Marty Rozelle at: rgl97marty@therozellegroup.com.

The next meeting will be on August 4, and the final meeting will likely be in early October.

Summary of Resource Portfolios Suggested by Stakeholders

STAKEHOLDER TABLE 1

RESOURCE TYPE	2014	2025	2035
Coal	75%	47%	22%
Market Purchases	21%	17%	12%
Hydro	1%	1%	1%
Combined Cycle	1%	14%	25%
Combustion Turbine	1%	1%	1%
Energy Efficiency	1%	5%	10%
Solar	0%	5%	10%
Wind	0%	5%	10%
CHP	0%	3%	5%
Nuclear	0%	0%	0%
Other 1 (Fuel Cell)	0%	1%	2%
Other 2 (LFG/ Digester)	0%	1%	2%
TOTAL	**100%**	**100%**	**100%**

STAKEHOLDER TABLE 2

RESOURCE TYPE	2014	2025	2035
Coal	75%	25%	15%
Market Purchases	21%	25%	25%
Hydro	1%	1%	1%
Combined Cycle	1%	1%	1%
Combustion Turbine	1%	0%	0%
Energy Efficiency	1%	15%	18%
Solar	0%	8%	10%
Wind	0%	8%	10%
CHP	0%	8%	10%
Nuclear	0%	0%	0%
Other 1 (Biomass)	0%	8%	10%
Other 2 ( )	0%	0%	0%
TOTAL	**100%**	**99%**	**100%**

STAKEHOLDER TABLE 3

RESOURCE TYPE	2014	2025	2035
Coal	75%	50%	40%
Market Purchases	21%	16%	10%
Hydro	1%	1%	1%
Combined Cycle	1%	10%	16%
Combustion Turbine	1%	1%	1%
Energy Efficiency	1%	5%	10%
Solar	0%	2%	3%
Wind	0%	5%	7%
CHP	0%	10%	13%
Nuclear	0%	0%	0%
Other 1 ( )	0%	0%	0%
Other 2 ( )	0%	0%	0%
TOTAL	**100%**	**100%**	**100%**

STAKEHOLDER TABLE 4

RESOURCE TYPE	2014	2025	2035
Coal	75%	50%	35%
Market Purchases	21%	15%	10%
Hydro	1%	1%	1%
Combined Cycle	1%	20%	20%
Combustion Turbine	1%	5%	10%
Energy Efficiency	1%	5%	5%
Solar	0%	1%	4%
Wind	0%	1%	4%
CHP	0%	1%	4%
Nuclear	0%	0%	5%
Other 1 (Fuel Cell)	0%	0%	1%
Other 2 (Battery)	0%	1%	1%
TOTAL	**100%**	**100%**	**100%**

STAKEHOLDER TABLE 5

RESOURCE TYPE	2014	2025	2035
Coal	75%	48%	30%
Market Purchases	21%	12%	3%
Hydro	1%	1%	1%
Combined Cycle	1%	16%	25%
Combustion Turbine	1%	1%	2%
Energy Efficiency	1%	7%	14%
Solar	0%	4%	8%
Wind	0%	11%	16%
CHP	0%	2%	5%
Nuclear	0%	0%	0%
Other 1 ( )	0%	0%	0%
Other 2 ( )	0%	0%	0%
TOTAL	**100%**	**102%**	**104%**

(AVERAGE OF TABLES)

RESOURCE TYPE	2014	2025	2035
Coal	75%	44%	28%
Market Purchases	21%	17%	12%
Hydro	1%	1%	1%
Combined Cycle	1%	12%	17%
Combustion Turbine	1%	2%	3%
Energy Efficiency	1%	7%	11%
Solar	0%	4%	7%
Wind	0%	6%	9%
CHP	0%	5%	7%
Nuclear	0%	0%	1%
Other 1 (Biomass)	0%	2%	2%
Other 2 (Battery & Fuel Cell)	0%	0%	1%
TOTAL	**100%**	**100%**	**101%**

2015 Integrated Resource Plan

Stakeholder Workshop #3

Aug 4, 2015
Plainfield, IN

Welcome

Welcome

- Safety message
- Why are we here today?
- Objectives for stakeholder process
- Introduce the facilitator

The Facilitator

- Duke Energy Indiana hired Dr. Marty Rozelle of The Rozelle Group and her colleagues to:
  - Help us develop the IRP stakeholder engagement process
  - Facilitate and document stakeholder workshops

Why are we here today?

- Duke Energy Indiana developing 2015 Integrated Resource Plan (IRP)
- Proactively complying with proposed Commission IRP rule
- Today is the 3rd of 4 stakeholder workshops prior to filing the IRP by November 1, 2015

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Objectives for Stakeholder Process

- **Listen:** Understand concerns and objectives
- **Inform:** Increase stakeholders' understanding of the IRP process, key assumptions, and challenges we face
- **Consider:** Provide a forum for productive stakeholder feedback at key points in the IRP process to inform Duke Energy Indiana's decision-making
- **Comply:** Comply with the proposed Commission IRP rule

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Agenda

08:30	Registration & Continental Breakfast
09:00	Welcome, Introductions & Agenda
09:20	Meeting 2 Comments & Responses
09:45	Scenario Review
10:15	Break
10:30	Portfolio Review
11:30	Lunch
12:15	Modeling (Results; Observations; Next Steps)
01:30	Sensitivity Exercise
02:45	Closing Comments

Scott Park, Director IRP Analytics - Midwest

Meeting 2 Comments & Responses

Meeting 2 Comments and Response

Topic	We heard/observed...	Response
Conference Call	Poor sound quality	Raised issue with IT and corrected
Wi-Fi	Poor Wi-Fi connectivity	Since internet access is not critical to the meeting, stakeholders will now be responsible for providing for their own internet access
CO2 footprint	What is the CO2 footprint of the portfolios?	Reductions in CO2 data will be provided for each portfolio in each scenario

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Meeting 2 Comments and Response

Topic	We heard/observed...	Response
Stakeholder Exercise	Exercise was very helpful and informative	We felt that having stakeholders develop specific input and present that to the group was very productive and we will make use of a similar exercise format in future meetings
One on One Conference Call	Due to problems with the conference call sound quality, several calls were conducted with two stakeholders to review the content of the June 4th meeting as well as discuss IRP issues	Conference calls were productive and overall understanding between stakeholders and Duke Energy Indiana improved, but differences of opinions still exist

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Jim Hobbs, Lead Engineer

Scenario Review

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Seven Scenarios

Core Scenarios

1. No Carbon Regulation
2. Carbon Tax
3. Clean Power Plan (Proposed Rule)

Change of Outlook Scenarios

4. Hybrid scenario 1 (No Carbon Regulation changing to Carbon tax)
5. Hybrid scenario 2 (Carbon tax changing to No Carbon Regulation)

Stakeholder-Inspired Scenarios

6. Increased Customer Choice
7. Climate Change

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Core Scenarios

- No Carbon Regulation
  - No carbon tax/price or regulation
  - Moderate levels of environmental regulation
  - No Renewable Energy Portfolio Standard (REPS)
- Carbon Tax
  - Carbon tax $17/ton in 2020, rising to $50/ton
  - Increased levels of environmental regulation
  - 5% REPS
- Clean Power Plan (CPP) (Proposed Rule)
  - Carbon reduced 20%
  - Increased levels of environmental regulation
  - 5% REPS

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Change of Outlook Scenarios

- Hybrid scenario 1 (No Carbon Regulation changing to Carbon tax)
  - No Carbon Regulation scenario initially
  - Change to Carbon Tax scenario for latter part
  - Demonstrates impact of delayed carbon regulation

- Hybrid scenario 2 (Carbon tax changing to No Carbon Regulation)
  - Carbon Tax scenario initially
  - Change to No Carbon Regulation scenario for latter part
  - Demonstrates impact of repeal of carbon regulation

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Stakeholder-Inspired Scenarios

- Increased Customer Choice
  - Carbon Tax scenario basis
  - Roof top solar serves additional 1% of load per year beginning 2020
  - Customers adopt higher levels of Energy Efficiency
  - New utility-scale generation served by merchant generators, e.g., Dynegy or Calpine

- Climate Change
  - Higher summer temperatures increase demand and prices for power and fuel
  - Carbon tax same as Carbon Tax scenario
  - Even hotter summer 2019 and "polar vortex" 2020, and every 5 years thereafter, causing higher prices

Break

Brian Bak, Lead Planning Analyst & Jim Hobbs, Lead Engineer

Portfolio Review

Nine Portfolios

1. Optimized No Carbon Tax
2. Optimized Carbon Tax
3. Optimized Clean Power Plan
4. Portfolio 1 w/ CC's
5. Portfolio 2 w/ CC's
6. Portfolio 3 w/ CC's
7. Stakeholder Distributed Generation
8. Stakeholder Green Utility
9. High Renewables

Portfolio Template

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT					
CHP					
CC					
EE & IVVC					
Solar					
Wind					
Biomass					
RETIREMENTS					
Unit					
MW					
MARKET (Annual average GWh)					
Market Purchases					
Market Sales					

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Optimized No Carbon Tax Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	1,040	208	208	416	208
CHP	44	29	15		
CC					
EE & IVVC	220 / 3.1%	126 / 1.9%	82 / 3.1%	11 / 3.1%	1 / 3.1%
Solar					
Wind					
Biomass					
RETIREMENTS					
Unit		WR2-6 Oil CTs			
MW	(834)	(834)			
MARKET (Annual average GWh)					
Market Purchases	3,647	4,577	2,731	3,490	3,791
Market Sales	(2,211)	(1,810)	(2,533)	(2,329)	(2,170)

Note- Portfolio components are preliminary and might change during the more detailed modeling phase
- Energy efficiency percentages are cumulative EE over total annual retail sales

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Optimized Carbon Tax Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	734	**318 (WR6)**		416	
CHP	44	29	15		
CC	448			448	
EE & IVVC	224 / 3.1%	126 / 1.9%	82 / 3.1%	11 / 3.1%	5 / 3.2%
Solar	270	20	180	70	
Wind	400		250	150	
Biomass	14	2	6	6	

RETIREMENTS					
Unit		WR2-6 Oil CTs Gal2,4		Gib5	
MW	(1,424)	(1,114)		(310)	

MARKET (Annual average GWh)					
Market Purchases	**6,467**	5,078	5,198	**7,140**	**8,450**
Market Sales	(868)	(1,600)	(1,004)	(558)	(310)

Note- Portfolio components are preliminary and might change during the more detailed modeling phase
- Energy efficiency percentages are cumulative EE over total annual retail sales

Optimized Clean Power Plan Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	208				208
CHP	29	15	15		
CC	896	**896**			
EE & IVVC	220 / 3.1%	126 / 1.9%	82 / 3.1%	11 / 3.1%	1 / 3.1%
Solar	290	20	130	110	30
Wind	400		300	100	
Biomass	14	2	6	6	

RETIREMENTS					
Unit		WR2-6 Oil CTs Gal2,4 Gib5			
MW	(1,424)	(1,424)			

MARKET (Annual average GWh)					
Market Purchases	**7,878**	5,230	**7,720**	**8,395**	**10,168**
Market Sales	(815)	(1,718)	(585)	(540)	(416)

Note- Portfolio components are preliminary and might change during the more detailed modeling phase
- Energy efficiency percentages are cumulative EE over total annual retail sales

Portfolio 1 w/ CC's Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	624			416	208
CHP	44	29	15		
CC	448	**448**			
EE & IVVC	220 / 3.1%	126 / 1.9%	82 / 3.1%	11 / 3.1%	1 / 3.1%
Solar					
Wind					
Biomass					
RETIREMENTS					
Unit		WR2-6 Oil CTs			
MW	(834)	(834)			
MARKET (Annual average GWh)					
Market Purchases	2,521	4,287	1,452	2,067	2,277
Market Sales	(2,797)	(2,001)	(3,366)	(3,046)	(2,773)

Note- Portfolio components are preliminary and might change during the more detailed modeling phase
- Energy efficiency percentages are cumulative EE over total annual retail sales

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Portfolio 2 w/ CC's Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	208				208
CHP	44	29	15		
CC	896	**448**		448	
EE & IVVC	224 / 3.1%	126 / 1.9%	82 / 3.1%	11 / 3.1%	5 / 3.2%
Solar	300	20	200	80	
Wind	400		250	150	
Biomass	14	2	6	6	
RETIREMENTS					
Unit		WR2-6 Oil CTs Gal2,4		Gib5	
MW	(1,424)	(1,114)		(310)	
MARKET (Annual average GWh)					
Market Purchases	5,082	4,706	3,655	5,166	**6,803**
Market Sales	(1,499)	(1,704)	(1,834)	(1,587)	(873)

Note- Portfolio components are preliminary and might change during the more detailed modeling phase
- Energy efficiency percentages are cumulative EE over total annual retail sales

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Portfolio 3 w/ CC's Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT					
CHP	29	15	15		
CC	1,344	896			448
EE & IVVC	220 / 3.1%	126 / 1.9%	82 / 3.1%	11 / 3.1%	1 / 3.1%
Solar	320	20	140	120	40
Wind	400		300	100	
Biomass	14	2	6	6	

RETIREMENTS	Total	2016-20	2021-25	2026-30	2031-35
Unit		WR2-6 Oil CTs Gal2,4 Gib5			
MW	(1,424)	(1,424)			

MARKET (Annual average GWh)	Total	2016-20	2021-25	2026-30	2031-35
Market Purchases	**7,578**	5,230	**7,715**	**8,377**	**8,991**
Market Sales	(951)	(1,718)	(586)	(546)	(953)

Note- Portfolio components are preliminary and might change during the more detailed modeling phase
- Energy efficiency percentages are cumulative EE over total annual retail sales

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Stakeholder Distributed Generation - Target vs Model

Energy Mix (%)	2025 Target	2025 Model	2035 Target	2035 Model
Market Purchases	11%	9%	8%	13%
Coal	36%	42%	19%	16%
Hydro	1%	1%	1%	1%
CC	8%	12%	9%	17%
CT	1%	0%	1%	0%
EE	11%	5%	16%	8%
Solar	7%	7%	10%	10%
Wind	10%	10%	13%	13%
CHP	9%	8%	12%	11%
Nuclear	0%	0%	3%	3%
Battery/Fuel Cell	1%	1%	2%	2%
LFG/Digester/Biomass	5%	5%	6%	6%
	100%	100%	100%	100%

