srea
SouthernRenewable.org

Southern Renewable Energy Association
P.O. Box 14858, Haltom City, TX 76117

October 9, 2018

Gwen R. Pinson
Executive Director
Public Service Commission
211 Sower Boulevard
P.O. Box 615
Frankfort, KY 40602-0615

RE: BIG RIVERS ELECTRIC CORPORATION INTEGRATED RESOURCE PLAN
DOCKET # 2017-00384

Dear Ms. Pinson,

This letter constitutes the Readlst file required by 807 KAR 5:001, Section 8(5).

The Southern Renewable Energy Association has not requested intervention in Big Rivers Electric Corporation's Integrated Resource Plan (Docket #2017-00384); however, pursuant to 807 KAR 5:001, Section 11(2e), we file the attached written comments regarding the subject matter of the case, including an original unbound and ten (10) additional copies.

Sincerely,

Simon Mahan

Simon Mahan
Executive Director
Southern Renewable Energy Association
simon@southernwind.org
337-303-3723

cc: Service List, Electronically

Southern Renewable Energy Association
P.O. Box 14858, Haltom City, TX 76117

SouthernRenewable.org

BIG RIVERS ELECTRIC CORPORATION 2017 INTEGRATED RESOURCE PLAN

DOCKET #2017-00384

COMMENTS OF THE SOUTHERN RENEWABLE ENERGY ASSOCIATION

October 9, 2018

The Southern Renewable Energy Association (SREA) is an industry-led initiative that promotes the use and development of renewable energy in the south. Since 2013, SREA has engaged in IRP processes in Arkansas, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Tennessee and Virginia. We strive to provide the most up-to-date and publicly available market information regarding renewable energy resource availability, pricing, performance and forecasting. SREA appreciates the opportunity to comment on the Big Rivers Electric Corporation's (BREC) 2017 Integrated Resource Plan (IRP).

In early 2017, SREA submitted a comment letter to the Kentucky Public Service Commission regarding Kentucky Power Company's (KPC) integrated resource plan (IRP), Docket #2016-00413. Our comment congratulated KPC for performing an outstanding IRP. KPC's IRP plans to procure 300 megawatts (MW) of wind energy resources by 2021 and 120 MW of solar energy resources by 2031, as well as 10 MW of battery storage by 2025. KPC stated that, "Wind resources were selected by the IRP model because they lower costs to customers over their lifetime."[1] Given KPC's fair evaluation of renewable energy resources, BREC's current IRP is unacceptable and needs substantial improvement.

1. <u>Renewable Energy Data Assumptions</u>

The National Renewable Energy Lab (NREL) publishes its Annual Technology Baseline (ATB) as a resource for "realistic and timely set of input assumptions (e.g., technology cost, fuel costs), and a diverse set of potential futures (standard scenarios) to inform electric sector analysis in the United States. The products of this work, including assessments of current and projected technology cost and performance for both renewable and conventional electricity generation technologies, as well as market projections of more than a dozen scenarios produced with NREL's Regional Energy Deployment Systems (ReEDS) model…."[2] NREL's ATB is one of the most comprehensive, and accurate, resources for various energy resource inputs. NREL's ATB is used by regional transmission organizations (RTOs) including the Midcontinent Independent System Operator (MISO)[3] and PJM.[4] NREL's ATB data should be used for model inputs and future forecasts. Given that future purchases of renewable energy resources would take several years before power production, NREL ATB data starting in 2019 or 2020 is recommended, as well as incorporating future pricing and performance levels. NREL's ATB is updated annually, usually in July or August.

1.1 Wind Energy

NREL's ATB evaluates wind energy resources as "techno-resource groups" (TRGs) that effectively provides a scale of various wind energy opportunities.[5] For example, TRG 1 resources are anticipated to be the lowest cost and highest performance wind energy resources, and are mostly concentrated in the Central US. A fair amount of wind energy capacity potential in the Southeast opens in TRG 5, with the entire Southeastern region opening up with TRG 7. Based on the current market, the "low" values for NREL ATB's land-based wind resources should be used, beginning in 2019 or 2020. Evaluating these three different wind energy resources provides a adequate range of wind energy resources available to the Southeast.

Evaluating multiple types of wind energy resources, and not solely evaluating the lowest cost options (e.g., TRG 1 resources), may help identify different generation profiles that more closely align with a particular utility's demand load. Geographic diversity of renewable energy resources is anticipated to generally increase capacity value of a particular resource and reduce overall generation variability. Hourly and sub-hourly wind energy generation profiles are available from the NREL Wind Integration National Database (WIND) Toolkit for up to 122,000 different sites across the country. Data are available from NREL, here: https://www.nrel.gov/grid/wind-toolkit.html

The federal Production Tax Credit (PTC) for wind energy is expiring. The details of the PTC will be discussed later; however, for the chart below, the PTC has been converted into a rough reduction in overnight capital costs. Generally, CAPEX costs below have been reduced by $600/kW in 2019 and 2020, $500/kW in 2021, and $400/kW in 2022.

