IMPA
INDIANA MUNICIPAL POWER AGENCY

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Indiana Utility Regulatory Commission
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Indianapolis, IN 46204

Dear Dr. Borum,

Thank you for your July 25, 2018 draft comments on Indiana Municipal Power Agency's 2017 Integrated Resource Plan. IMPA appreciates the opportunity to review your comments and provide feedback prior to the final report. Attached are responses to various questions and comments included in your report.

Once again, thank you for the opportunity to review your comments and provide clarifying information to you. We look forward to working with you and your staff as we develop future IRPs.

Thank You,

Frank J. Smardo.
Sr. VP, Engineering
Indiana Municipal Power Agency

3.2 Background

3.2.1.1 Question

IMPA states on Page 1-12 that its members are in eight load zones, but throughout its IRP, there is only discussion of five load zones. Could IMPA please explain? *(Note: There is a quote from the IRP below this question that appears to be unrelated to the question.)*

3.2.1.1 Answer

This is referring not to load, but to IMPA's generation and contractual resources. The goal was to emphasize geographic diversity of generation and contractual sources of energy.
From the IRP Page 1-12:

> IMPA's existing resources are diverse in terms of size, fuel type and source, geographic location and vintage. IMPA owns or controls generation in MISO and PJM as well as in the Louisville Gas & Electric/Kentucky Utilities (collectively LG&E) control area. In total, **IMPA's generation and contractual resources reside in eight (8) different load zones in Indiana, Illinois, Iowa and Kentucky (Emphasis Added)**. This diversity reduces IMPA exposure to forced outages, locational marginal prices (LMPs), zonal capacity rates and regional fuel costs.

The eight areas referenced and resources are shown below:

1) Duke IN – Gibson #5, Duke PPA, Solar
2) NIPS – Rensselaer, Solar
3) Vectren – Solar
4) AEP-I&M – Anderson and Richmond CTs, WWVS, AEP CB, Solar
5) IPL – Georgetown CTs
6) ALTW – Crystal Lake WF
7) Ameren – Prairie State #1 & #2
8) LGE/KU – Trimble County #1 & #2

IMPA's load resides in the following areas:

1) Duke IN
2) NIPS
3) Vectren
4) AEP-I&M
5) Duke OH

3.3 Load Forecasting

3.3.1.1 Question

Based on Table 5, page 31, it appears that IMPA incorporated the above-mentioned dummy variables for some load zones. Is this correct? If so, given that there was a variable for Peak and Off-Peak and other time and temperature related variables, what was the rationale for considering a dummy variable? For example on Table 5, page 31, it isn't obvious that a dummy variable is a useful indicator for both peak days and peak seasons within the same model.

3.3.1.1 Answer

The dummy variable was primarily used to enhance fit for energy between months and signify peak seasons (i.e. winter and summer). December through February were assigned a 1 as well as June through August, while remaining months were assigned a zero. This helped both R^2 and the standard error of the estimation.

3.3.1.2 Question

The references to Tables 8 and 9 seem inconsistent. Table 8 appears to be for energy models but the last sentence of the first paragraph on page 34 refers to Table 9 for energy models and the last sentence of the next paragraph refers to Table 8 for peak models.

3.3.1.2 Answer

Table 8 is for the energy models and table 9 is for the peak demand forecast variables. The sentence in question should have been deleted in editing.

3.3.1.3 Question

What does IMPA mean by: "On/Off Peak Days" as a variable (Page 33, Table 8)? Is this the number of peak days vs. off-peak days? It appears this is based on page 35 "Calendar inputs (e.g., peak days per month) which were determined using a calendar and adjusted for holidays." How is this done? If so, is it correct that some "peak days" may actually be non-holiday weekdays? From the information provided, it is not clear.

3.3.1.3 Answer

Yes, these variables are the number of on peak and off peak days in a month based on the generally accepted market definition of peak and off peak days. These are not meant represent peak days of energy

usage, simply peak days as defined by NERC. An on peak day is any non-holiday weekday. Off peak days are weekends and NERC holidays. All non-holiday weekdays are peak days.

3.3.1.4 Question

What is the purpose of developing spring and fall peak models (page 34)?

