Vectren 2016 Integrated Resource Plan (IRP)

November 29, 2016 Stakeholder Meeting 3 Summary

The following is a summary of the third of three Vectren IRP stakeholder meetings in 2016 and is meant to provide a high level overview of the discussion on November 29, 2016.

Welcome (Slides 1-3)
Gary Vicinus, Pace Global – Managing Director of Consulting Practice

Mr. Vicinus opened the meeting and welcomed guests to Vectren headquarters, located within Vectren's service territory in Evansville, IN. He mentioned that this is an important IRP for Vectren and reviewed meeting guidelines and the agenda.

Vectren IRP Process Overview (Slides 4-7)
Gary Vicinus, Pace Global – Managing Director of Consulting Practice

Mr. Vicinus briefly reviewed Vectren's commitments for the 2016 IRP and recapped the information that was provided at previous public stakeholder meetings. He commented on Vectren's approach and structured analysis process for this IRP. Materials from all meetings can be found at www.vectren.com/irp.

The Preferred Portfolio (Slides 8-21)
Carl Chapman, Vectren Chairman, President & CEO

Mr. Chapman reviewed the current environmental controls on Vectren's generation resources and stated that Vectren's current fleet is among the cleanest in the Midwest. Vectren has reduced carbon emissions by 31% between 2005 and 2015. Mr. Chapman stated that electric bills have remained flat since 2011, and that Vectren has not filed a base rate case in 6 years. He highlighted the following changes in Vectren's resource mix based on the preferred portfolio:

(MWs)	2015	2036
Coal Base Load (24/7 Power)	68%	16%
Natural Gas Peaking	17%	22%
Natural Gas Base Load (24/7 Power)	0%	41%
Energy Efficiency/Demand Response	8%	11%
Renewable	6%	8%
Other	2%	1%

Mr. Chapman reviewed the Vectren Preferred Portfolio timeline. Highlights include:

- Retire Broadway Avenue Gas Turbine 1 (50 MW) and add universal solar (4MW) in 2018
- Retire Northeast Gas Turbines 1 & 2 (20 MW) and add universal solar (50 MW) in 2019
- Exit joint operations of Warrick 4 (150 MW) in 2020
- Complete Culley 3 upgrades for Effluent Limitation Guidelines in 2023
- Retire Brown 1& 2 and Culley 2 coal units (580 MW) and add combined cycle natural gas plant (889 MW) in 2024
- Retire Broadway Avenue Gas Turbine 2 (65 MW) in 2025

Mr. Chapman reviewed the rationale for selecting the preferred portfolio and discussed the benefits of duct-fired combined cycle gas generation. Mr. Chapman reviewed the next steps in Vectren's IRP process which include filing the IRP on December 16, 2016 and preparing filings for energy efficiency, solar generation, and generation transition.

Duct-firing gas generation technology will be used because of significantly lower capital costs per installed MW and its ability to provide efficient peaking capacity. The Duct-firing option provides quick response peaking capacity energy at a lower heat rate than most simple cycle technologies.

Existing EPA Regulations (Slides 22-25)
Angila Retherford, Vectren Vice President of Environmental Affairs & Corporate Sustainability

Ms. Retherford commented on the post-election regulation outlook. It is unclear which regulations the new administration intends to review other than the Clean Power Plan (CPP) and Waters of the US rule. Final regulations like the Effluent Limitation Guidelines (ELG) and Coal Combustion Rule (CCR) require notice and comment to rescind and/or modify. These rules are difficult to set aside and must be supported by a technological or human health rationale. Compliance costs for these regulations are high and thus become a key driver to Vectren's plan. The Paris agreement can be set aside by an executive order. The CPP is currently in litigation and regardless of the Trump Administration's action, it is likely that some states will continue to defend the rule.

A stakeholder asked for clarification of the time periods that Vectren cited for its carbon reduction percentages. The 31% reduction is from 2005 through 2015. The 60% reduction from a 2005 baseline will be achieved by the end of the plan. A stakeholder asked about what investments are needed to comply with CCR. Controls for bottom ash conversion and a waste water treatment plant at Culley are needed. The timeline for this is being discussed with IDEM.

