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southernwind.org

Southern Wind Energy Association
P.O. Box 1842, Knoxville, TN 37901

February 14, 2017

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FEB 16 2017

PUBLIC SERVICE
COMMISSION

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

RE: KENTUCKY POWER COMPANY 2016 INTEGRATED RESOURCE PLAN
DOCKET #2016-00413

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

The Southern Wind Energy Association has not requested intervention in Kentucky Power Company's 2016 Integrated Resource Plan (Docket #2016-00413); 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
Director
Southern Wind Energy Association
simon@southernwind.org
337-303-3723

cc: Service List

Southern Wind Energy Association
P.O. Box 1842, Knoxville, TN 37901
southernwind.org

KENTUCKY POWER COMPANY 2016 INTEGRATED RESOURCE PLAN

RECEIVED
FEB 16 2017
PUBLIC SERVICE COMMISSION

DOCKET #2016-00413

COMMENTS OF THE SOUTHERN WIND ENERGY ASSOCIATION

FEBRUARY 13, 2017

The Southern Wind Energy Association (SWEA) is an industry-led initiative that promotes the use and development of wind energy in the south. Over the past three years, SWEA has engaged in IRP processes in Arkansas, Georgia, Louisiana and Tennessee. We strive to provide the most up-to-date and publicly available market information regarding wind energy resource availability, pricing, performance and forecasting. SWEA appreciates the opportunity to comment on the Kentucky Power Company (KPC) 2016 Integrated Resource Plan (IRP).

Approximately 82,000 megawatts of wind power capacity are currently online in the United States, including, 8 gigawatts of wind energy generation capacity that was installed in 2016.[1] Low wind power prices have encouraged substantial wind power purchases, even in states where such purchases are not required. Some such wind purchases include Alabama Power (404 MW)[2], Appalachian Power (495 MW), Arkansas Electric Cooperative (309 MW)[3], Georgia Power (250 MW)[4], Gulf Power (272 MW)[5], SWEPCO (469 MW)[6] and the Tennessee Valley Authority (1,542 MW).[7] With nearly 3.8 gigawatts of existing wind power purchase contracts, voluntary wind energy purchases in the south underscore the benefits of low-cost wind power.

SWEA would like to congratulate KPC for performing an outstanding IRP. In keeping with standards set by KPC's parent company, American Electric Power (AEP), KPC's Preferred Portfolio responsibly incorporates low cost wind energy resources in the near term. Under the four scenarios evaluated, including the Low Band, Mid Band, High Band, and No Carbon scenarios, each scenario selected 300 megawatts of wind energy resources for near-term purchase and incorporation into KPC's generation portfolio. As such, SWEA recommends:

- Immediately issue a request for proposals (RFP) for at least 300 megawatts of wind energy resources, and select preferred wind power purchase agreement(s) before the end of 2017 for delivery by 2020/2021.
- Evaluate multiple wind energy resources (including local, imports and high voltage direct current) under a variety of performance and cost conditions.
- Incorporate cost and performance improvements for wind energy resources over time.
- Use 15%-30% capacity values for various wind energy resources.
- For future IRPs, evaluate the technical feasibility of higher levels of renewable energy penetration beyond 20%.

Multiple, Low-Cost Wind Energy Resources are Available to KPC

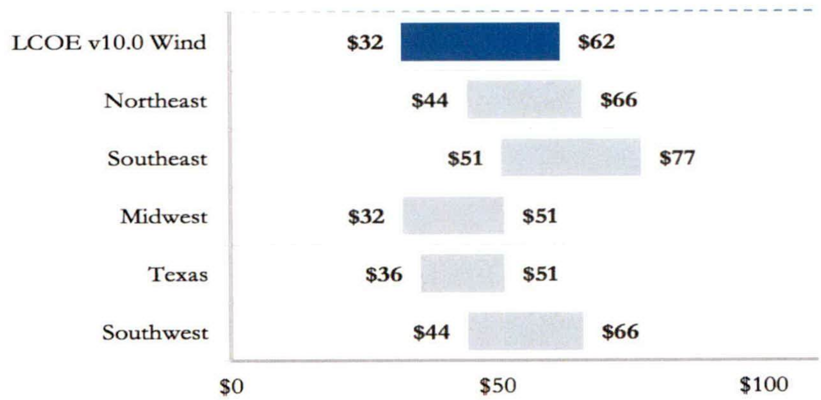
In the 2016 Integrated Resource Plan KPC evaluated a single wind energy resource at a 38% capacity factor with a $47 per megawatt hour (MWh) price. Due to KPC's geographic location, multiple wind energy opportunities exist for the utility:

- KPC can import wind from the Southwest Power Pool (SPP), Midcontinent Independent System Operator (MISO) or PJM regions via the existing AC grid. The wind procurements mentioned above have utilized this model.
- Two separate high voltage direct current (HVDC) transmission projects currently under development, the Plains & Eastern Clean Line and the Southern Cross project, will provide a direct connection between high capacity, low cost wind energy resources from Oklahoma and Texas and the eastern region of the United States.
- Finally, wind turbine technology has advanced significantly, and wind energy development within Kentucky is now an economic reality.

These three wind options utilize unique and geographically diverse wind resources with different that each provide different costs and benefits to utility purchasers. For example, Figure 3 below outlines unsubsidized wind energy costs in different areas of the United States. SWEA recommends evaluating each opportunity separately and on its own merits.

When SWEPCO conducted its IRP process in Louisiana in 2015, it evaluated three separate tranches of wind energy resources that varied based on capacity factor, and price. By evaluating several tranches of wind energy resources, KPC can better plan for its needs into the future. SWEA encourages KPC to evaluate multiple wind energy resources under a variety of performance and cost conditions.

Figure 1. Unsubsidized Wind Energy Levelized Cost of Energy – Regional Sensitivity ($/MWh)



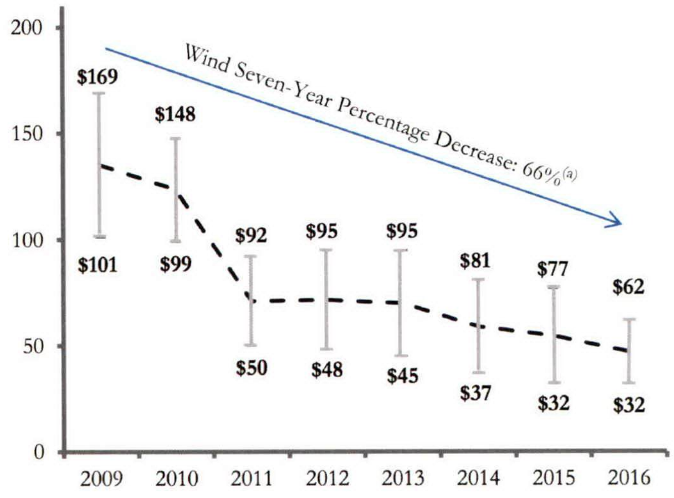
Source: Lazard Associates 2016[8]

Assumes wind capacity factors of 35%-40% for the Northeast, 30-35% for the Southeast, 45%-55% for the Midwest, 45-50% for Texas, and 35-40% for the Southwest.