3.3.1.4 Answer

From a practical matter, there may not seem to be much planning value in producing peak load forecasts for the shoulder months; however IMPA maintains these forecasts as a way to continually audit forecasts in months where peak forecasting can be challenging. This modeling and auditing helps IMPA understand the nature of its member loads.

3.3.1.5 Question

IMPA mentioned it also considered expected daily load, temperature, wind speed, barometric pressure, and intra-day temperature deviations. Did IMPA give effect to any of these factors? If so, what was IMPA's rationale?

3.3.1.5 Answer

The variables stated in Table 9 were found to be statistically significant and were used in the final forecast model for demand. What is not shown, out of space constraint, are the variables that were considered but not used due to lack of significance. The rationale for including these variables, apart from their statistical significance, was their intuitive impacts on the forecast. For example, wind speeds were found to have a "cooling" effect on peak demand in the summer while in the winter the effect was opposite and drove peaks higher.

3.3.1.6 Question

Do IMPA communities obtain any detailed demographic information to supplement the total household data? If not, have IMPA or its member cities considered conducting a survey using a random but representative sample from its member cities?

3.3.1.6 Answer

IMPA communities have never provided IMPA any detailed demographic data. It is not known if the member cities have attempted any surveys, however given their somewhat limited resources it is unlikely accept for in the largest communities. The use of IMPA survey data has been contemplated but ultimately dismissed given the volume of surveys that would be required to achieve a valid sample from each of IMPA's diverse communities.

3.3.1.7 Question

Do IMPA communities provide any detailed end-use/appliance information to supplement the energy intensity analysis? In other words, does IMPA have any empirical data to support the 2% annual rate of decline in energy intensity according to the International Energy Agency's 2016 report "Energy Efficiency Market Report: 2016?" (Page 5-35). Table 10 shows projections for Real GDP Growth. The Organization for Economic Cooperation and Development ("OECD") is consistently higher than the other sources.

3.3.1.7 Answer

No, IMPA member communities have never provided detailed end-use appliance information. IMPA's primary concern in developing an estimate for growth rates in energy intensity was having an unbiased and, hopefully, independent forward looking estimate for those growth rates. The most credible estimate IMPA was able to find was the -2% y/y decline in energy intensity cited in the "Energy Efficiency Market Report: 2016." End use data on appliance information would be difficult to ascertain as noted in answer 3.3.1.6. Going forward however, IMPA may be able to utilize national level data to refine the -2% y/y estimate used for this load forecast.

For estimates of Real GDP growth, IMPA's main goal was to use unbiased growth estimates. In Table 10, the column "Applied Growth Rate" illustrates IMPA's assumed growth rate for the purposes of the load forecast. While the OECD is higher, in the out years, it is the only source of long term growth estimate IMPA could discover.

