COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

THE 2018 INTEGRATED RESOURCE PLAN OF LOUISVILLE GAS AND ELECTRIC COMPANY AND KENTUCKY UTILITIES COMPANY	**)** **)** **)** **)**	**CASE NO. 2018-00348**

RESPONSE OF
LOUISVILLE GAS AND ELECTRIC COMPANY
AND
KENTUCKY UTILITIES COMPANY
TO ATTORNEY GENERAL'S INITIAL REQUEST FOR INFORMATION
DATED OCTOBER 4, 2019

FILED: OCTOBER 25, 2019

AMENDED FILING: NOVEMBER 1, 2019

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Daniel K. Arbough**, being duly sworn, deposes and says that he is Treasurer for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Daniel K. Arbough

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

Notary Public

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Robert M. Conroy**, being duly sworn, deposes and says that he is Vice President, State Regulation and Rates, for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Robert M. Conroy

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

Notary Public

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Michael P. Drake**, being duly sworn, deposes and says that he is Director – Generation Services for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Michael P. Drake

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 23rd day of October 2019.

Notary Public (SEAL)

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Christopher M. Garrett**, being duly sworn, deposes and says that he is Controller for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Christopher M. Garrett

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

Notary Public

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **David E. Huff**, being duly sworn, deposes and says that he is Director of Advanced Meter Initiatives for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and that the answers contained therein are true and correct to the best of his information, knowledge and belief.

David E. Huff

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 23rd day of October 2019.

Notary Public (SEAL)

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Thomas A. Jessee**, being duly sworn, deposes and says that he is Vice President, Transmission for Louisville Gas and Electric Company and Kentucky Utilities Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Thomas A. Jessee

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

Notary Public

My Commission Expires:

4/1/2020

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Elizabeth J. McFarland**, being duly sworn, deposes and says that she is Vice President, Customer Services for Louisville Gas and Electric Company and Kentucky Utilities Company and an employee of LG&E and KU Services Company, and that she has personal knowledge of the matters set forth in the responses for which she is identified as the witness, and the answers contained therein are true and correct to the best of her information, knowledge and belief.

Elizabeth J. McFarland

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

Notary Public

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Gary H. Revlett**, being duly sworn, deposes and says that he is Director – Environmental Affairs for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Gary H Revlett
Gary H. Revlett

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

(SEAL)
Notary Public

My Commission Expires:

CONNIE YORK
NOTARY PUBLIC
Kentucky, State At Large
I.D. # 628548
My Commission Expires 8/7/2023

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Stuart A. Wilson**, being duly sworn, deposes and says that he is Director, Energy Planning, Analysis & Forecasting for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Stuart A. Wilson

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

Notary Public (SEAL)

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **John K. Wolfe**, being duly sworn, deposes and says that he is Vice President, Electric Distribution for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

John K. Wolfe

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 14th day of October 2019.

Notary Public

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 1

Witness: Stuart A. Wilson

Q-1. Reference IRP vol. 1, p. 5-5, regarding the retirement of the Zorn 1 CT in 2021, ". . . as the anticipated cost to comply with impending gas pipeline regulations and maintain sufficient gas pressure to operate Zorn 1 is in the tens of millions of dollars. . ."

a. Identify the "impending gas pipeline regulations" referenced in this paragraph.

b. Will this regulation pose a cost issue for any of the Companies' other CTs and/or for CR7? Provide a discussion.

A-1.

a. "Impending gas pipeline regulations" refers to the Safety of Gas Transmission and Gathering Pipelines regulations from a Notice of Proposed Rulemaking in April 2016. An initial phase of this rule was issued in late September 2019.

b. The Companies do not anticipate similar cost issues for the other CT sites or CR7. It is anticipated that the pipelines supplying gas to the other sites (Trimble County, Paddy's Run, E. W. Brown, and CR7) are either already compliant with the referenced regulations or that compliance can be met through scheduled inline inspections (using enhanced technologies). Enhanced inline inspection technologies cannot be used in the Ballardsville pipeline due to pipeline characteristics and pressure restrictions on the pipeline.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 2

Witness: Stuart A. Wilson

Q-2. Reference IRP vol. 1, p. 5-5, Table 5-1. Explain whether the final line of the table, "Total Demand-Side Resources" is an accurate description of the figures it references.

A-2. The label in the final line of the table was not accurate. The line should have been labeled, "Total Resources," as the figures accurately reflect the sum of the Generation and Demand-Side Management Resources. The corrected table is shown below.

Table-1: LG&E and KU Generation Resources, September 2018

			Total Net Capacity (MW)	
Resource	**Number of Units**	**Unit Size (Range in Net Summer Capacity, MW)**	**Summer**	**Winter**
Baseload/Intermediate				
Coal	14	106-549	5,156	5,200
Natural Gas Combined Cycle ("NGCC")	1	662	662	683
Peaking				
Large-Frame SCCT[1]	15	12-165	2,172	2,418
Small-Frame SCCT[1]	7	121	87	98
Renewable				
Solar	1	8	8	0
Hydro	11	8-10.5	96	72
Total Generation Resources	49	106-549	8,181	8,471
Demand-Side Management Resources				
Curtailable Service Rider	N/A	N/A	141	141
Demand Conservation Program	N/A	N/A	127	0
Total Resources			8,449	8,612

[1] Small-frame SCCTs comprise Cane Run 11, Paddy's Run 11 & 12, Zorn 1, and Haefling 1 & 2. All of the Companies' other SCCTs are large-frame SCCTs.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 3

Witness: Stuart A. Wilson / Elizabeth J. McFarland

Q-3. Reference IRP vol. 1, p. 5-13, wherein the IRP states that all growth in distributed generation is forecasted to occur through net metering, and that net metering is forecasted to increase from 3 MW to 170 MW by the end of 2033, although the forecast is "particularly uncertain."

a. Confirm that the modeling for net metering growth took into account the "favorable net metering policy" then-enacted that provided for a netting of usage against the retail rate.

b. Update the modeling for net metering penetration as a result of the March 26, 2019 enactment of Senate Bill 100 in the 2019 Regular Session of the Kentucky General Assembly, which repealed in significant part, the "favorable net metering policy."

c. Pursuant to the article at the link below,[2] confirm that on or about February 1, 2019 the Companies issued an RFP for between 10 MW – 200 MW of renewable energy by January 1, 2022, and the Companies are requesting that the source be located within Kentucky.

   i. Confirm that pursuant to the article, all evaluations of the RFP were expected to be complete by March 29, 2019. If so confirmed, provide the results of the evaluations.

d. Explain whether the Companies' resource planning takes PURPA Qualifying Facilities into consideration, and if so, how.

e. Explain why no distributed generation is anticipated to occur through increased industrial CHP, cogeneration, or through PURPA Qualifying Facilities.

f. Reference the Companies last IRP, Case No. 2014-00131, the Staff Report at p. 42, citing the 2014 IRP filing, vol. 3 at p. 27, which states that the Companies do not

[2] https://www.lanereport.com/110233/2019/02/lge-and-ku-issue-request-for-renewable-energy/

purchase power from non-utility sources. Is this a policy decision of the Companies, or is it based solely on the cost of power from such sources?

(i) Have the Companies ever purchased power from a non-utility source? If so, provide details.

g. Confirm that in the Companies' last IRP, Case No. 2014-00131, the Staff Report at pp. 54-55 recommended that the Companies continue to discuss the existence, and promotion of any cogeneration and distributed generation in their systems, and the impact of such generation on their systems.

h. Provide a discussion of whether and how the Companies use CHP and/or cogeneration as an economic development tool in discussions with both new and existing industrial customers. If the Companies do not do so, explain why not.

A-3.

a. Confirmed. The base case forecast for net metering growth is based on a net metering policy where all renewable energy (i.e., energy that reduces consumption from the grid and energy that is pushed back to the grid) is compensated at the retail rate.

b. The legislation referenced simply authorizes the PSC to establish net metering rates, but to date, the rates have not been changed.

c. Confirmed.

i. No, the referenced article did not indicate that the RFP evaluations were expected to be completed by March 29, 2019. The article indicated that the evaluations were expected to be completed by late May. The Companies' evaluation of the RFP and the corresponding negotiations are ongoing, with a filing anticipated in the upcoming months.

d. Existing and announced qualifying facilities are considered in the Companies' load forecast.

e. Because of the limited growth in these facilities historically, the IRP assumes all growth in distributed generation occurs through net metering.

f. In Volume I of the 2014 IRP at p. 8-25, the Companies stated, "The IRP does not include purchases from non-utility sources." The Companies' discussion of electricity purchases from non-utility sources has been updated in the 2018 IRP, in Section 8.(3).(d), to include electricity purchases from qualifying facilities.

(i) Yes. See Table 8-10 in Section 8.(3).(d), Volume I of the 2018 IRP. On an ongoing basis, the Companies purchase power from qualifying facilities under

existing tariffs (SQF and LQF), as discussed in the Companies' response to item no. 10(a) in the "Recommendations in PSC Staff Report on the Last IRP – Case No. 2014-00131," which is contained in Volume III of the 2018 IRP.

g. Confirmed.

h. As previously stated on the AGs Data Request 3f above, on an ongoing basis, the Companies purchase economic market power and power from qualifying facilities under exiting tariffs (SQF and LQF), as discussed in the Companies' response to item no. 10(a) in the "Recommendations in PSC Staff Report on the Last IRP – Case No. 2014-00131," which is contained in Volume III of the 2018 IRP. The Companies further utilize our employees' knowledge and expertise in power systems and engineering when speaking with existing customers and prospects in the economic development context. If a customer or prospect has a process that elevates CHP or co-generation as an opportunity, we will evaluate and advise on the engineering, economic benefits, and risks of such systems.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 4

Witness: Stuart A. Wilson

Q-4. Reference IRP vol. 1, p. 5-15, wherein the IRP states "A detailed evaluation (using production cost simulation models) of all demand-side and supply-side resource options is impractical due to the significant amount of time required for computer simulation."

a. Explain what length of time is referenced in the statement that leads to the Companies' believing the described process "is impractical."

b. Explain how the Companies determined the length of time provided in response to 4(a), above.

A-4.

a. The specific length of time has not been determined. The Companies' Long-Term Resource Planning Analysis evaluated 864 combinations of the 6 resources listed in Table 10 on page 18 of the 2018 IRP Long-Term Resource Planning Analysis. These resources were selected as the most cost-effective resources over a broad range of resource types. Performing this analysis and evaluating the results took approximately 3 months. If the Companies evaluated, for example, all 15 of the resources listed in Table 2 on page 7 of the 2018 IRP Resource Screening Analysis, the time required for the analysis would likely more than double and the inclusion of less favorable technologies in the detailed analysis would not improve the analysis. Furthermore, when a need for capacity is identified, the Companies will issue a public Request for Proposals for any and all sources of generating capacity and will evaluate all responses.

b. See the response to part (a).

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 5

Witness: Stuart A. Wilson

Q-5. Reference IRP vol. 1, p. 5-18, paragraph 1. When calculating capacity costs for existing and new generation, explain why the Companies believe it is reasonable to include the revenue requirement associated with new generation that considers net book value, but ignore the revenue required associated with the net book value of existing resources.

A-5. The investments that make up the net book value of an existing resource are sunk costs and should not be considered in an economic analysis. When considering whether to add new generating resources or retire existing resources, the analysis should consider only future costs that can be avoided. For existing units, future costs include the capital and fixed operating and maintenance costs required for the ongoing operation of the unit.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 6

Witness: Stuart A. Wilson

Q-6. Reference IRP vol. 1, p. 5-18, paragraph 1 and IRP vol. 3, p. 5, response to 10 (e)(i). Explain the apparent inconsistency of treating unrecovered capital costs of an existing resource as sunk when contemplating retirement and considering "Captial and fixed costs for existing units . . . in the resource planning analysis."

A-6. See the response to AG 1-5.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 7

Witness: Stuart A. Wilson

Q-7. Reference IRP vol. 1, p. 5-19, the heading "Long-Term Resource Planning Analysis – Models and Methods." Explain the role that hedges, both physical and financial, play in this analysis.

A-7. Hedges did not play a role in the Companies' 2018 IRP Long-Term Resource Planning Analysis.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 8

Witness: Gary H. Revlett

Q-8. Reference IRP vol. 1, p. 5-20. Explain whether the Companies have received any degree of certainty regarding the Affordable Clean Energy Rule, and if so, to what degree?

A-8. The Affordable Clean Energy ("ACE") Rule was published on July 8, 2019. The Companies will evaluate the heat rate improvement ("HRI") projects identified in the final ACE rule for their technical and economic feasibility as they might apply to each of the Companies ACE-affected electric generating units. With that information, the Companies will be able to aid the Commonwealth of Kentucky in meeting Kentucky's ACE rule timelines for developing and submitting a state implementation plan ("SIP") for the ACE rule to EPA by July 8, 2022. Upon submittal, EPA has one year to approve Kentucky's ACE SIP. Certainty regarding ACE Rule related projects and impacts occurs upon EPA approval of Kentucky's ACE SIP.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 9

Witness: Stuart A. Wilson / Christopher M. Garrett

Q-9. Reference IRP vol. 1, p. 5-20, the heading "Generating Unit Operating Life." Provide a discussion of the various factors that could become relevant in whether the Companies utilize a 55-year, or 65-year generating unit operating life.

a. Have the companies always planned on a 65-year generating unit operating life? If not, provide the operating life traditionally relied upon.

b. Provide the operating lives utilized in setting depreciation rates for the Companies' generation units, by unit.

c. Explain why the Companies have deemed it reasonable to assume only two operating life scenarios, 55 and 65 years, instead of relying on performance and on-going costs of each unit in resource planning?

A-9.

a. No. The Companies have not traditionally evaluated fixed operating life scenarios for generating units. In the 2014 IRP, all existing units were assumed to operate through the end of the IRP planning period unless their capacity factor consistently dropped below 10 percent.

b.

Company	Station	Function	Unit	Retirement Date	Operating Life
KU	Brown	Steam	3	2035	64
KU	Brown	Combustion Turbine	8	2025	30
KU	Brown	Combustion Turbine	9	2031	37
KU	Brown	Combustion Turbine	10	2031	36
KU	Brown	Combustion Turbine	11	2026	30
KU	Ghent	Steam	1	2034	60
KU	Ghent	Steam	2	2034	57
KU	Ghent	Steam	3	2037	56
KU	Ghent	Steam	4	2038	54
KU	Haefling	Combustion Turbine	1 and 2	2020	50
KU	Dix Dam	Hydro		2041	100
KU/LGE	Brown	Combustion Turbine	5	2031	30
KU/LGE	Brown	Combustion Turbine	6	2029	30
KU/LGE	Brown	Combustion Turbine	7	2029	30
KU/LGE	Trimble County	Steam	2	2066	55
KU/LGE	Trimble County	Combustion Turbine	5	2032	30
KU/LGE	Trimble County	Combustion Turbine	6	2032	30
KU/LGE	Trimble County	Combustion Turbine	7	2034	30
KU/LGE	Trimble County	Combustion Turbine	8	2034	30
KU/LGE	Trimble County	Combustion Turbine	9	2034	30
KU/LGE	Trimble County	Combustion Turbine	10	2034	30
KU/LGE	Paddys Run	Combustion Turbine	13	2031	30
KU/LGE	Brown	Solar		2041	25
LG&E	Trimble County	Steam	1	2050	60
LG&E	Cane Run	Combustion Turbine	7	2055	40
LG&E	Cane Run	Combustion Turbine	11	2018	48
LG&E	Mill Creek	Steam	1	2032	60
LG&E	Mill Creek	Steam	2	2034	60
LG&E	Mill Creek	Steam	3	2038	60
LG&E	Mill Creek	Steam	4	2042	60
LG&E	Paddys Run	Combustion Turbine	11	2018	48
LG&E	Paddys Run	Combustion Turbine	12	2018	48
LG&E	Zorn	Combustion Turbine	1	2019	49
LG&E	Ohio Falls	Hydro		2045	111

c. The results of the 2018 IRP Reserve Margin Analysis show that the Companies' existing resources are economically optimal for meeting system reliability needs in 2021. In addition, Section 4.2 of the Long-Term Resource Planning Analysis evaluated early retirement of Brown 3 and replacement with solar and battery storage resources.

These analyses considered the current performance and on-going cost of the Companies' existing marginal resources. For long-term resource planning purposes, the 55-year and 65-year operating life scenarios were selected for the purpose of developing long-term planning scenarios based on reasonable estimates of when the Companies' generating units might be expected to retire. The basis for selecting the 55- and 65-year operating life scenarios is discussed in Section 3.3 of the 2018 IRP Long-Term Resource Planning Analysis in Volume III of the 2018 IRP. Actual retirement decisions will be based on specific unit factors (including performance and costs), system needs, replacement costs as applicable, and then-current regulations.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 10

Witness: Stuart A. Wilson

Q-10. Reference IRP vol. 1, Table 5-4 at p. 5-21. Confirm that if the Companies decide to utilize the 55-year generating unit operating life, by the time the Companies file their next IRP the Companies likely will need to decide whether to acquire at least some new supply side resource(s).

A-10. See the response to Question No. 9. The 55- and 65-year operating life scenarios were selected for the purpose of developing long-term planning scenarios. Decisions involving unit retirements and replacement capacity will be evaluated as needed on a case-by-case basis.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 11

Witness: Stuart A. Wilson

Q-11. Reference IRP vol. 1, p. 5-22, wherein the IRP concludes that "solar generation has virtually no value in the Companies' service territories as a source of winter capacity."

a. Explain why it is reasonable to impart value to capacity only if it is expected to be available during the seasonal peak.

b. Should the Commission take the Companies' conclusion as an indication that LG&E/KU's resource planning accounts only for system peaks, and does not take into account an intention to serve load every hour of the year at the lowest reasonable cost?

A-11.

a. This statement refers specifically to the resource's capability to meet load at the time of winter peak. Given that the Companies' winter peak is expected to occur during nighttime hours, a solar resource has a zero capacity rating in the wintertime. The capacity rating for all of the Companies' resources are adjusted where applicable to reflect their ability to meet peak load in each season.

b. No. The Companies' resource planning is designed to meet load in every *moment* at the least reasonable cost, as noted repeatedly in Section 5 (pages 5-2, 5-3, and 5-22) and in the "2018 IRP Reserve Margin Analysis" and the "2018 IRP Long-Term Resource Planning Analysis" in Volume III of the IRP, which discuss the granular nature of the analyses performed. Also see the response to PSC 1-39.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 12

Witness: Stuart A. Wilson

Q-12. Reference IRP vol. 1, p. 5-24, footnote 17. Provide a copy of the 2016 Synapse Energy Economic Forecast referenced, as the link provided is no long accessible.

A-12. The report remains accessible at the link originally provided in the footnote: http://www.synapse-energy.com/sites/default/files/2016-Synapse-CO2-Price-Forecast-66-008.pdf.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 13

Witness: Stuart A. Wilson

Q-13. Explain whether the Companies' IRP analyses included an examination of the economic feasibility of the early retirement(s) of one or more coal-fired units and replacement with either gas-firing of existing plants, renewable resources or a combination of both. For example, Northern Indiana Public Service Co. on October 31, 2018 filed its IRP [3] which has concluded that in certain scenarios, early retirement of its coal units could save ratepayers more than $4 billion over 30 years. Include in your analysis the availability of investment tax credits and renewable energy certificates, if any.

A-13. As discussed on page 5-38 of Volume I and in Section 4.2 of the 2018 IRP Long-Term Resource Planning Analysis in Volume III, the Companies evaluated replacing Brown 3 in the near-term with a combination of solar and battery storage resources, and found that continuing to operate Brown 3 resulted in a lower cost. This analysis considered the availability of investment tax credits but did not assign a value to renewable energy credits. The Companies' IRP analysis did not consider gas-firing of Brown 3.

[3] The actual IRP filing is accessible at the following link: https://www.nipsco.com/docs/librariesprovider11/rates-and-tariffs/irp/2018-nipsco-irp.pdf?sfvrsn=15
and an executive summary of the IRP filing can be accessed at the following link:
https://www.nipsco.com/docs/librariesprovider11/rates-and-tariffs/irp/irp-executive-summary.pdf?sfvrsn=9

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 14

Witness: Stuart A. Wilson

Q-14. Provide a discussion regarding the extent to which the Companies have examined the potential for both: (i) building and owning their own renewable generation sources within their service territories; and/or (ii) entering into PPAs for renewable generation from sources located within or outside their service territories. With regard to resources outside their territories, explain how congestion or the risk of congestion could affect the cost and benefits in determining resource decisions.

a. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," § 4.4 regarding Available Transmission Capacity ("ATC"), which determines the amount of power that can be imported from neighboring regions. Confirm that based on the summer months of 2016-2017, and the winter months of 2017-2018, the Companies' ATC is zero 45% of the time.

(i) Confirm that during peak hours, ATC is assumed to be approximately 500 MW for 66% of the time.

(ii) Provide any estimates of ATC availability for the next three (3) calendar years.

(iii) Provide cost estimates for the transmission system upgrades that would be necessary to increase the Companies' ATC by the following amounts: (1) 100 MW; (2) 250 MW; and (3) 500 MW for year 2021.

(iv) Explain whether any of the findings and conclusions of the 2018 IRP Reserve Margin Analysis pertaining to ATC would change in any manner if the Companies were to join an RTO. Provide a detailed discussion.

b. Have the Companies, or any entity acting on their behalf, conducted any studies or analyses of the cost impact of congestion with regard to entering into any external PPAs for renewable energy or other resources? If so, provide copies of all such studies.

c. With regard to the cost-effectiveness of continuing to use existing coal-fired generation assets as opposed to switching to renewable sources of generation, state whether the IRP modeling examines both a coal plant's marginal cost of energy, and a renewable source's lower, levelized, cost of energy.

A-14.

(i) The Companies have built and own the 10 MW Brown Solar facility at the E.W. Brown Station, a 30 kW Business Solar facility in Louisville in partnership with the Archdiocese of Louisville, and the first 500 kW section of the Companies' Solar Share community solar program. The Companies expect to have an additional Business Solar facility in service by the end of 2019 in partnership with Maker's Mark in Loretto, KY. The business solar and solar share programs continue to be available to expand to additional customers that are interested in participating.

(ii) In February 2019, the Companies issued a request for proposals for up to 200 MW of renewable energy to be purchased through a PPA, the evaluation and negotiation of which is currently ongoing. The RFP specified that the renewable energy was to be delivered to the Companies' transmission system. Any congestion, risk of congestion, and the associated cost would be borne by the renewable energy supplier and would be reflected in the offer price.

a. Based on the daily ATC data that includes weekdays during the summer months of 2016 and 2017 and the winter months of 2017 and 2018, the Companies' ATC for importing power from neighboring regions is zero 45% of the time.

(i) Confirmed.

(ii) ATC is calculated for only the next 18 months and posted on the Open Access Same-Time Information System ("OASIS"). See attached.

(iii) The Companies have not performed this analysis.

(iv) The Companies have not performed this analysis.

b. No.

c. See the response to Question No. 13. The Companies compared the full cost of operating Brown 3 (i.e., the ongoing capital and O&M costs as well as energy costs) against the costs of solar generation and battery storage and determined that continuing to operate Brown 3 resulted in a lower cost.

Segment	POR-POD	11/1/2019	12/1/2019	1/1/2020	2/1/2020	3/1/2020	4/1/2020	5/1/2020	6/1/2020	7/1/2020	8/1/2020	9/1/2020	10/1/2020	11/1/2020	12/1/2020	1/1/2021	2/1/2021	3/1/2021	4/1/2021
		EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC
P/LGEE/BLGR-LGEE//	BLGR:LGEE	-1,268	-1,468	-1,975	-1,648	-1,291	307	-562	-797	-668	-160	-475	-821	-590	-1,161	-1,806	-1,757	-2,101	175
P/LGEE/BLGR-MISO//	BLGR:MISO	-6,403	-1,885	-5,478	-2,572	-1,312	-805	-2,601	-6,724	-6,056	-4,713	-5,045	-909	-1,748	-1,620	-5,343	-3,630	-4,943	696
P/LGEE/BLGR-OMU//	BLGR:OMU	-1,006	-759	-3,094	-2,752	-1,628	-2,680	-2,100	-2,647	-2,843	-2,301	-5,808	-1,308	-4,559	-2,387	-3,025	-2,724	-2,468	321
P/LGEE/BLGR-PJM//	BLGR:PJM	-2,050	-1,811	-5,624	-2,616	-1,162	-715	-2,846	-7,355	-6,616	-5,154	-5,376	-810	-1,878	-1,951	-5,727	-3,896	-5,349	637
P/LGEE/BLGR-TVA//	BLGR:TVA	-5,905	-9,705	-14,077	-11,535	-3,696	-4,819	-8,508	-11,268	-10,623	-8,838	-9,716	-3,740	-7,605	-9,155	-14,273	-13,079	-12,887	717
P/LGEE/BROWN-LGEE//	BROWN:LGEE	200	-680	-572	-399	200	200	200	-428	-736	-1,258	-422	200	200	-861	-827	-624	-349	200
P/LGEE/BROWN-OMU//	BROWN:OMU	-497	-845	-780	-606	-1,062	-799	-1,082	-1,658	-1,934	-6,327	-5,730	-3,593	-4,293	-3,727	-4,832	-4,404	-3,850	200
P/LGEE/BROWN-PJM//	BROWN:PJM	-1,427	-2,524	-3,960	-3,127	-1,729	200	-871	-1,529	-1,325	-1,000	-1,087	-1,435	-1,293	-2,316	-3,948	-3,655	-3,772	200
P/LGEE/EEI-LGEE//	EEI:LGEE	-661	-1,169	-1,741	-1,284	-449	-377	-563	-1,527	-1,478	-1,281	-643	-342	-459	-2,356	-1,772	-2,237	-1,404	-351
P/LGEE/EEI-OMU//	EEI:OMU	-1,848	-3,301	-5,170	-3,731	-490	-388	-558	-4,430	-4,413	-3,977	-1,527	-317	-433	-3,465	-1,943	-3,319	-2,068	-566
P/LGEE/EEI-PJM//	EEI:PJM	-3,201	-6,422	-9,714	-7,394	-3,580	-945	-1,852	-3,392	-3,060	-2,268	-2,072	-3,345	-2,514	-4,460	-7,631	-9,208	-7,144	-338
P/LGEE/GRIVER-LGEE//	GRIVER:LGEE	-124	-1,558	-2,325	-1,735	200	200	12	-1,965	-1,884	-1,616	-629	197	-152	-1,663	-2,432	-2,031	-1,696	200
P/LGEE/GRIVER-MISO//	GRIVER:MISO	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
P/LGEE/GRIVER-OMU//	GRIVER:OMU	-208	-270	-332	-258	-446	-336	-461	-705	-822	-3,292	-3,068	-1,874	-2,277	-2,902	-3,694	-3,403	-3,065	200
P/LGEE/GRIVER-PJM//	GRIVER:PJM	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
P/LGEE/GRIVER-TVA//	GRIVER:TVA	-3,623	-3,763	-5,021	-4,408	-2,661	-2,129	-3,264	-4,758	-5,063	-5,083	-4,744	-2,847	-3,543	-3,975	-5,337	-4,867	-4,108	200
P/LGEE/KMPA-LGEE//	KMPA:LGEE	-666	-1,223	-1,820	-1,343	-334	-279	-393	-1,601	-1,547	-1,341	-531	-238	-322	-2,380	-1,839	-2,261	-1,419	-354
P/LGEE/KMPA-MISO//	KMPA:MISO	-4,787	-8,090	-12,425	-9,500	-4,890	-763	-2,624	-4,798	-3,920	-1,618	-3,056	-4,726	-3,822	-7,001	-11,874	-10,179	-10,586	-827
P/LGEE/KMPA-OMU//	KMPA:OMU	-934	-462	-532	-515	-206	-186	-230	-324	-354	-330	-824	-132	-181	-3,517	-1,974	-3,370	-2,100	-575
P/LGEE/KMPA-PJM//	KMPA:PJM	-2,745	-5,383	-8,126	-6,228	-3,081	-657	-1,591	-2,901	-2,596	-1,436	-1,799	-2,826	-2,175	-5,371	-9,284	-8,225	-8,813	-341
P/LGEE/KMPA-TVA//	KMPA:TVA	-115	-745	-975	-759	-1,029	-837	-1,367	-1,903	-2,140	-2,086	-1,586	-803	-1,112	-581	-819	-703	-1,105	121
P/LGEE/LGEE-EEI//	LGEE:EEI	-1,549	-1,829	-2,292	-1,983	-1,394	-1,182	-1,682	-2,131	-2,257	-2,214	-1,933	-1,250	-1,500	-1,969	-2,557	-2,295	-3,954	629
P/LGEE/LGEE-LGEE//	LGEE:LGEE	2,997	2,997	-1,076	2,997	2,997	2,997	2,667	1,160	924	577	1,212	2,997	2,997	2,997	-742	2,222	2,125	1,279

Segment	POR-POD	11/1/2019	12/1/2019	1/1/2020	2/1/2020	3/1/2020	4/1/2020	5/1/2020	6/1/2020	7/1/2020	8/1/2020	9/1/2020	10/1/2020	11/1/2020	12/1/2020	1/1/2021	2/1/2021	3/1/2021	4/1/2021
		EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC
P/LGEE/LGEE-MISO//	LGEE:MISO	-1,101	-1,616	-2,522	-1,991	-1,232	326	-515	-1,046	-839	-1,275	-674	-872	-772	-1,345	-2,314	-2,276	-2,556	846
P/LGEE/LGEE-OMU//	LGEE:OMU	-1,994	-2,077	-3,315	-2,654	-2,039	-1,257	-2,586	-3,334	-3,574	-2,673	-2,499	-1,445	-1,746	-2,931	-3,865	-3,468	-3,464	321
P/LGEE/LGEE-PJM//	LGEE:PJM	-940	-1,433	-2,220	-1,739	-1,039	-1,113	-2,886	-894	-802	-1,442	-577	-1,294	-664	-1,204	-2,080	-2,022	-2,238	784
P/LGEE/LGEE-TVA//	LGEE:TVA	-3,178	-3,287	-4,419	-3,837	-2,292	-1,836	-2,841	-4,161	-4,397	-4,313	-4,033	-2,323	-2,866	-3,949	-5,412	-4,862	-5,647	903
P/LGEE/MISO-LGEE//	MISO:LGEE	-2,198	-2,607	-3,904	-2,877	183	-352	-380	-3,315	-3,175	-2,752	-1,084	-144	-274	-4,692	-4,045	-4,627	-2,865	-717
P/LGEE/MISO-OMU//	MISO:OMU	-4,176	-473	-586	-455	-782	-599	-803	-1,259	-1,464	-1,510	-847	-454	-616	-4,275	-5,564	-5,040	-4,425	323
P/LGEE/MISO-TVA//	MISO:TVA	-5,301	-5,133	-6,907	-6,033	-3,564	-2,647	-4,556	-6,707	-7,162	-7,149	-6,682	-3,536	-4,606	-5,412	-7,358	-6,560	-5,553	1,640
P/LGEE/OMU-EEI//	OMU:EEI	-2,061	-4,396	-5,446	-4,315	-3,709	-2,792	-5,289	-4,601	-4,873	-5,588	-4,763	-3,292	-3,823	-5,379	-9,027	-8,492	-8,817	245
P/LGEE/OMU-LGEE//	OMU:LGEE	-1,941	-799	-866	-838	65	-233	-1	-1,418	-1,657	-59	-103	4	-49	-7,357	-4,006	-6,865	-4,372	-919
P/LGEE/OMU-MISO//	OMU:MISO	-2,457	-2,645	-4,071	-3,191	-1,790	129	-909	-1,868	-2,184	-2,833	-1,802	-1,559	-1,283	-3,753	-6,347	-5,846	-6,037	241
P/LGEE/OMU-OMU//	OMU:OMU	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
P/LGEE/OMU-PJM//	OMU:PJM	-2,797	-2,229	-3,418	-2,667	-1,429	-489	-730	-2,129	-2,486	-1,641	-1,063	-1,239	-1,008	-5,948	-4,853	-5,790	-4,668	-837
P/LGEE/OMU-TVA//	OMU:TVA	-2,115	-5,195	-5,283	-4,132	-2,528	-2,071	-2,947	-4,020	-4,241	-4,730	-4,143	-2,637	-3,269	-5,326	-8,990	-8,245	-8,858	243
P/LGEE/PJM-EEI//	PJM:EEI	-3,884	-4,375	-5,412	-4,752	-3,584	-3,027	-4,096	-5,124	-5,457	-5,499	-4,750	-3,211	-3,792	-4,110	-5,222	-4,733	-4,267	629
P/LGEE/PJM-LGEE//	PJM:LGEE	-972	-3,034	-4,480	-3,335	931	1,558	25	-3,809	-3,628	-3,127	-1,234	-153	-304	2,193	-5,249	2,176	-597	213
P/LGEE/PJM-MISO//	PJM:MISO	10,082	11,898	11,951	10,066	10,066	10,066	10,066	10,066	10,066	10,066	10,066	10,066	10,066	11,951	11,951	10,066	10,066	10,066
P/LGEE/PJM-OMU//	PJM:OMU	-399	-526	-650	-505	-854	-651	-890	-1,371	-1,600	-7,071	-6,590	-3,963	-4,926	-6,254	-7,978	-7,271	-6,539	321
P/LGEE/PJM-TVA//	PJM:TVA	-4,012	-3,950	-5,248	-4,600	-2,847	-2,212	-3,458	-5,071	-5,363	-5,370	-5,010	-2,970	-3,765	-4,195	-5,648	-5,116	-4,306	1,640
P/LGEE/TRIMBLE-LGEE//	TRIMBLE:LGEE	-923	-1,145	-1,571	-1,300	-936	200	-427	-625	-528	-126	-373	-630	-458	-899	-1,406	-1,371	-1,602	167
P/LGEE/TRIMBLE-OMU//	TRIMBLE:OMU	-6,294	-9,653	-14,191	-11,511	-3,863	-4,719	-8,511	-11,452	-10,680	-8,956	-10,125	-3,785	-7,948	-9,926	-6,090	-5,485	-4,970	200
P/LGEE/TVA-EEI//	TVA:EEI	-3,789	-1,248	-2,639	-1,267	123	-749	151	567	538	629	326	474	455	-1,200	-2,807	-1,550	-1,640	629
P/LGEE/TVA-LGEE//	TVA:LGEE	-972	-1,770	-2,719	-1,991	55	-164	-260	-2,386	-2,188	-1,967	-1,999	-1,042	-1,354	-1,810	-2,797	-2,319	-1,883	249
P/LGEE/TVA-MISO//	TVA:MISO	-5,553	-825	-980	-994	-8,028	-387	-4,233	72	238	309	48	259	202	-1,030	-1,105	-1,202	-1,216	1,372

Segment	POR-POD	11/1/2019	12/1/2019	1/1/2020	2/1/2020	3/1/2020	4/1/2020	5/1/2020	6/1/2020	7/1/2020	8/1/2020	9/1/2020	10/1/2020	11/1/2020	12/1/2020	1/1/2021	2/1/2021	3/1/2021	4/1/2021
		EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC	EFFATC
P/LGEE/TVA-OMU//	TVA:OMU	-1,227	-2,272	-3,651	-2,625	-655	-518	-677	-3,151	-2,896	-2,706	-1,104	-377	-511	-2,586	-4,188	-3,388	-2,676	326
P/LGEE/TVA-PJM//	TVA:PJM	-3,032	-6,574	-9,991	-7,641	-3,736	-167	-1,937	-3,716	-3,625	-826	-2,221	-3,587	-2,610	-5,224	-8,769	-7,568	-8,594	1,372

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 15

Witness: Stuart A. Wilson

Q15. For purposes of comparing noncombustible renewable energy generation to fossil fuel generation sources, and costs attendant with both forms of generation, explain whether the Companies' modelling compares energy consumption based on the fossil fuel equivalence approach, or the captured energy approach as discussed in more detail in the EIA publication accessible at the below-referenced link.[4]

A-15. Not applicable. As stated and described in the referenced article, the fossil fuel equivalence approach and the captured energy approach are alternatives for comparing "the energy *consumption* for electricity from noncombustible renewable sources with other energy sources," (emphasis added) not for comparing energy generation or costs.

[4] https://www.pressreleasepoint.com/eia-offers-two-approaches-compare-renewable-electricity-generation-other-sources

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 16

Witness: Stuart A. Wilson

Q-16. Reference the Companies' prior IRP docket, Case No. 2014-00131, the Companies' response to Sierra Club 2.3. In that response, the Companies stated that fixed O&M and capital costs are not: (i) factored into the calculation of revenue requirements for any of the scenarios modeled as part of the IRP; (ii) impacted by the scenarios evaluated; therefore, they were not considered in the analysis; and (iii) considered when assessing whether to retire existing units.

a. For each of (i) – (iii), above, explain whether this remains the same for the instant IRP filing, and if so, explain fully why.

b. Given that environmental compliance requires significant sums of capital costs, and both fixed and variable O&M, explain whether the failure to take fixed O&M and capital costs into consideration is consistent with the Commission's requirement to take into consideration the impact of existing and future environmental regulations, as set forth in question no. 9, above.

c. Reference the Companies' Reply Comments to the Sierra Club in that same case, p. 5, in which they state that with regard to Sierra Club's criticisms of the Companies' analysis of capital and fixed operating and maintenance ("O&M") costs of existing units and the retirement of existing units, they ". . . will consider performing alternative analyses for possible unit retirements in future IRP scenario modeling." Explain whether such alternative analyses were employed in the instant IRP, and if so: (i) identify them and where they are located in the filing; (ii) explain whether they were used as inputs in the Strategist modelling; and (iii) explain whether they were used in calculating total revenue requirements.

d. Reference Case No. 2014-00131, the Staff Report at p. 49, quoting the Companies' response to the Sierra Club's comments, item no. 2, wherein the Companies stated they ". . . . will consider performing alternative analyses for possible unit retirements in future IRP scenario modeling; indeed, the Companies already perform rigorous, time-consuming analyses of the kind suggested." Identify where the current IRP filing takes such alternative analyses into consideration.

e. Do the Companies now agree with the Sierra Club that the failure to consider the economic impact of capital and fixed O&M costs biases the modeling results in favor of retaining existing units? Provide a discussion.