NREL ATB Wind Energy Pricing Examples With Production Tax Credit as Overnight Cost Reduction ($/kW) by Year

		2019	*2020*	*2021*	*2022*	*2023**	*2024**	*2025**
TRG1	Overnight $/kW	$730	$687	$739	$787	$1,133	$1,075	$730
	Capacity Factor	50%	50%	51%	51%	52%	52%	53%
	LCOE $/MWh	$19	$21	$22	$23	$27	$26	$24
TRG5	Overnight $/kW	$840	$803	$839	$874	$1,208	$1,142	$1,075
	Capacity Factor	44%	45%	45%	46%	47%	48%	48%
	LCOE $/MWh	$25	$26	$27	$28	$31	$29	$28
TRG7	Overnight $/kW	$1,013	$991	$1,023	$1,054	$1,384	$1,313	$1,241
	Capacity Factor	35%	36%	37%	38%	38%	39%	40%
	LCOE $/MWh	$39	$40	$39	$39	$41	$39	$36

Source: based on LBNL 2014, 2018 NREL ATB
*No PTC Value

1.2 Solar Energy

Costs for fixed-tilt versus single-axis tracking solar projects are estimated to be approximately similar, with minor capital cost and maintenance cost differences; however, capacity factors are anticipated to increase significantly with single-axis trackers. NREL's ATB only evaluates single-axis tracking systems, with the best performing projects achieving an estimated 27% capacity factor (NREL ATB projects located in Daggett, CA). As a proxy for fixed-tilt solar projects, it is recommended that a

20% capacity factor be used (NREL ATB projects located in Kansas City, MO). NREL's ATB converts solar DC power to AC power output for capacity factor purposes, while keeping several financial metrics in $/kWDC units.

To provide a better range of pricing and performance, it is recommended that the "Mid" overnight costs for Kansas City and Daggett utility-scale solar projects from NREL's ATB should be used, along with the 20% and 27% capacity factors, respectively, beginning in 2019.

Due to new guidance from the IRS, solar power projects that qualify for the 30% ITC in 2019, 26% ITC in 2020, or the 22% ITC in 2021 each have until the end of the year 2023 to become operational. A 10% ITC is available for projects that commence construction in or after 2022, and for projects that become operational in or after 2024. At the same time the federal ITC is slated to decline, the NREL ATB shows that solar power installed costs are anticipated to decline, almost in the exact same proportion as the ITC phaseout through 2023. Applying the ITC phaseout to the NREL ATB 2018 overnight capital costs, results in overnight costs of approximately $700/kWDC for projects that begin construction between now and 2021, which are also operational by the end of 2023. By 2024, when the bulk of the ITC has expired, solar pricing is anticipated to decline an equivalent amount, thus overall levelized cost of energy of utility-scale solar projects are anticipated to remain relatively flat from 2019-2030. For utility-scale solar projects with 20% capacity factors, and taking the ITC into account for near-term projects, overall LCOE is anticipated to remain in the mid-$30s/MWh range for the next decade. For projects with 27% capacity factors, LCOE values in the $20s/MWh are anticipated. We have worked with utility-scale solar development companies in the region who have corroborated the view that utility-scale projects in BREC region can be currently be delivered with an LCOE in the mid-$30/MWh range thanks to the ITC value and for the decade ahead with the forecasted future cost-declines following the ITC step-down to 10%.

NREL ATB Utility-Scale Solar Energy Pricing (ITC Included)

		2019	2020	2021	2022	2023	2024	2025
Mid	Overnight $/kWdc	$707	$707	$707	$707	$707	$784	$775
	Capacity Factor AC	20%	20%	20%	20%	20%	20%	20%
	LCOE $/MWhAC	$32	$32	$32	$$32	$32	$38	$38
Low	Overnight $/kWdc	$707	$707	$707	$707	$707	$784	$775
	Capacity Factor AC	27%	27%	27%	27%	27%	27%	27%
	LCOE $/MWhAC	$20	$20	$20	$20	$20	$24	$23

