Vectren Integrated Resource Plan (IRP) Stakeholder Meeting

Gary Vicinus – Meeting Facilitator
Vice President and Managing Director, Pace Global
April 7, 2016

VECTREN
Energy Delivery

Agenda

1:00 p.m.	Sign-in/ refreshments	
1:30 p.m.	Welcome	Carl Chapman, Vectren President and CEO
1:35 p.m.	Take attendance in person and on phone (give name and organization) Meeting Format and Ground Rules	Gary Vicinus, Pace Global – Managing Director of Consulting Practice
1:45 p.m.	Vectren IRP Process Overview and Discussion of Uncertainties	Gary Vicinus, Pace Global – Managing Director of Consulting Practice
2:45 p.m.	Break	
2:55 p.m.	Sales and Demand Forecast Update	Matt Rice, Manager Market Research & Analysis
3:05 p.m.	Customer-Owned Distributed Generation Forecast	Mike Russo, Itron – Forecast Analyst
3:20 p.m.	Resource Options – Generation Resource Alternatives	Mike Borgstadt, Burns & McDonnell –Project Manager
3:35 p.m.	Resource Options – Generation Retrofit Alternatives	Scott Brown, Manager Generation Planning
3:45 p.m.	Resource Options – Energy Efficiency	Shawn Kelly, Director Energy Efficiency
4:00 p.m.	Stakeholder Questions, Feedback and Comments	
4:30 p.m.	Adjourn	

Meeting Guidelines

1. Please hold most questions until the end of the presentation (Clarifying questions about the slides are fine throughout). You may write questions on these topics or others using the cards at your table. We will collect them as we go and use to facilitate discussion.
2. For those on the webinar, we will open the (currently muted) phone lines for questions within the allotted time frame. You may also type in questions via the chat feature.
3. At the end of the presentation, we will open up the floor for “clarifying questions,” thoughts, ideas and suggestions.
4. There will be a parking lot for items to be addressed at a later time.
5. Additional questions and suggestions may be sent to IRP@vectren.com for a period of two weeks after this meeting.
6. We will address most verbal questions here. Please allow a few weeks for responses to written questions submitted to IRP@vectren.com or follow-up questions from this meeting.

Vectren's IRP Process

- Vectren's IRP process is designed to determine a preferred portfolio that best meets all objectives over a wide range of market futures to meet our customers' future energy needs:
    - Objectives and Overview of Planning Process
    - Metrics
    - Key Inputs
    - Screening Process
    - Selection of Portfolios
    - Risk Assessment
    - Findings and Recommendations

Purpose and Guidelines for Vectren’s 2016 IRP

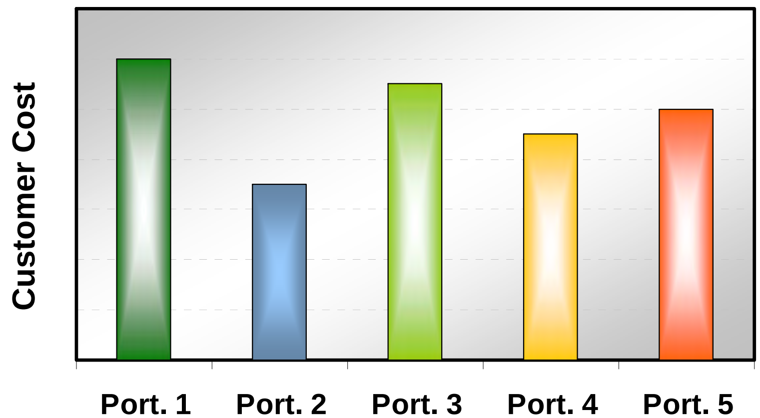
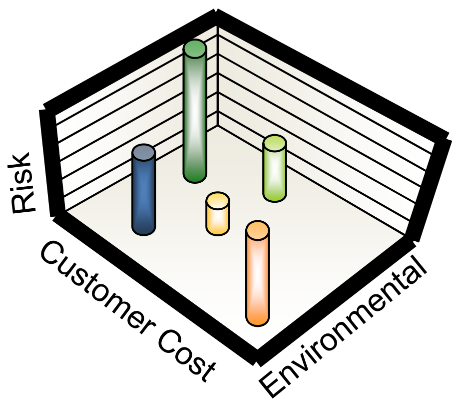
Vectren is seeking to develop its 2016 IRP to test what future portfolio best meets customers’ needs for reliable, low cost, environmentally acceptable power over a wide range of future market and regulatory conditions.

- The 2016 IRP will follow the IURC’s directive to assess options against a wide range of future market conditions and to perform a comprehensive risk assessment to ensure its recommended portfolio performs well against a wide range of futures

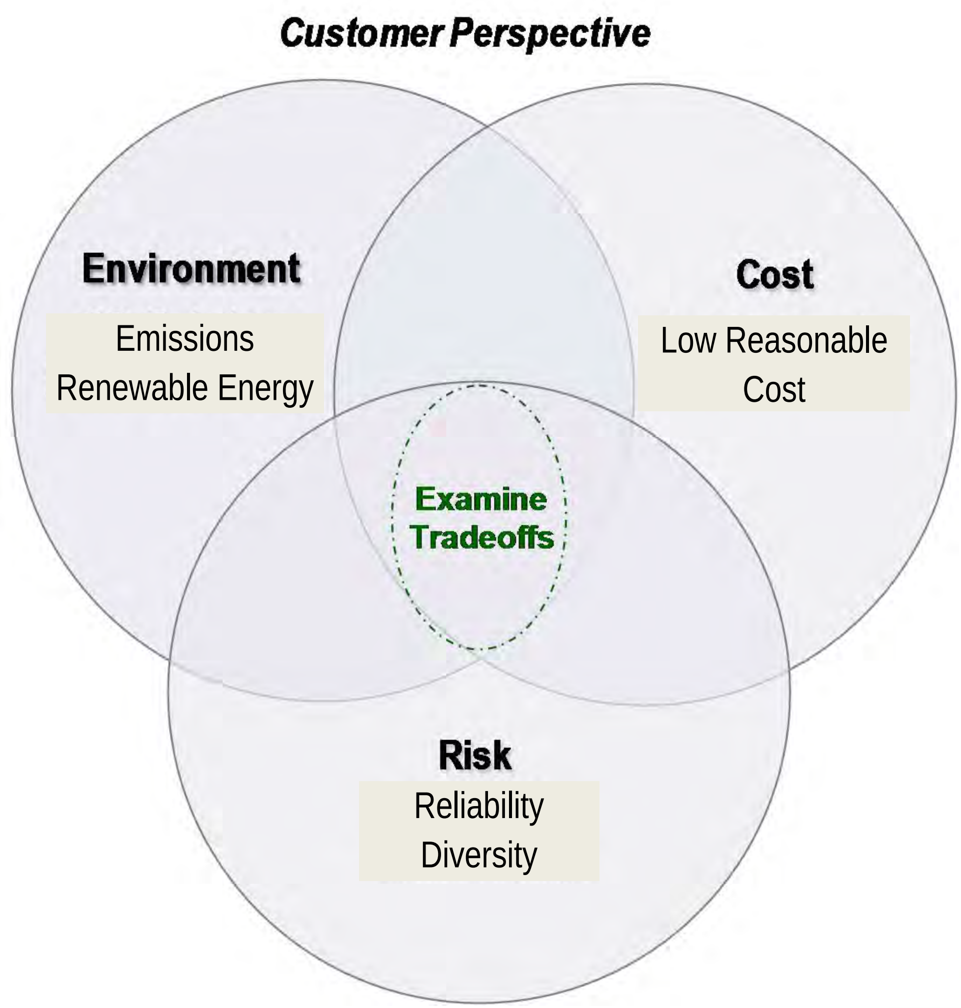
- Vectren will conduct a thorough stakeholder process beginning today, to ensure it receives feedback from its stakeholders throughout the process
  - There will be at least three stakeholder meetings: today, late July and late fall

IURC = Indiana Utility Regulatory Commission

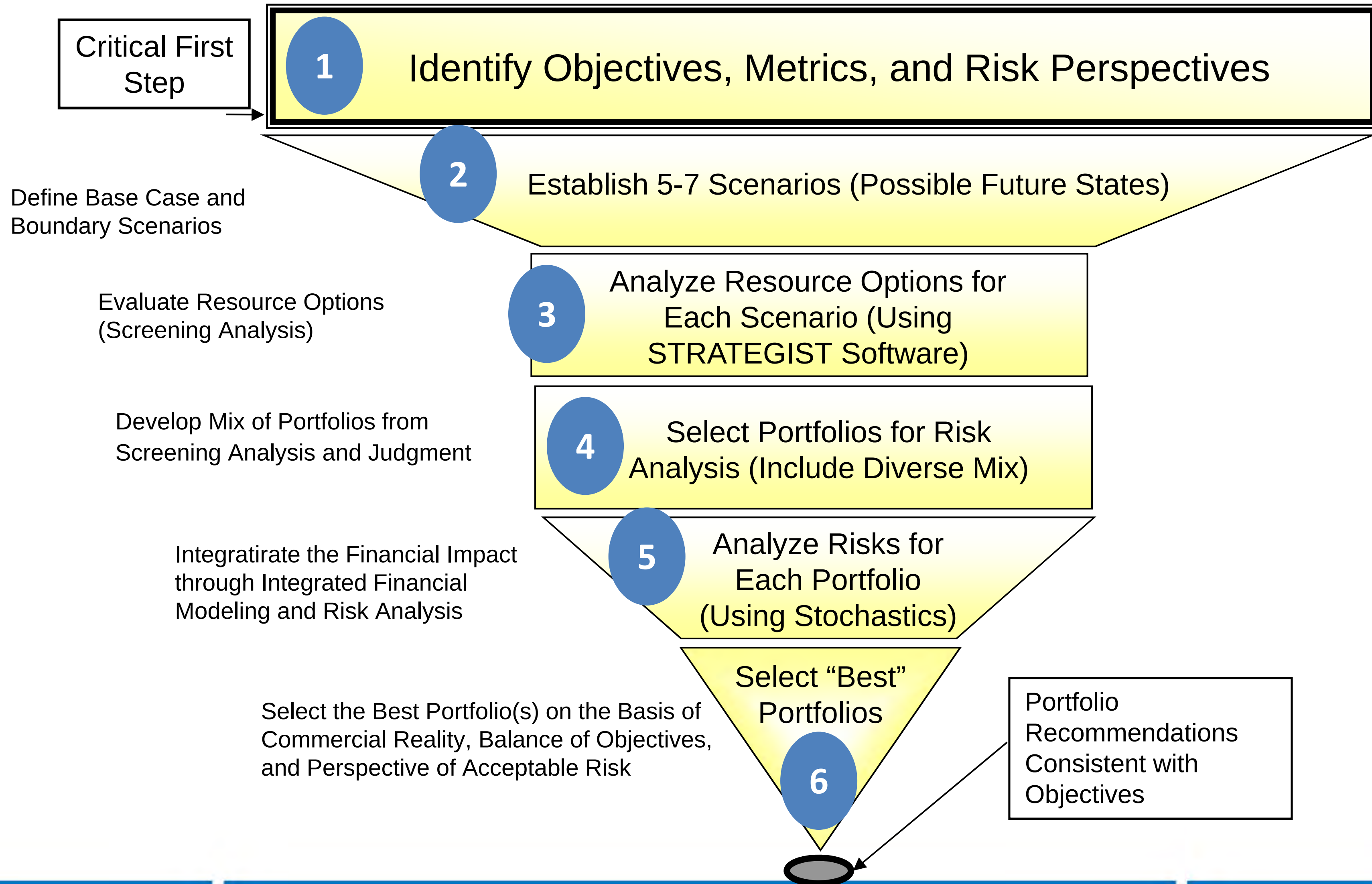
Vectren's Approach Will Build on Traditional Approaches, Considering Multiple Objectives

Traditional Approach	Vectren Approach
▪ Focuses on minimizing customer costs ▪ Portfolio evaluation is one-dimensional	▪ Focuses on the simultaneous evaluation of multiple objectives and tradeoffs - Risk Mitigation - Customer Cost - Environmental Stewardship
	

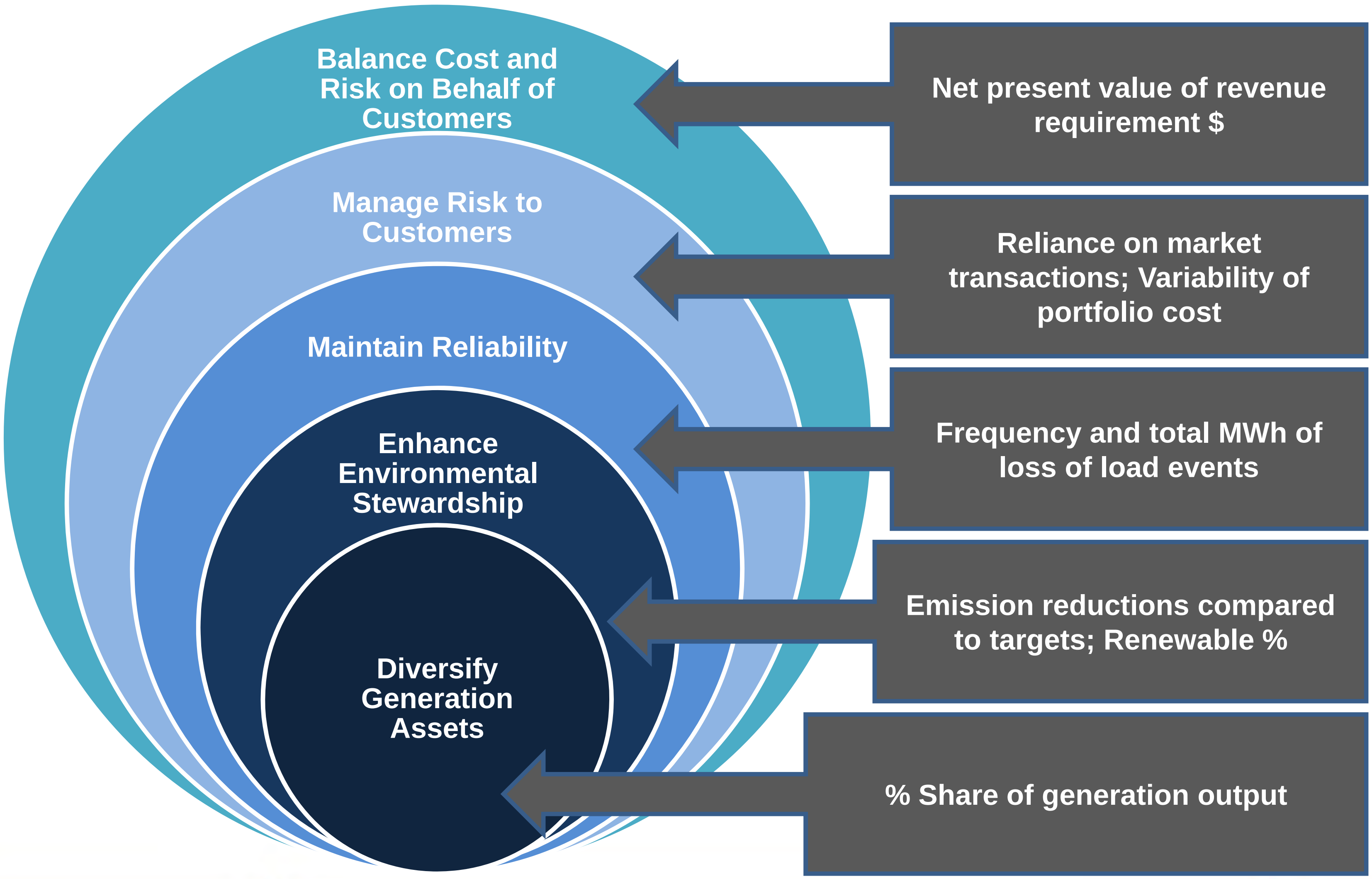
The Selected Portfolio Will Identify and Evaluate Tradeoffs on Key Metrics