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Stakeholder Distributed Gen Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	832		208		624
CHP	**609**	131	290	15	174
CC	1,344		896		448
EE & IVVC	**650 / 8.5%**	189 / 2.8%	203 / 5.7%	138 / 7.3%	120 / 8.5%
Solar	**2,480**	670	970	420	420
Wind	**2,050**	450	800	550	250
Biomass	303	106	137	60	
RETIREMENTS					
Unit		WR2-6 Oil CTs	Gal2,4 Cay1,2 Gib1,5		Gib2,3
MW	(4,283)	(834)	(2,189)		(1,260)
MARKET (Annual average GWh)					
Market Purchases	3,920	3,682	2,716	3,910	5,372
Market Sales	(2,707)	(2,824)	(2,554)	(2,872)	(2,580)

Note- Portfolio components are preliminary and might change during the more detailed modeling phase
- Energy efficiency percentages are cumulative EE over total annual retail sales

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Stakeholder Green Utility - Target vs Model

Energy Mix (%)	2025 Target	2025 Model	2035 Target	2035 Model
Market Purchases	16%	16%	13%	19%
Coal	50%	58%	38%	36%
Hydro	1%	1%	1%	1%
CC	18%	13%	19%	20%
CT	3%	0%	6%	0%
EE	5%	6%	8%	8%
Solar	2%	2%	4%	4%
Wind	3%	3%	6%	6%
CHP	2%	2%	5%	5%
Nuclear	0%	0%	0%	0%
Battery/Fuel Cell	0%	0%	0%	0%
LFG/Digester/Biomass	0%	0%	0%	0%
	100%	100%	100%	100%

Stakeholder Green Utility Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	624		624		
CHP	261	29	73	73	87
CC	**1,344**		896		448
EE & IVVC	**650 / 8.5%**	189 / 2.8%	203 / 5.7%	138 / 7.3%	120 / 8.5%
Solar	**930**	40	380	300	210
Wind	**800**		250	300	250
Biomass	16	2	6	8	

RETIREMENTS	Total	2016-20	2021-25	2026-30	2031-35
Unit		WR2-6 Oil CTs	Gal2,4 Gib5 Cay1,2		Gib1
MW	(3,023)	(834)	(1,559)		(630)

MARKET (Annual average GWh)	Total	2016-20	2021-25	2026-30	2031-35
Market Purchases	**6,035**	4,575	5,739	**6,537**	**7,289**
Market Sales	(1,077)	(1,832)	(814)	(746)	(914)

Note- Portfolio components are preliminary and might change during the more detailed modeling phase
- Energy efficiency percentages are cumulative EE over total annual retail sales

High Renewables Portfolio

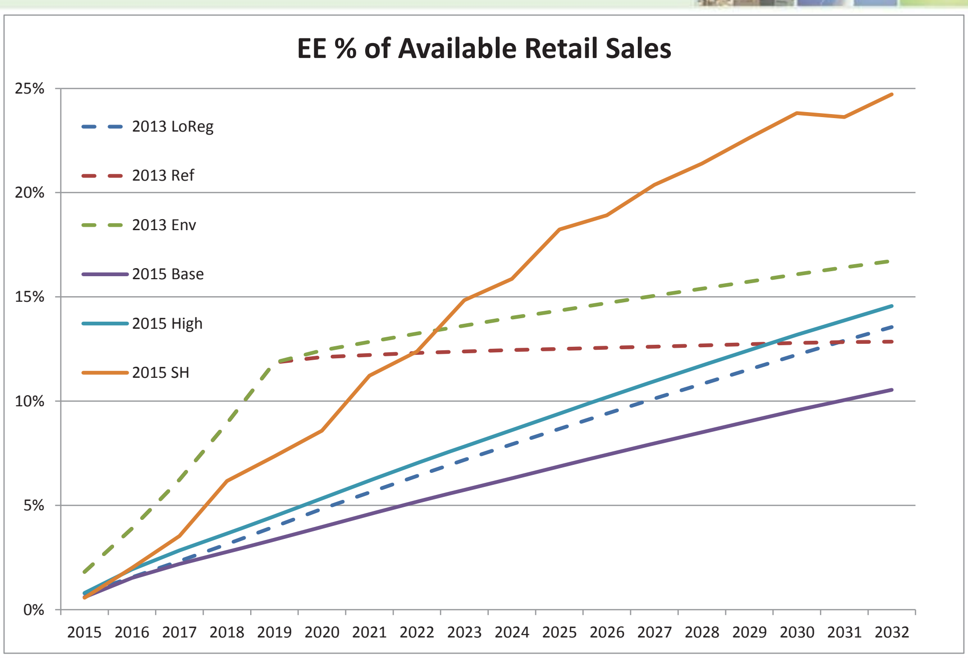
ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	526	**318 (WR6)**	208		
CHP	44	29	15		
CC	448				448
EE & IVVC	220 / 3.1%	126 / 1.9%	82 / 3.1%	11 / 3.1%	1 / 3.1%
Solar	1,010	20	130	**260**	**600**
Wind	2,300		300	**500**	**1,500**
Biomass	14	2	8	4	

RETIREMENTS	Total	2016-20	2021-25	2026-30	2031-35
Unit		WR2-6 Oil CTs Gal2,4			Gib5
MW	(1,424)	(1,114)			(310)

MARKET (Annual average GWh)	Total	2016-20	2021-25	2026-30	2031-35
Market Purchases	5,701	5,052	4,753	**6,662**	**6,336**
Market Sales	(1,247)	(1,614)	(1,190)	(747)	(1,437)

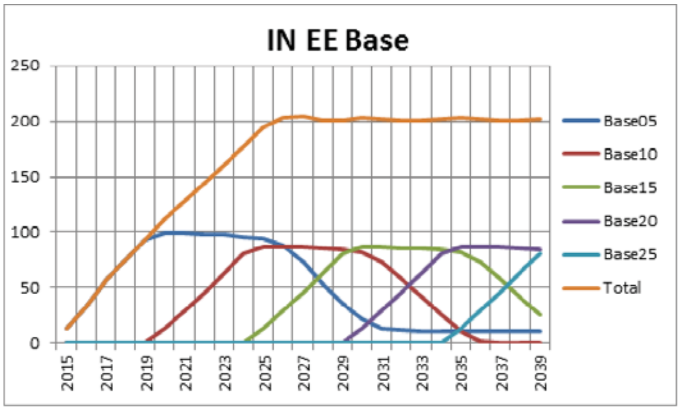
Note- Portfolio components are preliminary and might change during the more detailed modeling phase
- Energy efficiency percentages are cumulative EE over total annual retail sales

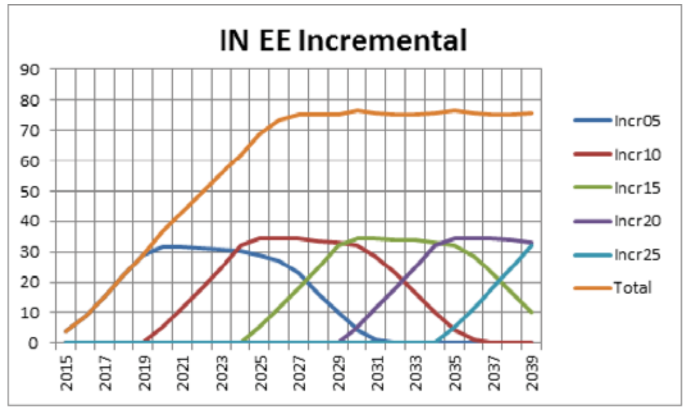
EE Summary



Energy Efficiency Bundles

- In order to model utility sponsored EE as a resource, this portion of EE needs to be removed from the load forecast and put into bundles for economic selection by the resource planning model.





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Lunch

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Scott Park, Director IRP Analytics – Midwest & Brian Bak, Lead Planning Analyst

Modeling

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Modeling Overview

- Modeling to date, has been conducted using *System Optimizer* and results should be viewed as preliminary
  - System Optimizer is a long term optimization model for resource selection
  - Prosym is a detailed dispatch model to better measures detailed system performance
- 7 scenarios
- 9 portfolios
- For each of the 63 scenario-portfolio pairs, the following will be presented
  - PVRR
  - CO_2 reduction
  - Energy served from market purchases
  - Observations from modeling results across each scenario

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No CO2 Scenario

METRIC 2016-2035	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
PVRR ($MM)	**16,832**	17,313	17,355	**16,875**	**17,277**	17,380	23,202	19,429	17,617
CO2 Emissions (+/-)	15%	4%	1%	12%	1%	-2%	**-49%**	**-24%**	**-11%**
Mkt Purch (max/avg)	15% / 9%	15% / 10%	**15% / 7%**	**15% / 6%**	**15% / 7%**	**15% / 6%**	**15% / 7%**	17% / 12%	15% / 8%

Scenario Observations

- The No CO2 Optimized & No CO2 Optimized w/CC portfolios had the lowest PVRR's
  - Gas generation appears to work best in this scenario for the majority of resource needs
  - The CC portfolio is only slightly more costly than CT portfolio but has only 2/3 the market purchases
- While being the lowest cost portfolios by on the order of $500 MM, they had the greatest increase in CO2 emissions
- The profile of market purchases are relatively equal across all portfolios in the No CO2 scenario and do not appear to be a distinguishing risk factor

Note: -Baseline year for CO2 reduction is 2016; carbon intensity of market purchases assumed to be equal to that of DEI fleet
- Portfolio components are preliminary and might change during the more detailed modeling phase

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CO2 Tax Scenario

METRIC 2016-2035	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
PVRR ($MM)	23,402	**23,196**	**23,224**	23,447	23,248	**23,243**	27,237	24,345	23,445
CO2 Emissions (+/-)	2%	-4%	-9%	-3%	-9%	-13%	**-55%**	**-33%**	**-22%**
Mkt Purch (max/avg)	24% / 16%	23% / 17%	**18% / 13%**	19% / 13%	**18% / 13%**	**17% / 12%**	**15% / 10%**	19% / 15%	19% / 15%

Scenario Observations

- The portfolios optimized for carbon reduction as well as the High renewables portfolio have the lowest PVRR's
  - The range (variability) of costs across all portfolios is less than that in the No CO2 scenario
  - Overall costs are up approx. 35% primarily due the carbon tax
- CO2 emissions are down in most portfolios with the Stakeholder and High Renewables portfolios achieving the greatest reductions
- Market purchases are relatively high in all portfolios and provide some foresight that the interaction with the market takes on increasing importance in a carbon constrained world

Note: -Baseline year for CO2 reduction is 2016; carbon intensity of market purchases assumed to be equal to that of DEI fleet
- Portfolio components are preliminary and might change during the more detailed modeling phase

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CPP Scenario

METRIC 2016-2035	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
PVRR ($MM)	19,498	19,185	**18,664**	19,221	**18,913**	**18,686**	23,010	19,853	19,470
CO2 Emissions (+/-)	-3%	-7%	-11%	-7%	-11%	-13%	**-52%**	**-27%**	**-24%**
Mkt Purch (max/avg)	38% / 31%	36% / 29%	**27% / 20%**	32% / 25%	29% / 23%	24% / 19%	**22% / 10%**	**32% / 17%**	36% / 27%

Scenario Observations

- The portfolios optimized for carbon reduction have the lowest PVRR's
  - The range (variability) of costs across all portfolios is somewhat greater than the No CO2 scenario
  - Overall costs are up ~10% vs the No Carbon scenario primarily due to the carbon emissions constraint
- CO2 emissions are down in all portfolios, with the largest reduction in the Stakeholder and High Renewables portfolios
- Market purchases are high in this scenario across all portfolios indicating potential price risk to customer bills

Note: -Baseline year for CO2 reduction is 2016; carbon intensity of market purchases assumed to be equal to that of DEI fleet
- Portfolio components are preliminary and might change during the more detailed modeling phase

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No CO2/CO2 Scenario

METRIC 2016-2035	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
PVRR ($MM)	**21,672**	**21,705**	21,742	**21,704**	21,718	21,766	26,080	23,089	21,930
CO2 Emissions (+/-)	-4%	-4%	-9%	-9%	-13%	-13%	**-55%**	**-33%**	**-22%**
Mkt Purch (max/avg)	25% / 16%	23% / 16%	**18% / 12%**	23% / 13%	**16% / 12%**	**16% / 11%**	**15% / 9%**	19% / 15%	19% / 14%

Scenario Observations

- The No CO2 Optimized & No CO2 Optimized w/CC portfolios had the lowest PVRR's
  - Gas generation appears to work best in this scenario for the majority of resource needs
  - The CC portfolio is only slightly more costly than CT portfolio but has 20% lower market purchases
  - The range of costs across all portfolios is less than that in the No CO2 scenario (~$260vs800MM)
- CO2 emissions reductions are greatest in the Stakeholder and High Renewables portfolios. Significant reductions are also achieved in the carbon optimized portfolios with added CCs
- Market purchases are higher than the No CO2 scenario across all portfolios due to the carbon tax in the latter 10 years, although this was mitigated somewhat in the w/CC portfolios

Note: -Baseline year for CO2 reduction is 2016; carbon intensity of market purchases assumed to be equal to that of DEI fleet
- Portfolio components are preliminary and might change during the more detailed modeling phase

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CO2/No CO2 Scenario

METRIC 2016-2035	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
PVRR ($MM)	**18,495**	18,598	18,761	**18,540**	**18,635**	18,786	23,558	20,703	18,953
CO2 Emissions (+/-)	13%	9%	2%	9%	0%	-1%	**-47%**	**-24%**	**-7%**
Mkt Purch (max/avg)	15% / 9%	15% / 11%	15% / 8%	**15% / 7%**	**15% / 7%**	**15% / 7%**	15% / 8%	17% / 13%	15% / 9%

Scenario Observations

- The portfolios optimized for no CO2 tax and CO2 with CC portfolio have the lowest PVRR's
  - The range (variability) of costs across all portfolios is similar to that of the No CO2 scenario
  - Overall costs are 7% higher than the no carbon and 19% lower than the carbon tax scenario
- CO2 emissions showed the greatest reduction in the Stakeholder and High Renewables portfolios
- Market purchases rise initially with the carbon tax in 2020 then decline following the carbon tax removal in 2025.
  - Overall purchases are only slightly higher than the No CO2 scenario

