Director's Report

For Indianapolis Power Light's 2019 Integrated Resource Plan

October 14, 2021

Dr. Bradley Borum

Director of Research, Policy and Planning
on behalf of the Indiana Utility Regulatory Commission

TABLE OF CONTENTS

Draft Director's Report Applicable to Indianapolis Power & Light's 2019 Integrated Resource Plan and Planning Process

I. PURPOSE OF IRPS

Indianapolis Power & Light Company's (IPL's) 2019 Integrated Resource Plan (IRP) was submitted on Dec. 16, 2019. By statute[1] and rule, integrated resource planning requires each utility that owns generating facilities to prepare an IRP and make continuing improvements to its planning as part of its obligation to ensure reliable and economical power supply to the citizens of Indiana. A primary goal is a well-reasoned, transparent, and comprehensive IRP that will ultimately benefit customers, the utility, and the utility's investors. At the outset, it is important to emphasize that these are the utilities' plans. The Director's report does not endorse the IRP nor comment on the desirability of the utility's "preferred resource portfolio" or any proposed resource action.[2]

The essential overarching purpose of the IRP is to develop a long-term power system resource plan that will guide investments to provide safe and reliable electric power at the lowest delivered cost reasonably possible. Because of uncertainties and accompanying risks, these plans need to be flexible as well as support the unprecedented pace of change currently occurring in the production, delivery, and use of electricity. IRPs may also be used to inform public policies and are updated regularly.

IRPs are intended to be a systematic approach to better understand the complexities of an uncertain future, so utilities can maintain maximum flexibility to address resource requirements. Inherently, IRPs are technical and complex in their use of mathematical modeling that integrates statistics, engineering, and economics to formulate a wide range of possible narratives about plausible futures. The utilities should utilize IRPs to explore the possible implications of a variety of alternative resource decisions. Because of the complexities of integrated resource planning, it is unreasonable to expect absolutely accurate resource planning 20 or more years into the future. Rather, the objective of an IRP is to bolster credibility in a utility's efforts to understand the broad range of possible risks that utilities are confronting.[3] By identifying uncertainties and their associated risks, utilities will be better able to make timely adjustments to their long-term resource portfolio to maintain reliable service at the lowest reasonable cost to customers.

Every Indiana utility and stakeholder anticipates substantial changes in the state's resource mix due to several factors[4] and, increasingly, Indiana's electric utilities are using IRPs as foundations for

---

[1] Indiana Code § 8-1-8.5-3.

[2] 170 IAC 4-7-2.2(g)(3).

[3] In addition to forecasting changes in customer use of electricity (load forecasting), IRPs must address uncertainties pertaining to the fuel markets, the future cost of resources and technological improvements in resources, changes in public policy, and the increasing ability to transmit energy over vast distances to access economical and reliable resources due to the operations of the Midcontinent Independent System Operator (MISO) and PJM Interconnection, LLC (PJM).

[4] A primary driver of the change in resource mix is due to relatively low cost natural gas and long-term projections for the cost of natural gas to be lower than coal due to fracking and improved technologies. As a result, coal-fired generating units are not as fully dispatched (or run as often) by MISO or PJM. The aging of

their business plans. Since Indiana is part of a vast interconnected power system, Indiana is affected by the enormity of changes throughout the region and nation.

The resource portfolios emanating from the IRPs should not be regarded as being the definitive long-term plan that a utility commits to undertake. Rather, IRPs should be regarded as illustrative or an ongoing effort that is based on the best information and judgment at the time the analysis is undertaken. The illustrative plan should provide off-ramps to give utilities maximum optionality to adjust to inevitable changing conditions (e.g., fuel prices, environmental regulations, public policy, technological changes that change the cost effectiveness of various resources, customer needs, etc.) and make appropriate and timely course corrections to alter their resource portfolios.

II. INTRODUCTION AND BACKGROUND

IPL serves more than 500,000 retail customers in Indianapolis and neighboring areas. IPL's service area covers about 528 square miles. IPL's following context of changes in the resource mix and statement of purpose is consistent with the IRP statute and rule.

> "The 2019 Integrated Resource Plan ("IRP") was developed in an environment with expectations for unprecedented technological change and power market evolution over the planning horizon. Changing customer preferences and expectations, declining costs of renewables and storage, a changing regional resource mix, and the growing importance of carbon reduction have all played into IPL's planning strategy and process for this IRP."
> *(IPL's IRP Executive Summary – page XX)*

To address "unprecedented technological changes," IPL, with significant stakeholder input, developed their Preferred Resource Portfolio to be flexible and satisfy the requirements to deliver safe, reliable, and economic electricity to customers at just and reasonable rates. As part of a "holistic" evaluation of the current coal fleet, IPL concluded it was cost-effective to retain Petersburg 3 and 4 but retire 630 megawatts (MW) of the Petersburg units 1 and 2 by 2023. The capacity would be replaced by a diverse portfolio of resources that are cleaner and less expensive including wind, solar, storage and energy efficiency. As new resources are required beginning in 2023, IPL intends to maintain a high degree of optionality at the lowest delivered cost by conducting requests for proposals (RFPs) for competitive all source bidding. *(IPL's IRP Executive Summary page XX)*

IPL's IRP was exemplary and very well done. IPL made significant improvements in the current IRP compared to the 2016 IRP. The Director further cites the commitment of IPL's management and resource planning staff as the primary driver of the substantial improvement in IPL's IRP. The Director also commends IPL for facilitating a robust stakeholder process by having an open conversation and a willingness to consider the ideas and perspectives of others. IPL held five public stakeholder meetings and other technical meetings with individual or combinations of stakeholder groups. IPL provided detailed modeling assumptions early in the process, enabling meaningful discussion about inputs and methodology. IPL made good use of public data IPL also provided access to confidential data to interested stakeholders who signed non-disclosure agreements.

Indiana's coal fleet, the dramatic decline in the cost of renewable resources, the increasing cost-effectiveness of energy efficiency as a resource, and environmental policies over the last several decades that reduced emissions from coal-fired plants are also drivers of change.

IPL, like other utilities, has continually improved the modeling of energy efficiency (EE) and other distributed energy resources (DERs), but it remains a daunting and controverisal task. Consistent with prior comments urging sharing of information with the Midcontinent Independent System Operator (MISO), IPL has participated in a collaboration with the MISO to better understand the potential ramifications of DERs on IPL's distribution system operations and planning, IPL's IRP, and MISO's operations and planning. *(IPL's IRP page 104)* IPL seems to recognize the emerging consensus that the values of EE and DERs (e.g., avoided costs at all levels) are time- and location-dependent, which requires short-interval data such as that made possible by advanced metering infrastructure (AMI). The Director appreciates IPL's ongoing investment to improve the quality, scope, and quality of data (such AMI[5] and more in-depth information about their customers appliances / end-uses and demographic data).

III. FIVE PRIMARY AREAS OF FOCUS

Consistent with IPL's comment about significant challenges, the primary areas of focus of the Director's comments, include the interrelated relationships among: Load Forecasting; Demand Side Management (DSM), which includes EE and demand response (DR); Risk / Scenario Analysis; the Stakeholder Process; and continual improvements to all aspects of IRP. The continual improvements include enhancements to load forecasting, risk analysis, and all forms of DERs, including storage such as Hybrid Energy Systems (HES), Electric Vehicles (EVs), and avoided costs.

IV. LOAD FORECAST

IPL serves approximately 500,000 customers. *(Introduction- IPL's IRP page 1)*

> "IPL anticipates stable customer growth in the Residential sector primarily in multifamily units, such as apartments, condos and townhouses. This growth is expected to increase average annual load at a rate of 1.7% over the planning period. Customer growth is expected to be modest in the Commercial sector keeping load relatively flat with an average annual growth of 0.5%. Industrial sector load is anticipated to decline at an average annual rate of -0.1% over the planning period due to a declining manufacturing employment outlook and efficiency trends." *(IPL IRP page 30)*

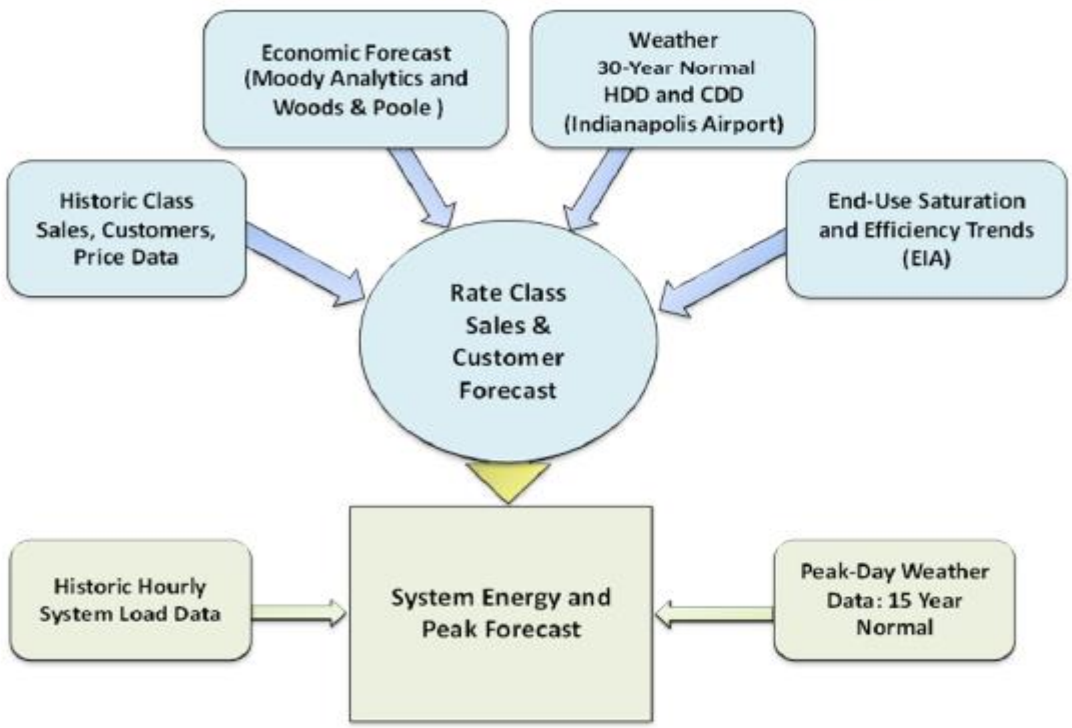
The load forecast in this IRP was developed by IPL using Itron's Statistically Adjusted End-Use ("SAE") load forecasting methodology. Historically, Gross Domestic Product (GDP) and other economic indicators exhibited strong correlation with electricity sales. As such, load forecasts were heavily reliant on GDP and economic forecasts. However, since 2008, this linkage is less pronounced. Sales have flattened due to efficiency improvements from codes and standards and utility-sponsored DSM while GDP has continued to grow. Itron's SAE methodology addresses this

[5] AMI benefits include 15-minute interval usage data, avoided truck rolls for service reconnection, better outage prediction through a "last gasp" from meters, remote verification of outage status, remote voltage sensing which supports distribution operations, and residual customer satisfaction from these enhanced services. [U]nder the IPL TDSIC Plan, IPL will replace approximately 350,000 residential and small commercial single and three phase electric meters over a five-year period beginning in 2020…{B]eginning in 2010, as part of the Smart Energy Project, IPL initiated AMI to capture demand meter interval data which was still being manually read. (IPL IRP page 23)

issue by incorporating end use saturations and efficiency trends using U.S. Energy information Administration (EIA) data.

Figure 4.5 provides an overview of the workflow of Itron's SAE model that builds up to a System Energy and Peak forecast. The dependent variables are being predicted using estimates of cooling requirements (XCool), heating requirements (XHeat) and other uses (XOther). These three variables are constructed using the weather, economic, utility price, and end use inputs. Thus, all structural and equipment changes, predicted economic impacts, price elasticities and weather assumptions are captured in the resulting forecast. *(IPL IRP pages 31-32)*. The following graphic is on page 32 of IPL's IRP.

Figure 4.5 | Forecasting SAE Model Overview of Inputs



IPL forecasts monthly sales and customers for each rate code which are aggregated into a system-level forecast adjusted for historic line loss factors. The system-level forecast along with the system hourly load history, peak-day weather and end use intensity data drive the peak forecast. The residential sector incorporates saturation and efficiency trends for 17 end-uses and the commercial sector captures end-use intensity projections for 10 end-use classifications across 10 building types. The EIA doesn't provide saturation and efficiency trends for the industrial sector. As part of the DSM Market Potential Study (MPS), IPL conducted an in-depth end-use analysis of each customer sector in order to gain an accurate representation of the saturations and efficiencies of equipment in the service territory. Results from the analysis informed the EIA intensity base year assumptions used in the Itron models. Future energy intensities are derived from the EIA's 2018 Annual Energy Outlook (AEO) for the East North Central Census Division. *(IPL's IRP pages 32 and 33)*

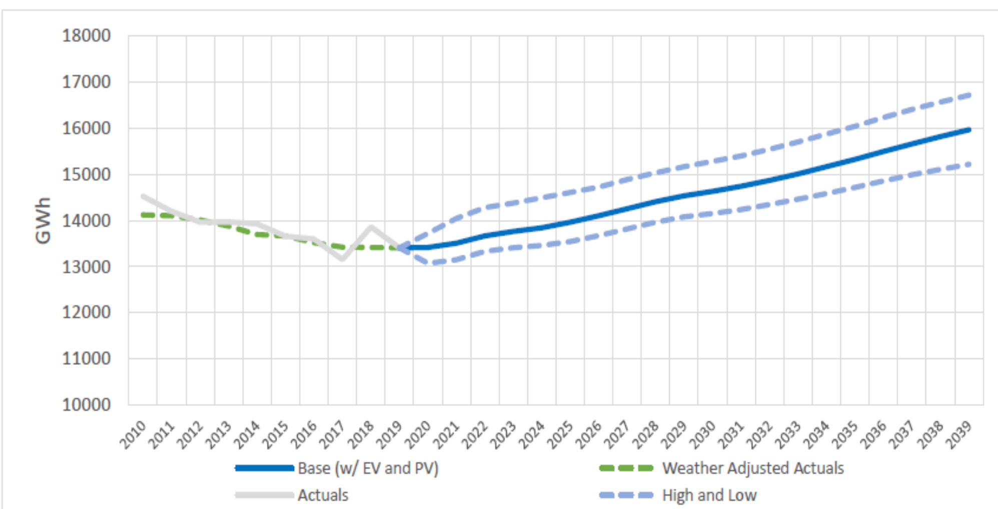
IPL incorporated economic and weather inputs into the forecast model. IPL used Moody's Analytics projections from Q4 2018 to develop two scenarios. The scenarios were 'Exceptionally Strong Growth' and 'Lower Trend' forecasts that were one standard deviation from the base forecast mean. *(IPL IRP page 35).*

The weather variable was based on historical and normal monthly heating degree days ("HDD") and cooling degree days ("CDD") which were derived from National Oceanic and Atmospheric Administration (NOAA) daily temperature data for the Indianapolis Airport. For the residential and commercial classes, a temperature base of 60 degrees was used in calculating HDD and a temperature base of 65 degrees was used in calculating CDD. Generally, industrial classes are not considered weather sensitive. The base temperature selection is determined by evaluating the sales/weather relationship and determining the temperature at which heating and cooling loads begin. *(IPL IRP page 33-34).*[6]

> "IPL-sponsored DSM was included as an endogenous variable in the sales models. As an input, the models assessed correlation between historic sales and historic DSM estimating a DSM coefficient. For example, if the model estimates a coefficient of 0.5, then the model is saying that 50% of the historic DSM is captured in the historic sales. IPL then adjusts out any planned DSM based on this approach." *(IPL IRP page 35).*

The following Base, High, and Low Forecast chart is on page 36 of IPL's IRP.