A-16. For clarity, the references specified pertain to fixed O&M and capital costs for existing generating units. As stated in Section 4.2.2 on p. 39 of the 2014 IRP Resource Assessment in Volume III of the 2014 IRP, "if an existing coal unit's capacity factor was consistently less than 10 percent in a given load-CO_2 price scenario, the unit was assumed to be retired in the year when its capacity factor consistently dropped below 10 percent." Because the timing of unit retirements was prescribed by this simplifying assumption, fixed O&M and capital costs for existing units were not considered in that analysis.

a. See response to Question No. 9c. The 2018 IRP Reserve Margin Analysis and the analysis in Section 4.2 of the 2018 IRP Long-Term Resource Planning Analysis that evaluated the early retirement of Brown 3 considered ongoing capital and fixed O&M costs.

   The Long-Term Resource Planning Analysis evaluated fixed operating life scenarios of 55 years and 65 years. Because the timing of unit retirements was prescribed by these scenarios, capital and fixed O&M for existing resources were not considered in this analysis. For a given scenario, these costs are the same for all resource plans evaluated and are not needed to identify the least-cost resource plan.

b. All costs required to operate through at least 2021 were considered to determine which resources are economically optimal for meeting system reliability needs in 2021. Furthermore, the High CO_2 price scenario reflects the estimated impact should there be future CO_2 regulations. When known, the costs associated with potential upcoming environmental regulations will be evaluated in a long-term resource planning context, and the analysis will consider all relevant costs and alternatives over a range of scenarios.

c.
   i. See the response to part (a).

   ii. The Companies did not utilize Strategist in the 2018 IRP.

   iii. The ongoing fixed O&M and capital costs were included in the revenue requirements calculation in the 2018 IRP Reserve Margin Analysis and in section 4.2 of the 2018 IRP Long-Term Resource Planning Analysis.

d. See the response to part (c).

e. The Companies neither agree nor disagree with the Sierra Club. Whether or not to include fixed O&M and capital costs depends upon the context of the underlying analysis.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 17

Witness: Stuart A. Wilson

Q-17. Reference IRP vol. 1, p. 5-28, wherein the IRP discusses "Cost of Service," and notes that "Electricity prices are anticipated to increase at a planned rate over the first five years of the forecast period."

a. Explain the support for the assumption regarding the planned rate of increasing electricity prices over the first five years of the forecast period.

b. Provide the rate of increase over the referenced five-year period.

c. Explain why two percent is the most-reasonable inflation rate for electricity prices.

A-17.

a. The assumptions were based on the Company's most recent five-year forecast at the time the 2018 IRP was developed.

b. 3.36% per annum.

c. See the response to PSC 1-25.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 18

Witness: Stuart A. Wilson / Robert M. Conroy

Q-18. Reference IRP vol. 1, p. 5-28, wherein the IRP notes, "All growth in distributed generation through 2033 is forecasted to occur through net metering."

a. Explain why the Companies do not forecast any generation additions over the next 15 years from qualifying facilities.

b. Explain whether the Companies have sought or received waivers from the obligations imposed by 18 C.F.R. § 292.303.

A-18.

a. See the response to Question No. 3e.

b. The Companies have not sought or received a waiver for the obligations imposed by 18 C.F.R. § 292.303.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 19

Witness: Stuart A. Wilson / David E. Huff

Q-19. Reference IRP vol. 1, p. 5-35 & 5-36, and Table 5-13. Based on the Companies' actual experience, provide the observed summer capacity in MWs for the Demand Conservation Program in 2019. Explain the variation between the observed actual MW capacity of the program in 2019, compared to the forecasted amount of 96.

A-19. The Companies have not called a load control event in 2019. However, the Companies did conduct a 10-minute test (called a SCRAM[5]) on August 20, 2019 to assess the level of demand reduction associated with the Residential and Small Nonresidential Demand Conservation Program. Based on this test, the level of demand reduction was 30-50 MWs. Including 27.5 MW of demand reduction for the Large Nonresidential Demand Conservation Program, the total demand reduction was 57.5-77.5 MW. The difference is explained consistent with the Companies' assumptions about attrition in demand reductions provided by the program over time due to switches ceasing to function or being removed from service without the Companies' knowledge, as well as to account for customers leaving the program due to reduced incentive levels."[6]

[5] https://psc.ky.gov/pscecf/2017-00441/rick.lovekamp%40lge-ku.com/12062017050458/LGE_KU_Testimony_and_Exhibits.pdf, page 45 of 182
[6] https://psc.ky.gov/pscecf/2017-00441/rick.lovekamp%40lge-ku.com/12062017050458/LGE_KU_Testimony_and_Exhibits.pdf, page 47 of 182.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 20

Witness: Daniel K. Arbough / Stuart A. Wilson

Q-20. Explain how the Companies' IRP modeling takes into consideration the continuing costs of complying with state and federal environmental regulations for coal-fired generating plants, including but not limited to ash storage and ash pond remediation/reclamation.

a. Provide any year-over-year inflation factors and discount rates used in estimating costs for environmental compliance with regard to coal-fired generation, including ash storage and ash pond remediation/reclamation.

b. Provide a discussion of how the year-over-year inflation factors and discount rates for environmental compliance with regard to coal-fired generation, including ash storage and ash pond remediation/reclamation are taken into consideration in considering the costs and benefits of continued operation of coal-fired plants, as opposed to obtaining other power sources.

A-20. See the response to Question No. 16. Environmental regulations regarding ash storage and ash pond remediation/reclamation require the Companies to take action regardless of whether a given generating unit continues to operate, and were therefore not considered as part of the 2018 IRP analysis.

a. Escalation included in known O&M contracts is factored into cost estimates for environmental compliance. Estimated O&M increases in contracts that will expire during the IRP period are also included, based on the best-known information for the applicable contracts. Capital contracts awarded do not have additional escalation added to the contract value. For future capital projects, should the timelines be accelerated or delayed from the original estimate a 4% per annum rate is used to make the timing adjustment.

b. See the response to Question No. 16.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 21

Witness: Daniel K. Arbough / Counsel

Q-21. Produce the most recent estimate that the Companies have prepared or caused to be prepared of the capital and O&M costs to comply with the following regulations:

a. Mercury and Air Toxics Standards;

b. Coal Combustion Residuals rule;

c. Effluent Limitations Guidelines;

d. 316(b) cooling water intake rule;

e. NAAQS, including any new ozone standard, including any standards still in the draft stages or which are still open to pubic comment;

f. Cross State Air Pollution Rule;

g. Carbon regulations, including the Clean Power Plan and the Affordable Clean Energy Plan;

h. Any applicable state environmental regulations; and

i. Pending enforcement actions by citizen groups or regulatory agencies of any state and/or federal environmental requirements.

A-21.

a. See attached.

b. See attached.

c. See attached.

d. See the response to PSC 1-32.

e. See the response to Question No. 86(a).

f. The Companies have no plans related to the Cross State Air Pollution Rule.

g. The Companies are in the process of evaluating the applicability of heat rate improvement projects identified in the Affordable Clean Energy Plan across the fleet of generating units. Screening level analysis has been undertaken which includes a range of potential costs for individual projects. These costs range from $200,000 to $60,500,000 per individual heat rate improvement project, per unit. Additional engineering design and analysis will be required for candidate projects that are identified based on the State of Kentucky's implementation plan. Until the implementation plan is drafted and additional engineering design analysis is completed, it is not possible to accurately estimate the cost of compliance for the fleet. The Companies are currently in discussion with the State regarding the implementation.

h. Virtually all state environmental regulations are a result of federal regulations, as such, the cost are covered under previous sections of this response.

i. The IRP represents a snapshot in time of the Companies' resource assessment and load forecasting. The Commission's scope in an IRP proceeding is limited to the processes used in the IRP by the utility to prepare the resource assessment and adequacy under review. The Commission's role under 807 KAR 5:058 is limited to addressing procedural issues and not substantive issues. Without wavier of this objection, the Companies have two pending enforcement actions related to environmental requirements with an estimated O&M impact. O&M cost estimates for these enforcement actions are being provided under seal and subject to the Companies' joint petition for confidential treatment.

   a. EPA Notice of Violation re Mill Creek sulfuric acid mist – current estimate: $[redacted]
   b. Kentucky Energy and Environment Cabinet Notice of Violation re Brown selenium – current estimate: $[redacted]

Q-21a.	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Mercury and Air Toxics Standards O&M	$21,006,030	$19,822,705	$20,826,741	$20,815,095	$21,653,280	$23,136,427	$22,484,841	$21,903,769	$22,278,440	$21,983,074	$22,546,570

Note - Capital costs associated with Mercury and Air Toxics Standards compliance were incurred prior to 2018.

Q-21b.	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Coal Combustion Residuals Rule Capital	$308,129,476	$144,606,024	$80,821,754	$46,124,387	$23,595,304	$16,699,254	$215,396	$215,396	$215,396	$215,396	$215,396
Coal Combustion Residuals Rule O&M		$5,009,540	$7,854,032	$8,043,491	$8,278,987	$8,545,197	$8,642,188	$8,574,981	$8,675,764	$8,740,062	$8,921,737

Q-21c.	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Effluent Limitations Guidelines Capital	$1,317,983	$665,500	$2,477,498	$36,391,000	$114,243,253	$98,823,692	$17,531,029				
Effluent Limitations Guidelines O&M					$145,814	$1,886,269	$5,567,943	$5,637,781	$5,709,286	$5,781,901	$5,850,373

Note - The ELG rule is currently under reconsideration by the EPA, with draft revisions due for release in late 2019 and then a final rule issued in mid-2020.
Until the rule is finalized, all potential future capital and O&M expenses are speculative.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 22

Witness: Gary H. Revlett

Q-22. Provide the most recent attainment status of Jefferson, Oldham, Trimble and Fayette counties with the EPA's ozone NAAQS. Provide a discussion of the impacts and ramifications of each county's attainment status.

A-22. Trimble and Fayette are attainment for the EPA's ozone NAAQS. Therefore, there are no impacts or ramifications on the Companies from this regulation within those counties.

Jefferson County and portions of Oldham and Bullitt counties are marginal non-attainment for the EPA's ozone NAAQS. Louisville Metro Air Pollution Control District (LMAPCD) is currently assessing methods of achieving attainment status for the EPA's ozone NAAQS. LMAPCD is performing a photochemical grid model analysis to assess the impact of volatile organic compound (VOC) and nitrogen oxides (NOx) impact on ozone levels. Based on the outcome of that model, decisions will be made on how ozone level might be reduced. Those decisions may require reductions in emissions from sources within the Louisville-Jefferson County KY-IN metropolitan statistical area, which may include reductions from the Companies generating assets within Jefferson County.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 23

Witness: Stuart A. Wilson

Q-23. State whether the IRP modelling takes into consideration estimates for gas transportation, and if so, whether estimates are prepared for both firm and interruptible transportation.

A-23. Yes, gas transportation costs were included. See Tables 1 and 2 in the 2018 Resource Screening Analysis. "Firm Gas Cost" reflects estimates for gas transportation costs for applicable generation resources. No estimates were prepared for interruptible transportation costs because in order to ensure the units are available when needed, firm gas transportation is necessary.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 24

Witness: Stuart A. Wilson

Q-24. In any IRP scenario in which one or more supply side resources may be indicated, state whether any of the Companies' analyses have included pumped water storage.

a. Discuss whether constructing an open-loop pumped storage facility in proximity with either or both of the Companies' hydropower facilities at the Ohio River Falls, and/or the Dix Dam would be economically feasible under any scenario.

b. If not, then explain whether the companies have conducted any due diligence with regard to a closed-loop water facility.

c. Explain to what extent the physical height of the upper pool is relevant with regard to the amount of power that can be generated.

A-24. Pumped hydro energy storage systems were considered in the "2018 IRP Resource Screening Analysis" in Volume III of the 2018 IRP (see page 8, Section 2.1.2), but were not selected for inclusion in the Long-Term Resource Planning Analysis as land-use requirements for pumped hydroelectric facilities make these storage technologies unsuitable in the Companies' territory.

a. See the response above.

b. See the response above.

c. The Companies have not evaluated the specifics of a pumped hydro energy storage system. See the response above.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 25

Witness: Stuart A. Wilson

Q-25. Provide the capacity factors (both summer and winter) and dispatch rates for the Companies' hydropower resources for each of the past three (3) years.

A-25. Net generation and net capacity factors are tabled below.

	Dix Dam Station		Ohio Falls Station	
Season	Net Generation (MWh)	Net Capacity Factor (%)	Net Generation (MWh)	Net Capacity Factor (%)
Summer 2016	35,093	23.7%	167,111	39.6%
Winter 2016	32,984	22.6%	123,573	29.1%
Summer 2017	18,626	12.6%	156,322	35.9%
Winter 2017	83,606	57.3%	88,724	20.3%
Summer 2018	52,696	35.5%	147,118	33.1%
Winter 2018	94,506	64.7%	51,217	11.7%

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 26

Witness: Stuart A. Wilson

Q-26. Reference Figure 5-17 at p. 5-31. State whether the electric vehicle ("EV") charging patterns are based on so-called "DC fast charge" facilities, slower charging facilities or a combination of both.

a. In the event the adoption of EVs throughout the service territory should lead to increased load, have the companies performed any analyses, studies or modeling regarding whether the use of batteries, and/or additional peak generation would be more cost effective?

b. If the Companies' response to subpart a., above is "yes," state whether this in any way changes the Companies' response to question no. 14, above, and if so, explain in complete detail.

c. Provide copies of any analyses, studies or modeling regarding the cost effectiveness of batteries as opposed to both small-frame SCCTs and large-frame SCCTs.

A-26. The charging patterns are based on a combination of both types of charging facilities.

a. The Companies have not performed such analysis.

b. Not applicable.

c. The 2018 IRP Long-Term Resource Planning Analysis in Volume III discusses how the Companies evaluated portfolios containing both SCCTs and battery storage replacement alternatives. As mentioned on page 24, depending on the cost of energy used to charge the battery and expected run times, battery storage could be more cost effective than SCCTs in some scenarios given that it can be deployed in smaller MW increments.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 27

Witness: Stuart A. Wilson / Counsel

Q-27. Reference IRP vol. 1, p. 5-37, footnote 31, wherein the IRP notes "The increase [in the upper end of the target reserve margin] from 21 percent to 25 percent is driven primarily by an increase in the assumed variability of winter peak demands."

a. Explain, in detail, the studies the Companies have conducted, or plan to conduct, regarding programs (DSM, DCP, etc.) to narrow the variability of winter peak demands. Any discussion should include whether the Companies have discovered any cost-effective programs to reduce the variability, thus allowing customers to pay less to maintain reliability at a much-less bloated reserve margin.

A-27.

a. The Companies object to the request to the extent it implies that target reserve margins in the IRP are "bloated" and may be significantly reduced while maintaining adequate reliability. The Companies have submitted a Reserve Margin Analysis with the IRP filing.[7] The analysis concludes that a reserve margin of 25 percent is necessary to meet the 1-in-10 loss-of-load event ("1-in-10 LOLE") physical reliability guideline. This is the same guideline, among other factors, the Companies used to calculate the upper end of the reserve margin in the 2014 IRP case. Without waiving this objection, the Companies state they have not conducted such studies.

[7] IRP, Vol. III, 2018 IRP Reserve Margin Analysis.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 28

Witness: Elizabeth J. McFarland

Q-28. Regarding the level of EV penetration, explain whether the Companies have considered utilizing blockchain technology and apps[8] to enhance the ability of customers who procure charging devices and technology of their own to rent-out their private stations to other EV owners/users.

a. Do the Companies believe that the potential for owners of EV recharging facilities to use the rent proceeds to pay the costs for the charging facilities, will enhance the level of EV penetration in the Companies' service territories?

A-28. The Companies have not considered utilizing blockchain technology and apps to enhance the ability of customers who procure charging devices and technology of their own to rent-out their private stations to other EV owners/users.

a. The Companies are actively promoting EVs as discussed in response to the PSC First Data Request question 11. The Companies are unclear what, if any, effect the potential for EV owners to earn money by allowing others to utilize their recharging facilities would have on the adoption and thus the penetration of EVs in the Companies' service territories.

[8] https://emotorwerks.com/about/enewsso/latest-news/353-blockchain-enabled-electric-car-charging-comes-to-california

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 29

Witness: Stuart A. Wilson

Q-29. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," Final Recommendation at p. 26, which concludes that if the Companies' load increases by 300 to 400 MW, "the reliability and production cost benefits from adding new SCCT capacity would more than offset the cost of the capacity." Should the need to procure one or more peaking units arise at any point in the future, as a potential alterative thereto, have the Companies explored the potentials for one or more of the following:

a. batteries;

b. CHP; and/or

c. energy performance contracts (EPCs) to obtain additional reductions in energy consumption for schools, hospitals and office buildings, which can be supplemented with blockchain technology to perform the complex bookkeeping associated with EPCs?

A-29. As discussed on page 5-6 of Volume I, the Companies will evaluate all market available alternatives before committing to a particular course of action.

a. The Companies evaluated battery storage as a source of peaking capacity in the 2018 IRP Long-Term Resource Planning Analysis.

b. The Companies did not evaluate CHP in their 2018 IRP. See the response to Question No. 3e.

c. The Companies did not evaluate EPCs in their 2018 IRP.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 30

Witness: Elizabeth J. McFarland / Counsel

Q-30. Demonstrate where in the IRP filing the Companies addressed affordability of electricity rates, and if so, how.

a. Explain whether the Companies are aware that a growing number of its large industrial customers are concerned that rates are becoming unaffordable. See, for example, comments from the Kentucky Auto Industry Association referenced in the article accessible at the below link.[9]

A-30. The Companies object to the request to the extent it implies that affordability of rates is a filing requirement or required element of integrated resource planning under 807 KAR 5:058. The subject of the Companies' IRP filing is not whether their rates are just and reasonable as required by Kentucky law. Even if it were, the Commission has recently stated that affordability is not a factor that the Commission can consider in approving rates because KRS 278.170 prohibits rates that establish an unreasonable preference between classes of service.[10] The Companies further object to the implication of the request that their electric rates are unaffordable or becoming so. Historically, the Companies' residential customers have enjoyed rates among the lowest in the country, nearly 20 percent lower than the national average in Central Kentucky.[11] Furthermore, the article cited in the request does not reference the Companies' electric rates and does not address reliability, but does acknowledge that relatively low electric rates in the Commonwealth have been a key factor in attracting auto industry investment in Kentucky. Without waiving these objections, the Companies state that the objective function for every analysis supporting the IRP is to minimize the present value of customers' revenue requirements.

[9] https://www.utilitydive.com/news/new-campaign-will-ask-coal-users-to-face-the-cold-hard-economic-case-agai/539613/
[10] *In the Matter of: Electronic Application of Kentucky-American Water Company for an Adjustment of Rates*, Case No. 2018-00358 (Ky. PSC Jan. 3, 2019), at 4.
[11] *See, e.g.*, Robert Hadley, "Low Rates, high-speed connectivity," The Lane Report's Central Kentucky Market Review 2019-20, at 56.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 31

Witness: Stuart A. Wilson

Q-31. Reference IRP vol. 1, p. 6-3, the heading "Loss of Large Customers." In this heading the Companies state that at the time of the 2014 IRP, "a number" of large customers closed, resulting in a loss of annual load of 555 GWh. Provide the number of customers lost, their individual annual load for the last three complete years of operation, and state whether the Companies are aware if any of these customers left the system due to increasing electric rates. Provide also any studies the Companies, or any consultants acting on their behalf, may have prepared regarding elasticities of demand pertaining to each Company's "all-in" rates.

A-31. The table below details the sales lost by the customers detailed in the "Loss of Large Customers" section of the IRP.

Large Customer Sales (GWh)						
	2013	2014	2015	2016	2017	2018
Customer 1	341.9	370.0	309.8	31.0	13.4	8.5
Customer 2	98.7	92.6	85.8	84.9	73.2	65.6
Customer 3	25.0	30.9	26.7	19.0	10.1	0.1
Customer 4	24.8	27.5	23.6	21.9	7.7	-
Customer 5	36.7	26.9	0.1	-	-	-
Customer 6	88.1	85.1	81.1	74.5	63.1	35.3
Customer 7	20.0	21.2	21.4	21.7	20.9	17.0
Customer 8	18.6	19.9	20.0	18.7	8.1	-
Customer 9	6.9	8.6	8.5	7.1	5.0	0.8
Total	660.6	682.7	576.9	278.8	201.5	127.3

The Companies do not know whether any of these customers left due to increasing electricity rates.

Neither the Companies nor any consultants acting on the Companies' behalf have prepared studies on elasticities of demand pertaining to each Company's "all in" rates. Rather, the Companies rely on a number of available sources to assess the reasonableness of elasticity assumptions in the load forecasting process. As detailed in IRP Volume 1, p 5-28, "Forecast models incorporate class-specific estimates of price elasticity between -0.1 and

-0.3. These values are similar to those from a 2010 survey conducted by energy consultant Itron. In a review of other utility IRPs, a figure of -0.1 to -0.2 was commonly used with the EIA and the Electric Power Research Institute ("EPRI") being among the most commonly cited sources."

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 32

Witness: Stuart A. Wilson

Q-32. Reference IRP vol. 1, p. 6-2 & 6-3. Explain whether the 215 GWh of western Kentucky coal load is included in the 555 GWh of load lost due to "A number of the Companies' large customers" closing.

A-32. No, it is not included in the 555 GWh.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 33

Witness: Stuart A. Wilson

Q-33. Discuss how the IRP takes into consideration projections that most of the Commonwealth's population growth through 2025 will occur in the Lexington and Louisville metropolitan areas.[12]

a. Can the Companies confirm that the decreased energy usage depicted throughout this IRP, as exemplified at Table 5-11, is not due to any potential population decrease in their service territories?

b. Do the Companies believe there is a correlation between the urbanization movement in their service territories, as discussed on p. 6-7, and efficiency gains for the residential and commercial classes, as discussed on p. 6-4?

A-33.

a. Confirmed. There are many rural areas of the service territory where population may decline, but the growth in the urban areas is anticipated to more than offset this for the service territory as a whole.

b. Yes, there is likely a correlation due to increased access to new equipment and higher real income levels in the urban areas. However, the magnitude of the relationship has not been quantified. Also, as mentioned in the response to PSC 1-38 as well as page 6-9 from IRP Vol I, many new premises are part of multi-family units. These units are typically smaller in size, resulting in lower electricity consumption as compared to the average customer in the service territory.

[12] See, e.g., "Kentucky Demographics: Present and Future," Kentucky State Data Center, University of Louisville Dept. of Urban and Public Affairs, in particular p. 25, accessible at: http://www.ksdc.louisville.edu/wp-content/uploads/2015/08/kysu.pdf

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 34

Witness: Stuart A. Wilson

Q-34. Reference IRP vol. 1, p. 5-37. Confirm that the Companies are targeting a reserve margin range of 17% - 25% for resource planning.

a. Reference NERC's M-1 Planning Reserve Margin, accessible at the link below.[13] Confirm that the SERC-North 2018 reference margin is 18%, the 2022 Anticipated Reserve Margin is 19.20%, and the 2022 Reference Margin level is 15%.

A-34. Confirmed.

a. The Companies confirmed all but the 2018 reference margin from the link provided. For the SERC-North 2018 reference margin, the link shows 15% instead of 18%.

[13] https://www.nerc.com/pa/RAPA/ri/Pages/PlanningReserveMargin.aspx

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 35

Witness: Stuart A. Wilson

Q-35. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," p. 10. Confirm the following target reserve margins in surrounding RTOs: (i) MISO, at 17.1%; (ii) PJM at 15.8%; and (iii) TVA at 15%.

A-35. Confirmed.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 36

Witness: Stuart A. Wilson

Q-36. State whether the Companies continue to set the value of their avoided cost of capacity at zero.

A-36. Yes, the Companies' avoided capacity cost is zero.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 37

Witness: Stuart A. Wilson / Elizabeth J. McFarland

Q-37. Reference IRP vol. 1, p. 6-8, "Increasing Electric Heating Penetration."

a. Is the increasing penetration of electric heating for electric utilities that also have their own LDC operation part of a national trend, or is this true only for LG&E? Provide a discussion and any pertinent data.

b. Provide the average residential bills for the months of November through March for both LG&E (both electric and gas) and KU, for the past three calendar years. If the Companies can break out the portion of the electric bill used for heating purposes, provide that information separately.

c. Does LG&E provide public service messages promoting the cost-effectiveness of gas heating? If so, provide copies of examples.

A-37.

a. The increasing penetration of electric heating for electric utilities that also have their own LDC operation is part of a national trend (see the following EIA article from May 2019):

https://www.eia.gov/todayinenergy/detail.php?id=39293

The article states that the trend is more pronounced in Midwest and South regions: "The share of all-electric homes has risen in each census region over the past decade, particularly in the Midwest and South… From 2005 to 2015, the share of U.S. homes using electricity for their main heating equipment increased from 30% to 36%."

b. See attached. At this time, the Companies are not able to break out the portion of the electric bill used for heating purposes.

c. Both KU and LG&E consistently communicate energy efficiency education information and safety messaging. LG&E does not promote one heating source over another.

Louisville Gas and Electric Company and Kentucky Utilites Company
Average Residential Bill
November through March
2016, 2017, 2018

Average Residential Electric Bill

		January	February	March	November	December
Kentucky Utilities	2016	$ 149.10	$ 160.12	$ 128.25	$ 85.61	$ 130.40
	2017	$ 155.08	$ 128.36	$ 113.50	$ 97.19	$ 136.82
	2018	$ 208.66	$ 158.91	$ 121.30	$ 100.50	$ 136.78
Louisville Gas and Electric Company	2016	$ 102.28	$ 103.72	$ 87.93	$ 74.89	$ 94.85
	2017	$ 104.63	$ 84.95	$ 78.40	$ 81.58	$ 97.18
	2018	$ 130.20	$ 107.30	$ 82.08	$ 74.94	$ 92.42

Average Residential Gas Bill

		January	February	March	November	December
Louisville Gas and Electric Company	2016	$ 100.98	$ 98.46	$ 74.77	$ 44.49	$ 85.74
	2017	$ 108.08	$ 93.03	$ 78.05	$ 56.20	$ 93.73
	2018	$ 138.08	$ 114.01	$ 84.86	$ 57.40	$ 91.40

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 38

Witness: Stuart A. Wilson

Q-38. Reference IRP vol. 1, Tables 6-11 & 8-1. Explain what depreciable lives were used for each of the "Existing Capabilities" in the table.

A-38. Depreciable lives were not considered in the development of these tables. The Companies' existing capability decreases in 2019 due to the planned retirement of Brown 1 and 2.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 39

Witness: Stuart A. Wilson

Q-39. Reference IRP vol. 1, p. 7-2 & 7-3, Tables 7-3 & 7-4. Explain the lines "System Billed Sales," "System Used Sales" and "Energy Requirements." Any explanation should indicate in which category technical and non-technical losses are, and are not, reflected.

A-39. For a given year, System Billed Sales is the sum of sales over twelve billing periods, where each billing period includes days from at least two calendar months. System Used Sales is the sum of sales over twelve calendar months. Energy Requirements is the sum of System Used Sales, losses, and utility use.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 40

Witness: Stuart A. Wilson / Thomas A. Jessee

Q-40. Reference IRP vol. 1, p. 5-7, which states, inter alia, "Energy requirements are the sum of electricity sales and transmission and distribution losses."

a. Provide a table depicting the Companies' transmission and distribution energy losses for each of the past four (4) years. To what extent, if any, has the Companies' increased capital spending for transmission and distribution modernization over the past several years reduced such losses? Describe in detail.

A-40.

a. The Companies have not monitored any change in losses over the past several years as a result of new capital projects.

Transmission and Distribution Line Losses (GWh)				
Company	**2015**	**2016**	**2017**	**2018**
KU	1,338	1,294	1,256	1,356
LG&E	540	600	518	541

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 41

Witness: Stuart A. Wilson

Q-41. Reference IRP vol. 1, p. 7-1 through 7-7. Update the Tables with observed information for 2018, and if available, annualized amounts for 2019.

A-41. See tables below:

Table 7.(2)(a)
KU Annual Average Number of Customers by Class

	2013	2014	2015	2016	2017	2018
Residential	420,223	421,978	423,957	426,230	429,411	431,618
Commercial	80,252	80,047	80,162	80,674	81,236	81,572
Industrial	2,734	2,926	2,969	2,842	2,662	2,421
Public Authority*	7,579	7,342	7,423	7,646	7,751	7,935
Public Street and Highway Lighting	1,353	1,408	1,446	1,456	1,454	1,444
Virginia Retail	28,742	28,526	28,350	28,221	28,122	27,933
Req. Sales for Resale	12	12	11	11	10	10
Total Customers	540,895	542,239	544,318	547,080	550,646	552,933

Table 7.(2)(a)
LG&E Annual Average Number of Customers by Class

	2013	2014	2015	2016	2017	2018
Residential	348,048	350,587	353,419	356,424	359,658	362,112
Commercial	42,065	42,264	42,697	42,914	43,574	44,002
Industrial	426	437	473	580	573	567
Street Lighting	650	656	659	672	680	655
Public Authority	4,124	4,098	4,123	4,154	4,253	4,375
Total Customers	395,313	398,042	401,371	404,744	408,738	411,711

Table 7.(2) (b)
KU Recorded and Weather-Normalized Annual Generation & Energy Sales by Class

	2013	2014	2015	2016	2017	2018
SYSTEM BILLED SALES:						
Recorded	21,206	21,631	21,317	20,549	19,897	21,078
Weather Normalized	21,128	21,346	20,923	20,493	20,423	20,476
SYSTEM USED SALES:						
Recorded	21,269	21,611	20,902	20,757	19,984	20,917
Weather Normalized	21,262	21,254	20,792	20,603	20,291	20,373
ENERGY REQUIREMENTS:						
Recorded	22,602	23,023	22,261	22,073	21,257	22,291
Weather Normalized	22,595	22,642	22,144	21,909	21,584	21,711
SALES BY CLASS:						
Residential	6,195	6,335	5,995	6,048	5,698	6,320
Commercial	3,906	3,883	3,803	3,849	3,778	4,011
Industrial	6,843	7,071	6,884	6,635	6,499	6,429
Lighting	41	42	42	43	44	42
Public Authorities	1,542	1,558	1,556	1,571	1,508	1,565
Requirement Sales for Resale	1,880	1,886	1,855	1,876	1,755	1,792
KENTUCKY Retail	20,407	20,775	20,135	20,022	19,282	20,159
VIRGINIA Retail	862	836	767	735	702	757
SYSTEM LOSSES	1,311	1,389	1,338	1,294	1,256	1,356
Utility Use	22	23	21	22	17	19
ENERGY REQUIREMENTS	22,602	23,023	22,261	22,073	21,257	22,291
Weather Normalized:						
Residential	6,180	6,148	5,963	5,947	5,929	6,008
Commercial	3,908	3,797	3,757	3,833	3,809	3,886
Industrial	6,844	7,061	6,880	6,635	6,501	6,429
Lighting	41	42	42	43	44	42
Public Authorities	1,543	1,539	1,547	1,569	1,513	1,537
Requirement Sales for Resale	1,879	1,846	1,849	1,856	1,788	1,731
VIRGINIA Retail	867	822	756	719	708	738

Table 7.(2) (b)
LG&E Recorded and Weather-Normalized Annual Generation & Energy Sales by Class

	2013	2014	2015	2016	2017	2018
SYSTEM BILLED SALES:						
Recorded	11,682	11,838	11,888	11,919	11,503	12,057
Weather Normalized	11,726	11,748	11,796	11,740	11,669	11,574
SYSTEM USED SALES:						
Recorded	11,698	11,817	11,767	11,948	11,527	12,064
Weather Normalized	11,732	11,686	11,722	11,812	11,690	11,650
ENERGY REQUIREMENTS:						
Recorded	12,245	12,282	12,329	12,570	12,066	12,626
Weather Normalized	12,279	12,146	12,282	12,426	12,237	12,193
SALES BY CLASS:						
Residential	4,164	4,157	4,081	4,215	4,004	4,370
Commercial	3,863	3,904	3,905	3,943	3,854	3,949
Industrial	2,522	2,584	2,617	2,640	2,562	2,606
Public Authorities	1,131	1,155	1,145	1,131	1,087	1,120
Lighting	18	17	19	19	20	17
TOTAL LG&E SALES	11,698	11,817	11,767	11,948	11,527	12,062
SYSTEM LOSSES	525	439	540	600	518	541
Utility Use	22	26	22	22	21	23
ENERGY REQUIREMENTS	12,245	12,282	12,329	12,570	12,066	12,626
WEATHER NORMALIZED SALES BY CLASS:						
Residential	4,190	4,033	4,061	4,082	4,138	4,076
Commercial	3,869	3,901	3,885	3,940	3,873	3,860
Industrial	2,523	2,583	2,615	2,641	2,569	2,606
Public Authorities	1,131	1,152	1,142	1,129	1,090	1,091
Lighting	18	17	19	19	20	17

Table 7.(2) (c)
KU Actual and Weather-Normalized Combined Company Coincident Peak Demands (MW)

	2013	2014	2015	2016	2017	2018
SUMMER Actual	3,919	3,870	3,807	3,934	3,914	3,873
	2012/2013	**2013/2014**	**2014/2015**	**2015/2016**	**2016/2017**	**2017/2018**
WINTER Actual	4,153	5,035	5,112	4,415	4,016	4,790

Table 7.(2) (c)
LGE Actual and Weather-Normalized Combined Company Coincident Peak Demands (MW)

	2013	2014	2015	2016	2017	2018
SUMMER Actual	2,515	2,443	2,585	2,524	2,589	2,618
	2012/2013	**2013/2014**	**2014/2015**	**2015/2016**	**2016/2017**	**2017/2018**
WINTER Actual	1,754	2,079	1,967	1,808	1,797	1,909

Table 7. (2)(d)
KU Energy Sales and Coincident Peak Demand for Firm and Contractual Commitment Customers

	2013	2014	2015	2016	2017	2018
Energy Sales (GWh)	19,749	20,044	19,353	18,925	18,172	18,984
Coincident Peak Demand (MW)	3,843	4,922	5,030	3,782	3,747	4,651

Table 7. (2)(d)
LG&E Energy Sales and Coincident Peak Demand for Firm and Contractual Commitment Customers

	2013	2014	2015	2016	2017	2018
Energy Sales (GWh)	11,308	11,384	11,311	11,504	11,004	11,523
Coincident Peak Demand (MW)	2,486	2,048	1,915	2,468	2,525	2,573

Table 7. (2)(e)
KU Interruptible Customers Energy Sales and Combined Company Coincident Peak

	2013	2014	2015	2016	2017	2018
Energy Sales (GWh)	658	731	782	1,097	1,110	1,176
Coincident Peak Demand (MW)	76	113	82	152	167	139

Table 7. (2)(e)
LGE Interruptible Customers Energy Sales and Combined Company Coincident Peak

	2013	2014	2015	2016	2017	2018
Energy Sales (GWh)	390	433	456	444	523	541
Coincident Peak Demand (MW)	28	31	52	56	64	45

Table 7.(2)(f)
KU Annual Energy Losses (GWh)

	2013	2014	2015	2016	2017	2018
Annual Energy Loss	1,311	1,389	1,338	1,294	1,256	1,356
Loss Percent of Energy Requirements	6.2%	6.4%	6.4%	6.2%	6.3%	6.5%

Table 7.(2)(f)
LG&E Annual Energy Losses (GWh)

	2013	2014	2015	2016	2017	2018
Annual Energy Loss	525	439	540	600	518	541
Loss Percent of Energy Requirements	4.3%	3.6%	4.4%	4.8%	4.3%	4.3%

Table 7.(2)(h)-1
KU Average Annual Use-per-Customers by Class (kWh)

	2013	2014	2015	2016	2017	2018
Residential	14,742	15,013	14,141	14,190	13,269	14,643
Commercial	48,672	48,509	47,441	47,711	46,506	49,171
Industrial	2,502,926	2,416,610	2,318,626	2,334,624	2,441,397	2,655,514
Public Authority	203,457	212,204	209,619	205,467	194,556	197,227
Utility Use & Other	30,303	29,830	29,046	29,533	30,261	29,086

Table 7.(2)(h)-1
LG&E Average Annual Use-per-Customers by Class (kWh)

	2013	2014	2015	2016	2017	2018
Residential	11,964	11,857	11,547	11,826	11,133	12,068
Commercial	92,012	92,372	91,458	91,881	88,447	89,746
Industrial	5,920,188	5,913,043	5,532,770	4,551,724	4,471,204	4,596,120
Public Authority	274,248	281,845	277,710	272,268	255,584	256,000
Utility Use and Other	27,692	25,915	28,832	28,274	29,412	25,954

Table 7.(2)(h)-2
KU Percentage of Class Sales to Total Energy Sales (kWh)

	2013	2014	2015	2016	2017	2018
Total Residential	30%	29%	29%	29%	28%	30%
Commercial	18%	18%	18%	19%	19%	19%
Industrial	32%	33%	33%	32%	32%	31%
Public Authority	7%	7%	7%	7%	8%	7%
Utility Use and Other	0%	0%	0%	0%	0%	0%
Virginia Retail	4%	4%	4%	4%	4%	4%
Req. Sales for Resale	9%	9%	9%	9%	9%	9%
Total Company	100%	100%	100%	100%	100%	100%

Table 7.(2)(h)-2
LG&E Percentage of Class Sales to Total Energy Sales (kWh)

	2013	2014	2015	2016	2017	2018
Residential	36%	35%	35%	35%	35%	36%
Commercial	33%	33%	33%	33%	33%	33%
Industrial	21%	22%	22%	22%	22%	22%
Public Authority	10%	10%	10%	10%	10%	9%
Lighting	0%	0%	0%	0%	0%	0%
Total Company	100%	100%	100%	100%	100%	100%

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 42

Witness: Gary H. Revlett

Q-42. Reference IRP vol. 1, p. 8-2, "Efficiency Improvements." Explain how the new Affordable Clean Energy Rule and its determination of best system of emission reduction affects the Companies' plans to conduct improvements to generation efficiencies.

