

# Wabash Valley Power

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Dr. Bradley K. Borum  
Research, Policy, and Planning Division Director  
Indiana Utility Regulatory Commission  
101 W. Washington St., Suite 1500 East  
Indianapolis, IN 46204

Dear Dr. Borum:

In response to the Draft Report of the IURC Regarding Wabash Valley Power's (WVPA) 2015 Integrated Resource Plan, these are our comments.

## Load Forecasting

1. WVPA, on page 13, is commended for conducting a residential end-use survey every two years.

### Questions:

#### a. Is the survey required by the Rural Utilities Service (RUS)?

*WVPA is not a RUS borrower and therefore not subject to RUS requirements. Nevertheless, it is our understanding that RUS requires borrowers with residential demand of 50 percent or more of total kWh to provide for a residential consumer survey at least every 5 years.*

**b. Would WVPA please provide greater detail on the survey instrument and process? It is not clear from WVPA's discussion whether this was a phone survey and, if so, whether WVPA conducted any verification of the residential end uses such as age, connected load, or condition. It also is unclear whether WVPA used the survey to obtain demographic information as well. It would be beneficial if WVPA provided a discussion of how the survey information was integrated into WVPA's load forecasting models and evaluation of EE, demand response, and customer-owned generating resources.**

*The residential survey was conducted by phone. Phone interviews were conducted with adult members of a household whose residential electric provider was determined to be a WVPA member system. All customers were selected at random from cooperative billing data. A total of 5,799 interviews were conducted (a minimum of 300 interviews in the 19 participating systems – for some cooperatives, sample size exceeded 300). The maximum margin of sampling error for any member system is +/- 5.7 percentage points at the 95 percent confidence level. For the WVPA system as a whole, which is reported as a weighted average, the maximum margin of error is +/- 1.3 percent confidence level. WVPA did ask about the age of a customer's water heater, heating system, air conditioning system and home. We did not ask about the condition of these systems. We asked the customer to describe their home and how many people live in the household most of*

*the year. We also asked for the customer's age, main source of household income and income category.*

*For the residential average use model, electric air conditioning and heating market share was taken into account by weighting weather variables by market share. Currently, air conditioning market share is higher than space heating market share, therefore there is more room for market penetration in heating appliances than in cooling appliances. However, electric heating faces greater competition with propane and natural gas than does electric air conditioning. Market share of electric water heaters and miscellaneous plug loads (e.g., cell phone chargers, DVRs, cable boxes, and phantom loads) are also expected to increase throughout the forecast period as well.*

2. Beginning on page 34, WVPA uses forecasts of the number of customers and usage per customer to determine residential and small commercial loads. The usage per customer is unclear. WVPA states that it uses an SAE model to produce a "base index" (page 34), that air conditioning and heating market share is accounted for by weighting weather variables by market share (page 36), that appliance and lighting efficiency were accounted for in some unexplained manner (page 37), and that heating degree days (HDDs) and cooling degree days (CDDs) were included to weather normalize (page 38). It is further stated that average use was modeled econometrically using household income, appliance market share, people per household, electricity price, and weather (page 39).

**Comments:**

**The load forecasting discussion would benefit from elaboration and clarification. For example, the discussion of small commercial use per customer that "was modeled as a function of weather and retail sales per employee" (page 39) would benefit from a more detailed discussion. On page 34, WVPA states that it uses "Econometric and regression models..." (page 34). However, the next paragraph suggests WVPA is using a hybrid econometric/end-use residential model in an attempt to capture the benefits of both techniques. On page 34, though, WVPA says it does not employ end-use modeling.**

**Questions:**

**a. Would WVPA please clarify?**

**Residential Average Usage**

*The residential average use model has four independent variables: weighted HDD, weighted CDD, price of electricity, and a base index. A twenty-year history of actual monthly average usage is used to develop model coefficients and to calibrate the models to system-specific data. A description of the development of each factor follows:*

***Weighted HDD*** – *the weighted HDD is a function of HDD, market share of electric heating equipment, and efficiency of electric heating equipment. The appliance share is based on the residential saturation studies conducted by WVPA. Average whole house heating efficiency is sourced from the Energy Information Administration's (EIA) Annual Energy Outlook. The factor is computed as HDD times market share divided by efficiency.*