Figure 4.8 | IPL Base, High & Low Load Forecast (2020-2039)



The Residential Sector is comprised of three primary customer types; those with gas heat (57%), electric heat (7%) and gas heat (36%) with electric water heaters. On a percent of sales basis, the

[6] "Future normal weather assumptions uses a 20-year weather trend approach to capture the effects of climate change on normal temperatures. Using this approach, IPL calculated the year-over-year trend in the 20-year rolling average HDDs and CDDs over the past 20 years. HDDs have declined on average by -0.3%; whereas CDDs have increased by 0.6%. These trend percentages are assumed to continue over the period of the analysis. The base year (2019) normal HDDs and CDDs are 20-year averages of 2009–2018 HDDs and CDDs" (IPL IRP page 34)

residential customer types are disaggregated as follows: 46% gas heat. 8% electric heat and 46% gas heat with electric water heat. The Residential Sector makes up 38% of IPL's total sales. The key residential forecast economic drivers are Marion County housing starts, Marion County household income and Marion County household size. Over the next 20 years, the number of housing starts are projected to grow at an average annual rate of 2% while household income is projected to grow at an average annual rate of 0.8%. Both will increase customer volume and total usage. Household size is anticipated to decline at a rate of -0.4% which is consistent with the trend in household growth primarily coming in the form of multifamily apartments. *(IPL's IRP page 36)* This is a trend cited by the Indianapolis Business Journal. "Between 2007 and 2018, the volume of apartments in downtown Indianapolis has grown by 250%. Apartments are on average smaller in conditioned square footage than a single-family home and therefore require less electricity." *(IPL's IRP page 37)*

The Commercial sector includes customers with demand of less than 500 kilowatts (kW). Also included in this sector are larger secondary service demand metered customers between 50 – 500 kW; examples include grocery and box stores. The Commercial sector comprises 40% of total IPL sales. IPL anticipates continued growth from large commercial projects. The key economic drivers to the Commercial forecast are Marion County non-manufacturing employment (expected to grow at 0.8%) and Marion County non-manufacturing GDP (resulting in an annual growth of 1.9%). The combined variable used in the forecast had an average annual growth rate of 1.04%. The number of new customers is projected to grow at an average annual rate of 0.42%; while the average use per customer is exhibits only modest growth at an average annual rate of 0.13%. *(IPL IRP page 39)*

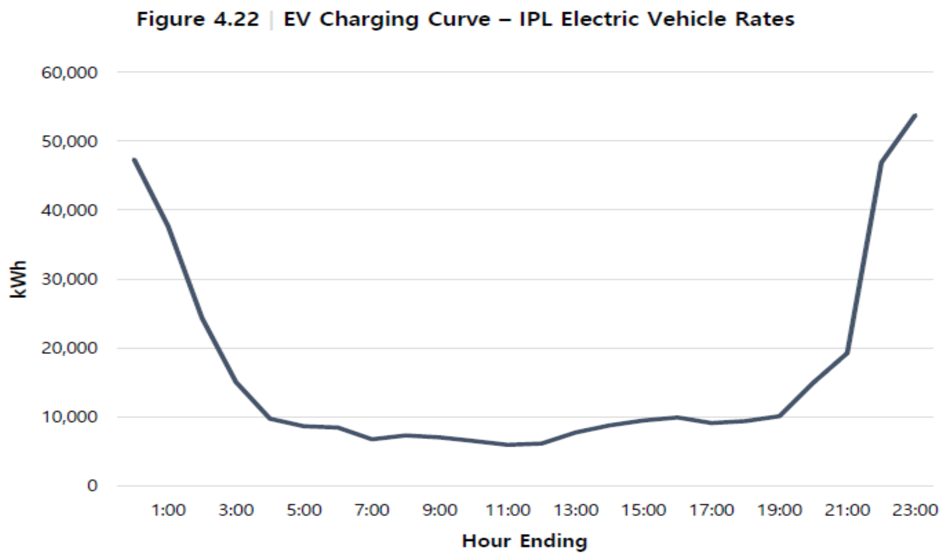
The Industrial Sector is comprised of demand metered customers larger than 500 kW. These customers receive three phase primary service to about 200 customers with total energy usage at around 22% of total IPL sales. As with the Commercial sector, the primary economic drivers for IPL's Industrial forecast are Marion County manufacturing GDP and Marion County manufacturing employment. Over the 20-year planning horizon, manufacturing GDP is anticipated to increase at an average annual growth rate of 1.57% while employment is anticipated to decline at a rate of -0.53% annually. The economic variables used in the forecast are weighted more heavily to employment resulting in an average annual growth rate of 0.93%. *(IPL IRP page 41)* IPL's load forecast is exogenously adjusted to reflect anticipated customer loads larger than 5 MW that may not be picked up in the Moody's economic input data. These customer additions are tracked by IPL's Strategic Accounts group. *(IPL's IRP page 43)*

One risk to the load forecast will increasingly include EVs. The market for EVs is expected to grow rapidly, driven by declining battery costs and improved performance. This increased EV adoption has the potential to result in significant measurable future grid impacts but this has not been an immediate concern for distribution system planning (DSP), investment, and operations. Eventually, controlled EV charging may also serve as a resource in grid management. As of late 2018, the number of EVs remains relatively small with approximately 500 registered in the City of Indianapolis compared to about 515,300 total vehicles registered in the greater Indianapolis area. The penetration rate remains below 0.01%. IPL implemented an EV program in 2011. This program resulted in 162 charging stations in homes, business and public parking facilities as part of the Smart Grid [7] Investment Grant. IPL has both a Time of Use ("TOU") EVX rate for customer premises and a public EVP rate for public charging stations. At present, approximately 130 customers participate in Rate EVX. *(IPL's IRP page 45)*

---

[7] IPL is incrementally investing in smart grid assets. (IPL's IRP page 20).

Over the past few years, load growth has been fairly flat but that may change with EVs. Even though EV penetration has increased slower than IPL anticipated *(IPL's IRP Page 26)* the increases in EVs will not only result in additional electric use it could also alter IPL's load shapes, future resource requirements, and the distribution system.



Graphic - IPL IRP page 46

Another risk to the forecast is the use of photo voltaic (PV) in the form of a distributed energy resource located on the customer's home or business. PV was projected similar to IPL's modeling of EVs. The PV forecasting process closely mirrored the approach MCR (IPL's consultants) took in developing the EV forecast. *(IPL's IRP page 51)*

The PV unit forecast was developed using the December 2018 Solar Energy Industries Association (SEIA) and Wood Mackenzie Power and Renewables Solar Market Update Report, often referred to as the Greentech Media (GTM) as the primary source. The specific methodology was a straight-forward matter of developing the 2019-2023 GTM report compound annual growth rates for residential and commercial & industrial solar installations and applying that to the number of residential and commercial & industrial net metered installations in the IPL service territory as of year-end 2018. *(IPL IRP page 52)*

Figure 4.25 | PV Summary and Prototypical PV Systems

Attribute	Residential	C&I
IPL NEM count (Adjusted EIA counts from IPL 2018 NEM file)	177	21
Size (kW - DC)	8	125
Panel type	Anti-reflective crystalline silicon	Anti-reflective crystalline silicon
Array type	Fixed	Fixed
Capacity factor	15.8%	15.8%
Production basis	PVWatts – 46241	PVWatts – 46241
System cost/watt	$2.70	$1.83
System cost	$21,600	$228,750
Annual O&M	$192	$2,250

(IPL IRP page 52)

IPL Rate CGS (Commercial General Service) costing periods and PVWatts 8,760 annual hour production data for the 8-kW prototypical residential system and 125-kW prototypical commercial & industrial system were used to develop the on-peak MWh, off-peak MWh and peak MW forecasts. IPL created an average 8,760-hour PV profile using IPL's Rate REP (Renewable Energy Production) solar customer data. IPL used this profile to spread MCR's monthly PV forecast out to every hour for the IRP model. *(IPL IRP page 52)*

Figure 4.26 IPL Forecast of EV & PV Counts and Demand

	EV Count	EV Summer kW	EV Non-Summer kW	PV Count	PV MW
2020	5,621	901	1,226	240	4.34
2021	7,843	1,255	1,709	264	4.65
2022	9,968	1,596	2,174	291	4.98
2023	11,939	1,913	2,605	321	5.34
2024	15,469	2,481	3,379	354	5.72
2025	19,543	3,138	4,273	390	6.13
2026	24,364	3,915	5,331	430	6.56
2027	30,566	4,915	6,693	474	7.04
2028	37,743	6,073	8,269	524	7.67
2029	46,268	7,448	10,142	579	8.34
2030	56,148	9,043	12,313	640	9.07
2031	68,348	11,012	14,995	707	9.84
2032	82,173	13,246	18,036	761	10.66
2033	97,192	15,673	21,340	863	11.55
2034	112,667	18,173	24,745	953	12.51
2035	128,128	20,671	28,147	1,053	13.54
2036	143,283	23,120	31,481	1,163	14.65
2037	157,912	25,484	34,700	1,285	15.86
2038	171,925	27,748	37,783	1,421	17.30
2039	185,298	29,909	40,726	1,571	18.85
2040	197,177	31,829	43,339	1,737	20.53

Note: The EV forecast kW are for Rate EVX.

DIRECTOR'S COMMENTS – LOAD FORECASTING

IPL significantly changed its load forecasting approach and narrative beginning with the 2016 IRP from the 2014 IRP. IPL retained Itron for the 2016 forecast and in the preparation of the report. The result was a significant improvement in the methodologies and clarity of the load forecasting section of the 2016 IRP and the 2019 IRP. We urge IPL to continue to build on this successful collaboration with outside experts.

It was disappointing that, unlike the 2016 forecast prepared by Itron, that included a well-written Appendix, there was not a comparable Appendix in the 2019 forecast. To make things more confusing, Volume 2 of IPL's 2019 IRP includes in the appendix portions of the 2013 Itron Long-Term Electric Energy and Demand Forecast Report prepared for IPL. While unclear, it seems that IPL staff is using Itron's Statistically Adjusted End-use (SAE) methodology that was developed in 2016. It is also unclear whether the SAE model used by IPL was updated. The DSM Market Study stated:

> "The 2016 Long-term Electric Energy and Demand load forecast consists of the most recent Itron load forecast completed for IPL for the planning horizon of 2016-2036. Future years were escalated by a compound annual growth rate." *(Appendix on page A-2)*

Company Response: AES Indiana did not contract with Itron to perform the load forecast or write a report for the 2019 IRP. Instead, the forecast was performed internally using the Itron methodology with support and review from Itron. AES Indiana appreciates the Director's feedback and will consider contracting Itron for the load forecasting and appendix report in the next IRP. *(AES Comments on Draft Director's Report, p. 1)*

The SAE model was updated. The intention of Attachment 4.3 (Residential SAE Modeling Framework and Commercial SAE Modeling Framework) including in the 2019 IRP Volume 2 is to provide a general summary of the SAE methodology used in the 2019 IRP load forecast. This is the same methodology used in 2016. AES Indiana updated all SAE data included in the 2019 IRP load forecast so that it is consistent with the 2019 EIA Annual Energy Outlook. AES Indiana will work to avoid this confusion in its next IRP. *(AES Comments on Draft Director's Report, p. 2)*

Director's Response to Comments: The Director appreciates the explanation provided. It is the Company's choice as to how to prepare the load forecast and the associated documentation. The Director's primary concern is that enough explanation be provided so that a reader can understand what was done, why, and how.

Actual weather data comes from NOAA for the Indianapolis Airport (IND). For the Residential forecast, the base temperature used for HDD is 60 degrees and for CDD 65 degrees. For the Commercial forecast, 55 degrees is used for HDD and 60 degrees for CDD. The base temperature used in the 2019 IRP are different than what was used in its 2016 IRP where 60 degrees was used for HDD and 65 for CDD for both classes. Historically, over the past 10 years or so, it was common for utilities to use a base temperature of 65 degrees for both heating and cooling degree days. It is not clear what led IPL to change their temperature base for calculating degree days for the Commercial class after the 2016 IRP. It is becoming common for utilities to use something less than 65 degrees, especially for heating degree days. In future IRPs, it would be interesting to analyze the appropriateness of changes to the HDD and CDD.

Company Response: Adjusting the base temperature for calculating the HDDs and CDDs for the Commercial sector in the 2019 IRP generally improved key forecast model statistics – R-square and Mean Absolute Percent Error. The improvement in statistics indicates that this base temperature adjustment better captures the heating and cooling breakpoints for the Commercial sector. AES Indiana will provide additional analysis and explanation for any similar adjustments in future IRPs. *(AES Comments on Draft Director's Report, p. 2)*

Director's Response to Comments: The Director appreciates AES's willingness to provide additional information in future IRPs.

Normal weather comes from a 20-year trend model on degree days. This seems to be something new in 2019 for IPL. The limitation of trend models is that they assume the trend will continue in the future which may not be the case. IPL states that this is done to "capture the effects of climate change on normal temperatures". Simply using a shorter time period to calculate normal weather the way they use to would capture that as well. The weather normals were based on 30 years in the 2016 IRP and now they are using only 20 years anyway. The change to a shorter time-period is reasonable though and in line with many utilities given warming trends.

<u>Residential</u>

IPL's forecast for the Residential Sector continues to have three customer types - electric heat, gas heat, and gas heat with electric water heat. The main economic drivers are Marion County housing starts, Marion County household income, and Marion County household size. The energy forecast is the result of a forecast of the number of residential customers multiplied by a residential use per customer forecast from a monthly statistically adjusted end-use model for each customer type and then the three types are aggregated to total Residential. The number of customers model is a linear regression model driven by the population forecast for Marion County. The residential use per customer model for each customer type is a monthly statistically adjusted end-use model in which sales are a function of heating, cooling, and other end-use variables. The end-use variables capture the interaction of end-use intensity projections, household characteristics such as size and real income, electricity price, and heating and cooling degree days.

The narrative for the residential forecast is confusing. The number of residential customers grows at 0.8% (Figure 4.9) and average use grows at 0.4% (Figure 4.10). Thus, it seems like sales should grow at 1.2% (0.8+0.4). But the text on page 38 states that there is a "forecasted flat-to-declining sales per customer." Note this seems to contradict Figure 4.10. Also, Figure 4.12 indicates sales grow at 1.7%, not 1.2%. *(IPL's IRP pages 36-39)* The March 26, 2019 Stakeholder meeting presentation by IPL discussed the load forecast. The base case results discussed there had residential average use increasing 0.4% on an average annual growth rate over the period 2020-2039, the number of customers growing at a rate of 0.8%, and total residential sales growing at a rate of 1.2%.

Company Response: The total residential sales growth rate should have been listed at 1.2% in Figure 4.12 Residential Sales on pg. 39 of the 2019 IRP Volume 1. This would be consistent with the growth rate presented for total Residential sales at the March 26, 2019 Stakeholder meeting. Additionally, the Director is correct in noting the contradiction that the sales per customer (average use) is not forecasted to decline. The appropriate characterization is that AES Indiana's historical residential sales per customer has been flat-to-declining due to the shift to multifamily housing as well as increases in organic and AES Indiana-sponsored efficiency. However, average use is forecasted to be flat-to-slightly increasing at a rate of 0.8% due to saturation of efficient residential lighting potential and an increasing volume of miscellaneous electronic devices in homes. *(AES Comments on Draft Director's Report, p. 3)*

Director's Response to Comments: The Director appreciates the clarification.