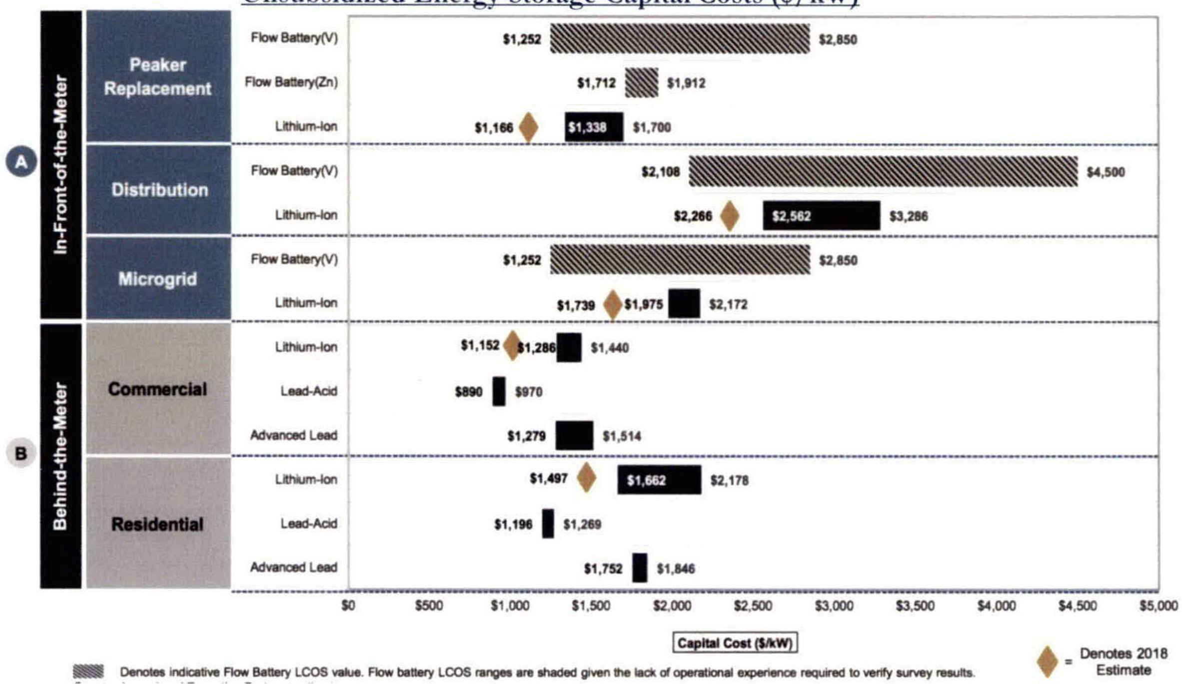
Source: NREL ATB 2018[6], 20-year LCOE, "Mid" is Kansas City, "Low" is Daggett

2. Energy Storage Data Assumptions

Lazard Associates' estimated capital costs for various energy storage technologies reaches as low as $1,152/kW in 2018. It is more difficult to assign a particular LCOE for energy storage solutions; not only because of the variety of technology (batteries, fly wheels, etc.) and rapidly declining prices, but because energy storage project finances are highly dependent on the type of services being provided. For example, Lazard Associates notes that, "Although energy storage developers/project owners often include Energy Arbitrage and Spinning/Non-Spinning Reserves as sources of revenue for commissioned energy storage projects, Frequency Regulation, Bill Management and Resource Adequacy are currently the predominant forms of realized sources of revenue."[7] For example, an energy storage project that predominately provides frequency regulation may appear to be exceptionally costly, on an LCOE basis, compared to a traditional power plant; however, such a facility is providing a highly valued service that may not be accurately reflected in current integrated resource planning processes, models or specific utility markets. Energy storage is not simply a "cost adder" to renewable energy to establish better capacity value.

The design of an energy storage project can also vary based on the specific services desired; for example, a recent presentation by GTM Research showed four-hour and eight-hour energy storage resources compared to peaking power resources. The researchers found that in 82% of planned future peaker plants would be at risk from eight-hour storage projects (e.g., 100 MW/800 MWh).[8] Due to limitations in resource planning practices, LCOE or even capital costs alone will not adequately assess the full benefits of energy storage. As energy storage resources begin to be co-located with renewable energy resources, those energy storage technologies may qualify for federal incentives, such as the investment tax credit. Energy storage pricing, as with renewable energy, is anticipated to continue to considerably decline, while performance is expected to improve, especially over the near-term.

Unsubsidized Energy Storage Capital Costs ($/kW)



Source: Lazard Associates 2017[9]

2.1 Energy Storage Modeling

In February 2018, the Federal Energy Regulatory Commission (FERC) issued Order Number 841 regarding energy storage. FERC stated, "In a November 2016 Notice of Proposed Rulemaking (NOPR), the Commission noted that market rules designed for traditional generation resources can create barriers to entry for emerging technologies such as electric storage resources. Today's final rule helps remove these barriers by requiring each regional grid operator to revise its tariff to establish a participation model for electric storage resources that consist of market rules that properly recognize the physical and operational characteristics of electric storage resources." FERC noted in its rule that, artificial "restriction on competition can reduce the efficiency of the RTO/ISO markets, potentially leading an RTO/ISO to dispatch more expensive resources to meet its system needs."[10] Even though

RTO/ISO compliance filings are due to FERC in early December, with tariff implementation due by December 2019, utilities should strive to follow the spirit of FERC Order Number 841 in developing multiple modelling capabilities, sensitivities and analyses around energy storage issues.[11] In keeping with the principles of FERC Order Number 841, it is recommended that multiple energy storage configurations be evaluated (e.g., 2MW/2MWh, 2MW/4MWh, 2MW/8MWh, etc.), using sub-hourly dispatch, with multiple revenue streams (e.g., capacity credit, energy, frequency/voltage control, etc.), as stand-alone projects as well as coupled with generation resources (such as renewable energy resources).

Models that use sub-hourly intervals can better quantify the value of both capacity and flexibility benefits provided by advanced energy storage. By comparing flexibility benefits to the cost of storage—thereby using a "net cost" analysis of capacity investment options—planners can more accurately compare advanced energy storage with traditional capacity resources. Analysis of models that look at system flexibility needs and risk management will be more likely to reduce costs to ratepayers, including through use of storage. In addition to providing an LCOE regarding energy storage options, it is also recommended that values also be provided in $/kW-mo or $/kW-yr terms.