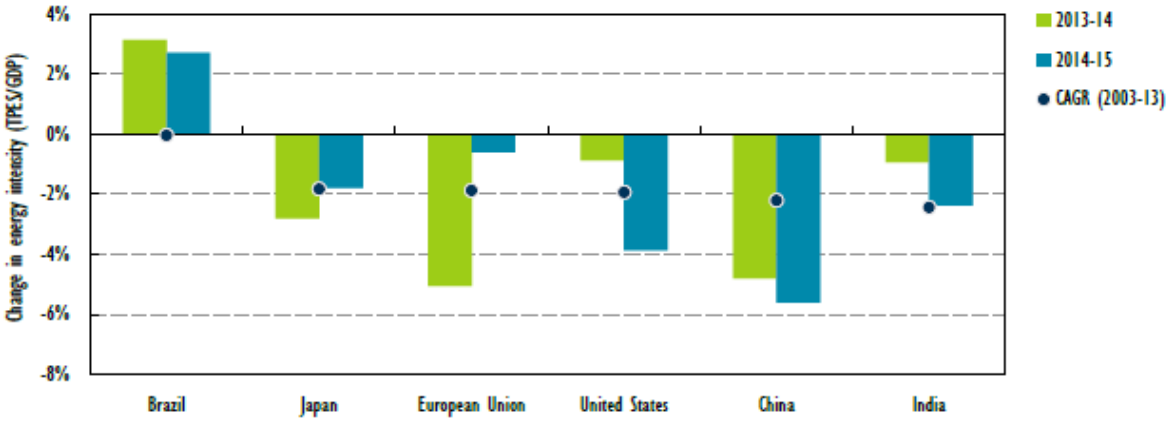
3.3.1.8 Question

Did IMPA consider that relatively optimistic projections of real GDP might result in an upward bias for the forecast and, ultimately, for long-term resource planning, especially if some of the other variables were optimistic? The Director appreciates the difficulty in finding objective and quality data sources but is concerned with using International Energy Agency's OECD-wide projection of changes in energy intensity. This data source may be questionable because the factors driving intensity (prices and personal income) are probably very different in many OECD nations and may be less representative of a specific state. Also, nations with tight labor markets may have increasing intensity while those that do not may have decreasing intensity.

3.3.1.8 Answer

IMPA's assumed growth rates for real GDP growth in 2017, 2018, and 2019 were 2.16%, 2.1%, and 1.8%. 2017 GDP growth was approximately 2.5%. [1] IMPA tried to account for high forecasts in the GDP survey data by not using abnormally high or low estimates for growth where there were large deviations from consensus. As for the energy intensity variable, IMPA notes the concern that OECD's estimates for global energy intensity may be too optimistic; however, IMPA did use a rate that was consistent with the noted improvements in energy intensity for the United States, shown below. This was not clearly stated on our part however.

Figure 1.3 Changes in primary energy intensity for selected countries



IMPA appreciates the Director's concerns and agrees with the Director that some macroeconomic data may not be suitable for use in a much smaller geographic footprint. IMPA will endeavor to find data more relevant to the Indiana footprint.

3.3.1.9 Question

Kudos to IMPA and its member cities for installing AMI. Consistent with the IRP rule to strive for continual improvement, how does IMPA plan to utilize the wealth of information from AMI to provide more detail to enhance the load forecasting?

3.3.1.9 Answer

IMPA is a wholesale utility and does not have a retail AMI system and has no input as to the systems that member communities may deploy. Many IMPA members do not have AMR, let alone fully implemented AMI systems. However, a few of the larger communities do have AMI systems. To the extent data can be shared by those members with AMI, IMPA will attempt to use this information in the future.

[1] https://fred.stlouisfed.org/series/GDPC1

3.3.1.10 Question

What geographic region (state/census region/national) is used for the economic variables? IMPA specifically states "Indiana Non-Farm Income" but what about GDP and household debt?

3.3.1.10 Answer

Real GDP and household debt are national metrics used in IMPA's load forecast. IMPA strives to find a balance between using national economic data that is updated more frequently/consistently, and using state level data that may not be updated as frequently. Smaller intervals between data releases allow for a fine tuning of our load forecast on a monthly basis. Informational gains from using more frequently updated variables, in our findings, outweighs the slightly improved model fit (in some cases) of using Indiana specific data.

3.3.1.11 Question

If household debt and Indiana non-farm payroll are driven solely off GDP, why not just use GDP as the driver in the energy models since both of those variables will change at the same rate that GDP does? (Page 35 – Section 5.4).

3.3.1.11 Question

GDP wasn't a reliable predictor for some of the load zones. Also, our statistical analysis suggested that Indiana Non-Farm Payrolls tend to grow at a slightly lower rate than national GDP growth. In other words, Indiana payroll growth tends to lag the broader economy. However, in other load zones real GDP was statistically significant (Table 8, 5-33).

3.3.1.12 Question

What is the source for the assumed GDP growth rates in the low- and high-growth scenarios (Page 41 – last paragraph)?

3.3.1.12 Answer

The GDP growth rate for the low growth scenario was based on a subjective use of low end of economic growth rates found in Table 14 (10-67). The discussion of this can be found on page 10-78.

The GDP growth rate for the high growth scenario was based on the EIA's high growth case as published in their 2017 Annual Energy Outlook. Further discussion can be found on page 10-85.

3.3.1.13 Question

We understand that IMPA believed that national data on real GDP and non-farm incomes provided a better *fit* in the regression analysis than regional and state data, (Page 5-35). How did IMPA come to that conclusion?