Vectren Will Follow a Structured Approach



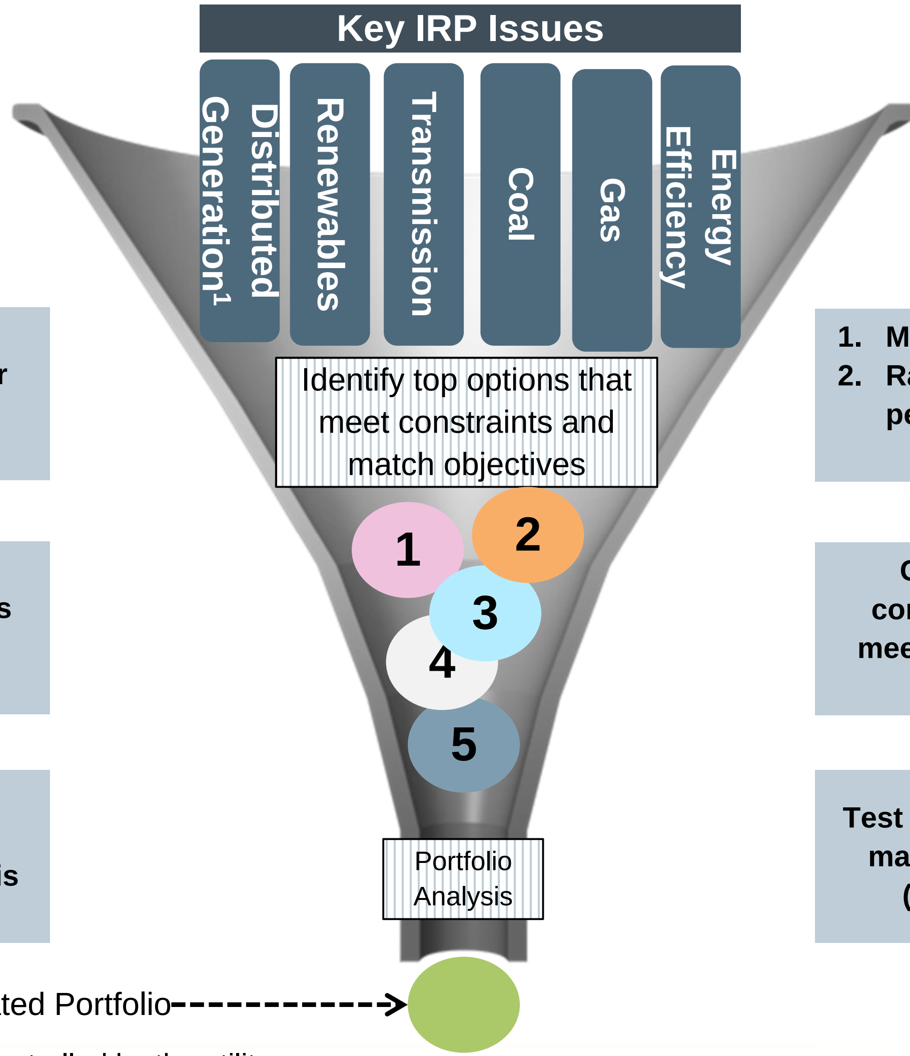
1 Objectives and Metrics



MWh = Mega Watt Hour

2-4

Structured Screening Process to Address Issues Efficiently and Select Portfolios



Task

Screen feasible options for each "issue category"

Combine individual options into integrated portfolios

Perform quantitative scenario-based risk analysis

Select Integrated Portfolio

Approach

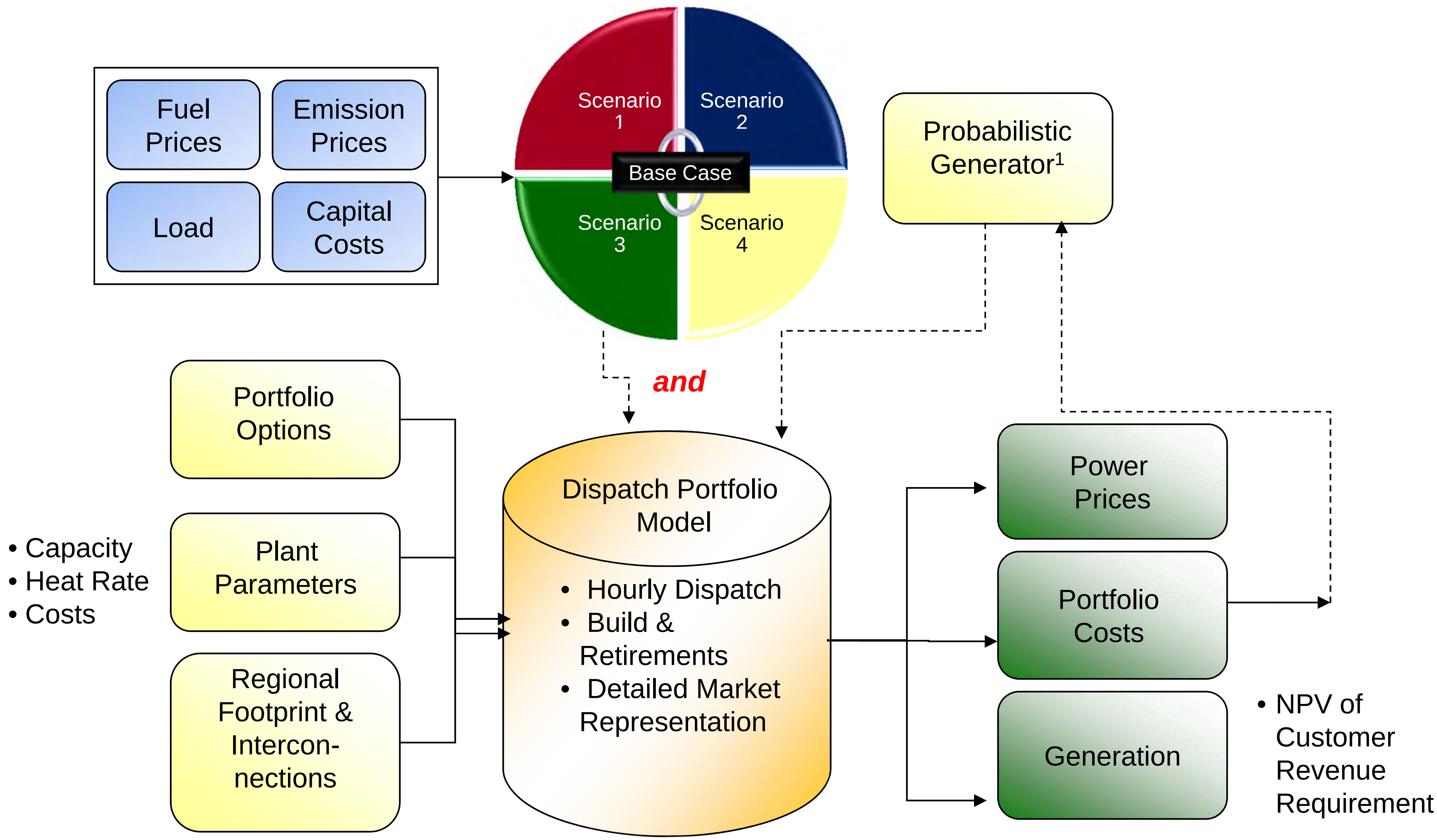
1. Meet planning constraints;
2. Rank by cost and environmental performance

Collaborate with Vectren to construct portfolio options that meet constraints and incorporate various strategy options

Test each portfolio against external market risks and all key metrics (Full portfolio assessment)

1 Distributed generation may not be controlled by the utility

5-6 Process for Addressing Uncertainty



[1] Stochastic modeling is for the purpose of estimating the probability of outcomes within a forecast to predict what conditions might be like under different situations

NPV = Net Present Value

Step 2: Selection of Drivers, Portfolios and Futures (Stakeholder Input)

Purpose and Guidelines for Scenario Development

Vectren is seeking to develop a base case and 5-7 alternatives, internally consistent scenarios (potential futures), to test which portfolios are optimal over a wide range of future market and regulatory conditions. We would like to solicit your list of risk factors/drivers, options and scenarios

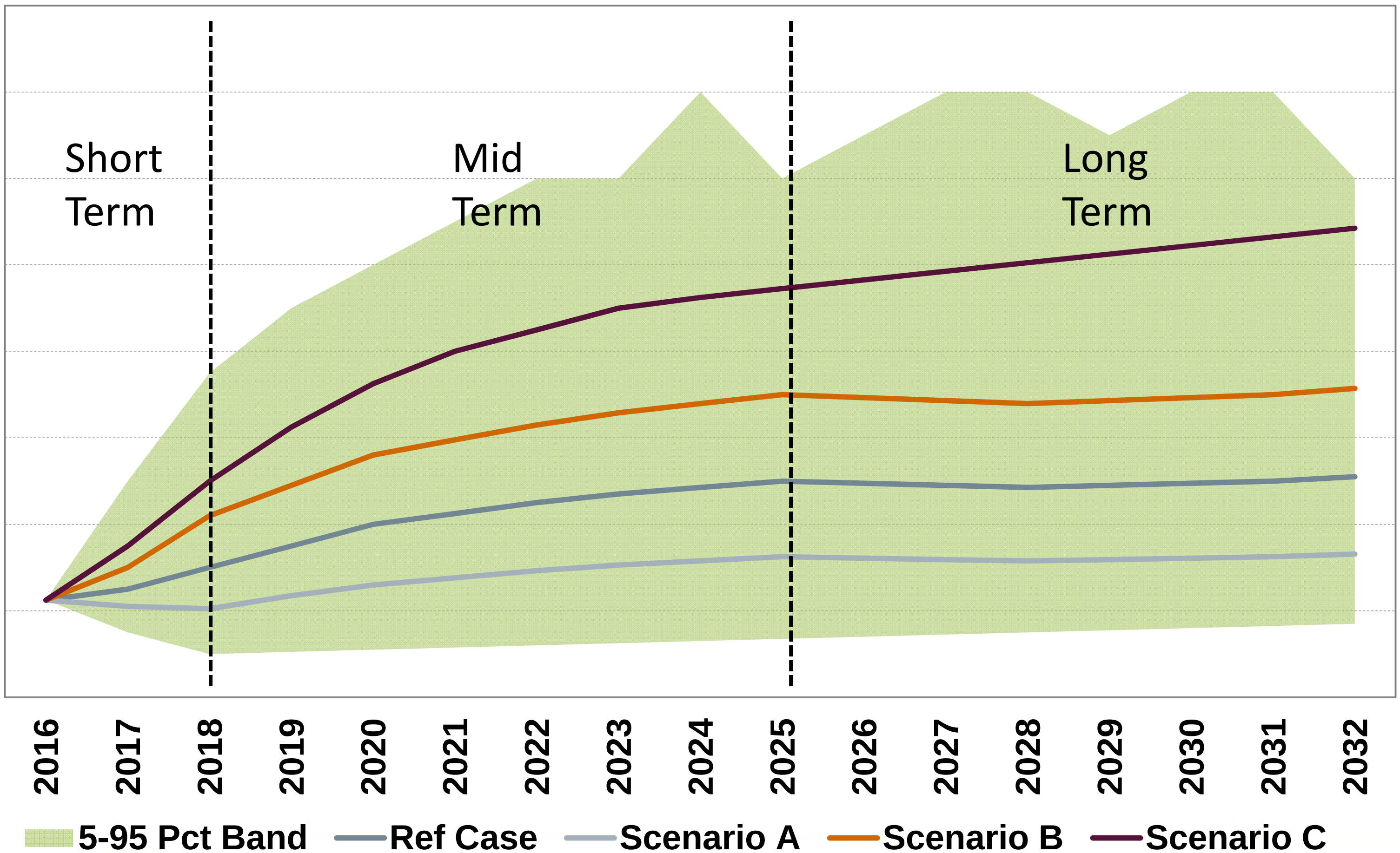
- **List Risk Factors**
  - **Environmental Regulations:**
  - **Technological Assumptions (Speed of technological growth and adoption):**
  - **Market Drivers:**

Purpose and Guidelines for Portfolio Development

- Next we want to ensure we consider all of the relevant demand side and supply side options, which we will expose to the scenarios we develop around the key drivers:

- **Stakeholder input into the consideration of options**:
  - **Demand Side Resources (Energy efficiency and demand response):**
  - **Distributed Energy Resources:**
  - **Supply Side Resources (Generation options):**

The Objective of this Analysis is to Find Portfolios that Perform Well Against a Range of Boundary Conditions



Step 3: Vectren's Base Case Assumptions

Vectren's Base Case

- **Load**
  - Today, Matt Rice (Vectren) will review Vectren's reference forecast as the Base Case
  - In addition, Customer-Owned Distributed Generation forecast will be discussed by Mike Russo from Itron
- **Technology Options**
  - Today, Mike Borgstadt (Burns & McDonnell) and Scott Brown (Vectren) will discuss technology choices, and Shawn Kelly (Vectren) will discuss Energy Efficiency
- Other model inputs/major assumptions will be discussed in our next public meeting in July

Step 4: Selection of Portfolios

Purpose and Guidelines for Scenario Development

- From the Screening Analysis, Vectren will select a range of portfolios which capture least cost portfolios, diverse portfolios and renewable portfolios to ensure all relevant portfolios are considered.
- Then, a risk assessment is performed.

