Indianapolis Power & Light Company
**2016 IRP Public Advisory Meeting #3**
August 16, 2016

## Welcome & Safety Message

Bill Henley, IPL Vice President of Regulatory & Government Affairs

Bill Henley introduced himself and welcomed participants. He thanked everyone for attending Indianapolis Power & Light Company's (IPL) public advisory meeting.

Teri Tillery of IPL's community relations group gave a safety message related to tips for attending the Indiana State Fair including weather preparedness, foot wear, sunscreen, hydration and sanitation. She pointed out the location of the rest rooms and gave directions for exiting the building in the event of an emergency evacuation.

Mr. Henley shared that IPL has listened to stakeholders and decided to host this extra meeting per their request to present modeling updates and draft results. He explained that IPL added a scenario based on the feedback from the previous public meeting as well and will discuss sensitivity analysis today. The goal of this meeting, and all public advisory meetings, is to foster relationships built on transparency, trust and respect. Throughout the IRP public advisory process, IPL values stakeholders' comments and feedback. IPL will continue to assess modeling results from now until the final public meeting on September 16th.

## Meeting Guidelines

Joan Soller, IPL Director of Resource Planning
(slides 3-6)

Joan Soller thanked all participants in the room and on the phone for attending the meeting, and then asked everyone to introduce themselves. She noted that the agenda allows time for feedback and that there are no scheduled exercises for this meeting. Guidelines are the same as past IRP public advisory meetings. There will be time for questions at the end of each presentation section.

Ms. Soller noted that the time between this meeting and the final meeting is only a month apart. Therefore, she requested stakeholders provide feedback and questions earlier rather than later. She asked participants to send in any comments they may have by August 23. IPL will respond by September 6.

**Summary & Feedback from IRP Public Advisory Meeting #2**
Joan Soller, IPL Director of Resource Planning
(slides 7-12)

Ms. Soller reviewed the topics discussed at the second stakeholder meeting and mentioned that IPL has responded in writing to the stakeholder presentations that were made at the second meeting in writing. This write up is available on IPL's IRP webpage. IPL will share today how the feedback from the metrics and portfolio exercises is incorporated into the modeling updates. Ms. Soller shared that the base case has changed some since June, and we will discuss those changes and details today.

Stakeholder interaction has continued since the last meeting. IPL has met with Citizens Energy to talk about the IRP scenarios and potential future rate design. IPL has also met with Hoosier Interfaith Power & Light (HIPL) to discuss DSM collaboration in the future. IPL Resource Planning staff met with the IPL Advisory Board to discuss stakeholder feedback and suggestions for continued stakeholder engagement. IPL is working to schedule a meeting soon with National Association for the Advancement of Colored People (NAACP) as well.

A participant asked the question:

- Can you share with us who all is on the IPL Advisory Board?
    - Greg Fennig, IPL Vice President of Public Affairs, provided the five members who currently sit on the board: Jim Morris, Vice Chair Pacers Sports & Entertainment, Dan Elsener, President of Marian University, Joyce Rogers, IU Foundation, Melinda Kennedy, Cummins and Sam Odle, Bose McKinney.

Ms. Soller shared the results of the stakeholder portfolio exercise from the second meeting. IPL showed the initial base case operating capacity in 2034. She reviewed the range of stakeholder preferred capacity by resource type from the June meeting exercise. IPL created a portfolio that reflected aggregate stakeholder feedback which includes the retirement of all coal assets, the maximum achievable DSM, a minimum level of baseload generation to meet North American Electric Reliability Corporation (NERC) reliability standards voltage stability requirements, and the balance split between solar, wind and battery storage. In this portfolio, 2030 was used since it is an inflection point for more strict Clean Power Plan carbon limitations.

Ms. Soller shared the results of the stakeholder metrics exercise from the second meeting with the scores based on what stakeholders felt to be most important or interesting. The metrics that received a score of two or more are listed on Slide 11. IPL is still considering what metrics to use to compare portfolios based on a combination of those proposed by IPL and stakeholders.

**IRP Modeling Update**
Joan Soller, IPL Director of Resource Planning
(slides 13-25)

Ms. Soller discussed the evolution of the Base Case since June. Resource planning staff met with IPL Transmission planners to discuss the preliminary scenario results which included significantly more renewables than the 2014 IRP base case. The transmission planners shared the minimum base load generation needed to meet NERC reliability standards voltage stability requirements for IPL's 138kV system.

Other model modifications/updates included:

(1) Corrected battery capacity assumptions.
(2) Added a 10% capacity credit for future wind assets based on expected transmission upgrades. IPL's current wind power purchase agreements (PPAs) do not include any capacity credits. Firm transmission service from MISO is required to secure the wind assets, which was not part of the negotiated agreements.
(3) Added costs for a small battery to provide ancillary services for the wind assets based on the proposed requirement in FERC (RM-16-6).
(4) Added costs to reflect capacitors for wind based on the final rule issued by FERC earlier this year (Order 827).
(5) IPL limits the amount of wind available to add per year to reflect construction feasibility of 250 MW per year.
(6) Established a maximum about of wind in the portfolio to match minimum load based on the base case load duration curve.

Ms. Soller reviewed the final Base Case results in terms of a snapshot in 2036 and compared them to the initial Base case results. There are more wind assets and less batteries. The natural gas component is fairly stable. IPL did not impose early retirements on existing units; it was assumed that they would run until the end of their useful life.