A-42. The Companies have historically implemented economically justified efficiency projects within the construct of compliance with the Clean Air Act, Prevention of Significant Deterioration, and New Source Review regulations. The Companies' plans for generation efficiency improvement identified in IRP vol. 1, p. 8-2, have been or will be reviewed under those same requirements.

Under the additional requirements of the Affordable Clean Energy (ACE) rule, the Companies will evaluate the heat rate improvement (HRI) technologies identified by EPA within the ACE rule for each affected electric generating unit in the Companies' fleet. The evaluations will determine the best system of emission reduction (BSER) for each unit based on technical and economic reasoning and maintain compliance with all aspects of Clean Air Act requirements.

The generation efficiency improvements identified in IRP vol. 1, beginning on p. 8-2 were not specific to the ACE Rule. However, there is potential overlap with ACE rule Heat Rate Improvement (HRI) technologies. For example, turbine overhauls in the referenced section of the IRP could be expanded to include steam turbine blade path upgrades (a HRI technology) and boiler tube replacements could include redesign/replace economizers (a HRI technology).

The Companies regularly assess methods to improve generation efficiencies to continue to reduce the cost of electricity. The generation efficiency improvements identified in IRP vol. 1, beginning on p.8-2 will continue to be undertaken assuming they continue to be the correct option to help reduce environmental impact, maintain the efficient use of generation facilities, are economically justified, and meet regulatory compliance (including the ACE rule).

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 43

Witness: John K. Wolfe

Q-43. Reference IRP vol. 1, p. 8-5. Explain the meaning of the sentence, "The Companies plan to continue to design for near unity power factor at the substation bus where capacitor installations on the distribution system are reasonable and feasible."

A-43. LG&E and KU plan to continue designing and installing distribution class capacitor banks to improve circuit and/or substation power factor to near unity. By operating near unity power factor, the need to transfer reactive power across the system is reduced. This results in an overall reduction of system losses.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 44

Witness: Stuart A. Wilson

Q-44. Reference IRP vol. 1, p. 8-8, Table 8-3.

a. Explain how the Companies determined the anticipated capacity factor for each unit in each year provided.

b. If available, for each generating unit that is expected to operate at a capacity factor of 5% or less for any year between 2018 and 2033, provide the following:

i. The number of days each unit is anticipated to operate each year, 2018 through 2033.

ii. The number of hours each unit is anticipated to operate each year, 2018 through 2033.

iii. For each unit that is anticipated to operate at least one (1) hour each time it is dispatched, provide the anticipated run time for each dispatch over one (1) hour.

A-44.

a. Capacity factors were calculated by dividing annual forecast generation from the Companies' business plan by the product of average capacity for each unit and the number of hours in each year.

b.

i. See attached. The following groupings of CTs have very similar characteristics: Brown 5 & 8-11, Brown 6-7, and Trimble County 5-10. As a result, the model dispatches the first unit in each grouping most, followed by the second, followed by the third, and so on. In reality, generation is more evenly distributed within each grouping. For this reason, modeled capacity factors for each CT grouping (rather than for each specific CT) more accurately reflect the Companies' expectations for these units. The attachment contains anticipated capacity factors for each CT grouping, as well as the data requested.

ii. See the response to part (b)(i).

iii. See attached.

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Capacity Factors																
Brown 5 & 8-11	4%	4%	4%	3%	3%	3%	3%	1%	1%	1%	1%	0%	1%	0%	1%	1%
Brown 6-7	10%	7%	6%	7%	8%	5%	4%	5%	5%	5%	5%	3%	4%	3%	4%	6%
Trimble County 5-10	11%	11%	11%	10%	10%	9%	11%	11%	11%	12%	12%	8%	9%	8%	12%	12%
Days of Operation																
Bluegrass 3	63	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown 5	113	148	126	124	125	114	107	47	45	46	48	37	35	36	41	50
Brown 6	62	75	67	82	82	68	52	55	58	65	58	54	52	43	61	71
Brown 7	67	48	58	51	77	59	50	51	61	58	63	49	47	42	57	69
Brown 8	63	46	40	30	33	29	32	28	34	32	36	26	26	22	26	41
Brown 9	38	56	46	39	40	36	33	35	44	42	37	29	28	29	33	38
Brown 10	44	67	59	47	52	48	54	33	29	41	31	23	24	25	25	36
Brown 11	34	40	35	29	31	27	31	24	33	26	26	24	25	19	23	29
Cane Run 11	4	4	7	6	2	0	3	1	3	1	1	2	3	0	3	0
Haefling 1-2	4	8	6	2	3	1	3	3	5	0	0	2	3	0	3	4
Paddy's Run 11	6	3	4	2	3	0	2	1	2	2	0	1	2	0	1	0
Paddy's Run 12	7	2	3	6	1	0	2	2	2	2	1	1	2	0	3	0
Paddy's Run 13	93	114	124	98	98	77	53	126	123	124	136	127	121	122	154	150
Trimble County 8	151	95	94	54	60	55	59	53	66	79	84	56	67	48	80	79
Trimble County 9	121	66	49	113	99	102	104	110	124	116	132	109	118	103	135	131
Trimble County 10	47	32	37	42	35	26	29	29	41	47	51	30	45	27	43	46
Zorn 1	0	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Hours of Operation																
Bluegrass 3	455	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown 5	1,319	1,989	1,577	1,619	1,603	1,224	1,315	311	304	283	290	184	193	181	210	344
Brown 6	1,092	813	649	795	815	581	447	514	574	664	585	432	469	341	516	671
Brown 7	972	445	467	462	744	430	400	399	483	502	503	344	387	315	417	550
Brown 8	583	326	251	165	161	100	127	102	158	123	153	75	107	70	92	213
Brown 9	426	441	322	240	224	134	159	202	246	234	184	114	123	135	141	196
Brown 10	426	529	502	400	357	359	438	148	130	184	120	70	91	74	99	175
Brown 11	265	229	209	134	112	84	107	79	131	58	57	59	80	51	70	86
Cane Run 11	8	37	26	21	11	0	17	2	10	7	5	9	17	0	14	0
Haefling 1-2	5	53	24	8	12	4	15	12	14	0	0	9	15	0	17	14
Paddy's Run 11	8	17	16	8	10	0	8	4	10	17	0	4	8	0	4	0
Paddy's Run 12	11	14	14	22	5	0	5	8	14	14	5	5	5	0	17	0
Paddy's Run 13	886	993	927	786	753	614	421	1,000	960	1,021	1,080	1,052	1,012	1,042	1,254	1,151
Trimble County 8	1,993	553	518	281	310	259	320	249	322	381	404	261	356	197	346	363
Trimble County 9	1,496	339	243	789	709	745	777	846	1,009	1,023	1,261	787	905	738	1,123	1,117
Trimble County 10	417	153	167	183	169	103	134	155	202	235	197	132	202	119	181	180
Zorn 1	0	32	18	0	0	0	0	0	0	0	0	0	0	0	0	0

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1	1	63	4	3	5	7	17	15	5	4	2	4	6	3	2	2	10
2	3	24	17	8	4	4	17	17	11	4	6	10	3	2	2	2	2
3	4	5	13	3	28	29	4	15	5	4	4	4	7	4	2	2	4
4	3	27	8	2	2	5	15	6	16	1	5	6	5	8	2	7	14
5	1	11	12	28	29	36	6	6	5	9	7	4	5	8	2	4	2
6	2	5	34	16	7	17	4	3	4	12	4	3	17	2	2	5	4
7	2	8	11	29	8	7	27	19	7	4	1	4	4	2	6	2	2
8	2	26	13	6	1	14	3	15	1	15	4	4	2	3	4	6	4
9	2	17	8	14	1	1	21	12	4	4	4	3	2	2	9	7	4
10	2	5	12	7	1	1	7	1	4	4	4	4	4	2	2	2	4
11	2	16	6	10	1	1	7	1	1	4	4	4	1	2	3	9	
12	2	4	8	5	1	7	12	1	1	4	2	5	4	8	5	2	
13	2	10	14	8	1	4	5	4	4	4	4	4	25	9	4	6	
14	2	56	7	11	1	1	5	1	4	4	4	1	12	13	2	4	
15	2	37	10	4	16	7	4	1	4	4	4	4	5	2	4	3	
16	2	30	11	13	6	1	29	1	4	4	4	4	11	6	5	3	
17	2	17	11	12	7	3	30	1	4	4	8	6	6	8	3	3	
18	2	113	11	11	1	1	14	14	5	4	2	8	7	3	2	7	
19	2	6	10	11	1	7	9	16	6	4	7	10	8	2	2	12	
20	2	12	5	7	1	12	13	1	5	4	10	4	3	2	9	12	
21	2	41	11	5	1	5	1	1	4	6	4	5	4	2	2	2	
22	4	3	5	5	1	1	1	1	8	5	4	5	3	11	3	3	
23	3	19	5	3	11	1	1	1	2	4	4	4	11	2	2	6	
24	6	3	10	3	37	1	5	1	5	4	4	1	3	2	2	3	
25	3	6	13	10	1	8	1	1	2	4		9	7	7	6	2	
26	2	5	8	11	7	1	1	10	3	4		4	16	9	2	2	
27	3	14	8	12	1	1	6	5	7	4		4	9	5	10	3	
28	2	6	6	11	1	58	1	6	5	4			2	3	2	3	
29	2	11	10	11	1	5	3	1	4	1			4	8	3	3	
30	2	1	11	4	1	1	12	6	5	1			2	8	2	24	
31	2	1	12	6	4	10	5	1	4	4			9	7	8	2	
32	2	3	11	5	44	1	1	1	5	4			3	3	2	4	
33	7	14	11	18	30	1	7	1	8	5			10	13	16	7	
34	2	5	3	43	24	1	12	1	6	6			2	3	3	2	
35	2	53	2	14	6	4	1	6	4	5			6	6	4	2	
36	1	11	16	26	29	1	1	8	4	4			1	4	5	2	
37	4	12	18	5	2	6	1	4		9			10	10	4	2	
38	5	1	9	29	3	5	1	24		4			14	2	2	7	
39	3	10	32	6	24	4	1	17		4			6	2	2	12	
40		7	11	10	33	20	11	17		4			10	8	6	1	
41		3	12	15	2	22	14	26		4			10	3	2	2	
42		6	15	2	3	14	1	26		2			13	11	5	4	
43		5	52	19	26	14	1	5		4			10	2	10	3	
44		8	41	4	19	7	1	25					2	7	14	2	

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1	
45		7	8	3	5	5	1	27					2	5	16	4			
46		7	16	4	12	56	1	1					2	4	3	6			
47		6	4	2	5	7	5	7					12	3	2	8			
48		32	10	53	1	16	3	1					6	7	8	2			
49		32	8	11	11	22	2	1					3	3	6	6			
50		9	7	2	1	28	44	1					9	3	5	2			
51		22	10	6	1	6	65	2					8	3	3	2			
52		27	1	7	1	5	10	4					11	13	2	9			
53		62	3	11	2	3	24	1					8	16	6	2			
54		9	17	3	8	26	6	1					10	2	5	6			
55		5	12	4	1	4	12	1					11	2	4	2			
56		7	7	13	1	13	17	1					1	8	6	2			
57		10	8	7	10	6	18	7					2	10	10	6			
58		6	4	4	1	2	41	1					13	4	2	4			
59		6	4	7	5	8	4	10					12	2	2	2			
60		7	4	5	1	1	18	8					9	2	3	7			
61		4	17	11	5	12	27	5					8	3	4	2			
62		30	9	5	2	1	35	5					29	2	2	3			
63		27	5	9	5	1	6	1					11	6	4	2			
64		11	5	10	11	3	4	1					9	2	2	4			
65		1	1	8	11	2	5	1					9	2	5	4			
66		12	3	7	7	2	34	1					8	4	2	3			
67		13	7	10	2	6	4	1					8	7	4	3			
68		11	5	9	5	11	3	1					10	2	2	4			
69		8	13	10	1	1	16	3					7	2	34	3			
70		11	16	8	10	1	28	15					11	2	2	7			
71		4	19	8	1	10	51	19					14	11	2	2			
72		10	6	3	1	5	13	6					8	35	4	4			
73		26	1	11	1	3	10	23					11	2	19	6			
74		12	15	4	1	1	6	8					3	5	2	3			
75		13	11	4	15	11	1	1					9	9	2	3			
76		6	32	2	7	3	9	1					3	2	2	12			
77		6	12	5	41	6	1	6					7	2	5	3			
78		1	24	9	10	12	1	1					8	2	3	5			
79		4	15	3	26	12	1	1					9	5	14	8			
80		16	35	36	1	9	5	1					7	10	19	2			
81		2	17	8	1	2	4	1					5	3	2	3			
82		9	3	12	7	5	11	1					14	3	4	3			
83		7	9	8	1	7	1	4					10	3	3	6			
84		8	9	9	1	12	2	6					11	7	2	3			
85		6	10	7	1	1	1	1					9	7	2	4			
86		36	4	2	1	1	11	4					7	7	3	3			
87		8	4	12	1	1	1	6					9	2	8	4			
88		11	20	7	11	1	1	5					8	2	4	2			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1	
89		39	10	9	8	3	6	11					7	3	2	4			
90		86	3	5	1	5	2	1					4	8	5	4			
91		41	5	4	3	8	2	1					2	3	2	3			
92		16	15	2	4	40	1	1					7	5	9	2			
93		151	35	10	8	6	13	3					6	5	2	5			
94		79	11	18	9	60	11	1					4	2	2	6			
95		14	10	2	8	5	8	1					11	5	2	5			
96		162	7	5	1	8	6	4					15	10	5	2			
97		16	4	8	5	7	6	1					18	2	8	4			
98		39	6	4	1	4	6	11					7	5	7	3			
99		16	4	8	1	7	11	12					4	4	2	5			
100		17	9	5	1	6	1	4					16	2	2	3			
101		6	3	3	1	1	1	4					7	7	10	8			
102		3	8	3	1	2	1	5					1	4	4	9			
103		38	9	9	4	8	1	4					8	6	2	5			
104		17	5	12	25	1	3	9					2	2	3	2			
105		33	7	10	14	1	7	1					8	2	2	2			
106		28	9	8	5	1	14	1					3	11	3	8			
107		15	12	4	6	1	13	1					7	2	2	4			
108		8	12	4	7	1	7	1					2	24	2	6			
109		40	6	4	6	1	5	1					1	4	2	2			
110		36	4	4	9	11	4	1					3	2	2	2			
111		18	7	10	1	12	5	4					2	2	2	2			
112		28	4	12	1	1	17	3					1	2	8	2			
113		10	9	11	1	6	10	4					6	3	8	3			
114		10	12	4	1	7	41	1					4	3	4	3			
115		78	11	10	1	9	37	1					1	4	8	3			
116		114	8	9	1	12	5	7					3	4	2	2			
117		54	5	3	4	11	6	1					5	16	3	5			
118		22	12	8	2	4	6	1					5	2	5	2			
119		27	7	15	3	8	23	9					7	2	4	2			
120		5	9	7	6	11	8	1					4	5	8	1			
121		66	9	9	1	7	37	7					8	2	5	2			
122		14	11	12	10	1	25	6					6	2	4	3			
123		13	11	12	10	6	59	2					8	2	4	4			
124		35	14	7	1	1	7	6					6	2	2	8			
125		14	10	8	4	1	5	1					4	3	2	2			
126		3	11	8	14	6	1	1					6	2	2	5			
127		13	9	6	1	1	3	1					5	2	2	2			
128		13	6	2	7	2	1	1					5	8	16	3			
129		9	8	49	8	3	1	9					1	24	2	4			
130		5	7	4	5	14	1	12					4	18	2	2			
131		4	22	28	1	8	1	5					4	4	2	4			
132		14	10	13	1	3	1	2					7	5	4	3			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1	
133		11	4	4	1	6	1	9					5	2	2	7			
134		3	7	12	1	5	3	1					3	3	3	2			
135		4	3	7	3	9	7	1					3	8	7	2			
136		12	2	6	4	10	10	1					1	2	32	5			
137		8	3	16	15	24	3	2					4	9	27	5			
138		38	3	6	6	9	1	1					16	15	2	3			
139		12	7	3	4	12	5	1					6	2	9	2			
140		4	4	38	6	3	11	1					4	2	3	2			
141		3	2	4	2	1	11	1					5	2	5	6			
142		1	5	7	3	1	5	10					2	2	3	6			
143		13	9	19	7	1	9	1					6	2	4	2			
144		27	5	23	1	1	3	1					4	7	6	3			
145		8	13	17	1	1	4	1					4	7	2	3			
146		4	7	12	1	1	1	5					20	6	2	2			
147		30	38	30	4	8	1	1					22	3	9	6			
148		12	6	6	1	8	5	6					5	6	2	2			
149		53	4	7	1	6	1	1					2	3	10	2			
150		6	5	3	1	1	2	1					6	11	14	6			
151		11	22	2	10	5	2	1					1	2	3	8			
152		12	13	5	1	11	9	1					5	2	2	7			
153		5	8	2	1	12	6	4					19	5	27	5			
154		5	6	5	1	1	72	1					1	6	2	12			
155		8	3	13	1	3	17	1					8	9	2	2			
156		8	7	5	3	5	6	3					8	8	12	2			
157		6	3	12	1	16	10	5					9	5	2	4			
158		7	7	12	4	1	5	3					1	5	4	6			
159		24	2	4	1	9	5	2					4	3	2	5			
160		6	17	10	1	5	4	3					5	6	12	8			
161		6	17	2	1	5	13	7					5	10	2	2			
162		12	10	9	1	4	4	1					2	2	7	3			
163		8	2	24	5	3	6	1					1	3	5	2			
164		11	7	26	1	8	5	1					5	3	7	4			
165		6	16	12	3	1	30	1					12	3	6	4			
166		5	9	5	8	1	3	12					6	6	10	2			
167		10	7	18	3	1	5	1					3	4	6	4			
168		5	11	20	6	1	6	9					8	2	2	10			
169		39	2	9	5	4	5	1					2	2	7	6			
170		8	10	2	3	3	14	3					14	2	6	5			
171		6	3	11	3	13	8	25					3	2	4	3			
172		8	1	3	5	9	1	2					5	8	10	3			
173		10	45	11	3	1	1	1					4	2	11	2			
174		5	18	7	7	1	3	1					9	2	10	6			
175		6	4	10	1	1	1	1					2	9	9	2			
176		29	3	2	1	4	1	1					15	2	7	8			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1	
177		28	6	2	1	1	1	2					7	2	8	4			
178		78	6	13	1	3	4	8					4	2	2	7			
179		14	4	37	11	1	5	8					5	4	5	6			
180		7	12	7	1	1	3	2					1	3	8	3			
181		10	3	10	11	6	5	1					8	4	6	4			
182		9	10	10	1	4	6	1					8	3	6	1			
183		5	10	2	13	10	1	1					7	6	2	2			
184		11	5	5	12	13	1	1					2	4	9	3			
185		7	5	11	2	1	11	1					6	2	6	4			
186		1	7	13	1	3	1	1					8	13	1	3			
187		7	9	10	1	1	4	11					5	10	5	2			
188		1	4	9	1	1	16	3					1	3	7	2			
189		4	5	4	1	6	1	11					2	11	8	3			
190		18	6	7	9	4	8	1					10	3	7	3			
191		15	12	6	8	3	10	1					3	7	6	3			
192		5	13	6	5	1	9	1					1	8	14	3			
193		9	10	4	6	1	4	1					6	8	14	2			
194		16	4	7	1	4	1	1					11	8	10	2			
195		6	8	5	1	1	1	6					14	7	7	3			
196		4	10	5	1	1	1	7					11	2	10	10			
197		12	8	6	1	8	1	1					5	3	7	2			
198		5	7	10	1	1	4	1					1	5	12	9			
199		3	10	17	12	3	14	1					3	2	5	8			
200		14	12	9	7	1	6	5					3	2	4	10			
201		30	12	5	20	5	14	1					2	2	5	6			
202		89	10	4	1	2	37	1					8	2	8	10			
203		5	11	7	1	5	5	1					1	2	6	3			
204		19	8	12	1	5	30	1					4	2	11	4			
205		5	9	10	1	2	64	1					7	2	11	2			
206		4	4	11	1	5	18	1					9	6	13	3			
207		32	7	13	5	4	12	1					8	4	9	5			
208		49	8	8	6	4	6	1					3	2	9	3			
209		4	8	15	10	2	17	10					8	3	9	5			
210		26	7	14	1	1	13	10					11	2	13	5			
211		136	32	7	1	1	6	19					16	8	11	5			
212		40	5	9	1	1	13	2					5	2	8	2			
213		13	4	15	1	1	4	11					4	7	2	3			
214		24	35	4	1	13	9	5					8	4	9	2			
215		34	11	5	3	1	1	8					10	2	5	6			
216		36	9	15	4	4	1	8					10	2	10	4			
217		5	5	17	3	12	1	8					1	6	2	4			
218		6	9	4	3	37	4	1					3	16	2	2			
219		31	4	2	1	3	1	1					6	2	2	5			
220		35	6	4	1	1	1	1					3	19	8	4			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
221		5	4	9	1	1	1	1					9	2	8	8		
222		10	15	12	1	1	4	1					9	5	5	7		
223		30	3	4	5	1	5	5					9	2	3	2		
224		7	36	6	10	1	8	1					5	6	8	4		
225		10	16	1	20	5	10	1					7	2	2	9		
226		13	19	9	12	4	1	10					1	2	5	3		
227		1	16	6	2	7	1	6					7	2	3	2		
228		7	5	10	11	9	1	1					7	3	2	6		
229		34	1	5	8	1	5	7					7	3	4	3		
230		14	11	14	8	1	6	1					7	3	7	3		
231		12	5	1	6	3	2	1					6	16	5	3		
232		14	5	4	1	1	7	10					9	8	5	2		
233		30	3	7	1	1	1	6					9	5	2	9		
234		1	8	15	2	1	1	1					8	2	2	2		
235		10	6	9	1	27	1	1					5	3	2	3		
236		1	9	6	1	5	1	7					4	5	16	3		
237		8	3	5	8	21	7	1					5	4	6	6		
238		12	39	3	1	2	1	1					6	4	5	2		
239		10	7	6	1	44	1	1					9	2	2	6		
240		5	17	2	11	4	5	1					6	6	5	8		
241		4	12	2	5	8	2	1					6	2	3	2		
242		11	18	5	2	1	5	2					4	4	3	3		
243		6	11	4	1	1	15	2					11	2	3	4		
244		6	6	6	4	1	25	2					8	3	11	3		
245		7	10	7	10	1	39	7					9	2	1	3		
246		11	2	10	1	1	39	2					7	3	17	2		
247		11	1	6	1	7	12	1					9	2	13	2		
248		62	2	7	8	12	13	1					12	2	5	4		
249		5	6	11	8	1	16	1					12	7	24	2		
250		6	1	12	11	4	4	1					1	8	2	10		
251		11	1	5	1	1	15	1					6	5	2	6		
252		13	6	2	4	6	41	1					8	2	6	7		
253		8	2	6	1	1	17	1					9	1	6	2		
254		10	5	5	1	1	4	1					8	5	2	3		
255		9	2	6	1	9	13	1					1	7	2	2		
256		8	6	12	1	10	62	1					8	6	2	2		
257		11	17	12	1	6	2	1					8	10	3	2		
258		6	17	4	3	9	15	1					8	10	3	2		
259		10	1	7	2	5	16	8					10	3	7	6		
260		35	2	7	5	1	5	4					7	6	2	4		
261		7	2	7	2	1	3	3					11	5	3	2		
262		37	10	5	2	1	2	8					14	9	17	3		
263		7	2	12	6	1	4	1					3	8	15	2		
264		27	4	4	1	10	1	3					3	7	2	2		

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1	
265		32	19	8	3	6	1	1					14	3	28	2			
266		13	20	9	1	2	1	1					7	2	2	4			
267		7	1	4	2	9	1	1					2	2	3	11			
268		1	9	8	8	7	1	1					1	2	2	8			
269		29	2	6	1	8	12	2					6	3	24	5			
270		3	9	9	1	3	1	4					1	2	9	7			
271		1	1	10	1	21	14	3					1	3	6	6			
272		3	16	8	12	3	1	5					7	2	12	5			
273		13	17	4	8	7	11	2					10	2	4	3			
274		4	5	3	2	13	1	1					10	2	4	2			
275		10	39	11	4	4	4	1					2	2	3	8			
276		8	4	6	3	9	1	1					1	1	6	8			
277		53	12	5	1	6	6	6					8	3	13	2			
278		11	9	9	1	9	1	1					4	5	10	6			
279		28	5	6	10	9	1	1					4	13	3	6			
280		5	6	5	6	8	2	1					3	3	3	2			
281		33	11	5	16	3	4	1					6	2	5	2			
282		129	5	10	4	2	7	5					3	4	4	6			
283		7	3	15	4	10	1	7					3	6	5	4			
284		30	7	4	1	1	5	1					2	2	6	3			
285		44	7	16	1	3	4	1					1	3	6	2			
286		17	12	5	1	6	4	1					7	3	9	12			
287		16	13	31	1	2	9	7					4	5	6	9			
288		30	9	4	1	1	1	1					1	3	2	5			
289		27	11	2	1	1	1	1					2	2	3	13			
290		43	11	4	2	8	1	1					1	5	2	6			
291		61	3	10	1	1	1	1					6	11	2	3			
292		47	9	3	2	1	1	1					3	11	7	4			
293		32	8	4	6	5	17	1					2	2	6	12			
294		16	10	3	6	13	3	1					16	6	3	3			
295		91	5	16	5	6	7	1					7	2	2	3			
296		9	5	30	7	9	24	2					10	3	8	3			
297		16	3	4	5	5	7	1					3	3	3	2			
298		10	7	2	20	4	8	1					5	9	7	2			
299		78	36	3	15	3	4	1					8	9	12	3			
300		38	8	3	15	1	1	1					3	2	14	4			
301		31	3	3	8	1	1	5					1	3	8	2			
302		15	12	16	3	15	1	1					9	2	8	3			
303		4	12	4	5	7	1	2					8	2	12	4			
304		25	7	2	1	8	1	1					1	5	13	3			
305		10	10	2	1	13	7	1					7	2	8	8			
306		14	8	13	1	3	8	7					4	2	4	3			
307		3	7	16	6	9	8	6					2	2	7	2			
308		7	9	14	4	1	1	1					21	2	5	2			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
309		13	2	2	2	1	1	1					3	6	9	2		
310		16	11	11	1	1	1	8					10	3	13	4		
311		13	2	13	1	1	9	1					6	8	14	16		
312		10	5	12	1	1	1	1					5	7	6	2		
313		1	3	12	1	6	1	4					17	4	6	5		
314		8	8	11	5	2	5	1					15	5	8	14		
315		9	4	6	8	3	6	9					8	8	5	8		
316		9	16	11	1	16	2	1					1	2	5	5		
317		6	2	7	5	4	4	1					4	8	5	2		
318		11	1	10	1	2	1	1					3	2	9	2		
319		8	9	11	1	17	1	1					16	3	4	2		
320		8	6	2	9	6	1	1					8	4	8	5		
321		1	17	9	6	15	1	1					4	11	11	2		
322		8	4	11	1	16	9	1					2	9	18	2		
323		5	55	10	1	8	11	1					3	2	6	2		
324		9	17	8	1	1	4	9					1	2	11	2		
325		27	1	5	1	5	8	1					16	3	5	10		
326		5	2	5	1	3	12	10					8	7	5	2		
327		5	3	4	1	1	4	1					9	2	5	4		
328		1	3	19	1	1	10	3					6	14	14	2		
329		9	18	4	2	1	4	25					9	4	10	12		
330		12	11	3	4	7	8	2					2	2	12	5		
331		15	6	29	3	1	1	1					1	2	10	4		
332		8	9	2	5	12	1	1					1	2	14	5		
333		12	2	2	1	7	4	1					10	6	9	4		
334		14	1	6	1	11	1	1					11	8	2	6		
335		35	1	4	1	7	1	2					8	6	10	4		
336		3	1	32	7	8	1	5					10	9	6	3		
337		13	5	2	1	1	1	6					3	2	2	14		
338		12	6	4	3	1	13	1					9	8	4	9		
339		84	7	7	1	8	6	2					10	3	5	2		
340		8	2	8	1	13	11	1					8	2	4	6		
341		11	4	2	10	2	4	1					7	2	2	6		
342		12	6	9	3	4	10	1					8	2	6	4		
343		8	4	2	1	11	1	1					8	2	4	4		
344		9	6	5	1	1	1	1					4	3	2	4		
345		9	3	9	3	4	10	17					4	10	15	5		
346		12	6	2	7	1	6	2					2	4	8	3		
347		11	3	7	1	1	2	1					8	5	2	6		
348		11	16	5	1	1	7	1					12	2	2	2		
349		54	6	2	1	1	1	1					9	3	7	6		
350		7	8	4	6	1	1	1					7	2	6	6		
351		8	6	3	9	6	1	1					8	2	3	2		
352		79	4	4	1	4	1	6					7	5	3	2		

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
353		6	7	10	1	5	1	7					6	8	6	2		
354		36	3	10	1	2	6	1					4	11	6	2		
355		7	3	10	1	6	2	1					12	12	12	3		
356		10	4	10	3	9	13	1					10	3	2	14		
357		1	2	3	12	4	4	1					9	3	5	2		
358		2	9	8	2	27	2	1					7	2	4	6		
359		10	7	7	1	13	16	1					12	7	3	7		
360		5	7	6	1	3	13	1					8	4	2	4		
361		13	10	7	1	5	3	1					6	7	27	2		
362		1	9	13	1	15	3	1					9	6	2	2		
363		9	9	9	11	3	19	5					8	5	4	2		
364		8	7	11	1	6	6	1					11	2	11	2		
365		16	6	13	12	12	1	1					7	6	4	2		
366		40	6	3	8	6	4	1					11	5	11	5		
367		17	5	10	10	3	1	1					10	2	13	2		
368		6	10	10	11	1	1	1					6	2	16	4		
369		61	8	4	2	1	1	1					9	5	10	2		
370		10	11	6	1	2	1	11					5	8	4	5		
371		25	8	7	1	1	1	5					11	2	4	5		
372		4	12	5	1	7	12	7					3	6	5	5		
373		3	15	12	1	3	2	3					7	2	3	2		
374		26	6	4	8	1	1	1					8	2	6	3		
375		29	5	24	8	1	9	1					8	2	4	2		
376		14	8	4	1	4	7	8					5	5	5	2		
377		13	7	4	6	10	1	4					9	3	9	5		
378		3	6	4	1	7	1	8					12	9	7	7		
379		3	12	2	1	10	8	7					14	7	5	5		
380		29	7	20	1	5	11	1					7	11	10	4		
381		10	11	13	1	1	1	3					4	4	10	2		
382		8	10	16	18	6	7	1					2	2	10	6		
383		6	6	23	5	1	1	1					4	4	7	3		
384		27	7	4	4	1	6	1					8	2	5	6		
385		81	10	2	4	9	1	1					2	9	11	2		
386		42	7	7	1	1	1	1					5	2	2	3		
387		12	2	27	1	1	1	6					1	6	2	2		
388		5	4	2	1	1	7	2					3	2	7	3		
389		11	6	10	1	1	2	3					4	2	10	2		
390		5	9	17	1	8	1	6					1	4	2	8		
391		11	4	8	5	1	2	2					3	12	2	4		
392		11	3	16	6	1	4	1					1	2	3	2		
393		5	13	5	7	1	7	1					4	3	7	2		
394		7	5	3	1	1	26	1					6	2	3	5		
395		4	18	2	1	3	5	1					4	3	8	3		
396		1	19	1	1	2	7	4					3	9	5	2		

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
397		12	16	2	1	3	10	1					4	2	4	3		
398		7	4	10	1	7	4	1					4	5	2	3		
399		9	4	11	1	1	1	1					7	2	7	3		
400		29	4	12	5	2	1	2					4	2	13	2		
401		14	6	12	2	1	3	1					2	3	14	5		
402		10	20	4	1	12	2	11					4	2	9	2		
403		4	32	2	1	4	6	1					1	5	8	3		
404		7	3	2	1	4	7	10					3	4	7	2		
405		6	19	10	5	1	3	3					16	2	9	3		
406		10	3	5	6	1	1	2					2	3	2	2		
407		5	6	8	8	12	1	3					2	6	11	5		
408		6	3	12	3	6	3	1					3	4	8	2		
409		1	18	9	1	1	6	1					15	4	8	2		
410		14	17	7	3	1	7	1					30	2	6	6		
411		11	8	11	1	4	9	1					6	3	9	5		
412		1	3	5	6	2	1	1					6	2	5	4		
413		9	6	2	1	10	5	9					5	2	7	2		
414		8	2	10	1	5	1	4					1	2	12	2		
415		34	8	14	12	1	1	5					4	4	7	7		
416		11	16	9	6	1	1						3	2	10	6		
417		12	15	3	3	1	1						2	4	12	6		
418		3	6	7	5	6	1						3	2	11	2		
419		5	2	10	1	8	3						9	2	9	6		
420		7	3	8	1	11	1						3	3	14	4		
421		44	6	9	8	1	1						2	2	9	5		
422		2	5	15	1	1	1						5	2	6	4		
423		13	3	6	10	1	1						4	2	5	4		
424		5	2	10	2	1	2						6	3	10	3		
425		10	13	14	3	2	2						8	2	8	8		
426		11	14	4	1	3	1						3	2	12	5		
427		3	10	5	1	2	1						6	2	10	2		
428		10	11	7	1	5	1						1	2	3	2		
429		6	11	12	1	2	12						1	3	10	2		
430		31	7	4	1	1	5						11	9	10	6		
431		6	3	4	6	1	3						7	3	8	6		
432		33	11	24	12	1	1						4	2	5	4		
433		27	5	4	12	1	1						6	4	6	7		
434		16	6	2	6	12	6						17	3	7	3		
435		8	6	12	4	1	1						14	8	7	5		
436		10	11	9	4	8	1						15	9	5	4		
437		9	32	5	7	14	9						7	3	8	2		
438		14	4	2	16	34	1						3	2	15	2		
439		11	11	3	15	1	1						5	6	2	5		
440		11	10	4	17	1	1						3	5	4	2		

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1	
441		12	11	2	2	1	6						1	2	6	2			
442		6	13	12	3	1	11						1	4	4	2			
443		15	9	18	3	1	1						3	3	19	2			
444		1	4	8	2	4	1						14	2	2	2			
445		7	11	3	1	6	1						12	11	7	4			
446		1	7	5	1	8	1						3	2	4	9			
447		8	3	12	1	9	1						5	6	3	3			
448		5	3	25	4	1	1						5	11	4	2			
449		16	28	15	1	1	1						9	5	2	4			
450		14	11	2	5	1	11						3	14	5	5			
451		7	17	6	1	1	1						8	13	3	3			
452		10	5	19	1	28	13						2	10	2	2			
453		11	24	34	4	3	8						6	5	4	8			
454		10	6	32	4	3	14						5	2	2	3			
455		13	3	17	5	6	1						7	7	3	2			
456		5	1	10	1	1	4						3	3	14	3			
457		11	30	3	5	1	1						9	3	2	11			
458		9	1	7	3	1	1						2	9	6	5			
459		8	3	9	1	1	1						3	3	2	9			
460		42	1	2	1	1	1						8	8	19	10			
461		23	2	9	14	7	4						2	8	5	2			
462		13	5	10	1	11	7						8	7	5	6			
463		66	3	3	11	1	1						2	2	6	10			
464		28	1	4	1	1	2						7	2	10	3			
465		5	1	10	4	3	1						3	7	3	3			
466		5	11	6	5	1	5						1	4	13	4			
467		4	4	14	1	7	8						2	4	5	2			
468		15	15	5	1	1	1						7	5	4	4			
469		6	10	6	1	1	1						12	9	6	5			
470		53	10	11	1	9	1						17	8	2	7			
471		78	2	5	1	9	1						6	3	4	8			
472		50	8	10	24	8	2						5	3	3	2			
473		29	7	5		9	2						11	7	3	2			
474		88	2	9		5	4						4	2	2	2			
475		8	5	10		3	5						6	2	4	6			
476		4	6	18		1	1						7	4	5	3			
477		9	9	13		1	1						5	2	8	3			
478		30	5	6		1	1						7	5	2	2			
479		135	10	4		7	1						2	5	17	3			
480		58	14	6		4	1						7	3	17	5			
481		20	9	7		2	7						6	2	17	3			
482		24	12	6		10	8						9	2	5	4			
483		3	16	4		2	8						11	1	5	2			
484		41	6	4		4	1						7	6	4	9			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1	
485		2	9	3		1	1						1	2	2	2			
486		21	12	11		5	1						6	2	6	2			
487		4	10	6		1	6						2	2	13	7			
488		4	7	5		2	1						2	2	6	2			
489		4	6	19		8	1						10	3	4	3			
490		1	11	8		1	3						9	2	8	2			
491		6	5	5		1	7						11	2	9	7			
492		1	10	16		3	3						9	3	10	2			
493		9	7	3		13	2						5	3	2	4			
494		5	10	2		9	1						4	4	11	2			
495		10	12	39		2	1						8	4	11	3			
496		4	10	3		5	5						5	6	9	7			
497		6	8	14		7	14						8	3	5	2			
498		9	6	12		1	5						10	2	10	6			
499		32	12	31		1	1						10	2	8	3			
500		1	6	2		9	4						9	4	6	2			
501		5	4	4		7	1						13	2	6	5			
502		1	32	1		5	1						12	6	8	5			
503		4	31	12		2	1						7	3	4	2			
504		4	17	3		9	1						7	10	7	2			
505		29	2	8		10	13						4	2	15	4			
506		11	8	2		5	6						8	3	4	2			
507		133	3	19		8	1						7	5	2	2			
508		8	12	7		1	1						8	2	7	2			
509		7	27	6		1	1						11	2	15	5			
510		35	16	35		1	9						8	8	9	8			
511		1	3	13		1	6						3	5	8	3			
512		6	4	5		1	10						14	2	15	4			
513		10	11	9		1	4						10	4	38	4			
514		35	11	10		2	4						17	2	13	4			
515		3	21	2		38	4						7	5	14	2			
516		5	7	13		3	6						8	4	4	2			
517		9	7	5		16	1						1	7	2	3			
518		11	7	5		7	1						1	5	10	2			
519		10	5	4		3	1						1	3	9	18			
520		38	10	4		7	1						3	2	3	3			
521		9	12	11		1	1						7	11	7	2			
522		25	12	9		1	1						5	2	5	2			
523		12	9	9		1	21						7	2	13	2			
524		32	7	8		1	14						3	2	4	4			
525		1	11	9		8	2						5	11	12	3			
526		1	4	2		1	6						12	7	10	2			
527		4	4	10		1	4						7	3	2	2			
528		1	2	6		1	16						3	6	4	6			