Note: -Baseline year for CO2 reduction is 2016; carbon intensity of market purchases assumed to be equal to that of DEI fleet
- Portfolio components are preliminary and might change during the more detailed modeling phase

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Increased Customer Choice Scenario

METRIC 2016-2035	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
PVRR ($MM)	25,321	**25,138**	**25,136**	25,339	**25,147**	25,157	28,090	26,017	25,349
CO2 Emissions (+/-)	-18%	-23%	-26%	-22%	-26%	-28%	**-61%**	**-44%**	**-36%**
Mkt Purch (max/avg)	15% / 11%	15% / 12%	**15% / 9%**	**15% / 9%**	15% / 10%	**15% / 9%**	**16% / 9%**	20% / 12%	15% / 11%

Scenario Observations

- The portfolios optimized for carbon reduction have the lowest PVRR's
  - The range of costs (variability) across all portfolios is the lowest of any scenario
  - Overall costs are 7% higher than the carbon tax scenario and 41% higher than the No CO2 scenario
- CO2 emissions showed the greatest reduction in the Stakeholder and High Renewables portfolios
  - Overall emission reduction was greatest in this scenario due to the very large solar deployment
- Market purchases were lower than in the Carbon Tax and CPP scenarios due to the excess nameplate capacity from the added solar deployment

Note: -Baseline year for CO2 reduction is 2016; carbon intensity of market purchases assumed to be equal to that of DEI fleet
- Portfolio components are preliminary and might change during the more detailed modeling phase

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Climate Change Scenario

METRIC 2016-2035	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
PVRR ($MM)	23,800	23,702	**23,559**	23,815	**23,605**	**23,606**	27,391	24,647	23,905
CO2 Emissions (+/-)	-3%	-9%	-19%	-9%	-20%	-23%	**-60%**	**-42%**	**-35%**
Mkt Purch (max/avg)	38% / 21%	38% / 21%	**35% / 17%**	37% / 18%	35% / 18%	**34% / 17%**	**26% / 13%**	35% / 20%	37% / 19%

Scenario Observations

- The portfolios optimized for carbon reduction have the lowest PVRR's
  - Overall costs are in line with the carbon tax scenario and ~33% higher than the No CO2 scenario
- CO2 emissions reductions were seen across all portfolios with the greatest reduction in the Stakeholder and High Renewables portfolios
  - Across the board reductions likely due to the de-rate of coal units in the hot, dry summer periods
- Market purchases were higher than all scenarios other than CPP due to reliance on the market to serve higher average energy demand and spikes during the hot summer and polar vortex years

Note: -Baseline year for CO2 reduction is 2016; carbon intensity of market purchases assumed to be equal to that of DEI fleet
- Portfolio components are preliminary and might change during the more detailed modeling phase

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Modeling Next Steps

- Extend scenario-portfolio modeling into Prosym
- Supplement with sensitivity analysis
- Analyze and evaluate the output data
  - How variables change over time
  - Hot summer and polar vortex years in Climate Change scenario
- Aggregate and package data into a usable format that supports
  - Discussion
  - Decision making

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Scott Park, Director IRP Analytics - Midwest

Stakeholder Exercise

Sensitivity Development Exercise

- Whereas scenarios are a set of correlated assumptions and describe possible futures
- Sensitivities are meant to assess a portfolios response to changes in a key variable
  - Not so much of an expectation of the future
  - But rather a view into *"what happens if…"*

Stakeholder Exercise

- Discuss at each table
  - List sensitivities
  - Define upper and lower levels
  - Present to the larger group
- Stakeholder data will be used to inform final sensitivity analysis

Marty Rozelle, President, Rozelle Group

Closing Comments, Stakeholder Comments

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Next Steps

- Please complete comment cards or send by August 11 to Marty at: RGL97marty@rozellegroup.com
- Meeting summary and other materials will be posted on website by August 18 (http://www.duke-energy.com/indiana/in-irp-2015.asp)
- Next workshop is scheduled for the Friday, October 16th

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Duke Energy Indiana 2015 Integrated Resource Plan

Stakeholder Workshop 3
Summary
August 4, 2015

Welcome and Introductions
Dr. Marty Rozelle, The Rozelle Group Ltd.

Marty Rozelle, the facilitator, welcomed everyone to the third public workshop for the Duke Energy Indiana 2015 Integrated Resource Plan (IRP). There were several attendees on the phone as well. For the safety reminder, she said that in case of emergency, everyone should exit the building and go to the grassy area, or shelter in place in the basement. She introduced herself and repeated the objectives of Duke's stakeholder process. She asked participants to introduce themselves. There were 22 in-person attendees including a Commissioner from the Indiana Utility Regulatory Commission, and 4 people joined by telephone.

Agenda Overview
Scott Park – Duke Energy Director IRP Analytics, Midwest

There is a very full agenda today. A similar format to past meetings will be used. The main focus of new material is scenario and portfolio modeling that has been performed since the last meeting. Mr. Park reminded participants that scenarios represent possible states of the world, and portfolios are sets of resources. He said that today Duke will be presenting cost, carbon reduction, and market purchases for each of the 63 combinations of scenarios and portfolios that were evaluated. The workshop includes a participant exercise to help develop sensitivities for additional modeling.

Meeting 2 Comments, Responses, and Updates
Scott Park

Mr. Park mentioned some comments received at the last meeting, and Duke's response to those. Due to a series of technical challenges at past meetings, WiFi is not being provided at this meeting. The conference call-in line has been fixed. Participants suggested analyzing the carbon footprint of portfolios, and this has been done, as presented later today. Some people commented that the stakeholder exercise was helpful, so the one included in the meeting today will be similar.

Finally, Mr. Park said that Duke had made follow-up calls to two stakeholders who weren't able to adequately participate in the last meeting due to these technical difficulties. One of them thanked Duke for doing this, and said he appreciated the quality of the conversation. He mentioned remaining concerns he has, observing that the coal industry is dying, and utilities cannot 'just say no' to the Clean Power Plan that as just been finalized, as the Indiana Governor has done. He also suggested that these meetings should be held in the downtown Indianapolis area, and should include access to Wi-Fi for the convenience of the participants, and he objects to not having it provided.

Scenario Review
Jim Hobbs, Duke Energy Lead Engineer

Jim Hobbs reviewed the scenarios discussed at the last meeting. He said that Duke has looked at 7 alternatives, describing them as three subgroups characterized as "core" scenarios, "change of outlook" scenarios, and "stakeholder inspired" scenarios. Scenarios used for modeling include the following:

<u>Core Scenarios:</u>

1. No carbon regulation
2. Carbon tax
3. Clean Power Plan (CPP) (proposed rule)

Change of Outlook Scenarios:

4. Hybrid 1 – no carbon regulation changing to carbon tax
5. Hybrid 2 – carbon tax changing to no carbon regulation

Stakeholder-inspired Scenarios:

6. Increased customer choice
7. Climate change

Participant questions and comments included the following:

- Is carbon tax same as carbon price, and would that work with cap and trade?
    - For modeling, Duke used a tax of $17/ton, or in some scenarios used a shadow price that mimics a tax.
- Has there been consideration of changes in the market behavior that would occur as a result of a carbon-constrained world; for example, assumption of no Appalachian coal being available in future?
    - Coal prices were provided by Duke's vendor EVA, who evaluates major coal basins and make assumptions about them. These assumptions reflect reductions in demand for coal.
- The "clean power plan" scenario is looking at a reduction of 20% in emissions (from 2012), and the newly-released final Clean Power Plan calls for a 32% reduction from 2005 levels. Based on that, do you think you're capturing the CPP goals?
    - They may be similar, but since the CPP just came out yesterday the model was not specifically modeling it. Some of the portfolios that were modeled, however, show significant emission reductions.
- Is this 20% rate-based or mass-based? Is there any scenario here that would accommodate the higher reduction rates inherent in the CPP?

- The percentages used in modeling using rate-based is much more complex, so rates have been converted to mass – what we show here are absolute carbon emission reductions. Rates are more a construct of the proposed rule.

- A participant thanked Duke for providing a range of scenarios.

Portfolio Review
Brian Bak, Duke Energy Lead Planning Analyst
& Jim Hobbs

Brian Bak explained that 9 portfolios have been developed, and will be discussed today. Two of these were specifically designed to meet stakeholder suggestions developed at the last workshop. The portfolios are characterized as:

1. No Carbon Tax (optimized)
2. Carbon Tax (optimized)
3. Clean Power Plan (optimized)
4. No Carbon Tax with Combined Cycle
5. Carbon Tax with Combined Cycle
6. Clean Power Plan with Combined Cycle
7. Distributed Generation (stakeholder suggested)
8. Green Utility (stakeholder suggested)
9. High Renewables

The model *System Optimizer* was used to calculate portfolio attributes. The model looks for the least-cost plan, and tended to favor combustion turbines. He explained the format of the tables he will present here, which show elements of each portfolio in terms of new additions, unit retirements, and annual market purchases needed to serve loads, over 5-year increments from 2016 to 2035. He noted that market purchases can be considered a risk factor, where large purchases are required, as they could affect consumer costs.

Participants had several clarifying questions, and then comments were provided for each of the portfolios.

- Are customer-installed combined heat and power (CHP) systems counted here?
  - The model output can be viewed as a mix of customer and utility-owned cogeneration.
- Where is gas conversion of coal-fired boilers reflected here? This is a very different category of gas unit.
  - It was originally used as a separate category, but has been combined in to other gas categories in the data presented here.
- Please define the acronym IVVC.
  - Integrated volt-var control, which is a smart grid technology.
- Participants had several questions about the EE (energy efficiency) & IVVC category and asked for further clarification. They asked that EE and IVVC be presented separately for the next meeting, and wanted more information on what is included in the EE ‘bundles’. Duke clarified that distributed energy is not included in the EE category but is reflected in the solar category.

- Is the combustions turbine (CT) category truly CT, not gas conversion?
  - Yes.
- How are retirements modeled? Are they inputs or outputs?
  - They are outputs, at the request of stakeholders.
- Is there a revised set of slides from Saturday? Those on the phone do not have the same version.
  - The minor page numbering differences were explained.
- Are environmental regulations included in these portfolios?
  - Yes, but only those we know about today.
- Can Duke calculate the customer rate effect of the portfolios?
  - No, we just look at present value of revenue (PVRR) in the modeling group. Ratemaking is separate, and comes 'after the fact'.

<u>1.Optimized No Carbon Tax Portfolio</u>

Questions and comments on this scenario were as follows:

- A participant stated that he disagrees strongly with the EE/IVCC data leveling out over time, particularly in this portfolio. He feels that the market will respond to this situation by forcing more EE adoption. The market does not "do nothing", even if politicians might not do anything.
- A participant noted that Duke Energy's CEO issued a statement yesterday saying that emissions from power plants have been reduced by 22% over the past decade. She felt this indicated that even the utility believes more diversity will be required. She pointed out that this portfolio does not foster diversity.
  - Mr. Park responded that this portfolio is actually 'cleaner' than current conditions as it includes more gas generation.
- Please explain the Miami-Wabash and Connersville units.
  - These units are all older; 166 megawatts (MW) of oil-fired combustion turbine units would be retired in this portfolio.
- If the utility is going to buy solar from a developer, where would that show up here?
  - In the solar category.
- What does 'optimized' mean?
  - The lowest cost option for meeting the objectives built into the model.
- A participant suggested adding a category to include the demand forecast used in each case, which would clarify the purpose of the portfolios.
- Are transmission and distribution expenditures included in these portfolios?
  - No. These are only generation-based portfolios.
- A participant asked for clarification of data totals on the charts.
  - Duke explained that these numbers aren't directly additive, because each type of unit has a different capacity factor.

<u>Optimized Carbon Tax Portfolio</u>

Mr. Bak noted that a distinguishing feature of this plan is that market purchases tend to increase quite a bit in the later years of the planning horizon. Participants said:

- It would be helpful to know the target load being used here.
- Now that the Clean Power Plan has been finalized, do you think the carbon tax scenario is likely or unlikely?
  - This scenario was an attempt to make assumptions about a carbon-constrained future. If we'd had the final rule earlier, this portfolio would have been different. However, due to the timing, Duke won't be able to do full modeling of the proposed CPP before filing this IRP.

<u>Optimized Clean Power Plan Portfolio</u>

This portfolio also results in relatively high market purchases, and includes the addition of 896 MW of combined cycle gas generation.

- A participants asked if the model makes assumptions about the carbon intensity of market purchases.
  - Yes. Market purchases are assumed to have the same carbon profile as the overall Duke fleet.
- Does the implicit or shadow price of carbon used in the models have a relationship to MISO (Midcontinent Independent System Operator)? What's the source of the shadow price?
  - The MISO price is higher in this scenario. EVA develops the shadow price (outputs) which Duke used as input to its model. There will be more modeling done here as a result of the Clean Power Plan.
- What efficiencies were used as capacity factors for solar and wind?
  - Wind capacity factor was assumed to be 40% for the first 300 megawatts, and 30% for further, less desirable, sites. The solar capacity factor was about 20%.
- Why are market purchases so significantly higher in these last two portfolios?
  - Market purchase prices are based on EVA-provided data. If the market prices are assumed to be lower than the price of adding new generation, the model will select it. Scott Park noted that in the 'real world', the utility may elect to build new generation rather than take the risk of higher market dependence.
- Were market costs developed specifically for each portfolio?
  - Yes, they vary among them.
- A participant believes that the failure to incrementally increase EE adoption levels in these portfolios is a fatal flaw error, which compromises the credibility of the work.

<u>Portfolio 1 (No Carbon) with Combined Cycle</u>

Mr. Bak noted that this portfolio brings down the market purchases generally in line with market sales.

Portfolio 2 (Carbon Tax) with Combined Cycle

In this portfolio, the model selects a CC early in the planning process, and has an elevated level of market purchases in later years.