A participant asked the question:

- Is the limit for wind regulatory related, transmission or grid stability related?
    - Ms. Soller responded that 1000 MW is based solely on the minimum loading on the IPL system and a practical approach not to secure more.

IPL named the scenario to reflect the stakeholder feedback from the June meeting. "Quick Transition" The resource mix changes significantly in 2030. This new and balanced resource mix includes natural gas, the maximum achievable level of demand side management and demand response (DSM and DR) from IPL's 2016 DSM Market

Potential Study (MPS), solar, wind and batteries. The wind selected now is coupled with energy storage.

A participant posed a request:

- The participant asked to see the breakdown of DSM & DR. What is IPL recording for MWh/GWh?
    - The DSM in each scenario is in a future slide in the appendix of this meeting's presentation.

A participant on the phone asked:

- You say existing assets will run through their useful live. Two Petersburg units were built in the 1960s and are 50 years old, aren't they at the end of their useful life now or in the next five to ten years?
    - Ms. Soller responded that the useful life of Petersburg 1 & 2 is 2032 and 2034, respectively. IPL therefore left this in the model for the base case and let the economics of those units indicate what is most effective.

Ms. Soller briefly summarized IPL's six scenarios and the characteristics of each scenario.

A participant noted:

- There is quite a difference between the operating capacities for the base case scenario compared to the quick transition scenario planning capacities.
    - Ms. Soller responded yes. The planning capacity is based on what MISO will allow us to count for Resource Adequacy purposes. There is a slide later in the deck that compares the two.

Ms. Soller shared the scenario results on Slide 19. This graph shows the variability of each scenario based on the model inputs driving what the model selects. In the Robust Economy scenario, the model calls for significant additions of wind. In the Recession Economy scenario, the model selected the Pete units to refuel and did not add any significant new additions. In the Strengthened Environmental Scenario, the model adds wind and refuels of the coal fired units. Ms. Soller referred the audience to the handout "Potential Portfolio expansions (in operating capacity) based on 2016 IRP Scenario Analysis" for more details.

Following this discussion from Ms. Soller, a few participants asked some questions:

- What is OSM?
    - Ms. Soller noted that this is the Office of Surface Mining which regulates fly ash disposal.
- On the handout, there is solar and community solar. What is the difference?
    - Solar is utility scale solar at 10 MW. Community solar is at 1 MW.

- Is it all assumed to be utility owned?
    - The model does not take ownership into account; it includes operating characteristics and costs only. IPL is agnostic regarding ownership for modeling purposes. IPL wanted to show two sizes of solar.
- How does being agnostic work with the present value of revenue requirement (PVRR)?
    - IPL assumes its capital structure when modeling costs since IPL does not know others' capital structures.

Ms. Soller shared scenario observations including variances in planning capacities.

A participant asked:

- The footnote that notes how wind assets are paired with energy storage in anticipation of purposed FERC rule, which rule is this referring to?
    - The referred rule to be the Rulemaking 16-6 that is pending still.

As Ms. Soller alluded to earlier, Slide 22 shows a side by side comparison of the operating and planning capacities. The most change you can see is the green, the wind assets. Also, DSM varies by scenarios. Appendix slides show the DSM mix for the 20 years. DSM in the Quick Transition scenario based on IPL's Market Potential Study (MPS) and Customer Adoption expectations. Not all the DSM is cost effective, but IPL wanted to see what it would look like if we could achieve the maximum amount of DSM in this scenario.

Another participant question:

- You have technical potential then the economic potential which is where the cost effectiveness screens are applied, and from my understanding, IPL uses the Total Resource Cost (TRC). This participant continued by expressing her confusion on how IPL utilized DSM cost effectiveness in the modeling. She stated her understanding that if anything survives the TRC screen would be considered a potential DSM measure as part of the maximum achievable potential.
    - Ms. Soller answered that the model uses the Utility Cost Test (UCT) to be on par with supply side resources. She also clarified that the Quick Transition scenario does not select DSM based on economics. IPL forced the maximum amount of DSM. In the other five scenarios, the model selected other resources in front of DSM because they were more cost effective.

**Clarification follow up:**
In the Market Potential Study (MPS), AEG used the TRC test to screen the Technical Potential to Economic Potential. Their cost effectiveness screen contained an avoided cost (benefit) for capacity equal to the cost to build a simple cycle combustion turbine. The Capacity Expansion Model uses the UCT test and since we are capacity long, we are not gaining a capacity benefit like the one in the MPS. Thus, the AEG cost effectiveness screen allows more measures through which are put into "block" inputs for the Capacity Expansion Model. The Capacity Expansion Model uses a tighter screen equivalent to the UCT which filters out the DSM that is not cost effective based on IPL's resource needs.

- Can you speak to the point that DSM is not chosen after other resources?
    - The model first selects the resource mix based on capacity requirements and the most cost effective combination for capacity and energy needs.

    - To explain further, the production cost results, which IPL is still reviewing, shows the variable capacity factors for each resource based on what is most economic. The capacity factor is basically how much of that resource is used. The model will select what is most cost effective based on capacity and energy requirements needed for each portfolio.