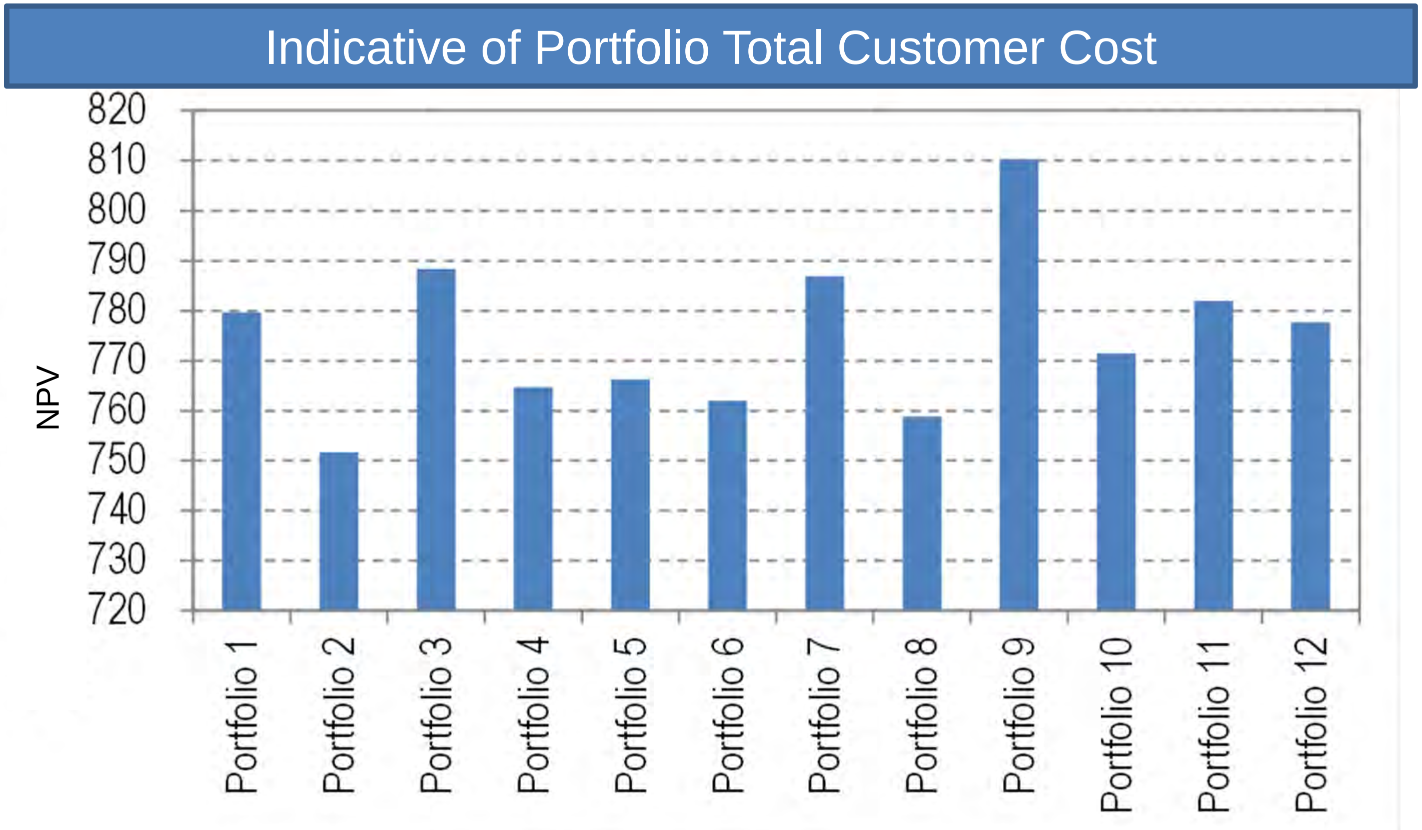
- **Guidelines for portfolio development:**
  - Screening assessment will determine least cost portfolios for each scenario (potential future)
  - Next, Vectren will select other portfolios that capture more diverse, green, or modular generation and/or achieve reliability objectives
  - From this group of portfolios, a risk assessment is performed
- **Graph will show selection of "best" portfolios for conducting risk assessment**

(i) Dispatch portfolio model will select least cost portfolios

(ii) Selection of more diverse portfolios

(iii) Other portfolios suggested by stakeholder process

Results of Technology Screening Assessment



NPV = Net Present Value

Step 5: Stochastic Risk Assessment

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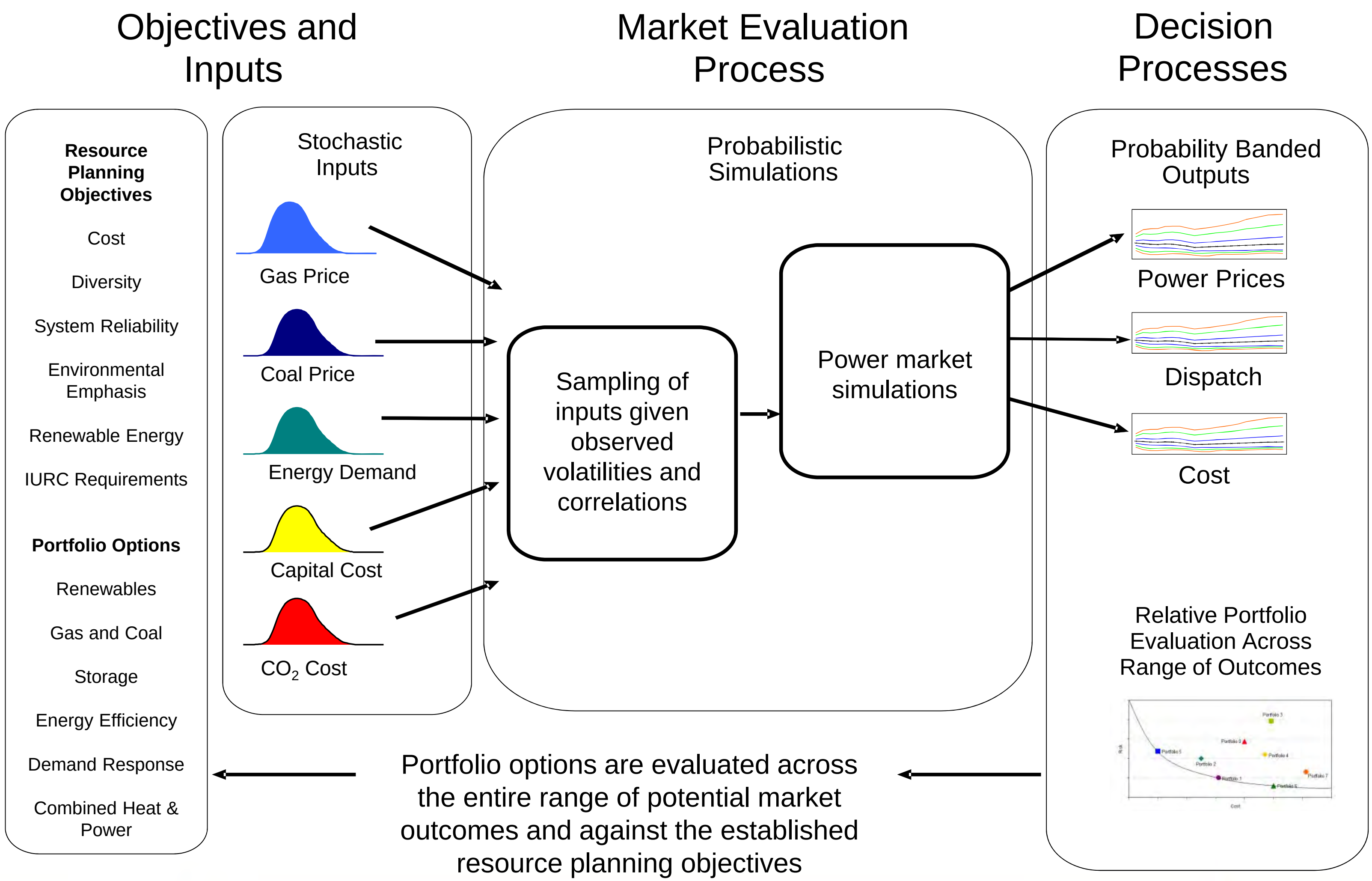
Incorporating Stochastic Risks into the Planning Process Tests Portfolios against Wide Range of Outcomes

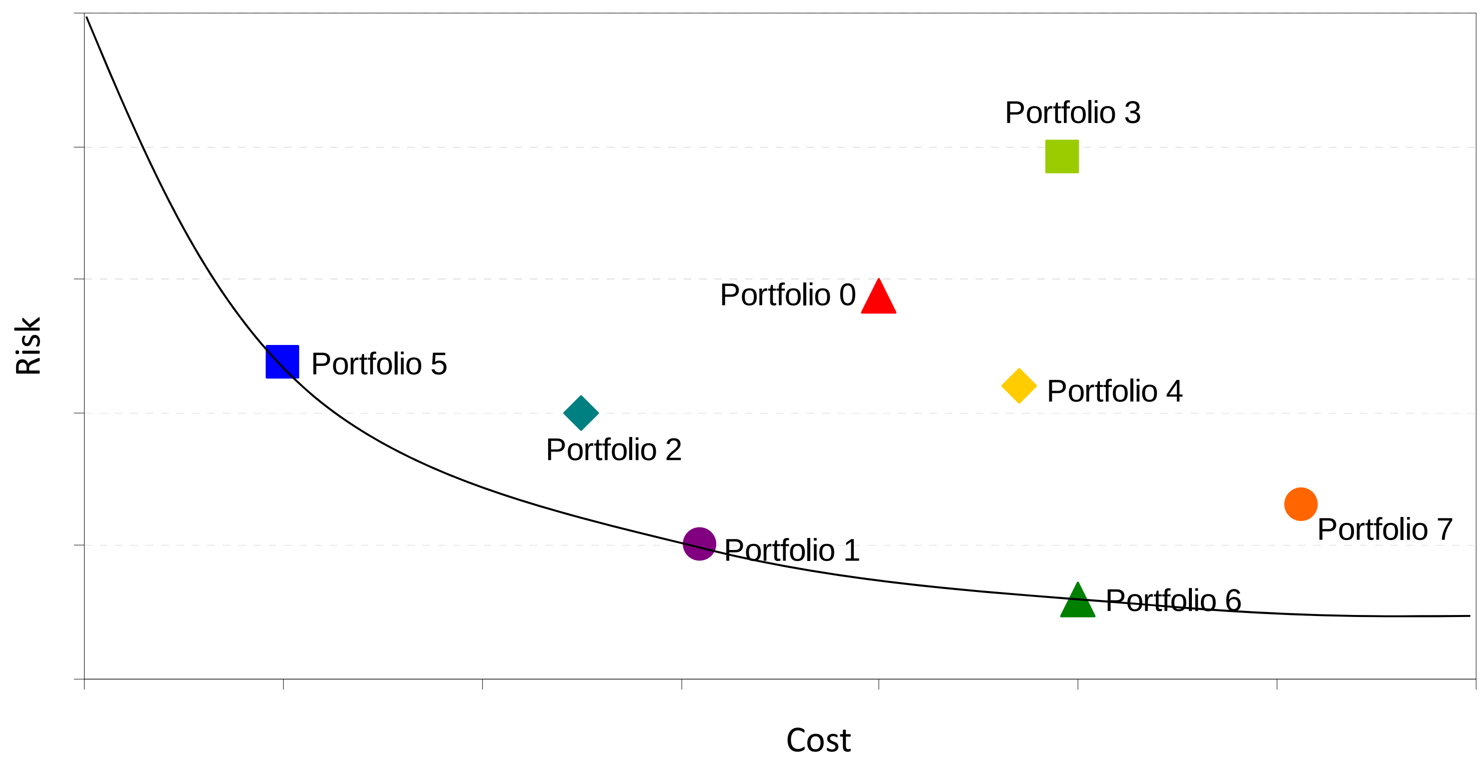


CO_2 = Carbon Dioxide

Step 6: Selection of Preferred Portfolio

Illustrative Results Presentation

- Portfolios above line are less desirable because of higher expected cost and risk



Illustrative

Illustrative Example: Scorecard Summary of Portfolio Options

Criteria		Cost			Risk			Environmental		
Portfolio		Cost Metric 1	Cost Metric 2	Cost Rating Score	Risk Metric 1	Risk Metric 2	Risk Rating Score	Environmental Metric 1	Environmental Metric 2	Environmental Stewardship Score
Portfolio 1										
Portfolio 2										
Portfolio 3										
Portfolio 4										
Portfolio 5										
Portfolio 6										
Portfolio 7										
Portfolio 8										
Portfolio 9										
Portfolio 10										

Score Rating: Favorable Neutral Unfavorable

Preferred Portfolio

Preferred Portfolio

- **The preferred portfolio best meets objectives over a range of scenarios:**
  - Volatility in demand and prices for both gas and power
  - Significant conservation measures
  - Consideration of alternative energy (solar, wind, cogen)
  - Environmental regulation changes
  - Pace of infrastructure replacement
  - Decarbonization commitments that ratchet over time
  - Local economic factors