3. Federal Tax Credits

The federal Production Tax Credit (PTC) and Investment Tax Credit (ITC) are the primary incentives for the wind energy industry and solar energy industry, respectively. Because of congressional action in 2015, the PTC and ITC are being phased out, even while federal incentives for conventional forms of generation remain in place. Information provided below is meant to provide additional clarity regarding the PTC and ITC and generally how these incentives should be considered for modeling purposes.

3.1 Production Tax Credit

Wind energy developers can qualify projects for specific PTC vintages by commencing construction in a year and bringing such projects online within four calendar years. For example, a wind energy project that commences construction by the end of 2016 has until the end of 2020 to begin operation, and still qualify for the full PTC. Projects that begin construction in 2017 have until the end of 2021 to become operational, 2018 projects by 2022, and 2019 projects by 2023. Renewable energy project developers frequently safe harbor qualified clean energy equipment, in anticipation of a future contract and reflect cost reductions in the proposals.

The PTC is awarded on a generation basis, at a rate of $24/MWh for the first ten years of a project's operation. Because the PTC is a tax credit and it frequently exceeds a project developer's total tax base, developers will frequently monetize the PTC with tax equity. Tax equity erodes the full dollar value of the PTC. According to the Lawrence Berkeley National Lab (LBNL), for a developer with tax appetite, the 100% PTC value is reduced to $19.8/MWh.[12] According to LBNL, developers should expect a $15-$19/MWh reduction in overall cost of energy from the PTC. In order to achieve an equivalent PTC cost reduction, it is recommended that wind energy resources' overnight capital costs be reduced by roughly $600/kW for resources that become operational in 2020 (reflecting 100% of the PTC value), $500/kW for wind resources operational in 2021 (80% of PTC value), and $400/kW for wind resources operational in 2022 (60% of PTC value). Due to the high cost of tax equity for project financing, it is estimated that the 40% PTC (for projects that commence construction in 2019) is essentially value-less and not anticipated to be attractive to many wind developers.

<u>Schedule of Wind PTC Cost Reductions by Project In-Service Dates</u>

	2019	2020	2021	2022	2023	Future
Wind PTC	$19.8/MWh	$19.8/MWh	$16.9/MWh	$14.2/MWh	No Value	0
OR Wind PTC (Overnight $/kW translated)	*$600/kW*	*$600/kW*	*$500/kW*	*$400/kW*	*No Value*	*0*

Source: Adaptation from LBNL 2014[13]

3.2 Investment Tax Credit

Rules for the ITC for solar are slightly different. Based on IRS Notice 2018-59, "As modified, § 48 phases down the ITC for solar energy property the construction of which begins after December 31, 2019, and before January 1, 2022, and further limits the amount of the § 48 credit available for solar energy property that is not placed in service before January 1, 2024." In effect, the ITC phase-out for solar ends for projects that commence construction in 2019, 2020 or 2021 by January 1, 2024. For solar projects that begin construction on or after January 1, 2022, a permanent 10% ITC is available.[14]

Most utility-scale solar energy projects will elect to receive the ITC. The ITC is based on total project expenditure. It is recommended that the full 30% ITC be incorporated for projects that begin operation before 2024, and a 10% ITC be incorporated for projects that begin operation in 2024 and future years.

Additionally, new energy storage projects can also qualify for the ITC, provided that those projects are added to new or existing wind energy or solar energy projects. Currently, stand-alone energy storage projects do not qualify for the federal ITC.[15]

Schedule of Solar ITC Cost Reductions by Project In-Service Dates

Construction Begins	2019 Operational	2020 Operational	2021 Operational	2022 Operational	2023 Operational	Future Op.
Before 2020	30%	30%	30%	30%	30%	10%
2020		26%	26%	26%	26%	10%
2021			22%	22%	22%	10%
2022 and Future				10%	10%	10%

Source: Adaptation from IRS 2018[16]

4. Market-Based Benchmarking

Many utilities have issued requests for proposals (RFPs) for renewable energy resources from around the country; however, not all utilities publicly summarize results from those solicitations. Wherever recent results from renewable RFP solicitations are made public, it is highly encouraged that those data be used as benchmarks when developing IRP data inputs.

It is highly recommended that utilities should develop a request for proposals (RFP) or request for information (RFI) in tandem with IRP development to receive the most recent market information, specific to that utility. Developing an RFP or RFI to coincide with an IRP would create a significant amount of high quality data, while potentially expediting future power purchase agreements, procurements or developments.

4.1 Xcel Energy Colorado All-Source Solicitation

Xcel Energy, a Colorado electric utility, published the results of its 2017 All-Source Solicitation request for proposals in December 2017.[17] Xcel received over 400 bids representing over 100,000 MW of capacity from a wide variety of technologies; however, most bids provided wind energy or solar power resources. The median bid price or equivalent for stand-alone wind energy resources was $18.10/MWh, suggesting several projects below and above that price. Adding battery storage to wind energy resulted in median bids of $21/MWh. For stand-alone solar energy resources, the median bid was $29.50/MWh. Adding battery storage to solar energy resulted in median prices of $36/MWh. While these prices may be specific to Xcel, the fact remains that these represent real project bids and are aligned with projections by NREL's ATB, Lazard Associates and these comments.