    - Ms. Soller called on IPL's external consultant from ABB, Diane Crockett, for any further insight. Diane added that the model looks at IPL needs for resources in the short term. IPL does not need to buy or add any resources because of IPL's high reserve margin in the short term. DSM bundles were split into two tranches: 2018 to 2020 and 2021 and beyond.

      Unless the DSM bundle has a low cost, it is not selected. When you see the names of the bundles, you can see why the model chose which bundles it did. It depends on the avoided costs, and the avoided cost is low in the short term because of the low gas price in the short term. The model looks at capacity and energy at the same time. It looks at capacity to go towards reserve and then looks at need for that resource to serve IPL load. Demand side resources are screened at the same time as supply side resources.

- The participant further asked if the modeling is by program or by end use. Is it a measure grouping?

    - Erik Miller, IPL Analyst , responded that IPL models by like measures, and not by programs. IPL used the achievable potential, then bundled by like

measures and load shapes. This worked well for the capacity expansion modeling. Taking these results and then getting to the DSM program level is the next step after the IRP.
    - Appendix Slide 42 shows the DSM selected in the Base Case. Color coding that the measures are similar and the 8760 load shapes (i.e. 8760 hours per year) for each bundle. The grouping is also based on cost tiers.

A participant asked:

- On the cost side for DSM, are these nominal or real $ on the appendix slide?
    - They are in real dollars.
- And can you explain why the DSM budget spending is slowly growing, but the handout shows that the DSM being added drops off?
    - Mr. Miller addressed the question. He notes that the handout lists the MW or peak demand equivalent of DSM. As IPL adds DSM, capacity goes up, but then DSM measures reach the end of their useful life which may be viewed as retiring. The handout provides the incremental DSM in MWs or peak demand with measures retiring off. A more accurate comparison would be to look at Slide 23 to see how much incremental DSM is modeled in MWhs, similar to annual DSM savings targets. This is consistent with the forecasted IPL DSM budget slides.

- For example, 2 MW in 2030 in Base Case. That is net incremental DSM?
    - No, that is cumulative DSM. What IPL has at that point in time.

**Clarification follow up:**
The handout contains incremental DSM with the impacts of measures retiring off.

Ms. Soller added that internally DSM is most often discussed about in terms on MWh, while the capacity expansion plan is in terms of capacity in MW.

Ms. Soller shared the Present Value of Revenue Requirements (PVRRs) listed for each scenario. The PVRR estimates costs over the 20 year period for each of the scenarios. The peak load input is different in some scenarios. For example, Base Case, Strengthened Environmental and Quick Transition scenarios have the same load assumptions. The other scenarios, the load varies.

The light blue that is shown in the High Adoption of DG scenario represents the costs for those customer distributed generation assets. The actual costs will likely vary for those customers. IPL wanted to at least model what the costs might look like using IPL's capital cost structure since IPL cannot model what customer capital cost structures look like. Without this cost, IPL felt the comparison to the other portfolios would not be apples to apples, but apples to oranges.

Furthermore, this helps us make the case for showing the $/MWh as a metric which IPL intends to do. IPL will also show a longer term PVRR in the IRP and probably at the next meeting.

A participant question:

- In the wind plus energy storage, what is the technology cost down curve?
    - Ms. Soller replied that storage cost decreases by roughly 50% in the next ten years. These numbers are confidential. IPL worked with the AES Energy Storage team. She notes that IPL is probably more aggressive than other utilities regarding this technology cost curve, but this is based on AES's global expertise.

**Sensitivity Analysis Setup**
Patrick Maguire, IPL Director of Corporate Planning & Analysis
(Slides 26-36)

Mr. Patrick Maguire introduced himself to the audience. Mr. Maguire notes his section focuses on sensitivity analysis which is the next step in the IRP modeling process for IPL. This next step evaluates these portfolios across different potential changes in the future through variable driver changes. IPL will model two deterministic sensitivities around carbon, including a delayed Clean Power Plan and a high carbon price. Carbon prices are modeled stochastically as well, but IPL wanted to isolate carbon in a deterministic run to determine the impact on the base case. The stochastic modeling will drive the bulk of the sensitivity analysis and will change multiple variables simultaneously, including load (peak and energy), commodity prices, carbon prices, capital costs, and unit availability.

Mr. Maguire presented an IRP modeling process flow chart. The first phase of the IRP modeling includes the capacity expansion model that generates the portfolio and one production cost run that generates a PVRR for each portfolio using the base case assumptions for all portfolios. The next steps in the process are the setup of stochastic parameters and the stochastic modeling. Mr. Maguire focused on the last two steps.

Mr. Maguire showed a slide with side-by-side comparison diagrams for deterministic and stochastic modeling. This discussion builds on the scenario and sensitivity presentation by Ted Leffler from the April 11$^{th}$ public meeting. A deterministic model runs each selected portfolio through an additional sensitivity by changing one or more specific variables by a fixed and known amount. For example, the portfolios could be run through the production cost model with high natural gas prices or a combination of high natural gas prices and high load.

Comparing the deterministic approach to the stochastic approach, Mr. Maguire noted that the first two steps of the modeling process are the same – the scenarios are developed, drivers are identified and changed, and the result is a set of resource portfolios. He described that the primary difference for stochastic modeling is that rather than isolating one or a couple variables and changing them, multiple variables are changed simultaneously based on estimated probability distributions and correlations between variables.

