

2014 Resource Assessment Addendum



PPL companies

**Generation Planning & Analysis
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1 Introduction

Louisville Gas and Electric Company (“LG&E”) and Kentucky Utilities Company (“KU”) (collectively, “the Companies”) filed their 2014 Integrated Resource Plan (“IRP”) on April 21, 2014. On the same day, nine KU municipal customers provided notices of termination of their wholesale power agreements. As a result, KU’s forecasted summer peak demand will be reduced by approximately 325 MW after April 30, 2019.¹

As a result of the municipal contract terminations, the Companies informed the Kentucky Public Service Commission (“KPSC”) on August 12, 2014 that they were withdrawing their application for a Certificate of Public Convenience and Necessity (“CPCN”) for a 2x1 natural gas combined cycle (“NGCC”) generating facility at the existing Green River station, scheduled to be operational by summer 2018. The Companies continue to seek approval to construct a 10 MW photovoltaic solar facility at the E.W. Brown station by December 2016.

The resource expansion plans in the 2014 IRP assumed that both the Green River NGCC and Brown Solar Facility would be approved and constructed. Accordingly, the resource expansion plans in the IRP were focused on the post-2018 period. The 2014 IRP also identified a short-term need for capacity prior to the completion of the Green River NGCC and noted that the Companies would look to existing market resources to meet that need.

This addendum to the 2014 IRP provides updates to the load forecasts resulting from the municipal contract terminations, updates the capacity and energy needs considering the removal of the Green River NGCC, and includes the addition of a short-term capacity purchase and tolling agreement for May 2015 through April 2019. The Brown solar project is included as filed in the IRP in April. After all of these changes, the resulting expansion plans for the 2014-2028 period are provided and updated for all 21 scenarios in the originally filed 2014 IRP.

2 Capacity and Energy Need

When the Companies filed the 2014 IRP in April 2014, nine KU municipal customers provided termination notices for their wholesale power agreements. Figure 1 and Figure 2 show the impact of the municipal customers’ departures on the three load scenarios that were originally filed in the 2014 IRP.² The departing municipal load impact, as well as updated Low, Base, and High energy and peak demand forecasts, are presented in tabular form in Appendix A.

¹ The wholesale power contract with the City of Paris provided for a 3-year termination notice so their contract will terminate on April 30, 2017. The summer peak load of the City of Paris is forecasted to be 16 MW.

² The peak loads and energy requirements in Figure 1 and Figure 2 are net of the impact of demand-side management (“DSM”) programs. The load scenarios originally filed in the 2014 IRP are presented in Table 5.(6)-1 and Table 5.(6)-2 of Section 5 of Volume I.