3.3.1.13 Answer

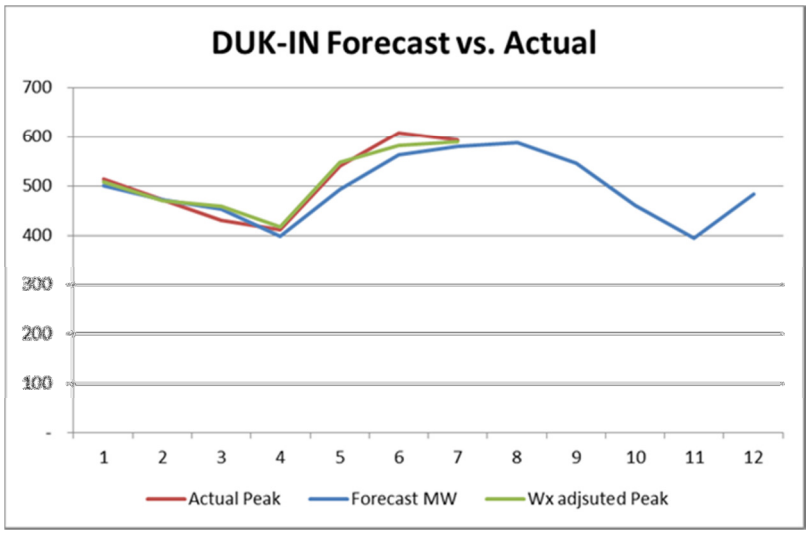
The more frequent reporting of national level data increased our number of observations which not only improved model fit via comparisons of model R^2, it also lowered standard error of the estimate.

3.3.1.14 Question

What changes to load forecasting has (or is) IMPA considering to enhance the explanatory values and credibility of their load forecasting processes?

3.3.1.14 Answer

IMPA feels that from both a planning and commercial standpoint, forecasting peak demand is the biggest challenge. One key variable that feeds the peak demand forecast is the monthly energy forecast. More specifically, a daily energy consumption multiplier is applied to the monthly load forecast to forecast the peak demand. In other words, we are concerned with how much of the monthly energy consumption for the month occurs on the peak day. Historically, this has been between 3.8% and 4.2%, depending on load zone. It's recently been discovered this value is declining so we continue to revise estimates of that value to enhance understanding of how the system behaves during peak conditions. Since the revision of this estimate, we have been tracking weather adjusted peaks fairly well in 2018. The chart below illustrates this tracking YTD for our DUK-IN load zone.



3.4 Energy Efficiency

3.4.1 Comment

Despite the success of energy efficiency there is no energy efficiency in the Base Expansion plan. (Page 13, Table 1).

3.4.1.1 Question

Is the above characterization correct? If so, would IMPA please explain how a significant amount of energy efficiency is not included in the Base Expansion plan?

3.4.1.1 Answer

IMPA continues to pursue its board approved Energy Efficiency Program as noted in the resource summary on page 1-11 and 12 and is included in our base action plan on page 1-14. These existing plans are captured in our load forecast as the load forecast is produced off net, metered loads. On an ongoing basis, we account for increased energy efficiency through the use of our energy intensity variable in the load forecast. In making expansion plans, AuroraXMP has a set of resources available to it and these include not only traditional generator resources, but also energy efficiency in the form of demand response resources. Since AuroraXMP optimizes expansion plans on a zonal basis and portfolio optimization is a subset of those resources chosen in the broader plan, IMPA must select assets that were deployed in the zonal expansion. In the base case, these demand response options were never deployed, as shown in the table below.

Generation by Fuel

Zone Name	2018	2019	2020	2021	2022	2023	2024	2025	2026
MISO									
Water	9,158,743	9,140,428	9,164,245	9,139,090	9,139,090	9,139,090	9,162,841	9,139,090	9,139,090
Wind	51,839,395	55,142,312	56,930,163	56,880,375	57,032,796	57,216,906	57,255,184	56,940,203	56,664,444
Solar	2,748,059	2,895,465	2,918,983	2,924,758	2,936,547	2,951,889	2,979,729	2,991,129	3,003,637
Nuclear	99,306,149	99,283,954	99,552,825	99,286,445	99,289,840	99,299,286	99,571,607	99,294,475	99,324,486
Coal	392,696,536	377,983,974	371,522,372	369,774,717	370,853,202	373,060,627	369,061,765	350,767,680	240,270,030
NG	98,541,252	121,102,378	132,324,478	136,765,108	140,140,674	142,808,167	154,547,220	176,125,250	287,531,863
Other	13,415,079	13,093,858	13,133,199	12,490,800	12,496,036	12,492,656	12,535,529	12,499,290	12,494,153
FO	24,680	24,696	34,089	27,781	38,923	42,049	34,675	27,767	28,031
DR	-	-	-	-	-	-	-	-	-
Storage	72,592	113,299	126,179	136,446	170,840	162,779	151,480	150,914	140,546
Total Capacity	667,802,485	678,780,364	685,706,533	687,425,520	692,097,948	697,173,419	705,300,030	707,935,799	708,596,279