A participant asked:

- In probabilistic analysis, the higher number of runs you get the better conversions you get to calculate a grand mean. Have you done an analysis of your analysis to know if you have enough scenarios to have a high enough confidence level and to not have artificially high error bars?
    - Mr. Maguire responded no. However, each scenario is run in the production cost model and stressed for varying inputs. The sampling method is called a Latin Hypercube, stratified Monte Carlo. This allows fewer draws to be used.

Mr. Maguire discussed the advantages and shortcomings of each modeling approach. A deterministic model can be easier to set up and administer while still being robust with the right amount and combination of variables. The shortcomings are that it can be more qualitative and may not capture interrelatedness between variables. The advantages of a stochastic approach is that it does capture interrelatedness well and uses well-established statistical methods to do so. The shortcomings are that it is difficult to setup up the parameters and feed the results through a production cost model for every iteration.

A participant reached out with a general question:

- Which Indiana IOU is using which model? This participant is unsure what percentage of utilities are using which methodology.
    - Mr. Maguire response that he does not know the exact percentage. Across the country, for example, TVA mentioned their approach in IRP presentation for IPL.

Mr. Maguire moved on to the process for setting up the parameters. IPL and ABB work on identifying the variables to model stochastically, then analyze the specific characteristics of each variable. This includes the type of probability distribution (e.g. normal, lognormal, triangular) and other properties such as random walking mean reversion, and seasonality. The next steps of using those distributions and statistical properties to generate multipliers is embedded in the ABB Strategic Planning model.

Mr. Maguire focused on natural gas as an example. Natural gas is a well-established market with a lot of historical data. Mr. Maguire showed a histogram of historical spot

prices to show a the natural gas price distribution. IPL observes the historical prices and set up the parameters with their distributions and came up with a set of multipliers. A multiplier of 1 will not change from the fundamental curve.

A participant asked:

- Did you take the results of your analysis and see if it overlays well with the historical log normal pattern?
    - IPL's consultant, Diane Crockett from ABB, notes that modeling results are still being evaluated so this has not been done this yet.

Mr. Maguire then focused on carbon prices. The carbon market does not exist so you cannot rely on historical data to develop the stochastic draws. This shows that we have to establish stochastic multipliers differently. Synapse Energy Economics published their Spring 2016 National Carbon Dioxide Price Forecast in March, and the report is public. This report provides a useful range for establishing the lower and upper bounds of carbon prices. This range was used to develop stochastic draws on carbon prices for IPL's sensitivity analysis.

Next, how does IPL use this information with the multipliers for analysis? Mr. Maguire walked through an illustrative example on Slide 34. In this example, three variables with five independent draws gives you fifteen iterations. Once you have set of multipliers, this is fed into Integrated Model, which generates electricity prices for every year. IPL will have 50 iterations, 20 years and 8760 hours. This combination is then fed through the production cost model which generates the PVRRs. The values for the 50 iterations are locked and used for all portfolios. The results will be 50 PVRRs for 6 different portfolios.

We use this to evaluate the portfolio is the formation of the IPL. What is the risk? What is expected value of each portfolio across all different future worlds? The range of PVRRs across a varied set of variable assumptions allows for a robust risk sensitivity analysis. The results also feed into the calculation of the other metrics besides PVRR.

A participant asked:

- Is there a purpose to the green, yellow, orange and red colored boxes on the Slide 34?
    - Mr. Maguire noted this is heat map with conditional formatting in Microsoft Excel to show that green is lower and the red is higher and orange in between.

A participant on the phone asked:

- Will you share the results of the stochastic modeling in the next meeting?
    - Yes, IPL will share these results at the September 16, 2016 meeting.

A participant goes and asked about DSM:

- MWh v. MW for DSM selection. Can we dive into this next time in the meeting?
    - Ms. Soller noted that IPL will publish the energy mix for each scenario with the other post meeting materials prior to the September public meeting.

A participant asked about stochastic parameter set up:

- Are stochastic parameters treated independently or are the correlations between variables considered?
    - IPL does feed in a correlation matrix for each variable.

A participant on the phone asked a question from the last section:

- Can you explain why 2030 is the retirement date for Petersburg 1-4, Harding Street 5 & 6 and most other fossil fuel resources? Why would it be economical to retire nearly all older fossil fuel generation in the same year versus phased in over time beginning in early 2020s? Petersburg is already is lower capacity levels than historically. 59% last year and less than that so far this year.
    - Ms. Soller clarifies about the Quick transition scenario. The changes to the resource mix in this scenario was not chosen for economics. IPL fixed that there was no coal by 2030. She agrees that it would not be reasonable, practical or economical to retire all at once. In the other scenarios, the economics are run for making changes.

Ms. Soller alerted the participants that there is an error on the handout. The Recession Economy scenario should show refueling Petersburg units in 2018. IPL will update the handout.

**Post meeting follow up**:
Please see revised attachment titled *2016 IPL Candidate Resource Portfolios based on Scenario Results (in operating capacity)* on IPL's IRP webpage for the updated Capacity Expansion Results table to reflect these corrections.

Ms. Soller further clarified by noting that refueling the Petersburg units is economic in the Recession Economy and Strengthened Environmental scenarios.

Ms. Soller asked the stakeholders if this presentation is what the expected and that IPL is working to be transparent.