Portfolio 3 (Clean Power Plan) with Combined Cycle

Participants had these comments and questions on this portfolio:

- Gallagher 2 and 4 would retire in all cases. Why does Gibson 5 retirement move around to different timeframes in the various portfolios?
    - The cost of keeping the plant running becomes uneconomical faster in the CPP scenario, whereas in other options it won't happen until the cost of coal makes it uneconomical. The model makes these selections based on economics.
- A participant observed that the Edwardsport plant has higher emissions and is more expensive to run than some others, so why doesn't the model select its retirement? Is this an artificial input?
    - No, the model would select it for retirement if it was economical to do so.
- Do you assume you'd recover costs using the current rates?
    - No, the model doesn't calculate cost recovery but assumes that costs would be recovered.
- Wouldn't the high cost of market purchases drive the model to build additional resources earlier in the planning period?
    - The model could have been forced to build resources earlier, but this is what the model selected. On the other hand, you could look at construction of CCs as 'insurance' against the higher cost of market purchases.
- Looking at EE and IVVC, a participant pointed out that the state mandate is to reach 2%, but these models show achieving more than 3%.
    - Duke clarified that the mandate actually gets to 11.9%, as a function of total sales, but in reality one must look at total available sales, which reflects opts out and reduced ease of installing additional conservation measures after a certain point.
- Are you assuming that opt-out customers would continue to install voluntary EE measures?
    - This 3% is utility EE and does not include customer-installed systems, which are only reflected in the load forecast. This is a challenge in trying to model EE as a supply-side resource.
- The participant suggested that this could be achieved by making 'off-model' adjustments.
    - Mr. Park said he would look into this.

Stakeholder Distributed Generation Portfolio

Jim Hobbs introduced two portfolios that were developed directly based on stakeholder suggestions at the last workshop. He noted that neither of the stakeholder-developed portfolios were optimized in the modeling, but dispatch of resources was optimized.

To explain the 'distributed generation' portfolio he showed the chart of a portfolio suggested by participants at the last IRP workshop, with desired percentages of each generation type. In comparing this with the developed portfolio, he noted that, for reasons already discussed, the desired level of EE could not be achieved in the Duke modeled scenario. There are much higher levels of renewable resources than included in other portfolios.

- A participant observed that the "numbers don't add up" on this portfolio, considering the capacity factor of wind and solar, and the level of predicted market purchases.
    - Mr. Park explained that part of the higher market sales included non-dispatchable solar and wind resources that are sold when not needed. CC units have a very high capacity factor to offset this.
- How is the Customer Choice Scenario being reflected in the portfolios?
    - Generally, the desire for increased distributed generation from that scenario has been added to all portfolios.

Stakeholder Green Utility Portfolio

Mr. Hobbs explained that this portfolio closely resembles the mix of resources suggested by stakeholders; however, the model would not select as much combined cycle as stakeholders suggested, nor is the level of coal quite as low.

High Renewables Portfolio

This alternative was developed to illustrate high rates of adoption of renewable resources, but not as high levels as the stakeholder-suggested portfolios. Participants asked:

- How are coal plants being used in this case? New capacity doesn't seem to match retirements.
    - Capacity factors of the coal units go down, but not so much as to drive new capacity in all timeframes.
- Does Wabash River gas conversion qualify as a renewable? Does that conversion push out solar and wind to later years? Why does this appear in a high renewable portfolio?
    - No, Wabash River is not considered a renewable. Any capacity addition is going to delay other resource additions. The model selected Wabash conversion over renewables, because this is not an exclusive renewables portfolio.

<u>Energy Efficiency Discussion</u>

Scott Park provided some additional information on the EE components of these portfolios. He said that Duke wanted to compare what was included in the 2013 IRP under the mandate with now, after the mandate has been removed. To illustrate, he showed charts that showed how it was handled in these models. EE tends to be a heterogeneous 'resource', which makes it difficult to model as a supply-side resource. Because there are hundreds of EE programs, each having its own supply curve, these programs were 'bundled' in the model, to be included incrementally. Mr. Park noted that these models are preliminary and more refined assumptions may be possible in later versions.

Participants asked for clarification on what these charts include and how they should be read. Mr. Park said that "EE base" bundles include the lowest-cost bundle of different vintages over time. Incremental EE includes another series of higher cost bundles. Programs included here only include utility-sponsored programs. Some participants thought this topic needed more refinement and possibly quite different assumptions. Mr. Park again noted that it's challenging to model EE as a supply-side resource, because Duke can only include utility-sponsored programs since these are the only ones they can make assumptions about.

Lunch

Modeling Results, Observations, Next Steps
Scott Park

Mr. Park explained that Duke has only used the *System Optimizer* model to date, and the next phase will using *Prosym* to look at details such as hourly dispatch. In this presentation, he reviewed each of the 63 scenario-portfolio pairs, showing the PVRR cost, carbon dioxide (CO2) reduction, market purchases, and observations on the results. He explained the matrix used to show each element of the discussion, noting that each portfolio is going to perform differently in each of the "worlds" described in the various scenarios.

Assumptions for modeling are that the baseline year for CO2 reduction is 2016, and the carbon intensity of market purchases are assumed to be equal to that of the Duke Energy Indiana fleet. He reminded participants that the stakeholder-driven portfolios are not optimized in the model.

These results highlight the tradeoffs inherent in different approaches, looking at overall costs versus carbon reductions versus the need to purchase power from the market.

Several participants asked when stakeholders can have access to the models and the underlying data. Mr. Park said stakeholders can come in to the Duke Energy Indiana office and sign a nondisclosure agreement. They can also have electronic access if provisions are made.

<u>No CO2 Scenario</u>

Not surprisingly, this is the least-cost scenario, but does not reduce carbon emissions in most portfolios except the more "green" ones suggested by stakeholders. The addition of combined cycles adds value in reducing carbon emissions. Comments included:

- Can we quantify what type of gas generation we're talking about?
- These models do not specify gas resources, except where CC is specified in the portfolio.
- A participant suggested that this scenario is misnamed, and should be called "no CO2 penalty" or "price" scenario. People might think it means "CO2-Free", which it doesn't.
- A participant suggested that if all utilities do similar IRPs that rely heavily on gas, then the market prices of gas will change, and it could change the cost models.

<u>Carbon Tax Scenario</u>

This scenario has higher costs but reduces emissions under all portfolios. Market purchases, however, are quite high. As with other scenarios, gas generation is an important component.

<u>CPP Scenario</u>

As might be expected, the portfolios that are more heavily reliant on renewable resources reduce carbon emissions the most. Participant questions were:

- Focusing on the market risk question, why do market purchases increase in portfolios that have the most renewables?
    - It's most likely a function of price, but Duke agrees that this question probably needs more discussion with modeling experts.
- A participant asked for clarification about the types of gas generation that are included.
    - Mr. Park cautioned participants not to focus on Wabash River 6 gas conversion, since this is a very small contribution to the models.
- How do market purchases increase potential price risk to customer bills?
    - Duke would be subject to buying more energy in a volatile market.

No CO2 to CO2 Scenario & CO2 to No CO2 Scenario

These models combine years of no carbon regulation with later years of regulation and costs of emissions. They result in high market purchases and various levels of CO2 emissions over the planning period.

<u>Increased Customer Choice Scenario</u>

This scenario assumes there will be incremental 1% per year distributed generation starting in 2020. This increases costs of the plan by quite a bit because rooftop solar is expensive, but even in the "no CO2" portfolio there is an overall reduction in emissions, and market purchases are relatively low.

There was discussion about assumptions on costs and contributions of rooftop solar, and whether these should be included as utility costs and benefits.

Climate Change Scenario

Carbon-constrained portfolios perform better in this climate change scenario that in some other scenarios. Market purchases are high, as may be expected. Comments included the following:

- A participant said this information is very hard to comprehend and evaluate properly, without access to the modeling data. She felt that more explanation of each slide might help.
- Another person observed that the scenarios and portfolios are much better than those included in the last IRP process.
- If and how will transmission be factored into these results?
    - We won't really be doing that. Transmission is a completely separate effort and requires unique optimization. However, utilities try to coordinate generation and transmission planning to the extent possible.

Next Steps

Mr. Park said that the next step in the modeling process is to use the *Prosym* model, supplemented with sensitivity analysis. Participants had the following comments:

- A participant observed that the information provided was exactly what some stakeholders had expected. He referred to an IURC report saying that utility-preferred options were 'hard-wired' in favor of the utilities. He was concerned that now that the first stage of the modeling is completed it's more difficult to ascertain that.
    - Mr. Park assured participants that there are no preferred alternatives at this point, and nothing is 'hard wired in' – the model has been allowed to select options.
- Another comment was that in all the scenarios across all portfolios, the PVRR ranges are relatively small, essentially within 'modeling error'; therefore, when evaluating portfolios, cost may not be the most important discriminating factor.
    - Mr. Park agreed, and said these data are used mainly to help decide what directions Duke wants to take.
- Is customer cost of rooftop solar included in the PVRR?
    - That cost is only included in the Stakeholder Distributed Generation portfolio.
- Is this reliance on market purchases typical of other parts of the Duke system?
    - It's more common when you're part of a Regional Transmission Organization (RTO) such as MISO in Indiana.

Sensitivity Development Exercise
All

Scott Park introduced the exercise for today in which participants could suggest what types of factors might be changed in the models to evaluate sensitivity of the portfolios to changes in scenario assumptions. They were asked to work in groups at tables, to identify sensitivity factors and a range of variation by percentages. The tables then reported back to the whole group.

Suggestions of the groups were as follows:

Sensitivity	Rationale	Up%	Down%
Natural gas prices	Everyone will need gas, so range needs to be bigger	300	10
Energy efficiency prices & rates of adoption		high	low
Cost of renewables		5	50
Combined Heat & Power		Cut barriers in half	No down side
Load forecast		5	2
Extreme weather	Forced outage rates of generation (would cause transmission line losses)		
Carbon emissions		100	No less than CPP
Roll back Opt Out provision in EE	Back to conditions of 2013 before opt out		
Energy storage costs	There is no activity today to benchmark from	0	25
Market prices		30	30
Deregulation potential		dereg	
Transmission expansion costs	Increase in market cost could cause more creative demand-response solutions, such as MISO MTEP transmission expansion plan to carry wind/solar energy across territories, to lower market price.	add	
Those on the phone said they may provide more			

Closing Comments

The next and last meeting will be on October 16, probably here in Plainfield. He reminded participants to please complete the comment forms, which are very helpful to Duke in improving the process.

The facilitator reminded participants to please fill out comment forms about the meeting. Additional comments can be emailed to Dr. Marty Rozelle at: rgl97marty@therozellegroup.com.

2015 Integrated Resource Plan

Stakeholder Workshop #4

October 16, 2015
Plainfield, IN

Welcome

Welcome

- Safety message
- Why are we here today?
- Objectives for stakeholder process
- Introduce the facilitator

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The Facilitator

- Duke Energy Indiana hired Dr. Marty Rozelle of The Rozelle Group and her colleagues to:
  - Help us develop the IRP stakeholder engagement process
  - Facilitate and document stakeholder workshops

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Why are we here today?

- Duke Energy Indiana developing 2015 Integrated Resource Plan (IRP)
- Proactively complying with proposed Commission IRP rule
- Today is the 4th of 4 stakeholder workshops prior to filing the IRP by November 1, 2015

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Objectives for Stakeholder Process

- **Listen:** Understand concerns and objectives
- **Inform:** Increase stakeholders' understanding of the IRP process, key assumptions, and challenges we face
- **Consider:** Provide a forum for productive stakeholder feedback at key points in the IRP process to inform Duke Energy Indiana's decision-making
- **Comply:** Comply with the proposed Commission IRP rule

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Scott Park, Director IRP Analytics - Midwest

Agenda and Meeting 3 Comments & Responses

Agenda

08:30	Registration & Continental Breakfast
09:00	Welcome, Introductions & Agenda
09:15	Meeting 3 Comments & Responses
09:30	Scenario Review
10:00	Break
10:15	Portfolio Review
10:45	Scenario Modeling Results
11:45	Lunch
12:30	Sensitivity Modeling Results
01:00	Decision Making (Preferred Portfolio & Short Term Implementation Plan)
01:45	Lessons Learned from 2015 IRP Stakeholder Process
02:15	Closing Comments

Meeting 3 Comments and Response

Topic	We heard/observed…	Response
Clean Power Plan (Final Rule)	Will the final rule of the Clean Power Plan be modeled?	No; the release of the final rule happened too late in the IRP process to model it in time for submission of the IRP. See separate slide on the CPP.
Wi-Fi	Not having Wi-Fi access makes participation in the stakeholder process more difficult	We are working to provide Wi-Fi access to stakeholders in meeting #4
Energy Efficiency	The amount of EE being presented in most portfolios is too low	The amount of EE shown in the portfolios is only a subset of total EE and is result of how EE is subdivided for modeling purposes. Later in the meeting, a comprehensive view of EE will be shown.

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Scenario Review

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Seven Scenarios

Core Scenarios

1. No Carbon Regulation
2. Carbon Tax
3. Clean Power Plan (Proposed Rule)

Change of Outlook Scenarios

4. Delayed Carbon Regulation
5. Repealed Carbon Regulation

Stakeholder-Inspired Scenarios

6. Increased Customer Choice
7. Climate Change

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Core Scenarios

- No Carbon Regulation
  - No carbon tax/price or regulation
  - Moderate levels of environmental regulation
  - No Renewable Energy Portfolio Standard (REPS)
- Carbon Tax
  - Carbon tax $17/ton in 2020, rising to $57/ton
  - Increased levels of environmental regulation
  - 5% REPS
- Clean Power Plan (CPP) (Proposed Rule)
  - Carbon reduced 20%
  - Increased levels of environmental regulation
  - 5% REPS

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Change of Outlook Scenarios

- Delayed Carbon Regulation
  - No Carbon Regulation scenario initially
  - Change to Carbon Tax scenario for latter part
  - Demonstrates impact of delayed carbon regulation

- Repealed Carbon Regulation
  - Carbon Tax scenario initially
  - Change to No Carbon Regulation scenario for latter part
  - Demonstrates impact of repeal of carbon regulation

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Stakeholder-Inspired Scenarios

- Increased Customer Choice
  - Carbon Tax scenario basis
  - Roof top solar serves additional 1% of load per year beginning 2020
  - Customers adopt higher levels of Energy Efficiency
  - New utility-scale generation served by merchant generators, e.g., Dynegy or Calpine

- Climate Change
  - Higher summer temperatures increase demand and prices for power and fuel
  - Carbon tax same as Carbon Tax scenario
  - Even hotter summer 2019 and “polar vortex” 2020, and every 5 years thereafter, causing higher prices

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Final Clean Power Plan Rule

- The final rule of the Clean Power Plan was released in early August of this year.
- The time to read, understand and develop modeling, plus the absence of any specific SIP details precluded the final rule from being explicitly modeled in the 2015 IRP
- The proposed rule was modeled as a scenario based on the belief that the final rule would be similar to the proposed rule
- The final rule differed from the proposed rule in a number of signifcant ways
- Between the Carbon Tax scenario and the proposed rule some lessons were learned regarding how portfolios respond to carbon regulation
- Continuing to evaluate a wide range of compliance options such as renewables, gas conversion and gas co-firing (i.e. Wabash River 6 gas conversion)
- Duke Energy Indiana will be evaluating the final rule and will work with the State and stakeholders to better understand the implications of the final Clean Power Plan.