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
529		1	10	10		7	2						12	4	9	5	
530		1	8	6		5	2						5	3	11	3	
531		7	12	12		10	2						9	2	3	6	
532		5	5	8		5	1						6	7	5	4	
533		18	9	7		3	1						6	2	12	4	
534		14	16	10		5	1						3	6	8	2	
535		24	13	3		1	5						6	4	11	3	
536		2	8	5		3	4						19	4	12	3	
537		14	8	2		1	6						3	2	11	2	
538		10	14	11		13	1						4	2	6	6	
539		55	8	4		4	1						7	2	8	2	
540		35	8	8		11	6						4	3	4	6	
541		7	13	5		1	6						1	3	7	6	
542		3	9	10		6	4						13	2	8	4	
543		11	10	7		6	1						3	2	3	8	
544		3	10	7		1	1						5	3	4	7	
545		1	8	2		3	3						14	2	4	7	
546		1	13	7		1	1						4	2	4	3	
547		1	9	10		1	14						2	22	11	7	
548		5	10	4		1	1						3	2	5	2	
549		4	16	5		1	11						5	1	2	4	
550		1	7	8		13	1						2	2	4	2	
551		8	7	3		5	6						7	2	3	2	
552		6	8	7			1						8	2	10	7	
553		9	11	6			1						4	2	3	6	
554		15	6	2			1						10	5	5	2	
555		1	3	2			1						5	4	4	5	
556		1	29	7			1						8	3	5	2	
557		4	14	4			13						3	2	2	2	
558		2	40	2			13						3	3	4	2	
559		1	3	5									6	4	6	2	
560		12	13	2									3	2	6	2	
561		1	41	2									7	2	30	2	
562		1	11	13									5	6	5	3	
563		4	6	7									4	12	4	3	
564		5	58	7									5	7	9	3	
565		8	18	4									2	2	2	3	
566		7	8	3									7	4	5	2	
567		6	7	2									7	7	4	2	
568		10	17	10									19	7	4	4	
569		6	9	6									15	3	2	6	
570		1	19	2									1	2	6	2	
571		4	7	17									6	2	4	5	
572		1	3	7									6	11	2	2	

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
573		1	3	2									1	2	2	3		
574		10	3	3									15	3	2	4		
575		13	36	8									5	2	2	3		
576		3	29	2									9	2	2	2		
577		12	10	13									6	4	45	3		
578		2	24	12									8	3	5	2		
579		9	10	7									10	10	10	7		
580		11	5	8									6	8	2	2		
581		2	5	7									1	4	15	3		
582		23	9	10									5	10	5	2		
583		2	9	7									4	4	2	6		
584		4	2	9									13	3	11	2		
585		12	12	3									7	2	2	2		
586		13	5	12									5	8	4	2		
587		5	15	5									8	4	8	2		
588		10	10	7									6	6	16	4		
589		13	6	4									7	13	4	2		
590		12	5	11									10	7	16	5		
591		14	5	11									9	9	6	6		
592		13	11	11									8	2	12	3		
593		13	11	11									9	2	3	3		
594		6	5	7									11	7	2	5		
595		1	8	8									3	5	2	12		
596		7	10	7									9	4	7	3		
597		4	8	9									5	4	4	10		
598		1	11	6									7	2	4	3		
599		9	13	12									5	13	10	3		
600		1	12	14									8	2	4	2		
601		1	14	4									8	4	3	6		
602		6	5	3									9	5	5	2		
603		8	7	9									6	3	5	3		
604		13	10	15									10	2	9	2		
605		5	5	4									9	3	11	3		
606		2	7	14									7	4	9	2		
607		6	7	6									8	2	4	2		
608		13	12	15									11	4	11	7		
609		4	9	4									7	2	9	6		
610		1	7	2									7	2	6	2		
611		2	24	3									11	2	8	2		
612		8	18	7									10	2	5	2		
613		10	27	10									8	2	10			
614		33	41	3									7	3	6			
615		1	4	4									4	2	2			
616		9	15	4									9	3	7			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
617		1	10	40									9	5	15			
618		2	18	7									9	2	13			
619		1	41	5									10	2	4			
620		1	8	5									7	7	11			
621		1	15	6									8	2	14			
622		8	4	3									15	2	11			
623		3	10	4									10	3	7			
624		16	2	6									4	4	7			
625		2	7	4									7	5	12			
626		2	1	5									6	2	12			
627		2	11	3									5	2	8			
628		4	5	2									3	2	6			
629		15	12	13									8	2	7			
630		7	2	15									9	3	8			
631		3	4	15									10	5	15			
632		17	1	3									8	2	9			
633		23	25	11									11	2	5			
634		2	15	12									10	2	3			
635		11	16	13									3	3	2			
636		8	15	12									5	10	7			
637		1	4	11									5	2	2			
638		5	17	8									6	2	9			
639		8	7	11									10	3	8			
640		4	4	7									8	6	13			
641		1	6	11									6	2	9			
642		1	12	13									9	5	6			
643		1	14	2									10	4	6			
644		10	11	10									9	2	9			
645		1	9	11									5	5	11			
646		15	8	10									4	4	14			
647		8	12	8									7	2	8			
648		11	4	6									7	2	7			
649		9	9	2									4	2	11			
650		9	11	2									4	2	12			
651		1	8	3									4	15	9			
652		1	8	28									11	16	8			
653		9	7	3									11	6	3			
654		2	9	17									2	5	2			
655		3	7	6									3	2	3			
656		2	10	4									3	3	15			
657		8	3	12									11	7	4			
658		10	8	2									9	4	2			
659		1	8	7									8	2	14			
660		6	12	7									21	4	5			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
661		8	9	2									14	2	18			
662		1	9	7									4	2	8			
663		2	10	5									1	10	18			
664		1	10	7									4	6	2			
665		9	3	7									2	5	6			
666		6	9	10									3	3	2			
667		1	6	8									3	5	2			
668		4	7	10									5	2	6			
669		5	8	2									7	3	5			
670		7	6	8									4	3	2			
671		3	3	7									2	10	2			
672		15	15	6									15	9	3			
673		7	3	7									9	8	4			
674		12	15	13									27	2	2			
675		13	6	9									5	6	19			
676		9	10	11									27	5	5			
677		20	4	12									3	2	2			
678		16	4	3									12	2	24			
679		34	6	11									19	2	6			
680		11	3	14									1	2	2			
681		4	2	5									8	7	5			
682		7	2	5									8	2	4			
683		3	15	7									9	8	3			
684		1	17	7									1	6	2			
685		1	4	9									4	16	4			
686		2	11	11									24	5	11			
687		7	5	5									5	2	4			
688		8	4	2									6	8	2			
689		8	30	8									15	4	17			
690		4	2	5									9	2	11			
691		1	4	3									19	6	27			
692		1	3	17									2	5	6			
693		1	8	15									4	6	6			
694		3	4	4									1	2	3			
695		8	12	4									17	5	6			
696		11	11	7									6	5	6			
697		7	5	32									7	6	5			
698		6	8	16									9	2	3			
699		5	11	7									2	2	3			
700		9	6	2									1	2	3			
701		1	14	3									8	3	9			
702		1	9	8									4	6	2			
703		12	6	6									8	3	18			
704		9	12	3									5	2	10			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
705		2	6	2									8	4	5			
706		7	6	9									4	2	2			
707		1	5	3									8	2	4			
708		1	11	7									2	2	15			
709		1	10	6									5	2	2			
710		9	11	2									5	4	2			
711		1	8	11									2	2	2			
712		1	13	8									3	7	12			
713		1	10	3									1	4	5			
714		1	4	6									17	2	6			
715		5	8	7									10	2	2			
716		2	8	5									10	2	2			
717		4	9	12									13	4	16			
718		7	9	3									1	2	8			
719		6	12	8									1	5	13			
720		2	7	11									1	2	14			
721		7	9	13									1	13	18			
722		1	15	8									1	2	15			
723		1	3	12									1	2	13			
724		1	6	9									2	5	12			
725		12	6	7									2	4	13			
726		5	34	6									1	10	6			
727		4	9	14									6	10	2			
728		2	40	9									4	3	8			
729		1	3	7									6	2	9			
730		5	4	11									7	19	5			
731		14	9	2									5	9	10			
732		8	3	6									4	2	2			
733		6	5	9									6	2	5			
734		1	5	10									11	3	13			
735		3	5	5									8	2	12			
736		6	13	6									3	2	11			
737		8	3	3									8	4	6			
738		6	29	6									5	2	2			
739		5	8	10									8	2	2			
740		11	8	3									14	3	4			
741		9	8	6									10	2	3			
742		1	2	4									2	5	4			
743		1	2	11									8	2	5			
744		1	4	2									7	8	6			
745		10	2	3									7	2	11			
746		13	2	2									6	4	15			
747		3	13	6									7	3	12			
748		1	14	4									5	5	8			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
749		1	8	2									7	8	10			
750		1	5	38									3	2	11			
751		11	10	11									7	6	6			
752		2	12	4									5	8	4			
753		2	11	3									5	4	12			
754		2	7	9									15	7	15			
755		2	3	6									11	6	12			
756		3	11	5									4	3	5			
757		3	5	3									6	4	8			
758		4	5	5									11	2	8			
759		3	12	1									10	3	10			
760		1	11	2									4	5	14			
761		1	12	15									5	6	9			
762		1	13	9									14	6	11			
763		1	4	1									6	10	16			
764		1	11	14									10	6	10			
765		1	5	26									9	3	10			
766		15	11	17									6	2	6			
767		1	12	3									4	4	5			
768		15	12	11									6	5	5			
769		38	7	3									10	5	12			
770		13	6	3									8	2	7			
771		3	10	4									7	13	3			
772		1	8	2									9	6	2			
773		1	4	5									9	4	13			
774		1	29	2									6	6	7			
775		10	4	7									10	4	9			
776		8	31	2									9	2	4			
777		7	11	6									6	4	3			
778		3	4	11									8	4	4			
779		8	5	2									16	2	3			
780		9	5	4									13	5	6			
781		10	17	5									9	2	9			
782		5	3	4									2	2	6			
783		1	8	10									3	2	6			
784		1	2	10									1	7	2			
785		1	8	12									2	2	33			
786		1	11	13									1	7	11			
787		15	3	9									1	2	5			
788		3	6	10									2	2	7			
789		6	6	10									7	3	15			
790		9	9	5									2	2	14			
791		26	10	3									2	2	5			
792		2	13	10									2	4	18			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
793		2	9	5									8	2	18			
794		11	11	7									3	2	3			
795		5	12	17									4	2	2			
796		1	6	7									2	3	4			
797		1	9	5									5	2	3			
798		5	11	7									9	6	2			
799		1	5	13									3	6	2			
800		3	5	4									5	2	2			
801		4	6	8									16	4	6			
802		1	10	7									3	3	12			
803		10	5	9									1	2	4			
804		9	5	8									1	4	3			
805		12	11	5									2	3	6			
806		1	7	3									14	2	6			
807		1	10	3									14	4	18			
808		3	12	2									3	2	42			
809		4	11	5									1	3	3			
810		1	10	12									3	2	5			
811		12	11	5									5	4	7			
812		1	7	4									4	10	6			
813		1	8	11									16	3	7			
814		10	4	30									4	4	2			
815		9	17	2									3	2	5			
816		6	16	2									2	6	17			
817		5	4	5									4	2	16			
818		4	33	16									3	2	31			
819		6	34	7									4	4	2			
820		1	12										3	4	5			
821		1	12										6	2	2			
822		7	3										6	2	8			
823		3	3										5	2	18			
824		4	3										13	4	4			
825		5	20										14	2	9			
826		14	16										4	2	4			
827		6	6										8	2	2			
828		6	2										5	6	9			
829		1	10										11	9	23			
830		5	18										2	9	16			
831		5	4										1	9	42			
832		3	6										25	6	21			
833		1	9										3	5	3			
834		1	9										2	4	6			
835		1	7										15	2	4			
836		9	5										6	9	11			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
837		2	7										3	7	4			
838		15	5										4	6	9			
839		5	3										2	6	4			
840		5	10										11	5	13			
841		10	8										3	2	15			
842		4	13										6	2	5			
843		4	3										8	2	7			
844		10	6										16	8	11			
845		1	11										4	2	8			
846		5	12										5	5	6			
847		1	5										8	3	5			
848		10	8										19	5	10			
849		6	8										3	2	5			
850		4	7										3	4	4			
851		13	14										8	3	7			
852		11	12										18	8	6			
853		7	10										8	9	4			
854		4	11										1	2	5			
855		4	5										9	3	6			
856		5	7										2	13	13			
857		4	9										15	3	8			
858		6	9										6	6	8			
859		1	6										6	3	15			
860		1	4										7	4	13			
861		1	6										1	3	3			
862		1	5										1	2	8			
863		1	6										18	3	13			
864		5	3										1	3	5			
865		35	12										6	3	11			
866		28	8										11	6	13			
867		51	4										14	3	14			
868		21	3										11	3	8			
869		5	4										5	3	6			
870		3	5										1	2	4			
871		2	15										3	4	8			
872		1	3										3	5	2			
873		1	3										2	2	9			
874		5	40										8	4	11			
875		1	13										1	3	12			
876		5	30										6	3	6			
877		5	4										1	2	9			
878		9	3										4	13	13			
879		1	8										7	15	10			
880		1	5										1	5	11			

Start Number		Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
881		3	5										9	3	13			
882		10	2										1	2	6			
883		8	7										6	3	9			
884		9	2										8	2	9			
885		10	17										8	2	5			
886		13	7										5	2	8			
887		6	3										4	4	7			
888		8	18										7	9	12			
889		9	17										4	3	6			
890		4	9										2	2	7			
891		1	3										6	5	11			
892		1	8										10	4	4			
893		14	6										9	2	8			
894		3	5										4	3	9			
895		13	2										1	3	8			
896		1	2										7	2	2			
897		6	4										7	5	4			
898		5	5										5	4	5			
899		1	5										7	13	30			
900		2	7										11	11	10			
901		4	6										9	8	2			
902		1	7										6	2	3			
903		1	11										7	2	4			
904		1	3										3	2	24			
905		1	6										6	2	4			
906		1	8										4	13	2			
907		7	5										9	10	2			
908		24	9										7	11	10			
909		3	10										5	2	5			
910			13										6	2	3			
911			13										5	6	4			
912			11										9	2	8			
913			12										9	2	33			
914			13										8	9	2			
915			8										5	9	2			
916			9										4	3	41			
917			11										2	8	2			
918			10										10	10	12			
919			9										5	7	2			
920			7										6	5	16			
921			7										6	2	17			
922			8										5	7	3			
923			9										2	4	2			
924			11										10	6	4			

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
925		5										9	5	7			
926		9										9	2	17			
927		7										10	3	17			
928		4										2	6	2			
929		10										11	4	5			
930		8										8	5	18			
931		8										10	2	17			
932		4										5	7	19			
933		6										5	3	17			
934		4										4	2	18			
935		12										24	3	6			
936		3										3	3	27			
937		16										7	2	41			
938		32										2	3	3			
939		12										8	4	60			
940		13										2	14	41			
941		26										4	4	15			
942		28										5	2	14			
943		8										2	2	15			
944												9	2	2			
945												3	3	41			
946												3	2	17			
947												15	13	61			
948												7	2	8			
949												2	2	6			
950												2	3	14			
951												6	2	4			
952												1	3	3			
953												7	4	7			
954												10	2	3			
955												10	3	9			
956												2	2	2			
957												1	2	11			
958												33	4	11			
959												5	2	6			
960												3	2	6			
961												3	6	2			
962												3	3	10			
963												1	6	6			
964												3	2	4			
965												5	5	2			
966												18	5	2			
967												15	2	8			
968												29	10	14			

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
969													14	4	14		
970													17	2	14		
971													2	4	11		
972													3	5	13		
973													5	5	8		
974													4	4	2		
975													5	8	10		
976													3	4	13		
977													8	2	9		
978													10	2	2		
979													3	8	6		
980													5	6	2		
981													8	3	2		
982													3	2	11		
983													1	6	6		
984													8	5	6		
985													4	2	11		
986													9	2	12		
987													3	3	2		
988													5	2	8		
989													1	2	13		
990													4	2	12		
991													5	2	8		
992													5	3	11		
993													16	2	12		
994													4	4	9		
995													16	2	12		
996													13	2	9		
997													2	4	6		
998													2	2	12		
999													5	2	9		
1000													4	3	15		
1001													9	2	4		
1002													4	5	12		
1003													4	2	8		
1004													4	7	10		
1005													7	2	9		
1006													2	4	9		
1007													7	3	11		
1008													2	3	10		
1009													6	2	10		
1010													2	2	2		
1011													1	3	8		
1012													4	2	3		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1013													2	6	7		
1014													3	2	3		
1015													1	2	10		
1016													10	2	5		
1017													4	2	6		
1018													8	2	12		
1019													1	8	4		
1020													5	2	10		
1021													5	2	2		
1022													10	2	10		
1023													5	2	8		
1024													8	2	2		
1025													1	10	5		
1026													9	7	8		
1027													2	5	5		
1028													16	5	4		
1029													9	2	6		
1030													2	14	6		
1031													2	8	4		
1032													1	7	2		
1033													2	3	2		
1034													10	7	2		
1035													12	7	8		
1036													9	4	6		
1037													1	2	15		
1038													9	11	2		
1039													9	2	5		
1040													11	6	4		
1041													3	10	15		
1042													41	4	6		
1043													8	5	5		
1044													10	10	2		
1045													10	3	8		
1046													8	6	5		
1047													4	7	6		
1048													8	5	2		
1049													12	3	3		
1050													4	2	4		
1051													8	5	5		
1052													2	4	17		
1053													5	3	2		
1054													8	11	3		
1055													5	2	4		
1056													8	8	4		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1057													10	2	9		
1058													10	2	4		
1059													1	5	2		
1060													6	2	5		
1061													4	2	2		
1062													5	2	11		
1063													9	2	6		
1064													11	5	6		
1065													12	2	3		
1066													6	2	8		
1067													7	2	2		
1068													9	3	16		
1069													13	4	6		
1070													8	2	18		
1071													4	2	14		
1072													8	2	3		
1073													11	2	6		
1074													11	2	5		
1075													5	4	11		
1076													4	2	2		
1077													7	4	5		
1078													7	2	10		
1079													6	4	2		
1080													8	2	3		
1081													6	5	6		
1082													13	2	8		
1083													5	5	2		
1084													10	6	5		
1085													6	4	4		
1086													9	2	3		
1087													10	3	5		
1088													6	5	2		
1089													24	2	6		
1090													9	3	2		
1091													11	3	2		
1092													9	2	4		
1093													1	2	2		
1094													8	10	2		
1095													2	2	11		
1096													4	9	6		
1097													1	3	8		
1098													5	2	4		
1099													1	7	6		
1100													6	2	4		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1101													2	2	15		
1102													1	2	12		
1103													1	5	7		
1104													2	2	4		
1105													9	2	10		
1106													5	3	12		
1107													2	7	12		
1108													7	10	9		
1109													15	2	2		
1110													13	2	5		
1111													12	4	3		
1112													36	2	14		
1113													4	7	9		
1114													8	2	6		
1115													5	3	13		
1116													24	2	7		
1117													18	7	6		
1118													3	5	3		
1119													7	2	10		
1120													6	2	9		
1121													8	9	11		
1122													4	6	12		
1123													4	2	4		
1124													1	3	12		
1125													32	9	9		
1126													15	2	14		
1127													4	5	13		
1128													30	8	8		
1129													4	2	10		
1130													3	13	7		
1131													5	5	2		
1132													6	2	9		
1133													1	11	9		
1134													15	2	10		
1135													4	3	10		
1136													7	6	14		
1137													5	4	15		
1138													8	3	4		
1139													5	2	10		
1140													4	6	5		
1141													4	2	2		
1142													4	2	5		
1143													4	2	6		
1144													3	2	9		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1145													3	2	4		
1146													3	6	4		
1147													6	4	2		
1148													5	3	17		
1149													10	2	5		
1150													2	2	18		
1151													7	3	6		
1152													9	2	2		
1153													1	14	18		
1154													9	10	17		
1155													3	5	4		
1156													9	2	17		
1157													7	2	7		
1158													2	2	4		
1159													8	2	5		
1160													2	2	2		
1161													12	2	2		
1162													1	4	5		
1163													1	2	4		
1164													4	2	7		
1165													8	5	8		
1166													15	8	3		
1167													5	4	5		
1168													4	2	12		
1169													11	2	5		
1170													10	2	2		
1171													8	2	2		
1172													9		3		
1173													3		2		
1174													11		2		
1175													12		14		
1176													12		2		
1177													10		7		
1178													6		7		
1179													12		3		
1180													9		6		
1181													5		2		
1182													9		4		
1183													11		2		
1184													6		4		
1185													8		4		
1186													9		5		
1187													14		18		
1188													9		19		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1189												6		17			
1190												8		8			
1191												5		3			
1192												10		10			
1193												7		12			
1194												9		2			
1195												6		7			
1196												3		3			
1197												10		4			
1198												13		11			
1199												4		7			
1200												7		11			
1201												5		7			
1202												6		5			
1203												9		5			
1204												7		6			
1205												9		13			
1206												11		7			
1207												7		6			
1208												3		3			
1209												5		3			
1210												7		9			
1211												7		15			
1212												8		2			
1213												5		2			
1214												8		9			
1215												5		15			
1216												5		13			
1217												6		8			
1218												10		6			
1219												7		15			
1220												1		38			
1221												5		13			
1222												1		15			
1223												11		9			
1224												5		8			
1225												11		9			
1226												7		5			
1227												4		5			
1228												9		13			
1229												11		5			
1230												10		13			
1231												11		10			
1232												7		2			

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1233													5		4		
1234													11		2		
1235													11		2		
1236													12		3		
1237													15		9		
1238													9		11		
1239													4		6		
1240													8		4		
1241													9		13		
1242													8		10		
1243													3		13		
1244													1		14		
1245													8		12		
1246													4		9		
1247													6		3		
1248													7		8		
1249													4		6		
1250													7		9		
1251													7		12		
1252													2		3		
1253													4		6		
1254													15		2		
1255													4		2		
1256													2		4		
1257													1		5		
1258													41		10		
1259													3		2		
1260													6		9		
1261													4		3		
1262													4		5		
1263													4		28		
1264													5		21		
1265													3		2		
1266													4		2		
1267													2		3		
1268													7		4		
1269													3		7		
1270													40		3		
1271													4		3		
1272													11		2		
1273													1		4		
1274													4		3		
1275													7		4		
1276													4		6		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1277												6		31			
1278												3		5			
1279												5		6			
1280												10		9			
1281												3		7			
1282												39		3			
1283												6		2			
1284												17		5			
1285												4		2			
1286												13		19			
1287												8		6			
1288												16		2			
1289												5		4			
1290												6		3			
1291												9		17			
1292												5		4			
1293												4		3			
1294												5		4			
1295												5		2			
1296												4		15			
1297												4		3			
1298												3		8			
1299												6		5			
1300												7		3			
1301												2		3			
1302												8		2			
1303												4		2			
1304												3		6			
1305												5		3			
1306												2		4			
1307												5		7			
1308												1		7			
1309												6		7			
1310												18		2			
1311												3		2			
1312												16		7			
1313												7		2			
1314												1		4			
1315												2		6			
1316												3		10			
1317												1		11			
1318												1		6			
1319												1		4			
1320												1		10			

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1321													1		8		
1322													3		4		
1323													6		7		
1324													12		9		
1325													7		5		
1326													11		2		
1327													8		7		
1328													13		15		
1329													9		11		
1330													9		4		
1331													2		11		
1332													6		13		
1333													5		5		
1334													5		5		
1335													7		11		
1336													9		10		
1337													9		8		
1338													5		4		
1339													2		4		
1340													10		2		
1341													12		15		
1342													10		8		
1343													10		6		
1344													10		4		
1345													9		2		
1346													12		8		
1347													11		2		
1348													8		10		
1349													2		9		
1350													1		13		
1351													11		7		
1352													11		6		
1353													11		2		
1354													1		6		
1355													7		11		
1356													7		15		
1357													8		5		
1358													6		7		
1359													4		12		
1360													10		12		
1361													10		9		
1362													11		4		
1363													3		8		
1364													8		3		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1365													10		3		
1366													10		2		
1367													6		12		
1368													5		2		
1369													10		2		
1370													14		15		
1371													7		6		
1372													7		3		
1373													5		13		
1374													11		5		
1375													9		2		
1376													5		6		
1377													8		13		
1378													7		5		
1379													6		8		
1380													8		14		
1381													5		3		
1382													10		2		
1383													12		10		
1384													5		3		
1385													7		2		
1386													8		19		
1387													9		6		
1388													9		2		
1389													13		2		
1390													15		15		
1391													4		5		
1392													17		3		
1393													9		4		
1394													32		2		
1395													2		2		
1396													4		2		
1397													4		3		
1398													6		2		
1399													5		5		
1400													5		8		
1401													4		5		
1402													5		12		
1403													20		10		
1404													5		5		
1405													19		29		
1406													4		2		
1407													5		4		
1408													4		18		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1409													7		5		
1410													5		3		
1411													5		20		
1412													15		17		
1413													7		6		
1414													4		5		
1415													3		17		
1416													16		5		
1417													15		9		
1418													5		16		
1419													6		38		
1420													1		5		
1421													23		7		
1422													5		2		
1423													1		9		
1424													8		2		
1425													19		15		
1426													18		5		
1427													7		4		
1428													4		11		
1429													5		8		
1430													28		8		
1431													5		10		
1432													7		7		
1433													6		4		
1434													3		18		
1435													4		10		
1436													3		4		
1437													11		8		
1438													3		4		
1439													7		13		
1440													16		6		
1441													8		2		
1442													2		7		
1443													3		2		
1444													4		15		
1445													12		2		
1446													16		9		
1447													1		8		
1448													9		8		
1449													13		5		
1450													11		3		
1451													9		5		
1452													10		12		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1453													7		8		
1454													7		14		
1455													4		10		
1456													4		3		
1457													4		7		
1458													10		13		
1459													6		8		
1460													3		11		
1461													4		13		
1462													8		6		
1463													9		6		
1464													5		9		
1465													15		2		
1466													9		4		
1467													6		12		
1468													7		6		
1469													10		10		
1470													4		12		
1471													7		10		
1472													6		8		
1473													4		13		
1474													3		3		
1475													8		11		
1476													10		12		
1477													9		7		
1478													8		9		
1479													14		8		
1480													11		14		
1481													7		7		
1482													7		5		
1483													5		10		
1484													1		6		
1485													6		9		
1486													8		6		
1487													10		9		
1488													6		4		
1489													3		6		
1490													6		5		
1491													6		8		
1492													8		10		
1493													8		4		
1494													5		3		
1495													5		3		
1496													6		6		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1497													10		17		
1498													8		16		
1499													6		5		
1500													8		7		
1501													10		3		
1502													9		2		
1503													9		8		
1504													5		2		
1505													10		4		
1506													10		16		
1507													9		5		
1508													11		2		
1509													10		2		
1510													8		6		
1511													3		4		
1512													9		18		
1513													5		7		
1514													9		6		
1515													15		14		
1516													20		9		
1517													18		3		
1518													10		3		
1519													14		16		
1520													13		14		
1521													12		5		
1522													6		2		
1523													2		16		
1524													10		2		
1525													7		7		
1526													6		3		
1527													4		5		
1528													2		2		
1529													18		3		
1530													19		40		
1531													9		2		
1532													27		15		
1533													3		2		
1534													6		18		
1535													13		6		
1536													29		5		
1537													1		10		
1538													8		2		
1539													8		5		
1540													8		43		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1541												1		41			
1542												4		7			
1543												3		3			
1544												17		22			
1545												5		18			
1546												6		33			
1547												4		3			
1548												15		2			
1549												9		2			
1550												19		3			
1551												2		15			
1552												4		19			
1553												1		18			
1554												4		9			
1555												11		4			
1556												5		3			
1557												5		2			
1558												5		3			
1559												7		2			
1560												9		7			
1561												8		2			
1562												5		2			
1563												5		3			
1564												11		3			
1565												5		11			
1566												13		3			
1567												50		5			
1568												3		2			
1569												19		3			
1570												12		8			
1571												12		9			
1572												2		2			
1573												5		3			
1574												2		12			
1575												2		7			
1576												2		6			
1577												7		2			
1578												8		7			
1579												3		7			
1580												6		4			
1581												9		6			
1582												4		11			
1583												10		9			
1584												8		9			

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1585													10		12		
1586													6		2		
1587													8		8		
1588													9		6		
1589													8		7		
1590													3		4		
1591													10		6		
1592													7		2		
1593													1		7		
1594													8		13		
1595													8		4		
1596													8		11		
1597													14		13		
1598													10		14		
1599													2		5		
1600													8		12		
1601													7		6		
1602													7		1		
1603													6		12		
1604													7		7		
1605													12		11		
1606													12		12		
1607													9		10		
1608													10		11		
1609													3		16		
1610													9		7		
1611													4		11		
1612													6		9		
1613													8		10		
1614													11		14		
1615													12		3		
1616													16		6		
1617													12		5		
1618													4		7		
1619													7		9		
1620													11		11		
1621													10		5		
1622													3		10		
1623													8		10		
1624													9		8		
1625													11		10		
1626													6		7		
1627													6		7		
1628													9		10		

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1629													9		3		
1630													7		8		
1631													3		5		
1632													8		8		
1633													8		13		
1634													5		12		
1635													14		2		
1636													12		3		
1637													29		5		
1638													6		6		
1639													22		3		
1640													8		18		
1641													12		45		
1642													41		10		
1643													4		2		
1644													4		8		
1645													4		12		
1646													6		3		
1647													3		16		
1648													4		4		
1649													4		4		
1650													3		7		
1651													3		2		
1652													3		5		
1653													15		15		
1654													2		2		
1655													1		4		
1656													25		3		
1657													3		2		
1658													2		2		
1659													25		4		
1660													14				
1661													9				
1662													6				
1663													9				
1664													15				
1665													5				
1666													3				
1667													2				
1668													4				
1669													4				
1670													7				
1671													6				
1672													5				

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1673													4				
1674													3				
1675													5				
1676													4				
1677													9				
1678													5				
1679													4				
1680													3				
1681													7				
1682													4				
1683													7				
1684													2				
1685													2				
1686													4				
1687													3				
1688													4				
1689													1				
1690													15				
1691													6				
1692													1				
1693													5				
1694													3				
1695													3				
1696													16				
1697													7				
1698													3				
1699													8				
1700													40				
1701													8				
1702													9				
1703													10				
1704													5				
1705													41				
1706													8				
1707													6				
1708													9				
1709													10				
1710													9				
1711													4				
1712													14				
1713													17				
1714													4				
1715													9				
1716													7				

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1717													8				
1718													7				
1719													9				
1720													7				
1721													9				
1722													10				
1723													6				
1724													9				
1725													6				
1726													10				
1727													8				
1728													13				
1729													3				
1730													5				
1731													8				
1732													10				
1733													10				
1734													1				
1735													6				
1736													1				
1737													2				
1738													1				
1739													2				
1740													9				
1741													11				
1742													5				
1743													4				
1744													6				
1745													9				
1746													8				
1747													7				
1748													9				
1749													5				
1750													6				
1751													6				
1752													6				
1753													2				
1754													5				
1755													9				
1756													9				
1757													11				
1758													11				
1759													13				
1760													8				

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1761													10				
1762													6				
1763													3				
1764													7				
1765													3				
1766													5				
1767													6				
1768													8				
1769													5				
1770													11				
1771													7				
1772													5				
1773													26				
1774													1				
1775													1				
1776													1				
1777													1				
1778													4				
1779													1				
1780													10				
1781													10				
1782													5				
1783													11				
1784													10				
1785													10				
1786													12				
1787													4				
1788													2				
1789													1				
1790													7				
1791													3				
1792													5				
1793													1				
1794													14				
1795													5				
1796													8				
1797													2				
1798													4				
1799													4				
1800													1				
1801													3				
1802													1				
1803													4				
1804													2				

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1805													1				
1806													1				
1807													2				
1808													8				
1809													5				
1810													1				
1811													18				
1812													13				
1813													13				
1814													4				
1815													4				
1816													5				
1817													4				
1818													7				
1819													6				
1820													2				
1821													7				
1822													21				
1823													7				
1824													6				
1825													4				
1826													7				
1827													20				
1828													20				
1829													8				
1830													5				
1831													7				
1832													11				
1833													16				
1834													6				
1835													6				
1836													8				
1837													4				
1838													4				
1839													1				
1840													1				
1841													5				
1842													17				
1843													11				
1844													3				
1845													16				
1846													29				
1847													16				
1848													6				

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1849													3				
1850													2				
1851													14				
1852													6				
1853													16				
1854													8				
1855													2				
1856													5				
1857													1				
1858													1				
1859													14				
1860													16				
1861													1				
1862													5				
1863													5				
1864													9				
1865													3				
1866													8				
1867													2				
1868													5				
1869													2				
1870													5				
1871													1				
1872													6				
1873													4				
1874													8				
1875													3				
1876													3				
1877													17				
1878													6				
1879													10				
1880													13				
1881													6				
1882													6				
1883													4				
1884													11				
1885													6				
1886													10				
1887													12				
1888													5				
1889													7				
1890													12				
1891													8				
1892													7				

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1893												5					
1894												9					
1895												10					
1896												1					
1897												6					
1898												3					
1899												6					
1900												6					
1901												8					
1902												11					
1903												10					
1904												7					
1905												4					
1906												1					
1907												3					
1908												9					
1909												2					
1910												8					
1911												8					
1912												1					
1913												7					
1914												8					
1915												5					
1916												8					
1917												2					
1918												5					
1919												6					
1920												12					
1921												12					
1922												2					
1923												8					
1924												1					
1925												3					
1926												8					
1927												10					
1928												8					
1929												6					
1930												4					
1931												6					
1932												10					
1933												10					
1934												4					
1935												10					
1936												8					

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1937													2				
1938													9				
1939													11				
1940													8				
1941													4				
1942													7				
1943													8				
1944													4				
1945													7				
1946													8				
1947													10				
1948													13				
1949													10				
1950													1				
1951													1				
1952													9				
1953													10				
1954													11				
1955													3				
1956													11				
1957													10				
1958													9				
1959													2				
1960													3				
1961													4				
1962													2				
1963													3				
1964													2				
1965													2				
1966													3				
1967													16				
1968													2				
1969													11				
1970													11				
1971													5				
1972													3				
1973													2				
1974													1				
1975													4				
1976													4				
1977													4				
1978													2				
1979													5				
1980													4				

Start Number	Bluegrass 3	Brown 5	Brown 6	Brown 7	Brown 8	Brown 9	Brown 10	Brown 11	Cane Run 11	Haefling	Paddys Run 11	Paddys Run 12	Paddys Run 13	Trimble Co 08	Trimble Co 09	Trimble Co 10	Zorn 1
1981												6					
1982												2					
1983												1					
1984												6					
1985												4					
1986												6					
1987												2					
1988												1					
1989												5					
1990												2					
1991												3					
1992												1					
1993												5					
1994												9					
1995												7					
1996												8					
1997												5					
1998												3					
1999												7					
2000												6					
2001												39					
2002												16					

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 45

Witness: Elizabeth J. McFarland

Q-45. Reference IRP vol. 1, p. 8-12, Table 8-7. Provide the costs for the Solar Share that were previously redacted since the bids have been analyzed and a contractor ultimately chosen.

A-45. See "Table 8-7: Capital Costs" on page 8-12 of the IRP, Volume I. This information is being produced on a confidential basis and subject to the Companies' joint petition for confidential protection filed October 19, 2018, and the terms of the Confidentiality Agreement between the Companies and the Kentucky Office of the Attorney General, Office of Rate Intervention, executed August 30, 2019.

CONFIDENTIAL INFORMATION REDACTED

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 46

Witness: Stuart A. Wilson

Q-46. Reference IRP vol. 1, p. 8-12, Table 8-8.

a. Provide a breakdown of the "Variable and Fixed O&M Costs," between fixed and variables costs.

b. Based on the costs provided as "variable" in response to 47 (a), above, provide a further breakdown of the variable expenses between expenses related to items that vary with usage, like fuel, and costs that vary with the number of starts, such as long-term inspection and overhaul expenses.

c. Provide the calculations for costs categories for "Average Variable Production Costs."

A-46. a. A breakdown of the variable and fixed O&M costs in millions of dollars is provided in the table below, which is being provided under seal and subject to a joint petition for confidential treatment.