The participant on the phone asked a follow up question:

- It seems the retirement of Pete 1 and refuel Pete 2-4 refuel should be the same as Strengthened Environmental scenario 2018 for the Quick Transition scenario. The participant suggested that IPL treat Pete in 2020 the same as in the

Strengthened Environmental scenario in the Quick Transition scenario. Retiring all units in 2030 is not a quick transition.

The Quick Transition scenario fixes the portfolio based on the exercise feedback received from stakeholders in the June meeting. This is not a straight economic model. IPL will consider this change.

**Post meeting follow up**:
IPL updated the Quick Transition scenario based on the feedback received during the meeting. Please see revised attachment titled *2016 IPL Candidate Resource Portfolios based on Scenario Results (in operating capacity)* on IPL's IRP webpage. IPL also added letters to the columns and numbers to the rows for clarity & ease.

A participant asked:

- Wind assumes 10% capacity credit; what is the assumed capacity credit for solar?
    - Ms. Soller responded that MISO assumes 12% capacity credit for wind. IPL uses 10% as a rule of thumb and because it is a round number. For solar, MISO allows 48% capacity credit in peak period. IPL has 95 MW of power purchase agreements (PPAs) and the actual experience of these assets is 45%. Therefore, IPL is using the actual 45% experience for modeling purposes. The State Utility Forecasting Group (SUFG) receives monthly IPL solar output data to support their studies regarding solar in Indiana.

**Next Steps**
Joan Soller, IPL Director of Resource Planning
(slides 37-40)

Thanks for participating today. Please email the IPL IRP team at ipl.irp@aes.com with any comments or questions. Ms. Soller offers that if any stakeholder would like to meet with IPL to reach out and the IPL IRP team would be happy to meet with them. IPL will post responses by September 6, and if questions are received early, IPL will respond earlier. The next meeting is a full day meeting on September 16th. IPL will present final model results, sensitivity analysis results, go over our preferred resource portfolio and short term action plan. Please fill out feedback forms and recycle your nametag as you exit the meeting room.

**From:** Jennifer Washburn
**To:** IPL IRP
**Subject:** Questions re EE Bundles
**Date:** Monday, August 08, 2016 10:49:29 PM

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Good evening,

CAC has the following questions about IPL's EE bundles pasted below. Please let me know if you have any questions or concerns. Thanks in advance!!

Sincerely,
Jennifer

- Questions regarding DSM/EE Bundles

    - Considering the recent version of the IRP strawman rule that eliminates the requirement to do cost-benefit screens of DSM prior to putting DSM into the IRP modeling, are you using the DSM Market Potential Study's Technological Potential savings level?

        - If not, which MPS potential level of savings are you using: Technological Potential, Economic Potential, Achievable Potential, or Program Potential?

        - If you are using Economic Potential, which cost benefit screen are you applying: UCT, TRC, or another?

        - If you are using Achievable Potential, which resources are you relying upon to apply the Achievable Potential screens?

        - If you are using Program Potential, which resources are you relying upon to apply the Achievable Potential screens?

    - Are EE bundles grouped/bundled by end use and by cost, e.g. residential lighting 0-3 cents, residential lighting 4-6 cents, etc.? If not, could you please explain why?

    - How big are each of the EE bundles?

    - Are industrial customers who have opted out of DSM programs included in your Market Potential Study? Are they included in your DSM groupings in your IRP analysis?

    - How are new technologies incorporated into your MPS?

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Mission Statement: To initiate, facilitate and coordinate citizen action directed to improving the quality of life of all inhabitants of the State of Indiana through principled advocacy of public policies to preserve democracy, conserve natural resources, protect the environment, and provide affordable access to essential human services.

- IPL Response to CAC Questions regarding DSM/EE Bundles (8-17-2016)

    - Considering the recent version of the IRP strawman rule that eliminates the requirement to do cost-benefit screens of DSM prior to putting DSM into the IRP modeling, are you using the DSM Market Potential Study's Technological Potential savings level?

        - If not, which MPS potential level of savings are you using: Technological Potential, Economic Potential, Achievable Potential, or Program Potential?

            In its 2016 IRP, IPL is using the Maximum Achievable Potential (MAP) to reflect expected customer adoption limitations.

        - If you are using Economic Potential, which cost benefit screen are you applying: UCT, TRC, or another?

            IPL did not use Economic Potential.

        - If you are using Achievable Potential, which resources are you relying upon to apply the Achievable Potential screens?

            Customer adoption rates were developed based on program benchmarking, IPL program achievements in the near term, and market research and evaluation analyses conducted by AEG in the Midwest and around the nation.

            Maximum Achievable Potential (MAP) estimates customer adoption of economic measures when delivered through DSM programs under ideal market, implementation, and customer preference conditions and an appropriate regulatory framework. Information channels are assumed to be well established and efficient for marketing, educating consumers, and coordinating with trade allies and delivery partners. MAP establishes a maximum target for the savings that an administrator can hope to achieve through its DSM programs.

            Realistic Achievable Potential (RAP) reflects expected program participation given DSM programs under more typical market conditions and barriers to customer acceptance, non-ideal implementation channels, and constrained program budgets.

        - If you are using Program Potential, which resources are you relying upon to apply the Achievable Potential screens?

            IPL did not use Program Potential.

- Are EE bundles grouped/bundled by end use and by cost, e.g. residential lighting 0-3 cents, residential lighting 4-6 cents, etc.? If not, could you please explain why?