Wind Power Prices and Performance Will Continue to Improve

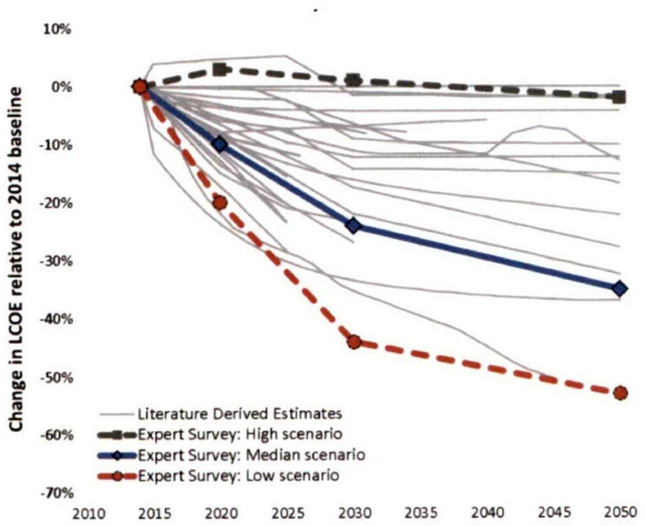
KPC accurately reflects that solar prices are anticipated to decline over its planning timeframe, but anticipates wind power prices will increase over time. Wind power prices have declined by 66% over the past seven years as a result of improvements in wind turbine technology, and these trends are expected to continue.[9] By 2020, unsubsidized wind power prices are anticipated to decline by an additional 10%, with a 24% cost reduction by 2030.[10] SWEA recommends KPC incorporate improvements for wind energy resources over time.

Figure 2. Unsubsidized Wind Power LCOE Reductions from 2009 to 2016 ($/MWh)



Source: Lazard Associates 2016[11]

Figure 3. Estimated Future Reductions in LCOE: Expert Survey Results vs. Other Forecasts



Source: LBNL/NREL 2016[12]

Higher Wind Power Capacity Values Exist

KPC has assigned a capacity value of 5% for wind energy resources. PJM has assigned a capacity credit value of 13%[13] for wind energy resources, similar to the MISO market capacity value of 15.6%[14] and the Electric Reliability Council of Texas' (ERCOT) wind energy capacity value of 14% for summer, non-coastal wind projects.

MISO assigns specific capacity values to wind projects based on their individual performance, with wind farm-specific capacity values of up to 26.2%. ERCOT also provides separate capacity values based on geographic location (coastal or noncoastal wind farms) to better capture geographic variation, as well as seasonal capacity values (summer or winter).[15]

Because capacity resources provide financial value, properly attributing capacity value to wind energy resources can reduce overall utility costs by incorporating the otherwise inherent value of wind energy resources as opposed to requiring a separate (and potentially costly) addition of firm capacity.

PJM's methodology for determining wind power capacity value is restrictive and not reflective of actual dependable capacity, especially for KPC. KPC is a winter peaking utility; however, PJM's methodology relies on expected generation and load demands during summer peak periods. As shown by ERCOT's capacity value methodology, wind energy resources generally perform best during winter peaking conditions. Thus, only using a summer peaking capacity value methodology underestimates the value associated with a winter peaking wind energy resource, especially for a winter peaking utility like KPC.