Additional confusion is created by an obvious error in the vertical axis when comparing Figures 4.9 and 4.10. The vertical axis is the same and that is not possible. It is also confusing that the residential and commercial average energy use sections of the 2013 load forecast report written by Itron are included in Volume 2 of the IRP. Why the 2013 Itron report and not the 2016 version?

To avoid double counting the impact of EE, IPL sponsored DSM was included as an "endogenous variable" in the sales models. This allowed IPL to adjust out of the load forecast any effects from planned DSM. Unfortunately, there is little detail to better understand what was done. *(IPL's IRP page 35)*

Company Response: In the 2019 IRP load forecast, AES Indiana included a DSM variable in the sales models for rate codes that participate in DSM. The endogenous variable is a data stream that included all historic/realized DSM and all planned DSM for 2018-2020 based on the Commission order in Cause No. 44945 and selected DSM from the 2016 IRP for 2021-2039. This was done to capture the planning horizon in the 2019 IRP.

AES Indiana only included this variable in the sales models if it was considered significant (using p-value) and did not impair other model statistics (R-square). By correlating the DSM variable's history with AES Indiana load history, the model provides a coefficient for the variable that indicates the volume of the variable's planned DSM that is included as a reduction in the load forecast going forward. For example, a coefficient of -0.8 would mean that 80% of the DSM variable's planned DSM is being reduced from the load forecast. This method captures the trend embedded in AES Indiana's load history and results in a forecast that is reduced for DSM.

Because DSM is treated as a resource in the IRP model, AES Indiana needed to include a load forecast that is free of all planned DSM. Modeling a future that assumes no future planned DSM provides a blank slate for the model to add DSM. To achieve this, AES Indiana grossed up the load forecast that had been reduced for planned DSM as described above. AES Indiana made this adjustment in spreadsheets outside of the model. *(AES Comments on Draft Director's Report, pp. 3-4)*

Director's Response to Comments: The additional explanation provided is helpful.

<u>Commercial</u>

Prior to its 2016 IRP, IPL did not model or forecast Commercial and Industrial (C&I) separately as many utilities. Instead, IPL modeled and forecast Small C&I and Large C&I. Starting with its 2016 IRP, IPL modeled and forecast Commercial and Industrial separately. IPL's Commercial sector includes customers with demand of less than 500kW. The main economic drivers are Marion County nonmanufacturing employment and Marion County nonmanufacturing GDP. The commercial forecast driver is heavily weighted towards nonmanufacturing employment; 80% on the employment variable and 20% on the GDP variable. Employment is thought to be a better predictor of commercial sales.

The 2019 IRP contained less information about Commercial sales than the 2016 IRP. The 2016 IRP says Commercial customers, like Residential, are modeled and forecast using the Statistically Adjusted End-Use model; except using a total sales model as opposed to an average use model. If IPL's 2019 IRP continued to use the Itron methodology that was used in 2016, it should be more clearly stated. In other words, the 2016 IRP stated the Commercial model was similar to the Residential except total sales were used instead of average use. There is no mention of this in the 2019 IRP. Has this changed or is it the same as in the 2016 IRP? In the 2019 IRP, there is a picture of Commercial average use on page 40 which makes the use of the SAE model unclear. The 2019 IRP narrative also doesn't mention other model drivers (in addition to the economic ones) that were mentioned in the 2016 IRP. The reduced information did not include billing days, price, end-use intensity trends (measured on kWh per square footage basis), and heating and cooling degree days. Based on the presentation by IPL to the March 26, 2019, IRP stakeholder meeting, IPL used an equation with total sales as the dependent variable.

Company Response: There was no change. The methodology that AES Indiana used for the 2019 IRP load forecast was identical to the methodology used for the 2016 IRP load forecast – both used Itron's Statistically Adjusted End Use methodology. All data sets, including economics, EIA saturations, sales, customers, weather, and utility price forecasts, were updated to contemporary 2019 data. As noted by the Director, the Commercial models forecast total sales by month by rate code, whereas the Residential models forecast average use by month by rate code in both 2016 and 2019. AES Indiana will include additional information in the next IRP to make sure that the methodology is clear. *(AES Comments on Draft Director's Report, p. 4)*

AES Indiana used an equation with total sales as the dependent variable. As indicated in the previous response, AES Indiana used the same Itron methodology for the 2019 IRP load forecast as the 2016 IRP load forecast. This included the same driving variables but updated to the most contemporary 2019 data. AES Indiana will improve the description around the methodology and variables in the narrative of next IRP report. In addition, AES Indiana agrees that having Itron provide a detailed report (as noted by the Director on pg. 8 of the Draft Director's Report) could better facilitate the understanding of the methodology and general load forecasting process. AES Indiana will consider including Itron for this work in the next IRP. *(AES Comments on Draft Director's Report, pp. 4-5)*

Director's Response to Comments: The additional information is helpful. To clarify, the Director understands that how to prepare and support the load forecast is a company decision. The Director only asks that the supporting methodology, data, and reasonable documentation be provided.

Industrial

Unfortunately, there is not nearly as much detail on the model and data used to forecast this important sector as there was in the 2016 IRP. IPL's Industrial forecast includes roughly 200 demand metered customers larger than 500 kW. *(IPL's IRP page 39)* The main economic drivers are Marion County manufacturing employment and Marion County manufacturing GDP, with the variable heavily weighted towards employment. The "economic activity" measure used for the Industrial models is a weighting of manufacturing output and manufacturing employment with a significantly higher weight on the latter. While it appears that this was done with care and with valid results in this case, manufacturing employment can be a problematic driver for sales because as manufacturing processes become automated manufacturing employment and sales move in opposite directions.

The narrative for the economic input does not seem right. GDP grows at 1.57% and employment at -0.53%. If you combine those two with equal weights, it would be close to the average of those (actually 0.62% for 20 years). If employment were weighted more heavily, as the text states, it would be lower than the amount with equal weights (since employment has the lower growth). Instead, it is higher (0.93%). Also, manufacturing employment can be a poor indicator of industrial energy use, particularly if the level of process automation changes. *(IPL's IRP page 41)*

Company Response: The Director is correct in noting that the weighted economic percentage appears high at 0.93% given the GDP and Employment growth indicated. The chart presented on IPL IRP Volume 1 – pg. 43 that notes the percentage of 0.93% is for rate code SL (which is categorized as a large commercial and industrial class of customers). This rate code is forecasted using nonmanufacturing GDP and employment (with growth rates of 1.8% and 0.73%, respectively) rather than manufacturing GDP and employment. AES Indiana should have included the chart for rate code HL1 that appropriately ties to manufacturing GDP and employment and presents a growth rate of -0.16%.

AES Indiana agrees with the Director that manufacturing employment can be a poor indicator of industrial energy use due to process automation changes. That is why AES Indiana also includes GDP as part of the weighted economic variable in the load forecast models. *(AES Comments on Draft Director's Report, p. 5)*

Director's Response to Comments: The additional discussion is helpful.

IPL exogenously adjusts its Industrial forecast for anticipated customer loads larger than 5 MW. *(see page 43 of IRP)*.[8] These customers are tracked by IPL's Strategic Accounts Group because it is assumed that changes for customers this large are not being picked up in Moody's economic forecast given it is difficult to predict this type of change. The discussion is confused but IPL appears to exogenously adjust the load forecast for near term expected increases measured in megawatts for individual customers. The question arises whether these adjustments should be changed over a five to 10-year period. The large megawatt load changes for individual large customers may not be reflected in the near-term forecast so an exogenous adjustment might be reasonable, but it seems likely these types of changes are reflected in the broader historical load history and thus accounted for in the long-term forecast beyond an assumed early period in the forecast horizon. If these large customer changes are captured in the historical load data, perhaps it makes sense to slowly taper off the adjustment. Because of the higher certainty in the near-term, it seems likely there may be a higher probability that these exogenous adjustments in large customer load growth may not persist in the longer-term planning horizon which is another concern for a broader forecast band.

Company Response: There may be a misunderstanding as to how the anticipated large customer load is being captured in the forecast. Here's an example of the process to help with understanding

> Each quarter the load forecasting team meets with the Strategic Accounts team to assess new customer loads at AES Indiana. A hypothetical example of new customer load may be that an existing customer is adding a new 10 MW facility on January 1, 2023. Using customer input on the type of facility, the AES Indiana team estimates a load factor for this addition (for example – 80%) to calculate annual MWh consumption (in this case 10 * 0.8 * 8760 = 70,080 MWh annually). The forecasting team then divides this estimate by 12 months and adds it to the load forecast starting January 1, 2023. This load remains on the system unless the customer indicates that it is only temporary or shutting down.

AES Indiana agrees that a portion of customer load growth is reflected in the broader load history and thus is accounted for in the long-term forecast. However, this growth is primarily in smaller customers that are less than ~5MW. Any expected customer loads greater than ~5MW are generally larger than the typical customer load increases reflected in the broader load history (or those assumed to be captured in the economic data). As such, the models will not fully capture the impact of the load from these customer additions in the projections. Thus, Itron recommends that the forecast be adjusted upward for these loads at the point in time when the specific customer load is scheduled to come onto AES Indiana's system. Unless this customer's load is temporary or forecasted to shutdown at some point in the future, the load should reoccur each month after going into service. *(AES Comments on Draft Director's Report, p. 6)*

Director's Response to Comments: The Director understands the point being made by AES Indiana, but also knows that how to adjust a load forecast for larger than normal load additions is as much an art as a science. It is for this reason that a full explanation of what was done and why is helpful.

[8] The Industrial Sector is comprised of demand metered customers larger than 500 kW. IPL serves roughly 200 of these customers with total energy usage at around 22% of total IPL sales. (IPL's IRP page 41)

<u>Street Lighting</u>

There is no mention of the Street Lighting category and how it is forecast in the 2019 IRP. Given the energy efficiency improvements in all forms of lighting, this is surprising, especially since the 2016 IRP contained a forecast of street lighting.

Company Response: Street lighting was included in the 2019 IRP load forecast. It is forecasted using a simple regression model that estimates street lighting MWh volume using monthly binary variables to capture correlation with available sunlight duration across seasons.

As the Director notes, energy efficiency improvements are occurring in all forms of lighting, including AES Indiana's street lighting. As of December 2020, 92% of Company-owned streetlights have been converted which has resulted in a ~40% reduction in energy usage. The Company is working with the other municipalities within its service territory to convert additional Company-owned street lighting to LED by late 2021 or early 2022. AES Indiana did not include the impacts of the street lighting conversion in the 2019 IRP forecast due to the immateriality of the impact (~20,000 MWh annually). AES Indiana will include a discussion of street lighting usage and how it is captured in the load forecast or other analyses in future IRPs. *(AES Comments on Draft Director's Report, pp. 6-7)*

Director's Response to Comments: The additional information provided is helpful to understanding how street lighting load is being impacted by the installation of new lighting technologies.

<u>Forecast Bands</u>

After mentioning high and low economic forecast from Moody's, IPL states "The high and low forecasting approach will be described later in this section." *(IPL IRP age 33)* The discussion of this risk factor is minimal. IPL states the high and low load forecasts were developed from the growth rates from Moody's "Lower Trend" and "Exceptionally Strong Growth" scenarios with one standard deviation from the base forecast mean (as calculated using the Itron models) as the target in 2039. The Base, High, and Low Load Forecasts assume normal weather and do not include the effects of future DSM. *(IPL IRP page 35)*

Company Response: In addition to the deterministic base and high and low forecasting approach, load was modeled stochastically in the capacity expansion analyses that were performed to determine the 15 candidate portfolios. This analysis simulated 100 different load futures and used the expected value from these simulations in the candidate portfolios. By considering 100 different possible load simulations/outcomes, this method captures some of the uncertainty associated with load.

AES Indiana will include additional detail regarding how risk and uncertainty is captured either through stochastics or through different load forecasting scenarios in future IRPs. *(AES Comments on Draft Director's Report, p. 7)*

Director's Response to Comments: Additional detail on how risk and uncertainty is captured is desirable. The Director generally sees scenario analysis and stochastics as complementary to each other instead of as substitutes but also admits there is much to learn.

<u>Electric Vehicles, Solar, Distributed Energy Resources Effects on the Load Forecast</u>

The Director appreciates the excellent discussion of the EV forecast methodology and the potential implications of increased penetration of EVs. IPL provided a similarly good discussion of their distributed solar forecast. IPL hired MCR Performance Solutions (MCR) to assist in the development of a forecast for the market potential of EVs and Solar PV for the IPL service territory. It is expected that IPL will have a higher penetration of EVs, so it is gratifying that IPL recognized the importance of establishing a baseline and on-going research.

IPL developed an EV forecast based on existing, recent national forecasts adjusted or scaled to the IPL service territory. IPL was able to convert numbers of units of light duty EVs to on-peak and off-peak MWh and MW using IPL Rate EVX costing periods, IPL metered EV charging data, and prototypical EV attributes. IPL's consultant, MCR, created an average 8,760-hour charging profile using IPL EVX customer's AMI meter data from 2018. IPL used this load shape to spread the monthly on-peak and off-peak EV forecasts out to every hour for the IRP model. *(IPL IRP page 51)* A similar methodology was used for the PV forecast.

> "These planning efforts inform each other to ensure alignment in the consideration of DERs across the system. These resources can provide capacity and energy benefits. IPL continues to incorporate additional business and operational practices to maximize benefit." *(IPL's IRP page 27)*

While the Director expressed concerns about some aspects of the forecast, there is considerable appreciation for the good efforts of the management, staff, and consultants to improve the forecast. IPL expended considerable time and effort in explaining the forecast to stakeholders. Especially given the importance of the resource decisions over the next few years, the Director appreciates IPL's commitment to make continuing improvements to the load forecasting processes.

The Director reiterates the commendation for IPL being at the leading edge among Indiana utilities in utilizing AMI and other load research data to develop to better understand its customers' needs. The increased customer information will enable development of customer load shapes that will enhance the credibility of IPL's load forecasting and analysis of energy efficiency, demand response, other DERs, rate design/cost of service, and EVs. *(IPL IRP page 28 and page 92)* IPL states that more granular data will be used in developing its next IRP load forecast. IPL's utilization of North American Industry Classification System ("NAICS") codes and stratification by usage characteristics for manufacturing and non-manufacturing customers is a significant advancement. *(IPL IRP page 28)* IPL's collaboration with the MISO on sharing information on DERs is exemplary.

Company Response: As noted by the Director, AES Indiana plans to use more granular data in its load forecasting efforts in the next IRP. Specifically, AES Indiana plans to further utilize AMI data and work with key partners – like NREL and LBNL – to obtain DSM end use and customer load shapes to enhance DSM planning, DER planning and load forecasting efforts. This data should improve the estimation of the time and locational aspects of DSM and DERs to AES Indiana's load. *(AES Comments on Draft Director's Report, p. 8)*

Director's Response to Comments: AES Indiana's intentions to evaluate how to use more granular data to improve various aspects of the planning process is welcomed. The Director sees this as a long-term, evolutionary process.

It also bears repeating that IPL provided a very good discussion of EV and PV forecasting. The inherent complexities of DERs result in uncertainties, in large part, due to the operational demands and attributes. Differing applications introduce challenges for distribution system planning that, in turn, add complexities to the IRPs, Requests for Proposals for new resources, as well as wholesale market operations and planning. At the extreme, DERs may result in unintentional islanding and sustained over-voltage conditions.