Long-Term Energy and Demand Forecast

Presented by Matt Rice, Manager of Market Research & Analysis

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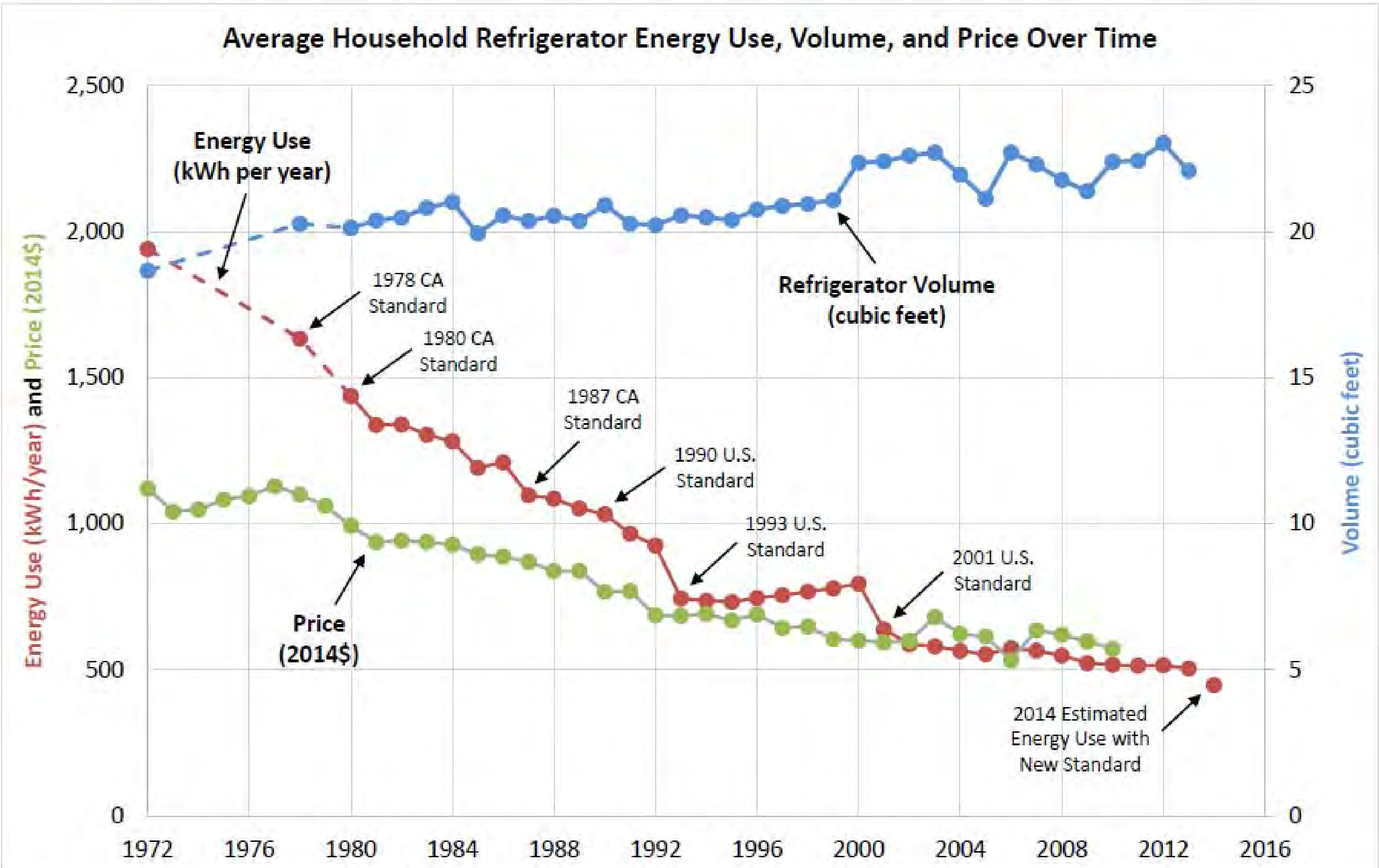
Forecast Summary

- Expect demand to remain relatively flat through the forecast period (Compound Annual Growth Rate (CAGR) is 0.1%)[1]
    - A large customer's adoption of customer-owned generation in 2017
- Moderate growth (Compound Annual Growth Rate is 0.5% beyond 2017)
    - Slow long-term population growth (0.2% annual growth) & moderate income growth (1.6% annual growth)
    - Strong end-use efficiency gains reflecting new and existing Federal codes and standards
        - Air conditioning, heating, lighting, refrigeration, cooking, etc. are all becoming more efficient over time
    - Residential and general service adoption of rooftop solar

[1] Future energy efficiency programs are not included in the sales and demand forecast and will be considered a resource option

Usage Trend Example

ASAP | APPLIANCE STANDARDS AWARENESS PROJECT



Sources: Association of Home Appliance Manufacturers (AHAM) for energy consumption and volume; U.S. Census Bureau for price.

kWh = Kilo Watt Hour

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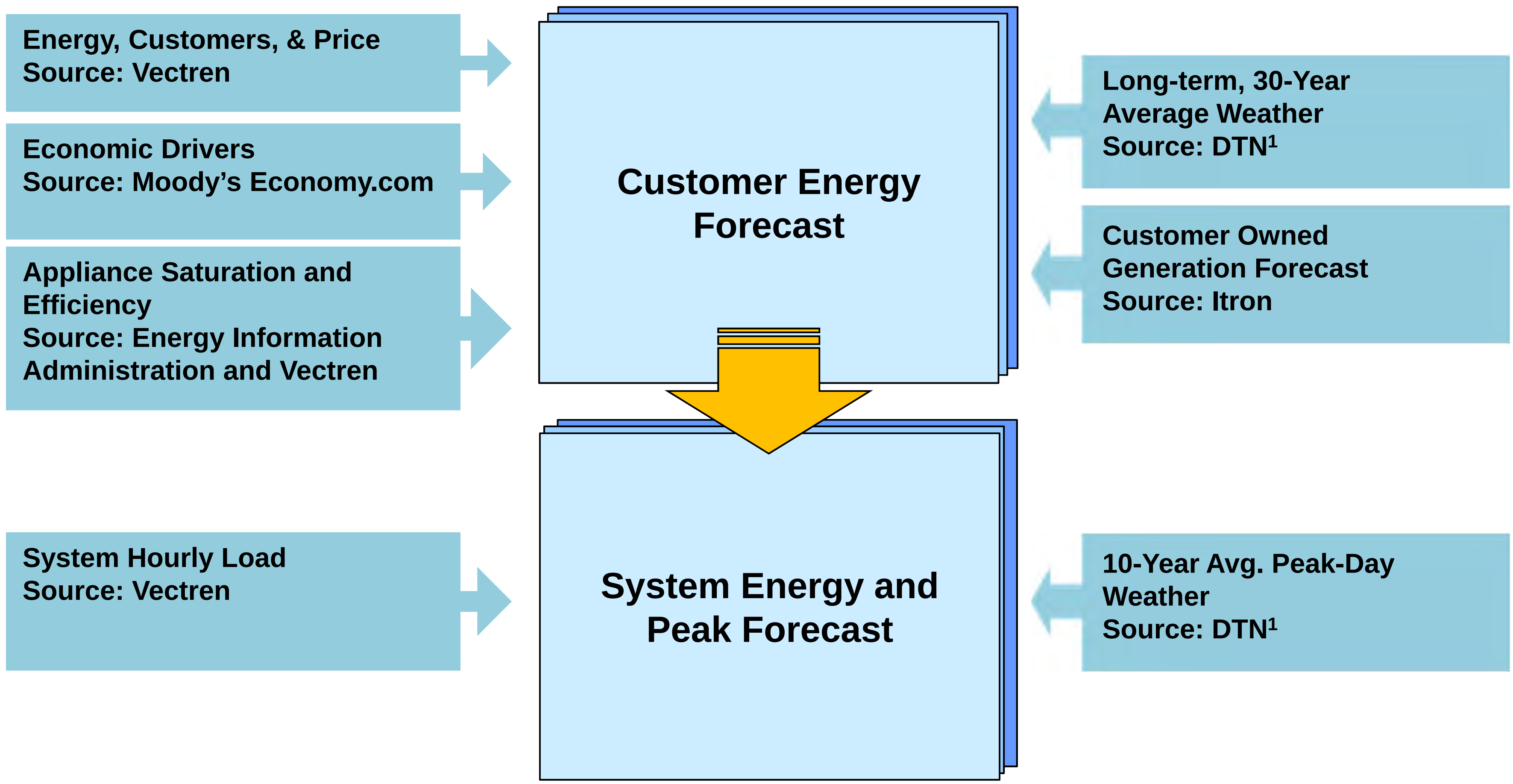
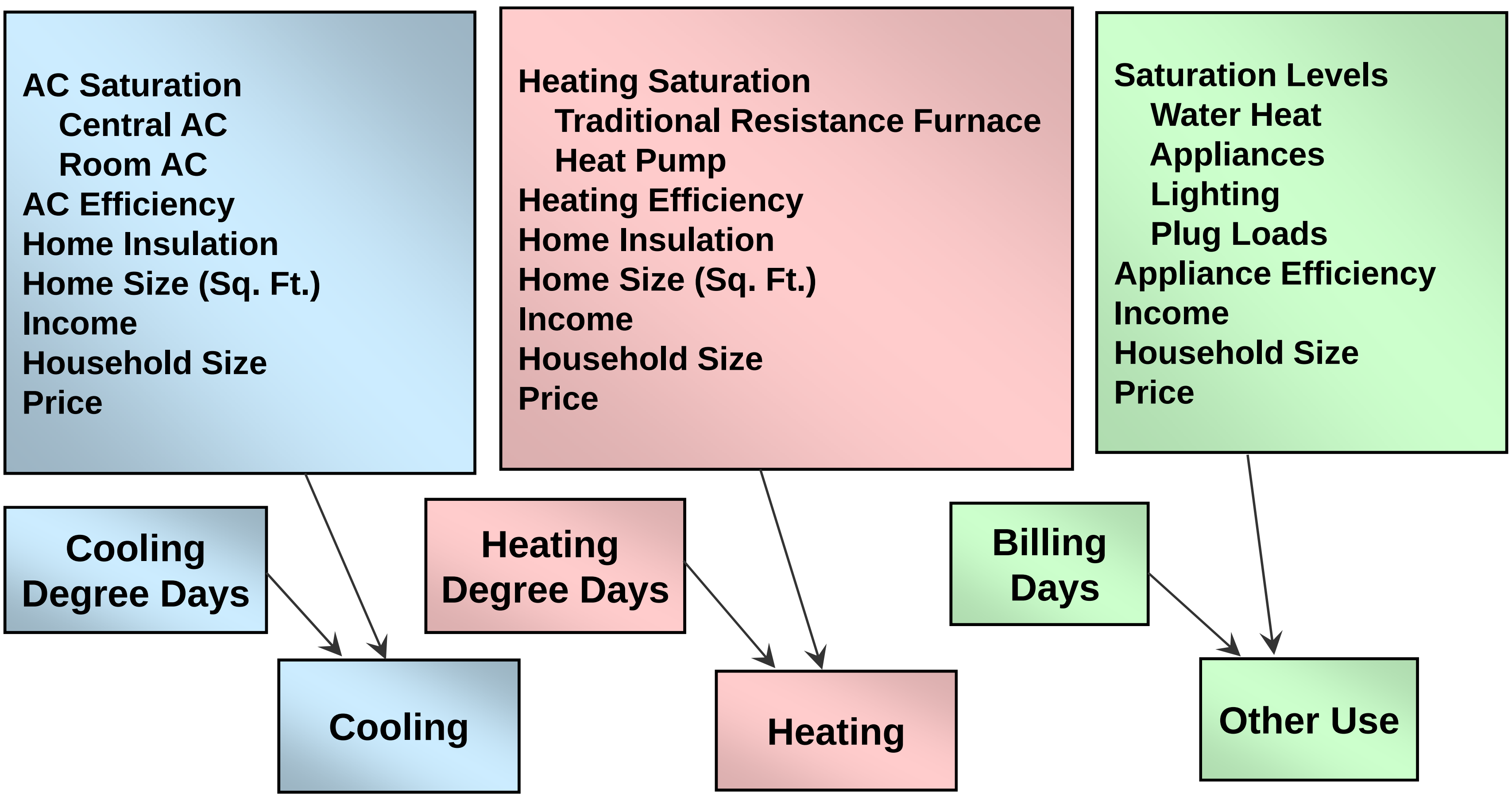
Bottom-Up Forecast Approach