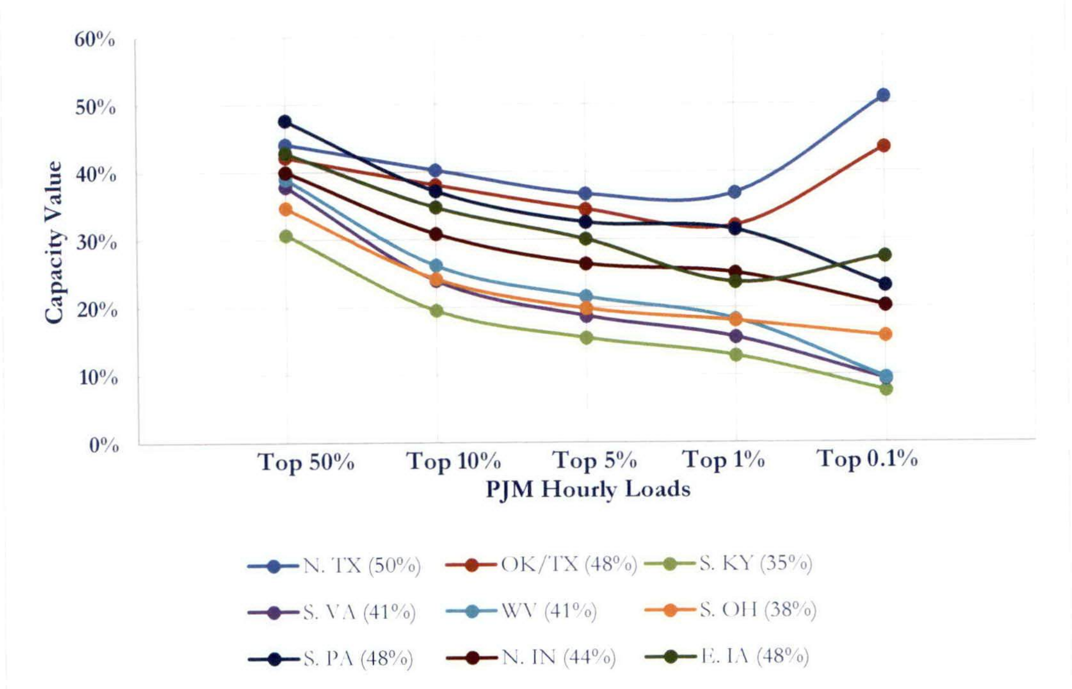
Based on a limited analysis performed by SWEA, several different wind energy resources would provide higher capacity values based on geography and methodology.* As mentioned previously, a variety of wind energy resources are available for KPC including in-state, PJM, MISO and HVDC wind energy resources. Comparing the estimated production profiles of nine separate sites from various states against both the PJM and LGEKU top load hours (50% of top loads, 10% of top loads, 5% of top loads, 1% of top loads and 0.1% of top loads) from 2007-2012 results in capacity values ranging from as low as 8% (southern Kentucky site vs. PJM's top 0.1%), to a high of 51% (northern Texas site vs. PJM's top 0.1%). Several trends are apparent:

- Capacity value generally declines, compared to average capacity factor, as load hours focus on fewer, and higher, peak loads.
- In some top 0.1% of load hours, capacity value actually increases (specifically sites from Texas, Oklahoma and Iowa compared to the PJM peak loads, and West Virginia, Ohio, and Iowa compared to the LGEKU peak loads).
- In virtually all cases, overall average annual capacity factors are higher than capacity value assigned by KPC.

* Sub-hourly wind power estimates, from 2007-2012 are available via the National Renewable Energy Lab (NREL) for 127,000 separate locations across the country via the Wind Integration National Dataset (WIND) Toolkit. Hourly load data from PJM are available via FERC Form 714, and Louisville Gas & Electric/Kentucky Utilities (LGEKU).

Figure 4. Hourly Wind Capacity Value by Location vs.

Top PJM Hourly Load Hours (2007-2012)†



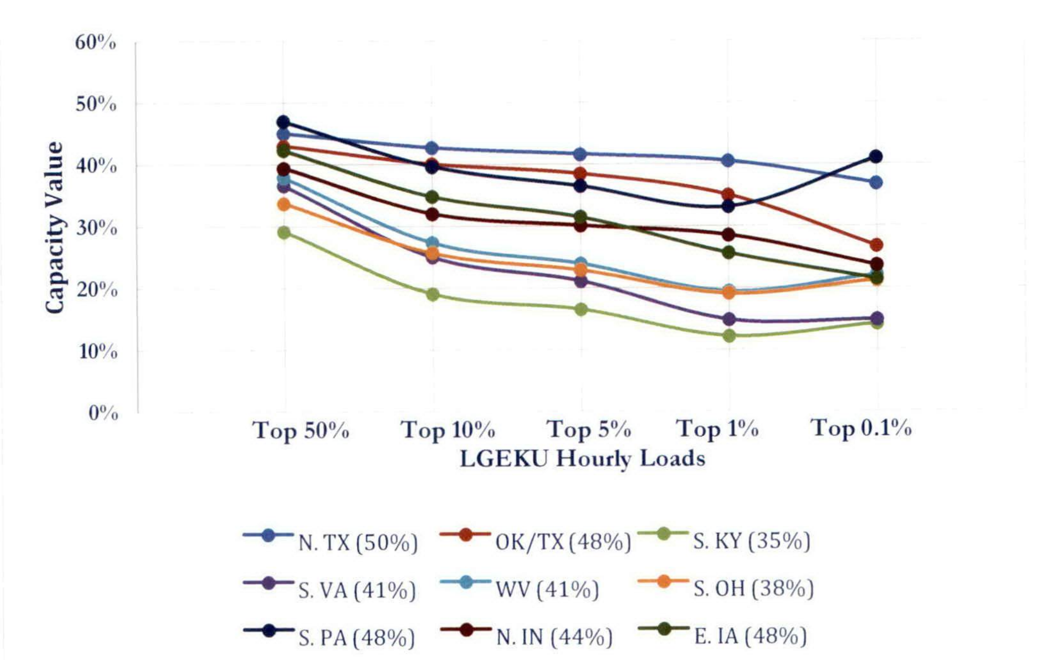
Data: FERC Form 714, Wind Integration National Dataset (WIND) Toolkit