Demand response was not alone in terms of resources that were not selected by the model when creating expansion plans. There were no new nuclear, fuel oil or coal assets built in our base expansion plan (page 12-103). For brevity's sake IMPA did not spend much time discussing resource options NOT selected in the expansion.

Finally, IMPA implemented a new model during this IRP cycle and while every effort was made to deploy EE as comparable as possible, there was a significant amount of time spent on implementation, build out and calibration of the model. Going forward, IMPA plans on enhancing its knowledge of the program and leveraging AuroraXMP staff to assist in implementing additional energy efficiency modeling capabilities.

3.4.1.2 Question

If energy efficiency is not in the Base Expansion plan, is it correct to assume that energy efficiency was not treated in a manner that is as "comparable as possible" to other resources in IMPA's long-term resource planning?

3.4.1.2 Answer

IMPA feels that, as stated in 3.4.1.1, it actually gave energy efficiency instant credit in the portfolio; however this was done by incorporating assumed EE impacts to the forecasted load. In choosing to handle EE in this manner, IMPA was able to allow EE's economic advantages to not distort the asset optimization portion of long term resource planning. By incorporating EE on the load side, IMPA in turn reduced its reliance on owned generation or contracts as sources of power. As stated in the IRP and the responses above, IMPA will continue to offer its board approved energy efficiency program.

3.4.2.1 Question

Consistent with the IRP rule requiring continual improvements, does IMPA plan to use its AMI to enhance EM&V for energy efficiency? If so, please provide details. Does IMPA and its member cities also plan to supplement the discrete load data available from AMI with appliance/end-use surveys that also include demographic information?

3.4.2.1 Answer

IMPA is a wholesale utility and does not have a retail AMI system and has no input as to the systems that member communities may deploy. Many IMPA members do not have AMR, let alone fully implemented AMI systems. However, a few of the larger communities do have AMI systems. To the extent data can be shared by those members with AMI, IMPA will attempt to use this information in the future. As stated previously, at this time, IMPA has no plans to implement system wide customer surveys.

3.5 Demand response

3.5.1.1Question

If IMPA did not include demand response in the Base Expansion plan, is it correct to assume that demand response was not treated in a comparable manner to other resources in IMPA's long-term resource planning?

3.5.1.1 Answer

Please refer to answer 3.4.1.1

In regard to the comment concerning the lack of participation in IMPA's existing demand response program, IMPA believes that the lack of customer involvement is primarily due to the low market capacity prices in MISO and PJM, especially MISO. The IMPA program is designed to flow through the market auction capacity value to the participating customer. With MISO capacity prices clearing at an average of $.50/kW-Month the last six years (less than $.20/kW-Month excluding 2016/2017), there is little benefit for a customer to sign up when the revenue is so small compared to cost of shutting down (or the risk of shutting down) production. Even in PJM where capacity prices are higher than MISO, the same six year average is only about $2.60/kW-Month. In PJM, the low prices coupled with shut down risk and Capacity Performance risk may not be enough to warrant participation.

3.5.2.1 Question

Consistent with the IRP rule requiring continual improvements, does IMPA plan to use its AMI to enhance EM&V for energy efficiency? If so, please provide details. Does IMPA and its member cities also plan to supplement the discrete load data available from AMI with appliance/end-use surveys that also include demographic information?

3.5.2.1 Answer

Please refer to answer 3.4.1.2

3.6 Interrelationship between Load Forecasting and DSM

3.6.1.2 Question

Is our understanding correct that the member communities are now in charge of the administration of energy efficiency and demand response? If so, do the members conduct the EM&V of energy efficiency and demand response? If this is accurate, can IMPA attest that EM&V is conducted consistently and in the same manner as IMPA would have done it if they were still a part of the statewide energy efficiency program?