V. ENERGY EFFICIENCY

IPL initiated the DSM planning process by contracting with GDS Associates, Inc. (GDS) to complete a market potential study and end-use analysis. The MPS helped to determiner an achievable level of DSM to ensure the level of DSM that is optimized within the IRP is reasonably achievable. *(IPL IRP, page 92)*

The purpose of the end-use analysis was to determine the saturation and efficiency levels of equipment located on the premises of IPL's residential, commercial, and industrial customers. These equipment saturations and efficiencies established the baseline year of the load forecast and helped establish the market characterization for DSM opportunities. GDS conducted 231 residential, 68 commercial, and 40 industrial surveys that gathered customer information on the volume and type of equipment located on the property. GDS followed up with 40 residential, 68 commercial, and 40 industrial site visits to confirm the information provided by the customers in the survey. Historically, end use information was taken from the EIA saturation and efficiency outlook for the region. IPL decided to include the end use analysis as part of the MPS in order to improve the accuracy of the baseline. Informed by the end use analysis, the market characterization set a baseline or current state of appliance saturations and efficiency adoption. *(IPL IRP, page 95)*

GDS used an Excel-based model to determine the Technical, Economic, Maximum Achievable, and Realistic Achievable Potential DSM estimates from the market characterization and measure characterization assumptions. *(IPL IRP, page 95)*

IPL and GDS created a DSM supply curve from individual measures in the realistic achievable potential. The supply curve was divided into eight sections or bundles starting from most cost-effective to the least cost-effective measures. Each bundle had a levelized cost defined by the measures making up the bundle and an 8760 hourly load shape. Load shapes were assigned to each measure and the measure load shapes were aggregated to derive the bundle load shape. Each bundle represents 0.25% of load. Each additional 0.25% bundle decrement becomes more expensive because a higher DSM target is more expensive to achieve. Each bundle spans the IRP 2021 – 2039 planning period and includes both residential and C&I measures. *(IPL IRP, page 99)*

IPL included two DR bundles in the optimization. One bundle consisted of residential and commercial air conditioner load management with all load impacts occurring in the summer. The second bundle was comprised of residential and commercial water heater control measures with both summer and winter load impacts. Each bundle ran the duration of the study period (2021 – 2039) and had a levelized cost and 8760-hour load shape. *(IPL IRP, page 103)*

The eight DSM decrements were loaded into PowerSimm as negative load items with hourly load for the twenty-year study period. If the Load Zone locational marginal price (LMP) is greater than the levelized cost, then the decrement is a net benefit to the portfolio based on energy savings. *(IPL IRP, page 103)*

The capacity credit for each DSM decrement was determined by the contribution to IPL's peak load which is forecasted to occur in July each year between the Hours Ended 3 PM and 6 PM using EEI format (HE15 and HE18). Each decrement's hourly contribution across these four hours for all 31 days of July were averaged together to arrive at the decrement's capacity credit. The capacity credit increases with time as the decrement energy savings accumulate but is held constant within a year. *(IPL IRP, page 103)*

DIRECTOR'S COMMENTS – ENERGY EFFICIENCY

IPL's discussion of EE bundling on pages 94 – 100 and the EE supply curve to develop bundles was well written and clear. IPL fulfilled its commitment to update its Market Potential Study (MPS). The MPS seemed to be generally well-regarded by stakeholders. The MPS and the development of DSM bundling were topics of several stakeholder meetings and several phone calls with stakeholders. The IPL staff and their outside consultants are well-regarded for their expertise and ability to explain the complex analysis. IPL's discussion at the bottom of page 103 regarding the capacity credit developed for each DSM bundle was well done. IPL sees EE as an opportunity to better understand its customers that should enable IPL to build a closer relationship with its customers. EE also gives IPL more flexibility to explore an evolution of the utility's resources and business model away from one based strictly on moving kilowatt-hours to one based on delivering energy service to customers. The Director believes IPL would agree that EE has delivered significant benefits over the last 40 years.

However, the Director hopes IPL will continue to develop the concepts that will set a foundation for reflecting the time and locational value of all forms of DERs (and HES). IPL's methodology seems to be new, unique, and well-reasoned.

IPL provided a helpful discussion of full avoided costs including Transmission and Distribution (T&D) system avoided costs used to determine the cost-effectiveness of DSM. *(IPL IRP page 104)*. The Director fully appreciates the daunting task of developing dynamic avoided costs that capture wholesale and distribution system costs. *(IPL IRP page 28)*. Because of the importance of DSM in a world characterized by changing technology and economics, more extensive and different analysis of DSM is warranted. These changing circumstances brings renewed attention to the different methodologies and the capability of calculating the different components of the full avoided cost of DSM. [9]

[9] As the Director has noted, intuitively, there seems to be broad agreement that full avoided costs would be a more precise method of establishing the value of all resources. In this regard, it is useful to comment that existing distribution system planning and long-term planning models are not yet designed to incorporate the very discrete information needed for accurately assessing full avoided cost that reflects time and location. These limiting factors will be changing as models, data, and computational capabilities increase and as analysts better understand the implications. So, it is important for IPL to prepare to fully utilize the increased capabilities.

Currently, the Director's primary concern is each bundle spans the entire planning period 2021 – 2039 and each bundle also combines residential and C&I measures. Combining unrelated measures across residential and C&I measures, except that they have similar levelized costs, makes a questionable load shape obscuring the time aspects of different measures. This is an important consideration since the PowerSimm model is designed to capture how weather effects load shapes and the performance of intermittent resources at an hourly level. In a world increasingly characterized by low marginal costs across most hours, it is important that the hourly impact of DSM measures be given particular attention.

Company Response: The approach to DSM bundling reduced the complexity of the 2019 IRP DSM selection process using the PVRR approach. That said, AES Indiana agrees that the DSM bundling approach for the 2019 IRP (using bundles that span the entire planning period and combining residential and C&I sectors) can be improved.

AES Indiana notes that PowerSimm did not create the load shapes for the DSM bundles included in IPL's 2019 IRP. Rather these load shapes were predefined using data supplied by GDS Associates, Inc. that was specific to the type of measure and the sector (residential or C&I) where it is installed.

AES Indiana is assessing capacity expansion models for use in the next IRP that adequately optimize DSM across a higher volume of bundles. This should allow for both residential and C&I bundles using shorter time segments. *(AES Comments on Draft Director's Report, p. 8)*

CAC and Earthjustice Response: We agree with the Director that the time valuing of DSM can better elucidate its value and that an accurate hourly shape of DSM is a critical input for that reason. In our opinion, the problem lies not in the grouping of measures across the residential and C&I sectors, but in the grouping of measures by cost. Grouping of DSM measures in some fashion is necessary to condense the problem size to a manageable level. And the Indiana utilities offer measures to both the residential and C&I sectors so in that sense IPL's methodology is consistent with the realities of DSM implementation. However, because DSM programs are typically developed to offer measures that cover multiple needs and to minimize multiple treatments of program participants, it does not make sense to separate measures by cost rather than by program type. Indeed, IPL's methodology runs the risk of selecting measures with a load shape, e.g. commercial HVAC measures, that is only partially consistent with the measures actually offered, e.g. a combination of commercial HVAC and residential appliance incentives. We agree that the measures selected do not need to dictate the program offered, but we do think broad agreement between the measures selected and those implemented (in terms of class and end-use) is a reasonable goal to aim for and would ensure that cost-effective DSM is being selected in the IRP.

We agree with the Director that there could be value in breaking up the DSM bundles into less than 19-year blocks. Ten-year blocks could be reasonable. Continuity of programs is extremely important for the success of DSM, so we would not recommend modeling programs in three-year blocks as I&M does, for example. The result of that approach has been volatile program savings. *(CAC and Earthjustice Comments on Draft Report p. 3)*

Director's Response to Comments: The Director appreciates the response from AES Indiana and the comments submitted by CAC and Earthjustice. The only thing the Director can say with absolute certainty is that all Indiana IOUs create EE bundles for use in the IRP model optimization and the utilities all use the IRP optimization results to inform the development of EE programs for inclusion in subsequent three-year EE plans. How the utilities perform these two functions appears to differ considerably, especially how IRP information is used to develop residential and C&I EE programs for later Commission approval. The Director appreciates much work remains to better understand what is done. Understanding what is done and how is a necessary condition to better understand what should be done.

VI. RESOURCE OPTIMIZATION AND RISK ANALYSIS

Director's Preface: As a preface to the Director's review of IPL's discussion of resource optimization and risk analysis, the Director commends IPL management's commitment to continual improvements. This commitment was evidenced by IPL's move to using the Ascend Analytics PowerSimm model that enabled IPL to utilize more advanced state-of-the-art analytical and methodological capabilities to good effect. IPL provided excellent discussions of resource adequacy (RA), transmission planning, and work with MISO to integrate supply-side alternatives such as solar and wind (e.g., clear information for capital costs and operating attributes). Future IRPs are well-served by IPL's mutually beneficial collaborative with MISO to share information on the potential implications of DERs, HES, and EVs. As important as the use of a vastly improved resource planning model was in this IRP, IPL's commitment to a thorough well-written explanation of its planning actions is also commendable. IPL placed special emphasis on the clarity of the discussion of resource portfolio modeling and results. IPL clearly states each step of the planning process and how the results at one step inform the analysis at the next step.

IPL's Characterization of their Resource Optimization and Risk Analysis: IPL's discussion notes its use of Ascend Analytics' PowerSimm (IPL's IRP page 4) model to incorporate risk and uncertainty with stochastic modeling of weather, load, renewable profiles, and commodity prices to effectively build risk analysis into the modeling framework and decision analysis in this IRP. IPL used Ascend Analytics' PowerSimm Automatic Resource Selection (ARS) module to perform long-term resource optimization. The advantage of ARS, compared with the previously used Capacity Expansion Model from ABB, is that it uses hourly dispatch modeling to make optimal resource selection. In addition, the PowerSimm ARS has the ability to perform stochastic capacity expansion to provide a robust plan as stated by IPL. The variations in modeling assumptions applied probabilistically across multiple scenarios created a wide range of uncertainty considered. *(IPL's IRP Executive Summary page XXIII)*

Modeling Methodology

IPL evaluated a set of fixed retirement dates on the Petersburg units based on age, existing technology, expected maintenance, and cost. IPL noted that capacity expansion models usually have the capability to co-optimize new build decisions with retirement decisions for existing resources. IPL recognizes this type of optimization can be useful, but that it introduces several modeling complexities and forces the modeler to make up front decisions about constraints for retirements. IPL established retirement dates instead of allowing the model to select the dates. *(IPL IRP, page 122)*

Based on these considerations, IPL developed five portfolios with retirements.

Portfolio 1 - No Early Retirements
Portfolio 2 - Pete Unit 1 Retire 2021 Pete Units 2-4 Operational

Portfolio 3 - Pete 1 Retire 2021; Pete 2 Retire 2023 Pete Units 3-4 Operational
Portfolio 4 - Pete 1 Retire 2021; Pete 2 Retire 2023; Pete 3 Retire 2026; Pete Unit 4 Operational Portfolio 5 Pete 1 Retire 2021; Pete 2 Retire 2023; Pete 3 Retire 2026; Pete 4 Retire 2030
(IPL IRP, page 123)

IPL created five scenarios based on different combinations of natural gas prices, existence of a carbon tax, and IPL load. *(IPL IRP, page 124)*

To determine the optimal level of DSM was targeted, IPL directly tested increasing DSM bundles included in each of the five portfolios. Bundles were added until the Present Value of Revenue Requirements (PVRR) increased. The result was 15 distinct candidate portfolios optimized with increasing levels of DSM. Each optimized portfolio was locked and then run through each scenario stochastically, yielding 75 production cost model runs simulated across a range of probabilistic futures. *(IPL IRP, page 155)*

IPL did not perform traditional scenario capacity modeling optimization. Instead, the 15 distinct candidate portfolios were derived using the Base scenario and the stochastic capacity expansion modeling capability of the Ascend Analytics' PowerSimm modeling platform. Each of the 15 candidate portfolios were created from stochastic capacity expansion runs with 8760-hour chronological unit commitment and dispatch across 100 iterations varying weather, load, and commodity prices. *(IPL IRP, page 120)* Then each of the 15 candidate portfolios were stochastically evaluated for each of the five scenarios. Each scenario and portfolio combination were evaluated stochastically with 100 iterations in a production cost model to widen the range of uncertainty considered. *(IPL IRP, page 120)* Four deterministic sensitivities for two scenarios and all portfolios evaluated (1) renewable and storage capital costs, (2) MISO capacity prices, (3) wind capacity factors, and (4) wind LMP basis. *(IPL IRP, page 120)*

These sensitivities did not require additional production cost model runs because the sensitivity analysis was conducted in the financial revenue requirement model. *(IPL IRP page 143)* IPL utilized a spreadsheet-based set of financial models to build the revenue requirement. The purpose of the revenue calculation outside of PowerSimm was to provide a transparent, flexible method to calculate PVRR, compare scenarios and portfolios, and to build customized outputs for stakeholders. *(IPL IRP, page 121)*

For this exercise, IPL assumed that uncertainty increases through time. When estimating the quantitative impact that resulted from cost changes of wind, solar, and storage units, IPL adjusted the cost 10% to 20% higher or lower starting 2026, then gradually increased the cost variation to 25% to 50% by 2038.

As for the wind capacity factor analysis, IPL adjusted the annual capacity factor ranging from 30% to 46% with a base capacity factor of 42%.

Portfolio Metrics

IPL identified three primary categories of metrics for this IRP: cost, risk, and environmental. All metrics were based on stochastic modeling results for each scenario and portfolio.

IPL used three primary cost metrics:

1. 20-year PVRR
2. Annual revenue requirement
3. Levelized $/kWh rate

    (IPL IRP, page 150)

PowerSimm also identifies the financial risk associated with each energy portfolio, quantifying this as the "risk premium." The risk premium is defined as the probability-weighted average of costs above the median. The risk premium will be larger for portfolios with wider cost distributions, or riskier portfolios, and smaller for portfolios with narrow cost distributions, or a less risky portfolio. IPL added the risk premium variable to the expected value, creating a risk adjusted PVRR. *(IPL IRP, page 150)*

The second risk metric IPL considered was a market interaction variable. This metric is based on annual market purchases and sales for each portfolio across the different scenarios. IPL included market interaction as a risk metric because heavy reliance on the market could introduce market price and volume risk if IPL does not have a balanced portfolio. *(IPL IRP, page 153)*

IPL included the following environmental metrics:

1. Annual CO_2 emissions
2. Annual CO_2 intensity (tons/MWh)
3. Annual SO_2 emissions
4. Annual NOx emissions

IPL also estimated water intake and discharge at Petersburg for the portfolios.

IPL only optimized the Reference Case and none of the other four scenarios were optimized. That is, IPL used stochastic analysis to optimize the Reference Case across the five retirement portfolios and across three levels of DSM. The result is 15 optimized portfolios all based on the Reference Case. These 15 portfolios were locked and run stochastically through each scenario. The result is 75 production cost model results simulated across a range of probabilistic futures.

IPL's resource planning is consistent with the IRP rule to ensure reliability as well as the Planning Reserve Margin (PRM) required by the MISO which is consistent with NERC reliability requirements. [10]

---

[10] IPL's capacity expansion model incorporates MISO calculation of an Installed Capacity ("ICAP") PRM and an Unforced Capacity ("UCAP") PRM using a Loss of Load Expectation (LOLE). The ICAP PRM is higher than the UCAP PRM because it does not account for generator outage events that translate into a unit's Equivalent Forced Outage Rate Demand (xEFORd). For the 2019-2020 MISO Planning Year (June 1 – May 31), the ICAP PRM is 16.8% and the UCAP PRM is 7.9%. IPL's capacity expansion model accounts for individual units' xEFORd, IPL IRP page 6.