Multiple stakeholders commented that addressing health concerns from climate change, continued coal use, air quality, and ash pond issues are the "right thing to do." It was noted that Vectren is reducing its carbon emissions by 60%. The preferred plan also results in additional reductions of both SO_2 & NOx by approximately 80% from 2012-2015 average level.
A stakeholder asked what will happen to the Brown plant if a gas plant is built there. A final decision has not been made regarding the location of a gas plant, though it has been modeled for the Brown location. The biggest decommissioning issue is the ash pond, which must be done regardless. A stakeholder asked about the decision to exit operations at Warrick 4 vs. maintaining Culley 2 due to higher CO_2 emissions at Culley. Culley 2 is expected to be retired in 2024, and the impact on customer rates drove this decision.

A stakeholder asked how exiting operations at Warrick 4 is going to work. Alcoa is a large company making a major decision. At this time, Vectren still cannot make a final determination. A commercial customer asked if the additions or retirements of these generating units had been modeled in regard to how it would impact his facility. He was concerned that it could lead to additional costs to upgrade electrical equipment. The IRP analysis is focused on determining the

best course of action to meet customers' needs for power over the next 20 years. The subsequent engineering phase will assure that the generating units, transformers, and transmission lines are designed to maintain electric service to all customers that meets federally mandated standards.

A stakeholder asked how MISO determines wind and solar capacity credit. MISO requires a reserve margin from all its members (not just Vectren) to meet peak day demand, and the reliability of renewable assets are part of this calculation. The credit is based on how much capacity can be counted on at peak demand.

A stakeholder asked for clarification on "roll-off" terminology associated with Energy Efficiency (EE) [slide 12]. Vectren assumes that EE savings are still in place even though Vectren does not continue to get credit for these "rolled-off" energy savings.

In a follow-up conversation with the CAC, Rina Harris, Vectren Director of Energy Efficiency, further explained the graph on slide 12. Vectren clarified the slide was a graphical illustration of the EE modeled in the preferred portfolio of the IRP. The total historical energy efficiency, roll off, and the new energy efficiency represented the 11% of EE illustrated on slide 11, showcasing the percent of EE in the preferred portfolio in 2036. Vectren noted that historical EE represented cumulative net savings between 2010 and 2015. Roll-off represented savings Vectren no longer gets credit for due to measure life constraints or technology baseline changes. An example of a CFL bulb was used as a reference. If a CFL bulb has an average a five-year measure life, Vectren can only claim credit for savings for five years, as it is assumed that codes and standards will require an efficient lighting replacement in the future. New EE represented the EE in the preferred portfolio, assuming a 10-year measure life.

Optimization Modeling Results and Portfolio Development (slides 26-40)
Matt Lind, Burns & McDonnell – Associate Project Manager

Mr. Lind reviewed the methodology used for the computer-generated portfolios. He provided an update to the 50 MW solar costs described at the July 22, 2016 public meeting to the cost modeled in the IRP. The Levelized Cost of Electricity (LCOE) for a 50MW solar facility was lowered from $172/MWh to $149/MWh in 2016$ based on changes to the cost of land, assumed capacity factor of the facility, and normalized treatment of the investment tax credit (ITC). Mr. Lind noted that the cost of solar was assumed to decline in the future, so costs would be lower in every future study year from that presented. Mr. Lind also provided a comparison of other public LCOE reference points. Differences in public LCOE numbers compared to Vectren LCOE numbers typically are due to capacity factor and cost to build assumptions. The capacity factor is calculated by dividing the total amount of energy a plant produces over the course of a year divided by the amount of energy the plant would have produced had it been running 24/7 - 365. For example, capacity factors in the Southwest are much higher than those in the Midwest. Typically, public LCOE studies do not include all of the costs included in Vectren's estimate. Typical items excluded include but are not limited to: land, PV modules, inverters, engineering work, transmission interconnection etc. Mr. Lind then reviewed details of the computer-generated, balanced, and stakeholder portfolios.

A stakeholder asked if input numbers to the portfolio model would be made available. Vectren did share major input costs at the public meeting on July 22, 2016. Additionally, the IRP report will include input costs, such as fuel costs, resource costs, etc. A stakeholder commented that Vectren should use land it already owns for solar. Vectren cannot assume solar will be on land owned by Vectren, as there may be sites more suitable elsewhere. A stakeholder asked which portfolio is the preferred portfolio. Portfolio L is the preferred portfolio. A stakeholder commented that competitive bids from PPAs are the best way to determine solar costs. Vectren will consider PPAs. A stakeholder asked if solar panels can last 25 years. It depends on their location and maintenance. Warranties can be up to 25 years.