***Weighted CDD*** - *the weighted CDD is a function of CDD, market share of electric AC equipment, and efficiency of electric AC equipment. The appliance share is based on the residential saturation studies conducted by WVPA. Average AC efficiency is sourced from the EIA's Annual Energy Outlook. The factor is computed as CDD times market share divided by efficiency.*

*Price – the real price of electricity. Projections are developed by requesting information from member cooperatives about planned changes in retail price and supplementing with information related to WVPA’s wholesale cost projections.*

*Base Index – The base index is similar to a base appliance index used in a traditional SAE model specification and represents the change in household consumption due to non-space conditioning appliances. The base index includes changes in baseload consumption due to changes in household income and people per household as economic drivers. Furthermore, each member cooperative’s market share of electric water heaters is incorporated into the base index. Finally, impacts of expected increases in miscellaneous plug loads and impacts on lighting consumption due to the Energy Independence and Security Act of 2007 lighting regulations are included. These final two components are taken from the EIA’s Annual Energy Outlook for the Residential Sector.*

**b. Did WVPA use an SAE model?**

*The models used by WVPA are not specifically an SAE model in the traditional sense. Typically, SAE models include AC, Space Heat, and Base Indices. The answer to a. above further clarifies the models used to project residential average usage.*

**c. If yes, how was the SAE model developed and calibrated to Indiana data? It would be easier to understand the methods used if WVPA would provide the actual model specifications in the document and provide a discussion of how WVPA uses the model(s).**

*Not applicable.*

**d. As a matter of interest, would WVPA also please provide a discussion on the efficacy of “retail sales per employee” as a model driver for the commercial forecast?**

*The reason we selected retail sales per employee is twofold. Average usage is a rate of consumption per customer instead of a volume of total consumption. So we looked to use an economic independent variable that is also a rate instead of a volume, much like household income is used to predict residential household consumption instead of total area income. Second, our theory is that economic recovery will likely occur first by increasing output per employee before employment growth. For many of our member systems, small commercial average usage is very stable and does not exhibit much growth, so any economic variable demonstrating growth is not likely to provide a statistically significant fit.*

3. The energy and peak forecasts for large commercial customers were provided by member cooperative staff and discussed with WVPA for reasonableness.

**Questions:**

**a. Does WVPA know whether these forecasts were developed using econometric techniques or are based on informed opinion or expert judgement? Especially for long-term (probably anything more than one or two years), this kind of “informed opinion” forecasting is not ideal.**

*The forecasts for large commercial customers are based on informed opinion. Generally, we adjust only the first one to two years for probable load growth. Beyond the first two years, we assume 0.0% - 2.0% load growth for any individual customer.*

**b. Has any attempt been made to model these larger customers with econometric techniques?**

*No.*

4. WVPA states on page 35 that forecast period weather is based on “averages for the 20 years ending in 2014.”

**Question:**

**a. Are they mathematical averages or proper normals? On page 38, WVPA mentions “projected normal weather.” The weather discussion seems to be inconsistent.**

*We use a 20-year mathematical average as the definition of normal weather. This 20-year average is updated, or “rolled forward” for each iteration of the load forecast.*

5. There seems to be a disconnect between the load forecast shown in Section 3 and the one used in selecting resource options (Sections 4 and 5). First, the magnitude of the monthly peaks in Graph 5-7 (page 74) is larger than the peak load in Table 3-11 (page 51). Second, the power supply requirements in the expansion plans for the various scenarios (Tables 4-5, 5-1, 5-2, 5-3, and 5-4) show drops in requirements from 2027 to 2028 (about 17 MW except in the pessimistic economy scenario). The monthly load and peaks in Graphs 5-6 and 5-7 (pages 73-74) show a similar drop. However, the load forecast in Table 3-11 (page 51) increases by 16 MW in that period. There doesn't seem to be an explanation for the discrepancy.