DIRECTOR'S COMMENTS – RESOURCE OPTIMIZATION AND AND RISK ANALYSIS

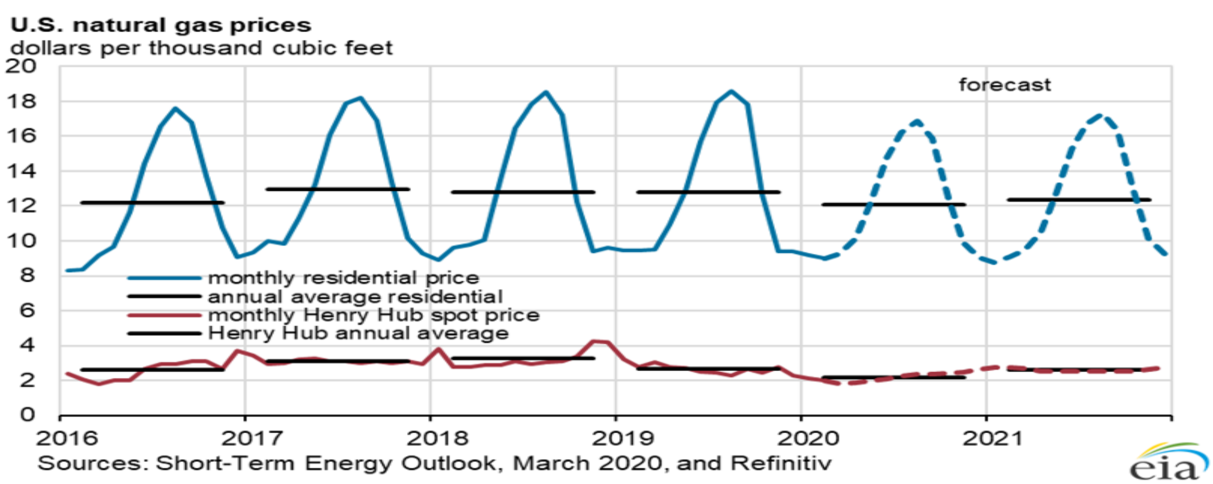
Overall IPL's process is very well done and documented, but we don't know how alternative portfolios might have performed if they were optimized. However, if our understanding is correct that only optimization runs were conducted for the Reference Case and none of the other four scenarios were optimized, this means IPL's scenario optimization is much more limited than one might initially think with the 15 optimized portfolios and 75 production cost runs. The 15 candidate portfolios were created from capacity expansion runs based on different retirement dates on the existing coal units and different levels of DSM decrements. Then each portfolio was evaluated using stochastic analysis against five scenarios defined by high-impact drivers such as natural gas prices,[11] potential carbon legislation and load forecasts.

IPL claimed stochastic capacity expansion was used but it seems all the 15 candidate portfolios came from deterministic capacity expansion runs. If this is not a correct characterization, please explain how those iterations reached only one candidate portfolio for each retirement date and DSM level combination. It is not clear to the Director how the results of the stochastic analysis were used to select the sole candidate portfolio for each retirement date and DSM level combination.

Company Response: AES Indiana views its analysis as stochastic, not deterministic. As noted by the Director, "the 15 candidate portfolios were created from capacity expansion runs based on different retirement dates on the existing coal units and different levels of DSM decrements. Then each portfolio was evaluated using stochastic analysis against five scenarios defined by high-impact drivers such as natural gas prices, potential carbon legislation and load forecasts." *(Director's Report p. 17).* All replacement resources selected to fill capacity shortfall for each of the 15 candidate portfolios were chosen within the stochastic capacity expansion model. The capacity

---

[11] In order to estimate the impact of gas price change, IPL adjusted natural gas price 30% to 40% higher than baseline starting in the first year of the study for High Gas Price scenario and reduced the price 30% to 40% lower in Low Gas price scenario. As the extreme high/low gas price assumption could provide you better understanding of the impact resulted from natural gas price, the assumption should also reflect the real business projection. The chart below shows U.S. natural gas price projection. The price has been flat since 2016. Therefore, we suggest that IPL consider gradually increasing the natural gas price instead of an abrupt change starting on the first year of the study.



expansion analysis for each of the 15 initial portfolios predetermined only the Petersburg retirement dates and DSM levels.

This approach is reasonable. PowerSimm's stochastic capacity expansion model used 100 iterations for each combination of Petersburg retirements and levels of DSM. Each iteration consists of a unique simulation of weather, load, renewables, market prices, and dispatch for AES Indiana's current resources alongside candidate resources. Portfolio costs are determined as an average over all iterations. The objective function for the capacity expansion module is to minimize the portfolio's costs over all iterations while respecting capacity and energy constraints. The output from each candidate portfolio represents the optimal mix of resources based on the range of uncertainty covered in the stochastic iterations with the Petersburg retirement dates and DSM being predetermined. This is how the stochastic capacity expansion model can yield a single optimized candidate portfolio. *(AES Comments on Draft Director's Report, p. 9)*

Director's Response to Comments: The Director believes he understands the methodology employed by AES Indiana in the IRP optimization modeling. He appreciates that the model used by AES Indiana has significant capability for resource optimization, including combining chronological dispatch with a wide range of uncertainty using stochastic analysis. The Director believes it will be helpful in the future to spend more time in the stakeholder process thoroughly discussing the stochastic resource optimization methodology. Also, more discussion in the IRP report itself would be beneficial. The Director is not critical of the model used or the methodology. The primary concern, rather, is to have a better discussion of the model and the methodology so that interested stakeholders can better appreciate what was done.

Second, it seems all 15 candidate portfolios were based on the same set of assumptions and no candidate portfolio was derived from assumptions in different scenarios. The scenario analysis, conducted by IPL, seems to be a test for how those 15 candidate portfolios perform under different scenario assumptions. If this is the case, IPL lacks an appropriate scenario analysis.

Company Response: It is not the case that "all 15 candidate portfolios were based on the same set of assumptions and no candidate portfolio was derived from assumptions in different scenarios." As stated in AES Indiana's response to Director Comment #14, the stochastic capacity expansion model optimally selected replacement resources to meet the reserve margin requirement in each of the 15 portfolios based on 100 unique iterations of the future. These 100 iterations capture a broad range of uncertainty and in turn act as a substitute for having to use different sets of deterministic assumptions. The resulting optimized portfolio is the most robust candidate portfolio over a wide range of uncertainty. This approach also results in the need to run fewer scenarios since the optimized portfolio performed well across stochastic uncertainty.

In the scenario analysis that AES Indiana conducted, the 15 candidate portfolios were further stressed stochastically using different sets of scenario assumptions and compared to the base case.

AES Indiana will consider including additional capacity expansion scenarios in future IRPs. *(AES Comments on Draft Director's Report, p. 10)*

Director's Response to Comments: See the Director's response directly above.

Third, it seems retirements of coal units and DSM levels were all hard-wired in candidate portfolios. If so, the model was unable to be fully utilize the model's capabilities to perform optimization of a broad array of resources to capture a full range of uncertainties and risk.

However, concern about hardwiring was mitigated because IPL provided a detailed explanation about why it chose to select candidate retirement dates rather than letting the model make retirement decisions for existing coal units. Those reasons make sense from a computational and modeling standpoint. There are other reasons for hardwiring the resource decisions that were listed by IPL such as power plant operations and market conditions. Future IRPs would benefit from industry experts' judgments to evaluate whether there is a rationale for hardwiring certain resource decisions.

If our characterization is correct that only the Reference Case was optimized with five different levels of retirements and three different levels of DSM, the resource planning options may be unduly constrained. Even though the Director understands that capacity optimization using stochastic analysis probably was used as a substitute for performing traditional scenario analysis, the Director believes something is lost at an intuitive level when specific scenarios are not optimized. Perhaps the Director is failing to fully understand but it would be helpful to see a comparison of the stochastic capacity optimization conducted by IPL with the more traditional scenario analysis combined with stochastics.

Company Response: As stated in response to Director's Comments #14 and #15, the capacity expansion model is able to optimally select replacement resources under a wide range of uncertainty. This approach is reasonable and not unduly constrained given the other reasons for the retirement dates discussed in the IRP and recognized by the Director.

AES Indiana is considering methods and models to improve the process for the next IRP. *(AES Comments on Draft Director's Report, p. 11)*

Director's Response to Comments: See the Director's response directly above.

IPL's use of stochastic analysis on the reference case, combined with developing four distinct but non-optimized scenario analysis, is intriguing. IPL's analysis is certainly consistent with the IRP rule to use probabilistic analysis as complementary to traditional scenario analysis to provide additional perspectives. To advance the use of probabilistic analysis in concert with scenario analysis, the Director encourages IPL to expand the analysis in the next IRP to go beyond the 15 optimized scenarios predicated on the reference case. Specifically, we would like IPL, in consultation with stakeholders, to consider using stochastic analysis with distinct optimized scenarios and compare to a reference case with stochastic changes for important drivers. Perhaps, IPL and stakeholders would have other approaches that may result in better comparisons. For IPL, with important resource decisions becoming more imminent, the opportunity for additional insights would be propitious.

IPL's analysis of risk and uncertainty suggests that IPL understands the planning and operations of the bulk power system and their distribution system is increasingly stocastic in nature. That is, the use of probabilistic analysis can better capture the uncertainties inherent in the integration of renewable resources, the changing nature of load such as the various forms of DERs and EVs, and the attributes of the DERs and EVs that affect distribution system planning as well as the RTO's planning. To this end, the Director appreciates IPL's willingness to collaborate with the MISO to better understand the ramifications of DERs.

IPL provided an excellent discussion of resource adequacy and transmission planning. IPL highlighted the role of MISO and how IPL plans and operates within the MISO. IPL made it clear that IPL is responsible for resource adequacy and the preparation of long-term resource plans while necessarily having to adapt to changes in MISO planning and operations processes.

> "The shift to more weather-dependent, intermittent renewables and distributed resources mean that system peaks and operating risks are becoming less obvious and more difficult to manage in day to day operations. The planning assumption that most days follow predictable load profiles is also being challenged given the rise of demand responding to market prices. With the changes in the system, better forecasting will capture more unknows into operations and market decisions." (*MISO REGION RELIABILITY IMPERATIVE – Dec. 2020 Draft page 16.*

VII. THE STAKEHOLDER PROCESS

> "IPL held five public stakeholder meetings and other technical meetings, continuing to build upon the stakeholder process in the 2016 IRP. IPL provided detailed modeling assumptions early in the process, allowing for meaningful feedback and discussion about inputs and methodology. The company utilized public data when possible to provide transparency and confidential data was provided to interested stakeholders, consistent with Non-Disclosure Agreements." *(IPL's IRP Executive Summary page XXI)*

IPL received considerable accolades and appreciation for its efforts to communicate the very complex information to improve stakeholder understanding. IPL is also to be commended for its efforts to broaden the diversity of the stakeholder community. Top level management of IPL were involved throughout the process. As the resource decisions become more imminent, IPL expects the number and diversity of stakeholders to increase.

DIRECTOR's COMMENTS – THE STAKEHOLDER PROCESS:

IPL's stakeholder process was consistently well done. In addition to the stakeholder meetings that encouraged discussion, IPL held several conference calls to get a better understanding of issues. IPL's retention of a technical expert moderator facilitated focused discussion. Subject matter experts were available to stakeholders throughout the process including on conference calls. IPL involved stakeholders from the inception of the IRP process to the conclusion of the IRP. The participation by top management was also commendable.

With expected increases in the number and diversity of the stakeholder community, IPL should expect there will be a need for stakeholder education to better participate in the IRP processes of the future. IPL will need to provide discussions of important changes that IPL is undertaking or anticipates undertaking. Stakeholders will need to understand the value proposition of AMI and other customer information, the development of load shapes that reflect the time and locational value of full avoided costs. The data obtained will help stakeholders better understand the potential operational attributes of EE, DRs, DERs and HES constraints on the integration of DERs. The ramifications of changes in the resource mix, the rationale for integrating IRPs with DSP, and how these affect MISO's operations and planning should be discussed in future stakeholder processes.

VIII. FUTURE ENHANCEMENTS TO IPL's IRP PROCESSES

General

IPL provided very well-written narratives about its plans for future improvements to the IRP process. In the Director's opinion, despite some relatively minor concerns, IPL's IRP is exemplary. IPL's strong commitment to develop improved databases, acquire state-of-the-art planning tools, continue to advance analytical methods, continual development of IPL's staff expertise, and the appropriate use of outside experts establishes an excellent foundation for addressing resource requirements. [12]

Future Enhancements to IPL's Load Forecasts

For most of the electric industry's history, load forecasts have been the foundation and primary driver for resource planning. IPL recognized the need for improved data including AMI and other customer information to support improvements in load forecasting. IPL has already used data from AMI to better understand EVs and PVs. So, IPL's extending the use of AMI and other customer data more broadly for other types of load research will be a significant improvement in the next IRP. *(IPL's IRP page 28 and page 205-206)* IPL recognizes DERs are likely to increase and appreciates the need to better understand the potential positive and negative operational and planning attributes of different forms of DERs.

[12] **IPL plans to improve load research and load forecasting by using AMI data.** IPL recognizes that the current load research sample is outdated, especially with the deployment of AMI. IPL plans to work with Itron for more robust load research. These forecasts will help IPL better understand usage trends which includes identifying customer deployment of DERs and EVs. **Seasonal capacity assessment:** Resource capacity credit can vary by season, requiring careful consideration of a portfolio used to serve load reliably. Changes to the capacity construct could have a significant impact on the capacity credit for renewables. **Hourly and sub-hourly modeling:** Hourly and sub-hourly modeling allows IPL to evaluate its ability to meet load for all hours. Some resources such as batteries offer exceptional flexibility. This value may be more accurately captured by sub-hourly modeling, though this currently pushes the limits of many available models. **Explore modeling DSM, EE, and DR shapes hourly and sub-hourly to assess peak reduction, load shifting value:** Hourly and sub-hourly shapes for DSM, EE, and DR allow IPL to evaluate more accurately how these resources can contribute towards meeting load obligations. **Dynamic wind, solar, and storage ELCC:** Wind, solar, and storage's ability to meet reserve requirements is influenced by the penetration of each resource. Therefore, allowing for a dynamic ELCC value that provides feedback based on model selections could produce a more comprehensive optimization. **Bottom up electric vehicle and distributed solar forecast integrated with generation, transmission, and distribution planning:** Electric vehicles and solar distribution are closely tied to IPL's transmission and distribution system. As penetration of these resources increases, the need to incorporate grid infrastructure becomes more important and IPL will continue to evaluate the feasibility of doing so. **Scenario planning centered on decarbonization that prioritize least cost, reliability, and effectiveness:** IPL's 2019 IRP has informed the importance of a carbon tax on influencing the optimal plan for customers. IPL will continue to monitor research and policies that influence the viability of resources. *(IPL's IRP page 205-206)*

> "IPL recognizes that as more distributed energy resources ("DERs") are added to our system, their role will increase in future transmission, distribution and resource planning efforts. These planning efforts inform each other to ensure alignment in the consideration of DERs across the system. These resources can provide capacity and energy benefits. IPL continues to incorporate additional business and operational practices to maximize benefit." *(IPL's IRP page 27)*

Because different types of DERs will be an increasing component of IPL's resource mix, it will be necessary for IPL to explain the ramifications of DERs with and without HES. IPL understands the integration of DERs, HES, and EVs adds significant complexities to DSP. Some DERs and HE may participate in the wholesale markets. Therefore, there is growing urgency for IPL and MISO to continue their collaboration on sharing planning and operational for mutual benefit.