Xcel RFP Responses by Technology 2017

RFP Responses by Technology

Generation Technology	# of Bids	Bid MW	# of Projects	Project MW	Median Bid Price or Equivalent	Pricing Units
Combustion Turbine/IC Engines	30	7,141	13	2,466	$ 4.80	$/kW-mo
Combustion Turbine with Battery Storage	7	804	3	476	6.20	$/kW-mo
Gas-Fired Combined Cycles	2	451	2	451	[redacted]	$/kW-mo
Stand-alone Battery Storage	28	2,143	21	1,614	11.30	$/kW-mo
Compressed Air Energy Storage	1	317	1	317	[redacted]	$/kW-mo
Wind	96	42,278	42	17,380	$ 18.10	$/MWh
Wind and Solar	5	2,612	4	2,162	19.90	$/MWh
Wind with Battery Storage	11	5,700	8	5,097	21.00	$/MWh
Solar (PV)	152	29,710	75	13,435	29.50	$/MWh
Wind and Solar and Battery Storage	7	4,048	7	4,048	30.60	$/MWh
Solar (PV) with Battery Storage	87	16,725	59	10,813	36.00	$/MWh
IC Engine with Solar	1	5	1	5	[redacted]	$/MWh
Waste Heat	2	21	1	11	[redacted]	$/MWh
Biomass	1	9	1	9	[redacted]	$/MWh
Total	430	111,963	238	58,283		

Source: Xcel Energy 2017[18]

4.2 Northern Indiana Public Service Company Request for Proposals

Northern Indiana Public Service Company (NIPSCO), an electric company in the MISO system, held an integrated resource plan (IRP) meeting on July 24, 2018 to discuss renewable energy options. As part of its IRP process, NIPSCO shared results from an all source request for proposals (RFP) summary. NIPSCO received bids for wind energy, solar energy, energy storage, and amalgamations of those resources together. The company received proposals across five states, predominately via power purchase agreement (PPA), but also as asset sale or option. Resources offered as asset sale or as an option were provided at an average bid cost of $1,151.01/kW for solar energy projects, and $1,457.07/kW for wind energy projects. For PPA's, average bids for solar energy reached $35.67/MWh, and average bids for wind energy reached $26.97/MWh. Solar plus energy storage projects were offered as asset sales at $1,182.79/kW and also as a PPA at $5.90/kW-Mo plus

$35/MWh.[19] These values provide recent market data that are relevant to states in MISO and further south.

NIPSCO RFP Responses by Technology 2018

	Technology	# of Bids	Bid MW (ICAP)	# of Projects	Project MW	Average Bid Price	Pricing Units	Comments
Asset Sale or Option	Combine Cycle Gas (CCGT)	7	4,846	4	3,055	$959.61	$/kW	
	Combustion Turbine (CT)	1						
	Solar	9	1,374	5	669	$1,151.01	$/kW	
	Wind	8	1,807	7	1,607	$1,457.07	$/kW	
	Solar + Storage	4	705	3	465	$1,182.79	$/kW	
	Wind + Solar + Storage	1						
	Storage	1						
Purchase Power Agreement	Combine Cycle Gas (CCGT)	8	2,715	6	2,415	$7.86	$/kW-Mo	+ fuel and variable O&M
	Solar + Storage	7	1,055	5	755	$5.90	$/kW-Mo	+ $35/MWh (Average)
	Storage	8	1,055	5	925	$11.24	$/kW-Mo	
	Solar	26	3,591	16	1,911	$35.67	$/MWh	
	Wind	6	788	4	603	$26.97	$/MWh	
	Fossil	3	1,494	2	772	N/A		Structure not amenable to price comparison
	Demand Response	1						
	Total	90	20,585	59	13,247			

Source: NIPSCO 2018[20]

5. BREC IRP Review

The BREC IRP has significant deficiencies that may hamper resource planning "at the lowest possible cost".[21] SREA recommends that BREC issue a request for proposals (RFP) for renewable energy resources to serve as a benchmark for its current assumptions, and as a potential pool of new resources for procurement.

5.1 Data Input Assumptions

BREC should replace its use of the EIA CapEx and performance information, at least for wind energy and solar power. EIA has historically provided an exceptionally narrow, and inaccurate reflection of real market data for renewable energy resources and have been lampooned over the past several years for being woefully inaccurate. A 2015 article from *Politico* asks, "Why are the government's energy forecasts so bad?" and states "Change is hard to anticipate. But when it comes to renewables, the EIA seems to have failures of plain sight."[22] A 2016 *The Hill* article followed up with, "A recent peer-reviewed study led by the co-author of this column reviewed 630 projections made by the EIA between 2004 and 2014 that could be checked against actual data. The study found that most of EIA's projections for renewables sharply under-projected generation or capacity, with especially pronounced under-projections of wind and solar in more recent years."[23] In 2017, an article in Quartz stated, "Every two years, the US Energy Information Administration (EIA), America's official source for energy statistics, issues 10-year projections about how much solar, wind and conventional energy the future holds for the US. Every two years, since the mid-1990s, the EIA's projections turn out to be wrong. Last year, they proved spectacularly wrong."[24] In 2018, an article noted, "the EIA assessment of generation costs across technology types in 2022 more closely resembles a copy-paste of renewables' market data from back in 2015."[25] EIA is not a reliable nor credible source on current renewable industries and should not be used for renewable energy resources.