Source: SWEA 2017

† Not comprehensive. Does not include full suite of contractual options, such as firming or oversubscription. Individual projects may be higher, or lower, depending on location and turbine type. Illustrative purposes only.

Figure 5. Hourly Wind Capacity Value by Location vs.

Top LGE/KU Hourly Load Hours (2007-2012) *



Data: FERC Form 714, Wind Integration National Dataset (WIND) Toolkit

Source: SWEA 2017

RTO's frequently re-evaluate capacity value methodologies for renewable energy, and multiple methodologies currently exist nationally. For comparison, SWEPCO used the methodology and values provided by the Southwestern Power Pool (SPP) for its wind energy capacity value inputs. However, SWEPCO also recognized that some wind energy resources may actually provide higher capacity value than what the SPP methodology would recognize. SWEPCO used two separate capacity values for different wind energy resources – a 10% wind energy capacity value supplied by SPP, and a 20% wind energy capacity value based on its own research.[16] As a member of PJM, KPC may find it advantageous to recommend higher capacity value methodology in order to fully collect value associated with high performance wind energy contracts. Based on the analysis provided here, KPC could similarly see capacity values of roughly 15%-30%, depending on wind farm site and methodology.

Wind Power Generation Mixes of >20% Are Possible

KPC considered wind energy resources as a 75 MW tranche available each year with a cap of 300 MW. As mentioned previously, under every scenario evaluated, the maximum amount of wind energy is selected for each year up to the 300 MW cap, indicating a strong financial benefit of wind power. The 300 MW cap results in a wind penetration level of approximately 15% by 2022. The Department of Energy's *Wind Vision* report, evaluated a national scenario with 20% wind energy penetration levels by 2030, and 35% by 2050.[17] A study completed in 2014 by General Electric for PJM similarly found that "the PJM system, with adequate transmission expansion and additional regulating reserves, will not have any significant issues operating with up to 30% of its energy provided by wind and solar generation."[18] Kansas, South Dakota and Iowa have all surpassed 20% wind energy penetration.[19] MidAmerican (a major Iowan utility), already receives approximately 50% of its energy from wind power[20], and recently announced plans to receive 85% wind power.[21] In preparation for its next IRP, SWEA encourages KPC to evaluate the technical feasibility of higher levels of renewable energy penetration.

Federal Tax Credit Phase-Out Encourages Immediate Action

KPC's preferred plan incorporates at least 300 MW of wind power by 2021. Wind power development firms are able to qualify projects for the federal production tax credit (PTC). The federal PTC provides a 10-year tax credit that currently stands at $23 per megawatt hour (MWh) and that changes over time with inflation. In order to qualify for the full PTC, a wind farm developer have begun construction before the end of 2016, with operation beginning no later than December 31, 2020.

However, the PTC declines in value by 20% each year a wind farm developer delays beginning construction (e.g., projects that start construction in 2017 receive just 80% of the PTC's full value, dropping to 60% and 40% for projects that start construction in 2018 or 2019, respectively). Wind farms that begin construction in 2020 are currently slated to receive no federal PTC benefit.