**Questions:**

**a. Is the difference in the pass-through loads discussed on page 40, at least partially?**

*Yes, the difference in Table 3-11 and Graph 5-7 is attributable to the pass-through loads.*

**b. Do we understand correctly that WVPA states the pass-through loads are not included in energy or peak managed by WVPA but are included in planning load? If this understanding is correct, please provide a discussion.**

*In section 3, WVPA states that “each customer is forecasted separately and their load is not included in the total energy or peak load managed by Wabash Valley “. This statement relates purely to load forecasting. WVPA does manage the energy use and peak loads of our pass-through loads customers; just not in the conventional way we manage the loads of the other rate classes.*

*Pass-through loads are included in WVPA's total planning load because we have the ultimate responsibility to meet the large power customers' energy requirements and make purchases at market to meet the minimum reliability requirements. However, each pass-through loads customer has their own customized power supply portfolio based on their respective risk tolerances.*

6. The weather ranges (extreme and mild) are possibly too extreme to show more realistic forecast variance on page 42.

**Questions:**

**a. Although it is good practice to examine extremes that are relatively low risk but have significant ramifications if realized, would it have been better to have these extreme and mild ranges as separate scenarios or sensitivities and have a more modest difference around the reference case?**

*WVPA does not believe that the weather ranges are too extreme; however we will take this into advisement for future IRPs.*

**b. Would WVPA have been better served by having several different load forecasts (perhaps four or more in addition to the reference case) and describe these different forecasts as partially attributable to weather?**

*WVPA is content with our approach but will take this comment under advisement for future IRPs.*

7. WVPA, on pages 41-42, discusses development of optimistic and pessimistic load forecasts. An econometric model of energy requirements as a function of economic activity and heating and cooling degree days was developed to generate energy requirements under optimistic economic conditions. An economic index composed of households and employment was created to represent the economy in the scenario forecasts. To generate the optimistic forecast, the optimistic case economic index forecast was compared to a base case projection. The econometric model coefficient is used to estimate the optimistic energy requirements forecast.

**Comment:**

**The description is too cursory to understand what was done to develop alternative load forecast based on economic drivers.**

**Questions:**

**a. How was the economic index created?**

*The economic index is computed as:*

$$\text{Index} = w_{\text{RCON}} \times \text{HH}_{\text{Idx}} + (1 - w_{\text{RCON}}) \times \text{Emp}_{\text{Idx}}$$

*$w_{\text{RCON}}$  = percentage of residential consumers on the system*

*$\text{HH}_{\text{Idx}}$  = number of households, indexed to 2014*

*$\text{Emp}_{\text{Idx}}$  = area employment, indexed to 2014*

**b. How was the index used to develop alternative load forecasts?**

*Please see the answer to c. below*

**c. How was the econometric model coefficient used to estimate the optimistic energy requirements forecast?**

*The following econometric model was run:*

$$\text{Total Energy} = \beta_0 + \beta_1 \text{Econ}_{\text{Idx}} + \beta_2 \text{CDD} + \beta_3 \text{HDD}$$

*Where the economic index is derived as described in a. above and CDD and HDD are unweighted cooling and heating degree days. To derive an optimistic energy forecast, the compound growth rate in the economic index was increased by 0.65% over the base case, and the coefficient  $\beta_1$  was multiplied by the difference in the optimistic and base economic indices to produce the additional energy from the optimistic case in each year. This additional energy was added to the base case energy forecast to compute optimistic energy requirements. Because the compound growth rate is allowed to vary, the resultant optimistic forecast shows a wider range in the forecast relative to base case over time. The 0.65% adjustment factor is derived by observing historical changes in economic activity and ensuring the ranges produce range projections consistent with the potential change in energy from the past.*

**d. It appears the base load forecast was estimated and projected using one methodology but the optimistic and pessimistic economy forecasts and the extreme and mild weather forecasts were developed using an entirely different methodology. Is this accurate?**

*The base case load forecast is a bottom-up approach in which each class is projected independently and the aggregate forecast of energy requirements is computed. In order to minimize budget and time constraints, range forecasts are prepared at the total system requirements level. Therefore, the secondary model is appropriate for that function.*

**e. Throughout the load forecast section, the information could have been made clearer if formal equations were used to supplement the written descriptions. Would WVPA please provide more detail on the rationale and the operations of these scenarios?**