A customer asked why we couldn't build solar in Arizona to reduce the cost per kW due to the higher annual solar output in that part of the country. There are several factors that make that impractical today:

1) Required capacity for our zone (MISO zone 6, which is mostly Indiana) must be predominately located within zone 6 due to transmission import limitations. This is referred to as the local clearing requirement (LCR). The requirement changes from year to year but is currently about 70%.
2) There are really three separate grids in the United States. The Eastern Interconnect, the Western Interconnect, and the third is most of Texas i.e. ERCOT (Electric Reliability Council of Texas). These three grids are not in synch with each other. Expensive AC to DC conversion equipment would be needed for power to flow across these grids.
3) Reliability is another issue as every mile that you are away from your generation is a mile in which something can go wrong such as tornados, lightning strikes, ice storms, wild fires, earthquakes, and transportation accidents.
4) Additionally, charges associated with transmission congestion and capacity would be expected to outweigh the benefit.

A stakeholder asked about the difference between the 38% solar rated capacity (Slide 17) and the Vectren capacity factor (slide 30). 38% referenced on slide 17 is the amount of capacity credit (measured in MWs) Vectren expects to receive from MISO for solar generation during MISO peak load periods in Southern Indiana. In other terms, Vectren expects to receive 38 MWs of credit towards meeting the planning reserve margin requirement for 100 MW of name plate capacity. The 19% annual capacity factor relates to the amount of expected energy production (measured in MWh) by solar generation in a typical year. The number is specific for Indiana and is derived from NOAA (National Oceanic and Atmospheric Administration) maps. Annual capacity factor is the amount of energy (measured in MWh) over the course of a year divided by what the panels could produce if the sun shined 24/7 - 365. This number is driven by weather conditions, panel orientation (south-facing or west-facing) and tilt, soiling, expected degradation, etc.

Risk Analysis (slides 41-71)
Gary Vicinus, Pace Global – Managing Director of Consulting Practice

Mr. Vicinus reviewed the risk analysis, which was conducted to evaluate expected performance of the 15 modeled portfolios. Mr. Vicinus walked the audience through how each portfolio

compared to several risk factors and reviewed the rationale for Portfolio L as Vectren's preferred portfolio. The metrics used to evaluate each portfolio were:

1) 20 Year Net Present Value Revenue Requirement (NPVRR),
2) Risk, defined as a combination of:
    a) Standard deviation of NPV,
    b) Average unaccounted capacity purchase needs,
    c) Market purchase risk, and
    d) Remote generation risk,
3) Cost-risk tradeoff (combined expected NPVRR and standard deviation risk),
4) Balanced energy/flexibility, defined as a combination of:
    a) Concentration metric,
    b) # of distinct baseload sources,
    c) Generation mix balance, and
    d) market flexibility,
5) Environmental, defined as:
    a) Carbon reduction and
    b) SO_2 and NO_X reduction, and
6) Local economic impact.

A stakeholder asked if the risk factors were weighted equally. Each of the six factors weighted equally, as displayed, in the balanced scorecard (Slide 70). A stakeholder asked if a less volatile (as measured by standard deviation) portfolio would offset increases in costs. To determine this, one must consider the cost/risk trade-off, which is illustrated on Slide 56. As seen on this slide, portfolios I and J are not cost competitive. The lower risk does not offset the higher cost of these portfolios. A stakeholder asked how the existing portfolio can exceed CPP goals. This portfolio is called "existing" portfolio, however it assumes that Vectren exits joint ownership of Warrick 4 and replaces it with a simple cycle gas turbine. The model also takes into account expected dispatch of the units and purchases more energy from the wholesale market which doesn't contribute to Vectren's carbon emission totals. A stakeholder commented that solar technology will improve, making it more viable in Southern Indiana. The issue is how fast solar costs will decline from current levels, which was considered in the high technology scenario.