	Fixed	Variable
2018	[redacted]	
2019		
2020		
2021		
2022		
2023		
2024		
2025		
2026		
2027		
2028		
2029		
2030		
2031		
2032		
2033		

b. A breakdown of the variable costs in part (a) in millions of dollars is provided in the table below, which is being provided under seal and subject to a joint petition for confidential treatment.

	Usage	Starts
2018	[redacted]	
2019		
2020		
2021		
2022		
2023		
2024		
2025		
2026		
2027		
2028		
2029		
2030		
2031		
2032		
2033		

c. Average variable production costs in cents/kWh reflect the variable costs provided in part (a) divided by total generation in each year.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 47

Witness: Stuart A. Wilson

Q-47. Reference IRP vol. 1, p. 8-13, Table 8-9.

a. Explain the calculation and determination of "Off-System Sales" for the years 2018 through 2033.

b. Explain whether the off-system sales amounts for 2018 and 2019 are correct, or are expected to be accurate.

A-47.

a. Off-system sales volumes were estimated using the results of the Companies' production cost model (PROSYM). In PROSYM, lower-cost generation resources are first allocated to serve native load. Once native loads are met, off-system sales may be made from available higher-cost generation resources that are projected to dispatch at a cost lower than the forecasted market electricity price.

b. The table below shows the comparison of off-system sales volumes for 2018-2019 from Table 8-9 with actual off-system sales. Note that the actual number for 2019 only includes off-system sales up to October 8. Given that there are more than two months remaining in 2019, the Companies expect that the actual off-system sales volumes in 2019 will be higher than the forecast.

Off-System Sales (GWh)	**2018**	**2019**
Forecast	613	260
Actual	669	258 (year-to-date 10/8/19)

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 48

Witness: Robert M. Conroy

Q-48. Reference IRP vol. 1, p. 8-28, "Electric Transportation." Explain whether the Companies have commissioned or completed any studies relating to the electrification of mass transit, such as city buses.

A-48. The Companies engaged Black & Veatch Management Consulting, LLC to support an electric bus collaborative process per the Stipulation and Recommendation in Case Nos. 2016-00370 and 2016-00371. Both Louisville Metro and Lexington Fayette Urban County Government were actively involved in the collaboration. The process per the Stipulation and Recommendation was to focus on "economical deployment of electric bus infrastructure ... as well as possible cost-based rate structures …." As the collaborative progressed, the parties provided input to the study, but the formal study was not finalized.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 49

Witness: Stuart A. Wilson

Q-49. Reference IRP filing vol. 2, the "Electric Sales & Demand Forecast Process."

a. Identify any and all outside consultants/contractors who assisted in the preparation of this report, and the gathering, processing and analysis of data upon which the report is based.

b. State whether the consultants/contractors identified in response to this question have utilized the same data and/or report for other utilities, either inside or outside of the Commonwealth, in other IRP filings. If so, identify the jurisdictions and provide docket numbers.

A-49.

a. No outside consultants/contractors were used in preparation of this report. The external parties mentioned in this report simply provided input data for preparing the analysis, as mentioned in the report.

b. Not applicable.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 50

Witness: Daniel K. Arbough / Stuart A. Wilson

Q-50. According to the articles at the link below,[14] several major insurance companies have issued new directives stating they will cease: (i) issuing new insurance policies to companies that derive more than 30% of their revenues from thermal coal mining; and (ii) making new investments in companies that have a large exposure to thermal coal mining or coal-based energy production. According to the second article ("Energy Transition Prompts More Insurers to Back Away From Coal"), insurance policy premiums and the cost of capital

a. Provide a discussion of whether these new directives on behalf of major insurance companies will have any effect on the Companies, their production facilities, and fuel sources, and if so, how.

b. State whether these new directives have entered into the Companies' planning and decision making regarding the instant IRP. If not, state whether they will or may enter into the Companies' planning and decision making regarding future IRP filings.

A-50.

a. The Companies are aware of these directives from a few of the major insurance companies. At this time, only a small number of the insurers utilized by the Companies have indicated they will not underwrite coal-based energy production. There are other insurers that can cost-effectively replace those insurers that will no longer participate in the Companies' insurance programs.

b. These directives noted in the referenced article dated July 1, 2019 were not considered in the Companies' 2018 IRP, which was filed in October 2018. They may enter into the Companies' future planning and decision making as the Companies continue to monitor the level of associated risk.

[14] https://www.latimes.com/business/la-fi-chubb-bans-coal-coverage-20190701-story.html

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 51

Witness: Stuart A. Wilson / Daniel K. Arbough

Q-51. Explain whether the Companies' IRP modelling takes into consideration the escalating number of coal mining company bankruptcy filings. If not, why not?

a. If the modeling does not take this factor into consideration, explain what would have to be done to do so.

b. If the Companies believe the increasing incidence of coal mining company bankruptcies is of little or no concern, explain fully why not.

c. Provide the most current forecast of KU's sales to the mining industry in both Kentucky and Virginia.

d. For the regions served by the Companies, provide any coal price estimates for the next ten (10) years the Companies may have conducted.

e. Are the Companies aware of any Moody's Investors Service analyses regarding the stability of coal mining companies over the next one (1) to five (5) years? If so, provide copies.

A-51. Yes. The Companies' IRP modeling considers coal mine bankruptcies by considering the load impacts of reduced demand from coal mining customers and the impacts that are implicit in coal price bids and market price forecasts.

a. Not applicable.

b. Not applicable. The Companies continue to closely monitor this issue.

c. This information is not available. The Companies forecast sales by rate schedule and not by industry.

d. See "Table 7: Delivered Coal Prices (Nominal $/mmBtu)" on page 15 of the "2018 IRP Long-Term Resource Planning Analysis" contained in Volume III of the 2018 IRP. This information is being produced on a confidential basis and subject to the Companies' joint petition for confidential protection filed October 19, 2018, and the

terms of the Confidentiality Agreement between the Companies and the Kentucky Office of the Attorney General, Office of Rate Intervention, executed August 30, 2019.

e. See attachments.

MOODY'S
INVESTORS SERVICE

Moody's 2019 Outlooks

Base Metals - Global, Steel - US, Coal - US

2019 Outlook

RESEARCH PUBLICATION

DECEMBER 12, 2018

Contacts

Rate this Research

Global Base Metals Analysts

New York
Carol Cowan
carol.cowan@moodys.com
+1.212.553.4999

London
Sven Reinke
sven.reinke@moodys.com
+44.207.772.1057

London
Lauras, Francois
francois.lauras@moodys.com
+44.207.772.5397

Mexico City
Marie Fischer-Sabatie
marie.fischer-sabatie@moodys.com
+52.551.555.5312

Sao Paulo
Barbara Mattos
barbara.mattos@moodys.com
+55.113.043.7357

Singapore
Brian Grieser
brian.grieser@moodys.com
+1.415.214.3845

Singapore
Kaustubh Chaubal
kaustubh.chaubal@moodys.com
+65.6398. 8332

South Africa
Douglas Rowlings
douglas.rowlings@moodys.com
+971.423.795.43

Sydney
Matthew Moore
matthew.moore@moodys.com
+61.292.708.108

Toronto
Jamie Koutsoukis
jamie.koutsoukis@moodys.com
+1.416.214.3845

US Coal Analysts

New York
Ben Nelson
benjamin.nelson@moodys.com
+1.212.553.2981

Carol Cowan
carol.cowan@moodys.com
+1.212.553.4999

US Steel Analysts

New York
Carol Cowan
carol.cowan@moodys.com
+1.212.553.4999

Michael Corelli
michael.corelli@moodys.com
+1.212.553.1654

Stable outlooks as economic growth slows

Higher costs, trade spats to play a role, coal decline continues

STABLE

Base Metals – Global

- Global growth appears to be slowing on tighter liquidity and trade tensions, with Moody's central economic scenario putting 2019 global GDP growth at 2.9%
- Trade tensions will weigh on sentiment, affect base metal demand
- Resource nationalism adds to uncertainty
- Balance sheets more resilient, increased cushion for sector weakening

STABLE

Steel – US

- Demand fundamentals to remain favorable, despite slower US GDP growth
- Higher capacity utilization levels of 2018 will hold in 2019
- Higher costs for scrap, labor, transportation and energy
- Trade frictions and increased imports could pressure steelmakers' performance

STABLE

Coal – US

- Secular decline in thermal coal continues, with natural gas, renewables gaining share
- Economic and regulatory pressures will continue to limit coal investments regardless of the US withdrawal from the Paris Climate Accord
- Restructured producers with diverse footprints, good cost positions, lean balance sheets are best positioned
- Export opportunities for Met coal boost cash flow in the near term; export market to remain volatile

Industry outlooks reflect our view of fundamental business conditions for an industry over the next 12-18 months. Since outlooks represent our forward-looking view on business conditions that factor into our ratings, a negative (positive) outlook suggests that negative (positive) rating actions are more likely on average. However, the industry outlook does not represent a sum of upgrades, downgrades or ratings under review, or an average of the rating outlooks of issuers in the industry, but rather our assessment of the main direction of business fundamentals within the overall industry.

1 Base Metals - Global

Base Metals – Global: Outlook is stable

2019 will soften vs. 2018 on indications global economic growth rates have peaked

NEGATIVE

What could change outlook to negative

- PMIs in the US, Europe and China track below 50 for at least two consecutive months
- Moody's global macro outlook is for GDP growth of less than 3%

STABLE

Drivers of the stable outlook

- PMIs in the US, Europe and China track between 50 and 55 for at least two consecutive months
- Moody's global macro outlook is for GDP growth of between 3% and 4%

POSITIVE

What could change outlook to positive

- PMIs in the US, Europe and China exceed 55 for at least three consecutive months
- Moody's global macro outlook for GDP growth is greater than 4%

Base Metals – Global: Outlook is stable

Key credit themes

- Global economic growth to decelerate in 2019
- Trade tensions to impact demand for base metals
- Political risk poses uncertainty on taxes, royalties, operating licenses
- ESG considerations, particularly environmental, will remain a focus
- Balance sheets, financial condition more resilient than in 2015/2016
- Investment in exploration and development necessary

Divergent growth picture, trade disputes, geopolitical risk all at play

GROWTH

- Increasingly divergent growth expectations contribute to 2019 being a more challenging year
- Growth appears to have peaked and be decelerating, particularly in China, a key driver of base-metals performance and expectations
- PMI statistics for the US and Euro area slowing, China remains in the low 50s
- Moody's central economic scenario puts 2019 US GDP at 2.3%, China at 6.0% and 1.8% for the Euro area

TRADE TENSIONS

- Trade uncertainty, retaliatory tariffs, Brexit, Commerce Dept tariffs on aluminum imports, potential sanctions on Rusal weigh on sentiment
- Coupled with slower growth, these trade issues will keep prices range-bound with some downside risk

POLITICAL RISKS

- Resource nationalism: Countries desire to retain more of the value of their natural resources contributes to uncertainty on tax, royalty, operating license stability, investment decisions
- New mines increasingly located in countries with greater political risk, lacking infrastructure, poorly defined mining regulations
- With increasing political risk, new greenfield mine development will take longer. Consequently deficits likely over the near to medium term, particularly in copper and nickel. BEVs likely to exacerbate this

Miners finances are solid ahead of any downturn, ESG risk remains elevated

FINANCIAL STABILITY

- Balance sheets more resilient, increased cushion for sector weakening
- Liability management, debt reduction, cost initiatives, solid liquidity position industry to better weather market weakness than in the trough 2015/16
- Cost creep on increasing freight rates, higher labor and other input costs, volatility in oil prices, will pressure margins
- Resource replenishment, capital spending on growth will be key factors to watch
- Lower prices than 2018 and higher costs will result in earnings contraction in 2019

ESG RISKS

- Although not a new issue, the mining industry has elevated exposure to environmental risks – increasing scrutiny and costs expected
- Soil and water pollution, as well as land use restrictions, are substantial risks
- Water shortage risk, and local community objections to new mine development also present a high risk, while carbon and air pollution risk are more moderate
- Increasing costs to comply with environmental regulations will be better absorbed by the stronger, larger companies in the sector
- Joint ventures more likely to share investment and environmental risks

Commodity price sensitivities

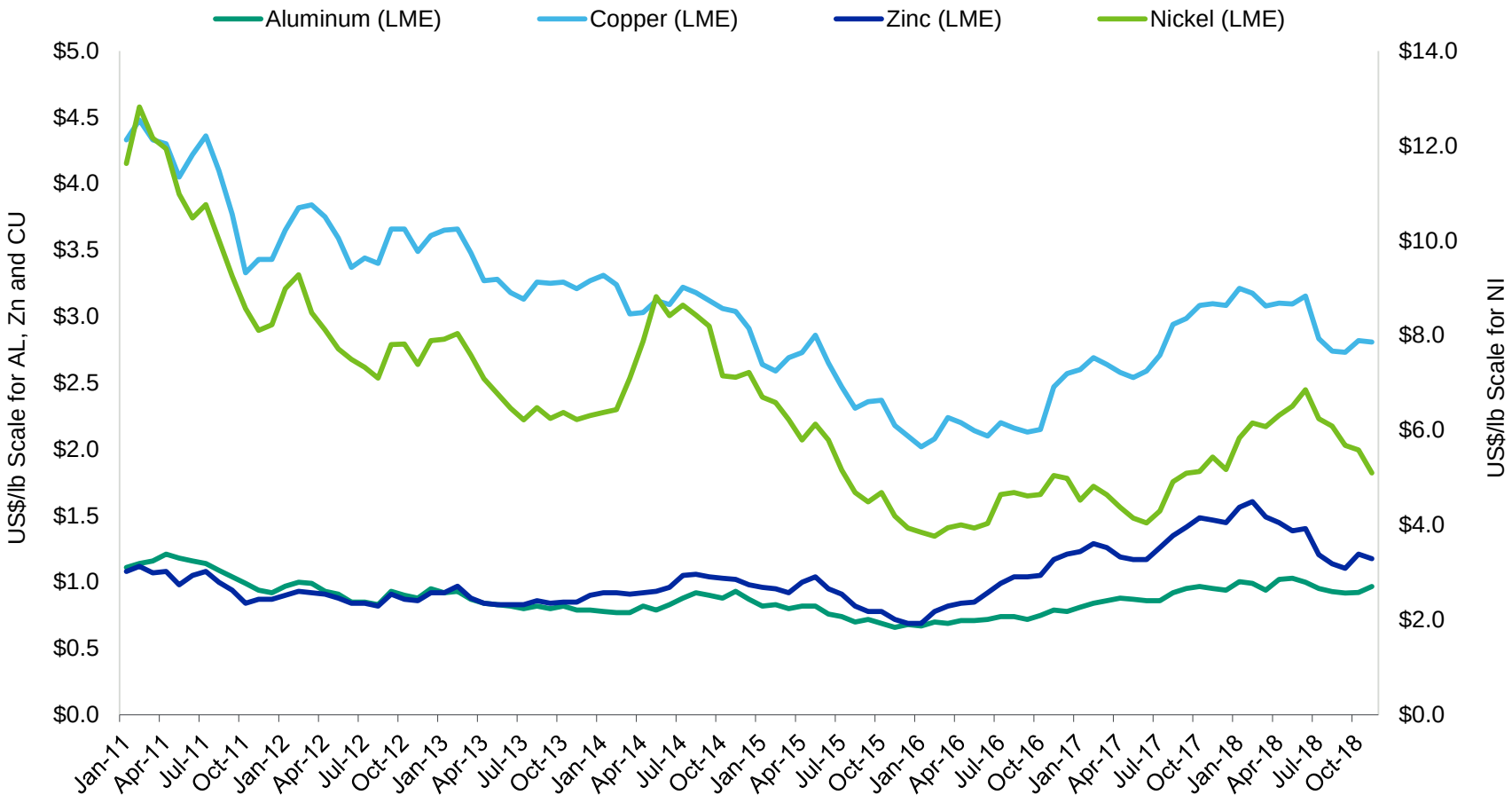
Commodity Price Sensitivities 2018 - 2019

	Ranges	Midpoint
Gold ($/oz)	$1,100 - $1,300	$1,200
Silver ($/oz)	$14.00 - $17.00	$15.50
Aluminum ($/lb)	$0.75 - $0.85	$0.80
Copper ($/lb)	$2.25 - $2.75	$2.50
Nickel ($/lb)	$3.75 - $5.25	$4.50
Zinc ($/lb)	$0.90 - $1.20	$1.10
Iron ore 62% Fe China ($/MT)	$45 - $75	$60

Source: Moody's Investors Service

Our price sensitivity ranges, as well as the midpoint, represent baseline approximations that we use to evaluate risk when analyzing credit conditions of companies within the sector. We periodically review, in light of changing global GDP expectations, our base metals, iron ore, metallurgical and thermal coal, gold and silver price ranges, to better sensitize future financial metrics for companies.

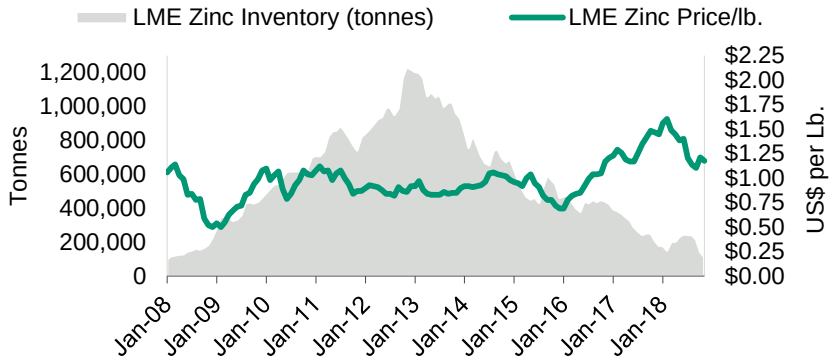
Base metal prices



[1] From January 2010 through November 2018
Source: Metal Bulletin

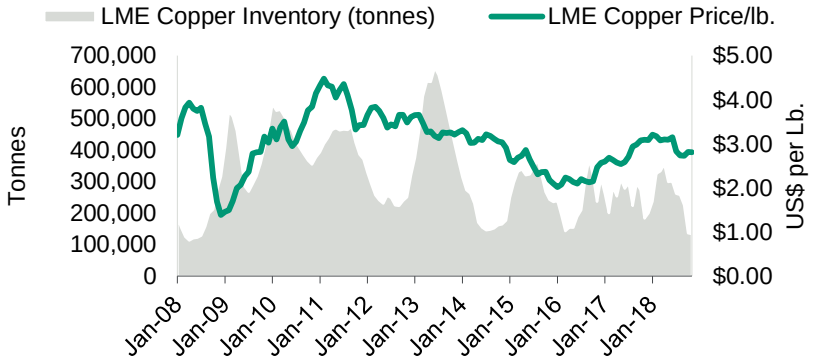
Base metal inventory & prices

LME Zinc Inventory vs. Price/lb.
January 2008 to November 2018



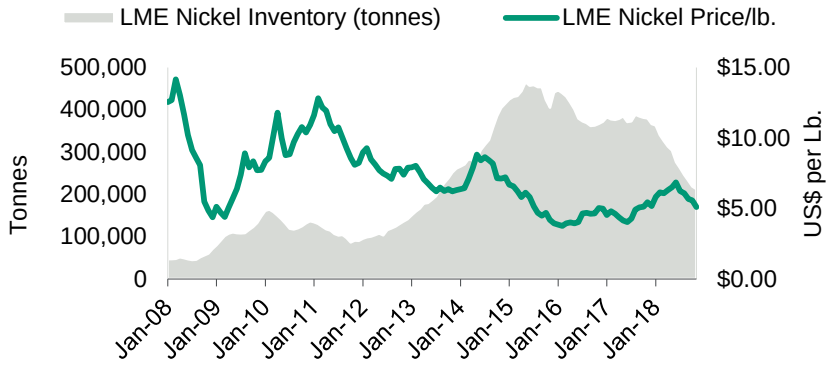
Source: London Metal Exchange, Metal Bulletin

LME Copper Inventory vs. Price/lb.
January 2008 to November 2018



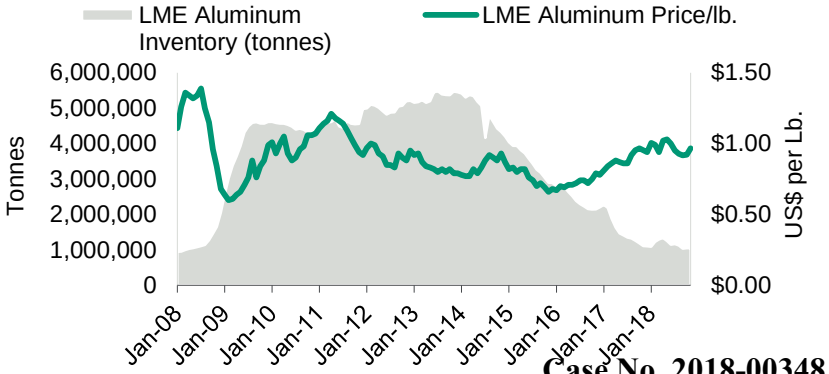
Source: London Metal Exchange, Metal Bulletin

LME Nickel Inventory vs. Price/lb.
January 2008 to November 2018



Source: London metal exchange, Metal Bulletin

LME Aluminum Inventory vs. Price/lb.
January 2008 to November 2018



Source: London Metal Exchange, Metal Bulletin

2 Steel - US

Steel – US: Outlook stable

Favorable fundamentals to hold in 2019, prices more moderate

NEGATIVE

What could change outlook to negative

- Capacity utilization is sustained below 75%
- PMI in the US tracks below 50 for at least two consecutive months

STABLE

Drivers of the stable outlook

- PMI in the US tracks between 50 and 55 for at least two consecutive months
- Capacity utilization is between 75% and 80%

POSITIVE

What could change outlook to positive

- PMI in the US exceeds 55 for at least two consecutive months
- Capacity utilization is sustained above 80%

Industry outlooks reflect our view of fundamental business conditions for an industry over the next 12-18 months. Since outlooks represent our forward-looking view on business conditions that factor into our ratings, a negative (positive) outlook suggests that negative (positive) rating actions are more likely on average. However, the industry outlook does not represent a sum of upgrades, downgrades or ratings under review, or an average of the rating outlooks of issuers in the industry, but rather our assessment of the main direction of business fundamentals within the overall industry.

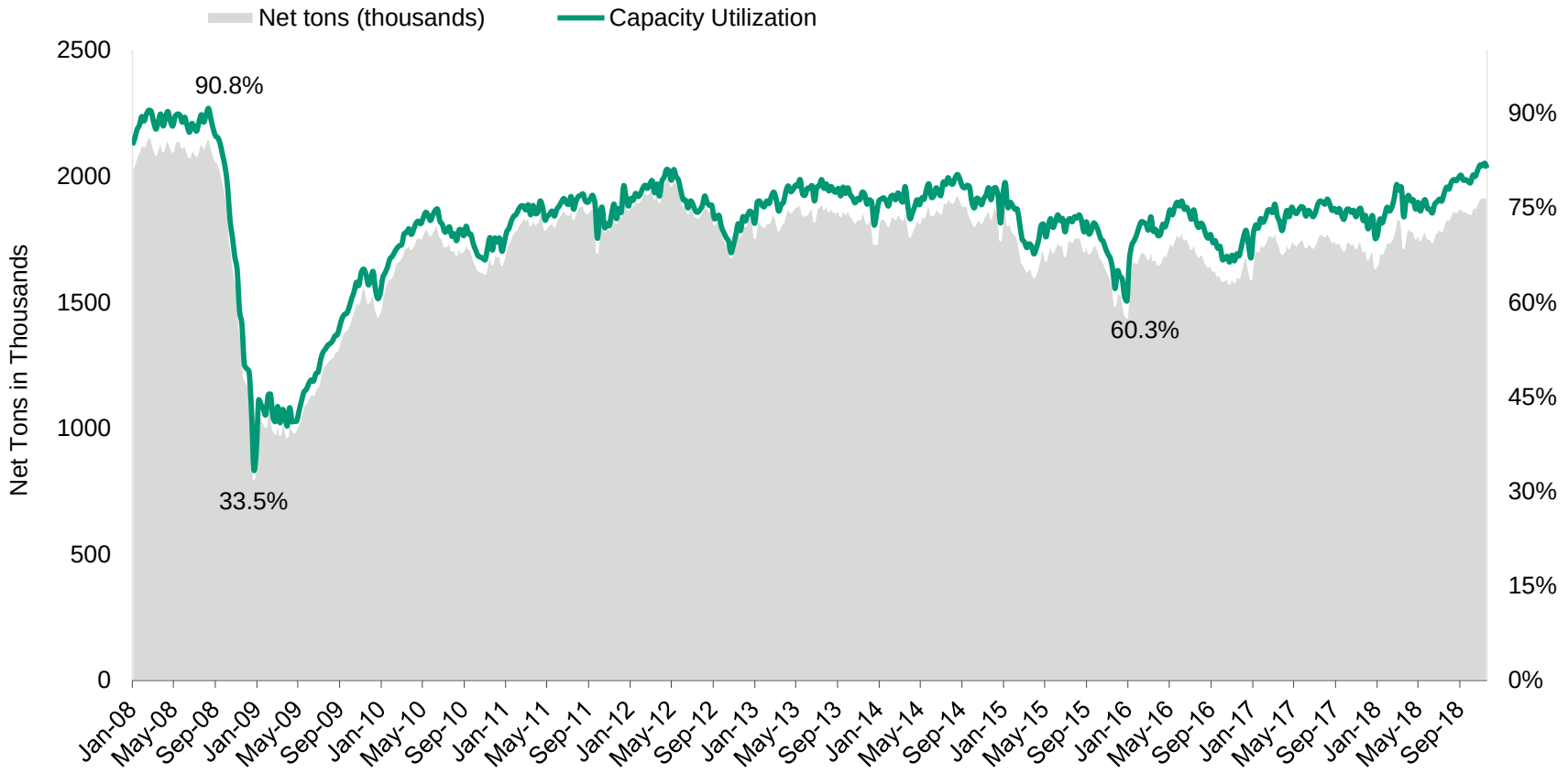
Steel – US: Outlook stable

Key credit themes

- We expect demand fundamentals to remain favorable, despite slower US GDP growth
  - Commercial construction, machinery and equipment markets, OCTG and auto (though last two sectors have peaked) still show good demand fundamentals, though material uptick from 2018 levels unlikely
  - Moody's forecasts 2019 US GDP growth to slow to 2.3%, versus 2.9% in 2018
- Higher capacity utilization levels of 2018 will hold in 2019
  - We expect utilization to range between 75% - 80%.The utilization rate was 80.7% the week ended December 1 and 78.1% YTD, versus 74.2% for the comparable 2017 period
  - Restarts, such as US Steel's (B1 stable) Granite City furnaces, could be a drag on industry improvement should demand weaken
- Cost rising
  - Scrap steel, labor, and transport costs rising, energy costs remain volatile while prices for iron ore and coking coal remain elevated

Steel production and capacity utilization

U.S. Raw Steel Output & Utilization
As of the week ending November 24, 2018



Source: American Iron & Steel Institute

Risks include trade tensions, ESG and substitution

ESG RISKS

- Environmental risks, particularly carbon-transition risk, will increase over the next several years with expanded regulations at all levels likely
- The global steel sector faces elevated risk, particularly with respect to CO2, air pollution
- Producers will face increasing costs over time, with blast furnace operators more challenged than Electric Arc producers
- US blast furnace operators will be less impacted than overseas producers

TRADE TENSIONS

- Trade frictions could lead to slowing growth and any actions that hurt key markets, such as auto, would be negative for steelmakers
- Increased import levels would pressure industry performance. Through November, finished steel imports were down 13.3% y-o-y, holding a 23% market share. Permit applications decreased following a meaningfully rise in October
- A wide differential between US/ international prices would increase imports, as will reset of quotas, at least for specific products

TECHNOLOGY AND INNOVATION

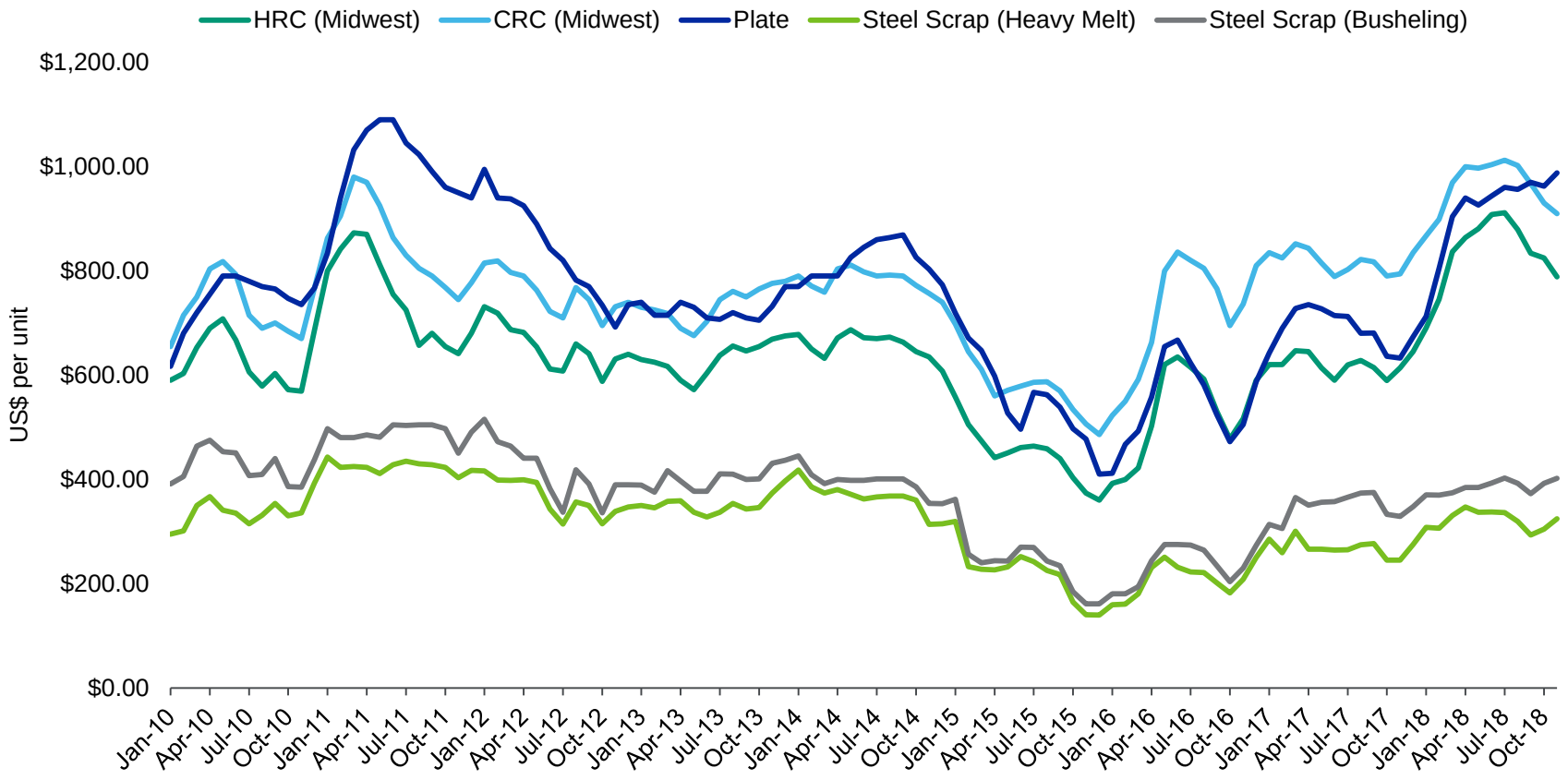
- Steel is at risk of substitution with aluminum in the auto industry as carmakers look to improve fuel economy
- Investing in technology to develop high-strength, lightweight steel that will not be replaced with aluminum will be critical

Steel prices have peaked, will decline in 2019

Hot-rolled coil down about $155/ton from H1 2018 highs

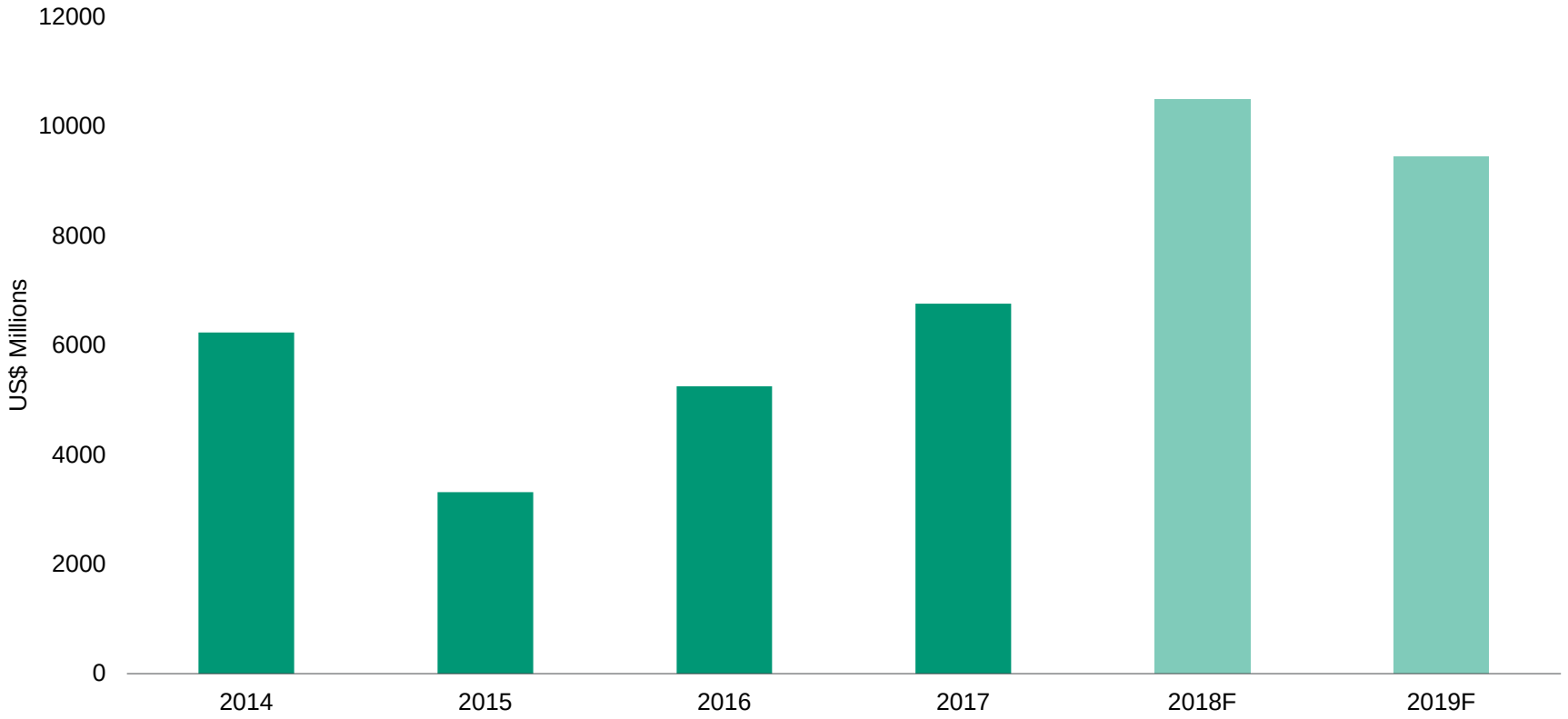
- Hot-rolled coil (HRC) prices have peaked, will average lower than 2018
  - We expect HRC prices to average between $750 - $800/ton for 2019
  - Improved demand fundamentals, together with expectations on tariffs, led to price run-up the H1 2018. HRC prices peaked at around $915/ton June/July. Now around $760/ton
  - The US imposed 25% tariffs on imported steel (with exceptions for South Korea, Brazil, Argentina, and Australia). These actions offer underlying support against the downside
  - Despite lower average prices expected in 2019, industry performance will be strong. EBITDA for the rated producers is anticipated to decline between 5% and 10% overall.

Steel prices have peaked, will decline in 2019



(1) From January 2010 through November 2018
(2) Rebar, Hot-Rolled Coil (HRC) and Cold-Rolled Coil (CRC) are measured in short tons.
(3) Heavy Melt and #1 Busheling Steel Scrap are measured in long tons.
Source: Metal Bulletin

US steelmakers' 2019 EBITDA will fall vs. 2018 results



(1) Figures includes financials for Nucor, Steel Dynamics, Commercial Metals Company, Carpenter Technology, United States Steel, AK Steel and Allegheny Technologies
(2) Incorporates Moody's standard adjustments
Source: Moody's Financial Metrics

3 | COAL - US

Coal – US: Outlook is stable

EBITDA to be essentially flat

NEGATIVE

What could change outlook to negative

» Cumulative coal producers' EBITDA is expected to decline by more than 3% over the next 12 months

STABLE

Drivers of the stable outlook

» Cumulative EBITDA is projected to remain relatively flat or grow roughly in line with inflation

» A meaningful retreat in pricing could lead to a negative outlook despite many significant contracted position for many producers.

POSITIVE

What could change outlook to positive

» Cumulative EBITDA growth is expected to exceed 7% over the next 12 months

Industry outlooks reflect our view of fundamental business conditions for an industry over the next 12-18 months. Since outlooks represent our forward-looking view on business conditions that factor into our ratings, a negative (positive) outlook suggests that negative (positive) rating actions are more likely on average. However, the industry outlook does not represent a sum of upgrades, downgrades or ratings under review, or an average of the rating outlooks of issuers in the industry, but rather our assessment of the main direction of business fundamentals within the overall industry.