IX. SUMMARY

IPL's IRP made signficiant advances to processes, analysis, methodologies, software, database development, and broad public policy perspectives such as understanding the attributes of DERs and EVs. IPL's load forecasting, EE, risk and scenario analysis; the stakeholder process, and the need for continual improvement such as modeling all forms of DERs, and the implications of EVs are well-documented. Despite the Director's commendation for the high quality of IPL's IRP, the additonal consideration of new technologies demonstrate there are opportunities for continued improvement as required by the IRPs. These include:

- Continuing to evaluate of state-of-the art software;
- Continuing efforts to enhance customer information such as conducting customer surveys that include the age, condition, capacity and other information about specific appliances / end-uses, demographic information;
- Improving the calculation of full avoided cost that reflect the dynamic changes in the time and location;
- Increasing sharing of information with the MISO, increased information about the ramifications and attributes of different DERs and EV infrastructure;
- Increasing integration of distribution system planning with IPL's IRP;
- Continuing to improve the narratives to explain the scenarios and portfolios.

To be clear, IPL's demonstrated willingness to use new state-of-the-art software is commendable for this and future IRPs. So, the Director trusts IPL will consider the use of advanced models that integrate DSP with IRPs. The integration of DSP and IRP software should, as the models develop, provide mutual planning benefits to MISO's planning and operations. The Director recognizes there is substantial amounts of analytical work that needs to be done to better understand the potential benefits and costs of energy efficiency, demand response, other forms of DERs and the implications of EVs. IPL has a good appreciation that, in addition to the analytical work, IPL will need to develop customer-specific data that is required to gain maximum benefits from the advances in modeling to accurately characterize the very complex distribution system and the increasing coordination with the MISO,[13] Because IPL is on the cutting-edge, IPL may want to engage experts from the National Laboratories and others. This work provides an opportunity to educate IPL's stakeholders.

X. STAKEHOLDER COMMENTS

(Director's responsive comments are single spaced and in italics and the Stakeholders comments are indented):

The public input to IPL's IRP has been gratifying. The following comments are intended to be a representative sampling of the public input into IPL's 2018 Integrated Resource Plan and stakeholder process. Often similar comments are raised by more than one commenter. To reduce redundancy, the Director selected some of the more salient and representative commentary.

As a preliminary matter, the Director will take this opportunity to remind all stakeholders of the limitations spelled out in IRP administrative rule on the appropriate content of the Director's report. According to 170 IAC 4-7-2.2(g), the Director's report can only address:

> (g) The draft report and the final report shall:
> (1) be limited to commenting on the IRP's compliance with the requirements of this rule;
> (2) list the areas where the director believes the IRP fails to comply with the requirements of this rule; and
> (3) not comment on:
> (A) the desirability of the utility's preferred resource portfolio; or
> (B) a proposed resource action in the IRP.

Given these guidelines, the Director will limit discussion of stakeholder comments that appear to target the resource portfolio developed by the IRP process or specific resource actions in the IRP. The Director will try to highlight stakeholder comments that address issues or questions about models, methodology, data, assumptions, and criteria used to evaluate the output of the IRP analyses.

Sierra Club (SC)

> "We believe IPL's 2020 IRP failed to fully assess the benefits that would accrue to customers from accelerating the retirement of all of IPL's high-cost coal units. In particular, IPL's customers would likely save money if IPL retired Petersburg units 3 and 4 and replaced those units with a diverse portfolio of clean energy resources." *(page 1 of SC's comments)*

The Director appreciates the SC's continuing participation in the IRP stakeholder process and the considerable analytic effort and expense.

[13] IPL's "distribution system consists of 4,961 circuit miles of underground primary and secondary cables and 6,110 circuit miles of overhead primary and secondary wire. Underground street lighting facilities include 773 circuit miles of underground cable. Also included in the system are 138 substations. Depending on the voltage levels at the substation, some substations may be considered both a bulk power substation and a distribution substation. There are 73 bulk power substations and 117 distribution substations; 52 substations are considered both bulk power and distribution substations..." (IPL's IRP page 22)

The Director agrees with SC and other stakeholders that IPL could have done more to analyze the changing benefits and costs of retaining or retiring various units at the Petersburg station. To this end, the Director thinks IPL could have let the model, to a greater extent than was permitted, co-optimize retirement dates of existing resources with the addition of new resources. The Director recognizes that there are real constraints on the ability of a utility to retire significant large generation resources and replace those facilities in a relatively short period of time. But a fuller co-optimization would have been informative even if unrealistic. Within this context the implication of real-world constraints could have been better understood. Without addressing the details in the SC's analysis, the Director would point out that the IRP is intended to encourage a robust assessment of various risks rather than a single specific plan that is unalterable regardless of changing information.

The Director acknowledges that SC in its analysis tried to account for significant design considerations including the ability of a replacement portfolio to meet the capacity needs in the top 50 hours of capacity need of the year in the MISO. But because of the uncertainties in selecting resources (including DERs), optionality in the selection of resources should be given considerable attention. While the SC concentrates much of its analysis on the cost of retaining Petersburg, IPL recognizes they must also satisfy reliability and resilience requirements. IPL must also maintain optionality to address changing public policy considerations. If SC does not believe IPL has sufficiently addressed the concerns raised in the SC analysis, the Director urges SC to vet its analysis with IPL and the stakeholders during the next IRP.

The Director sincerely appreciates the contributions to the IRP process. In particular, the analytical rigor and depth of SC's comments is very helpful to our review.

Indiana Advanced Energy Economy (AEE)

The Director appreciates AEE's participation and analysis of the cost-effectiveness of IPL's resource options. The following are AEE's comments regarding IPL's IRP.

> Indiana AEE appreciates the stakeholder process that IPL held and IPL's consideration of the feedback received from stakeholders. AEE supports IPL's stated criteria for evaluating various energy pathways, including lowered costs, customer centricity, flexibility, and reduced carbon intensity. Indiana AEE also appreciates that IPL was transparent about resource cost assumptions and is taking active steps to improve its modeling and data for better resource planning in 2022. *(Indiana AEE page 1)*
>
> In response to IPL's preferred resource portfolio, Indiana AEE makes 3 main points:
>
> 1. By deploying additional renewable energy and battery storage on a more expedited timeline, IPL could realize greater savings for consumers and satisfy growing commercial and industrial demand for these resources;
>
> 2. Indiana AEE appreciates IPL's efforts to incorporate energy efficiency, demand response and electric vehicles into this IRP, but could deploy these resources more aggressively to benefit consumers, especially commercial and industrial ("C&I") demand response; and
>
> 3. The Commission should closely scrutinize IPL's plan to invest in new combined cycle gas plants against cost-effective advanced energy alternatives. *(Indiana AEE page 2)*

Indiana AEE especially emphasizes that IPL should take care to properly account for the numerous benefits that energy storage offers to the grid (Indiana AEE page 4). The Director agrees that this is a difficult area of analysis with room for significant improvement across the industry. IPL has been at the vanguard of installing distributed renewable resources in the MISO region and has undertaken the additional steps of monitoring and better understanding the operational characteristics of IPL's customer-owned distributed solar resources. Since AES is a leader in using storage, the Director is confident that IPL has a good understanding of the potential importance and economic viability of battery storage, DSM / HES, and EVs. As AEE knows, battery storage technologies are expected to increase in penetration, capabilities, range of attributes, and coupling with Hybrid Energy Systems while decreasing in cost.

> Indiana AEE recommends the following six steps to meet the economic and environmental requirements for utility-delivered renewable energy production options and the renewable energy needs of companies in Indiana:
> **1. Seek advice and input from customers, industry, and other states,** including nearby states such as Michigan, Kentucky, and Missouri that are among the 15 states that have developed utility renewable energy programs;
> **2. Determine which approaches align best with state and utility circumstances,** taking into account how existing utility rates are structured, the presence or absence of an organized wholesale market, load growth and system resource needs, and the cost-effectiveness of various renewable energy sources, including energy from a PPA;
> **3. Account for the varying needs of different customers, including nonparticipants,** acknowledging that there is no one-size-fits-all solution for every customer and ensuring that the program is fair, transparent, and cost-based to protect both participating and non-participating customers;
> **4. Adopt replicable best practices (e.g., rate design),**
> **5. Guide customers through the decision and enrollment process** to ensure that customers have all the data and information they need to make informed decisions; and
> **6. Review, iterate, and improve** by providing annual updates to regulators, soliciting feedback from customers, and making improvements as needed. (Indiana AEE pages 6 - 7)

The Director agrees that much can be learned from the actions of other states and utilities. Also, that utilities must increasingly evaluate resource planning from the perspective that customers are opportunities, and not just loads. The Director believes that IPL is making substantial progress, but the opportunities opened up by changing technology and economics make this an ongoing process without a clearly defined end.

> Indiana AEE states that IPL does not consider or model C&I DR as a resource in its IRP despite IPL's MPS showing C&I day of and day ahead curtailable rates being cost effective under the Realistic Achievable Potential results. Nor does IPL provide an explanation for why curtailable rates were excluded in the IRP modeling. *(Indiana AEE p. 8)*

The Director does not know if there are model limitations that makes the evaluation of curtailable rates, or the impacts of different rate structures more generally, difficult in the IRP processes, but shares Indiana AEE's concern that more should be done to explicitly evaluate curtailable rates in the IRP. Rate designs need to be considered as a means to modify load and to incent desirable actions by customers, and these considerations should increasingly be included in IRPs to the extent reasonably feasible and as modeling capability allows.

Indiana Coal Council (ICC)

The Director appreciates the ICC's participation in the stakeholder process. The ICC has served to provide an important perspective that was given due consideration in the IRP. The Director will address some, but not all, of the ICC's enumerated comments or other ICC comments.

> Upon review of the IPL IRP, the ICC reached the following conclusions and recommendations:
>
> 1. IPL identifies its Preferred Resource Portfolio to include the retirement of Petersburg Units 1 and 2 by 2023, the addition of new capacity in 2023 obtained through an all source RFP, load reductions through demand side management (DSM) and energy efficiency (EE), and the preservation of Petersburg Units 3 and 4 for the foreseeable future. *(ICC page 2)*
>
> 2. IPL considered five scenarios with multiple portfolios in each. The Preferred Resource Portfolio was close in cost to the Reference Case in the first five years. IPL did not include costs related to the incremental transmission and distribution revenue requirements in the Preferred Resource Portfolio, which is often significant for renewables. *(ICC page 2)*

The Director recognizes that the IRP modeling process did not include the costs caused by incremental T&D investment that might be necessary for utility scale renewable resources to be deliverable to IPL's load, but does not share ICC's view that this is a major limitation of the IRP analysis. To the Director's knowledge these types of costs are better analyzed when looking at a specific project with specific operating characteristics and a specific location on the MISO transmission system. It is only then that such costs can be properly gauged and their impact on project economics be evaluated. The Director understands that the ICC's concern is that generation facilities once retired cannot be brought back if T&D upgrades change the economics of replacement resources. This is something that is properly considered within a utility's weighing of the numerous risks and uncertainties the IRP is designed to help decision makers evaluate. Given the extensive unknowns and uncertainties this is but one of many aspects of long-term resource decisions that must be considered.

ICC (Reliable Energy, Inc.) Response: T&D costs could be estimated for various locations either by IPL or one of its consultants. For any major capital decisions, it is appropriate to include cost factors or contingencies for all significant items, such as T&D costs. The goal of the IRP process is to minimize the unknowns and uncertainties, not to dismiss those that appear too complicated to address with sufficient accuracy.

This omission is particularly problematic given the similarity of costs during the first five years of the IRP analysis. Given that IPL failed to include what would likely be high costs, the motivation must be considered. There are many costs that are difficult to quantify and may contain some level of uncertainty. The failure to estimate such costs, even on a qualified basis, seems not to be in the spirit of developing a robust resource plan. *(ICC Comments on Director's Draft Report p. 4)*

Director's Response to Comments: *To supplement the Director's earlier comments, the Director cites the response by IPL to the comments on the Draft Director's Report by the ICC.*

> "The 2019 IPL IRP addressed this concern by considering the potential need for incremental transmission investment for new wind, solar, and energy storage by performing capital cost sensitivities. Page 190 IRP Volume 1, Figure 8.44 shows that even with a significant increase in capital costs (associated with transmission investment, for example), the PVRR for Portfolio 3 is lower than the mean PVRR for Portfolio 1 using base cost assumptions." (*IPL Response to Stakeholder Comments, p. 4*)

The Director thinks it is a reasonable practice to evaluate the sensitivity of resource options in the modeling and analysis process by significantly increasing the capital cost of the specific resource in question. The assumed increase in capital costs can represent the impact of any number of uncertainties that cannot be controlled, including the investment in transmission facility upgrades.

> 3. IPL concluded that carbon price assumptions were the major determinant for the model analysis. IPL used a single carbon forecast in all the carbon cases with stochastic modeling. The forecast was applied to both coal and gas but only within the fence-line of the power plant. For example, the base gas price did not reflect any carbon cost for methane emissions at the wellhead. While IPL acknowledged the carbon prices were used as a proxy for a carbon regime, IPL made no attempt to model the potentially more likely scenario of a future Federal Renewable Portfolio Standard, or its equivalent, with and without carbon offsets. *(ICC page 2)*

IPL's development of stochastic analysis to supplement traditional scenario analysis was well done. The ICC argues that the natural gas price did not include some relevant environmental costs. Especially since the environmental costs were broadly used as a proxy, the ICC's argument, for purposes of this IRP, highlights the difficulty of trying to evaluate the impact of potential national policies in a complicated political process. At the time IPL prepared this IRP, there didn't seem to be any appetite for a Federal Renewable Portfolio Standard by the Administration. It should also be noted that the Director has consistently urged utilities to be cautious about giving undue weight to speculative public policy changes. It is, however, appropriate for utilities and stakeholders to conduct "what if" scenarios and sensitivities, subject to well-reasoned caveats about the potential implications. To illustrate this point, prior to the election in 2016, there was a high degree of certainty that there would be some form of carbon dioxide reduction. After the 2016 elections some stakeholders urged no inclusion of carbon regulation be included in the IRPs. After the 2020 elections, some stakeholders will, likely, insist on including some speculative carbon costs. IPL, like other Indiana utilities, have given due consideration to carbon regulation in their IRPs. No one knows what the future holds but solid modeling and analysis, however imperfect, can help decision makers to better understand potential implications of various resource actions.

ICC (Reliable Energy, Inc.) Response: IPL used the same carbon price forecast as a proxy for carbon regulation in all cases except the one case, which assumed no carbon. Reliable Energy does not dispute that carbon scenarios should be considered. Reliable Energy objects to using only a carbon tax scenario as the proxy.

Carbon tax proposals are not new. As ICC noted in its comments, "(t)he failure over more than a decade does not support an argument that prudent planning should be based on a carbon price, even if it is just a proxy for other carbon regulations." In fact, ICC was restrained in its comments. Actually, carbon taxes have been proposed and rejected off and on for over 30 years. For a variety of reasons, carbon taxes have not been legislated and are unlikely to be legislated. Therefore, using carbon taxes as the only proxy is inadequate.

ICC believes it made a compelling argument that if there was any momentum related to carbon, it is in the adoption of Renewable Portfolio Standards (RPS) and Clean Energy Standards (CES) by states. A Federal RPS is actually a smaller leap from where the U.S. is today than a carbon tax. The reason to look specifically at net-zero plans, rather than using carbon taxes as a proxy, is the modeling of net-zero plans or CES versus carbon tax plans will produce different results. If one looks at a net-zero 2035 plan or a CES, for example, the economics of new natural gas plants may collapse because they would need to be retired by a date certain or retrofit with carbon capture. A 2035 retirement, for example, would require a shorter amortization period in modeling. Rather than 25 to 30 years, a new gas plant would need to be amortized over 11 to 13 years, depending upon its start date. If modeled with carbon capture, the plant could stay on-line longer, but its costs would be significantly higher. This "modeling" approach would be more reflective of expected costs.