Figure 1 – 2014 IRP Peak Load Scenarios with and without Departing Municipals

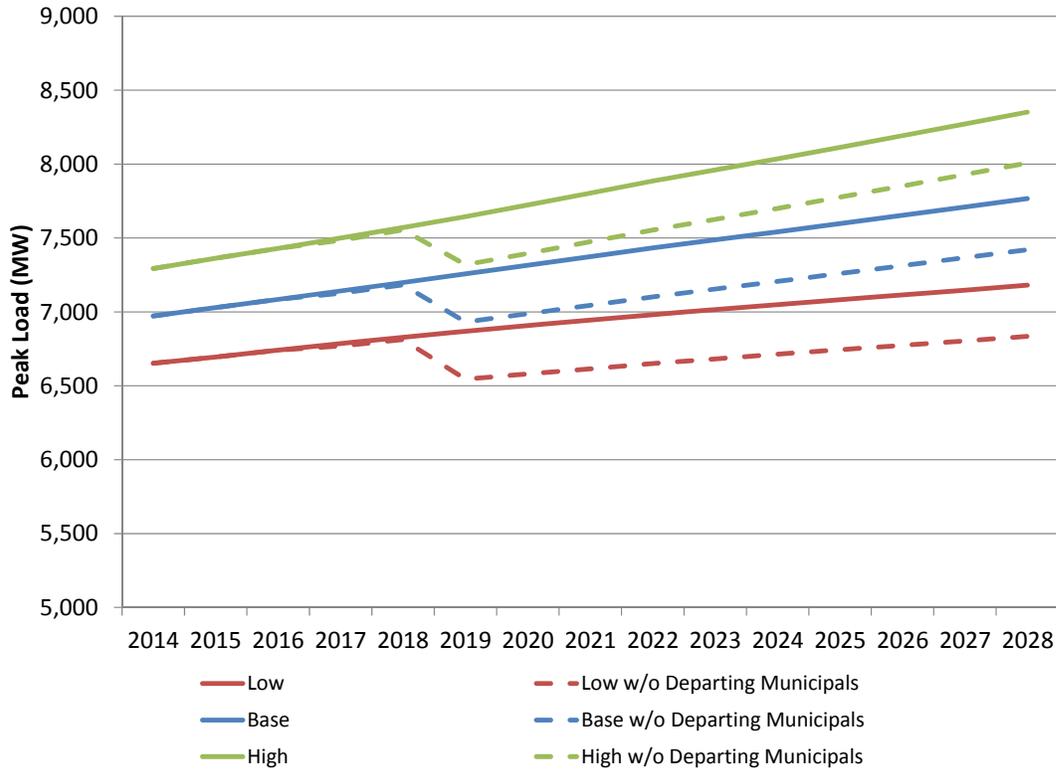
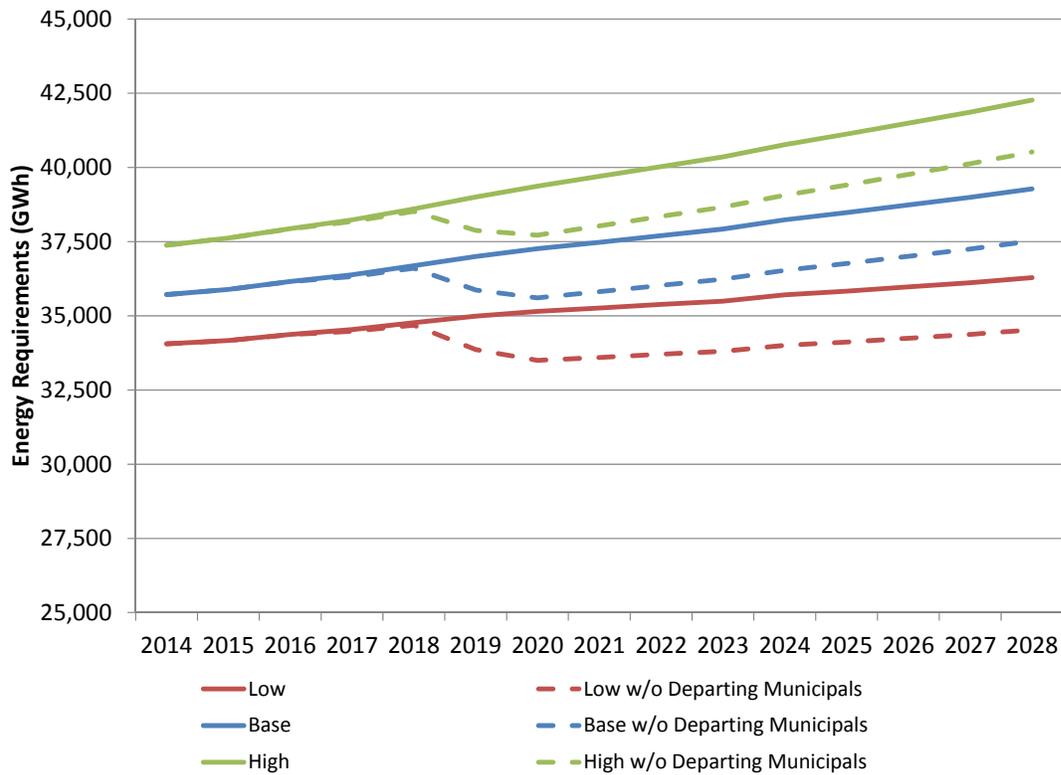


Figure 2 – 2014 IRP Energy Requirements Scenarios with and without Departing Municipals



To address the short-term need for capacity identified in the 2014 IRP, on September 19, 2014, the Companies requested approval for a four-year capacity purchase and tolling agreement with Bluegrass Generation for 165 MW from May 1, 2015 through April 30, 2019.³ The term of the agreement extends through the departing municipal customers' termination date, at which point the Companies' reserve margin is greater than the minimum of the target reserve margin range.