Coal – US: Stable outlook

Better conditions, but limited investment in new capacity

Key credit themes

- We expect natural gas and renewables to continue displacing thermal coal, leading to lower domestic consumption of coal in 2019
- Metallurgical (Met) coal prices are high today, but expected to remain volatile over a longer horizon; most US producers are high cost
  - Longer term shift to EAF's unfavorable for Met coal
- Regulatory pressures and uncertainties will continue to limit coal investments; cash diverted to share repurchases rather than investment in new mines; no new coal power plants are planned
  - US withdrawal from the Paris Agreement will not alter long-term trends
- Restructured producers with diverse footprints, good cost position and lean balance sheets are generally best positioned.
  - Most producers using strong cash flow from higher prices to fund shareholder returns and some M&A, a few are still reducing debt

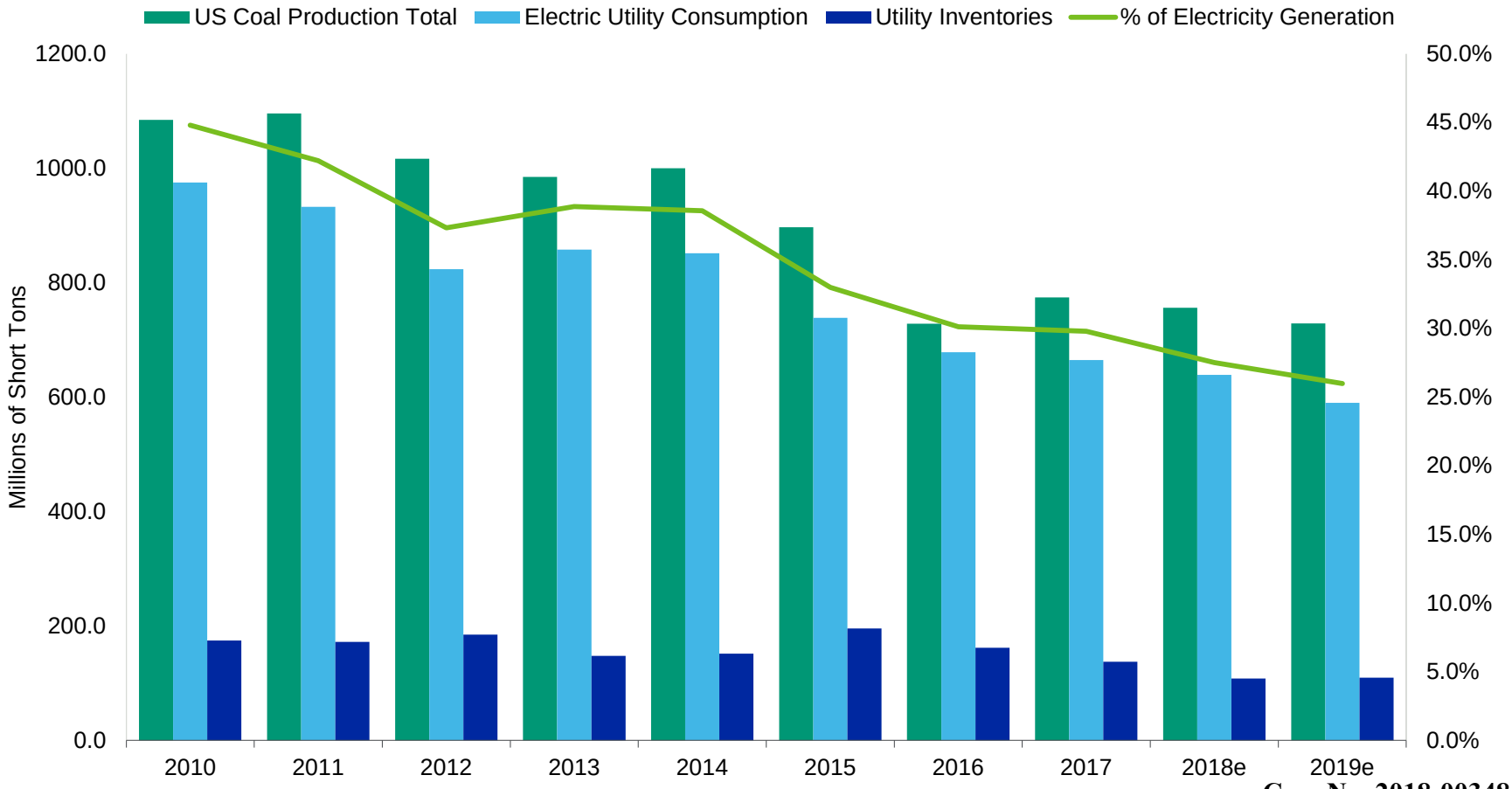
Slow decline continues on relatively low natural gas prices, renewables, regulations

Short-term stability will give way to long-term decline

- Natural gas and renewables will continue displacing thermal coal in the long term, reducing domestic demand for thermal coal
- Coal capacity investment will be limited on expected secular decline in demand for thermal coal. Impact of regulatory relief has been relatively modest; retirement of coal-fired power plants to continue.
- Higher-cost US producers to remain swing producers in the export market, leading to significant margin volatility; export market is strong today; more exports are also helping pricing in domestic coal basins.
- Our medium-term price sensitivity for metallurgical coal increased to $110-170/tonne, from $95-145, due to structural changes in the market, but still well below spot prices above $200.

Coal's share of electricity generation falling

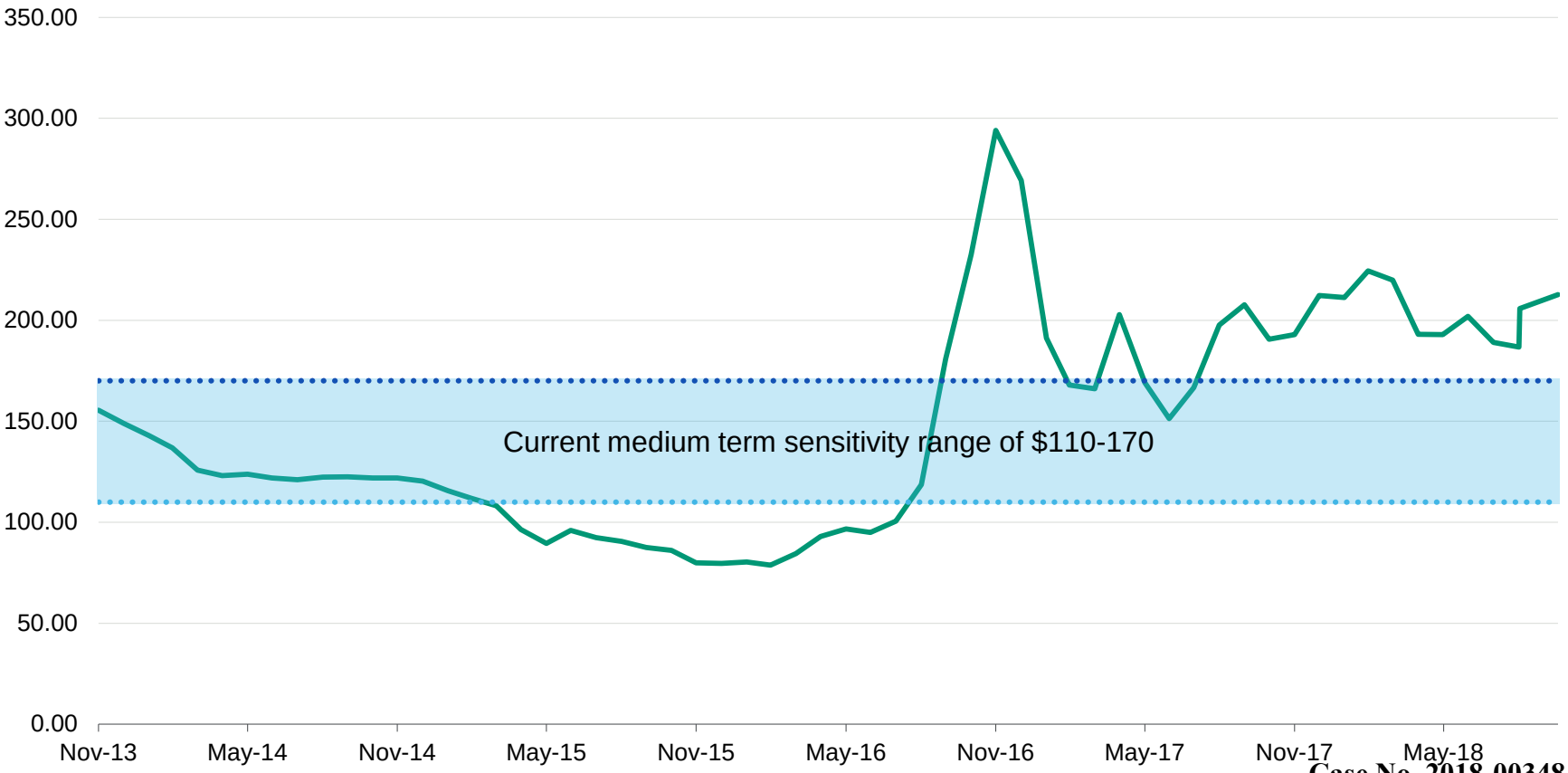
Continued secular decline in demand & consumption (US)



Source: Energy Information Association (EIA); EIA estimates as of October 30, 2018.

Met coal prices higher, but volatile

No near-term catalyst for significant decline from current levels, but met coal will remain volatile in the medium term



Global credit conditions to weaken amid slowing growth and rising risks

Credit risks will build in 2019 as economic growth slows, funding costs rise, liquidity tightens and market volatility returns. Trade tensions and growing geopolitical risks will likely escalate and have significant sector and regional impacts. Advances in digital technologies could trigger productivity improvements as well as business disruptions, while the ESG issue that is most likely to materially influence credit in 2019 is carbon transition risk.

Learn more: www.moodys.com/2019outlooks

MOODY'S
INVESTORS SERVICE

CORPORATES

MOODY'S
INVESTORS SERVICE

SECTOR IN-DEPTH
31 January 2019

Rate this Research

TABLE OF CONTENTS

Contacts

Benjamin Nelson +1.212.553.2981
VP-Sr Credit Officer
benjamin.nelson@moodys.com

Nirali Patel +1.212.553.7726
Associate Analyst
nirali.patel@moodys.com

Toby Shea +1.212.553.1779
VP-Sr Credit Officer
toby.shea@moodys.com

John Thieroff +1.212.553.7853
VP-Senior Analyst
john.thieroff@moodys.com

Jamie Koutsoukis +1.416.214.3845
VP-Senior Analyst
jamie.koutsoukis@moodys.com

Brian Oak +1.212.553.2946
MD-Corporate Finance
brian.oak@moodys.com

Coal – US

Pricing supports industry in 2019; secular decline remains medium-term risk

» **Continued retirement of coal-fired power plants will drive ongoing secular decline for thermal coal.** About 10% of US coal-fired generation will be retired during 2018-23, leading to less domestic demand for thermal coal. Recent policy actions are not significant enough to reverse the trend, but some slowing is expected compared to 2018.

» **Export opportunities for US coal producers support free cash flow generation at least through 2019, but will diminish in the medium term.** Coal demand is growing in Asia, particularly in India, as economic expansion drives the need for more power and power producers plan more coal-fired power plants. Growing demand, combined with a lack of investment globally and production issues for some producers in Asia, has created an opportunity for domestic companies. US coal producers' export economics depend on relatively high pricing and would be much less profitable in an environment of lower prices, since they are far from their export markets.

» **Consolidation would be helpful to the industry, but coal producers remain hesitant to do M&A.** The coal industry has numerous small companies that cannot by themselves easily toggle production enough to help the industry's overall supply/demand balance and support profitable pricing through the cycle. Consolidation will be tempting for the coal industry, since demand for thermal coal remains in secular decline, and most companies remain swing producers in the export markets.

» **Coal producers will deploy significant operating cash flow to shareholder returns in 2019, though more capital investment is starting to be discussed.** Improved pricing for both thermal and met coal have expanded operating cash flow generation for US coal producers, allowing them to spend more freely on shareholder returns. Some producers have discussed making meaningful capital investments for new coal mines, though they have not announced a final decision to do so. Investor response to any potential announcement is a critical factor to moving forward with such decisions.

» **Environmental, social, and governance (ESG) factors affect multiple dimensions of our credit analysis.** Some issues such as carbon dioxide emissions or reclamation liabilities are particularly important to the coal industry, and we have expanded ESG coverage within our credit analysis of individual companies. Investors and lenders to the coal industry have exhibited a long history of exerting pressure in this area, including significant historical resistance to mountaintop removal mining, and recoveries have been reduced by significant non-debt liabilities, such as estimated reclamation costs.

Q: How will scheduled retirements of US coal-fired power plants affect the coal industry?

Domestic demand for thermal coal will remain in secular decline after the current period of moderate prices ends. While thermal coal prices are stronger today than in recent years, eventually export markets will soften, forcing producers to reduce either domestic prices or production.

About 6% of coal capacity in the US was retired in 2018 in the US and we expect another 5% to retire during 2019-23. Most of the retiring plants will be replaced with combined-cycle gas-fired power plants rather than renewable sources of energy. Electricity output from coal-fired power plants will continue to decline during this period, reducing domestic demand for thermal coal. Average coal plant capacity factor is about 50% in the US.

Upcoming retirements of coal-fired capacity will reduce the demand for coal and recent policy actions are not significant enough to reverse the trend. According to the US Energy Information Administration (EIA), coal used to produce electric power in the US fell to 665 million tons in 2017, from about 1 billion tons in 2008, and will fall to about 600 million tons in 2019. Consumption by the power sector represented more than 90% of coal consumption in the US in 2017, and we do not believe that the export market, which should be near 100 million tons across coal types in 2019, is large enough to soak up the anticipated decline in domestic demand on an indefinite basis.

Thermal coal pricing is stronger today than in the recent past, buoyed by capacity rationalization earlier in the decade and better export opportunities since roughly 2016. Some producers have responded by reducing their domestic emphasis and exporting more thermal coal. But this shift is probably unsustainable through the full commodity-price cycle, and delivered costs to such distant markets as China and India will make exports less profitable when prices eventually retreat, forcing producers to sell to domestic customers at lower prices, or to cut production. Certain producers are less exposed to a downturn, either because they have significant operations outside of the US, such as Peabody Energy (Ba3 stable), or do not produce thermal coal, such as Warrior Met Coal (B2 stable).

We incorporate expectations for lower coal prices into our ratings with the assumption that higher-rated producers will retain adequate credit quality, based on credit metrics that are mostly very strong for their ratings today. Therefore, the potential credit impact of this scenario likely will be the most significant for companies at the lower end of the rating spectrum where it could cause cash flow and liquidity issues. Coal producers with Caa-level ratings include Cloud Peak Energy Resources (Caa1 positive), Murray Energy (Caa1 stable), and Wolverine Fuels (formerly Bowie Resource Partners, Caa1 stable).

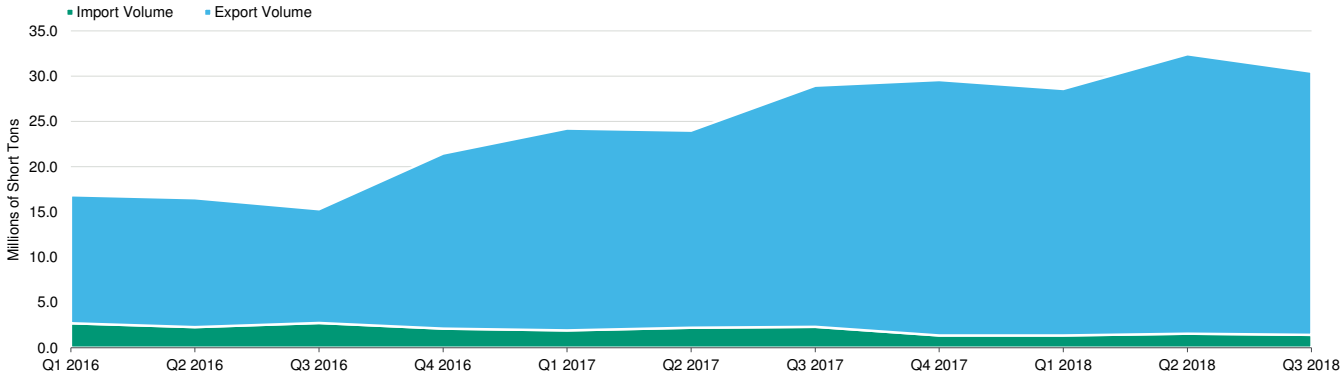
Q: Do you expect the export market for US coal to be durable throughout 2019?

We expect that coal producers will benefit from solid export prices in 2019, but we remain concerned about the longer-term sustainability of export volumes and margins. US producers are fairly high cost producers on a delivered basis. Coal pricing, particularly for metallurgical (met) coal used by steelmakers, is volatile historically and above our medium term sensitivity ranges today.

Coal exports increased significantly over the past two years, including more than doubling to 29.1 million short tons in the third quarter of 2018 from 12.6 million short tons in the third quarter of 2016. Exports to Asia contributed significantly to the increase in volumes shipped by US producers. Coal demand continues to grow in India and Southeast Asia. For power generation in India, a transition to low-carbon energy mix remains a work in progress, with a push toward renewable energy, but an evolving policy framework and weak credit quality among industrial power customers have held back the rise of renewable energy there. Slowing growth in coal demand from China, the largest consumer by far, has been significant enough to slow overall global coal demand. China has prioritized air quality and diversification of the energy mix in power generation and steel manufacturing, slowing coal demand there for both thermal and met. But emerging economies in Asia, Africa, and the Middle East will help offset that slowdown.

Exhibit 1

Exports up meaningfully since 2016



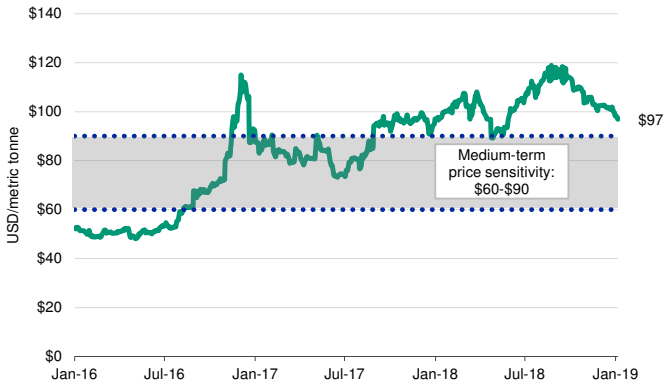
Volumes stated in millions of short tons
Source: US Energy Information Administration

We have increased our medium term sensitivity ranges for export coal to reflect some structural changes in the market, including a lack of investment by coal producers around the world. In October 2018 we raised our medium-term coal price sensitivities through 2020 to $60-$90/metric tonne for thermal coal, up from $55-$80 previously, and $110-170/metric tonne for met coal, up from $95-145 (see Exhibits 2-3). That said, we still expect ongoing volatility in pricing over time despite no near-term catalyst to weaken pricing.

Exhibit 2

Heightened prices imply export opportunities for both US thermal coal...

Newcastle coal futures prices, USD/metric ton

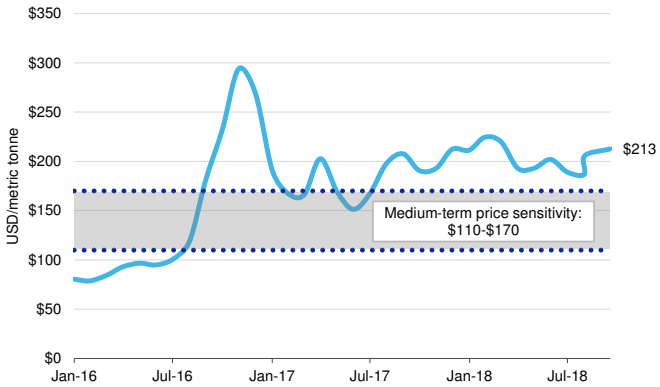


Note: shaded area indicates medium-term price-sensitivity range of $60-$90/metric ton
Source: FactSet; Moody's Investors Service (price range)

Exhibit 3

...and US met coal

Premium hard coking coal Jingtang, USD/metric ton



Note: shaded area indicates medium-term price-sensitivity range of $110-$170/metric ton
Source: FactSet; Moody's Investors Service (price range)

However, given our assumption for ongoing volatility in export coal pricing, combined with our view that pricing is above mid-cycle levels today, we do not expect that producers will be able to sustain current cash margins indefinitely. Cash margins for US-based coal producers, which account for a small percentage of the global coal trade, will narrow as prices eventually move back into our medium term sensitivity ranges. The International Energy Agency expects a stagnating global market for coal and a challenging situation for high cost US producers with export volumes falling meaningfully in the 2020s. Producers in other regions, such as Australia and Russia, will increase market share in the IEA's scenarios.

Q: To what extent will companies use operating cash flow to buy back shares?

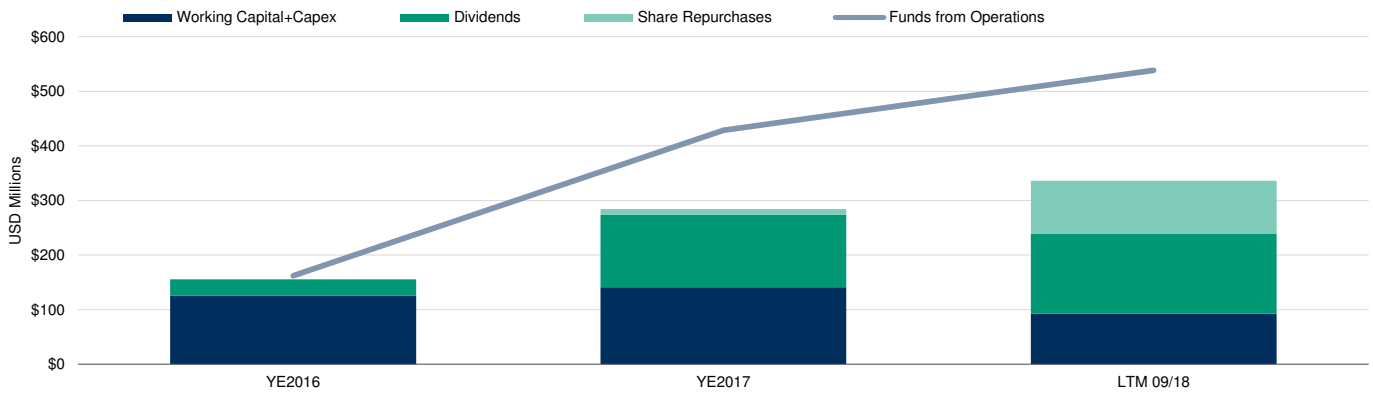
We expect that US coal producers' generation of operating cash flow in excess of maintenance capital spending will continue to contribute to shareholder returns, rather than growth capital investment and debt reduction, at least through 2019.

Recent strong prices for both thermal and met coal have contributed to stronger operating cash flow generation for most of the rated US coal producers, allowing them to spend more freely on shareholder returns (see Exhibit 4). A meaningful portion of the recent spending is concentrated in a small number of companies. For example, for the 12 months through September 30, 2018, Peabody spent more than $800 million for stock repurchases, while Warrior spent nearly $1 billion on dividends.

Exhibit 4

Cash spending on shareholder returns exceeds investments in working capital and capacity

Shareholder returns and growth capital investment for rated US coal companies, 2016-18



Source: Moody's Financial Metrics™ Note: slight variation in the peer group due to M&A transactions, emergence from bankruptcy, and other factors that affect financial results.

We anticipate that cash flow generation for the rated coal producers will remain strong at least through 2019. While export coal prices are volatile historically, we see no near term catalyst for a meaningful reduction in prices. US coal producers seem unwilling to invest more in additional capacity, outside of a few potential projects discussed conceptually at this point, amid steadily declining domestic demand and volatile export markets over an investment horizon for a mining asset. We expect producers will continue to spend much of their operating cash flow after maintenance spending on shareholder returns, at least through 2019. We are specifically interested in the investor response to an announcement of new capacity and, if the sentiment is negative like it has been in recent years, if a producer would proceed with the project anyway. We will remain focused on this issue through earnings season and well into 2019.

Q: How much M&A activity do you expect in 2019?

We believe that consolidation would be helpful for the coal industry, but rated producers have exhibited caution with regard to M&A, which we believe is inevitable in the long term and will be necessary to help support reasonable cash margins over time in what we expect will be a declining demand environment.

Despite stronger pricing and better cash flow, we continue to see bankruptcy filings and out of court restructuring activity for weaker and overleveraged coal companies. Westmoreland Coal and Mission Coal filed bankruptcy in October 2018—both of which were intended to provide an opportunity to restructure and sell assets. Cloud Peak is facing distress, announcing in November 2018 that it was reviewing strategic alternatives, including a possible sale of the company. But US coal companies face challenges selling their assets at times, because the acquisition costs do not include legacy liabilities, ages of the mines, and logistic accessibility. Profitability and accessibility will remain key considerations for any potential buyers.

Recent M&A for metallurgical coal assets has exhibited different characteristics than the last met coal M&A cycle earlier in the decade. Peabody's acquisition of Drummond's Shoal Creek Mine and Contura's (B2 stable) merger with Alpha were funded with cash and equity, respectively. The last cycle involved companies taking on significant debt at near-peak pricing, which ultimately contributed to bankruptcy filings for several rated producers when prices moved through a difficult cyclical trough.

M&A for thermal coal assets in the near term seems less likely absent lower valuations, perhaps through restructuring activity. For example, Cloud Peak, mentioned earlier as pursuing strategic alternatives, is located in the Powder River Basin where larger mines are running below capacity and Cloud Peak has a substantial debt load. Alliance Resource Partners (Ba3 stable) expressed a willingness to increase leverage temporarily for the right type of transaction, but recent M&A has been more focused on expanding passive investments in oil & gas. Many publicly-traded producers have also expressed significant doubt about acquiring assets with significant non-debt liabilities, which we believe would be the case with many of the unrated producers. Over a longer horizon, we believe that consolidation is inevitable for thermal coal producers because continued retirement of coal-fired power plants will reduce demand. A pull-back in the export market could also trigger greater distress and more M&A for thermal coal.

Q: How do you incorporate ESG factors into coal ratings?

Environmental, social, and governance factors (ESG) considerations affect multiple dimensions of our credit analysis and we have long incorporated them into our assessments of credit risk. We published a new cross-sector methodology that describes our general principles for assessing ESG risks globally in our credit analysis on January 9, 2019. We also updated and republished our Mining Industry methodology in September 2018, including a detailed section that describes our approach for the broader mining industry.

Some issues such as carbon dioxide emissions or reclamation liabilities are particularly important to the coal industry, based on the secular decline in coal demand and ongoing restructuring activity for the companies with weaker credit quality and business prospects. We have highlighted these issues through special reports, such as our August 2016 analysis of reclamation obligations, our environmental risk heat map report in September 2018, or our most recent industry outlook published in May 2018. We comment on ESG-related risks when we believe them to be material to credit and the environmental heatmap helps inform our view on materiality. We will continue to enhance our analytics on ESG-related risks in a manner that is consistent with this risk-specific approach.

Investors and lenders to the coal industry have exhibited a long history of exerting pressure in this area, including significant historical resistance to mountaintop removal mining, and recoveries have been reduced by significant non-debt liabilities, such as estimated reclamation costs (as noted above). Some investors and lenders do not participate in the sector, which could influence the companies' cost of capital. Our recent comment about Peabody's acquisition of the Shoal Creek met coal mine specifically noted that certain legacy liabilities were excluded from the transaction when we articulated a credit-positive thesis on this transaction. Our recent Credit Opinion on Contura Energy, which did a more significant met coal acquisition, explains how the assumption of significant legacy liabilities moderates the credit benefits of that transaction and constrains credit quality over the rating horizon. Our research also points out companies with relatively low legacy liabilities compared to peers, such as our recent Credit Opinion on Warrior Met Coal, and those with significant legacy liabilties, such as our recent Credit Opinion on Murray Energy.

Appendix: Key financial metrics for rated US coal companies

Exhibit 5

Ratings and key metrics for rated US coal companies

Company	Rating	Outlook	Revenue (millions)	EBITDA Margin %	Debt/EBITDA
Alliance Resource Partners, L.P.	Ba3	Stable	$1,954	33%	0.9x
Arch Coal, Inc.	Ba3	Stable	$2,361	17%	1.0x
Peabody Energy Corporation	Ba3	Stable	$5,702	29%	1.3x
CONSOL Energy Inc.	B1	Stable	$1,248	34%	2.8x
Coronado Group LLC (Private)	B1	Stable	n/a	n/a	n/a
Contura Energy, Inc.	B2	Stable	$1,812	14%	1.5x
Warrior Met Coal, Inc.	B2	Stable	$1,257	41%	0.9x
Foresight Energy, LLC	B3	Stable	$1,091	35%	3.4x
Natural Resource Partners L.P.	B3	Positive	$382	57%	3.7x
Bowie Resource Partners LLC (Private)	Caa1	Stable	n/a	n/a	n/a
Cloud Peak Energy Resources LLC	Caa1	Positive	$869	5%	7.7x
Murray Energy Corporation (Private)	Caa1	Stable	n/a	n/a	n/a

Source: Moody's Financial Metrics™; Moody's Investors Service (ratings)

Moody's related publications

Sector comments:

» Coal - US: High export prices drive buybacks over debt reduction and growth capital, November 26, 2018

» Coal - Global: Increasing price sensitivity ranges for seaborne metallurgical, thermal coal, October 8, 2018

Sector in-depth reports:

» Environmental Risks – Global: Heat map: 11 sectors with $2.2 trillion debt have elevated environmental risk exposure, September 25, 2017

» Basic Industries - North America: Minimal crossover activity likely through 2019, July 18, 2018

» Coal — US: Negative sentiment among coal investors produces lower bond-implied ratings, April 18, 2018

» Coal Mining - US: US production to continue sharp, secular decline absent carbon capture development, January 25, 2018

Outlooks:

» Base Metals - Global, Steel - US, Coal - US: 2019 outlooks stable on slowing growth (Slides), December 12, 2018

» Coal - North America: Met coal prices support stable outlook, but secular decline for thermal still looms, May 31, 2018

Rating methodologies:

» Mining, September 2018

» General Principles for Assessing Environmental, Social and Governance Risks, January 2019

To access any of these reports, click on the entry above. Note that these references are current as of the date of publication of this report and that more recent reports may be available. All research may not be available to all clients.

REPORT NUMBER 1155546

MOODY'S INVESTORS SERVICE

MOODY'S INVESTORS SERVICE

CORPORATES

SECTOR COMMENT
10 July 2019

Rate this Research

Contacts

Benjamin Nelson +1.212.553.2981
VP-Sr Credit Officer
benjamin.nelson@moodys.com

Toby Shea +1.212.553.1779
VP-Sr Credit Officer
toby.shea@moodys.com

Jamie Koutsoukis +1.416.214.3845
VP-Senior Analyst
jamie.koutsoukis@moodys.com

Glenn B. Eckert, CFA +1.212.553.1618
Associate Managing Director
glenn.eckert@moodys.com

Coal – North America

Fading utility demand for thermal coal will increase reliance on exports, met coal

Demand for thermal coal from the US utilities will erode significantly in the 2020-30 decade, driving the ongoing contraction in the coal industry and increasing its reliance on exports. We expect that the longer-term trend will have the greatest impact on demand for coal from the Powder River Basin (PRB) in Wyoming and Montana, but will ripple across all coal basins and present a significant challenge for the coal industry.

The pace and magnitude of the decline in coal demand for power generation remains uncertain. But the closures of coal-fired power plants already announced, plus other likely closures such as power plants more than 50 years old, would reduce coal to as little as 11% of total US power generation by 2030. This drop would represent a substantial reduction from the today's mid-20% contribution to power generation, and the continuation of an ongoing secular decline in thermal coal demand (see our reports, "Natural gas gaining momentum as energy transition awareness moves into spotlight," June 26, 2019; and "Power Generation – US: FAQ on the economics of renewable energy, battery storage, and the future of coal generation," June 12, 2019). Coal had represented half of domestic power generation as recently as 2008.

We expect that new natural gas-fired generation, and to a much lesser extent renewable energy, will replace most of the thermal-coal electric-generation capacity heading into retirement. We do not expect an increase in the capacity factor of the coal-fired units that remain in service. This will result in a significant decline in the domestic demand for thermal coal.

Falling utility demand for thermal coal ultimately will have a significant impact on the domestic coal industry. While we have a stable outlook for the coal industry over the next 12-18 months, based largely on our expectations of strong cash margins on metallurgical (met) coal used in steelmaking, utility demand for thermal coal will still fall significantly over a longer horizon despite regulatory easing in recent years. Utilities consumed about 84% of the US coal industry's 756 million tons of production in 2018. The further destruction of a meaningful portion of utility demand would be too significant to replace just through greater participation in other markets, such as industrial or home-heating uses, or by increased exports, whose profitability depends on relatively high prices because of the high costs of delivering US-produced coal to distant markets.

The PRB will be the hardest-hit major US coal basin as thermal coal declines. Profitability in the basin is under stress today, especially in the low-heat 8,400 BTU segment of the market, whose major producers have gone through bankruptcy in recent years. Peabody Energy (Ba3 stable) and Arch Coal (Ba3 stable) restructured their balance sheets under bankruptcy protection a few years ago and recently announced plans to combine their assets in the PRB to compete more effectively with natural gas and renewables. Cloud Peak is in bankruptcy protection today.

Other regions will also be hit hard, however. Central Appalachia's thermal coal market has declined markedly for more than a decade as low-cost natural gas exacerbated ongoing issues related to depletion and unfavorable geology, but the segment that remains, operated by such producers as Contura Energy (B2 stable), will be very hard-pressed to generate positive cash margins. The Northern Appalachia and Illinois Basin producing regions will fare better, especially the mines that have low cash costs or locations close to coal-fired power plants that will still be running.

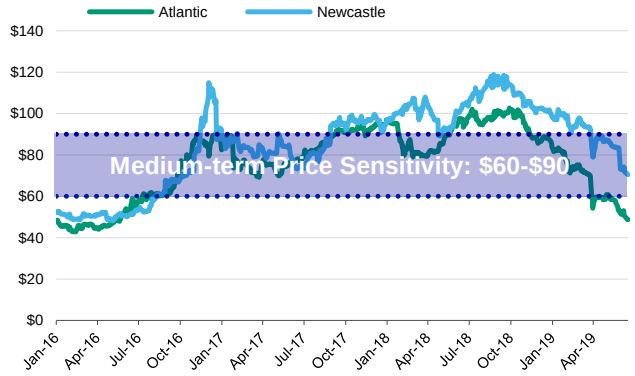
We expect that the coal industry will become even more reliant on exports in the coming decade, though cash flow from coal exports will be volatile. Exports represented just 3%-7% of annual coal disposition between 2000-10, a proportion that increased to about 15% by 2018 as power-generation demand for thermal coal declined and export pricing improved. A meaningful and sustained increase in the volume of coal exported will be challenging, particularly with risks to the economics of coal-fired generation rising in Asia. More than one-quarter of US coal will likely be exported by the early-to-mid 2020s – assuming thermal and metallurgical export prices support reasonable net-backs for producers. Most met coal is exported today, and Alliance Resource Partners (Ba3 stable), CONSOL Energy (B1 stable), and Foresight Energy (B3 stable) already export more than one-quarter of their thermal coal today. While export volumes for thermal coal will fall in 2019, and weakening prices threaten a more significant decline in 2020, export volumes for met coal will remain strong and will continue to drive disproportionately high earnings and cash flows in the near term.

But the emphasis on exports will increase even more over the longer term, as domestic demand for thermal coal falls, though cash flow will be volatile and limit debt capacity. Most exporters of thermal and met coal do not have the cost structures to compete effectively through full price-cycles, as in the thermal export market in the second half of 2019. Lower-rated producers such as Foresight, Murray Energy (Caa1 stable) and Wolverine Fuels (Caa1 stable) could experience stress more quickly, particularly if they cannot address their debt levels and maturities. Individual producers' export logistics and their ability to develop sustainable demand for their coal in such growth regions as India will influence their credit quality as the export market evolves. Exports from US producers will remain a small portion of the global coal trade, with much higher export volumes from countries closer to growth markets like Australia, Russia, and Indonesia, and this will be an ongoing and increasingly significant challenge for domestic producers.

Exhibit 1

Newcastle thermal coal prices have declined into our range...

USD/metric ton



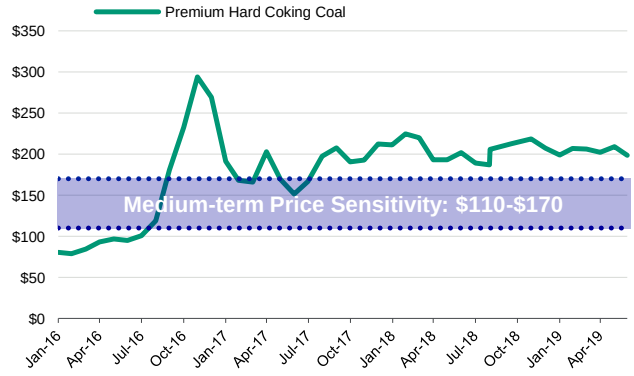
The medium-term sensitivity range applies to Newcastle thermal coal. API2 is shown for illustrative purposes only. Our price ranges, as well as the midpoint, represent baseline prices used to sensitize financial performance and evaluate risk when analyzing credit conditions of companies within the sector. We will periodically review, in light of changing global GDP and supply/demand expectations, these price sensitivities to better assess the resiliency of operating and financial performance of mining companies.

Source: FactSet, Moody's Investors Service

Exhibit 2

...while met coal prices have remained elevated.

Premium hard coking coal Jingtang, USD/metric ton



Our price ranges, as well as the midpoint, represent baseline prices used to sensitize financial performance and evaluate risk when analyzing credit conditions of companies within the sector. We will periodically review, in light of changing global GDP and supply/demand expectations, these price sensitivities to better assess the resiliency of operating and financial performance of mining companies.

Source: Metal Bulletin, Moody's Investors Service

We believe the coal producers' capital allocation reflects their uncertainty about the magnitude and pace of declining demand for thermal coal and the increasing focus on exports. Coal producers faced with ongoing secular decline in thermal coal demand are directing discretionary cash flow toward shareholder returns, and in a few cases considering expanding capacity in certain types of met coal.