As a member of MISO, BREC should adopt much of the same methodology and sources used by MISO's resource planning processes. For example, the MISO Transmission Expansion Planning (MTEP) process relies on data from the National Renewable Energy Laboratory's Annual Technology Baseline (ATB) regarding generation type, locations, performance levels and capital costs. MISO does not use the EIA capital cost assumptions for renewable energy resources.

5.2 Wind Energy

BREC stated that, "Onshore Wind was not considered due to the lack of viable locations for wind energy to be built in northwestern Kentucky."[26] Given that BREC is a member of the Midcontinent Independent System Operator (MISO) transmission system, BREC has direct access to excellent wind energy resources, outside Kentucky's borders. As part of the MISO Indiana Hub, BREC should be aware of the nearly 1,900 MW of already installed wind power capacity in that state, highlighting not only the technical but also the economic potential for wind energy resources nearby.[27] BREC is also connected to TVA, which already imports wind energy resources from Illinois, Iowa and other MISO-connected states.

BREC is aware of transmission capabilities and costs, due to its announced plans to contract with a power purchaser in Nebraska. With regards to BREC's Nebraska contracts, BREC has stated that, "Big Rivers will be responsible for delivery of energy to the interconnection point between MISO and SPP and each Nebraska Purchasers is responsible for firm transmission service to deliver energy to the applicable delivery points within the SPP."[28] Provided that energy exports across two RTOs appear to have little difficulty in BREC's forecasts and planning, energy imports should also be evaluated.

BREC provided scant information regarding wind energy in Kentucky. BREC stated, "Please see the attachment which includes a Wind Resource map of Kentucky which was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy in June 2012. This map shows that almost all of Kentucky's Wind Power Classification is rated as 'Poor' Resource Potential."[29] However, the map provided was not published originally in 2012; the map has "June 2010" printed at the bottom. However, versions of this map have been available from at least the mid-1990s. In the 1990s, NREL only evaluated wind speeds up to 50-meter hub heights, which is the same height as the map provided by BREC. NREL updated its wind speed mapping methodology a number of years ago and ceased using the wind "classification" scale referenced in BREC's IRP. Currently commercially available wind turbines frequently reach 100 meter hub heights, and NREL has more recently published wind speed maps at altitudes of up to 140 meter hub heights. Much of Kentucky is now capable of reaching 35%+ capacity factors with potential wind energy resources.[30] In short, BREC's wind energy map is approximately 30 years out of date and does not reflect the current state of the market.

As described earlier in these comments, wind energy resources are numerous and diverse in costs, performance levels, and levelized cost. In Kentucky Power's IRP, that utility evaluated multiple types of wind energy resources and found considerable demand for wind power.[31] BREC should model multiple types of wind energy resources and rely on the NREL ATB values to conduct its modeling.

5.3 Solar Energy

BREC effectively modeled a renewable portfolio standard, or a renewable energy mandate. BREC would only add up to 180 MW of fixed-tilt solar power if the utility is required to meet 25% of its "native peak load" capacity by renewable energy resources, by 2030. Modeling some sort of mandate was necessary because the inaccurate EIA costs used by BREC are too high for the models to naturally select those resources. BREC should use the NREL ATB data for model runs.

BREC only evaluated fixed solar power resources. Solar tracking systems boost power production during peak periods of the day, and by providing higher levels of valuable peak power, offset the increased cost and complexity of tracking systems. According to the IRP, "The tracking solar has not proven to be economical in western Kentucky." However, Owensboro Municipal Utilities (OMU) and Kentucky Municipal Energy Agency (KyMEA) recently announced an 86-megawatt solar power purchase agreement, and that project will use single-axis tracking.[32] In speaking with the solar development community, we can confirm that the expected LCOE economics for the OMU PPA is in the mid $30/MWh range based upon the 30% ITC and current build costs.

5.4 Tax Credits, Power Purchase Agreements

As mentioned previously in these comments, the federal PTC and ITC have significant implications for wind energy and solar energy resources in the very near term. It does not appear that BREC adequately incorporated these already-existing federal financial incentives, and as such, may miss low cost energy opportunities.

Power Purchase Agreements (PPAs) may enable renewable energy development companies to better monetize the PTC and/or ITC. However, BREC stated, "No power purchase agreements (PPAs) for renewables were included as a resource option in the IRP modeling."[33] Given that most renewable energy resources are procured via PPA, BREC has significantly limited real-world resources for modeling and evaluation.

BREC stated that it did not evaluate PPAs because "Power purchase agreements for renewables were not included as a resource option because Big Rivers did not have the market data to do so."[34] As provided in these comments, both from Xcel and NIPSCO, SREA recommends BREC use existing published reports regarding wind and solar project prices, and issue an RFP to collect PPA values. Now that BREC has these data provided by SREA, BREC should be required to re-run its models.