3.6.1.2 Answer

No. IMPA members are not in charge of the administration of the EE program. Applications for EE rebates are sent by the retail customers directly to IMPA. IMPA personnel review the applications for completeness and perform inspections if necessary. Upon final approval and installation, IMPA sends the rebate checks directly to the retail customer.

3.7 Resource Optimization and Risk Analysis

3.7.2 Comment

Regarding the Director's footnote (4), IMPA agrees with the definition of dark/spark spread.

3.7.3 Comment

IMPA states that PJM has a higher Base Case growth rate, but on page 65 it lists it at 0.3% for energy and 0.2% for demand (as compared to page 64 with MISO at 0.76% and 0.65%, respectively). Thus, PJM has a lower Base Case growth rate, not higher. (Page 86 – last paragraph).

3.7.3.1 Question

If this is a mistake, does this affect the IRP given IMPA's statement in Section 13 on page 127: "*The asset selection for the IMPA portfolio is dependent on the output of the Aurora zonal expansion module under the assumption that whatever is most efficient for the RTO should provide IMPA a set of diverse and rational asset choices for its own portfolio. In other words, if a resource is not built in the RTO expansion study, it cannot be considered for IMPA's portfolio (unless that resource is already an existing resource).*"

3.7.3.1 Answer

The statement "...reflecting higher Base Case growth rate for PJM such that additional gains from economic growth are muted" appears to be misstated. However, the load forecasts assumed for each case in the IRP are correct. That is, system loads fed into AuroraXMP for the high growth case are high for the high case (as shown in Figure 38) and low for the low load scenario (as shown in Figure 31). Therefore our expansion plans as reported in the IRP are valid. IMPA apologizes for the confusion.

3.7.5.1 Question

For figures 23 - 30 (e.g., Indiana Hub On-peak Dark Spread), the Director assumes these are in nominal dollars. Is this correct? Is the correct to say that the resource planning analysis was not adversely affected by using nominal dollars rather than real dollars?

3.7.5.1 Answer

It is correct that these values are nominal. These figures were merely stated as context for the current market conditions and to frame decision making using transparent and forward looking data. They were not a modeling input. Aurora requires the use of assumptions in real dollars, while its outputs are conveyed in nominal terms.

3.7.6 Comment

The Director recognizes the difficulty in predicting future environmental policy. It seems IMPA had no carbon tax for most iterations (page 152 High Growth Case Results). Specifically, IMPA states it "allowed for a handful of iterations to illustrate a modest carbon tax." Thus, the carbon dioxide risk is low (Figure 109). This looks like the assumption is driving the outcome. The Director expects the risk of being wrong about carbon dioxide prices to be most significant in this case, but IMPA does not allow that to happen by making its low carbon tax assumption. Also, in contrast to IMPA's assumption, it would seem reasonable to expect all of the risk to be on the high side since the carbon price is zero in the baseline, positive in some cases, and never negative.