In preparing the 2014 IRP, both the Green River NGCC and Brown Solar Facility were assumed to be approved and constructed. With the pending reduction in load caused by the municipal contract termination, the removal of the Green River NGCC, and the recommended addition of the Bluegrass capacity purchase and tolling agreement, the Companies re-evaluated their capacity and energy needs through the IRP planning period. Table 1 details the Companies' capacity supply/demand balance after making these adjustments.⁴

³ In the Matter of: Verified Application of Louisville Gas and Electric Company and Kentucky Utilities Company for a Declaratory Order and Approval Pursuant to KRS 278.300 for a Capacity Purchase and Tolling Agreement Case No. 2014-00321, Verified Application (Ky PSC Sept. 19, 2014).

⁴ For purposes of calculating reserve margin, loads subject to the Companies' curtailable service rider are considered supply-side resources.

Table 1 – Resource Summary (MW, Summer, 2014 IRP Base Load Forecast Adj. for Muni Termination)

	2015	2016	2017	2018	2019	2020	2025	2028
Forecasted Peak Load	7,364	7,450	7,520	7,607	7,337	7,394	7,666	7,826
DSM	(336)	(365)	(394)	(423)	(406)	(406)	(406)	(406)
Net Peak Load	7,028	7,085	7,126	7,183	6,932	6,988	7,260	7,421
Existing Resources ⁵	7,152	7,135	7,135	7,135	7,135	7,135	7,135	7,135
Planned/Proposed Resources								
Cane Run 7	640	640	640	640	640	640	640	640
Brown Solar ⁶	0	9	9	9	9	9	9	9
Bluegrass Capacity Purchase	165	165	165	165	0	0	0	0
Firm Purchases (OVEC)	155	155	155	155	155	155	155	155
Curtaillable Load	131	131	131	131	131	131	131	131
Total Supply	8,243	8,234	8,235	8,235	8,070	8,070	8,070	8,070
Reserve Margin (“RM”)								
Base Load	17.3%	16.2%	15.6%	14.6%	16.4%	15.5%	11.2%	8.7%
Low Load	23.1%	22.2%	21.7%	20.9%	23.3%	22.6%	19.7%	18.1%
High Load	12.0%	10.8%	10.0%	9.0%	10.2%	9.1%	3.8%	0.8%
RM Shortfall (16% RM)*								
Base Load	90	16	(32)	(98)	29	(36)	(352)	(538)
Low Load	478	415	384	332	479	437	248	142
High Load	(297)	(383)	(446)	(528)	(421)	(509)	(950)	(1,217)

*Negative values reflect reserve margin shortfalls.

As discussed in the Companies’ 2014 Reserve Margin Study, the Companies target a minimum 16 percent reserve margin (above peak load after adjusting for DSM programs) for the purpose of developing expansion plans. With the planned changes to the Companies’ generation portfolio, the Companies will have a long-term need for capacity beginning in 2020 in the Base load scenarios. In the Low load scenarios, the Companies do not have any additional need for capacity through the last year of the IRP which is 2028. In the High load scenarios, the Companies’ reserve margin is below the minimum of the target range from 2015 onward. Despite this fact, the analysis assumes a new generating unit cannot be commissioned prior to 2019 given the time needed to develop, permit, and construct the unit.

3 Updated Expansion Planning Analysis

In all 21 scenarios evaluated in the 2014 IRP, the Green River NGCC was added in 2018. In eight of the nine Base load scenarios, an NGCC unit was the next unit added after the Green River

⁵ Existing resources include the retirement of Tyrone 3 in February 2013 and the planned retirement of Green River 3-4 in April 2015 and Cane Run 4-6 in May 2015.

⁶ 90% of the capacity of Brown Solar is assumed to be available at the time of peak.

NGCC. In the Zero CO₂ price scenarios, NGCC capacity was added to meet customers’ growing need for energy and capacity. In the Mid CO₂ price and CO₂ mass emissions cap scenarios, NGCC capacity was added to meet the need for low CO₂-emitting resources in addition to customers’ energy needs.

The tables below contain optimal expansion plans for the 21 scenarios evaluated in the 2014 IRP. The expansion units highlighted in gray are the units included in the original IRP filing. The non-highlighted units make up the expansion plans that are updated for the departing municipal load and the removal of the Green River NGCC. The updated expansion plans are also listed by themselves, without the originally filed expansion plans, in Appendix B.