Companies such as Conuma (B2 stable) and Warrior Met Coal (B2 stable) only produce met coal today. Other companies such as Arch, Peabody, and Contura produce a mix of met and thermal coal, and already generate significant percentages of their EBITDA and cash flow from met coal. Others that focus primarily on thermal coal are moving more significantly into the met coal market, including CONSOL, with its Itmann project, and Murray, which acquired two met coal mines from Mission Coal.

Still others, most notably Alliance, are investing in non-coal assets to diversify their exposure. But that strategy has proven more difficult than expected for Natural Resource Partners (B2 stable), which diversified away from coal but became overleveraged after a series of acquisitions. Natural Resource Partners has moved to reduce debt by selling some assets issuing new debt, using the proceeds of those efforts to pay off existing debt.

Appendix: Ratings and key metrics for North American coal producers

Exhibit 3

Rated coal companies in North America

Data as of March 31, 2019

Company	Rating	Outlook	Revenues (USD, millions)	EBITDA Margin	Debt/EBITDA
Alliance Resource Operating Partners, L.P.	Ba3	Stable	$2,072.3	33.5%	0.9x
Peabody Energy Corporation	Ba3	Stable	$5,369.7	26.9%	1.1x
Arch Coal, Inc.	Ba3	Stable	$2,431.7	18.5%	0.8x
CONSOL Energy Inc.	B1	Stable	$1,413.3	33.7%	2.0x
Conuma Coal Resources Limited* (Private)	B2	Stable	$621.0	n/a	n/a
Warrior Met Coal, Inc.	B2	Stable	$1,334.5	43.4%	0.6x
Contura Energy, Inc.	B2	Stable	$2,158.0	13.9%	2.7x
Natural Resource Partners L.P.	B2	Stable	$258.4	81.4%	2.9x
Foresight Energy, LLC	B3	Stable	$1,133.3	27.1%	4.1x
Murray Energy Corporation (Private)	Caa1	Stable	$3,700.0	n/a	n/a
Wolverine Fuels Holding, LLC (Private)	Caa1	Stable	$637.0	n/a	n/a

[1] * indicates data as of December 31, 2018 year-end.
[2] Companies marked (Private) are using data from credit opinions.
Source: Moody's Investors Service, Moody's Financial Metrics™

Moody's related publications

Sector In-depth reports:

» Cross-Sector – Global: Natural gas gaining momentum as energy transition awareness moves into spotlight, June 26, 2019

» Power generation – US: FAQ on the economics of renewable energy, battery storage and fossil-fuel power plants, June 12, 2019

» Weak business prospects in Powder River Basin will continue in 2019, April 11, 2019

» Oil and Gas – North America: Natural gas going global amid rising demand, nimble supply, carbon transition, March 21, 2019

» Pricing supports industry in 2019; secular decline remains medium-term risk, January 2019, January 31, 2019

Sector comments:

» Coal - US: High export prices drive buybacks over debt reduction and growth capital, November 26, 2018

» Coal - Global: Increasing price sensitivity ranges for seaborne metallurgical, thermal coal, October 8, 2018

Outlooks:

» Coal – North America: Thermal coal remains in secular decline, but met prices support stable outlook, May 31, 2019

» Base Metals - Global, Steel - US, Coal - US: 2019 outlooks stable on slowing growth (Slides), December 12, 2018

» Coal - North America: Met coal prices support stable outlook, but secular decline for thermal still looms, May 31, 2018

Rating methodology:

» Mining, September 2018

To access any of these reports, click on the entry above. Note that these references are current as of the date of publication of this report and that more recent reports may be available. All research may not be available to all clients.

REPORT NUMBER 1180496

MOODY'S INVESTORS SERVICE

CORPORATES

SECTOR IN-DEPTH
11 April 2019

Rate this Research

TABLE OF CONTENTS

Contacts

Benjamin Nelson +1.212.553.2981
VP-Sr Credit Officer
benjamin.nelson@moodys.com

Dawei Ma, CFA, ACA +1.212.553.6094
Associate Analyst
dawei.ma@moodys.com

Toby Shea +1.212.553.1779
VP-Sr Credit Officer
toby.shea@moodys.com

Brian Oak +1.212.553.2946
MD-Corporate Finance
brian.oak@moodys.com

Coal - North America

Weak business prospects in Powder River Basin will continue in 2019

» **The Powder River Basin (PRB) of eastern Wyoming and Montana, the largest US coal-producing region, faces difficult business conditions today, with no clear solution in sight.** The US coal sector is in secular decline as it competes with natural gas and struggles against strong environmental regulations, and inexpensive natural gas and emissions controls at power plants. These factors have made PRB's low-sulfur coal less competitive. Export opportunities are also less significant compared to other basins due to logistical difficulties, including public opposition to exporting coal from the US west coast. A lack of consolidation in the PRB suggests that the region's economics will not improve on a sustainable basis despite production cuts by major producers in the PRB and stronger market conditions in other major coal basins. Arch Coal, Peabody Energy and Cloud Peak Energy Resources are the major rated producers in the region. Westmoreland has operations in the region, but recently filed for bankruptcy.

» **Major producers are throttling back production, but the industry remains fragmented and some smaller producers are still increasing production.** Higher-heat coals are faring somewhat better than lower-heat coals in the basin, due to an expanding price premium, but margins for rated producers have softened and production cuts are planned for 2019. Three producers represent about three quarters of production in the basin. Arch Coal and Peabody have announced plans to cut production for 2019. Cloud Peak continues to struggle with operational issues and a financially distressed balance sheet. The EIA expects that coal production in the Western region, which includes the PRB, will fall by nearly 10% in 2019.

» **Consolidation is not likely in the near term.** Peabody and Arch are focusing their efforts on producing metallurgical (met) coal, a key component in steelmaking and a stronger market today than thermal coal, and have shown little interest in consolidating the basin. Their balance sheets are far stronger than that of the only rated pure-play PRB producer, Cloud Peak, which is now evaluating strategic alternatives, including selling itself, but its high costs and less productive mines make it an unattractive buying target unless it restructures its considerable debt load.

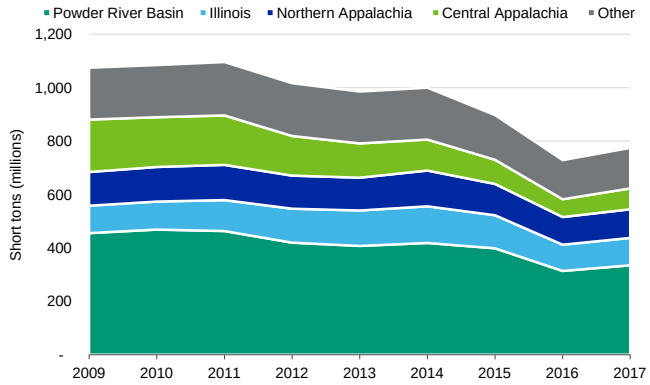
PRB is weakest major coal basin in declining US coal industry

The Powder River Basin (PRB) of eastern Wyoming and Montana, the largest US coal-producing region, faces difficult business conditions today, with no clear solution in sight. Deteriorating business conditions in the PRB have led to production cuts by some major producers, financial stress for producers with weaker credit quality, and a very difficult market for lower-heat coals (8,400 BTU or below). Arch Coal (Ba3 stable) and Peabody Energy (Ba3 stable) both guided toward lower production in the basin for 2019. Cloud Peak Energy Resources (Ca stable) is trying to overcome recent production issues, but missed an interest payment and likely will restructure in the near term.

The US coal industry is facing long-term secular decline driven by a combination of low-cost natural gas, tighter regulations, and a trend toward more renewable energy. Coal production fell by about a third over the past decade with significant regional variation. Central Appalachia (CAPP) has seen the most devastation with a 60% reduction in production from 2009-2017 and its share of the market tell to 10% from 18% over same horizon. CAPP ceded market share to the Illinois Basin and Northern Appalachia. The PRB, the largest coal-producing region in the US by volume, saw significant declines in production and remains vulnerable to continued switching to natural gas, even while holding a consistent share of the US coal market (see Exhibits 1-2).

Exhibit 1

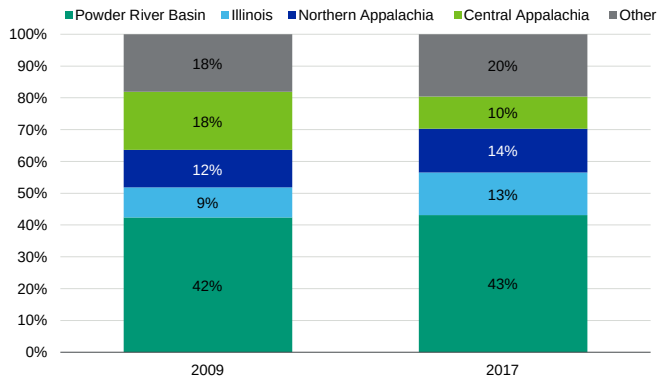
USl coal production fell significantly over the past decade...



Source: US Energy Information Administration (EIA)

Exhibit 2

...with CAPP expericing the most significant share loss.

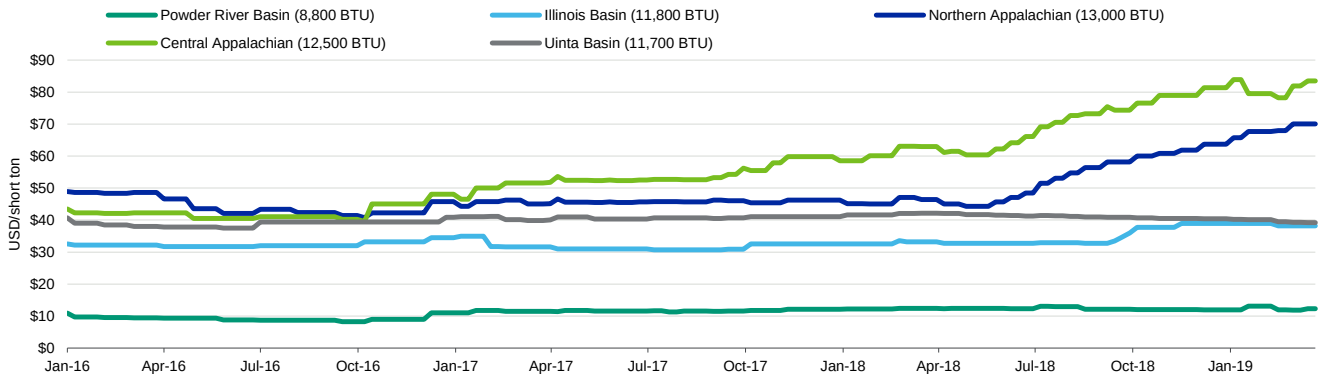


Source: EIA

Several factors make PRB especially vulnerable to the coal industry's decline. PRB's low-sulfur coal gained significant market share after the US adopted stricter emissions rules in the 1990s, but, since the early 2000s, regulators have required power generators to install scrubbers on new power plants. Combined with upgrades to existing plants and closures of older units, an increasing portion of power plants have been able to handle higher sulfur coal. Production of ILB coal, which tends to have high sulfur levels, has actually increased since 2009, as scrubbers have effectively made this high-heat coal more attractive on a relative basis. PRB's low-heat, low-sulfur coal is particularly vulnerable to switching because the smaller, unscrubbed power plants are more likely to retire in the coming years (see Exhibit 3).

Exhibit 3

PRB pricing remains flat while Appalachian pricing is up significantly



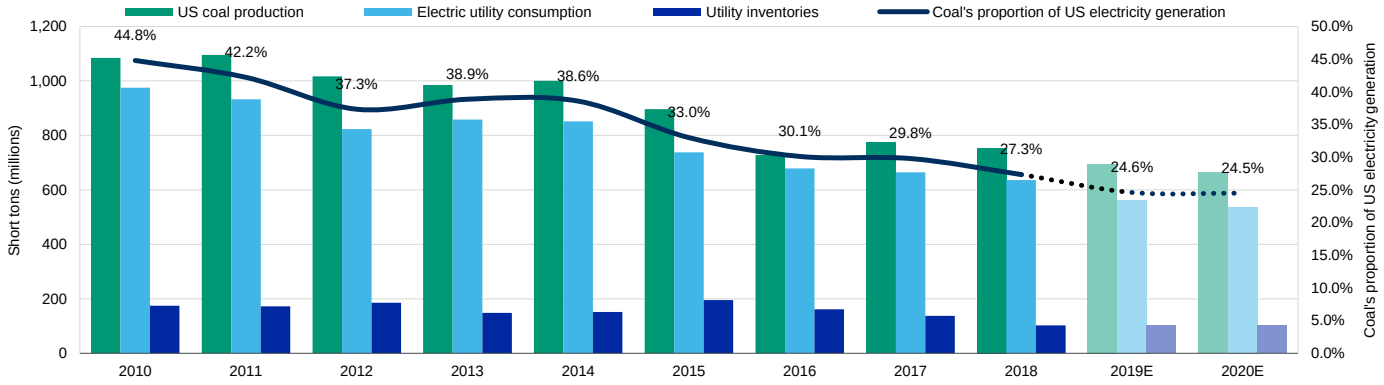
Source: EIA

Our base-case assumption of $2.50-3.50/MMBTU gas prices at the Henry Hub US benchmark through 2020 will make it increasingly difficult for coal to compete with natural gas. While we expect retirements of coal-fired power plants will slow in 2019 compared to 2018, we continue to expect a significant number of retirements over the next several years and, therefore, a significant reduction in demand for coal in the US. PRB is also vulnerable to the development of renewable energy, particularly wind, in a region with more abundant wind resources than other coal-producing basins.

Producers in the PRB also have limited export opportunities compared to producers in the eastern US basins. The combined effect of reduced production in recent years and significantly more exports in the past couple years have led to stronger pricing for eastern coal (see Exhibit 4). Logistical constraints make PRB exports more difficult, with limited port capacity and social opposition to coal exports from western ports. Transportation costs comprise a large proportion of PRB coal's total delivered cost as its low heat content means more tons are needed. As a result, most PRB coal is sold within the US and that is unlikely to change in the medium term.

Exhibit 4

Domestic demand for thermal coal continues to fall, but increased exports have tightened inventories

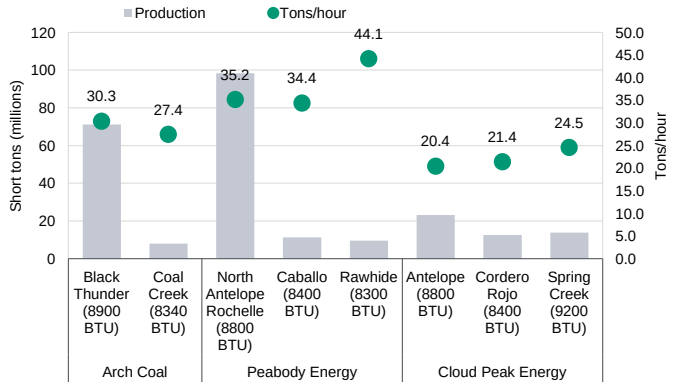


Source: EIA

Big producers throttling back production, while smaller producers ramp up

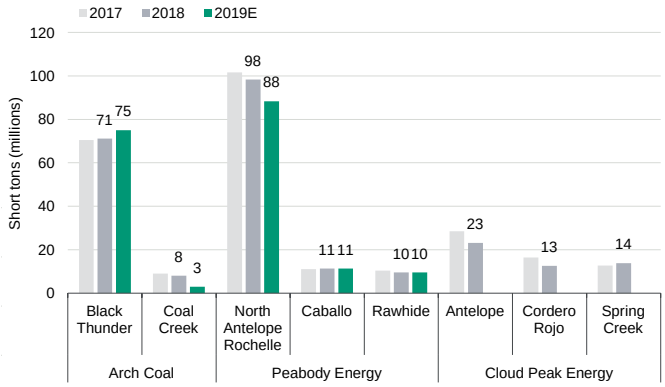
Rated coal producers saw weaker profitability from the PRB in 2018. In response to weakening market conditions, Peabody and Arch Coal plan to reduce production in the basin, where they operate the most productive mines (see Exhibits 6). Peabody plans to cut 10 million tons of annual production in 2019 from its higher-quality (8,800 BTU) and higher-cost coal from the North Antelope Rochelle mine. Arch plans to throttle back the Coal Creek mine, which produces lower heat coal, and focus on the Black Thunder mine, which produces higher heat coal. Higher-heat coals have fared somewhat better with an expanding premium over lower heat coals. We place significant emphasis on understanding mines' production and productivity (see Exhibit 5 and 6), as well as cash costs and net-backs to the mines after considering freight expenses.

Exhibit 5
Mine-level production and productivity
2018 production data



Source: Mine Safety and Health Administration

Exhibit 6
Historical production and guidance for 2019



Note: Cloud Peak did not give guidance for 2019. Forward view includes a combination of guidance statements and our estimates.
Source: Moody's Investors Service estimates

Cloud Peak is less diverse geographically with all operations in the PRB and only three operating coal mines. The company's Antelope mine still has production problems following heavy rains in the second quarter of 2018. Demand is weak for coal from Cloud Peak's Cordero Rojo mine, which produces lower-heat coal. In February 2019, we downgraded Cloud Peak's corporate family rating to Ca to reflect our sense that it is running out of options and the likelihood of a debt restructuring is heightened.

Some small producers coal increased production in 2018. Besides Black Hills Corporation (Baa2 stable), which consumes all the coal it produces from its Wyodak mine internally to generate power, all the other small PRB producers sell low-heat coal, which generates 8,400 BTU or less. In December 2017, Blackjewel bought Belle Ayr mine and Eagle Butte mine from Contura Energy (B2 stable), increasing production at Belle Ayr by 17% in 2018. Production also increased significantly at Lighthouse Resources' Decker mine, up 14% in 2018 from 2017 levels, and at Westmoreland's Absaloka mine (up 7%) and Western Fuels Association's Dry Fork mine (up 4%). Meanwhile, Arch Coal and Peabody, which together produce about 60% of the coal in PRB, will scale back production in 2019 in response to weak commodity prices.

Significant consolidation highly unlikely in near term

Consolidation is a logical step for a fragmented commodity industry experiencing secular decline and depressed profitability, but we expect it will be a slow process in the PRB. Major PRB producers such as Arch Coal and Peabody have shown little interest, while Cloud Peak has little ability to consolidate today. The coal industry has some unique impediments compared to other examples of consolidation that occurred in recent decades. For example, the pace of secular decline is very significant, reclamation liabilities could cause significant cash spending for a producer who buys and shuts down a mine to help improve market conditions, and the longer-term political and regulatory environment remains very uncertain.

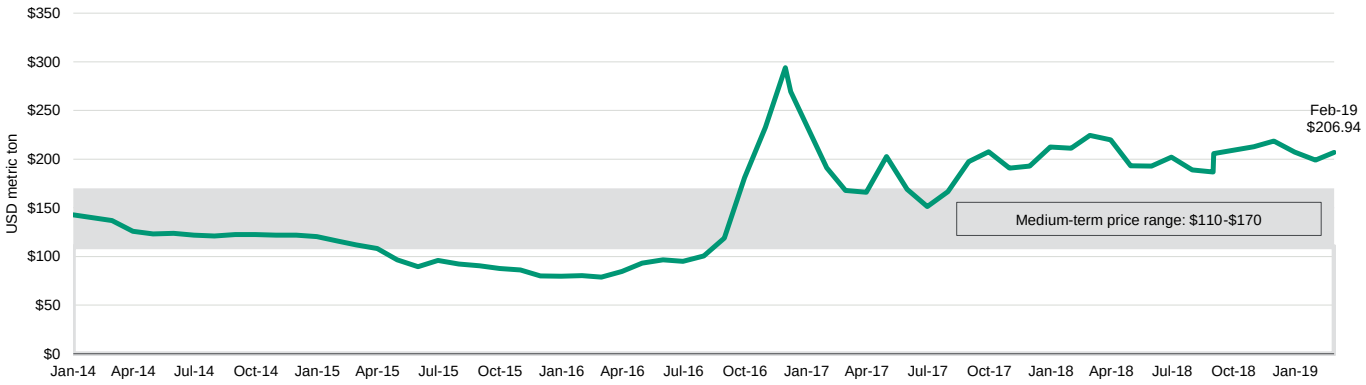
Peabody and Arch Coal have strong balance sheets today, but place emphasis on metallurgical coal and shareholder returns. Both Peabody and Arch Coal have operations in other basins, and both produce thermal and met coal, which steelmakers use to heat blast furnaces. While met coal pricing has been volatile historically, conditions have been strong with prices in early 2019 above $200/

metric ton (MT)—higher than our medium-term price range of $110-$170/MT (see Exhibit 7)—and both companies have discussed deploying capital toward leveraging the met coal market. Peabody added its Shoal Creek Mine, recently acquired from Drummond, and restarting its North Goonyella Mine in Australia, which had been taken offline following a combustion event. Arch Coal is developing its Leer South reserve to increase met coal production. Both companies' management have not expressed interest in consolidating the PRB during recent earnings calls and, as discussed earlier in the report, have adjusted to weaker market conditions by scaling back production at their own mines.

Exhibit 7

Met coal pricing is still above our medium-term price range

USD/metric ton, CFR Jingtang



Source: Metal Bulletin

Cloud Peak is focused exclusively on the PRB and announced publicly that the company is evaluating strategic alternatives. Other instances of financial distress, such as Alpha's bankruptcy that led to Blackjewel acquiring two mines from Contura in late 2017 and Westmoreland's recent bankruptcy, which led to Western Coal Acquisitions Partners' pending but approved purchase of the Kemmerer mine, resulted in new ownership rather than closed mines.

Appendix: Key financial metrics and comparisons for PRB coal producers

Exhibit 8

Revenue, margin and leverage for all rated coal producers

Company	Rating	Outlook	Revenue (millions)	EBITDA margin	Debt/ EBITDA
Teck Resources Limited	Baa3	Stable	$9,698	50.4%	0.95x
Alliance Resource Operating Partners, L.P.	Ba3	Stable	$2,003	33.3%	1.22x
Peabody Energy Corporation	Ba3	Stable	$5,582	28.4%	1.22x
Arch Coal, Inc.	Ba3	Stable	$2,452	18.3%	0.84x
CONSOL Energy Inc.	B1	Stable	$1,429	36.1%	2.14x
Conuma Coal Resources Limited (Private)	B2	Stable	$621	n/a	n/a
Warrior Met Coal, Inc.	B2	Stable	$1,378	44.6%	0.77x
Contura Energy, Inc.	B2	Stable	$2,031	15.6%	2.60x
Natural Resource Partners L.P.	B3	Positive	$251	81.7%	3.35x
Foresight Energy, LLC	B3	Stable	$1,105	28.0%	4.22x
Murray Energy Corporation (Private)	Caa1	Stable	$3,000	n/a	n/a
Bowie Resource Partners LLC (Private)	Caa1	Stable	$576	n/a	n/a
Cloud Peak Energy Resources LLC	Ca	Stable	$832	9.7%	4.40x

Data for public companies is consistent with the most recent reporting period. Data for private companies is consistent with most recent published Credit Opinion report available on Moodys.com.

Source: Moody's Financial Metrics™; Moody's Investors Service (ratings)

Moody's related publications

Outlooks:

» Base Metals - Global, Steel - US, Coal - US: 2019 outlooks stable on slowing growth (Slides), December 12, 2018

» Coal - North America: Met coal prices support stable outlook, but secular decline for thermal still looms, May 31, 2018

Sector in-depth reports:

» Coal – US: Pricing supports industry in 2019; secular decline remains medium-term risk, January 31, 2019

» Environmental Risks – Global: Heat map: 11 sectors with $2.2 trillion debt have elevated environmental risk exposure, September 25, 2018

Sector comments:

» Coal - US: High export prices drive buybacks over debt reduction and growth capital, November 26, 2018

» Coal - Global: Increasing price sensitivity ranges for seaborne metallurgical, thermal coal, October 8, 2018

Rating methodology:

» Mining, September 2018

To access any of these reports, click on the entry above. Note that these references are current as of the date of publication of this report and that more recent reports may be available. All research may not be available to all clients.

REPORT NUMBER 1163008

MOODY'S INVESTORS SERVICE

CORPORATES

OUTLOOK
31 May 2019

Rate this Research

TABLE OF CONTENTS

Contacts

Benjamin Nelson +1.212.553.2981
VP-Sr Credit Officer
benjamin.nelson@moodys.com

Dawei Ma, CFA, ACA +1.212.553.6094
Associate Analyst
dawei.ma@moodys.com

Jamie Koutsoukis +1.416.214.3845
VP-Senior Analyst
jamie.koutsoukis@moodys.com

Toby Shea +1.212.553.1779
VP-Sr Credit Officer
toby.shea@moodys.com

Glenn B. Eckert, CFA +1.212.553.1618
Associate Managing Director
glenn.eckert@moodys.com

Coal – North America

Thermal coal remains in secular decline, but met prices support stable outlook

Our outlook for the North American Coal industry is stable. This outlook reflects our expectations for the fundamental business conditions in the industry over the next 12 to 18 months.

» **Our stable outlook for the North American coal industry reflects our expectations for flat to slightly lower EBITDA through mid-2020.** Thermal coal production will drop following significant coal retirements in 2018, but prices remain favorable for most coals. US demand for thermal coal remains in secular decline and the price of metallurgical (met) coal will remain volatile. A negative outlook signals an anticipated decline of more than 3%; a significant drop in met coal or thermal coal prices would likely tip the outlook negative. Our longer term concern is growing with a confluence of economic, environmental, and social factors that weigh heavily on long term demand.

» **Conditions vary significantly by coal basin and the regional exposure for rated producers is very uneven.** Northern Appalachia (NAPP) producers such as CONSOL Energy and Contura Energy market coal to both thermal and met customers. Illinois Basin (ILB) producers such as Alliance Resources and Foresight Energy benefit from low-cost operations and access to the seaborne thermal market through Gulf Coast ports, despite periodic weather-related hurdles, as in early 2019. Central Appalachia remains very strained from falling demand for thermal coal by utilities in the US south, but met volumes have held up well. Powder River Basin (PRB) producers in the US west are highly vulnerable to falling demand, given their distance from most utility customers and social opposition to exports in the Pacific Northwest.

» **Our outlook for met coal used in steelmaking is more favorable, but new met capacity is on the horizon and conditions for European steelmakers are weakening.** Met coal prices are higher than a few years ago, but spot prices are still occasionally weak, and risks are rising for rated met coal producers through both organic and acquisition activity. Contura, Peabody Energy and Murray Energy picked up met coal capacity through mergers and acquisitions, while CONSOL, Contura and Warrior Met Coal have discussed new met coal projects. Only Peabody, with met coal assets in Australia, is diversified geographically beyond the US. China remains a significant influence on the met coal market and a catalyst for price volatility.

Secular decline is the dominant trend for thermal coal

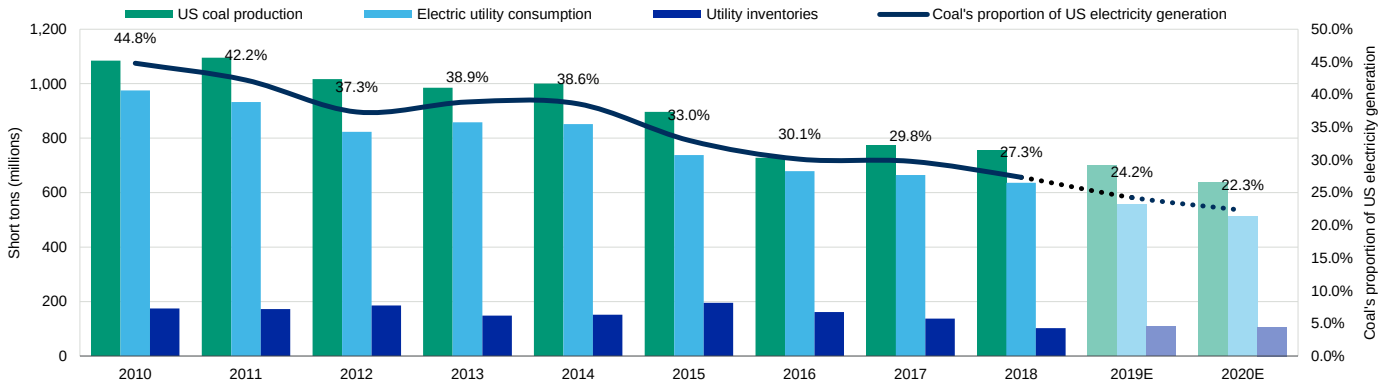
Our stable outlook for the North American coal industry reflects our expectations for flat to slightly lower EBITDA through mid-2020. US thermal coal production is set to drop through 2019 following significant coal retirements in 2018, and thermal coal demand remains in secular decline. Commodity prices will still remain favorable for most types of coal over our outlook period, but prices will remain volatile for metallurgical (met) coal.

A negative outlook signals an anticipated decline in coal industry EBITDA of more than 3%; a significant drop in met coal or thermal coal prices would likely tip the outlook negative. A change to a positive outlook is unlikely today, and would require our confidence that the sector's average EBITDA was likely to rise by more than 7% over the 12-to-18-month outlook period.

We expect further modest retirements in coal-fired power generation based on announced plans for 2019-20, but the pace and magnitude of retirements remains uncertain for the early 2020s. Consumption of coal by electric utilities declined significantly during the 2010s, retiring roughly half of their coal-fired capacity over the decade, including 6% in 2018 alone. Domestic demand for thermal coal will continue to fall as electricity generated from coal-fired power plants, with an average capacity factor of about 50% today, continues to decline in the coming years. Utilities and power generation companies will replace most of the retiring plants with combined-cycle gas-fired power plants, rather than renewable energy, but coal will continue to fall in the fuel mix as natural gas prices remain at levels that support continued coal-to-gas switching by utilities (see our report, "Oil and Gas – North America: Natural gas going global amid rising demand, nimble supply, carbon transition," March 21, 2019).

Domestic demand for thermal coal will therefore continue to erode rapidly. According to the US Energy Information Administration (EIA), US electric power generation consumed about 636 million tons of coal in 2018, down from about 1 billion tons in 2008, and will fall to about 555 million tons in 2019 (see Exhibit 1). The EIA expects that production will fall by more than 7% in 2019 with the most significant declines occuring in the Western region, which includes the Powder River Basin. The power sector represents more than 90% of US coal consumption. The export market for thermal coal has increased again in recent years, and higher met coal prices mean that some crossover tons with met-like characteristics can be placed into the met export market. Even so, we do not expect these opportunities will be strong enough to offset the anticipated decline in demand from power customers and our concern is growing that retirements could accelerate once again at some point in the early 2020s.

Exhibit 1
Secular decline continues in US thermal coal

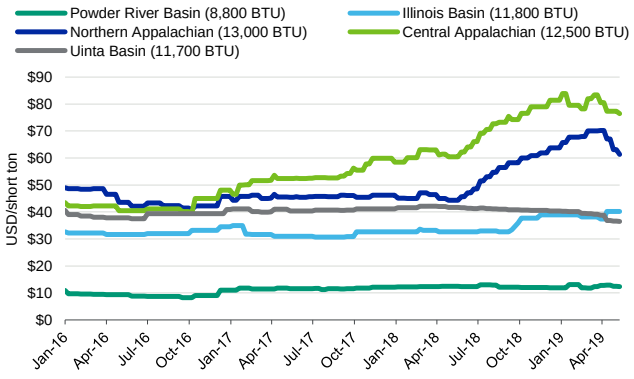


Note: Data as of May 23, 2019
Source: EIA

Thermal coal pricing is stronger today than a few years ago (see Exhibit 2), buoyed by capacity rationalization earlier in the decade and better export opportunities since roughly 2016. As US power generation moved away from coal, some producers responded by reducing their domestic emphasis and exporting more thermal coal (see Exhibit 3). But this shift is not sustainable through a full

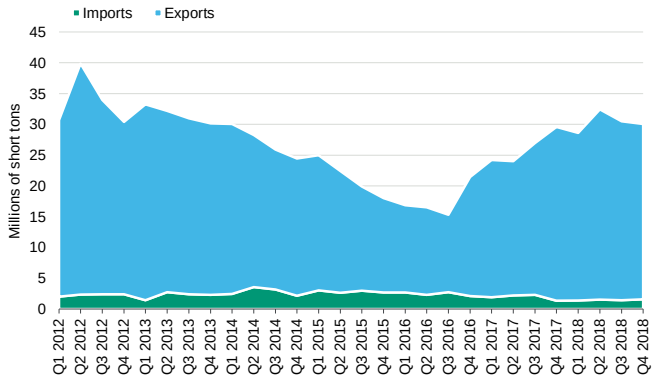
commodity-price cycle because delivery costs to reach distant markets such as China and India will make exports less profitable, if not unprofitable, when pricing eventually does retreat, forcing producers to sell to domestic customers at lower prices, or cut production.

Exhibit 2
Thermal coal pricing is generally stronger than a few years ago



Source: EIA

Exhibit 3
Exports began increasing significantly in 2016



Source: EIA

A recent downdraft in Atlantic basin thermal export prices (API2) and to a lesser extent Pacific basin thermal export prices (Newcastle), if sustained, would start having this effect in the second half of 2019, hurting individual producers with a lag due to differences in contract positions. Some producers such as CONSOL Energy (B1 stable), control export facilities and contract aggressively to lock in pricing. Certain rated producers are less exposed to a downturn in thermal coal pricing: Peabody Energy (Ba3 stable) has significant operations outside the US, while Warrior Met Coal (B2 stable) and Conuma (B2 stable) do not produce thermal coal at all. Canada's Teck Resources (Baa3 stable), a diversified mining company that has significant operations outside of coal, also produces met, not thermal coal.

We incorporate expectations for lower coal prices and lower cash margins into our ratings with the assumption that higher-rated producers will retain adequate credit quality based on credit metrics that are mostly very strong for their ratings today. Therefore, the potential credit impact of this scenario likely will be the most significant for companies at the lower end of the rating spectrum, including Murray Energy (Caa1 stable) and Wolverine Fuels (Caa1 stable), where it would threaten to create cash flow and liquidity problems. Cloud Peak Energy in May 2019 filed for bankruptcy protection following an operational problem with a key mine, combined with ongoing tight margins in the Powder River Basin (PRB).

PRB is most stressed US coal basin; exports drive profitability elsewhere

PRB is the most vulnerable coal basin today (see our report, "Weak business prospects in Powder River Basin will continue in 2019," April 11, 2019). The generally low-sulfur, low-heat coal produced in the PRB, in Montana and Wyoming, comes from mines in sparsely-populated areas far from most coal-fired power plants, requiring shipping to customers over long distances. Surface mines with significant scale help producers keep costs down, which is important considering the freight considerations, but PRB coal is still vulnerable to utilities switching away from coal. Although PRB coal's low sulfur content still allows its use by older and unscrubbed power plants, new gas-fired generation will continue to replace these plants, and wind energy is growing as a source of power generation in the western US.

Producers operating some of the largest PRB mines have throttled back production, including Peabody and Arch Coal (Ba3 stable). Following the bankruptcies of Westmoreland Coal, which operated one PRB mine, and Cloud Peak Energy, which operates exclusively in that region, the remaining PRB producers have strong balance sheets and emphasize operations elsewhere. Coal production in the PRB was 324 million tons in 2018, down 3% from 334 million tons in 2017. We expect that coal production in the PRB will experience the most significant decline in 2019.

The Northern Appalachian (NAPP) region, by contrast, is fairly well positioned today, serving both thermal and met customers; CONSOL Energy and Contura Energy (B2 stable) both produce coal that they can sell into both markets. Murray Energy is a very

significant producer of Appalachian thermal coal, making aggressive moves in the region recent years such as its recent purchase of met coal mines from bankrupt Mission Coal. Coal production in NAPP was 106 million tons in 2018, down 1% from 107 million tons in 2017.

Illinois Basin (ILB) producers such as Alliance Resource Partners (Ba3 stable) and Foresight Energy (B3 stable) should fare well in 2019. ILB coal has high heat and high sulfur, but is sold mostly to large baseload power plants with the latest scrubbing equipment. Low-cost longwall mining technology is used extensively in this region, which helps support competitive cost positions and enables ILB producers to sell to utilities located to the east. ILB coal can also be exported, and ready access to the Gulf Coast helps ILB coal compete in the seaborne thermal markets, which can ease or offset temporary shocks in domestic demand but also create some exposure to export price volatility. ILB coal production reached 107 million tons in 2018, up over 3% from 103 million tons in 2017.

Central Appalachia (CAPP) has lost substantial significance over the past decade, with production down by about three-quarters. ILB thermal coal and utility switching to natural gas have significantly reduced demand for CAPP coal. Although CAPP coal tends to have positive characteristics such as high heat and low sulfur content, adverse geology raises production costs in underground mines, and the CAPP region is less proximate to key power plants, which makes it more difficult to ship its higher-cost coal. Utilities in the region are also quickly moving away from coal, and CAPP's higher prices make its coal less attractive to utilities with scrubbing technology, which can buy cheaper higher-sulfur ILB and NAPP coal instead. Coal production in CAPP was 79 million tons in 2018, up 1% from 78 million tons in 2017.