5.5 Corporate Renewable Energy Procurement

Due to high demand by corporate customers for renewable energy resources, several states and utilities have developed corporate procurement strategies and regulation.[35] Such regulatory practices are frequently called "Green Tariffs". BREC should conduct a study of corporate renewable energy procurement practices by other utilities and states. Such a study should include best practices, estimated corporate interest within the BREC footprint, and recommendations for an action plan. For the IRP, BREC should develop a 100 MW renewable energy corporate procurement scenario for evaluation.

6. Conclusion

BREC's current IRP does not accurately evaluate wind energy or solar energy resources. BREC excluded all wind energy resources, tracking solar resources, power purchase agreement resources and did not include analysis with current federal incentives. By excluding viable resources, BREC cannot definitively prove that its IRP results in "lowest possible cost". SREA requests that BREC incorporate our data regarding renewable energy metrics and re-run analyses. SREA further requests that BREC issue an RFP for renewable energy collect real-world, directly relevant information for its planning purposes and potentially identify projects for procurement.

---

[1] Kentucky Power Company (May 2017). Kentucky Power Company's Response to the Comments of the Attorney General of the Commonwealth of Kentucky, Southern Wind Energy Association, and the Sierra Club to the Company's 2016 Integrated Resource Planning Report. [http://psc.ky.gov/pscecf/2016-00413/jkrosquist%40aep.com/05052017042644/KPCO_R_Comments_OAG_SWE_SC_050517.PDF]
[2] NREL (National Renewable Energy Laboratory). 2018. 2018 Annual Technology Baseline. Golden, CO: National Renewable Energy Laboratory. http://www.nrel.gov/analysis/data_tech_baseline.html.
[3] Midcontinent Independent System Operator (March 20, 2018). "MTEP19 Futures Development Workshop." [https://cdn.misoenergy.org/20180320%20MTEP19%20Futures%20Workshop%20Presentation150635.pdf]
[4] Muhsin K. Abdur-Rahman (April 25, 2016). "PJM's Clean Power Plan Modeling Reference Model and Sensitivities," PJM. [https://www.pjm.com/-/media/committees-groups/committees/mc/20160425-webinar/20160425-item-02-clean-power-plan-reference-model-results.ashx]
[5] National Renewable Energy Lab (November 2016). Regional Energy Deployment System (ReEDS) Model Documentation: Version 2016. [https://www.nrel.gov/docs/fy17osti/67067.pdf]
[6] National Renewable Energy Lab (July 2018). NREL Annual Technology Baseline (ATB) 2018. [https://atb.nrel.gov/]
[7] Lazard Associates (November 2017). Levelized Cost of Storage Analysis, Version 3.0. [https://www.lazard.com/media/450338/lazard-levelized-cost-of-storage-version-30.pdf]
[8] Ravi Manghani (March 2018). "Will Energy Storage Replace Peaker Plants?" GTM Research. [https://d3v6gwebjc7bm7.cloudfront.net/event/15/88/96/3/rt/1/documents/resourceList1519927946005/willenergystoragereplacepeakerplantswebinarslides1519927951937.pdf]
[9] Lazard Associates (November 2017). Levelized Cost of Storage Analysis, Version 3.0. [https://www.lazard.com/media/450338/lazard-levelized-cost-of-storage-version-30.pdf]
[10] Federal Energy Regulatory Commission (February 15, 2018). Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators. [Docket Nos. RM16-23-000; AD16-20-000; Order No. 841]. https://www.ferc.gov/whats-new/comm-meet/2018/021518/E-1.pdf
[11] Federal Energy Regulatory Commission (February 15, 2018). FERC issues final rule on electric storage participation in regional markets. [https://www.ferc.gov/media/news-releases/2018/2018-1/02-15-18-E-1.asp#.Wv3-1NOUv-Z]
[12] Mark Bolinger (April 2014). "An Analysis of the Costs, Benefits, and Implications of Different Approaches to Capturing the Value of Renewable Energy Tax Incentives," Lawrence Berkeley National Lab.
[13] Mark Bolinger (April 2014). "An Analysis of the Costs, Benefits, and Implications of Different Approaches to Capturing the Value of Renewable Energy Tax Incentives," Lawrence Berkeley National Lab.
[14] United States Internal Revenue Service (2018). Beginning of Construction for the Investment Tax Credit under Section 48, Notice 2018-59. [https://www.irs.gov/pub/irs-drop/n-18-59.pdf]
[15] Heather Cooper (November 15, 2017). "Add batteries to your wind farm and get more (ITC) juice," McDermott Will & Emery. [https://www.mwe.com/en/thought-leadership/publications/2017/11/add-batteries-to-wind-farm-get-more-juice]
[16] Heather Cooper (November 15, 2017). "Add batteries to your wind farm and get more (ITC) juice," McDermott Will & Emery. [https://www.mwe.com/en/thought-leadership/publications/2017/11/add-batteries-to-wind-farm-get-more-juice]
[17] Xcel Energy (December 28, 2017). 2016 Electric Resource Plan, 2017 All Source Solicitation 30-Day Report (Public Version) CPUC Proceeding No. 16A-0396E. [https://assets.documentcloud.org/documents/4340162/Xcel-Solicitation-Report.pdf]
[18] Xcel Energy (December 28, 2017). 2016 Electric Resource Plan, 2017 All Source Solicitation 30-Day Report (Public Version) CPUC Proceeding No. 16A-0396E. [https://assets.documentcloud.org/documents/4340162/Xcel-Solicitation-Report.pdf]
[19] Northern Indiana Public Service Company (July 24, 2018). NIPSCO Integrated Resource Plan 2018 Update Public Advisory Meeting Three. [https://www.nipsco.com/docs/default-source/about-nipsco-docs/7-24-2018-nipsco-irp-public-advisory-presentation.pdf]