Table 2 shows the optimal expansion plans for the Zero CO₂ price scenarios. In the Low load scenarios, the Companies have no need for additional capacity in the planning period. In the Base load scenarios, the Companies have a long-term need for capacity beginning in 2020. With Low gas prices, NGCC capacity is added in 2020, but with Mid and High gas prices, simple-cycle combustion turbine (“SCCT”) capacity is added. With Mid and High gas prices (and no CO₂ price), the Companies’ energy needs are primarily met with existing coal units and Cane Run 7 (“CR7”); SCCT units are added to meet the Companies’ need for capacity. With Low gas prices, the production cost savings associated with NGCC capacity more than offset the NGCC unit’s higher capital costs. In each of the High load scenarios, an NGCC unit is added as soon as possible (in 2019) to meet the need for capacity and energy.

Table 2 – Optimal Expansion Plans: Zero CO₂ Price Scenarios

CO ₂ Price	OC	OC	OC						
Load	LL	LL	LL	BL	BL	BL	HL	HL	HL
Gas Price	LG	MG	HG	LG	MG	HG	LG	MG	HG
2014									
2015	CR7 CR7	CR7 CR7	CR7 CR7						
2016	BRS BRS	BRS BRS	BRS BRS						
2017									
2018	GR5	GR5	GR5						
2019							2x1G(1) 2x1G(1)	2x1G(1) CTx3(1)	2x1G(1) CTx3(1)
2020				2x1G(1)	CTx3(1)	CTx3(1)			
2021									
2022									
2023							2x1G(1)	CTx3(1)	CTx3(1)
2024									
2025				2x1G(1)	SCCT(1)	2x1G(1)		2x1G(1)	2x1G(1)
2026							2x1G(1)		
2027					SCCT(1)				
2028									

CO₂ Price: Zero (OC) Load: Low (LL), Base (BL), High (HL) Gas Price: Low (LG), Mid (MG), High (HG)

Expansion units highlighted in gray are the units included in the original IRP filing.

Table 3 shows the optimal expansion plans for the Mid CO₂ price scenarios. Consistent with the original 2014 IRP filing, these scenarios continue to assume that Brown 1 and 2 are retired in 2020. In the Low load scenarios, the retirement of Brown 1 and 2 results in a long-term need for capacity beginning in 2025. With Low and Mid gas prices, NGCC capacity is commissioned prior to 2025 due to the benefits from low CO₂-emitting generation under Mid CO₂ prices; the production cost savings associated with low CO₂-emitting generation more than offset the increased cost of building new generation sooner. With High gas prices, capacity additions occur only as needed to meet reserve margin, since the impact of High gas prices more than offsets the benefits of low CO₂-emitting generation under Mid CO₂ prices. In the Base load scenarios, the Companies have a long-term need for capacity and energy beginning in 2020. This need is met by a 1x1 NGCC unit (368 MW) in the Low gas scenario and a 2x1 NGCC unit (737 MW) in the Mid and High gas scenarios. Because of the difference in size for these units, the next need for capacity occurs in 2021 in the Low gas scenario and 2027 in the Mid and High gas scenarios. With Mid gas prices, additional NGCC capacity is commissioned prior to the next need for capacity because of the benefits from low CO₂-emitting generation under Mid CO₂ prices.

Table 3 – Optimal Expansion Plans: Mid CO₂ Price Scenarios

CO ₂ Price	MC	MC	MC	MC	MC	MC
Load	LL	LL	LL	BL	BL	BL
Gas Price	LG	MG	HG	LG	MG	HG
2014						
2015	CR7 CR7	CR7 CR7	CR7 CR7	CR7 CR7	CR7 CR7	CR7 CR7
2016	BRS BRS	BRS BRS	BRS BRS	BRS BRS	BRS BRS	BRS BRS
2017						
2018	GR5	GR5	GR5	GR5	GR5	GR5
2019						
2020	Ret BR1-2 Ret BR1-2	Ret BR1-2 Ret BR1-2	Ret BR1-2 Ret BR1-2	Ret BR1-2 1x1G(1) Ret BR1-2 1x1G(1)	Ret BR1-2 2x1G(1) Ret BR1-2 1x1G(1)	Ret BR1-2 2x1G(1) Ret BR1-2 2x1G(1)
2021				2x1G(1)		
2022	2x1G(1)	2x1G(1)		2x1G(1)	2x1G(1)	
2023						
2024					2x1G(1)	
2025			2x1G(1)			
2026						
2027						Wind(2)
2028			Wind(2)			2x1G(1)

CO₂ Price: Mid (MC) Load: Low (LL), Base (BL) Gas Price: Low (LG), Mid (MG), High (HG)
Expansion units highlighted in gray are the units included in the original IRP filing.