By one estimate from the Lawrence Berkeley National Laboratory (LBNL), the full PTC is worth roughly $16/MWh (in PPA price terms) to wind project owners with a limited appetite for tax credits. That same LBNL report finds that, due to financing impacts, a 20% decline in the PTC may actually result in a loss of $5.60/MWh in real dollar value. If KPC delays issuance of a RFP for the full 300 MW of wind energy, the decline in value from the PTC can impact the overall PPA price, but also total savings.

Figure 6. Total Real PTC Devaluation Compared to Full PTC Qualification

(300 MW Wind, 40%CF)

Based off LBNL 2014[22], SWEA 2016[23]

According to IRS rules, so long as a 2016-qualified project is operational within four calendar years (by December 31, 2020), it will retain its full PTC qualification. For projects that begin construction before December 31, 2017, and qualify for the 2017 PTC, operation must begin before December 31, 2021. Because KPC's preferred plan incorporates 300 MW of wind energy as operational by 2021, the company should immediately issue an RFP for the full 300 MW, with operation beginning as late as 2020/2021.

Some wind farm developers have qualified wind projects under the 2016 PTC, and those projects may be available to KPC, if an RFP process is conducted expeditiously. KPC's sister companies have already issued RFPs for wind energy and operated those processes expeditiously. Appalachian Power Company issued an RFP in January 2016, and announced the selection of a 120 MW wind PPA just six months later. In August 2016, Southwestern Electric Power Company issued an RFP for wind energy, and anticipates making a PPA selection soon.

Figure 7. Recommended Wind Power Inputs

Contract Date		2017	2018	2019	2020	2025	2030
Delivery Date		2020/2021	2021/2022	2022/2023	2021/2024	2026/2029	2031/2034
$/MWh (incl. PTC)	Tranche 1	$25	$28	$31	$34	$32	$30
	Tranche 2	$37	$40	$43	$45	$42	$38
	Tranche 3	$52	$55	$59	$59	$55	$51
Installed $/KW	Tranche 1	$1,600			$1,575	$1,550	$1,525
	Tranche 2	$1,700			$1,675	$1,650	$1,625
	Tanche 3	$1,800			$1,775	$1,750	$1,725
Capacity Factor	Low Cost	50%			51%	52%	55%
	Mid Cost	40%			41%	43%	47%
	Moderate Cost	30%			33%	35%	38%
PTC Value Real $/MWh		$12	$9	$6	*PTC Phase Out*		
Cost Reductions %/MWh		*No Learning Curve*			11%	18%	24%

Recommendations

Multiple utilities across the south are voluntarily purchasing wind energy resources in an effort to diversify energy portfolios and reduce cost risks. Kentucky Power Company's 2016 Integrate Resource Plan incorporates low-cost wind energy resources in a reasonable and cost-effective manner. SWEA recommends:

- Immediately issue a request for proposals (RFP) for at least 300 megawatts of wind energy resources, and select preferred wind power purchase agreement(s) before the end of 2017 for delivery by 2020/2021.
- Evaluate multiple wind energy resources (including local, imports and high voltage direct current) under a variety of performance and cost conditions.
- Incorporate cost and performance improvements for wind energy resources over time.
- Use 15%-30% capacity values for various wind energy resources.
- For future IRPs, evaluate the technical feasibility of higher levels of renewable energy penetration beyond 20%.