A stakeholder commented that Portfolio L has one of the lowest relative amount of carbon emission reductions. This is true; however, it still far exceeds CPP standards. A stakeholder commented that if all environmental ratings were relative to each portfolio there would be a difference in ranking. The portfolios were measured against known environmental standards for CO_2, SO_2, and NO_X. Other risk factors do not have a standard and were therefore measured against other portfolios.

A stakeholder commented that the choice of risk metrics is subjective; Vectren should consider fuel cost for traditional generation vs no fuel cost for renewables. Vectren measured fuel risk similarly to how other utilities measure it. Fuel prices were varied for this analysis, which included 200 iterations for each portfolio in the risk analysis. A stakeholder commented that EE costs are not accurate. EE costs are modeled on 2016 costs and escalated as penetration levels increase.

The final portion of the meeting was dedicated to answering any additional questions and capturing stakeholder feedback. Vectren management joined Gary Vicinus in a panel discussion.

A stakeholder asked if health care costs were included in the local economic impact analysis. They were not included within the economic impact analysis. Vectren worked with the University of Evansville to understand the economic impact to the local community, should Vectren coal plants shut down. The software that they utilized does not include a mechanism for calculating health impacts. However, health impacts are considered within known and expected EPA regulations, which were factored into the IRP analysis.

According to EPA, the Clean Air Act (CAA) was designed by Congress to protect public health and welfare from different types of air pollution. The CAA requires EPA to establish national ambient air quality standards for criteria pollutants based upon levels deemed necessary to protect public health, and in the case of "primary" standards, levels deemed necessary to not only protect public health in general but also the health of sensitive populations such as asthmatics, children, and the elderly. In addition, there are specific provisions to address hazardous or toxic air pollutants that pose health risks which are technology based. Congress requires EPA to issue "maximum achievable control technology" (MACT) emission standards which are reviewed every eight years. As part of the review, EPA is required to give consideration to whether more stringent, risk-based standards are required to protect public health with an ample margin of safety. Since EPA clean air standards, both national ambient air quality standards and public health-based risk standards for hazardous air pollutants, already take public health into account, there is no basis for trying to further account for health impacts from the preferred portfolio.

A stakeholder suggested that loss of jobs from closing the coal plants would be offset by new jobs in constructing solar. There is an immediate impact on jobs in construction; however, solar plant operations do not require as many workers as a coal plant, limiting the long term economic benefit to the community. A stakeholder asked if displaced workers will be given job assistance. Vectren has met with union leadership on this issue. While there are no guarantees, Vectren will work to minimize job losses. A stakeholder commented that companies (Vectren customers) located in our area have announced high renewable use goals by 2020. Vectren has had meetings with large customers on this topic and will continue to help find solutions to meet customer goals.

A stakeholder asked if additional capacity is needed. The scenarios in the IRP process considered varying load forecasts. Additionally, the rated capacity of different resources impact how much capacity is needed. Some resources retire due to age and some are projected to retire due to anticipated cost. This capacity must be replaced. A stakeholder asked about the production efficiency of coal vs gas. Combined cycle gas generation is more efficient than coal generation. Additionally, Natural gas CO_2 emissions are about 50% of coal; natural gas also has lower NO_X emissions. A stakeholder asked if EE was considered to offset projected capacity costs. The NPV calculation captures EE program costs/impact, and the analysis does consider avoided capacity.

A stakeholder asked if the gas plant in the preferred portfolio will go live in 2024. Yes. Referring to slide 51, a stakeholder asked why it is unacceptable to purchase more than 30 MW

on the open market. Slide 51 is showing the average capacity shortfalls over the course of 20 years, based on 200 possible future states. The risk to market purchases is price volatility and capacity shortages. A stakeholder asked what the cost to customers would be for the 889 MW gas plant. Vectren will issue an RFP to finalize plant costs. The most recent tech assessment suggests that plant costs will be between $650 million and $710 million, not including gas line costs. A stakeholder asked about how Vectren will protect customers from costs associated with excess capacity that is used to sell power to the wholesale markets. The preferred portfolio includes very cost effective, highly efficient peaking capacity. Additionally, wholesale power market sales actually reduce customer rates. A stakeholder commented that in 20 years Vectren's current business model will no longer exist. Vectren considers its business model outside of the IRP process, which includes factoring customers' needs and desires.