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Break

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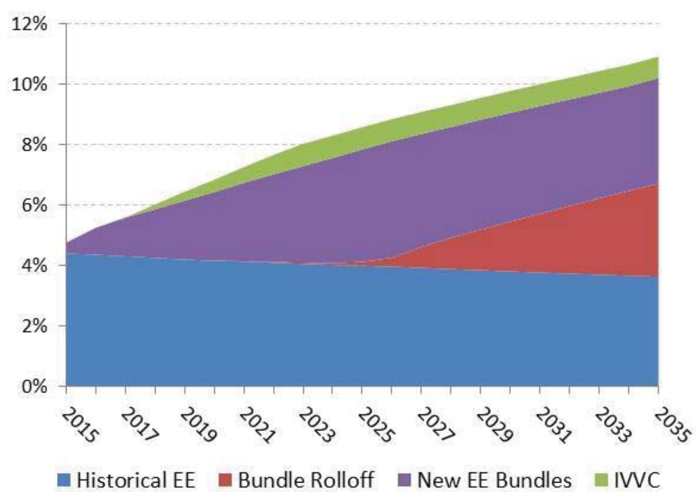
Brian Bak, Lead Planning Analyst

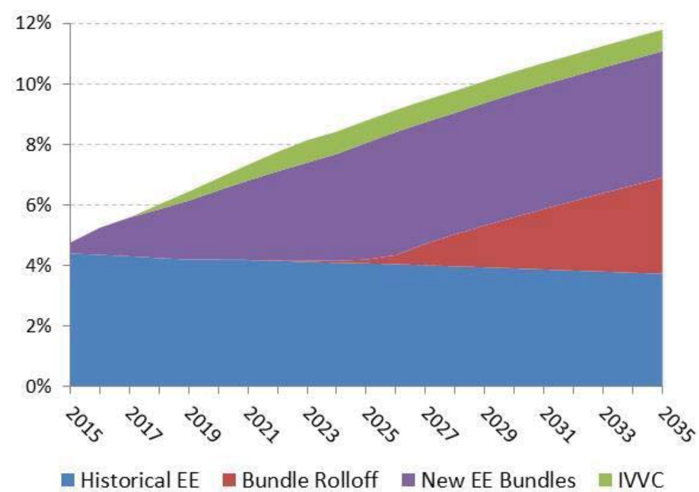
Portfolio Review

Cumulative Energy Efficiency % of Retail Sales

Portfolios 1 & 4

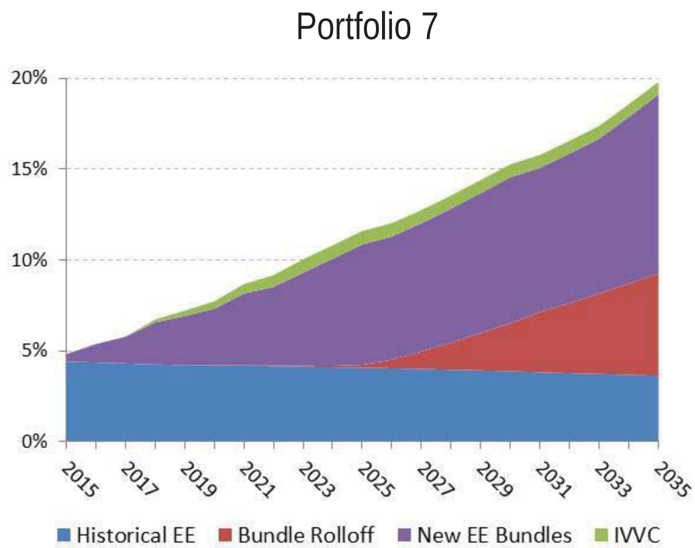


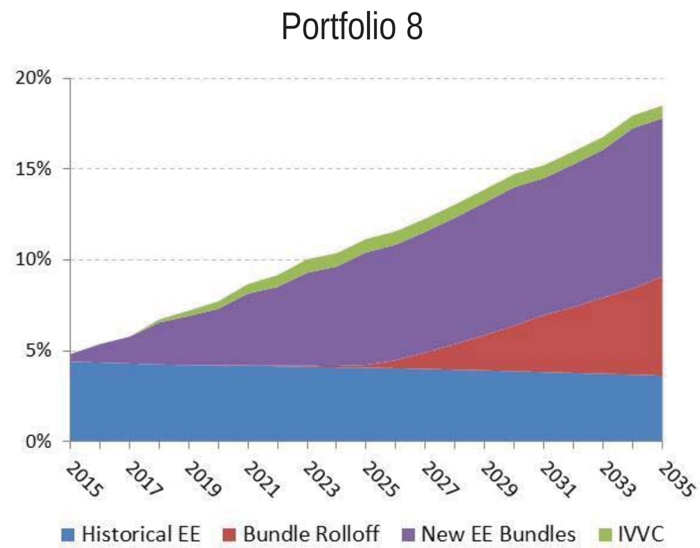
Portfolios 2, 3, 5, 6, 9



Notes: 1.) Cumulative EE calculated by adding back both historical EE (embedded in load forecast) and roll-off of new EE programs to both EE and load
2.) EE shown is based on *year-end* MWh attainment, *gross* of free-riders as a percentage of *retail* sales

Cumulative Energy Efficiency % of Retail Sales





Notes: 1.) Cumulative EE calculated by adding back both historical EE (embedded in load forecast) and roll-off of new EE programs to both EE and load
2.) EE shown is based on *year-end* MWh attainment, *gross* of free-riders as a percentage of *retail* sales

Nine Portfolios

1. Optimized No Carbon Tax
2. Optimized Carbon Tax
3. Optimized Proposed Clean Power Plan
4. Portfolio 1 w/ CC's
5. Portfolio 2 w/ CC's
6. Portfolio 3 w/ CC's
7. Stakeholder Distributed Generation
8. Stakeholder Green Utility
9. High Renewables

Portfolio Template

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT					
CHP					
CC					
EE & IVVC					
Solar					
Wind					
Biomass					
RETIREMENTS					
Unit					
MW					
Load Growth (MW)					
Reserve Margin					

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Optimized No Carbon Tax Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	832	208	208	208	208
CHP	44	29	15		
CC					
EE & IVVC	244 / 3.1%	124 / 1.9%	105 / 3.2%	11 / 3.2%	4 / 3.1%
Solar					
Wind					
Biomass					
RETIREMENTS					
Unit		WR2-6 Oil CTs			
MW	(834)	(834)			
Load Growth (MW)	1,288	501	259	261	267
Reserve Margin	15.8%	15.9%	15.4%	16.3%	15.6%

EE Notes: 1.) MW shown are incremental EE MW, net of roll-off in each period
2.) Percentages shown are cumulative new EE MWh, net of roll-off based in *hourly* MWh, *net* of free-riders as a percentage of *total* (not retail) sales

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Optimized Carbon Tax Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	624	416			208
CHP	15	15			
CC	448				448
EE & IVVC	276 / 3.6%	124 / 1.9%	106 / 3.3%	28 / 3.6%	18 / 3.6%
Solar	270	10	140	120	
Wind	450		150	250	50
Biomass	14	2	6	6	
RETIREMENTS					
Unit		WR2-6 Oil CTs Gal2,4			Gib5
MW	(1,424)	(1,114)			(310)
Load Growth (MW)	1,071	446	176	194	255
Reserve Margin	15.5%	15.9%	15.9%	14.7%	15.5%

EE Notes: 1.) MW shown are incremental EE MW, net of roll-off in each period
2.) Percentages shown are cumulative new EE MWh, net of roll-off based in *hourly* MWh, *net* of free-riders as a percentage of *total* (not retail) sales

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Optimized Clean Power Plan Portfolio (Proposed Rule)

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	624	208		208	208
CHP	44	29	15		
CC	448	448			
EE & IVVC	276 / 3.6%	124 / 1.9%	106 / 3.3%	28 / 3.6%	18 / 3.6%
Solar	270	20	130	120	
Wind	450		300	100	50
Biomass	14	2	6	6	
RETIREMENTS					
Unit		WR2-6 Oil CTs Gal2,4 Gib5			
MW	(1,424)	(1,424)			
Load Growth (MW)	1,071	446	176	194	255
Reserve Margin	15.3%	15.8%	15.3%	14.8%	15.3%

EE Notes: 1.) MW shown are incremental EE MW, net of roll-off in each period
2.) Percentages shown are cumulative new EE MWh, net of roll-off based in *hourly* MWh, *net* of free-riders as a percentage of *total* (not retail) sales

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Portfolio 1 w/ CC's Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	416			208	208
CHP	44	29	15		
CC	448	448			
EE & IVVC	244 / 3.1%	124 / 1.9%	105 / 3.2%	11 / 3.2%	4 / 3.1%
Solar					
Wind					
Biomass					
RETIREMENTS					
Unit		WR2-6 Oil CTs			
MW	(834)	(834)			
Load Growth (MW)	1,288	501	259	261	267
Reserve Margin	17.1%	16.7%	18.7%	16.9%	16.1%

EE Notes: 1.) MW shown are incremental EE MW, net of roll-off in each period
2.) Percentages shown are cumulative new EE MWh, net of roll-off based in *hourly* MWh, *net* of free-riders as a percentage of *total* (not retail) sales

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Portfolio 2 w/ CC's Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	208				208
CHP	15	15			
CC	896	448			448
EE & IVVC	276 / 3.6%	124 / 1.9%	106 / 3.3%	28 / 3.6%	18 / 3.6%
Solar	270	30	120	120	
Wind	450		150	250	50
Biomass	14	2	6	6	
RETIREMENTS					
Unit		WR2-6 Oil CTs Gal2,4			Gib5
MW	(1,424)	(1,114)			(310)
Load Growth (MW)	1,071	446	176	194	255
Reserve Margin	15.9%	16.0%	16.5%	15.2%	16.0%

EE Notes: 1.) MW shown are incremental EE MW, net of roll-off in each period
2.) Percentages shown are cumulative new EE MWh, net of roll-off based in *hourly* MWh, *net* of free-riders as a percentage of *total* (not retail) sales

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Portfolio 3 w/ CC's Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	208				208
CHP	44	29	15		
CC	896	896			
EE & IVVC	276 / 3.6%	124 / 1.9%	106 / 3.3%	28 / 3.6%	18 / 3.6%
Solar	270	30	120	120	
Wind	450		300	100	50
Biomass	14	2	6	6	

RETIREMENTS					
Unit		WR2-6 Oil CTs Gal2,4 Gib5			
MW	(1,424)	(1,424)			

Load Growth (MW)	1,071	446	176	194	255
Reserve Margin	17.5%	16.6%	19.4%	18.1%	15.9%

EE Notes: 1.) MW shown are incremental EE MW, net of roll-off in each period
2.) Percentages shown are cumulative new EE MWh, net of roll-off based in *hourly* MWh, *net* of free-riders as a percentage of *total* (not retail) sales

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Stakeholder Distributed Gen - Target vs Model

	2025		2035	
Energy Mix (%)	Target	Model	Target	Model
Market Purchases	11%	9%	8%	13%
Coal	36%	42%	19%	16%
Hydro	1%	1%	1%	1%
CC	8%	12%	9%	17%
CT	1%	0%	1%	0%
EE	11%	5%	16%	8%
Solar	7%	7%	10%	10%
Wind	10%	10%	13%	13%
CHP	9%	8%	12%	11%
Nuclear	0%	0%	3%	3%
Battery/Fuel Cell	1%	1%	2%	2%
LFG/Digester/Biomass	5%	5%	6%	6%
	100%	100%	100%	100%

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Stakeholder Distributed Generation Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	832		208		624
CHP	667	160	290	15	203
CC	1,344		896		448
EE & IVVC	725 / 8.8%	171 / 2.5%	239 / 5.7%	134 / 7.1%	181 / 8.8%
Nuclear	140				140
Battery	370		180	90	100
Solar	2,480	670	970	420	420
Wind	2,050	450	800	550	250
Biomass	353	106	162	60	25
RETIREMENTS					
Unit		WR2-6 Oil CTs Gal2,4	Gib5 Cay1,2 Gib1		Gib2,3
MW	(4,283)	(1,114)	(1,909)		(1,260)
Load Growth (MW)	1,071	446	176	194	255
Reserve Margin	20.2%	18.6%	18.9%	21.6%	21.8%

EE Notes: 1.) MW shown are incremental EE MW, net of roll-off in each period
2.) Percentages shown are cumulative new EE MWh, net of roll-off based in *hourly* MWh, *net* of free-riders as a percentage of *total* (not retail) sales

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Stakeholder Green Utility - Target vs Model

	2025		2035	
Energy Mix (%)	Target	Model	Target	Model
Market Purchases	16%	16%	13%	19%
Coal	50%	58%	38%	36%
Hydro	1%	1%	1%	1%
CC	18%	13%	19%	20%
CT	3%	0%	6%	0%
EE	5%	6%	8%	8%
Solar	2%	2%	4%	4%
Wind	3%	3%	6%	6%
CHP	2%	2%	5%	5%
Nuclear	0%	0%	0%	0%
Battery/Fuel Cell	0%	0%	0%	0%
LFG/Digester/Biomass	0%	0%	0%	0%
	100%	100%	100%	100%