*The ranges are meant to provide a means to the level of uncertainty to the base case forecasts which are developed with a very detailed examination of the energy and demand sensitivities to many possible drivers of consumption. The range models are based on standard econometric techniques and the resultant regressions used to estimate macro impacts of changes in the economy or weather are examined for statistical fit and validity.*

8. A summarized preliminary expansion plan for the high economic condition sensitivity is shown in Table 5-1. (page 68)

**Questions:**

**a. What does “preliminary” mean in this context?**

*“Preliminary” should not have been used. This is the expansion plan for the Optimistic Economy sensitivity.*

**b. Does WVPA consider this to be a scenario or a sensitivity?**

*Sensitivity is probably a better description of this and all of WVPA’s alternate expansion plans as we made minimal changes to the model to see how the expansion plans changed in the PLEXOS LT Plan.*

**c. Did anything else change besides the load forecast when performing this sensitivity?** *No.*

**d. For example, were all other assumptions such as gas prices and carbon kept the same between the base resource plan scenario and the optimistic economy sensitivity?** *Yes.*

**Resource Planning**

1. It appears that the costs for future resources are held constant over the forecast period and that there are no sensitivities/scenarios around that assumption.

**Questions:**

**a. Did WVPA hold the real costs of future resources constant over the forecast period?**

*No, costs were stated in 2015 dollars and escalated over the forecast period.*

**b. If yes, is WVPA concerned that this treatment may not capture the significance of the uncertainty?**

*As we continue to develop our IRP modeling, we may further explore the stochastic modeling of construction and O&M costs.*

**c. Would WVPA agree that some resources, especially solar, might be more significantly affected?**

*Based upon WVPA's analysis, construction and O&M costs are not the only factors impeding solar build out. The limited capacity factor and UCAP value of solar are much bigger contributors.*

2. The power supply expansion plans tend to overbuild in the short term (or build earlier than necessary). An example of this is in Table 4-5 (page 64) where capacity needs in 2016 is 59 MW, yet the plan shows 244 MW of additions (96 of CC, 144 of CT, and 4 of energy efficiency). The text acknowledges this but does not explain it. Note that sales of excess energy is not allowed (page 79).

**Question:**

**If WVPA agrees that the power expansion planning analysis results in a short-term overbuild, would WVPA provide a discussion of the rationale, how this happened, and what will WVPA do in future IRPs to compensate or correct for this tendency?**

*We agree that the model tends to overbuild. This is a result of allowing fossil fuel construction in only certain years of obvious need. The alternative would be to allow for the construction of a 59 MW CT/CC in 2016, another 123 MWs in 2017 and 86MW in 2018. This is not how WVPA manages its portfolio. By eliminating the sale of excess energy in the forecast, we avoid speculating on the spot market when adding resources which is consistent with our risk strategy. A possible alternative in the future would be to allow the model to purchase capacity, but this could lead to underbuilding. Tightening the reserve margin bands is another option, but this leads to modeling errors and lack of flexibility. Because of WVPA's strategy of partnership and diversification, the practical application is that the IRP provides guidance when evaluating opportunities to participate in a share of a larger regional generation project. WVPA will continue to investigate ways to improve our long-term capacity modeling.*

3. Wabash Valley states, "For the IRP, these reserve requirements of 14.3% in MISO and 15.4% in PJM are used for planning Wabash Valley's resource requirements needed in the future." (page 9)

**Questions:**

**a. In an effort to minimize revenue requirements or the delivered price to customers, what steps, if any, does WVPA anticipate considering to reduce resource adequacy requirements?**

*WVPA continues to promote energy efficiency and demand response in order to minimize the cost to customers. Large generation additions are expensive and lumpy so WVPA intends to manage short-term short or long capacity positions with market capacity transactions to help manage large capacity investment costs.*

**b. Would MISO and PJM, for example, allow WVPA (or any member utility) to reduce its resource adequacy requirements if the RTOs had greater confidence in WVPA's load forecasting, the capabilities of WVPA's DSM programs, or WVPA's long-term resource planning?**

*MISO and PJM resource adequacy requirements are based on regional needs and as such WVPA already receives substantial benefit in energy reliability over managing reserves on a stand-alone basis. The MISO and PJM RTOs already do checks and accreditation for forecasts and demand response to assure that they can have confidence in the forecasts and DSM resources. The RTOs could make premium products, like PJM's capacity performance products, to give greater value to companies who provide premium capacity products, including DSM. We do not really see a differentiation provided in load forecasting or long-term resource planning.*

4. WVPA, on page 62, said the PLEXOS model was used to evaluate each of the supply-side and demand-side resource options on an equivalent basis.