Table 4 shows the optimal expansion plans for the CO₂ mass emissions cap scenarios. Consistent with the results of the Mid CO₂ price scenarios, NGCC capacity is commissioned prior to the need for capacity in some of the Low and Mid gas price scenarios because the benefits of

low CO₂-emitting generation more than offset the increased cost of building new generation sooner.⁷ In fact, in the Base load, Low gas price scenario, NGCC capacity is added in 2019. This occurs because the model assumes new units are commissioned in June, and the system benefits from having the additional NGCC capacity year-round in 2020. With High gas prices, the need for low CO₂-emitting resources is further evidenced by the accelerated addition of wind generation.

Table 4 – Optimal Expansion Plans: CO₂ Mass Emissions Cap Scenarios

CO ₂	Cap	Cap	Cap	Cap	Cap	Cap
Load	LL	LL	LL	BL	BL	BL
Gas Price	LG	MG	HG	LG	MG	HG
2014						
2015	CR7 CR7	CR7 CR7	CR7 CR7	CR7 CR7	CR7 CR7	CR7 CR7
2016	BRS BRS	BRS BRS	BRS BRS	BRS BRS	BRS BRS	BRS BRS
2017						
2018	GR5	GR5	GR5	GR5	GR5	GR5
2019				2x1G(1)		
2020	Ret BR1-2 Ret BR1-2	Ret BR1-2 Ret BR1-2	Ret BR1-2 Wind(6) Ret BR1-2	Ret BR1-2 Ret BR1-2 2x1G(1)	Ret BR1-2 2x1G(1) Ret BR1-2 2x1G(1)	Ret BR1-2 2x1G(1) Ret BR1-2 2x1G(1)
2021			Wind(3)			
2022						
2023		2x1G(1)	Wind(5) Wind(1)			
2024	2x1G(1)					
2025						Wind(1)
2026						Wind(1)
2027			Wind(4) Wind(2)	2x1G(1)	2x1G(1)	Wind(3)
2028			Wind(1) SLPV(1) Wind(5)			Wind(5) SLPV(1) Wind(4)

CO₂ Price: Mid (MC) Load: Low (LL), Base (BL) Gas Price: Low (LG), Mid (MG), High (HG)
Expansion units highlighted in gray are the units included in the original IRP filing.

4 Summary

In the Base load scenarios, after adjusting for the departing municipal load and the removal of the Green River NGCC, the Companies’ next need for capacity occurs in 2020. In seven of nine Base load scenarios, this need is met by adding NGCC capacity. As a low CO₂-emitting resource, NGCC capacity is a cost-effective alternative for meeting customers’ long-term energy and capacity needs in a potentially carbon-constrained environment.

⁷ As mentioned previously, the Companies’ have a long-term need for capacity beginning in 2025 in the Low load scenarios and 2020 in the Base load scenarios.

Currently, uncertainty remains regarding the proposed CO₂ regulations for existing units. On June 2, 2014, the U.S. Environmental Protection Agency (“EPA”) issued proposed CO₂ regulations covering existing fossil fueled units with interim compliance beginning in 2020. Under the proposed regulations, EPA will finalize the federal rule by June 2015 and Kentucky will need to finalize a state compliance plan by 2016. The Companies will be monitoring the development of the proposed regulations and will develop a compliance plan once more certainty exists regarding their compliance obligations. Given the proposed timing of the regulations, it is likely that this will be an important consideration in the development of the 2017 IRP.