3.7.6.1 Question

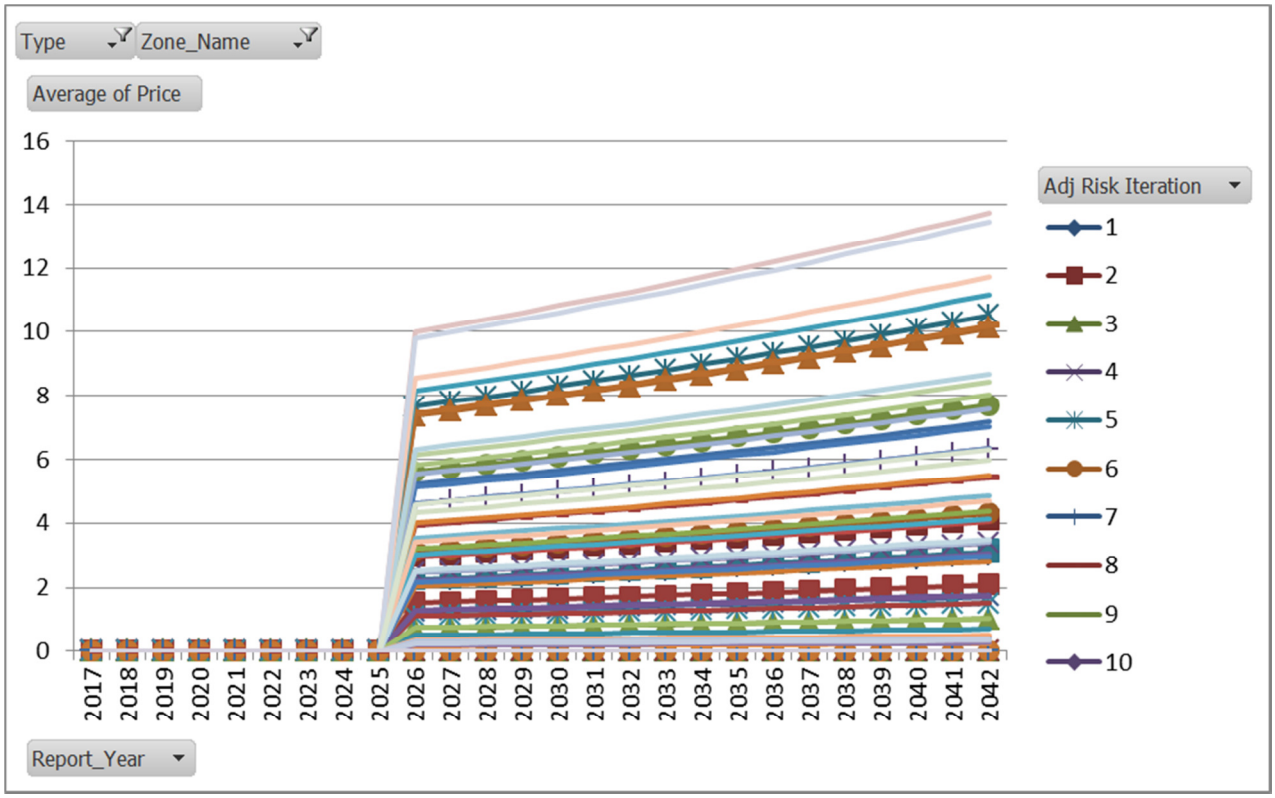
What are IMPA's thoughts on the above comment?

3.7.6.1 Answer

As the High Growth Case was intended to represent high growth, low regulation, the central assumption was that there would be no carbon tax (Figure 16, page 10-62). This presents a challenge when modeling uncertainty due to the fact that convergence to the mean value of $0.00 per ton of CO2 must hold and

negative pricing was not desirable. So with the left tail of the CO2 distribution constrained at $0 there needed to be sufficient volatility to capture a high growth regime that at the mean had zero CO2 costs, yet captured the risk that there was a regime shift to some sort of CO2 tax. IMPA's stochastic process still yielded an expected value of $2.00 per ton of CO2 in the stochastic case over 1,300 samples (13 years times 100 iterations) with 47% of the samples have a price of $0 (and roughly converging with the expected outcome). Ultimately, volatility wins with a constrained left tail and the right tailed values that are sufficient enough to pull the expected value of carbon past the desired mean of $0/ton.

With those challenges stated, IMPA still achieved iterations above $12 a ton in some draws, which would be punitive for a portfolio built and optimized, as it was, under an assumption of $0 a ton. So somewhat counter to the Director's comment, we did in fact capture risk of being wrong about carbon. IMPA's modeled distribution of CO2 tax outcomes is below. This illustrates the heavy right tailed nature of the distribution. The reason that Table 109 shows a low side risk for CO2 is due to the above mentioned fact that the mean of the stochastic analysis did not, and could not, come back to $0.



Additionally, as shown on page 152, this scenario did show some iterations that significantly spiked IMPA's average costs.

3.7.7.1 Question

In Section 16 regarding IMPA's Plan Selection, it is not clear what is driving the jump in Peak + Reserves from 2033 to 2034 (see Table 18 and Figure 117).

3.7.7.1 Answer

IMPA's long term cost based agreement with AEP-I&M includes a provision whereby AEP-I&M is responsible for the planning reserve requirements for the MW under contract (see contract description on page 4-24). The jump in the Peak + Reserves in 2034 reflects IMPA taking on the reserve requirement responsibility of an extra 197 MW upon contract expiration. In this case, approximately 30 MW assuming a long range 15% reserve requirement.