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Stakeholder Green Utility Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	832	208	624		
CHP	261	29	73	73	87
CC	1,344		896		448
EE & IVVC	635 / 7.8%	171 / 2.5%	209 / 5.3%	134 / 6.7%	121 / 7.8%
Solar	930	40	380	300	210
Wind	800		250	300	250
Biomass	14	4	4	6	

RETIREMENTS					
Unit		WR2-6 Oil CTs Gal2,4	Gib5 Cay1,2		Gib1
MW	(3,023)	(1,114)	(1,279)		(630)

Load Growth (MW)	1,071	446	176	194	255
Reserve Margin	20.1%	15.6%	20.0%	23.0%	21.9%

EE Notes: 1.) MW shown are incremental EE MW, net of roll-off in each period
2.) Percentages shown are cumulative new EE MWh, net of roll-off based in *hourly* MWh, *net* of free-riders as a percentage of *total* (not retail) sales

High Renewables Portfolio

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	624	416		208	
CHP	29	15	15		
CC	448				448
EE & IVVC	276 / 3.6%	124 / 1.9%	106 / 3.3%	28 / 3.6%	18 / 3.6%
Solar	1,010	20	130	260	600
Wind	2,300		300	500	1,500
Biomass	14	2	8	4	

RETIREMENTS					
Unit		WR2-6 Oil CTs Gal2,4			Gib5
MW	(1,424)	(1,114)			(310)

Load Growth (MW)	1,071	446	176	194	255
Reserve Margin	17.7%	15.9%	16.6%	16.8%	21.4%

EE Notes: 1.) MW shown are incremental EE MW, net of roll-off in each period
2.) Percentages shown are cumulative new EE MWh, net of roll-off based in *hourly* MWh, *net* of free-riders as a percentage of *total* (not retail) sales

Scott Park, Director IRP Analytics – Midwest

Scenario Modeling Results

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Modeling Overview

- A robust scenario analysis was conducted in order to develop a variety of portfolios as well as test the respective performance of each across a range of assumptions
- The probabilities of the presence as well as the timing of CO2 regulation were varied to further test the flexibility of each portfolio
- In addition to cost, two other variables are presented to gain additional insight into each of the portfolios with respect to market exposure and changes in CO2 emissions
- Where scenario analysis evaluates portfolios at a more macro level, sensitivity analysis was also conducted to further evaluate each portfolio to changes in a number of key variables

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Scenario Results (PVRR in MM$)

SCENARIOS	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
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	30,524	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

Observations

1. Portfolios optimized for CO2 regulation tend to be lower cost across the range of scenarios
2. Portfolios high in renewable resources tend to be higher costs across the range of scenarios

Note – Color coding scheme: In each row, 3 top portfolios shaded in green; middle 3 portfolios in yellow; and bottom 3 portfolios in red

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Probability Weighted Scenario Results (PVRR in MM$)

SCENARIO PROBABILITIES: No CO2 Tax	Delayed CO2 Reg	Repealed CO2 Reg	CO2 Tax	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
25%	25%	25%	25%	23,856	23,862	24,010	23,975	23,906	24,082	29,512	25,381	24,353
40%	20%	20%	20%	23,144	23,220	23,386	23,256	23,260	23,452	29,103	24,829	23,727
20%	20%	20%	40%	24,595	24,526	24,650	24,703	24,573	24,732	29,922	25,931	25,005
55%	15%	15%	15%	22,433	22,579	22,762	22,537	22,614	22,821	28,693	24,278	23,100
15%	15%	15%	55%	25,333	25,191	25,289	25,432	25,241	25,383	30,331	26,481	25,656
70%	10%	10%	10%	21,721	21,938	22,138	21,818	21,969	22,191	28,284	23,726	22,473
10%	10%	10%	70%	26,072	25,856	25,929	26,160	25,908	26,033	30,740	27,031	26,308

Observations

1. The CO2 Optimized portfolio is relatively low cost across the range of probabilities
2. The No CO2 Regulation Optimized & the CO2 Optimized portfolios are low cost in most probabilities
3. Portfolios high in renewable resources tend to be higher costs across the range of probabilities

Note – Color coding scheme: In each row, 3 top portfolios shaded in green; middle 3 portfolios in yellow; and bottom 3 portfolios in red

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Scenario Results (CO2 Emissions) (Reduction from 2016 – 2035)

SCENARIO PROBABILITIES				PORTFOLIOS								
No CO2 Tax	Delayed CO2 Reg	Repealed CO2 Reg	CO2 Tax	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
25%	25%	25%	25%	6.5%	0.9%	-1.3%	2.4%	-1.9%	-4.0%	-43.5%	-23.2%	-12.8%
40%	20%	20%	20%	7.8%	0.8%	-1.1%	3.6%	-2.0%	-3.8%	-45.7%	-24.2%	-13.1%
20%	20%	20%	40%	5.5%	-0.3%	-2.2%	1.0%	-3.4%	-5.3%	-46.5%	-25.3%	-15.2%
55%	15%	15%	15%	9.2%	0.7%	-0.9%	4.8%	-2.1%	-3.7%	-48.0%	-25.2%	-13.4%
15%	15%	15%	55%	4.5%	-1.4%	-3.1%	-0.4%	-5.0%	-6.7%	-49.6%	-27.4%	-17.6%
70%	10%	10%	10%	10.5%	0.6%	-0.6%	6.1%	-2.3%	-3.5%	-50.3%	-26.1%	-13.6%
10%	10%	10%	70%	3.6%	-2.6%	-4.0%	-1.8%	-6.5%	-8.0%	-52.7%	-29.5%	-20.0%

Observations

1. Portfolios with higher levels of renewables show the largest decrease in CO2 emissions
2. Portfolios with CC's fare better with respect to CO2 reduction
3. Portfolios with CT's provide the least amount of CO2 reduction

Note – Color coding scheme: In each row, 3 top portfolios shaded in green; middle 3 portfolios in yellow; and bottom 3 portfolios in red

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Scenario Results (Market Purchases)

SCENARIO PROBABILITIES				PORTFOLIOS								
No CO2 Tax	Delayed CO2 Reg	Repealed CO2 Reg	CO2 Tax	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
25%	25%	25%	25%	11.4%	11.9%	11.2%	9.6%	10.1%	9.6%	8.0%	12.3%	10.6%
40%	20%	20%	20%	11.0%	11.4%	10.8%	9.1%	9.5%	9.2%	7.8%	12.2%	10.1%
20%	20%	20%	40%	11.8%	12.3%	11.7%	10.0%	10.5%	10.1%	8.2%	12.5%	11.0%
55%	15%	15%	15%	10.5%	10.9%	10.4%	8.6%	9.0%	8.7%	7.6%	12.0%	9.6%
15%	15%	15%	55%	12.2%	12.7%	12.1%	10.5%	10.9%	10.5%	8.4%	12.6%	11.4%
70%	10%	10%	10%	10.1%	10.5%	10.0%	8.1%	8.5%	8.2%	7.4%	11.9%	9.1%
10%	10%	10%	70%	12.6%	13.1%	12.5%	11.0%	11.3%	10.9%	8.6%	12.8%	11.9%

Observations

1. Portfolios with CT's rely most heavily on market purchases
2. Portfolios with CC's replace market purchases with higher capacity factor generation
3. Portfolios with renewables replace market purchases with lower capacity factor generation

Note – Color coding scheme: In each row, 3 top portfolios shaded in green; middle 3 portfolios in yellow; and bottom 3 portfolios in red

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Commentary on Scenario Analysis

Seven scenarios is a significant increase in the number of scenarios compared to previous IRP's

- Improved insight on a portfolio's robustness

Overall Observations

- Optimized portfolios tended to be the lower cost portfolios
- Portfolios optimized to comply with some form of carbon regulation tended to be lower cost across the range of scenarios
- Portfolios high in renewable resources tend to be higher costs across the range of probabilities
- Optimized portfolios performed well in scenarios where the timing of CO_2 regulation changed
- Optimized portfolios preferred peaking capacity and market purchases for energy
  - Lower cost, but greater market exposure
- Portfolios with CC's replace market purchases with higher capacity factor generation
- Portfolios with renewables replace market purchases with lower capacity factor generation

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Lunch

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Brian Bak, Lead Planning Analyst

Sensitivity Modeling Results

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Sensitivity Analysis

- Where scenario analysis evaluates portfolios at a more macro level, sensitivity analysis was also conducted to further evaluate each portfolio to changes in a number of key variables
- Scenarios are beneficial since they provide a view of the world where the variables are modeled in a correlated fashion.
  - Better for higher level comparisons
- Sensitivities are beneficial more as a measure of risk and less of a possible outcome.
  - Changes in correlated variables are not made or kept to a minimum
  - Allows for better understanding of how the change in a single variable impacts a portfolio

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Natural Gas Price Sensitivity (PVRR Change)

- Natural gas is becoming an increasingly important fuel for electric generation in the midwest
- The natural gas price sensitivity was conducted at +/-30%

No Carbon Tax Scenario	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
Higher Gas Prices	1.0%	1.6%	2.2%	1.3%	1.9%	2.5%	1.4%	3.4%	1.1%
Lower Gas Prices	-2.1%	-2.8%	-3.6%	-2.8%	-3.4%	-4.3%	-2.9%	-5.0%	-2.3%
AVERAGE	-0.53%	-0.58%	-0.70%	-0.76%	-0.78%	-0.93%	-0.74%	-0.79%	-0.57%

Carbon Tax Scenario	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
Higher Gas Prices	0.6%	1.0%	1.6%	1.0%	1.4%	1.9%	1.2%	2.6%	0.7%
Lower Gas Prices	-2.6%	-3.1%	-3.8%	-3.5%	-3.8%	-4.6%	-3.1%	-4.7%	-2.8%
AVERAGE	-1.02%	-1.00%	-1.10%	-1.24%	-1.20%	-1.36%	-0.93%	-1.04%	-1.06%

Observations

1. Most portfolios show an increase in costs of approx. 1-2% with higher gas prices
2. Portfolios with CC's enjoy the greatest benefit with lower gas prices

Note – Color coding scheme shades 3 top portfolios in green; middle 3 portfolios in yellow; and bottom 3 portfolios in red

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Market Prices Sensitivity (PVRR Change)

- Participation in MISO increase the market interaction with respect to coal, gas and power prices
- The market price sensitivity was conducted at +/-30%

No Carbon Tax Scenario	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
Higher Market Prices	10.9%	10.6%	10.7%	10.8%	10.5%	10.6%	5.0%	10.1%	9.5%
Lower Market Prices	-12.7%	-12.3%	-12.4%	-12.6%	-12.2%	-12.3%	-6.4%	-11.6%	-11.2%
AVERAGE	-0.91%	-0.85%	-0.84%	-0.90%	-0.84%	-0.84%	-0.69%	-0.79%	-0.83%

Carbon Tax Scenario	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
Higher Market Prices	7.0%	7.4%	7.6%	7.2%	7.5%	7.7%	4.1%	7.4%	6.8%
Lower Market Prices	-8.7%	-9.1%	-9.4%	-9.0%	-9.4%	-9.6%	-5.7%	-9.0%	-8.5%
AVERAGE	-0.83%	-0.82%	-0.86%	-0.91%	-0.92%	-0.96%	-0.76%	-0.82%	-0.84%

Observations

1. Most portfolios show very similar average sensitivity to changes in market prices
2. Portfolios with greater amounts of renewables show less sensitivity to changing prices

Note – Color coding scheme shades 3 top portfolios in green; middle 3 portfolios in yellow; and bottom 3 portfolios in red

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Increased CHP Sensitivity

- The number of generic CHP projects that could be selected was increased

No Carbon Tax	No CO2 Opt	CO2 Opt	CPP Opt	No CO2 Opt w/ CC	CO2 Opt w/ CC	CPP Opt w/ CC	High Renewables
Base Case (MW)	44	29	44	44	29	44	29
Increased CHP (MW)	87	87	87	87	87	87	87

Carbon Tax	No CO2 Opt	CO2 Opt	CPP Opt	No CO2 Opt w/ CC	CO2 Opt w/ CC	CPP Opt w/ CC	High Renewables
Base Case (MW)	44	15	44	44	15	44	29
Increased CHP (MW)	87	87	87	87	87	87	73

Observations

1. Cost is not the limiting factor when it comes to CHP
2. Duke Energy Indiana is increasing efforts to develop cost effective CHP projects

Note – Color coding scheme shades 3 top portfolios in green; middle 3 portfolios in yellow; and bottom 3 portfolios in red

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Higher Carbon Tax Sensitivity

- In addition to the CO2 Tax and Proposed CPP scenarios, a sensitivity was conducted to measure the portfolio's responsiveness to a higher CO2 Tax

Carbon Tax Scenario	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
PVRR Change	24.8%	24.7%	23.6%	23.5%	23.4%	22.2%	12.2%	19.6%	22.9%
Additional CO2 Reduction	-7.3%	-8.3%	-8.4%	-9.3%	-10.3%	-10.1%	-5.6%	-10.2%	-9.2%

Observations

1. Portfolios with higher levels of renewable and CC generation are better able to absorb a higher tax on carbon
2. Portfolios with CC generation have more dispatch-able diversity in their respective fleets and appear to be better able to reduce CO2 emissions

Note – Color coding scheme shades 3 top portfolios in green; middle 3 portfolios in yellow; and bottom 3 portfolios in red

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EE Cost Sensitivity

- The cost (cost/kWh) for Energy Efficiency was varied +/-20%

No Carbon Tax		No CO2 Opt	CO2 Opt	CPP Opt	No CO2 Opt w/ CC	CO2 Opt w/ CC	CPP Opt w/ CC	High Renewables
Lower EE $/MWh	MWh	26%	27%	27%	26%	27%	22%	16%
	PVRR	-0.6%	-0.2%	-0.9%	-0.5%	0.0%	-0.6%	-1.1%
Higher EE $/MWh	MWh	-38%	-20%	-20%	-38%	-20%	-20%	-20%
	PVRR	0.1%	0.8%	0.0%	0.1%	0.9%	-0.2%	0.3%