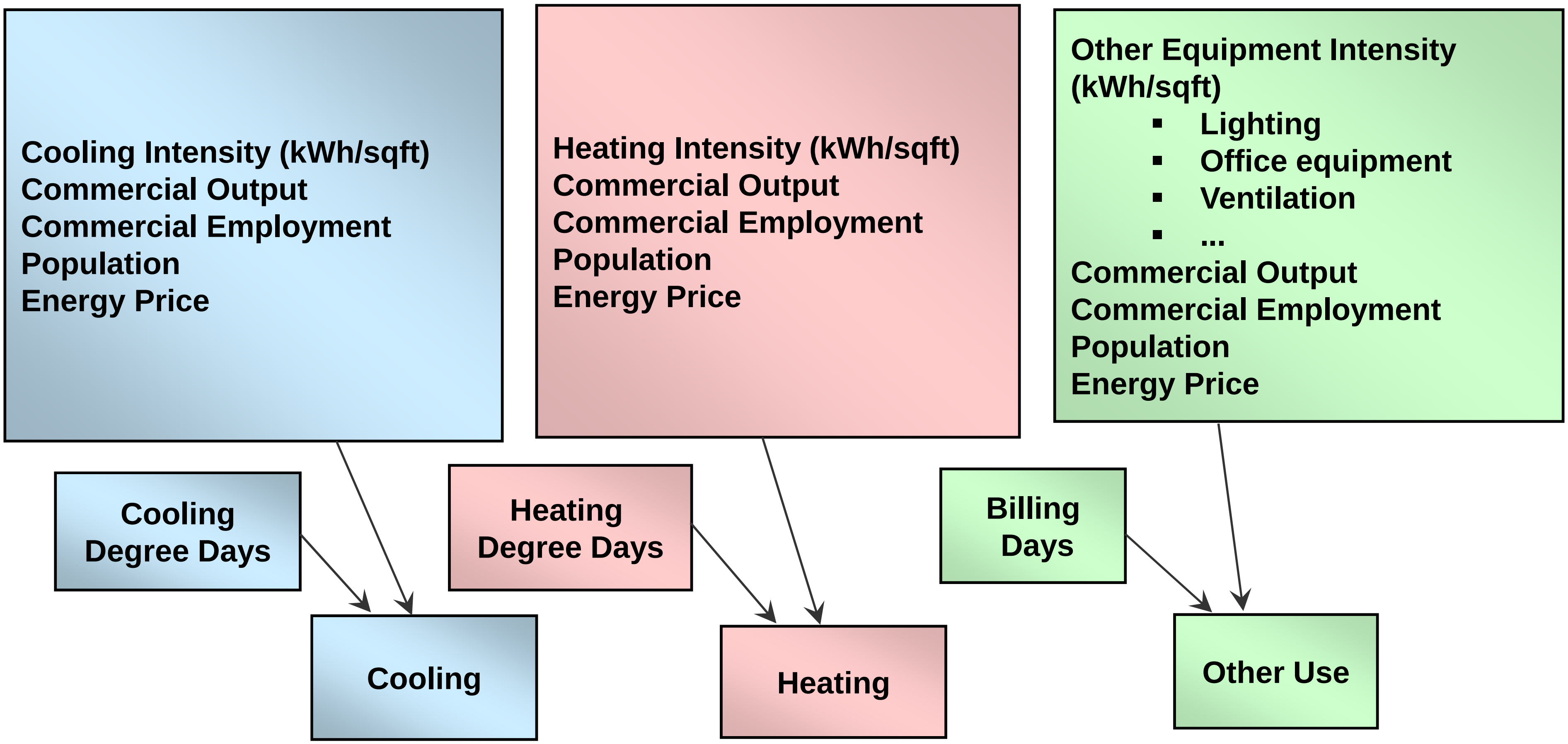


[1] Formerly Data Transmission Network, now known as DTN

Residential Forecast Model

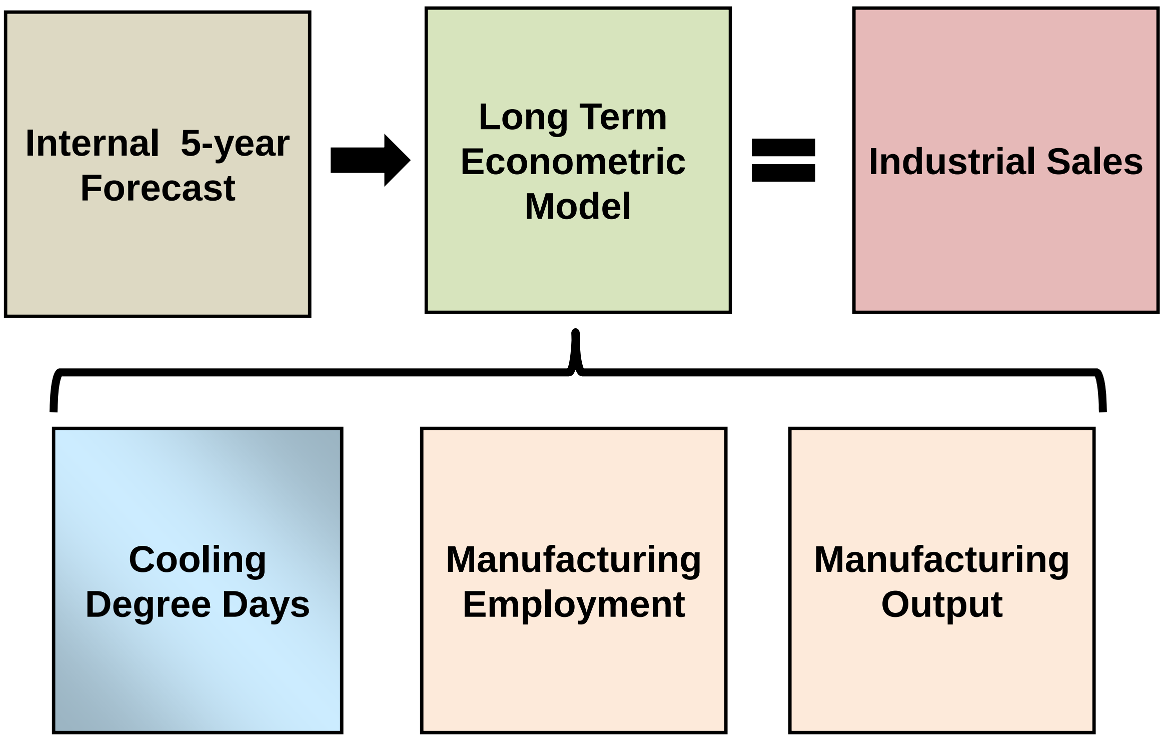


Commercial Forecast Model



Industrial Forecast

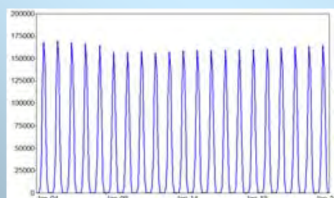
- The industrial (large customer) forecast is a two step approach
  - The first 5 years is based on Vectren's internal forecast
  - The long term growth rate is developed using the econometric model framework



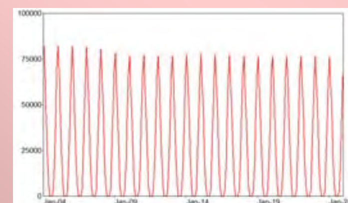
Peak Demand Forecast

- Peak demand is driven by heating, cooling, and base load requirements derived from the customer class forecasts

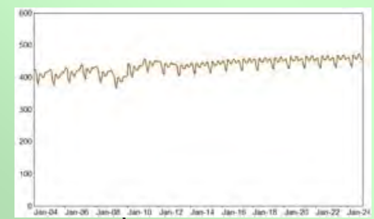
Cooling Load Requirements
- Residential
- General Service
- Large Customer



Heating Load Requirements
- Residential
- General Service



Base Load Requirements
- Residential
- General Service
- Large Customer
- Street Lighting



Peak-Day Temperature

Peak Day Cooling

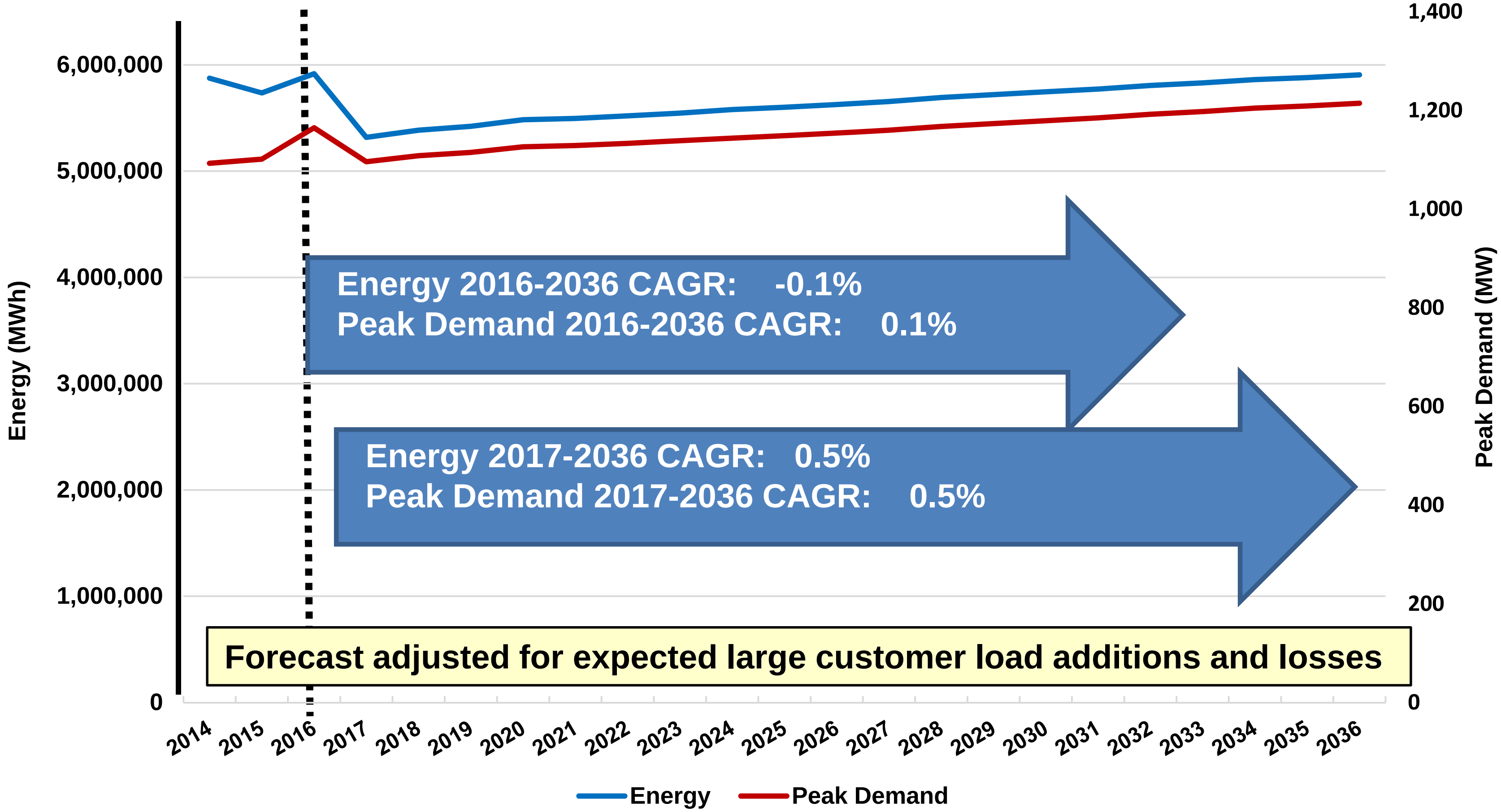
Peak-Day Temperature

Peak Day Heating

Peak Day Base Load

Energy and Demand Forecast[1]

Includes customer-owned generation forecast



[1] Future energy efficiency programs are not included in the sales and demand forecast and will be considered a resource option

CAGR = Compound Annual Growth Rate
MWh = Mega Watt Hour
MW = Mega Watt

Questions?

Customer-Owned Distributed Generation Forecast

Presented by Michael Russo, Forecast Analyst, Itron Inc.

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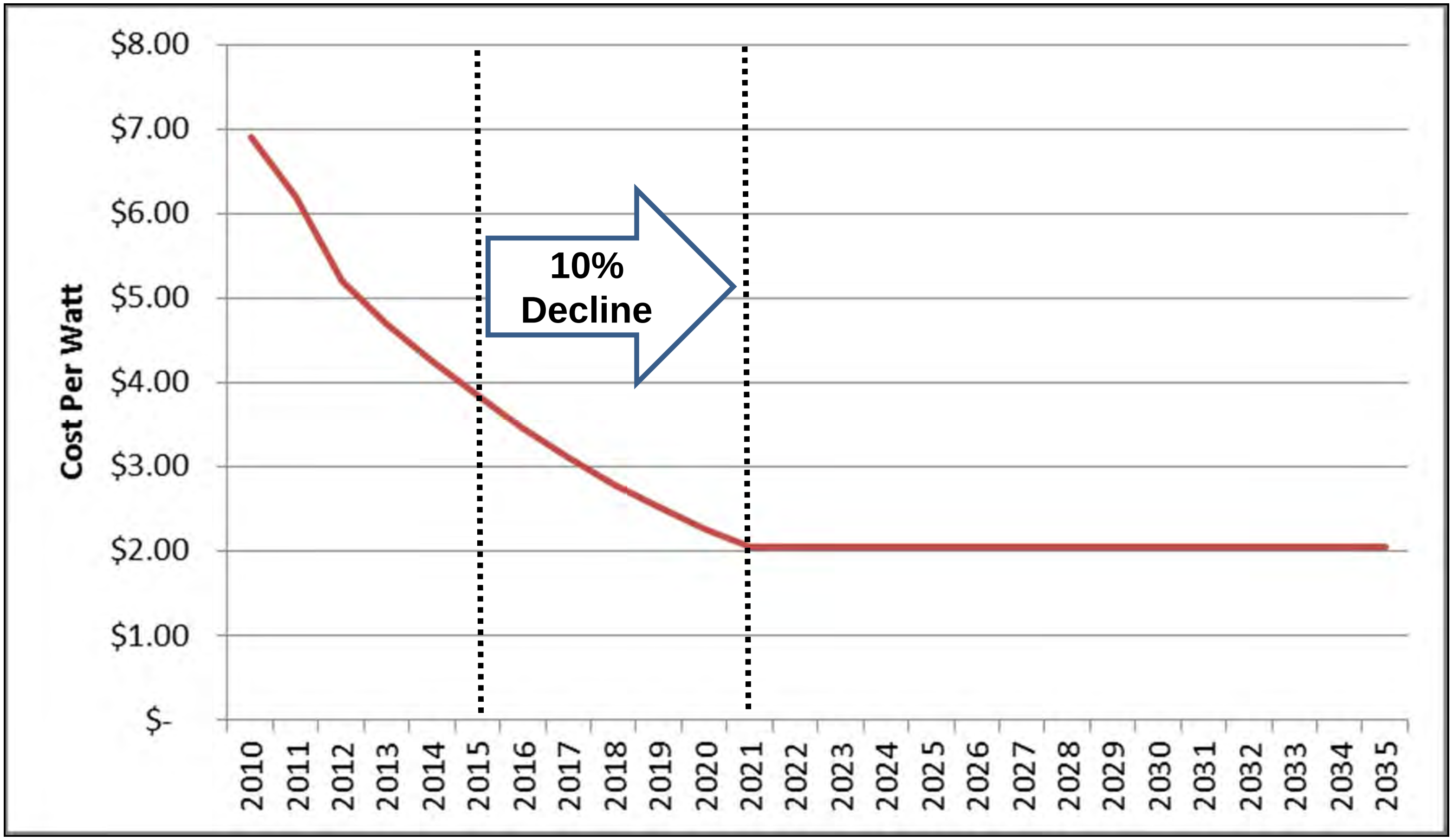
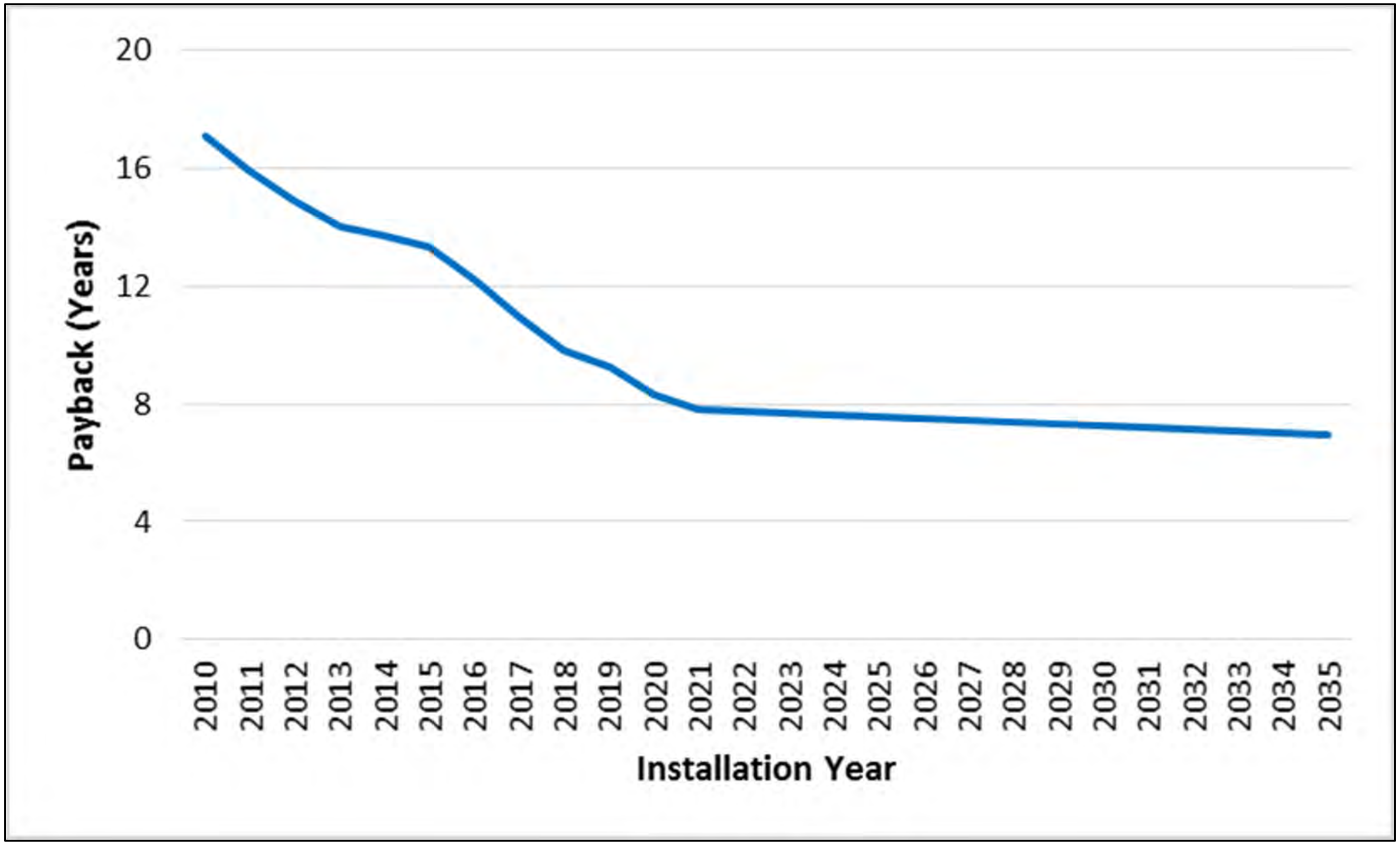
Solar System Cost Assumption