  Yes

- How big are each of the EE bundles?

  The bundles were generally between 30 MWh to 434,924 MWh over the IRP period. This data will be presented in the 2016 IRP.

- Are industrial customers who have opted out of DSM programs included in your Market Potential Study? Are they included in your DSM groupings in your IRP analysis?

  Yes. IPL maintains all customers in the baseline control totals and market characterization parts of the MPS and identifies the portion of "opt-out load" to proportionally adjust customer participation to calculate the maximum and realistic achievable potential DSM. For example, since 20% of commercial customer load has opted out of energy efficiency programs, the maximum and realistic achievable potential that is identified for all commercial load was reduced by 20% and since 50% of industrial customer load has opted out, the achievable potentials for this sector are reduced by 50%. No adjustment was made to calculate the technical and economic achievable potential DSM

- How are new technologies incorporated into your MPS?

IPL stays abreast of changes in the market place and discusses possible options with its DSM oversight Board, such as the smart-thermostat pilot program. In addition, IPL relied upon its MPS vendor, AEG, to continuously monitor and update its databases with the best available information from around the industry including unit energy and peak demand savings, measure replacement and installation costs (capital cost, incremental cost, annual operating and maintenance costs, etc.), measure life, baseline characteristics (early retirement, normal replacement, applicable codes & standards), non-energy benefits (water savings, health improvements, productivity gains, increased comfort, etc.), applicability (market sector, geographic region, etc.) and an internal measurement of data source quality, based on publication/review process, calculations, thoroughness, and other factors.

- AEG relies on key sources such as those listed below:
- U.S. Department of Energy National Laboratories (PNNL, ORNL, NREL)

- U.S. Energy Information Administration (Annual Energy Outlook)
- State and regional technical reference manuals (TRM)
- Northwest Power & Conservation Council's Regional Technical Forum (RTF) workbooks
- California's Database for Energy Efficient Resources (DEER)
- RSMeans Cost Data Books
- Building simulation data
- AEG and third-party evaluation and market research reports

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|---|---|
| **From:** | Brad Borum (IURC) |
| **To:** | Joan Soller |
| **Cc:** | Pauley, Morgan; Bob Veneck (IURC) |
| **Subject:** | Suggestions for Improving IPL"s Presentation of IRP Information |
| **Date:** | Wednesday, August 17, 2016 9:21:45 AM |

The intent of this e-mail is to follow-up on my questions at the August 16 IRP Public Advisory Meeting. At the outset, we want to commend you and your colleagues for a well-done and well-developed discussion of important topics and statistical concepts. We recognize the difficulty of presenting complex and detailed information so what follows is an attempt to make your presentation of the material clearer.

1. The graphs in the appendix labeled "Utility Spending by DSM Block" for each scenario need to indicate if the expenditures are in real or nominal dollars. At the meeting it was indicated that the graphs are based on real dollars. It would also be helpful to state the base year; for example, Real 2016 dollars.

2. The DSM information presented in the appendix regarding the level of real DSM expenditures for each year of the forecast period for each scenario, the graph on page 23 titled "DSM varies by scenario," and the separate one page handout titled "Potential Portfolio expansions in operating capacity changes based on the 2016 IRP Scenario Analysis," appears contradictory. Real expenditures are increasing slowly over time (see the appendix) and incremental DSM by scenario is also increasing over time (see page 23 of presentation) but DSM additions shown on the separate one page handout appears to be declining generally over time. For example, in the Base Case DSM falls from 17 MW in 2018 to 2 MW in 2030.

   What does the 17 MW of DSM in 2018 under the Base Case represent? Is it the DSM acquired in 2018 minus the DSM implemented in previous years that is rolling-off as the measures are retired?

   The level of DSM in 2017 for all of the scenarios shown on the one page document is 58 MW. The footnote states "DSM includes 58.1 of existing Demand Response." Does DSM in 2017 exclude energy efficiency? Do the DSM numbers for 2018 and beyond only include energy efficiency or some combination of energy efficiency and demand response? For example, how does the DSM number for 2017 in the Base Case compare to what is represented by the DSM number for 2018?

   Despite the comment that incremental DSM is increasing, we aren't certain of what is being presented on page 23 for the amount of DSM. It appears, that the rate of incremental DSM might be decreasing and, as a result, relatively insignificant at a time when units are being retired and new resources are being procured which should result in increased avoided costs to warrant more DSM; particularly if this was an environmental compliance method.

3. Jodi Perras and, we suspect others, expressed an interest in seeing the ramifications of a more aggressive retirement of coal. Realistically, this might not start for at least five years

out. I suspect the results would show a substantial increase in the PVRR. The model also might not solve without extraordinary and uneconomic resource additions. This information might provide the basis for a useful debate and inform future IRPs.

4. It seems that storage or other firming methods could be used to increase the capacity factors of wind and solar as well as increase the economic value of wind and solar by moving the consumption of such power to higher value hours. As a sensitivity, would IPL want to consider a lower cost trajectory for energy storage that results in higher capacity factors and perhaps increased value for wind and solar? To be clear, we have considerable regard for AES' expertise on storage so we will largely defer to you on whether a lower cost of new technologies is within the bounds of reason.