Carbon Tax		No CO2 Opt	CO2 Opt	CPP Opt	No CO2 Opt w/ CC	CO2 Opt w/ CC	CPP Opt w/ CC	High Renewables
Lower EE $/MWh	MWh	26%	27%	22%	26%	27%	22%	16%
	PVRR	-1.2%	-0.2%	-0.6%	-1.3%	-0.1%	-0.6%	-0.9%
Higher EE $/MWh	MWh	-24%	-20%	-21%	-39%	-20%	-21%	-20%
	PVRR	-0.3%	0.8%	0.3%	-0.4%	0.7%	0.2%	0.2%

Observations

1. Cost has a significant impact on economic selection of EE programs across all portfolios
2. Incentives have an impact on adoption rates, but the additional cost affects cost effectiveness
3. Customer behavior may not align with economic incentives (e.g. free light bulbs)

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Commentary on Sensitivity Analysis

- Portfolios with balance between CC and coal generation are better able to respond to variation in gas prices
- Portfolios with higher levels of renewables have higher fixed costs and costs overall, but are better able to withstand changes in variable cost factors (i.e. market prices, carbon taxes)
- CHP is cost effective across all portfolios if transactions can be made at generic cost assumptions
- Cost effectiveness and adoption rates (customer behavior) are a key and interrelated variables for Energy Efficiency programs

Explicit sensitivities not performed and rationale

- Load forecast: load variation was indirectly addressed by the different load assumptions in the various scenarios
- Roll back EE opt-out: speculative and difficult to specify
- Energy storage: screened out due to current high cost and short useful life; technology has niche applications
- Deregulation: difficult to specify without numerous speculative assumptions
- Transmission costs: difficult to incorporate transmission costs without siting specifics potentially at the MISO footprint level

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Scott Park, Director IRP Analytics - Midwest

Decision Making

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Portfolio Selection

- The Optimized CO2 Tax Portfolio w/ CC is the preferred portfolio for the DEI's 2015 IRP
  - Cost competitive relative to other portfolios across the range of scenario probabilities
  - Below average levels of market purchases
  - Relatively favorable response to changing gas prices
  - No significant shortcomings in the other sensitivities
  - Flexible in the near term and positioned well for future carbon regulation

Portfolio details:

ADDITIONS (MW)	Total	2016-20	2021-25	2026-30	2031-35
CT	208				208
CHP	15	15			
CC	896	448			448
EE & IVVC	276 / 3.6%	124 / 1.9%	106 / 3.3%	28 / 3.6%	18 / 3.6%
Solar	270	30	120	120	
Wind	450		150	250	50
Biomass	14	2	6	6	
RETIREMENTS					
Unit	0	WR2-6 Oil CTs Gal2,4			Gib5
MW	(1,424)	(1,114)			(310)

Note- The IRP preferred portfolio is not a set of specific resource decisions and will be updated in the analysis of the Final Rule of the Clean Power Plan
* Energy efficiency MW shown are incremental EE MW, net of roll-off in each period; percentages shown are cumulative new EE MWh, net of roll-off, over total annual MWh

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Lessons Learned

Lessons Learned Exercise

Group exercise to discuss improvement opportunities for each of the major topics in the IRP stakeholder process

- Each table is assigned a topic and can pick one other
- Each person at a table writes down
  - What they thought went well & what they would like to improve (and how)

<u>Topics</u>

1. Meeting structure: scenarios => portfolios => modeling => decision making
   a. Stakeholder exercises
   b. Duke Energy's role; Stakeholder's role
2. Scenario development
3. Portfolio development
4. Modeling
5. Decision making

Marty Rozelle, President, Rozelle Group

Closing Comments, Stakeholder Comments

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Next Steps

- Please complete comment cards or send by October 23rd to Marty at: RGL97marty@rozellegroup.com
- Meeting summary and other materials will be posted on website by November 2nd (http://www.duke-energy.com/indiana/in-irp-2015.asp)

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Duke Energy Indiana 2015 Integrated Resource Plan

Stakeholder Workshop 4
Summary
October 16, 2015

Welcome & Introductions
Dr. Marty Rozelle, The Rozelle Group Ltd.

Marty Rozelle welcomed everyone to the fourth and last stakeholder workshop for the 2015 Duke Energy Indiana (DEI) Integrated Resource Plan (IRP). She asked those in the room to introduce themselves. She said she'd check in with those on the phone occasionally to make sure they could hear the speakers. (Denise Hoffman, NAACP) She reviewed the objectives of the stakeholder process, as had been done at all previous meetings.

Agenda Overview
Scott Park – Duke Energy Director IRP Analytics, Midwest

Scott Park gave an overview of the agenda. He explained that this workshop will review scenarios and portfolios developed in previous meetings, and provide modeling results for the portfolios and the sensitivity analyses performed on them, which resulted in DEI's selection of a preferred portfolio for inclusion in the 2015 IRP. To help DEI improve future stakeholder processes, there will be an exercise for participants to evaluate the process and provide lessons learned.

Meeting 3 Comments, Responses, and Updates
Scott Park

Mr. Park discussed some of the comments made by participants at the last meeting and how they have been addressed. Regarding the request to incorporate the Clean Power Plan (CPP) into the IRP process, he noted that the final CPP rule was released too late to incorporate in the IRP process.

Participants had the following comments and questions about the treatment of the CPP:

- Could Duke request an extension for filing the IRP this year until January, to allow incorporation of the CPP? The participant noted that the state will be relying heavily on input from the utilities in developing the State Implementation Plan (SIP).
    - Mr. Park said that January would be too soon to be able to fully understand the rule and work with the consultant who models the national picture. This effort will, essentially, model 'a new world'. The utilities will need time to develop assumptions. There may be in interim step before the next 2-year IRP cycle to update this. Duke is assessing how it can communicate to stakeholders what they're learning from this process.
- A participant noted that the SIP won't be submitted until Sept 2018, so this timing may not be too bad. Also, the SIP requires stakeholder engagement as part of that process.
- A participant noted that DEI has modeled a number of scenarios that may adequately address these concerns, at least in the interim.
- A participant said that the Office of Utility Consumer Counsel's (OUCC) Susanne Brown is on the committee that's looking at the SIP. Everything is quite preliminary, so we just need to do our 'best guesses' at this time.
- In the trading scenario anticipated in the federal CPP, corporations will be allowed to determine if they sell credits or not; since Duke will be a position to do this, it would be helpful to know how the company will deal with this.
    - Mr. Park responded that multistate generators could take generation in one state and allocate it to another state. He thinks states will actually take steps to prevent this from happening, but the suggestion is not very defined at this time.

Previous workshop participants expressed concerns about Wi-Fi access in the meeting room, for which a number of approaches have been tried. DEI believes these issues have been solved for this meeting. The company recognizes that people make a significant commitment to spending all day at these meetings, and doesn't want to make that a hardship.

DEI has addressed comments made about energy efficiency (EE) with an approach that will be explained in this meeting. It has been modeled in a different way to better accommodate stakeholder concerns about the assumed level of EE adoption.

Scenario Review
Scott Park

Mr. Park reminded stakeholders that Duke has looked at 7 scenarios, describing them as three subgroups characterized as "core" scenarios, "change-of-outlook" scenarios, and "stakeholder-inspired" scenarios. To recap, scenarios used for modeling are the following:

Core Scenarios

1. No Carbon Regulation, defined as:
    - No carbon tax/price or regulation
    - Moderate levels of environmental regulation
    - No Renewable Energy Portfolio Standard (REPS)

2. Carbon Tax
    - Carbon tax of $17/ton in 2020 rising to $57/ton
    - Increased levels of environmental regulation
    - 5% REPS
3. Clean Power Plan (CPP) (proposed rule)
    - Carbon reduced by 20%
    - Increased levels of environmental regulation
    - 5% REPS

Change of Outlook Scenarios

4. Delayed Carbon Regulation
    - No initial carbon regulation changing to carbon tax later
5. Repealed Carbon Regulation
    - Carbon tax changing to no carbon regulation

Stakeholder-inspired Scenarios

6. Increased Customer Choice
    - Carbon tax scenario basis
    - Rooftop solar serves additional 1% of load/year starting in 2020
    - Customers adopt higher levels of EE
    - New utility-scale generation served by merchant generators
7. Climate Change
    - Higher summer temperatures increase demand & prices for power
    - Carbon tax same as Carbon Tax scenario
    - Even hotter summers & 'polar vortex' in 5-year increments increase prices

Participants had the following observations:

- A participant suggested that the core scenarios should be termed "carbon price" rather than "carbon tax".
- Because the carbon scenarios include trading of carbon credits, is Duke factoring in the benefit of selling carbon credits in scenarios that include retiring coal plants? If you look at costs you should also look at benefits.
    - A carbon tax is not the same as trading, but could be viewed as a market price for carbon. This might be similar to what is done for sulfur dioxide ($SO_{2)}$ allowance trading. We will need to further evaluate the Final Rule.
- Indiana Utility Regulatory Commission (IURC) staff suggested that a better modeling construct might be a trading assumption rather than a tax. At least, please describe this concern in the IRP for the stakeholders.
    - The compliance plan that addresses a future SIP would be the next level of detail to look at this, and DEI is not yet in a position to evaluate that.
- On the CPP scenario, are you going to quantify the assumed 20% reduction in carbon emissions?
    - As described later in this workshop, DEI has attempted to quantify changes emissions associated with the various portfolios.
- Under the SIP, the goal will be to reach a reduction target, and won't be prescriptive about how you get there. The utilities will need to suggest these

approaches. It seems, therefore, that all the utilities should want to be involved in this, which means that you can be more proactive about making assumptions.
    - DEI understands that the state will be looking to the utilities for help, and will be working with stakeholders.

Mr. Park talked about how DEI considered the CPP in developing the IRP. Although the final plan could not be explicitly modeled due to time constraints, certain assumptions were made based on the proposed rule. The final rule is quite different from the proposed, and DEI is evaluating the rule to determine what it needs to do to comply, while considering a wide range of compliance options. For example, it might make sense to convert Wabash River Unit 6 under this rule. The company will continue to work on this and adjust planning accordingly.

Participants had several comments:

- Is natural gas co-firing an option for Wabash River 6?
    - The unit could be converted to gas generation, which would have the operational characteristics of a coal plant with lower levels of emissions. We want to preserve the option of doing that. Co-firing is more of a fleet-wide option.
- A participant observed that Wabash River 6 is being packaged as a compliance mechanism, but one thing that remains is a boiler. It pushes timeframe of renewable adoption about 5 years down the road. Is the plant dispatchable?
    - DEI is not suggesting that gas conversion of Wabash River 6 is a renewable resource. They need to evaluate whether it makes economic sense to do the conversion, and they are not able to make that decision yet.
- A participant noted that other things can be used to co-fire with coal, e.g. biomass, and suggested that DEI consider these options.

Portfolio Review
Brian Bak, Duke Energy Lead Planning Analyst

Before addressing the portfolios, Brian Bak provided an explanation of how DEI has looked at EE in this current modeling, in response to several stakeholder comments. He showed charts that illustrated this concept. He explained that the term ‘bundle roll-off’ means that as the effects of the EE programs are evidenced through customer adoption, they get incorporated into the load forecast. This analysis illustrates the cumulative EE efficiencies of the portfolios as a percentage of retail sales, before the effects are rolled back into the load forecasts. This presents a truer level of overall EE.

Mr. Bak explained that 9 portfolios have been developed, as described at the August meeting. There have been only minor changes to these. Two of these were specifically designed to meet stakeholder suggestions developed at the last workshop. He used data tables to compare the results of the stakeholder portfolios developed by DEI to the suggestions made by stakeholders at the June workshop.

The portfolios analyzed are:

1. Optimized No Carbon Tax
2. Optimized Carbon Tax
3. Optimized Clean Power Plan (based only on the Proposed Rule, not Final)
4. Portfolio 1 with CC's (No Carbon Tax with Combined Cycle)
5. Portfolio 2 with CC's (Carbon Tax with Combined Cycle)
6. Portfolio 3 with CC's (Proposed Clean Power Plan)
7. Distributed Generation (stakeholder suggested)
8. Green Utility (stakeholder suggested)
9. High Renewables

He reviewed data tables from the last meeting summarizing generation additions and retirements for each portfolio as well as load growth and reserve margin calculations.

Participants had the following questions:

- There is a 20% carbon reduction goal for the CPP portfolio. Lately, it has been discussed that the Indiana goal will be 32%. Is 32% the right number to use when updating these portfolios? That would be a material change.
    - Duke observed that 38.5% might be the goal for Indiana. The company is still examining how a higher goal would look. Consequently, they can't lean too heavily on the current assumptions about the CPP.
- For Gibson 5, would waiting until after 2019 to close it require significant upgrades to the existing plant? If so, why does the Optimized Carbon Tax with CC portfolio show retirement in the 2031-35 timeframe?
    - DEI thought that a scrubber upgrade would be needed in 2023. However, in the absence of carbon regulation, CO_2 price ramps up quickly, so by the 2030's the price is so high it drives closure.
- Gibson is jointly owned, so how do you make decisions about that unit?

Scenario Modeling Results

Scott Park

The objective of the modeling process was to create a robust analysis. DEI did this by developing a variety of portfolios and testing performance across a range of assumptions. Finer-grained sensitivity analyses were also conducted for each portfolio, in which only one variable was changed.

Mr. Park showed tables that provided the relative cost (in Present Value of Revenue Requirements (PVRR in millions of dollars) of each portfolio in each combination of events (scenarios). The results for the 9 portfolios were color-coded on these tables for ease of viewing, with each color representing the lowest, middle, and highest 3 groups. He noted that combined cycle (CC) was added to several portfolios in order to see the cost, emissions, and level of market purchases change to the optimized portfolios.

He explained that DEI did a probability weighting for the portfolios. This looked at a range of various probabilities that 4 different ways that carbon regulation might occur to estimate the resulting costs of the 9 portfolios.