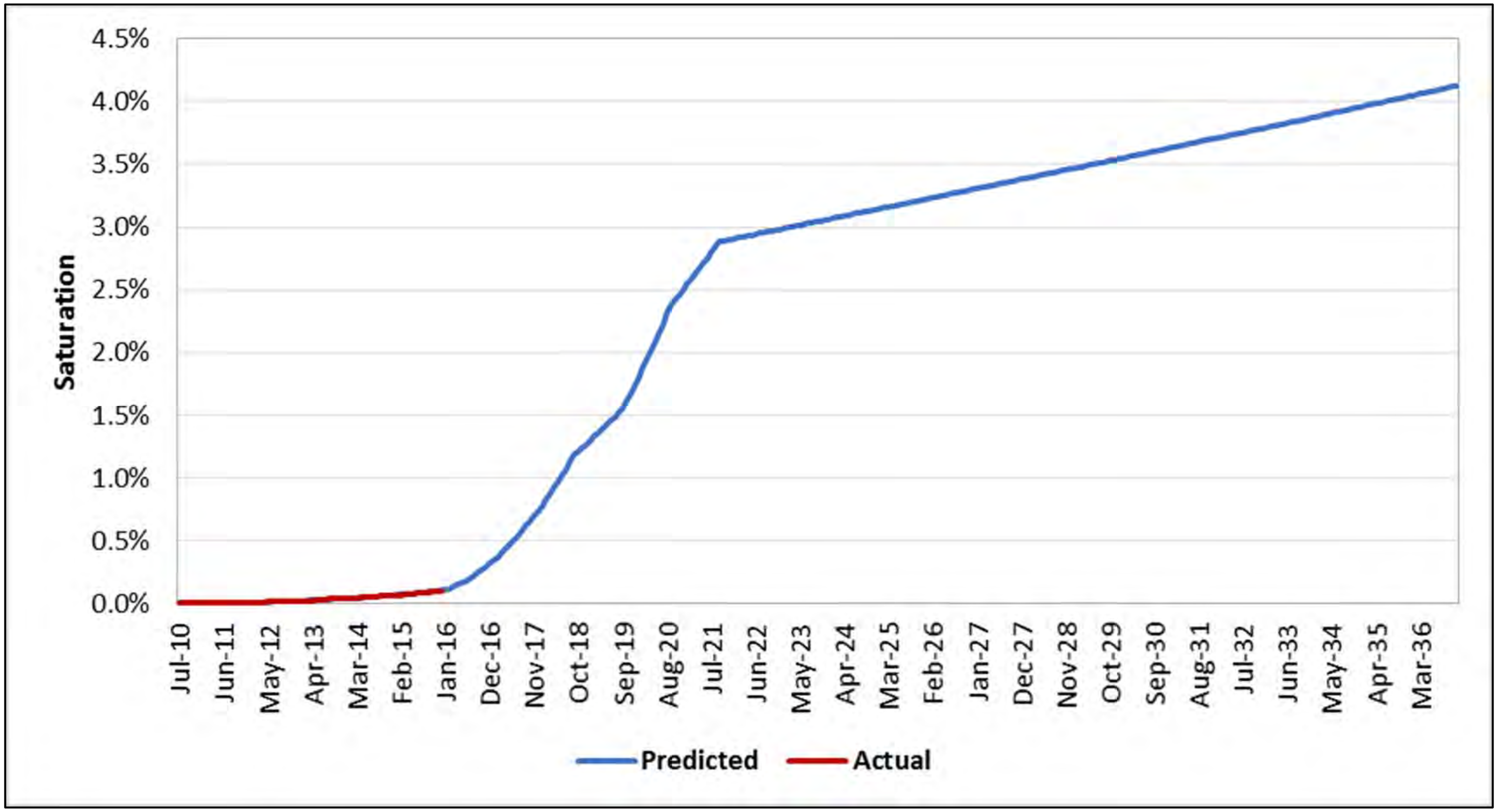
- Cost projections based on the Department of Energy's Sun Shot solar goals

Residential System Payback



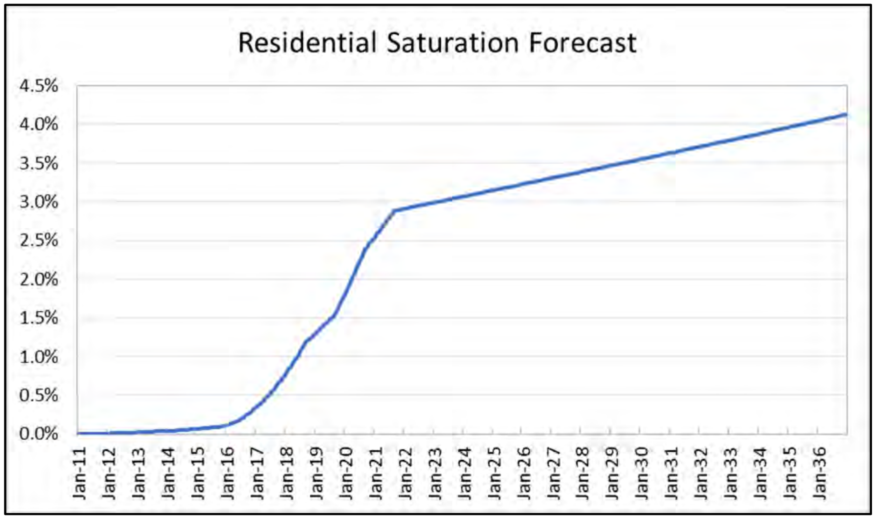
- Vectren specific residential solar system payback; incorporates declining solar cost projections, federal tax incentives, and Vectren electric rates

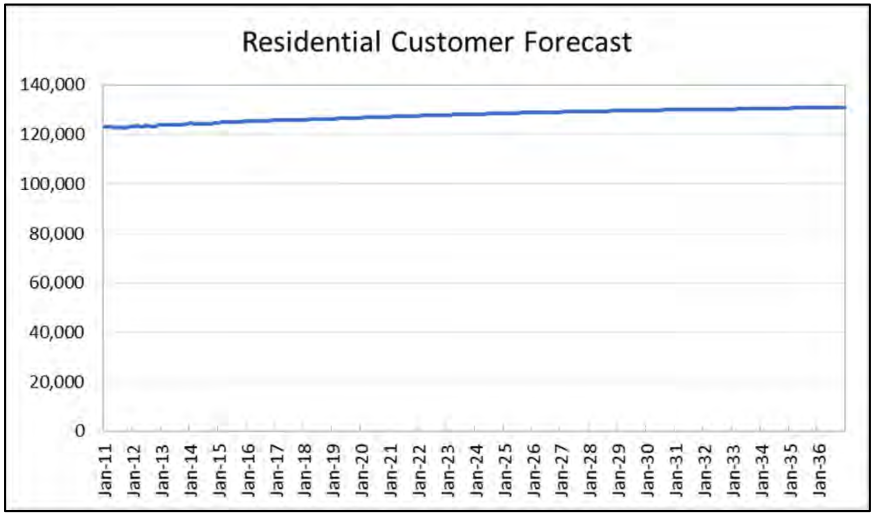
Residential Solar Saturation Model

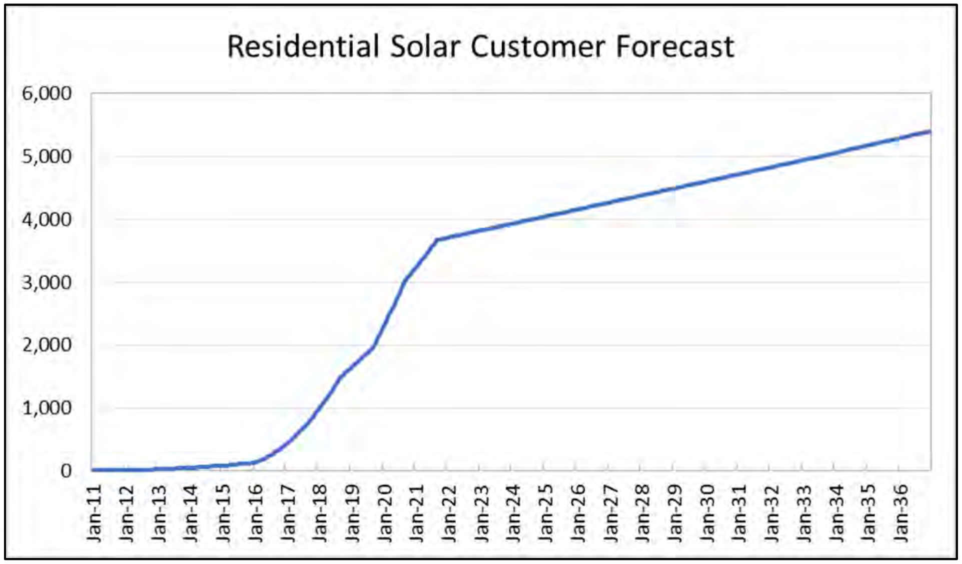


- Solar saturation is modeled as a function of system payback; incorporates declining solar costs, federal incentives, and Vectren electric rates