Said differently, to achieve the Director's stated goal to provide decisionmakers with the potential implications of carbon plans on various resource actions, a broader range of regulatory options should be considered. While Reliable Energy agrees no one knows the future, Reliable Energy believes a decision justified with only one methodology, particularly one that is not likely to go into effect, does not provide a sufficient basis for such a decision.

Further, it cannot be ignored that IPL itself concluded that carbon price assumptions were the major determinant for the model analysis. Given the importance of carbon pricing to the IRP's outcome, Reliable Energy requests the Director clarify that further analysis of various carbon scenarios is required. *(ICC Comments on Director's Draft Report pg. 5-6)* Concerns raised by Reliable Energy can be addressed in the next IRP.

Director's Response to Comments: *The Director stated above, "No one knows what the future holds but solid modeling and analysis, however imperfect, can help decision makers to better understand potential implications of various resource actions." This includes making a reasonable attempt to understand the impact of plausible potential policy actions by state and federal governments. This is especially the case where different policy choices can have different impacts on potential resource choices. To the extent the range of potential policy options evolves, appropriate thought must be given to whether and how to address this change in the resource acquisition decision-making process.*

5. The PVRR suffered from the same issues that have occurred in the other Indiana utility IRPs. The results for the first five years are very close. It is only projected savings from future years (which are highly theoretical) that swing the results. *(ICC page 2)*

The Director thinks the inclusion of annual revenue requirements is a helpful addition in IPL's IRP. It should not be surprising that the first five years are very close and that future results will increasingly diverge to better reflect future changes, technologies, public policy, and risk. This reflects that load is changing slowly and that any changes in the resource portfolio are being phased in over a period of years.

ICC (Reliable Energy, Inc.) Response: Reliable Energy is comforted by the Director's finding that the inclusion of the annual revenue requirements is a helpful addition. However, Reliable Energy believes that the Director's report is ignoring the more significant conclusion related to the comparability of the first five-year results, which is the benefit of deferring irreversible closure decisions given the significant unknowns concerning carbon policy, technology options, fuel prices, load (overall and its shape). Such deferral yields two significant benefits. First, it reduces the stranded costs of premature retirements, and second, it allows greater clarity around future investments.

As noted above, the comparability of costs in the first five years can be challenged on the grounds that IPL failed to include the associated T&D investment required in the first five years under the IPL preferred plan. *(ICC Comments on Director's Draft Report pg. 6-7)*

Director's Response to Comments: *The Director has responded above to the question about the inclusion of potential associated T&D investment costs.*

The Director is not ignoring the issues surrounding the potential benefits of deferring irreversible closure decisions. Rather, the Director appreciates IPL's modeling framework used to perform the retirement analysis (see Section 7.3 Modeling Framework of IPL's IRP, pages 122 – 154). It is the totality of the modeling framework, IPL's evaluation of the modeling results, and how this information was interpreted and used by IPL that is of critical importance.

> 8. Any IRP is "a snapshot in time" analysis. While there are always modest changes from any snapshot analysis, in this case monumental changes have occurred since IPL filed its IRP. The Coronavirus Pandemic has altered the U.S. and world societies and economies in just a few months. The Federal Reserve predicts the unemployment rate will exceed 30 percent and has concluded that the U.S. is already in a recession. With likely months remaining before recovery can begin and probably a full year or more to go before a vaccine will be available, it will be a rocky road for the U.S. While the full impacts are indeterminable at this time, what is known is that COVID-19 will have a severe impact on the economy, which in turn will affect energy markets, including level of demand, availability and cost of capital, and concerns about the affordability of power. *(ICC page 3)*

It is an accurate characterization that IRPs are a snapshot in time. The ICC recognizes that Covid 19 has resulted in significant changes in the near term that occurred after IPL released its IRP. Empirically, the short and long-term effects of the Covid19 are still developing. The ICC recognizes that "the full impacts of the Covid19 are indeterminable." These uncertainties provide additional warrant to maintain maximum flexibility in resource decisions and highlight why resource planning must analyze a wide range of potential futures.

> 10. The decisions that do not need to be made immediately should be deferred until the full consequences of COVID-19 are better understood with an eye to making steps to minimize rate impacts during these difficult and uncertain times. *(ICC Page 3)*

As the ICC recognized, given the full effects of the virus, including wide ranging economic effects, are indeterminable, it is not clear that indefinite deferral of specific resource decisions is the best decision. It may be a topic of discussion for the next IRP. Ultimately, this is a management decision that should be informed by thorough IRP analysis that provides information on the performance of diverse resource choices over a wide range of potential futures. The world is characterized by rapidly changing policies, technology, economics, and the result is that resource decisions must be made while explicitly accounting for these uncertainties and risks. A decision to defer a resource commitment requires a similar degree of consideration.

11. IPL did not discuss or even acknowledge the Indiana Legislature's 21st Century Task Force study that is currently underway. The results of the task force's study could be significant in the formulation of future state policy affecting Indiana utilities*. (ICC page 3)*

The Director is confident that IPL is aware of the 21st Century Task Force. IPL's IRP included an extensive and clear discussion of how IPL operates within the MISO and how these MISO requirements impact IPL operations and resource planning. IPL recognizes that as RTO requirements change the changes will impact IPL operations and how IPL makes resource commitments in the future. The performance of IRPs on a three-year cycle makes possible the ability to timely consider potential MISO changes.

The Indiana Coal Council also took issue with IPL's load forecasts contending the analysis was "in a relatively narrow range." The base forecast calls for 0.4 percent annual growth, which appears counter to what has occurred in recent history. While the low case calls for a slight dip in 2020, the cases do not capture the likely effect of the global recession that has already occurred. *(ICC pages 9 and 10)*

The ICC also had concerns about IPL's modeling of electric vehicles load and its inclusion in the system load forecast. ICC said the "incomplete consideration of the growth in EV's is important in two specific respects. First, IPL is potentially understating its resource requirements. Second, IPL is potentially mischaracterizing the shape of its load curve." *(ICC p.10)* ICC goes on to say this understates IPL's future capital requirements for new resources and understates the value of IPL's coal generating assets. *(ICC pages 10-11)*

The Director agrees, in part, with the ICC's comment that IPL's load forecasts were not as expansive as they could have been. As stated previously, it is unrealistic to expect IPL to capture the on-going effects of the global recession. Projecting load has always been problematic and historically utilities have overestimated load growth since the 1970s. It is possible that the movement to EVs and other forms of electrification will cause the opposite problem, one of consistently underestimating load growth. However, the impact of EVs is quite small currently and even very rapid growth in the number of EVs is likely to have a relatively small impact on load for several years. The Director is of the opinion that greater attention must be focused on the range of uncertainty affecting future load and the implications this might have for resource commitments.

ICC (Reliable Energy, Inc.) Response: ICC, in its initial comments, pointed out two concerns with IPL's limited consideration of EVs: the impact on demand and the impact on the shape of the load curve. ICC noted in its comments that IPL did not even bother to include medium- and heavy-duty trucks because its consultant concluded deployment of them "are at too early a stage to attempt to include them in a forecast." With all due respect to the consultant, at the time of the preparation of the IRP, there was sufficient information available in the marketplace to bracket potential penetration from which to develop a scenario.

After the preparation of the IRP and ICC's comments, the relevance of EVs has only increased. In January 2021, General Motors announced its plans to phase out vehicles using internal combustion engines entirely by 2035. Other manufacturers have similar targets. Also, in January 2021, President Biden announced plans to replace the U.S. government's fleet of about 650,000 vehicles with electric models. Most recently, the U.S. Postal Service announced plans to replace part of its fleet with EVs.7 While estimates vary, the expectation is that these conversions could increase electricity demand by over 25 percent and would flatten the load curve.

More directly related to this IRP, on March 2, 2021, IPL filed a petition with the Commission requesting approval of a comprehensive, $5.06 million EV-subsidization program, which would include subsidization of charger purchases and installations, an off-leak charging rate incentive, and the offering of an EV monthly subscription program through AES Indiana Motor. Cause No. 45509.

Reliable Energy certainly does not dispute the current EV-adoption numbers are low. Still, given the announcements and plans, Reliable Energy believes it would be appropriate to have a high EV penetration scenario in current 20-year IRPs. *(ICC Comments on Director's Draft Report pg. 7-8)*

Director's Response to Comments: *The load forecasting exercise is fraught with complexity caused by a rapidly changing world. The time pattern of EV penetration is but one of many considerations causing extreme levels of uncertainty. The Director is confident that the load impacts caused by increasing EV penetration will be better modeled in future IRPs. Nevertheless, the level of load uncertainty (and the associated load shapes) is not likely to be lessened so a range of load forecasts must be evaluated in the IRP modeling process to better understand the implications of this uncertainty for resource decisions.*

Additionally, the ICC contends the probabilistic assumptions IPL used in their IRP were not appropriate. For example, the ICC observed that the coal prices were the same, three natural gas futures were considered, and took exception to the treatment of CO_2 in IPL's analysis. [14]

> IPL used a single carbon forecast in all the carbon cases with stochastic modeling. The forecast was applied to both coal and gas but only within the fence-line of the power plant. For example, the base gas price did not reflect any carbon cost for methane emissions at the wellhead. While IPL acknowledged the carbon prices were used as a proxy for a carbon regime, IPL made no attempt to model the potentially more likely scenario of a future Federal Renewable Portfolio Standard, or its equivalent, with and without carbon offsets. *(ICC page 2)*

The Director believes IPL made a credible effort to inject stochastic modeling into its IRP. The Director disagrees with the ICC's comments that IPL was remiss in not developing a carbon cost for methane emissions starting at the well-head. Suggesting that a "federal renewable portfolio standard" be modeled in a scenario is certainly possible but no less speculative than modeling the potential impact of a price on carbon. A key capability of the use of scenario analysis is the ability to model inherently uncertain future policy choices. However, the ability to model potential futures is complex and requires much consideration. IPL's choice of modeling a price on carbon instead of a renewable portfolio standard is reasonable. Over several years, the utilities have been encouraged to be careful about modeling future public policy decisions because they are both potentially impactful and extremely uncertain.

The Director appreciates the ICC's perspective on IPL's important resource analysis and potential decisions. ICC's discussion highlights the vast uncertainties and factors to be considered in any resource decisions and that reasonable planning itself involves a discussion of how information is used and evaluated by the utility. In this area, IPL made significant improvements.

---

[14] The ICC quoting IPL "including a federal price on carbon in scenarios is a prudent planning exercise considering the national and global efforts for carbon reduction. The failure over more than a decade to obtain legislative agreement on a carbon tax does not support an argument that prudent planning should be based on a carbon price, even if it is just a proxy for other carbon regulation. (ICC Page 13)

ICC (Reliable Energy, Inc.) Response: The difference between deterministic modeling and stochastic modeling is as follows: in deterministic models, the output of the model is wholly determined by the parameter values; in a stochastic model, the stochastic forecasts possess some inherent randomness. While stochastic modeling has some value in certain situations, stochastic modeling in no way replaces the need for or value of deterministic modeling. IPL apparently recognized this with its natural gas price forecasts in that three different forecasts were assumed. ICC's issue was that IPL did not recognize this for either its coal or carbon price forecasts. *(ICC Comments on Director's Draft Report pg. 8)*

Director's Response to Comments: *See the Director's Response (on page 35 above) to ICC's Response to the use of a price on carbon by IPL and the lack of analysis by IPL using alternative carbon policy options available to state and federal policymakers. The Director believes the IRP addressed the concern such as pages 2 and 8.*

General Comments by ICC (Reliable Energy) on the Director's Report: ICC requests that the Director insert a section in the report addressing concerns that have occurred subsequent to the preparation of the IRP, which could affect the result. That the Director consider identifying assumptions that are also problematic in the context of recent events. *(ICC Comments on Director's Draft Report pg. 3)* ICC cites a number of these material events that occurred after the filing of the IRP. *(ICC Comments on Director's Draft Report pg. 8-11)*

Director's Response to Comments: *The Director's Report focuses on the methods, data, and assumptions used in the IRP modeling process – 170 IAC 4-7-2.2(g). Additionally, IRPs are snapshots in time—the information contained in an IRP is based on the best information at the present time, and predictions are made based on that information. It is to be understood that the planning environment is constantly changing and that these changes are the basis for including a wide range of risks and uncertainties in any planning process. And because of the inherently changing environment, it is also the reason for IRPs to be updated on a regular basis. Under Commission rules, IRPs are to be updated at least once every three years. It is not uncommon for a utility to update an IRP prior to seeking Commission approval to acquire resources.*

The City of Indianapolis (City)

> "One of the primary elements of 'Thrive Indianapolis' is the goal to meet 25 percent of municipal load with renewable energy by 2020, with a pathway to 100 percent by 2028, as well as meet 20 percent of the community-wide load from renewables by 2025, with a pathway to 100 percent by 2050. Secondly, the City seeks a more resilient energy grid using microgrids, energy storage, and increased energy efficiency. Moreover, with 7 percent of Indianapolis households facing energy costs that exceed 10 percent of their income (2.3 times greater than the national average), the City seeks to strategically shape programs that increase affordable access to energy and support low-income residents and families." *(City of Indianapolis page 1)*
>
> "…IPL's Preferred Resource Portfolio, portfolio 3b, which retires 630 MW of coal by 2023 and fills the capacity shortfall with a projected mix of demand side management, wind, solar, and storage, is a positive, cost-effective, near term step for IPL and Indianapolis to achieve its 20 percent community-wide goal by 2025 (IRP 2019, page 161). The City

recognizes that the IRP is effectively a concrete 5-year plan with extrapolations out to 2039." *(City of Indianapolis page 2)*

The City of Indianapolis appreciates that IPL valued customer feedback and encourages IPL to continue seeking and evaluating customer-driven scenarios (City of Indianapolis - page 3) Modeling for Carbon Neutrality: While the City recognizes that the IRP process is intended to outline the preferred resource mix for the next 20 years, the City asks that IPL consider modeling multiple scenarios to achieve carbon neutrality by 2050 in its next IRP – even if outside of the traditional 20-year scope. *(City of Indianapolis pages 2-3)*

IPL should consider opportunities to solicit customer-driven scenarios and input on criteria for selecting portfolios. Moreover, IPL should increase its transparency around the modeling, reports, and data informing its evaluation of scenarios. *(City of Indianapolis page 3)*

The Director appreciates the involvement of the City of Indianapolis in the stakeholder advisory process because the City sees what IPL does as affecting energy goals the City has developed. IPL implemented a well thought out advisory process. The openness of the process is reflected in the written discussion of critical issues contained in the IRP document. The Director trusts that IPL understands that there is always room for improvement and that the future advisory process will continue to improve.

The City of Indianapolis encourages IPL to address assumptions and constraints that may have limited the ability for renewable energy resources to efficiently and effectively compete in portfolio analyses and selection. *(City of Indianapolis page 3)*

The IRP rule requires IPL and other utilities to assess potential constraints. The Director believes IPL made a very good effort to treat all resources as comparable as reasonably possible. IPL was also very thorough in documenting the assumptions and data it was using at the various stages of the IRP evaluation process. The Director appreciates it might be helpful to have more discussion of how sensitive some of the resource choices are to reasonable changes in various assumptions and other inputs.

Carbon Pricing: IPL commendably includes potential carbon pricing via a carbon tax in three of its five scenarios… However, IPL's carbon pricing assumptions appear conservative compared to utilities nationally and in-state peers. *(City of Indianapolis page 3)*

It should be acknowledged that any IRP should be considered as a "snap-shot in time" that tries to reasonably account for the important drivers of risks and uncertainties for utility resource decisions. To IPL's credit, IPL included a price to assess the potential implications of a carbon price. All Indiana utilities gave some effect to carbon pricing with the recognition that it is a proxy. In such a confused political environment it is difficult to have much certainty regarding possible future policy choices, but reasonable scenarios must be developed. Future IRPs may have specific guidance.