Appendix 1: AEP Subsidiary Wind Power Purchase Agreements

Company	Wind Farm	State	Interconnection	Year	MW	Developer
AEP Ohio	Fowler II	IN	PJM	2009	50	BP Wind Energy
AEP Ohio	Fowler II	IN	PJM	2009	50	BP Wind Energy
AEP Ohio	Timber Road 1	OH	PJM	2011	54.55	EDP Renewables
AEP Ohio	Timber Road 1	OH	PJM	2011	44.55	EDP Renewables
Appalachian Power	Camp Grove	IL	PJM	2008	75	Orion Energy
Appalachian Power	Fowler III	IN	PJM	2009	100	BP Wind Energy
Appalachian Power	Grand Ridge II	IL	PJM	2009	51	Invenergy LLC
Appalachian Power	Grand Ridge III	IL	PJM	2009	49.5	Invenergy LLC
Appalachian Power	Beech Ridge	WV	PJM	2010	100.5	Invenergy LLC
Appalachian Power	Bluff Point	IN	PJM	2018	120	NextEra
Indiana & Michigan Power	Fowler I	IN	PJM	2009	100	BP/Dominion
Indiana & Michigan Power	Fowler II	IN	PJM	2009	50	BP Wind Energy
Indiana & Michigan Power	Wildcat	IN	PJM	2012	100	E.ON C&R
Indiana & Michigan Power	Headwaters	IN	PJM	2013	200	EDP Renewables
PSCo of Oklahoma	Weatherford	OK	SPP	2005	147	NextEra
PSCo of Oklahoma	Blue Canyon	OK	SPP	2005	151.2	EDP Renewables
PSCo of Oklahoma	Sleeping Bear	OK	SPP	2008	94.5	Edison Renewables
PSCo of Oklahoma	Blue Canyon V	OK	SPP	2009	99	EDP Renewables
PSCo of Oklahoma	Elk City	OK	SPP	2010	98.9	NextEra
PSCo of Oklahoma	Minco	OK	SPP	2010	99	NextEra
PSCo of Oklahoma	Sleeping Bear Wind Farm	OK	SPP	2008	94.5	Edison Renewables
PSCo of Oklahoma	Goodwell Wind	OK	SPP	2015	200	Trade Wind
PSCo of Oklahoma	Balko Wind	OK	SPP	2015	100	Apex Wind
PSCo of Oklahoma	Seiling Wind	OK	SPP	2014	198.9	NextEra
SWEPCO	Majestic	TX	SPP	2009	79.5	NextEra
SWEPCO	Majestic II	TX	SPP	2012	79.6	NextEra
SWEPCO	Flat Ridge 2	KS	SPP	2012	31	BP Wind Energy
SWEPCO	Flat Ridge 2	KS	SPP	2012	77.8	BP Wind Energy
SWEPCO	Canadian Hills	OK	SPP	2012	100.45	Apex Wind
SWEPCO	Canadian Hills	OK	SPP	2012	52.8	Apex Wind
SWEPCO	Canadian Hills	OK	SPP	2012	48	Apex Wind
AEP Energy Partners	Trent Mesa	TX	ERCOT	2001	150	AEP
AEP Energy Partners	Desert Sky	TX	ERCOT	2001	160	GE Energy
AEP Energy Partners	Southwest Mesa	TX	ERCOT	1999	74	Cielo Wind Power
AEP Energy Partners	South Trent	TX	ERCOT	2009	102	Babock & Brown/RES

Appendix 2. All of KPC's IRP Scenarios Add 300 MW of Wind Energy

Table 19. Cumulative PJM Capacity Additions (MW) and Energy Positions (GWh) for Mid, Low Band, High Band, and No Carbon Scenarios