Residential Solar Customer Forecast

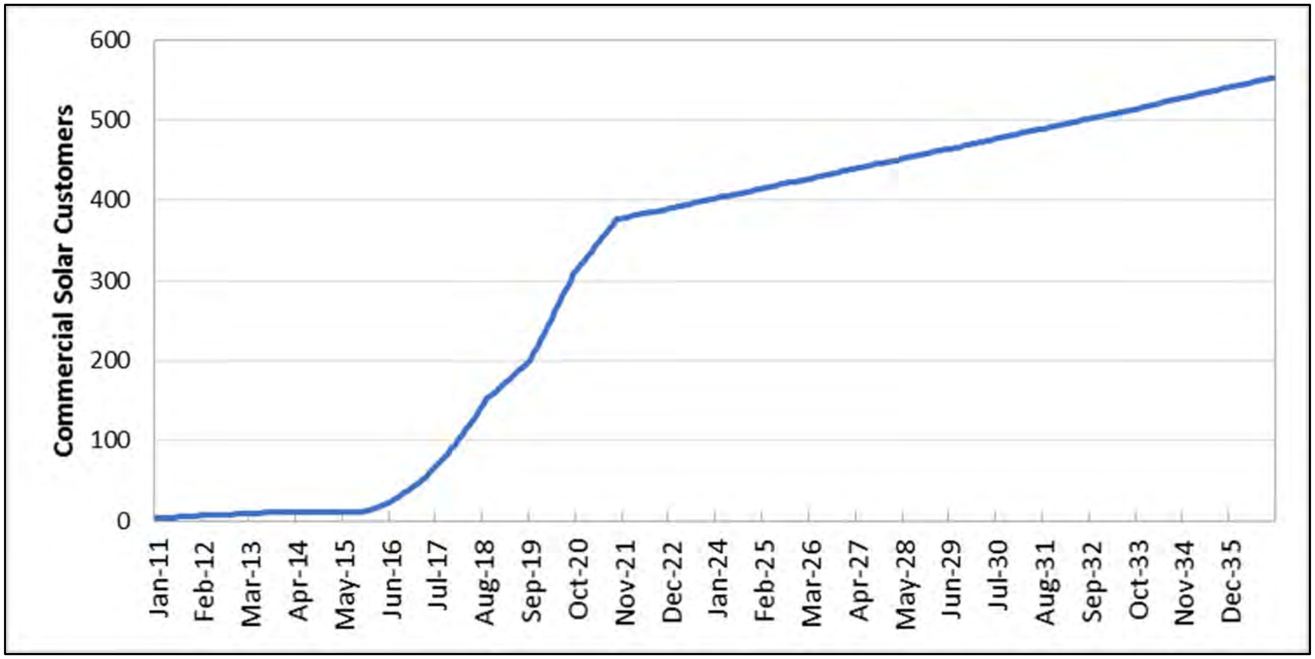




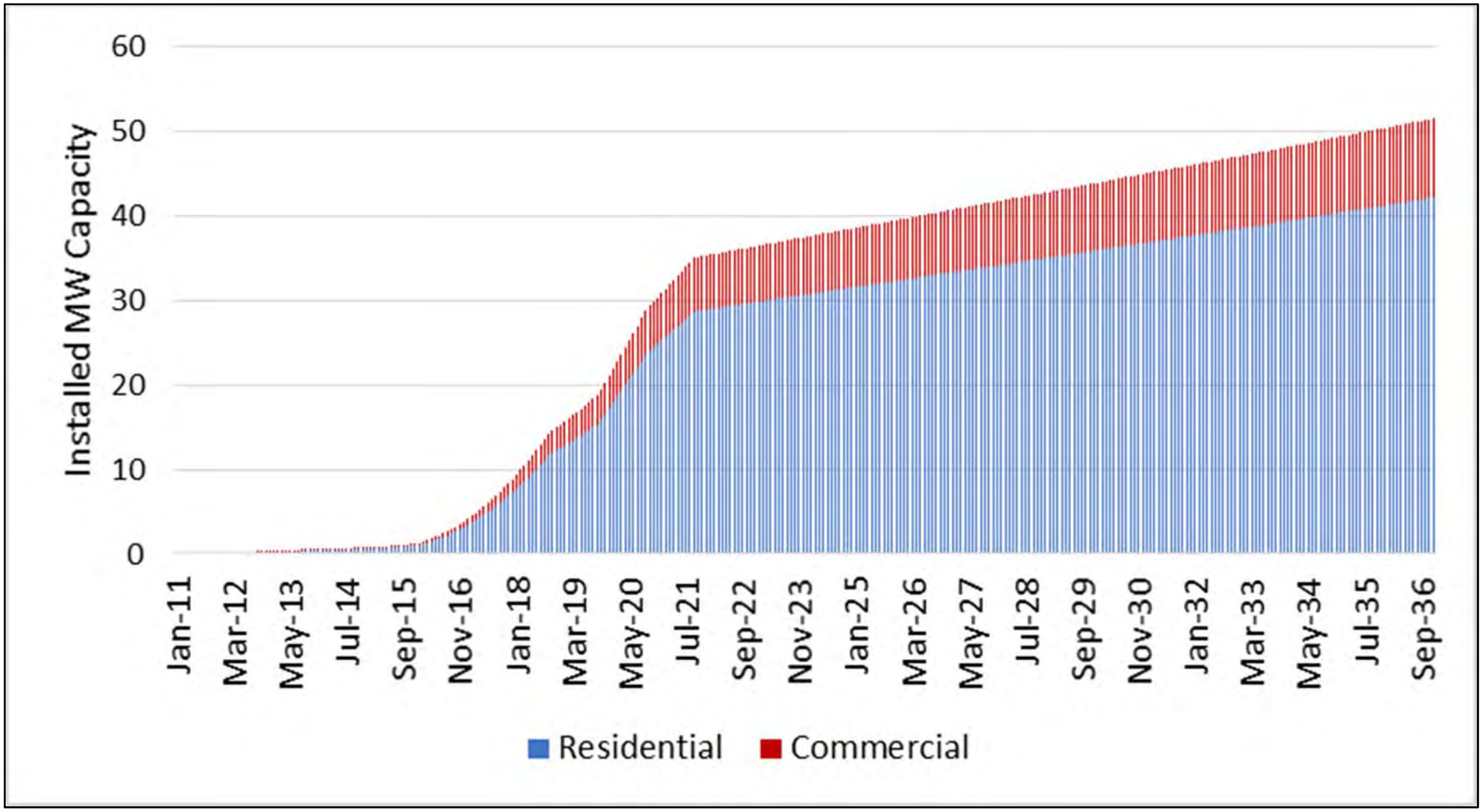


Commercial Solar Customer Forecast

- Limited adoption of commercial systems
  - Physical and ownership constraints
- Relationship between commercial and residential adoption maintained through the forecast period



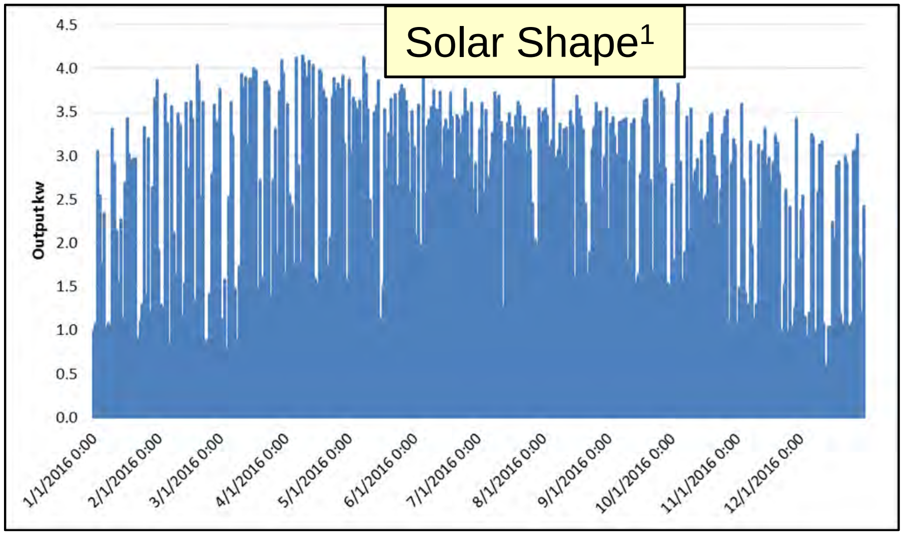
Total Solar Capacity



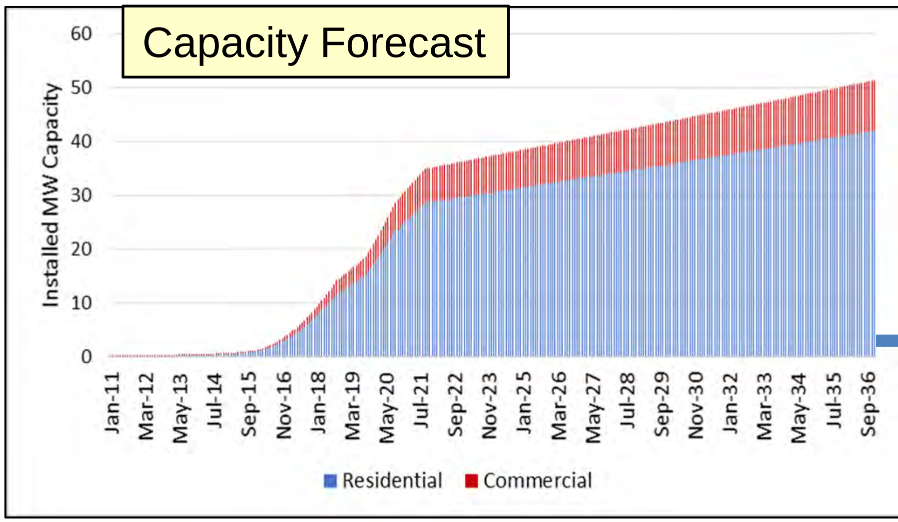
- Capacity forecast is the product of the solar customer forecast and a system size of 7.8 kW for residential systems and 17 kW for commercial system (based on Vectren average)

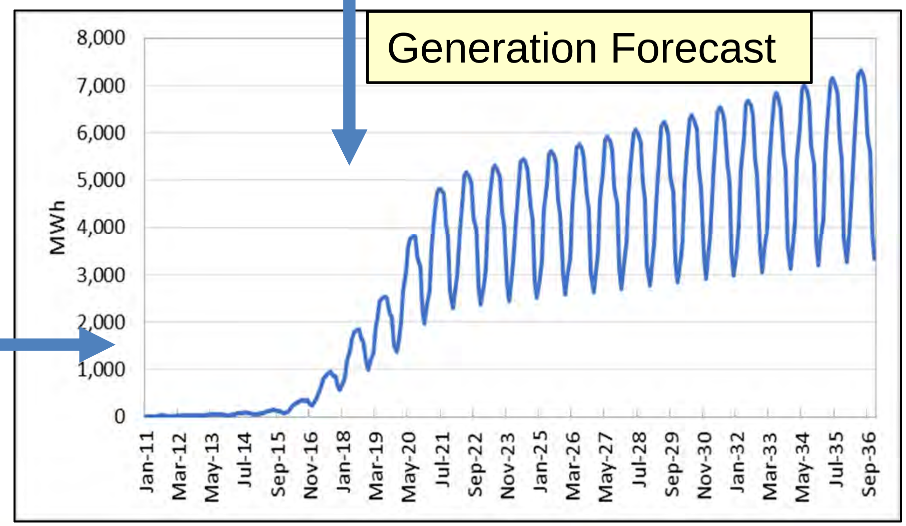
MW = Mega Watt
kW = Kilo Watt

Solar Generation Forecast (MWh)



Month	Monthly Load Factor
Jan	10.1%
Feb	12.6%
Mar	15.1%
Apr	17.6%
May	19.1%
Jun	20.0%
Jul	19.0%
Aug	18.4%
Sep	16.2%
Oct	14.6%
Nov	10.5%
Dec	8.7%

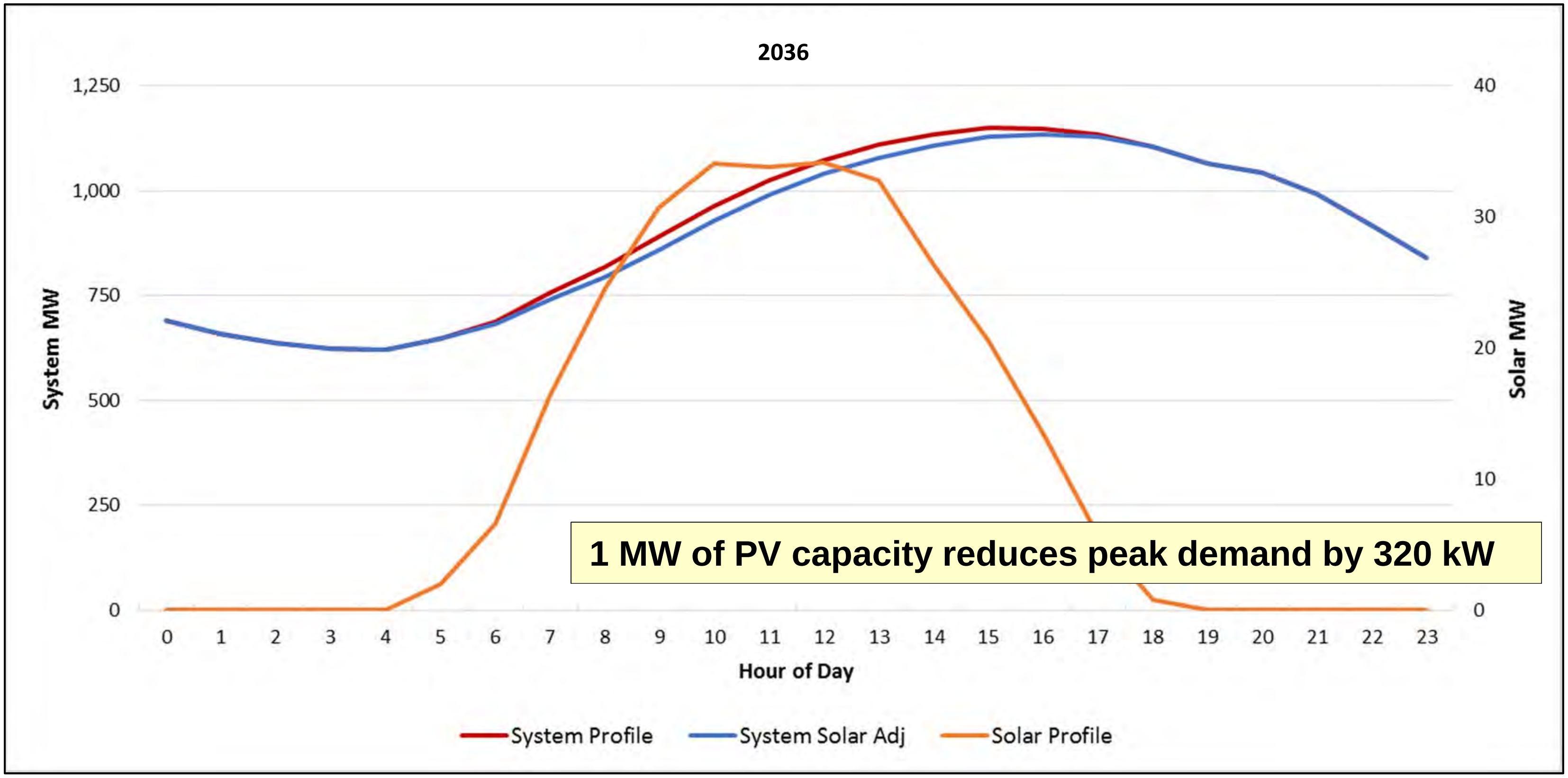




[1] Source: Evansville solar shape from National Renewal Energy Laboratory (NREL), a laboratory of the U.S. Department of Energy