The City of Indianapolis stresses that a transition to a "Greener Energy Future" can also be reliable and affordable if IPL considers a wide range of supply- and demand-side resources. When considering IPL's future grid mix and replacements to existing coal capacity, the City urges IPL to more thoroughly evaluate a full suite of demand- and supply-side resources, including energy efficiency, demand response, and energy storage in addition to renewable energy. *(City of Indianapolis page 4)*

Proactive, Market-Based Approach: The City applauds IPL for their initiative to pursue an all-source RFP procurement. This RFP does not prescribe or pre-suppose a solution and provides room for a wide range of supply- and demand-side resources to meet its upcoming 200 MW capacity needs. With this approach, solutions can include a portfolio of resources rather than a single resource, demand-side measures including demand response, flexibility in ownership options, and flexibility in the location of resources within MISO Zone 6. This all-source RFP is a proactive effort to look beyond a fossil-fuel generated energy supply and is an essential step to ensuring IPL's customers are receiving the best solutions the market can offer.

Incorporate Emissions as a Criteria for Evaluation*:* IPL indicates that it will score bids according to a set of 12 qualitative criteria, including "environmental impacts". However, the definition of this qualitative criterion does not include greenhouse gas emissions or decarbonization of electricity generation. Since multiple scenarios in the 2019 IRP included a carbon tax, IPL should consider incorporating a cost of carbon or, at the very least, explicitly assess greenhouse gas emissions in its evaluation of bids to the extent possible in this review process and for all future all-source RFP solicitations. *(City of Indianapolis page 5)*

Stakeholder Engagement: With proposals submitted by February 28, 2020, the City seeks clarity from IPL on how the results of the RFP will inform IPL's subsequent actions and the extent to which stakeholders will be engaged. For example, during NIPSCO's 2018 IRP process, the utility provided an overview of the proposals received during the RFP, offered a summary of the pricing structures, communicated preliminary results, and explained how the RFP results would be integrated into the IRP analysis. This not only informs customers and stakeholders about the process but builds on IPL's productive stakeholder engagements throughout 2019. *(City of Indianapolis page 5)*

In future planning processes, the City requests that IPL more thoroughly reflect and integrate customer goals and more explicitly align with "Thrive Indianapolis". The City recognizes that IPL modeled Portfolio 5 with "Thrive Indianapolis" in mind, but that portfolio only loosely reflected the City's necessarily ambitious carbon neutrality goals. *(City of Indianapolis page 6)*

The City of Indianapolis welcomes further discussion of these comments with the Commission, IPL, and other stakeholders on how to better align IPL's resource planning with the City's community-wide goals. The City is committed to working with IPL in delivering reliable, affordable, and clean electricity to shape a more equitable, sustainable, and resilient Indianapolis. *(City of Indianapolis page 6)*

The Director understands the comparison to the first RFP issued by NIPSCO but the situation with IPL is more directly comparable to NIPSCO's issuance of its second RFP which occurred well after the IRP was completed.

Indiana Office of Utility Consumer Counselor (OUCC)

At the outset, the Director is very appreciative of the OUCC's expansive comments. The OUCC's participation is valuable to the stakeholder process.

> IPL's 2016 plan had no early coal facility retirements. In sharp contrast, IPL's 2019 PRP has Petersburg Units 1 and 2 shutting down approximately ten years earlier than IPL planned just three years ago. Such a major shift in a short timeframe makes the OUCC wonder whether such major shifts will occur again, possibly rendering IPL's 2019 IRP PRP uneconomical when IPL submits its next triennial IRP.

The OUCC's suggestion that IPL provide more discussion of the changes in resource decisions from one IRP to the next is well-taken. The OUCC's request for greater clarity, is reasonable. From the Director's perspective, IPL appropriately reconsidered its resource decisions when confronted with new information. Moreover, IPL's decisions to maintain optionality of its resource decisions is well-reasoned. The Director thinks IPL's documentation of each step of the IRP analysis and how the information developed at one step was used to inform the next step is well documented. Except for some aspects of the load forecast discussion, IPL provided good narratives and descriptions about the purposes of doing various analyses. Overall, the documentation is well written and reasonably detailed.

> If IPL's over-forecasting trend continues in its 2019 IRP, it would cause IPL to build too much new capacity, thereby causing utility rates to be unreasonably high. Figures 4.28 and 4.29 in IPL's IRP show consistently high demand and energy sales forecasts for many years.

The Director assumes the OUCC's concern about over-forecasting recognizes that IPL removed all IPL-sponsored DSM from its load forecast over the planning period. It may be useful to note that electric utilities have over-estimated load forecasts since the mid-1970s (see the "NERC Fan") but the continual reductions in the load forecast trajectories is not intentional. Rather, it is more likely that the forecasts which, not unreasonably, gave considerable weight to recent history which influenced the future load trajectory.

The OUCC's comments provide an important rationale for IPL and other utilities to provide a well-written narrative. The OUCC's concerns also highlight the importance of enumerating IPL's continual improvements. As the OUCC observed, there are large and small changes in when and how customers use electricity (e.g., lighting efficiency, improved integration of cost-effective renewable resources, distributed energy resources, etc.)

The Director is of the opinion that greater attention must be focused on the range of uncertainty affecting future load and the implications this might have for resource commitments.

.

> It is not clear the retirement dates for the Petersburg units are optimal, since the model IPL used was not designed to select an optimal retirement date. Rather, fixed plant retirement dates were evaluated in each of the five portfolios. While such an approach is comparable to that used by some other Indiana electric investor-owned utilities ("IOUs"), the related

> potential for suboptimality should be recognized in evaluating IPL's early retirement proposals.

The Director believes IPL did a credible analysis of existing and potential resources, However, as the Report states, IPL could have done more analysis on the future of Petersburg. Future IRPs will have greater importance as resource decisions become more imminent. As a result, the rigor of the analysis should be commensurate with the uncertainty and risk.

> IPL's load forecast incorporated its electric vehicle ("EV") and distributed solar forecasts, it did not modify its expected load shape resulting from those forecasts. If implemented in the model, such modified shapes would affect the relative attractiveness of different resource options and thus could change the optimal resource mix over time.

The Director agrees with IPL that the impact of EVs and PVs was accounted for in the 8760 hours constituting the annual load shape included in the IRP model. It should be noted that IPL has been at the forefront of EV and DER analysis and is working with MISO to share information that would improve distribution system planning and operations, IRPs, and the MISO's system planning and operations. In current and past IRPs, the Director has urged IPL (and other utilities) to develop credible load shapes for EV and DERs. IPL's increasing use of AMI (hopefully other supporting information) should improve the credibility of load shapes and their value to load forecasting, resource planning, avoided cost calculations, and other benefits.

> The OUCC is concerned about the excessive amount of avoided T&D capacity costs IPL assumed. T&D capacity benefits are created when DSM programs alleviate capacity issues on specific circuits. None of IPL's DSM programs target specific circuits. There is no connection between circuit load reductions due to DSM and estimates of new circuit construction costs…Despite delivering DSM programs for approximately 25 years, IPL has no evidence supporting its assumptions concerning any relationship between DSM and avoided T&D costs. IPL has not identified any circuits at capacity. IPL simply assumed approximately 20% of its circuits are at *or near* capacity.

The Director will not prejudice the discussion of the efficacy of specific TDSIC proposals. However, if the Director understands the OUCC's position, the OUCC may be short-sighted. The Director believes that IPL (and other utilities) should make continual efforts to calculate the full avoided cost (generation, transmission, and distribution) that include transmission and distribution system costs that have locational and time dynamics. IPL stated they anticipate AMI data will provide much of the information that the OUCC seems to be concerned about (e.g., well-designed load shapes that reflect the time and locational value). In other words, improved data to coordinate distribution system planning with relevant IRP analysis and the MISO's operation and planning should help IPL to tailor distribution system capital expenditures more precisely.

Citizens Action Coalition (CAC) and Earthjustice
(Referred to as "Joint Commenters")

The Director agrees with the Joint Commenters' general commentary that IPL's IRP is well done. However, the Joint Commenters also expressed concerns about IPL's optimization of EE but complimented IPL on its stakeholder process and IPL's more rigorous analytics. (Joint Commenters *page 3) Joint Commenters' review of IPL's 2019 IRP and their participation in its pre-IRP stakeholder workshops raised the following main categories of concern:* [15]

• IPL's post-modeling revenue requirement model revealed that, under most scenarios, Portfolio 3 with incremental energy efficiency ("EE") savings of 1 percent and 1.25 percent of sales was cheaper than Portfolio 3 with an "optimized" level of EE – or .75 percent savings. This fact raises questions about whether the optimal level of EE was actually identified. (Section 3.2);

• IPL appears to have incorrectly modeled the cost of EE in several ways that would bias the model against EE (Sections 5.1, 5.2, and 5.3,);

• Particularly for the portfolios in which additional Petersburg units were retired, the constraints placed on renewable resources likely limited the selection of otherwise cost-effective resources (Section 3.1);

• IPL's retirement analysis focused on a set of fixed decisions without exploring the results of optimized retirement (Section 3.3); and

• IPL imposed reserve margin constraints that seem likely to have prevented the model from picking an optimal plan (Section 3.4.1)." (JC page 3)

The Director appreciates Joint Commenters' concerns about the treatment of EE (the Joint Commenters could extend this concern to other DERs). However, the Director believes that IPL is making significant advances in its treatment of EE. The Director understands IPL's focus is on the cost-effectiveness of the EE measures, and hence the Company's use of an EE supply curve to create EE bundles. IRP model selection of these bundles provides insight into the cost range over which the IRP model thinks EE is a cost-effective resource. This information should be used by IPL to develop its EE programs at a later date, but it is not in itself determinative as to what should be included in a well-developed EE plan.

The Joint Commenters recognize that IPL has low avoided costs. According to the Joint Commenters, the low avoided costs do not fully include reasonable estimates of transmission and distribution system related costs. The Director recognizes this is an area that warrants greater discussion in the IRP stakeholder advisory process. A better understanding of the evolving nature of avoided costs is especially important in a world increasingly characterized by low avoided costs across most hours of the year. There seems to be an emerging consensus that full avoided costs that vary by time and location would provide a better assessment of the value of EE and other DERs:

[15] "IPL deserves significant credit for the marked improvement it exhibited throughout this IRP in contrast to its prior IRP. IPL's 2016 IRP stakeholder process was contentious, did not result in the resolution of issues raised by stakeholders, and did not encourage active participation on the part of stakeholders. IPL's process for this IRP was the virtual opposite in all these respects. We felt that IPL staff wanted to hear from stakeholders and incorporated their feedback in many, though not all, respects. Rather than reacting defensively to criticism and suggestions from stakeholders, IPL actively sought out feedback from stakeholders. Finally, IPL's IRP is more thorough, more analytically rigorous, and based on the use of a model, though not without its drawbacks, that is better suited to performing IRPs. We greatly appreciated the collaborative thoughtfulness, attention to detail, and collaborative process and transparency that were core in this 2019 IRP process." (Joint Comments page 4)

1) *Improvements in load shapes and bundles of EE would increase the credibility of EE analysis. The credibility would improve by using more discrete load data and supplemental information about IPL's customers.*
2) *IPL is committed to utilizing Advanced Metering Infrastructure to obtain sub-hourly load research.*
3) *With improved data, IPL is setting a foundation for developing EE (and other DERs) to better reflect that full avoided costs that should include generation, transmission and distribution system costs vary by location and time.*
4) *IPL has demonstrated a commitment to work with the MISO to share mutually beneficial planning and operational information that, over time, will better integrate IPL's distribution system planning with their IRP, and the MISO's resource planning and operations. Sharing of information will facilitate the calculation of avoided costs.*

The Director recognizes that this is an area of analysis in the early stages of development but thinks EE must increasingly be seen differently than has traditionally been the case when the supply-side portfolio was based entirely on traditional generation facilities. The Director also thinks DR beyond basic utility interruptible load and load control needs to be examined with an eye to these same considerations.

The Director understands the Joint Commenters' concern about the revenue requirement results when incremental EE is added. The results seem counter intuitive, but the Director does not think there is a substantive flaw in the IRP model. The Director bases his determination on the overall results of the IRP modeling exercise. Nothing seems to indicate a significant failure.

The Director agrees with the Joint Commenters that the reserve margin constraints may have altered the planning scenarios. In part, the hardwiring of resources may have been a factor. If the Director's understanding is a correct characterization, there may be a reasonable rationale. Especially for future IRPs that will be increasingly consequential for resource decisions, constraints should be more fully discussed. Additionally, if there is a need for hardwiring resources, the reasons should be fully vetted in the stakeholder process.

Joint Commenters Response: In the comments filed by CAC and Earthjustice, we brought up several concerns about Ascend's PowerSimm model. In addition to the fact that it condenses "weather" into a single variable, temperature, one of our main concerns about PowerSimm is that the user cannot see the calculated Net Present Value ("NPV") for the portfolios. PowerSimm's objective function is to minimize total system cost, but the model never reports the cost of the optimal plan. It is the only IRP model of which we are aware that does not have that functionality. Among the concerns this raises is that it forecloses the ability to identify whether there are problems in the optimization and/or in the model code itself and, therefore, hinders a full evaluation of IPL's modeling.

In CAC Data Request 4-2, we asked IPL to provide the PVRRs produced by PowerSimm for all of the portfolios IPL modeled. IPL's response to CAC's request was: "Not available. PowerSimm does not report PVRR." We believe that this limitation is the reason why IPL had to utilize a spreadsheet to post-process the PowerSimm results and calculate the revenue requirements for the different portfolios. As IPL said in the IRP narrative:

> IPL utilized a spreadsheet-based set of financial models to build the revenue requirement. The revenue requirement calculation outside of PowerSimm provides

> a transparent, flexible method to calculate PVRR, compare scenarios and portfolios, and to build customized outputs for stakeholders. (IPL 2019 IRP, p. 121)

Since the PowerSimm model lacks transparency into its objective function, IPL needed to take the additional steps to process the modeling results outside of PowerSimm in order to try to provide a key IRP result, the NPVs of its plans. The spreadsheet calculated PVRRs do have the benefit of being easily audited, but that does not solve the problem of understanding the NPV calculation that PowerSimm is performing internally to actually arrive at an optimal plan.

This limitation within PowerSimm is one of the main reasons why we were concerned about the different results observed when IPL forced in an additional bundle of energy efficiency. After seeing the initial modeling results released by IPL, CAC requested that IPL evaluate portfolios with higher levels of energy efficiency to gauge the impact that the additional energy efficiency would have on the modeling results. After forcing in the additional energy efficiency bundle, the results indicated that the additional energy efficiency resulted in a lower cost plan, which raises serious concerns about the efficacy of IPL's modeling in identifying the least cost resource plan. We appreciate the Director acknowledging our concerns about this issue, but we respectfully disagree that this, combined with PowerSimm's inability to calculate PVRRs, is not a major concern with the model. *(Joint Commenters Response pg. 4-5)*

Director's Response to Comments: *The Director understands that it is desirable for the model to be able to provide PVRR results, not only cumulative but also for each year of the planning period. Despite this limitation, the Director believes AES Indiana's actions to develop corresponding revenue requirements using a spreadsheet-based set of financial models was helpful.*

Also, the Director does not think the PowerSimm model is fatally flawed because of the results observed when AES Indiana forced in an additional bundle of EE. Nothing else in the totality of the modeling results provides the slightest indication of a problem. Especially one significant enough that the IRP results, as a whole, should be considered questionable.