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2031 Net Energy Position (GWh)	Avg Net Energy Position (2017-2031) (GWh)
Mid	Base/Intermediate																2,211	1,399
	Peaking																	
	Solar (Firm)										4	11	19	27	34	49		
	Solar (Nameplate)										10	30	50	70	90	130		
	Wind (Firm)		4	8	11	15	15	15	15	15	15	15	15	15	15	15		
	Wind (Nameplate)		75	150	225	300	300	300	300	300	300	300	300	300	300	300		
	Battery Storage																	
	Energy Efficiency			8	16	25	32	33	35	37	40	43	45	46	48	53		
	CHP																	
	VVO															4		
	Demand Response																	
	Distr. Gen.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.5		
Low Band	Base/Intermediate																2,356	1,406
	Peaking																	
	Solar (Firm)												8	15	23	30		
	Solar (Nameplate)												20	40	60	80		
	Wind (Firm)		4	8	11	15	15	15	15	15	15	15	15	15	15	15		
	Wind (Nameplate)		75	150	225	300	300	300	300	300	300	300	300	300	300	300		
	Battery Storage																	
	Energy Efficiency			8	16	25	32	33	35	39	42	46	49	51	57	62		
	CHP																	
	VVO										4	4	4	4	4	4		
	Demand Response																	
	Distr. Gen.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.5		
High Band	Base/Intermediate															236	4,013	1,624
	Peaking																	
	Solar (Firm)											8	15	23	30	38		
	Solar (Nameplate)											20	40	60	80	100		
	Wind (Firm)		4	8	11	15	15	15	15	15	15	15	15	15	15	15		
	Wind (Nameplate)		75	150	225	300	300	300	300	300	300	300	300	300	300	300		
	Battery Storage																	
	Energy Efficiency			8	16	25	33	34	35	39	42	46	49	51	54	59		
	CHP																	
	VVO																	
	Demand Response																	
	Distr. Gen.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.5		
No Carbon	Base/Intermediate																671	1,093
	Peaking																	
	Solar (Firm)																	
	Solar (Nameplate)																	
	Wind (Firm)		4	8	11	15	15	15	15	15	15	15	15	15	15	15		
	Wind (Nameplate)		75	150	225	300	300	300	300	300	300	300	300	300	300	300		
	Battery Storage																	
	Energy Efficiency			8	16	25	32	33	35	39	42	45	48	50	56	61		
	CHP																	
	VVO																	
	Demand Response																	
	DG	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.5		

Base/Intermediate=NGCC; Peaking=NGCT, AD; CHP=Combined Heat & Power; VVO=Volt VAR Optimization;

Appendix 3. Hourly Wind Capacity Value by Location vs.

Top PJM Hourly Load Hours, figures (2007-2012)*

State (Net Capacity Factor)	Type	Top 50% (n=26,304)	Top 10% (n=5,261)	Top 5% (n=2,630)	Top 1% (n=526)	Top 0.1% (n=53)
N. TX (50%)	HVDC	44%	40%	37%	37%	51%
OK/TX (48%)	HVDC	42%	38%	34%	32%	44%
E. IA (48%)	MISO	43%	35%	30%	24%	27%
S. PA (48%)	PJM	48%	37%	33%	31%	23%
N. IN (44%)	PJM	40%	31%	26%	25%	20%
S. OH (38%)	PJM	35%	24%	20%	18%	16%
WV (41%)	PJM	39%	26%	22%	18%	10%
S. VA (41%)	PJM	38%	24%	19%	15%	9%
S. KY (35%)	Local	31%	20%	15%	13%	8%

Data: FERC Form 714, Wind Integration National Dataset (WIND) Toolkit

Source: SWEA 2017

Appendix 4. Hourly Wind Capacity Value by Location vs. Top LGE/KU Hourly Load Hours, figures (2007-2012) *

State (Net Capacity Factor)	Top 50% (n=26,304)	Top 10% (n=5,261)	Top 5% (n=2,630)	Top 1% (n=526)	Top 0.1% (n=53)
N. TX (50%)	45%	43%	42%	40%	37%
OK/TX (48%)	43%	40%	39%	35%	27%
E. IA (48%)	42%	35%	31%	26%	21%
S. PA (48%)	47%	40%	36%	33%	41%
N. IN (44%)	39%	32%	30%	29%	24%
S. OH (38%)	34%	26%	23%	19%	21%
WV (41%)	38%	27%	24%	19%	22%
S. VA (41%)	37%	25%	21%	15%	15%
S. KY (35%)	29%	19%	17%	12%	14%

Data: FERC Form 714, Wind Integration National Dataset (WIND) Toolkit

Source: SWEA 2017

[1] Energy Information Administration (January 10, 2017). Renewable generation capacity expected to account for most 2016 capacity additions.
[2] Alabama Power (2014). Chisholm View, Buffalo Dunes projects provide cost-effective power. [http://www.alabamapower.com/environment/news/chisholm-view-project-provides-low-cost-power.asp]
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