5. Especially given the uncertainties of the Clean Power Plan, IPL's proposed treatment of emission allowance prices seems reasonable. However, since this *may* be a significant driver of resource plans, does IPL believe that the emission price upper bound is sufficient? In other words, would IPL and its stakeholders benefit from the additional information derived by having a more extreme $CO_2$ price sensitivity than is contemplated by the current analysis?

6. For the next meeting that includes the sensitivities, it appears there might be opportunities to consider a couple of additional sensitivities that might provide additional useful information. By way of example, could internally consistent and logical cases be made for sensitivities that vary natural gas prices more than seems to be anticipated? We trust that with the sensitivities there will be more detail in the narratives for each of the cases which would be desirable.

7. The discussion of statistics and probabilistic analysis, while useful for many of us, probably was too technical for some stakeholders. We would welcome your thoughts on how to retain and expand on the information without leaving some stakeholders out of the important discussion. Because of the importance to all utilities and stakeholders, we may wish to make this a topic for the Contemporary Issues Conference.

Again, this was a daunting task and you provided useful information. Please don't hesitate to call me or send an e-mail if you wish to discuss further.

Thanks for the hard work and openness IPL is demonstrating in this IRP public advisory process.

Brad

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- Questions and IPL Responses to feedback following the August 16 IRP Public Meeting.

1. The graphs in the appendix labeled "Utility Spending by DSM Block" for each scenario need to indicate if the expenditures are in real or nominal dollars. At the meeting it was indicated that the graphs are based on real dollars. It would also be helpful to state the base year; for example, Real 2016 dollars.
    - IPL confirmed that these are Real 2016 Dollars and will revise and redistribute the slides with this noted.

2. The DSM information presented in the appendix regarding the level of real DSM expenditures for each year of the forecast period for each scenario, the graph on page 23 titled "DSM varies by scenario," and the separate one page handout titled "Potential Portfolio expansions in operating capacity changes based on the 2016 IRP Scenario Analysis," appears contradictory. Real expenditures are increasing slowly over time (see the appendix) and incremental DSM by scenario is also increasing over time (see page 23 of presentation) but DSM additions shown on the separate one page handout appears to be declining generally over time. For example, in the Base Case DSM falls from 17 MW in 2018 to 2 MW in 2030.

    - The "DSM varies by scenario" slide includes DSM net energy savings (without losses) presented in terms of incremental NEW DSM without considering the impacts of measure retirements. This represents annual net savings implementation targets.

    - In the "Utility Spending" slides in the appendix, incremental annual spending is presented. This represents the annual DSM direct cost budgets coinciding with each year in the "DSM varies by scenario" slide.
    - The handout presents the contribution of incremental DSM that reduces peak load (with losses) so it is comparable to incremental new capacity. Measure retirement impacts are included. For example, the total incremental DSM peak reduction in the base case through the study period (2017 -2036) is 208 MW. This is calculated by summing the DSM through the 2017 – 2036 period.
    - Please see the attached summary of DSM selected in the base case as an example. This data will be included for all scenarios in the IRP. We appreciate your feedback and are considering ways to represent the DSM information more clearly, such as overlaying MW, MWh and costs per year in a slide for each scenario.

    What does the 17 MW of DSM in 2018 under the Base Case represent? Is it the DSM acquired in 2018 minus the DSM implemented in previous years that is rolling-off as the measures are retired?

    - The 17 MW represents the total impacts of DSM programs selected by the model in 2018. Energy efficiency measures were selected; however, Demand Response (DR) programs were not selected. The net DSM increment does not reflect the impacts of measures reaching the end of their useful life (which may be likened to asset retirements) in terms of MWs.

The level of DSM in 2017 for all of the scenarios shown on the one page document is 58 MW. The footnote states "DSM includes 58.1 of existing Demand Response." Does DSM in 2017 exclude energy efficiency?

- No. The forecasted impacts of DSM, based upon the 2017 Action Plan as filed in Cause No. 44792 including energy efficiency, were included in the load forecast to maintain consistency between the 2016 IRP and current DSM filing. The model was configured not to select DSM in 2017 since it would not be practical to implement selected DSM in such a short time period.

Do the DSM numbers for 2018 and beyond only include energy efficiency or some combination of energy efficiency and demand response?

- The 2018 and beyond values include energy efficiency and current demand response. Additional demand response was not selected in the model for the IRP period.

For example, how does the DSM number for 2017 in the Base Case compare to what is represented by the DSM number for 2018?

- As stated above, the IPL included DSM filed in Cause No. 44792 as a reduction in the 2017 load forecast. The model then selected DSM resources for 2018-2036 based upon economic analysis. The 17 MW shown for 2018 in the handout represents what was selected in the model. The DR resources of 58 MW represent existing programs. In the study period, the model did not select any additional DR. The costs to maintain existing DR were modeled and are included in the PVRR for all scenarios.

Despite the comment that incremental DSM is increasing, we aren't certain of what is being presented on page 23 for the amount of DSM. It appears, that the rate of incremental DSM might be decreasing and, as a result, relatively insignificant at a time when units are being retired and new resources are being procured which should result in increased avoided costs to warrant more DSM; particularly if this was an environmental compliance method.