**Questions and Comments:**

**a. Was EE and demand response used to modify the load forecast prior to optimization? In other words, was the PLEXOS model limited to selecting only supply-side resources in the optimization process?**

*EE and demand response were modeled as supply-side options only.*

**b. Was the co-optimization capability of PLEXOS used to simultaneously analyze all resources?**

*PLEXOS simultaneously co-optimizes all generation candidates. CC, CT and renewables are all considered. Demand Response and Energy Efficiency resources (as long as they are modeled as generators) are included in the simultaneous co-optimization as well.*

**c. Consistent with the IRP Draft Proposed Rule, a discussion of how WVPA intends to increase its utilization of PLEXOS and how WVPA intends to obtain enhanced data to support the full capabilities of PLEXOS would be helpful. Additionally, a good description and overview of the various PLEXOS products would be helpful. A reader also would benefit from a greater discussion of the capabilities of PLEXOS compared to how they were actually used in the IRP.**

*WVPA has licensed PLEXOS for a little more than a year now. Our utilization of the model will increase through increased familiarity and training. The PLEXOS model allows for much closer simulation of an ISO energy/capacity/ancillary market. Our short term primary focus is structuring our model to properly replicate our current portfolio. We anticipate that this knowledge will transfer to expansion planning as well.*

*Enclosed is a description of the various features of PLEXOS.*



Plexos Features.pdf

**Risk Analysis**

1. The natural gas price projections (Graph 5-9 on page 76) seem high, with the base forecast over \$8/mmBtu in 2034. WVPA also uses a 100% higher price in the extreme case (>\$16/mmBtu). By comparison, EIA's AEO2015 Henry Hub base prices are \$5.69 in 2030 and \$7.85 in 2040. WVPA's highest prices are \$7.89 in 2030 and \$10.63 in 2040.

**Questions:**

**a. If this is an accurate statement of the range of prices used in the IRP, did WVPA consider using other sources and lower ranges of prices?**

*WVPA used energy, natural gas, coal, and carbon prices obtained from ACES. These prices utilize broker quotes and long-term price forecasts from Wood Mackenzie. WVPA is a firm believer of "one version of the truth". While the long-term prices may seem a little high, utilizing one source serves to keep energy, fuel, and carbon prices in sync. We feel that lower prices are captured in stochastic modeling.*

**b. Does WVPA have any concerns that the high prices, especially the extreme price, may skew the risk analysis?**

*This may change in future IRPs, but WVPA eliminated market sales and limited market purchases in our analysis. Due to this underlying assumption, generation needs were mainly provided through expansion alternatives. As long as the fuel sources are supplied by the same source and are in sync, we doubt that using another (cheaper) source would have much bearing on the outcome other than possibly displacing wind/solar/EE/DR with more fossil fuel generation.*

2. The methodology for the risk analysis seems to be on the right track but could be better explained.

**Questions:**

**WVPA states it “executed” the plans “against the stochastic variables” (page 78).**

**a. Would WVPA please provide more details on how this was done?**

*WVPA modeled the scenarios/sensitivities (Optimistic Economy, Pessimistic Economy, Carbon Emissions Regulation, Pulverized Coal Resource Addition) as separate expansion plans and executed them with all combinations of defined stochastic variables (Load, Energy Price, NG Price, Coal Price, Energy Price, Carbon Tax).*

**b. It appears that each stochastic variable was analyzed separately and then some were done in combination (see Chart 5-17 on page 83). Is this an accurate characterization?**

*Yes. See above answer.*

3. With reference to Appendix F, Market Price Assumptions (page 63), which displays forward market prices for the Indiana Hub.