Participants had the following observations on this analysis:

- Some of differences in PVRR seem to be within the margin of error, and not significant.
- DEI is modeling a CPP that's the draft rule, not the final rule, and the final rule is materially different in multiple respects.
- There used to be a distinguishing of constraints that were 'musts' and constraints that were 'wants'. This participant suggested that carbon constraints in today's world should be a 'must' constraint. In other words, carbon constraints are highly likely today and, therefore, some of the other scenarios would just drop out.
    - Yes, in this model, it was assumed that the probability of occurrence of driving assumptions was 100%. The probability weighting runs show different probabilities.
- The high renewables portfolio is just out of the yellow (mid-cost) range, and is not far from the lowest cost, given a margin of error. None of the probabilities (or portfolios) seem to include increased carbon regulation, which is what we actually have in the final CPP rule. Even if this is struck down in the short term, it is still highly likely that there will be strong carbon regulation in the future.
    - DEI didn't know about the doubling of restrictions in the final rule until the day before the last workshop. We simply did not have the time and capability to include those assumptions in these models.
- Another participant echoed this observation, and suggested that the color scheme used on the slides might be more refined to show the small differences.
- Another participant was in favor of having a wide range of alternatives, but suggested that you can't assign probabilities to non-compliant scenarios. So, this table needs to be more complex because there are only certain compliant scenarios in a carbon-constrained world.
    - All these scenarios assume different compliance constructs. When we get to the point of being able to model the final rule, we can look at variations; but, we are not necessarily taking the final rule as the only option. Even if a certain carbon price isn't assumed, market forces will come into play that 'de-carbonize' the availability of resources.

Mr. Park said that another analysis was done to calculate the absolute carbon emissions reduction that would result from each portfolio during the 2016 to 2035 timeframe. He pointed out that, in general, the lowest-cost portfolios tended to perform the worst in terms of carbon reduction, while the highest-cost portfolios did the best job of reducing emissions.

An assessment was also done to look at the level of market purchases required for each portfolio. In general, portfolios with combustion turbines (CTs) rely most heavily on market purchases, while portfolios with CCs replace market purchases with higher-capacity-factor generation. Portfolios with renewables replace market purchases with lower-capacity-factor generation. Questions asked by participants were:

- Is it correct to say that there has previously been an assumption that the carbon intensity of the market portfolio is the same as the Duke portfolio? Is that still true today?
    - We think so, but we don't know for sure; the market purchases come from a number of sources. The DEI fleet will become less carbon-dependent over time, and we assumed the overall market would be composed similarly. Generation after market purchases today is composed of about 90% coal, producing 1900 pounds of emissions per megawatt hour in carbon intensity. This will probably drop to about 1700 pounds.

Mr. Park emphasized that the IRP is not a decision document, but is a plan providing a direction. It can and does change over time as conditions change. In summarizing the scenario analysis, he noted that modeling a larger number of scenarios, compared to the last IRP process, gave DEI greater insight into the robustness of portfolios. Overall, the optimized portfolios tended to be the lower-cost options, even when optimized to comply with some form of carbon regulation. Optimized portfolios preferred peaking capacity and market purchases to provide energy. Portfolios high in renewable resources tended to have higher costs across the range of probabilities.

Sensitivity Modeling Results
Brian Bak

Mr. Bak explained that scenarios represent different world views, while sensitivities are a micro-level look at varying one element. He showed a chart that evaluates changes in PVRR of the portfolios that would occur from varying the natural gas price by 30% either way, up or down. Most portfolios show an increase in costs of approximately 1-2% with higher gas prices. Portfolios with CCs enjoy the greatest benefit with lower gas prices. He clarified that these prices are the average of all portfolios to that change.

A similar analysis was done to evaluate changes in market purchase prices of 30%. Most portfolios show similar average sensitivity to changes in market prices, and portfolios with higher amounts of renewables are less sensitive to changing prices.

Another sensitivity model was done to look at the effects of increasing the level of combined heat and power (CHP) included in the portfolios. This showed that cost is not the limiting factor for CHP. Mr. Bak told participants that DEI is increasing its efforts to develop cost-effective CHP projects. He mentioned as an example that Jim Hobbs has transferred to a group working on developing CHP programs for Duke. The key concern for effective CHP implementation is finding projects that work for both the utility and the private partners.

A final sensitivity was done for higher carbon prices. Not surprisingly, portfolios developed for carbon regulation handled higher carbon costs better.
DEI also looked at EE cost sensitivity, varying the cost by 20%. If the costs of EE bundles are lowered by 20%, the model will select more of them. This was the first time DEI tried to model EE as a resource. Mr. Bak noted that if a utility wants to raise EE adoption rates, they would need to offer a greater incentive to customers to do that, which in turn raises the overall program costs. It is, therefore, a complicated process to

analyze this, and there are a number of unknown variables. Cost effectiveness and customer adoption rates seem to be the key interrelated variables for EE programs.

Comments about the EE sensitivity included the following:

- A participant said that he understands the analytical reasons for doing this in this way, but he observed that DEI and other investor-owned utilities are pricing investor demand-side management (DSM) out of the marketplace. For example, in recent testimony the OUCC said that the IURC shouldn't approve the utilities' DSM plans because they are too costly. He feels that the cost assumptions made here for these analyses are erroneous, and EE is a critical resource in any plan.
  - Mr. Park agreed that it's an important part of the resource selection process. He pointed out that the load forecast does include some EE.
  - DEI's attorney noted that these are pending cases, and we can't debate them here.
- A participant said that, despite the pending cases, stakeholders are here to talk about cost effectiveness.
  - Duke agreed that cost effectiveness is a primary consideration for them as well.
- A participant referenced an observed increase in energy consumption by customers who are on budget billing. She asked how many DEI customers are on budget billing, observing that this seems to be a disincentive for energy saving.
  - DEI said that this reference was to Auto Pay, not budget billing. It's true that these customers tend to consume more energy.
  - DEI couldn't answer the question about the number of Auto Pay customers. OUCC offered that the IURC has a billing symposium going on now, indicating that about 18-20% of customers for all utilities (not just electric) use electronic bill-pay.
- Regarding the concept of rollback EE, a participant observed that people who are opting out aren't buying more Duke power. There are more market options for energy management now, such as distributed generation, and these will continue. Even though these options are not utility sponsored, they do affect these models; some way needs to be developed to capture this. He noted, however, that way EE is accounted for in this discussion is a big step forward.

In summarizing observations about the sensitivity analyses, Mr. Bak observed that portfolios with a balance between CC and coal generation are better able to respond to variations in gas prices. Portfolios with higher levels of renewables, although they have higher fixed costs and costs overall, are better able to respond to a variety of variable cost factors. CHP seems to be cost effective across all portfolios. He also explained why certain sensitivities suggested by stakeholders were not performed, mainly because of assumptions could not be made about certain elements like transmission costs, deregulation, or the potential for energy storage.

A stakeholder noted that the Stakeholder Green Portfolio performs well in all the sensitivities.

Lunch

Decision Making
Scott Park

Mr. Park told the group that DEI has selected the Optimized CO_2 Tax Portfolio with CC (Portfolio 2 w/CC) as the preferred portfolio for DEI's 2015 IRP. This portfolio was optimized for a carbon tax but included combined cycle, because it is cost competitive.

He pointed out to participants that the earlier years of the preferred plan are similar to the early years of the Optimized No Carbon Tax Portfolio and the High Renewables Portfolio. The benefit of this is that if the future evolves towards no carbon regulation or one that requires more renewables, the preferred portfolio can be redirected towards that future.

Participants had the following questions and comments:

- Is the capacity of a CT pretty close to a gas conversion? Does installation of CT push the timeframe for renewable installation out farther?
    - This is a generic CT. Wabash River 6 is not included in this profile. The CTs are more efficient than conversion of Wabash River 6, but this could show up again. We need 400 MW of peaking capacity, and natural gas conversion is a good peaking source, as are CTs. They both have higher heat rates so they won't be run much, but CT might run a bit more.
- Can you give another example of gas conversion similar to what you have in mind for Wabash River 6?
    - South Carolina Lee Unit 3. Mr. Park said this type of conversion is relatively easy to do, with boilers using gas instead of coal dust, and is inexpensive capacity in terms of dollars per kilowatt.
- How is this different from the same issue when it arose at Gallagher? There was an idea of installing a pipeline to Gallagher for gas conversion, but that didn't happen. Is there already a pipeline to Wabash River 6? This participant is skeptical of the feasibility of this proposal, suggesting that it is 'wishful thinking'. He will look at Lee Unit 3 to see the actual costs and what has been done.
    - Wabash River 6 is over 300 megawatts (MW), while Gallagher generates 140 MW per unit. Wabash River has convenient gas access; Gallagher would be more expensive and not justified. Under certain assumptions, gas conversion at Wabash River could be cost effective.
- How do you justify 416 MW of CT in the long term under a high renewables portfolio? This participant thinks that gas will also come under scrutiny in later years of the planning horizon.
    - We took forecasts for solar and wind, and cut this down by 25%, then let the model select. This produced more than 3000 MW of renewables, but there is still a preference for some CT. We recognize that this takes away from EE and other generation resources. This portfolio does not assume storage, which has a high fixed cost and wears out more quickly than most other resources.
- There was discussion about how load growth was estimated.

  - Mr. Park agreed that this is an issue that needs to be to tracked over time, since some variables aren't known. For example, increased customer generation would affect load growth. At this time, load growth percentage is decreasing and leveling out nationwide.
- A participant thought that 1000 MW of load growth is an overestimation, so that not as much gas generation might be needed in reality as portrayed here.
- A participant gave an example of this relative to a previous Gallagher case. When will demand reach the 2008 level?
  - We will have to look that up.
- Uncertainty, not carbon regulation, is what's challenging the utility industry. Once the uncertainty is resolved, investment decisions can be made more confidently.

In summary, DEI feels that the preferred portfolio is flexible in that it can transition in various directions over the planning period depending on world conditions. It is similar to the 'greener' portfolios in the near term, and can be more easily repositioned once some of the current uncertainties are resolved.

Lessons Learned from 2015 IRP Stakeholder Process
Group exercise

Marty Rozelle introduced the exercise to evaluate the overall stakeholder process for this IRP. She said we'd like to look at what's gone well and what could be improved. She asked people to discuss this in 5 topic areas, with each topic discussed at a table. Participants were asked to join the table topic of most interest to them. Ideas and suggestions from stakeholders are shown in the following table.

Topic: Meeting Structure	
Keep	**Change**
Great facilitator	Webcast option not available
Duke made great strides forward – excellent staff support, discussion, staff experts	Phone problems in not being able to mute those on phone
Good materials	Phone connection problems
Website distribution of materials	Not enough feedback time on modeling results, e.g. CPP proposed v. final rule
Duke more open to using stakeholder input in scenarios	Extent to which corporate decision making structure limits final plan
Duke responsive to questions and concerns	What should stakeholder relationship/role be to that process?
Higher level of engagement in discussions – more discussion of issues	How do you address changes that happen during the life of the IRP
Respect and openness to each other	A broader more diverse representation of stakeholders would be very helpful, e.g. Industrial customers, economic development interests, academia. Should we formally invite them?
Great meals	More 'user-friendly' ways of presenting information, to reach broader audiences. Perhaps produce published digest of meetings, e.g. news release – would this

	attract more participation? What about YouTube videos? Prepare something that will grab attention and communicate major findings.
Open flow of communication	
Comment: OUCC says attendance at public participation events has declined a lot, but they typically get lots of written comments via online opportunities	
Suggestion: Consider developing a 3-level stakeholder process 1. large group meetings 2. subgroups on technical details, interact with modelers, in between workshops 3. broad public outreach	

Topic: Scenario Development	
Keep	**Change**
	Need to be as comprehensive as you can be to make sure you're covering all the possibilities ('branches of the decision tree')

Topic: Portfolio Development	
Keep	**Change**
Improvement in explanation and treatment of EE, better graphics	More discussion and explanation of EE impacts
	Still confusion between scenarios and portfolios – more clarity on how scenarios "tilt" evaluations of portfolios
	Is this process designed to reflect reality or to change reality?

Topic: Modeling	
Keep	**Change**
Duke was much more receptive to stakeholder modeling assumptions.	We don't understand the model, so we need to just trust inputs (black box) -- might be addressed through the suggestion for technical subgroups working with Duke
Robust discussion of scenarios = better decision making	
Post modeling discussion of results was enlightening (stakeholders get to see "art" behind the "science")	
Comment: Commission might have a more active role under new rulemaking procedures Statute 412 Commission must do more of its own analysis and to look at statewide needs, e.g. in the current EE rule – also requires stakeholder engagement	

Topic: Decision Making	
Keep	**Change**
	Explain cost effectiveness, e.g. who are these solutions cost effective for?
	The company's business plan drives the process and the decisions, and presents constraints on decisions. The stakeholders role is to push that process toward their ends.
	Improve contextual information that's presented; i.e. many tables and data need better explanation/graphics for comparison

Closing Comments

Scott Park endorsed the idea of increasing the diversity of participants, and asked attendees to provide any suggestions they have to do so. It was suggested that DEI work with their commercial accounts executives to encourage industry participation. A participant reported that there are experts at Indiana University and Purdue who teach these topics, so consider inviting them and their students. Mr. Mullett offered to send DEI a reference to an IU expert in human behavior and energy.

Mr. Park asked participants if they had any final suggestions for improving the evaluation of EE. The following ideas were offered:

- Consider other opportunities for enhancing the efficiency of energy delivery, such as IVVC . For example, small water and sewer utilities have a great need for better efficiency, but they don't have the capital resources to do it. So utilities should look at how to help them. If you can achieve energy savings, it doesn't matter who does it, utility or user.
- There are other resources out there such as ACEEE. What happened to the EE market potential studies that used to be done? It's just a wrong assumption that EE levels decrease as time goes on, because the nature of things is that technologies get more efficient over time.
- DEI should look more closely at 3rd-party efficiency and opt-outs. These can have big effects on the IRP.
- How do you get the data for input to the EE modeling? Is it actual reductions in energy consumption from customers, or is it an assumption of what the measure is supposed to do, e.g. CFL light bulbs. Are outages included as energy savings?
    - Historical consumption is part of forecast. Yes, outages are included in energy savings.

The facilitator thanked participants for their hard work, continued attendance, and helpful suggestions throughout the process. She reminded participants to send any additional comments by October 23. Additional comments can be e-mailed to Dr. Marty Rozelle at: rgl97marty@therozellegroup.com