[20] Northern Indiana Public Service Company (July 24, 2018). NIPSCO Integrated Resource Plan 2018 Update Public Advisory Meeting Three. [https://www.nipsco.com/docs/default-source/about-nipsco-docs/7-24-2018-nipsco-irp-public-advisory-presentation.pdf]
[21] 807 KAR 5:058. Integrated resource planning by electric utilities. www.lrc.ky.gov/kar/807/005/058.pdf
[22] Michael Grunwald (June 24, 2015). "Why are the governments' energy forecasts so bad?" Politico. [https://www.politico.com/agenda/story/2015/06/why-are-the-federal-governments-energy-forecasts-so-bad-000111]
[23] Daniel Cohan (April 1, 2016). "An energy agency's forecasting flaws," The Hill. [https://thehill.com/blogs/pundits-blog/energy-environment/274869-an-energy-agencys-forecasting-flaws]
[24] Michael Coren (October 19, 2017). "The US government keeps spectacularly underestimating solar energy installation," Quartz. [https://qz.com/1103874/the-us-government-underestimated-solar-energy-installation-in-the-us-by-4813-along-with-renewable-wind-and-solar-generation/]
[25] Jules Kortenhorst (February 13, 2018). "Unmoored from Facts, Will EIA Projections Become Reality?" Rocky Mountain Institute. [https://rmi.org/unmoored-facts-will-eia-projections-become-reality/]
[26] Big Rivers Electric Corporation (September 21, 2017). Big Rivers Electric Corporation's 2017 Integrated Resource Plan. [http://psc.ky.gov/PSCSCF/2017%20cases/2017-00384/20170921_Big%20Rivers%20Electric%20Corporation%20Application.pdf]
[27] American Wind Energy Association (2017). U.S. Wind Industry Second Quarter 2017 Market Report. [http://awea.files.cms-plus.com/FileDownloads/pdfs/2Q%202017%20AWEA%20Market%20Report%20Public%20Version.pdf]
[28] Kentucky Public Service Commission (July 21, 2015). Big Rivers Electric Corporation Filing of Wholesale Contracts Pursuant to KRS 278.180 and 807 KAR 5:011 §13. Case No. 2014-00134. [https://psc.ky.gov/PSCSCF/2014%20Cases/2014-00134/20150721_PSC_ORDER.pdf]
[29] Big Rivers Electric Corporation (July 20, 2018) 2017 Integrated Resource Plan of Big Rivers Electric Corporation, Case No. 2017-00384, Response to Ben Taylor and the Sierra Club's Initial Request for Information dated June 21, 2018 [https://psc.ky.gov/PSCSCF/2017%20cases/2017-00384/20180720_Big%20Rivers%20Electric%20Corporation%20Response%20to%20Ben%20Taylor%20and%20the%20Sierra%20Club.pdf]
[30] Department of Energy (February 2015). [https://windexchange.energy.gov/states/ky]
[31] Kentucky Power (December 20, 2016). Integrated Resource Planning Report to the Kentucky Public Service Commission. [https://psc.ky.gov/pscecf/2016-00413/jkrosquist%40aep.com/12202016110531/KPCO_2016_IRP__Volume_A___Public__Version.pdf]
[32] Owensboro Municipal Utility (September 20, 2018). "OMU to include solar power in supply portfolio." [https://omu.org/blog/2018/09/20/omu-to-include-solar-in-power-supply-portfolio/]
[33] Big Rivers Electric Corporation (July 20, 2018) 2017 Integrated Resource Plan of Big Rivers Electric Corporation, Case No. 2017-00384, Response to Ben Taylor and the Sierra Club's Initial Request for Information dated June 21, 2018 [https://psc.ky.gov/PSCSCF/2017%20cases/2017-00384/20180720_Big%20Rivers%20Electric%20Corporation%20Response%20to%20Ben%20Taylor%20and%20the%20Sierra%20Club.pdf]
[34] Big Rivers Electric Corporation (July 20, 2018) 2017 Integrated Resource Plan of Big Rivers Electric Corporation, Case No. 2017-00384, Response to Ben Taylor and the Sierra Club's Initial Request for Information dated June 21, 2018 [https://psc.ky.gov/PSCSCF/2017%20cases/2017-00384/20180720_Big%20Rivers%20Electric%20Corporation%20Response%20to%20Ben%20Taylor%20and%20the%20Sierra%20Club.pdf]
[35] Advanced Energy Economy (2017). Making Corporate Renewable Energy Purchasing Work for All Utility Customers: Design principles for voluntary renewable energy programs. [https://info.aee.net/making-corporate-renewable-energy-purchasing-work-for-all-utility-customers]