5 Appendix A

Table 5 – 2014 IRP Departing Municipals Load Forecast

Year	Energy Requirements (GWh)	Peak Load (MW)
2014	0	0
2015	0	0
2016	2	0
2017	58	16
2018	83	16
2019	1,127	325
2020	1,654	327
2021	1,666	329
2022	1,678	331
2023	1,691	334
2024	1,704	336
2025	1,716	338
2026	1,729	341
2027	1,741	343
2028	1,754	345

Table 6 – 2014 IRP Load Scenarios Adjusted for Departing Municipals

Year	Energy Requirements (GWh)			Peak Load (MW)		
	Low	Base	High	Low	Base	High
2014	34,053	35,716	37,379	6,651	6,972	7,294
2015	34,164	35,892	37,621	6,694	7,028	7,362
2016	34,368	36,150	37,933	6,741	7,085	7,429
2017	34,477	36,326	38,174	6,769	7,126	7,484
2018	34,682	36,602	38,521	6,813	7,183	7,554
2019	33,864	35,871	37,878	6,544	6,932	7,319
2020	33,497	35,607	37,716	6,580	6,988	7,396
2021	33,597	35,813	38,030	6,615	7,045	7,474
2022	33,703	36,026	38,348	6,651	7,102	7,553
2023	33,804	36,231	38,658	6,682	7,154	7,627
2024	34,001	36,532	39,062	6,714	7,207	7,700
2025	34,117	36,762	39,406	6,744	7,260	7,776
2026	34,243	37,002	39,762	6,773	7,312	7,852
2027	34,374	37,249	40,123	6,804	7,366	7,929
2028	34,531	37,525	40,518	6,835	7,421	8,006

6 Appendix B

Table 7 – Updated Optimal Expansion Plans: Zero CO₂ Price Scenarios

CO ₂ Price	OC	OC	OC	OC	OC	OC	OC	OC	OC
Load	LL	LL	LL	BL	BL	BL	HL	HL	HL
Gas Price	LG	MG	HG	LG	MG	HG	LG	MG	HG
2014									
2015	CR7	CR7	CR7	CR7	CR7	CR7	CR7	CR7	CR7
2016	BRS	BRS	BRS	BRS	BRS	BRS	BRS	BRS	BRS
2017									
2018									
2019							2x1G(1)	2x1G(1)	2x1G(1)
2020				2x1G(1)	CTx3(1)	CTx3(1)			
2021									
2022									
2023							2x1G(1)	CTx3(1)	CTx3(1)
2024									
2025									
2026									
2027									
2028									

CO₂ Price: Zero (OC) Load: Low (LL), Base (BL), High (HL) Gas Price: Low (LG), Mid (MG), High (HG)

Table 8 – Updated Optimal Expansion Plans: Mid CO₂ Price Scenarios

CO ₂ Price	MC	MC	MC	MC	MC	MC
Load	LL	LL	LL	BL	BL	BL
Gas Price	LG	MG	HG	LG	MG	HG
2014						
2015	CR7	CR7	CR7	CR7	CR7	CR7
2016	BRS	BRS	BRS	BRS	BRS	BRS
2017						
2018						
2019						
2020	Ret BR1-2	Ret BR1-2	Ret BR1-2	Ret BR1-2 1x1G(1)	Ret BR1-2 2x1G(1)	Ret BR1-2 2x1G(1)
2021				2x1G(1)		
2022	2x1G(1)	2x1G(1)				
2023						
2024					2x1G(1)	
2025			2x1G(1)			
2026						
2027						Wind(2)
2028						2x1G(1)

CO₂ Price: Mid (MC) Load: Low (LL), Base (BL) Gas Price: Low (LG), Mid (MG), High (HG)

Table 9 – Updated Optimal Expansion Plans: CO₂ Mass Emissions Cap Scenarios

CO ₂	Cap	Cap	Cap	Cap	Cap	Cap
Load	LL	LL	LL	BL	BL	BL
Gas Price	LG	MG	HG	LG	MG	HG
2014						
2015	CR7	CR7	CR7	CR7	CR7	CR7
2016	BRS	BRS	BRS	BRS	BRS	BRS
2017						
2018						
2019				2x1G(1)		
2020	Ret BR1-2	Ret BR1-2	Ret BR1-2 Wind(6)	Ret BR1-2	Ret BR1-2 2x1G(1)	Ret BR1-2 2x1G(1)
2021			Wind(3)			
2022						
2023		2x1G(1)	Wind(5)			
2024	2x1G(1)					
2025						Wind(1)
2026						Wind(1)
2027			Wind(4)	2x1G(1)	2x1G(1)	Wind(3)
2028			Wind(1) SLPV(1)			Wind(5) SLPV(1)

CO₂ Price: Mid (MC) Load: Low (LL), Base (BL) Gas Price: Low (LG), Mid (MG), High (HG)