- The model evaluated DSM bundles for two time periods 2018-2020 and 2021-2036 and selected those bundles dependent on the system peak and energy needs. The reserve margin for 2018-2020 increased to 28-29% with the selection of the DSM bundles and it increased to 30% in 2021, falling to 26% by 2030. Since there is not a capacity or energy need until after 2030, the cost to implement bundles over $30/MWh in 2021 does not overcome the benefit that would not be seen until later in the study period.

3. Jodi Perras and, we suspect others, expressed an interest in seeing the ramifications of a more aggressive retirement of coal. Realistically, this might not start for at least five years out. I suspect the results would show a substantial increase in the PVRR. The model also might not solve without extraordinary and uneconomic resource additions. This information might provide the basis for a useful debate and inform future IRPs.

- We agree with you and reached out to our consultant and decided to modify the Quick Transition scenario to accommodate earlier changes in the resource mix. . We are modeling Pete 1 retirement and Pete 2-4 refueling in 2022. The PVRR is higher than the original scenario. We are reviewing the results and will share them on our website with the meeting notes and notify stakeholders when they are posted.

4. It seems that storage or other firming methods could be used to increase the capacity factors of wind and solar as well as increase the economic value of wind and solar by moving the consumption of such power to higher value hours. As a sensitivity, would IPL want to consider a lower cost trajectory for energy storage that results in higher capacity factors and perhaps increased value for wind and solar? To be clear, we have considerable regard for AES' expertise on storage so we will largely defer to you on whether a lower cost of new technologies is within the bounds of reason.

    - We included costs in the capital costs in order for future wind resources to comply with reactive power provisions (as indicated in FERC Order 827) through capacitor support and frequency response (proposed order in FERC docket RM 16-6) through battery support. The battery addition to wind was strictly for ancillary support and did not provide any direct energy firming or time shifting benefit. A larger battery would be needed to directly integrate with wind or solar assets.

    - The current modeling approach for wind, solar, and batteries addresses the concept of firming renewable resources by the way the units are selected in the capacity expansion model and dispatched in the production cost model. Since all resources are compared to the same Locational Marginal Price (LMP) node (called MISO Indiana in the ABB Reference Case), the model selects the wind, solar and batteries at the "same" location independently versus as a combined unit resource. IPL used two selectable battery sizes in this IRP: 20 MW (20 MWh) and 50 MW (200 MWh). The resource profile includes charging the battery in the off-peak and discharging the battery during peak times. In reality, many battery systems may charge and discharge continuously by individual cells; however, model limitations prevent replicating this at this time.

    - The resource output in the model is based upon the intermittent shape of the hourly energy profiles without any curtailment or congestion costs. If a battery is large enough and located properly, it may provide relief for a transmission loading event that may otherwise send a negative price signal or cause a physical curtailment at the generation facility. This in turn could improve capacity factors.
    - The cost curves we used are quite aggressive compared to public data that reflects battery cost forecasts. We will consider additional enhancements to model batteries and renewables; however, this may be considered an area of improvement for the next IRP. We wonder if a combined battery and renewable resource may support higher capacity credits then what is allowable by MISO tariff for each resource individually as well.

5. Especially given the uncertainties of the Clean Power Plan, IPL's proposed treatment of emission allowance prices seems reasonable. However, since this *may* be a significant driver of resource plans, does IPL believe that the emission price upper bound is sufficient? In other

words, would IPL and its stakeholders benefit from the additional information derived by having a more extreme $CO_2$ price sensitivity than is contemplated by the current analysis?

- This seems like a good idea. We will discuss it with our consultant and try to incorporate this.

6. For the next meeting that includes the sensitivities, it appears there might be opportunities to consider a couple of additional sensitivities that might provide additional useful information. By way of example, could internally consistent and logical cases be made for sensitivities that vary natural gas prices more than seems to be anticipated? We trust that with the sensitivities there will be more detail in the narratives for each of the cases which would be desirable.

    - IPL will review the inputs to the sensitivity analyses and provide more detail in the next meeting and the IRP narrative.

7. The discussion of statistics and probabilistic analysis, while useful for many of us, probably was too technical for some stakeholders. We would welcome your thoughts on how to retain and expand on the information without leaving some stakeholders out of the important discussion. Because of the importance to all utilities and stakeholders, we may wish to make this a topic for the Contemporary Issues Conference.

    - We agree with you and are happy to develop materials or help find a potential speaker to address this topic in a future Contemporary Issues Conference. We found these reference materials useful in preparation for the August 16 meeting.

    Borison, Adam. *Electric Power Resource Planning Under Uncertainty: Critical Review and Best Practices*. November 2014
    http://www.thinkbrg.com/media/publication/514_Borison_ResourcePlanningUncertainty_WP_20140121.pdf

    Blanco, Carlos and Soronow, David. "Energy Price Processes Used for Derivatives Pricing & Risk Management", *Commodities Now*, March 2001.
    http://web2.uwindsor.ca/courses/business/assaf/a_brownian.pdf

    Blanco, Carlos and Soronow, David. "Mean Reverting Processes", *Commodities Now*, June 2001.
    http://www.finanzaonline.com/forum/attachments/econometria-e-modelli-di-trading-operativo/2046757d1424436117-quando-entrare-nel-tsa-a_mean_reverting_processes.pdf

    Random Walk analogy:
    Szpiro, George G. *Pricing the Future: Finance, Physics, and the 300-Year Journey to the Black-Scholes Equation: A Story of Genius and Discovery*. New York: Basic Books, 2011.