**Questions:**

**a. How are the forward market prices developed?**

*The 5x16, Wrap, and 7x24 forward power market prices (\$/MWh) for Indiana Hub were obtained from ACES on 09/01/15. ACES uses broker quotes that are blended into Wood Mackenzie prices over time.*

**b. A description in the body of the report would be helpful for those who don’t have access to the confidential appendices.**

*We agree.*

4. WVPA ran one scenario with a carbon tax at \$15.07/ton in 2022 rising to \$38.46/ton in 2034. WVPA also adjusted market energy and fuel prices to reflect the impact of higher production costs. (page 70)

**Questions:**

**a. Would WVPA provide a description of how the carbon tax rate was set?**

*The “tax” is the embedded carbon tax in the Wood Mackenzie carbon world prices.*

**b. Also, would WVPA please provide a description of how the ramifications on market energy and fuel prices were done?**

*The carbon world energy and fuel prices were provided by Wood Mackenzie.*

5. The next question is in regard to the performance of expansion plans against stochastic variables. (page 78)

**Questions:**

- a. Was a Monte Carlo-type process used? *Yes.*
- b. How many stochastic draws were used to develop the scenario sensitivity impact of risk components presented in Charts 5-12, 5-13, 5-14, 5-15, and 5-16?

*We used 30 draws in each stochastic run.*

- 6. Tornado charts are presented in Charts 5-12, 5-13, 5-14, 5-15, and 5-16.

**Questions:**

- a. What other risk metrics are available from PLEXOS?

*No metrics are explicit within PLEXOS, but the raw data is available to calculate risk metrics.*

- b. What are the strengths and weaknesses of the alternative risk measures?

*As we continue to develop WVPA's modeling, we will explore other metrics.*

- c. Why was the tornado chart selected as the sole/primary risk metric to be presented?

*WVPA has used tornado charts in the past to help present the magnitude of the risk. We believe these charts fairly present the varying degree of the Monte Carlo endpoints.*

**Energy Efficiency**

- 1. WVPA modeled demand response and EE as a resource instead of a reduction in load (page 22) but acknowledge that the EE has been captured to the extent that it is in the historical data as mentioned on page 37.

**Questions:**

- a. Is it correct to say that WVPA did not remove EE from the historical data when it estimated its load forecast models? *Yes.*

- b. Did WVPA subsequently give effect to the EE that had been removed? Please elaborate on how EE was handled.

*The EE resource modeling is for new programs only. All existing programs are embedded as a reduction to our load numbers.*

- 2. WVPA's 2015 IRP, on page 58, states it is evaluating demand-side resource options on a comparable basis to supply-side resources.

**Questions:**

- a. Are EE and demand response programs put into bundles that the resource expansion models can select when optimizing resource options?

*No, our EE and DR programs are managed separately at WVPA, so bundling them for modeling purposes would differ from actual practice.*

- b. If EE and demand response are not included as bundles in the optimization process, then how is comparable treatment between DSM and supply-side resources implemented?

*The same as baseload and peaking generation. PLEXOS co-optimizes all generation options. As long as EE and DR are modeled as generators, they will compete against CC, CT, renewables, etc.*

**c. If EE and demand response are put together into bundles, then how are bundles developed? What data and assumptions were used to develop the bundles?**

*They are not bundled.*

3. ACES staff is responsible for the dispatch of Wabash Valley's demand response (DR) programs. Wabash Valley DR representatives inform ACES staff members of current program objectives, program parameters and information management functions. ACES utilizes the DR programs to manage costs, including high wholesale market prices, and respond to capacity shortages. (page 9)

**Questions:**

**a. Given that WVPA is in two RTOs and serves three states, would WVPA please provide the basis and rationale for how demand response is utilized?**

*WVPA's demand response resources are registered with MISO and PJM as DR resources that the RTOs can call when needed. WVPA receives capacity credits for our DR resources from the RTOs.*

**b. That is, is demand response used to reduce WVPA's system coincident peak, the RTOs' coincident peak, or other?**

*WVPA does not call our DR resources for peak savings. The RTOs call our DR resources when they need them.*

**c. What type of input does ACES have in determining the cost-effectiveness of demand response?**

*ACES assists WVPA with market analysis which helps us to determine how to best utilize our DR resources so that WVPA gets the most value from the resources.*

4. For EE, WVPA obtained high-level cost estimates from a condensed study of achievable efficiency potential. (page 58)

**Questions:**

**a. What does "condensed" mean in this context?**

*The condensed study was based on a compilation of studies prepared for other clients with similar customer demographics.*