MWh = Mega Watt Hour
MW = Mega Watt
kW = Kilo Watt

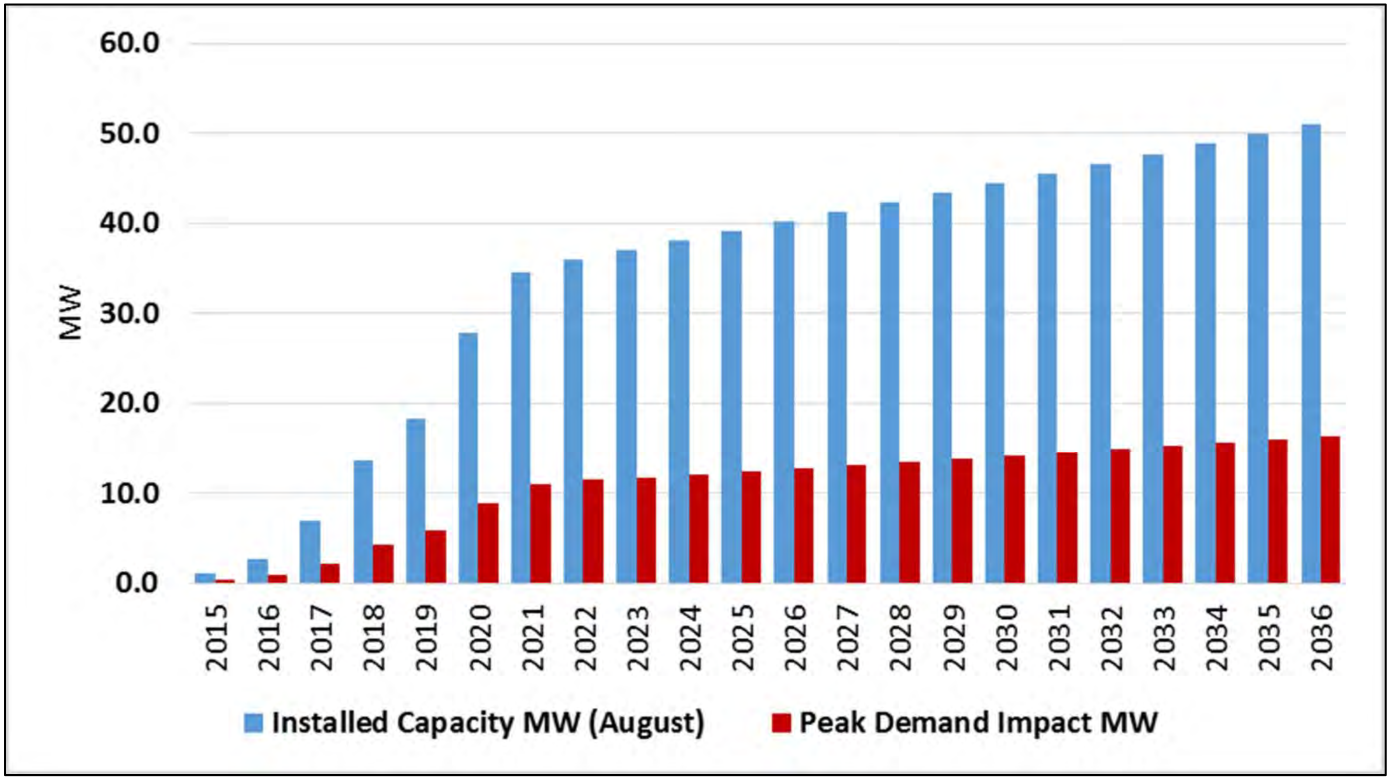
Impact on Summer Peak Demand



- Demand impacts based on a 0.32 peak demand impact factor – derived by combining the solar generation hourly load forecast with Vectren's system hourly load forecast

kW = Kilo Watt
PV = Photovoltaic
MW = Mega Watt

Solar Capacity & Demand Impact Forecast



- 51.1 MW of Capacity by 2036 translates into 16.2 MW peak demand impact

MW = Mega Watt

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Questions?

2016 IRP
Technology Assessment
Generation Resource Alternatives

Presented by Mike Borgstadt, Project Manager – Burns and McDonnell

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Overview

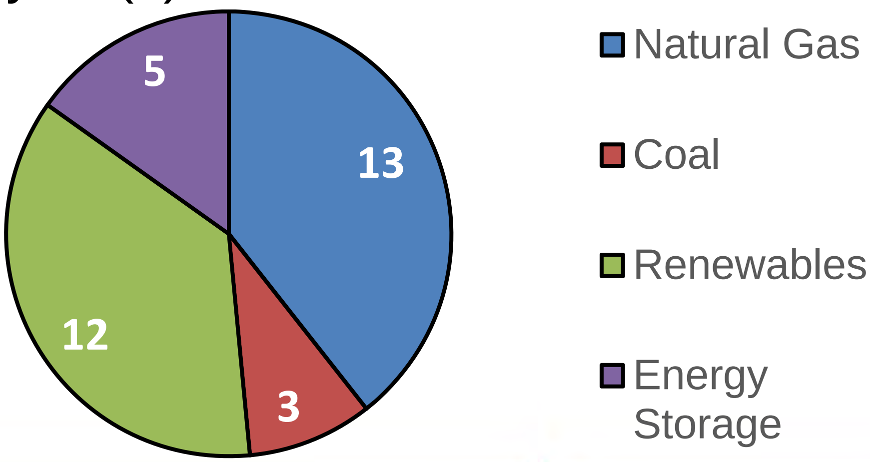
- Burns & McDonnell produced a Generation Technology Assessment that looks at a wide range of generation resources to place into the Strategist model
- The model will create10 and 20 year forecasts for the generation portfolios
- The Strategist model will consider what to deploy and when to meet customer energy requirements based on customer costs
  - Capital Costs
  - Fuel Costs
  - Operations & Maintenance Costs
  - Environmental Compliance Costs

Generation Technology Assessment

Burns & McDonnell's Generation Technology Assessment Report includes the following types of resources:

Generation Resource Options (33):

- Simple Cycle Gas Turbine Technology (4)
- Combined Cycles Gas Turbine Technology (5)
- Combined Heat and Power Turbine Technology (sited at customer facility) (4)
- Coal (2) – (Pulverized coal with carbon capture 500MW & 750MW)
- Integrated Gasification Combined Cycle (1)
- Wind (4)
- Solar Photovoltaic (5)
- Hydro (1)
- Wood (1)
- Landfill Gas (1)
- Battery (4)
- Compressed Air (1)



MW = Mega Watt

Generation Technology Assessment

Examples of candidates for gas fired generation:

Gas Simple Cycle (Peaking Units)	Example 1	Example 2	Example 3	Example 4
Combustion Turbine Type	LM6000	LMS100	E-Class	F-Class
Size (MW)	43.4 MW	99.5 MW	90.1 MW	219.8 MW
Fuel Efficiency (At Full Load)	37.0%	38.6%	30.2%	35.0%
Total Project Costs (2015 $/kW)	$1,880	$1,485	$1,230	$650

Examples of candidates for combined cycle generation:

Gas Combined Cycle (Base / Intermediate Load Units)	Example
Combustion Turbine Type	1x1 F-Class[1]
Size (MW)	317.5 MW
Fuel Efficiency (At Full Load)	51.6%
Total Project Costs (2015 $/ kW)	$1,190

[1] 1x1 Combined Cycle Plant is one combustion turbine with heat recovery steam generator and one steam turbine utilizing the unused exhaust heat from the combustion turbine.

kW = Kilowatt
MW = Mega Watt

Generation Technology Assessment

Example of a candidate for combined heat and power gas generation:

Gas Combined Heat and Power[1]	10 MW Combustion Turbine
Net Plant Electrical Output (MW)	10.3 MW
Fired Plant Steam Output (pph)	117,500
Turbine Cycle Efficiency	27.9%
Overall Plant Efficiency	68.8%
Total Project Costs (2015 $/kW)	$3,874

[1] Utility owned and sited at a customer facility

MW = Mega Watt
pph = Pounds per hour
KW = Kilo Watt

Generation Technology Assessment

Examples of candidates for renewable energy and energy storage:

Renewable Generation & Storage Technologies	Solar Photovoltaic Cells	Indiana Wind Energy	Lithium Ion Battery Storage
Base Load Net Output (kW)	9 MW (Scalable Option)	50 MW (Scalable Option)	10 MW/40 MWh (Scalable Option)
Capacity Factor (Energy output (MWh) 24/7 – 365)	Intermittent 19%	Intermittent 33%	Varies based on market application
Total Project Costs (2015 $/KW)[1]	$2,490	$1,940	$3,050
Peak Planning Capacity (MW credit towards planning reserve margin)	38%	10%	100%

- Solar & battery storage are forecasted at decreasing costs (on a real dollars basis) to be built in the future

[1]Total Project Costs (2015 $/kW) may change based on economies of scale. The Technology Assessment contains unique costs for the different scales of the projects.

MWh = Mega Watt Hour
MW = Mega Watt
kW = Kilo Watt

Questions?

2016 IRP
Technology Assessment
Supplemental Studies
Generation Retrofit Alternatives

Presented by Scott Brown, Manager of Generation Planning

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Retrofit Studies Overview

- As previously stated the Burns & McDonnell Technology Assessment looks at a wide range of generation resources that could be built
- Vectren additionally has studied several retrofit projects that could utilize existing generation assets in new ways…

Retrofit Studies Overview

- Retrofits were studied considering various factors:
  - Feasibility (Will it physically fit in the space)
  - Estimated cost to build / retrofit
  - Expected performance
    - MWs of capacity
    - Efficiency
    - CO_2 emissions
    - NO_x emissions
    - SO_2 emissions
    - Mercury
  - Expected costs to operate and maintain
  - Costs and feasibility to deliver the needed fuel

MW = Mega Watt
CO_2 = Carbon Dioxide
No_x = Nitrogen Oxide
SO_2 = Sulfur Dioxide

Potential retrofit projects that were studied:

- Conversion of the existing AB Brown gas turbine peaking units into a combined cycle unit
  - Achieve higher efficiency gas generation
  - Adds a small increment of generating capacity
- Co-firing up to 33% natural gas on the AB Brown Coal and FB Culley Coal Units
  - Reduces CO_2 and other emissions
  - Minimizes gas infrastructure build costs
- Conversion of the existing coal boilers at AB Brown and FB Culley to burn 100% natural gas
  - Eliminates issues associated with burning coal
  - Does not compete well with other 100% gas generation from an operational perspective

CO_2 = Carbon Dioxide

Retrofit Studies Overview

Potential retrofit projects that were studied:

- "Re-Powering[1]" existing coal units into gas fired combined cycle units
  - Reduces build costs compared to building a new Combined Cycle Unit
  - Retains many systems from the former coal unit
    - Steam Turbine and Condenser
    - Electric Generator, Step-up Transformer and Switchyard connections
    - Circulating Water System and Cooling Towers

[1] Repowering consists of reusing the existing steam turbine, electric generator, circulating water system, step-up transformer and switchyard connections from an existing coal unit. The boiler is replaced by using the waste heat from gas turbines via heat recovery steam generators. The gas turbines also drive electric generators.

Questions?

Energy Efficiency Modeling Discussion

Presented by Shawn Kelly, Director of Energy Efficiency
2016 Vectren IRP Stakeholder Meeting
April 7, 2016

VECTREN
Energy Delivery

Brief Overview of Vectren Energy Efficiency and Demand Response

- Energy Efficiency is using less energy without impacting level of service
- Vectren's culture has and will continue to fully embrace Energy Efficiency
- Energy Efficiency Programs since 2010 have saved nearly 700 million kWh
  - Enough to power nearly 60,000 homes for one year
- 2015 programs achieved almost 41 million kWh of annual savings
- Vectren offers a variety of residential and business programs[1]
- Successful collaborative oversight board approach with the CAC and OUCC
- Approved 2016 and 2017 plan
  - 74 million kWh of energy savings (16.1 MW of demand savings)
  - Over 1% of eligible sales (non-industrial opt out sales)
- Demand Response
  - 19.3 MW in 2016 from approximately 34,000 Summer Cycler switches
  - 56 MW in 2016 in interruptible contracts

[1] Joint with gas energy efficiency programs where possible to be more cost effective

kWh = Kilowatt hour
CAC = Citizens Action Coalition
OUCC = Office of Utility Consumer Counselor

MW = Mega Watt

VECTREN Energy Delivery

Major Energy Efficiency Modeling Assumptions

- Energy Efficiency savings amounts in 2016-2017 will be based on Energy Efficiency plan approved in Cause No. 44645. Included as an existing resource in our dispatch portfolio model
- No minimum level of Energy Efficiency embedded into our sales and demand forecast (IRP will select amount of EE)
- The forecast has not been adjusted for Energy Efficiency already captured in the history (we will monitor going forward)
- Energy Efficiency blocks will include both residential and commercial savings, which allows flexibility in future years to determine the proper mix
- Levelized Energy Efficiency costs over the measure life

Major Energy Efficiency Modeling Assumptions Cont.

- The model will select up to 8 blocks at 0.25% of eligible sales for a total of 2% of eligible sales[1] annually
- If the model selects peaks and valleys of Energy Efficiency, we will re-evaluate as year-to-year inconsistencies in programs is undesirable
- 80% net to gross ratio, which is consistent with our most recent evaluation
- Current plan costs used as the base cost for block pricing
  - Escalated in real dollars based on penetration model. The prices increase from block 1 up to block 8 and increases over time
- 50% load factor to convert energy to demand, consistent with the current plan

[1] 2% is slightly higher than Vectren's most recent market potential study at the high achievable level

Questions?

Stakeholder Questions, Feedback, and Comments

Gary Vicinus – Meeting Facilitator
Vice President and Managing Director, Pace Global
April 7, 2016

Vectren's Next Steps

▪Additional questions and suggestions may be sent to IRP@vectren.com for a period of two weeks after this meeting

▪At the next stakeholder meeting in July, Vectren will discuss and get stakeholder input on:

- its inputs for the 5-7 scenarios;
- the results of our initial Strategist runs;
- the resulting construction of the portfolios;
- the risk assessment assumptions; and
- gather input to build a stakeholder portfolio

▪ At the third and final stakeholder meeting in late fall, Vectren will discuss and get comments on:

- the results of the risk analysis, and
- the preferred portfolio