**b. Why has the study not been made available?**

*See above answer.*

**c. When was the study published, and by whom was the study prepared?**

*Please refer to our response to Question 5.a.-f.*

**d. How were the cost estimates in Table 4-3 developed?**

*We obtained achievable MWh savings and costs by year for residential, small C&I and large C&I from the condensed study described above. In order for EE to "compete" against other generating options, we converted these \$/Mwh costs into a cost to construct (\$/kW) by using our average load factor.*

**e. Are the cost estimates based directly on the condensed study of achievable efficiency potential? Yes, with the adjustment described previously.**

f. If no, how were the estimates modified going from the potential study to Table 4-3? *Not applicable.*

5. There is just a one-paragraph description of EE planning process but nothing one can understand regarding data used or how the programs were developed. (p. 60)

**Questions:**

**a. How does the consultant validate program savings?**

*WVPA's consultant, Navigant Consulting Inc., conducts program evaluation services that include: Impact, Process, and Benefit/Cost Analysis of our efficiency programs. Depending on an individual programs' portfolio impact, and available budget each year for EM&V activities, program evaluation activities include a combination of: program tracking data review, project engineering analysis, customer and implementation contractor phone interviews, and customer site-visits for a sample of projects. Following the conclusion of these program evaluation activities, the consultant develops realization rates of reported savings, benefit/cost results for our programs, and recommendations to improve program performance.*

**b. Does the consultant act as both the EM&V entity and the lead advisor on program development?**

*Yes. WVPA's consultant provides program evaluation services that directly inform the ongoing refinement of program operations and development of program enhancements. This integrated evaluation service helps ensure a continuous improvement process in the design and implementation of the programs. However, the consultant is not involved in the direct implementation of the programs.*

**c. Did the consultant prepare a market potential study?**

*No. WVPA determined a meta-study of other regional utilities' potential studies and historical energy savings performance was a reasonable and appropriate methodology to estimate achievable market potential when weighed against available resources and the cost of a potential study specific to WVPA's service territory.*

**d. How was this market potential information used and modified to develop the programs included in the IRP evaluation?**

*Navigant Consulting, on behalf of WVPA, conducted a meta-review of other recently completed potential studies for utilities in a reasonably similar geographical territory to WVPA. Navigant reviewed the following potential studies: Entergy Arkansas, 2015; Kansas City Power and Light, 2013, and ComEd, 2013. The findings from these other studies were synthesized, and presented to WVPA to inform forecasts of potential DSM savings for WVPA.*

**e. If a market potential study was not used, then what information was used and what is the source of this information? *See above answers.***

**f. How was the technical and economic viability of the EE programs assessed?**

*WVPA did not research or consider technical or economic potential. WVPA's meta-analysis of other potential studies focused solely on achievable potential.*

6. Appendix E presents information for an Expansion Energy Efficiency resource and an Expansion 1MW Demand Response resource.

**Questions:**

**a. Were these resources included in the PLEXOS optimization process?**

*These are the result of the base PLEXOS optimization.*

**b. How were the data presented for these resources developed?**

*The data is the result of the LT Plan module of PLEXOS.*

**c. What is the source of the data? Again, more information would be helpful to better understand how demand response and EE were evaluated.**

*The cost assumptions for EE have been discussed previously. The DR cost assumptions are based on internal historical costs.*

**Avoided Costs**

1. Request for clarification regarding WVPA's discussion of avoided costs estimation and usage in the IRPs. (page 61)

**Questions:**

**a. How is "the cost of network transmission to deliver the capacity to the distribution points of Wabash Valley's Members" developed or estimated?**

*While WVPA acknowledges that the cost of network transmission is a potential factor in avoided costs, our IRP states that transmission service fees have been excluded from our avoided cost calculation. In the future, we may choose to adjust this.*

**b. How is avoided cost used in the IRP process? Are avoided costs of transmission used in the IRP process?**

*WVPA's IRP states that avoided costs exclude transmission fees; however, they are adjusted for varying LMP prices and line losses.*

**c. How does the avoided energy costs in Table 4-4 differ from the market price assumptions presented in Appendix F?**

*The avoided energy cost is calculated by adding a 10 MW incremental load to peak hours, off-peak hours, and all hours of the forecast year. WVPA then dispatches this load (base load forecast plus the increment) against its portfolio of supply resources. We use the PLEXOS planning model to assess the production cost of two cases. The first case provides an estimated annual total production cost with the incremental load. The second case provides the estimated total annual production cost with a base forecast load. In each case, the PLEXOS model dispatches resources, including wholesale market purchases, to serve every hour of load.*

*As shown in Tables 4-4 a-c, WVPA calculates the annual marginal cost of serving the incremental peak, off-peak, and around the clock load. Since this modeling is done without adding new capacity resources to the model, the marginal cost reflects only the expected increase in energy cost to serve additional load.*

**d. Should they differ conceptually?**

*Yes. WVPA's load shape can differ from the RTO as a whole.*

**e. How are they each used in the IRP analysis?**

*The avoided cost calculation is used more implicitly than explicitly. The capacity expansion module of PLEXOS chooses the most economic resource option. The avoided capacity cost is based on the cost of a CT (which is one expansion option). The avoided energy cost is based on market energy which is an option in the model (within limits).*

**f. Are the avoided costs in Table 4-4 used to screen DSM measures prior to being included in bundles?**

*The capacity expansion module of PLEXOS evaluates DSM against a CT resource option.*

Sincerely,

**WABASH VALLEY POWER ASSOCIATION, INC.**



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# SIMULATOR FEATURES



## Generation

Detailed renewable and fossil generation technical-economical characteristics. Deterministic and stochastic unit commitment on/off decisions, random outages, temperature dependency and various autoregressive models for wind speed, solar radiation and natural inflows. Multiple fuels and Combined Cycle modelling details featuring non-convex heat rates, start-up/shutdown profiles, complex fuel transitions and operational modes.



## Transmission

Optimal power flow with losses fully integrated with dispatch and unit commitment. Security and n-x contingency constraints (SCUC), DC lines and phase shifters. Generic constraints and interface limits, transmission aggregation, Monte Carlo simulation, multiple AC networks, 10,000's buses and lines, nodal pricing and price decomposition.



## Capacity Expansion Planning

Optimal generation and transmission expansion planning over 30+ year timeframe. Optimal NPV of investment and production costs, chronological expansion for detailed ramping, fast frequency control and replacement reserves investment opportunities. Stochastic 2-stage optimization support, LRMC, optimal emission target decommissioning, capacity payments and reliability indices.



## Hydro Modelling

Highly detailed cascading hydro networks featuring GIS visualization from Google Earth. Efficiency curves, head storage dependency, waterway flow delay times, spillways, evaporation, deterministic and Stochastic solutions over any horizon. Seamless integration with detailed short-term unit commitment via target volumes or future opportunity cost decomposition. Pump storage energy and ancillary market co-optimization.



## Ancillary Services

Ancillary service provision co-optimised with generation dispatch and unit commitment. Detailed treatment of start-up and shutdown combined with ramping and reserve interaction minute-by-minute. Multiple reserve classes including spinning, regulation, up and down and replacement services.



## Emissions

Generation dispatch constrained by emission limits and/or reflective of emissions price and number of emission types. Flexible grouping for emission constraint sets over any timeframe including multi-annual.



## Financial

Comprehensive financial reporting to Generator, Region and Company level. Dynamic bidding of generation resources reflective of contract position and/or medium term revenue requirements based on recovery of build costs from capacity expansion planning. Bertrand and Cournot games, flexible user-defined mark-up definitions and automated schemes such as RSI.



## Gas Model

An integrated gas-electric model allows detailed modelling of the physical delivery of gas from fields, through pipelines and storage to gas and electric demands. Gas and electric models are solved simultaneously allowing decision makers to trade-off gas investments, constraints and costs against other alternatives.



## Scope and Compatibility

Highly configurable timeframe and simulation interval as short as 1-minute. Choose between regional, zonal and full-nodal network detail. Multiple pricing, uplift and capacity payment options to support various market rules. Choice of commercial mathematical programming engines (CPLEX, Gurobi, MOSEK, Xpress-MP).