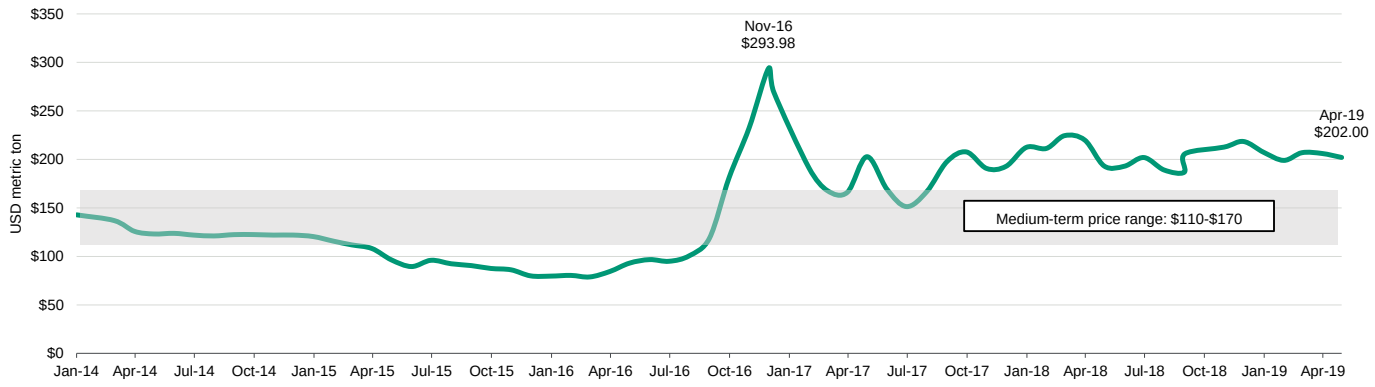
Robust met coal pricing in 2019 still volatile for long-term

Our outlook for met coal is more favorable today than our outlook for thermal coal, but met coal prices will remain volatile over a longer horizon. While thermal coal production is in long-term secular decline amid continued switching by utilities, met coal fundamentals are stronger, with generally stable conditions in the global steel industry, and very modest recent investment in new met coal capacity, which might otherwise have diluted commodity prices. Pricing for met coal remains relatively high with key reference prices in mid-2019 tracking near $200/metric ton (MT)—well above our medium-term sensitivity range of $110-$170/MT (see Exhibit 4). Our medium-term sensitivity range is based upon seaborne prices and the broader met coal trade around the world, with significant emphasis on conditions outside the US, particularly in Europe, the destination for most US met coal, and Asia, the destination for most met coal produced in Canada. We revised our outlook for the European steel industry to negative in late May 2019 and expect challenges in that region related to slowing economic growth and weakening end markets, especially auto.

Exhibit 4

Met coal price in mid-2019 exceeded our medium-term sensitivity range

USD/MT, CFR Jingtang



Source: Metal Bulletin; Moody's Investors Service (medium-term price range)

Current pricing supports strong cash flow generation for the rated met-focused coal producers. However, met coal prices have fluctuated wildly in the past and likely will remain volatile over a longer horizon, with some of the US capacity representing swing capacity in the global market. During a period of low met coal prices in 2015-16, many high-cost met coal producers experienced margin compression, and some filed for bankruptcy protection. We assume met coal prices will trend in the medium-term toward our sensitivity range, with sustained periods of high pricing bringing new supply to the market and pushing prices back down again. We also

anticipate that China's shift toward a more consumer-based economy will cut both its steel production and met coal demand in that key market, which anyway is closer geographically to the low-cost met coal producers of Australia.

New project announcements picked up in late 2018 and early 2019, following a long absence, but such amounts of new capacity will not affect the met coal market significantly. Several rated companies have announced new met coal projects or begun discussing potential new projects. A significant portion of this activity has been concentrated in the High Vol A segment of the market. Recent examples include Arch's Leer South project, Warrior's Blue Creek project, CONSOL's Itmann project, Contura's Lynn Branch project, as well as some others from unrated producers.

Appendix: Ratings and key metrics for rated North American coal producers

Exhibit 5
Rated coal companies in North America
Date as of March 31, 2019

Company	Rating	Outlook	Revenue (millions)	EBITDA margin	Debt/ EBITDA
Alliance Resource Operating Partners, L.P.	Ba3	Stable	$2,072	33.5%	0.91x
Peabody Energy Corporation	Ba3	Stable	$5,370	26.9%	1.07x
Arch Coal, Inc.	Ba3	Stable	$2,432	18.5%	0.78x
CONSOL Energy Inc.	B1	Stable	$1,413	33.7%	1.98x
Conuma Coal Resources Limited (Private)	B2	Stable	$621*	n/a	n/a
Warrior Met Coal, Inc.	B2	Stable	$1,335	43.4%	0.61x
Contura Energy, Inc.	B2	Stable	$2,158	13.9%	2.74x
Natural Resource Partners L.P.	B2	Stable	$258	81.4%	2.87x
Foresight Energy, LLC	B3	Stable	$1,133	27.1%	4.12x
Murray Energy Corporation (Private)	Caa1	Stable	$3,000*	n/a	n/a
Wolverine Fuels Holding, LLC (Private)	Caa1	Stable	$637*	n/a	n/a

* From the latest credit opinion
Source: Moody's Investors Service (ratings/outlooks); Moody's Financial Metrics™

Moody's related publications

Sector In-depth reports:

» Weak business prospects in Powder River Basin will continue in 2019, April 11, 2019

» Oil and Gas – North America: Natural gas going global amid rising demand, nimble supply, carbon transition, March 21, 2019

» Pricing supports industry in 2019; secular decline remains medium-term risk, January 2019, January 31, 2019

Sector comments:

» Coal - US: High export prices drive buybacks over debt reduction and growth capital, November 26, 2018

» Coal - Global: Increasing price sensitivity ranges for seaborne metallurgical, thermal coal, October 8, 2018

Outlooks:

» Base Metals - Global, Steel - US, Coal - US: 2019 outlooks stable on slowing growth (Slides), December 12, 2018

» Coal - North America: Met coal prices support stable outlook, but secular decline for thermal still looms, May 31, 2018

Rating methodology:

» Mining, September 2018

To access any of these reports, click on the entry above. Note that these references are current as of the date of publication of this report and that more recent reports may be available. All research may not be available to all clients.

REPORT NUMBER 1176170

MOODY'S INVESTORS SERVICE

MOODY'S INVESTORS SERVICE

CORPORATES

OUTLOOK
21 August 2019

Rate this Research

Contacts

Benjamin Nelson +1.212.553.2981
VP-Sr Credit Officer
benjamin.nelson@moodys.com

Glenn B. Eckert, CFA +1.212.553.1618
Associate Managing Director
glenn.eckert@moodys.com

Dawei Ma, CFA, ACA +1.212.553.6094
Associate Analyst
dawei.ma@moodys.com

CLIENT SERVICES

Americas	1-212-553-1653
Asia Pacific	852-3551-3077
Japan	81-3-5408-4100
EMEA	44-20-7772-5454

Coal – North America

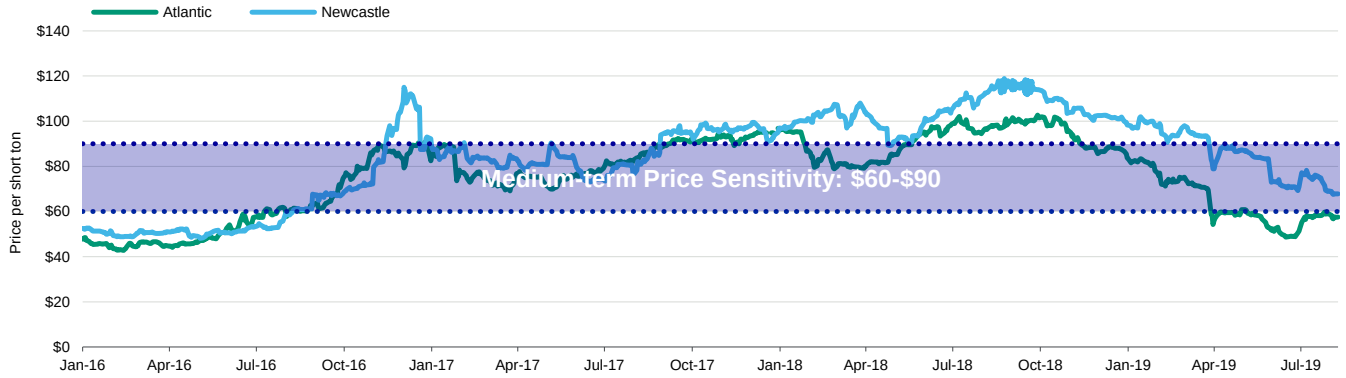
Weak export prices tip outlook to negative

» **Profitability will worsen in the next 12-18 months.** Our negative outlook for the North American coal industry reflects our expectation for weaker EBITDA in the second half of 2019 and meaningfully weaker EBITDA in 2020. The EBITDA decline is expected to be more than 3% over the next 12 months, a trigger to change our outlook to negative. A substantive decrease in export prices for thermal coal, particularly in Europe, combined with mostly open contract positions for some producers in 2020, will drive this decline. Weakness in the steel industry will also result in lower earnings for metallurgical coal operations, though pricing remains favorable compared with historical levels. A confluence of economic, environmental, and social factors also increase our concerns about the industry's longer-term demand prospects, as pressure on the industry is mounting, which makes numerous coal mines uneconomic in a reduced demand environment, especially smaller, higher cost mines that are highly vulnerable to retirement of specific coal-fired power plants.

» **Our outlook for thermal coal is increasingly stressed as economic, environmental, and social factors weigh heavily on demand from utilities.** Our long-term outlook for US thermal coal calls for a substantial volume reduction over the next decade driven by utilities switching to natural gas and renewable energy, which still benefits from government subsidies today. However, stronger conditions in the export market over the past couple years helped prop up prices and allow many producers to generate meaningful cash flow to fund shareholder returns. We expect a combination of significant retirement of coal-fired power plants in 2018, combined with a now-weakened export market, will bring more tons back into the domestic market and could drive prices lower, especially if natural gas prices remain very low and coal producers attempt to maintain production near current levels. Rated producers are well contracted through 2019, but many have substantial open positions beyond that and only a few, such as Consol Energy (B1 stable), have contracted the vast majority of their volumes for 2020. Alliance (Ba3 stable), CONSOL, Foresight Energy (B3 stable), Murray Energy (Caa1 stable), and Wolverine Fuels (Caa1 stable) are heavily concentrated in domestic thermal coal. Some producers, such as Peabody Energy (Ba3 stable), are more diverse operationally, geographically, and across coal types.

Exhibit 1

Thermal export prices drop significantly

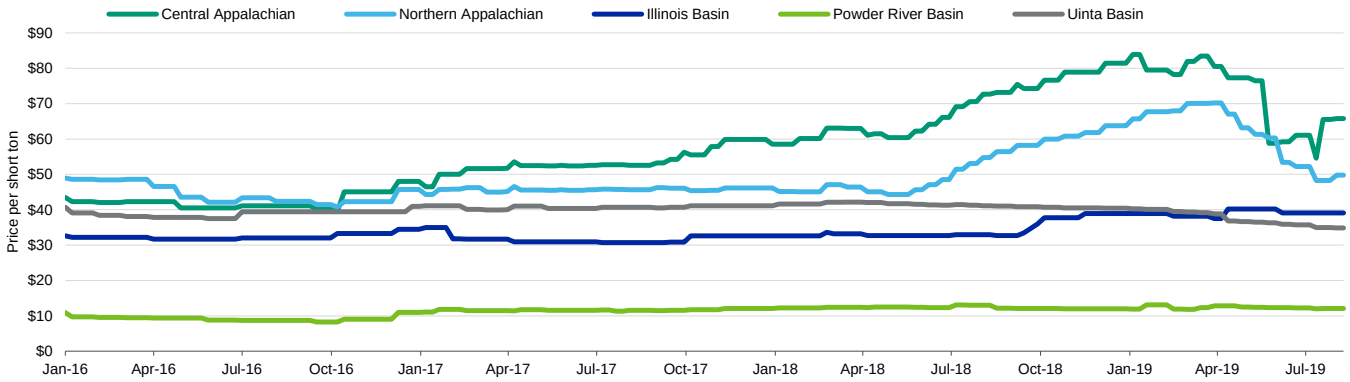


Source: Factset. Our price ranges, as well as the midpoint, represent baseline prices we use to sensitize financial performance and evaluate risk when analyzing credit conditions of companies within the sector. We will periodically review, in light of changing global GDP and supply/demand expectations, these price sensitivities to better assess the resiliency of operating and financial performance of mining companies.

» **Our medium-term price sensitivity range for export coal are unchanged.** For Newcastle thermal coal we use a medium term price sensitivity range of $60-$90/metric tonne and $110-$170/metric ton for high-quality met coal. Our most recent revision to the sensitivity ranges in October 2018 incorporated the benefit from very limited investment in new mines over the past several years. While we expected price volatility for exports and believed thermal coal prices would moderate during the next couple years, the pace and magnitude of the decline for thermal coal in the Atlantic Basin exceeded our expectations. Relatively mild weather, continued emphasis on renewables, and import restrictions by China remain a downside risk for prices in the Pacific Basin. Over a longer horizon, as demand for thermal coal declines in the United States, we expect the industry will become more dependent on export thermal and met coal.

Exhibit 2

Domestic thermal prices declined over last several months



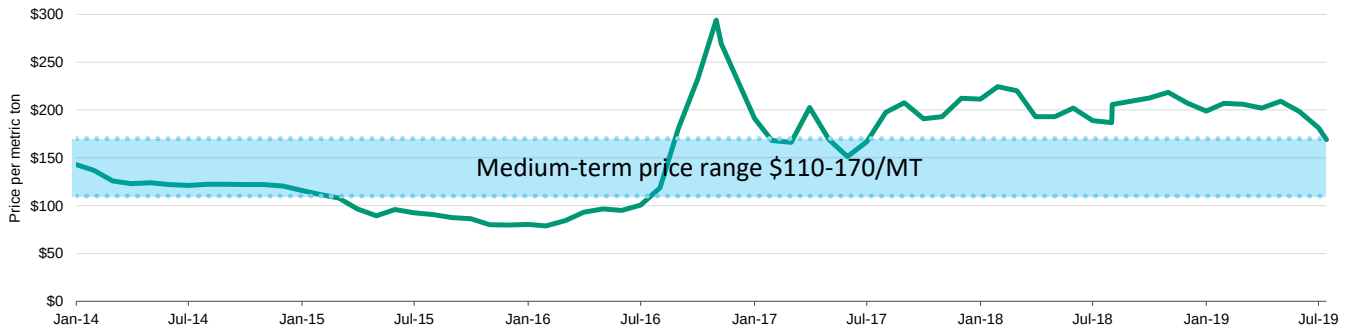
Source: EIA

» **Our outlook for met coal used in steelmaking is more favorable.** Some factors contributing to recent price weakness are temporary, but end-market demand from steelmakers is weakening and escalating trade tensions increase uncertainty heading into 2020. Our outlook for the European steel industry is negative and, while our outlook for the US steel industry is stable, steel producers' earnings will be down in 2019, with EAF producers faring better than those operating blast furnaces. Conditions for steelmakers in Asia are also weakening, particularly in China, where rising domestic supply of met coal and weakening demand by steelmakers are expected to pressure met coal pricing. Some met coal, like Contura Energy (B2 stable), are throttling back production a bit. Numerous miners announced acquisitions or potential expansions in met coal, including Arch Coal (Ba3 stable), Contura, CONSOL, Murray, Peabody, and Warrior Met Coal (B2 stable). Pricing remains at levels that will support reasonable earnings for producers, though somewhat lower than the figures for 2017 through early 2019. Over a longer horizon, we remain concerned that demand for metallurgical coal could tip into secular decline as the steel industry continues to shift toward electric arc furnaces, which recycle scrap steel, rather than basic oxygen furnaces, which make steel from pig iron from a blast furnace, which uses raw materials including metallurgical coal.

Exhibit 3

Metallurgical coal price dips to our medium-term price range

$/MT CFR Jingtang



Source: Metal Bulletin. Our price ranges, as well as the midpoint, represent baseline prices we use to sensitize financial performance and evaluate risk when analyzing credit conditions of companies within the sector. We will periodically review, in light of changing global GDP and supply/demand expectations, these price sensitivities to better assess the resiliency of operating and financial performance of mining companies.

Moody's related publications

Sector In-Depth

» FAQ on the economics of renewable energy, battery storage and fossil-fuel power plants, June 2019

Outlook

» Thermal coal remains in secular decline, but met prices support stable outlook, May 2019

» Outlook moves to negative on slowing end user demand, weaker steel spreads, May 2019

» Industry performance to remain solid on favorable fundamentals, economic factors, February 2019

» Steel-Asia 2019 outlook, November 2018

To access any of these reports, click on the entry above. Note that these references are current as of the date of publication of this report and that more recent reports may be available. All research may not be available to all clients.

REPORT NUMBER 1190520

CLIENT SERVICES

Americas	1-212-553-1653
Asia Pacific	852-3551-3077
Japan	81-3-5408-4100
EMEA	44-20-7772-5454

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 52

Witness: Michael P. Drake

Q-52. Explain whether any of the Companies' generating and/or transmission facilities are required to meet any North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection standards. If so:

a. explain whether the Companies' generating facilities have been designated as low, medium or high impact;

b. provide the costs of meeting such standards (both initial and on-going costs), and how they are calculated into the overall costs of these facilities; and

c. explain whether those costs are significant enough for them to be taken into consideration in the IRP modeling, and if so, how.

A-52. Yes, Generating and Transmission Facilities.

a. LKE Generating Facilities operate as low impact.

b. Initial costs of meeting standards: $1,808,000. Ongoing costs calculated into centralized support group costs.

c. These costs are maintained within centralized support group. Not significant enough to have costs be taken into consideration for IRP modeling.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 53

Witness: Thomas A. Jessee

Q-53. Provide an update on the status of the Companies' Joint Application with the FERC [15] to remove the merger mitigation de-pancaking component of their Rate Schedule No. 402.

A-53. On March 21, 2019, FERC issued an order conditionally granting the Companies' request to remove the merger mitigation de-pancaking ("MMD") component of Rate Schedule No. 402, subject to implementation of a transition mechanism for certain power supply arrangements.[16] On July 12, 2019, the Companies filed a proposed transition mechanism agreement in accordance with FERC's March 21, 2019 order.[17] FERC rejected the transition mechanism agreement proposed by the Companies in an order issued September 10, 2019.[18] Contemporaneous with the order rejecting the proposed transition mechanism agreement, on September 10, 2019, FERC also issued an order denying rehearing of its March 21, 2019 order but granting certain "clarifications" requested by intervenors that substantively modified the results of the March 21, 2019 order.[19] On October 10, 2019, the Companies filed requests for rehearing of both the order rejecting the transition mechanism and the "clarifications" issued by FERC. A request for rehearing and clarification of both orders was also filed by several intervenors. This matter is ongoing.

[15] FERC Docket Nos. EC98-2-00 and ER 18-2162-000.
[16] FERC required that LG&E/KU provide a transition mechanism for those customers located in the LG&E/KU market that reasonably relied on the de-pancaking mitigation. *See Louisville Gas and Elec. Co. and Kentucky Utilities Co*., 166 FERC ¶ 61,206, at P 34 (2019) (March 21, 2019).
[17] *Joint Application of Louisville Gas and Electric Company and Kentucky Utilities Company pursuant to FPA Section 205 of an Unexecuted Transition Mechanism Agreement*, FERC Docket Nos. ER19-2396-000 and ER19-2397-000.
[18] *See Louisville Gas and Elec. Co. and Kentucky Utilities Co.*, 168 FERC ¶61,151 (September 10, 2019).
[19] *See Louisville Gas and Elec. Co. and Kentucky Utilities Co.*, 168 FERC ¶61,152 (September 10, 2019).

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 54

Witness: Stuart A. Wilson

Q-54. Reference IRP sections pertaining to load forecast. Explain whether the Companies' load forecasts took into consideration the projected 15-year compound annual growth rate in peak demands developed by both MISO and PJM for: (i) their respective zones located closest to the Companies' service territories; and (ii) for the entire footprint of both RTOs.

A-54. While the Companies consider load forecasts of other utilities and RTOs to assess the reasonableness of their load forecast, load forecasts from other utilities or RTOs are not used as inputs to the Companies' load forecast models.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 55

Witness: Stuart A. Wilson

Q-55. Provide the projected peak load forecast for each company, by year, from the Companies' last IRP filing. Provide also the actual peak load for each of the last three (3) years for both companies.

A-55. The table below contains peak demand forecasts by company, by year as shown in table 5.(3)-5 on page 5-27 and table 5.(3)-8 on page 5-31 of Vol. I of the 2014 IRP as well as actual peaks by company, by year, for the last three years.

Year	KU Forecast	LG&E Forecast	KU Actual	LG&E Actual
2014	4,334	2,655		
2015	4,360	2,679		
2016	4,391	2,693	4,415	2,543
2017	4,425	2,720	4,004	2,608
2018	4,462	2,737	4,790	2,618
2019	4,505	2,752		
2020	4,538	2,779		
2021	4,577	2,798		
2022	4,602	2,832		
2023	4,628	2,860		
2024	4,670	2,873		
2025	4,709	2,888		
2026	4,742	2,912		
2027	4,767	2,943		
2028	4,784	2,982		

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 56

Witness: Daniel K. Arbough / Stuart A. Wilson

Q-56. Provide copies of any presentations the Companies and/or their parent companies may have made to investors regarding their plans for capital investments in the next five (5) years.

a. Provide the IRP's high and low cost scenarios for investment plans over the same time period.

A-56. All presentations made to investors discussing capital investments over the next five years are available on the PPL web site via the link below:
https://pplweb.investorroom.com/events#past:2019:10

a. The IRP did not evaluate high and low cost scenarios for investment plans.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 57

Witness: Michael P. Drake

Q-57. Provide the most-current remaining life assessment for Brown unit no. 3.

A-57. See attached.

Generation Services Engineering 2018 Steam Only Depreciation Study Evaluation

[CONFIDENTIAL]

5/25/18

Methodology

Many factors influence the end of life for a generating station. To complete this analysis the following assumptions were made regarding factors outside the direct technical evaluation:

- All necessary environmental permits and licenses will be maintained
- Future changes in environmental regulations are a consideration for unit retirement
- Units will continue to operate in a manner that is consistent with recent operating practices, with a similar number of annual starts and stops, and annual generation
- Units will continue to be operated in accordance with good industry practices with required renewals and replacements made in a timely manner

The steam generating units were reviewed at a high level and although many individual components could fail it was decided that those would not constitute an “end of life” event and could be mitigated. The boiler drum and turbine/generator were the two components/systems identified where catastrophic failure would be consideration for retirement.

Although the boiler is a complex system with many elements, the boiler drum is a large single component with approximately 240k hours of defined life and is significantly influenced by thermal cycling. Electric Power Research Institute (EPRI) studies indicate that after approximately 1,700 normal start/stop cycles the risk of a critical flaw developing is greatly increased.

The turbine/generator is a single system, whose failure could lead to significant downtime and repair/replacement costs. Several key factors are taken into consideration when evaluating the generator such as insulation type, winding age, recent inspection findings, and test results. Wear, cracking, and blade condition are key considerations for the turbine.

Review

The depreciation review process conducted by Generation Engineering consisted of evaluating key parameters (i.e. pressures, temperatures, voltages etc..) with equipment condition (i.e. inspection data, EPRI, IEEE, etc..) to provide a risk based assessment regarding the likelihood of equipment failure as compared to industry norms.

[CONFIDENTIAL]

Boiler
EPRI states:

- A critical flaw size crack appears on average at around 30 years of service (240,000 hours).
- The average number of cycles of a coal drum unit is expected to be 1,700 normal starts/stops to drive a critical flaw to failure.
- Natural Circulation boilers are more susceptible to ligament cracking than are Forced Circulation boilers.

The boiler review included previous inspection reports and a review of design vs typical operating temperatures and pressures.

Generator
Generators are regularly inspected and electrically tested. Those results were reviewed along with any other known issues. In most cases where the generator winding was beyond design life, no known issues have been observed and no concerns exist regarding condition.

Turbine
Turbines are inspected on a routine basis with periodic repairs/overhauls to bring the unit to as designed operation. To-date, no issues have been observed which did not allow a return to as designed operation.

Summary
Based on EPRI's research and the Generation Services Engineering review of units comparing their data, the boiler drum should not reduce the retirement year of each unit. While the EPRI "average end of drum life" for MC3 & MC4 are just short of the previous end of life depreciation study, the difference is not significant when considering these are typical and average numbers used from the analysis.

There are no known concerns regarding generator or turbine condition impacting unit end of life across the fleet.

No changes are recommended to existing unit retirement dates as identified in the 2015 study.

2018 Generation Services Engineering Depreciation Study
(Steam Units Only)

Station	Unit	2018 Retirement Dates
MC	1	2032
MC	2	2034
MC	3	2038
MC	4	2042
TC	1	2050
TC	2	2066
BR	1	2019
BR	2	2019
BR	3	2035
GH	1	2034
GH	2	2034
GH	3	2037
GH	4	2038

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 58

Witness: Christopher M. Garrett / Stuart A. Wilson

Q-58. Provide the following historical annual data by unit, from 2010 to present:

a. Fixed O&M cost;

b. Variable O&M cost (without fuel)

c. Fuel costs;

d. Capital costs

e. Capacity factor; and

f. Generation in kWh.

A-58. See attached.

	Fixed Costs by Unit										
	Year										
Unit	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	*
Brown 3	12,807,937.45	13,404,487.43	20,203,564.17	14,162,657.31	16,595,605.36	16,652,320.68	17,868,614.91	17,262,471.42	17,744,784.88	15,346,989.33	
Brown 5	188,070.12	145,903.99	145,645.95	112,660.40	106,750.56	328,300.15	231,403.75	473,900.92	420,389.06	183,126.94	
Brown 6	1,167,998.32	490,893.72	879,288.69	626,767.10	1,063,042.10	902,991.80	755,833.02	519,673.01	624,454.33	464,728.17	
Brown 7	532,933.07	602,422.33	728,219.75	291,926.54	864,698.41	309,648.02	426,347.72	343,794.09	626,940.81	272,009.78	
Brown 8	252,794.05	262,288.71	157,244.05	271,414.05	200,348.09	402,918.27	388,880.15	326,581.03	390,481.62	265,605.29	
Brown 9	401,688.55	463,364.04	223,607.51	567,457.72	199,788.80	366,054.41	523,904.40	393,469.43	373,240.08	258,133.67	
Brown 10	276,034.67	139,765.40	183,100.93	88,253.04	173,958.91	908,374.49	325,545.47	309,840.82	369,912.07	300,968.87	
Brown 11	441,060.79	137,066.27	146,807.60	177,324.32	198,816.38	284,364.40	286,550.11	212,427.40	388,145.52	227,915.22	
Brown Solar	-	-	-	-	-	-	7,975.22	199,960.32	132,819.28	140,390.65	
Cane Run 7	-	-	-	-	-	6,838,934.42	13,379,209.37	12,685,290.73	12,231,710.73	9,262,390.99	
Cane Run 11	23,004.21	59,951.05	32,581.13	29,639.30	62,595.47	92,998.15	46,202.88	77,353.96	125,795.46	101,140.44	
Dix Dam	588,267.94	492,215.64	329,956.77	456,447.11	613,476.71	1,057,327.43	391,952.28	336,004.38	454,077.54	458,255.33	
Ghent 1	16,902,837.22	13,696,040.52	16,899,354.57	15,025,924.53	16,751,941.19	25,766,169.85	18,220,607.96	18,693,378.90	20,806,040.23	15,558,164.07	
Ghent 2	11,545,707.12	10,661,542.52	20,052,227.94	10,932,467.81	13,878,745.09	17,421,724.87	16,986,275.12	16,273,757.26	19,832,413.50	13,196,404.58	
Ghent 3	13,944,770.29	22,258,477.06	14,006,950.09	10,802,223.14	16,061,116.91	17,375,590.00	18,633,067.31	18,087,487.04	20,928,250.00	11,654,314.93	
Ghent 4	19,099,911.06	13,475,405.28	15,561,188.04	17,555,994.89	25,901,395.91	18,480,076.64	18,277,729.84	19,744,579.13	18,438,373.00	12,172,775.23	
Haefling 1	71,862.66	150,591.08	68,132.19	64,686.09	61,623.08	59,740.39	80,539.00	64,708.71	30,702.25	24,409.74	
Haefling 2	50,293.58	37,695.77	37,353.22	22,577.34	22,891.84	13,337.34	10,430.34	17,066.48	21,689.98	11,070.30	
Mill Creek 1	14,269,465.34	12,114,126.17	11,388,530.35	18,286,796.87	11,630,795.90	15,029,838.57	12,736,475.51	15,931,094.97	14,317,939.01	12,532,979.62	
Mill Creek 2	10,721,610.92	9,632,472.62	16,964,126.55	10,344,029.49	13,918,985.08	12,825,791.25	13,894,312.49	10,981,938.73	13,079,893.27	9,646,988.09	
Mill Creek 3	11,661,728.45	16,391,003.86	10,683,123.37	16,116,323.69	11,740,812.01	14,826,858.97	18,786,038.32	15,951,025.32	17,130,339.17	11,389,878.07	
Mill Creek 4	16,885,124.88	14,133,879.76	16,369,557.93	14,832,203.51	22,483,349.12	17,427,633.24	20,598,636.38	18,888,031.29	18,852,078.50	11,422,202.47	
Ohio Falls	1,467,130.84	1,652,174.78	1,626,543.70	2,023,212.89	1,916,826.52	1,998,757.34	1,949,088.73	2,128,283.23	2,131,544.21	1,614,578.47	
Paddys 11	44,982.68	57,351.59	70,893.01	41,999.63	42,074.24	49,141.35	56,622.25	46,649.54	25,454.18	33,804.56	
Paddys 12	99,558.09	28,252.28	23,185.80	47,053.34	26,327.54	58,076.99	79,984.25	86,091.47	101,554.27	72,584.17	
Paddys 13	4,756,361.97	1,434,690.59	437,047.60	452,666.34	554,672.67	741,365.95	1,107,403.93	747,382.06	759,540.92	638,434.49	
Trimble County 1	22,286,759.23	19,734,310.66	14,656,859.33	18,037,195.34	16,063,844.88	22,172,636.85	18,187,696.20	20,933,188.18	20,805,330.78	13,917,303.52	
Trimble County 2	1,920,794.34	14,141,568.18	20,419,355.73	19,574,508.96	25,054,512.64	22,749,600.22	26,812,955.01	25,691,024.24	29,203,992.11	22,220,825.51	
Trimble County 5	500,165.76	415,935.62	449,354.77	362,840.82	715,037.85	581,775.34	642,566.27	627,805.20	649,064.40	491,689.30	
Trimble County 6	430,411.99	302,526.65	372,155.10	288,205.67	432,788.40	512,475.76	509,453.45	516,057.45	492,348.34	404,356.41	
Trimble County 7	79,997.78	85,128.94	155,054.84	143,198.08	157,256.39	487,816.70	266,914.19	326,538.48	351,211.42	186,122.24	
Trimble County 8	124,491.67	123,404.11	181,843.22	267,107.53	209,826.57	207,779.43	175,644.08	158,675.13	260,479.50	147,884.01	
Trimble County 9	88,168.72	130,628.39	229,281.37	123,632.43	174,738.90	163,840.80	222,836.29	193,341.82	257,047.44	162,766.86	
Trimble County 10	127,406.83	149,953.24	150,001.28	358,937.04	137,877.57	100,064.16	156,778.77	130,717.13	210,499.44	149,913.89	
Zorn 1	22,220.51	33,368.44	111,943.06	21,454.13	17,490.15	30,872.47	72,002.15	42,648.53	46,858.94	343,216.77	
	163,781,551.10	167,038,886.69	183,944,079.61	172,509,786.45	198,034,011.24	217,225,196.70	223,096,477.12	219,402,237.80	232,615,396.24	165,274,321.98	

* Data presented is year-to-date through September 2019.

Case No. 2018-00348
Attachment to Response to AG-1 Question No. 58(a)
Garrett

	Variable Costs by Unit										
	Year										
Unit	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	*
Brown 3	428,959.55	620,667.88	767,726.73	2,124,278.41	2,033,729.40	1,786,261.13	2,959,297.76	1,570,176.25	1,794,811.14	1,234,812.75	
Ghent 1	1,566,335.29	5,274,955.38	4,882,918.18	5,055,674.24	4,251,336.01	4,362,032.63	5,284,184.34	5,174,645.03	4,242,234.04	2,263,383.52	
Ghent 2	1,260,131.35	2,492,577.81	2,028,082.30	2,543,404.53	2,439,231.78	1,893,040.45	3,982,693.54	3,550,752.32	2,932,180.08	2,183,623.90	
Ghent 3	2,198,341.84	5,178,837.93	6,277,538.24	5,796,820.29	4,471,061.78	4,684,733.81	5,460,021.96	4,832,901.11	3,457,948.79	2,835,654.09	
Ghent 4	1,760,735.69	6,337,888.97	5,400,731.47	6,128,957.06	6,420,755.99	8,184,584.74	6,299,562.55	6,433,679.62	4,372,922.87	2,978,577.09	
Mill Creek 1	1,144,842.43	1,132,991.75	1,215,582.08	971,905.33	1,120,367.46	1,164,814.81	2,541,974.90	2,183,280.86	1,915,135.78	1,182,267.28	
Mill Creek 2	1,175,686.13	1,090,117.04	978,591.86	1,148,439.50	1,037,354.66	1,145,561.43	2,459,561.14	2,578,897.81	1,683,256.74	1,433,897.74	
Mill Creek 3	2,597,050.30	1,934,388.23	2,717,857.88	2,239,513.55	2,378,831.85	2,560,873.50	2,573,723.93	3,366,147.47	3,317,413.93	2,335,875.94	
Mill Creek 4	2,967,568.30	3,123,966.11	2,530,241.07	2,542,549.32	2,048,444.48	3,282,660.02	3,872,967.18	3,334,151.58	3,053,019.59	3,076,701.72	
Trimble County 1	2,364,120.02	2,994,119.02	4,263,149.38	3,933,460.46	4,537,471.94	3,475,271.04	3,996,441.36	3,263,525.84	3,581,278.11	2,680,756.05	
Trimble County 2	-	4,812,395.55	4,637,999.31	5,227,256.33	4,595,920.49	7,320,028.86	5,453,689.40	5,949,630.88	5,760,729.99	3,641,882.31	
	17,463,770.90	34,992,905.67	35,700,418.50	37,712,259.02	35,334,505.84	39,859,862.42	44,884,118.06	42,237,788.77	36,110,931.06	25,847,432.39	

* Data presented is year-to-date through September 2019.

	Fuel Costs by Unit									
	Year									
Unit	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019 *
Brown 3	67,604,462.57	58,601,062.63	46,141,000.97	55,014,482.97	54,092,936.95	41,200,015.06	34,911,627.46	33,236,800.58	40,548,075.19	24,509,094.91
Brown 5	716,054.59	445,445.63	362,480.39	334,059.74	1,589,326.90	2,001,750.67	607,784.58	300,129.96	2,440,834.13	1,028,442.93
Brown 6	3,509,647.85	2,228,418.01	4,233,333.30	2,599,387.43	10,982,787.93	6,344,737.30	1,000,579.14	1,029,733.22	5,224,811.46	3,154,741.58
Brown 7	3,530,448.98	2,663,507.91	3,305,498.23	2,128,526.05	11,750,050.78	5,090,920.03	941,293.40	623,142.73	4,847,517.39	1,103,350.09
Brown 8	864,466.51	725,409.37	166,322.02	230,031.44	1,943,290.07	2,453,504.22	3,870,803.24	2,340,456.04	2,047,987.55	382,470.30
Brown 9	542,382.35	727,419.85	381,885.67	419,622.53	1,823,505.97	3,008,288.95	4,008,377.70	1,804,202.59	2,058,641.65	1,127,129.59
Brown 10	494,679.76	287,254.47	168,456.61	134,484.92	1,935,721.62	3,026,491.25	3,641,117.59	2,256,631.80	1,688,048.49	673,375.68
Brown 11	780,616.13	221,652.13	301,397.92	204,984.86	2,206,114.61	2,043,064.14	2,308,524.05	504,644.61	1,111,873.28	879,842.11
Cane Run 7	-	-	-	-	-	56,147,242.63	94,711,600.19	84,147,034.38	104,961,155.78	76,705,716.67
Cane Run 11	82,152.28	46,019.51	137,796.30	120,487.91	9,863.15	40,829.28	16,782.02	333,282.88	336,312.89	244,675.57
Ghent 1	75,984,443.89	79,709,177.66	76,969,051.60	78,426,824.53	79,148,499.20	58,834,052.23	66,463,223.75	67,002,486.65	62,621,485.25	42,137,225.15
Ghent 2	74,082,995.85	81,728,575.47	73,080,026.64	81,944,619.87	81,261,912.93	60,444,107.28	63,042,435.73	60,428,465.86	66,588,037.05	50,030,967.08
Ghent 3	83,529,302.07	69,732,788.43	81,572,429.11	80,438,605.94	75,498,423.84	73,671,929.80	61,119,662.82	57,523,593.75	49,262,545.36	43,647,314.43
Ghent 4	66,273,965.30	71,549,742.58	67,778,359.24	73,341,480.99	72,630,502.97	78,598,159.94	68,269,237.97	70,928,648.81	59,601,353.87	40,169,904.22
Haefling 1	45,523.59	57,179.99	71,017.64	58,636.00	50,074.50	211,480.66	15,314.37	10,102.64	67,913.56	2,319.06
Haefling 2	48,782.79	66,232.57	50,090.42	19,734.75	95,773.66	217,334.97	13,643.98	9,496.62	66,537.58	822.04
Mill Creek 1	39,114,545.40	43,046,267.73	49,641,182.98	37,127,997.53	49,301,196.36	35,886,165.38	41,653,582.13	35,559,008.78	40,883,397.59	22,426,452.94
Mill Creek 2	41,438,810.97	43,740,489.27	36,743,843.21	48,335,532.69	44,759,499.40	35,511,757.17	39,095,866.97	36,503,783.13	32,770,221.15	29,205,350.76
Mill Creek 3	57,295,580.26	40,697,987.32	63,997,360.23	56,532,661.10	68,848,915.19	55,673,565.75	48,236,470.44	56,822,722.09	53,867,568.61	40,898,215.09
Mill Creek 4	64,801,358.44	67,567,287.76	57,890,135.04	71,081,342.27	61,487,445.40	69,222,431.01	58,143,280.77	62,908,630.65	57,360,555.81	50,424,429.40
Paddys 11	500,624.90	159,903.89	182,544.79	296,381.55	113,902.67	80,478.88	92,899.05	311,540.86	310,879.85	227,968.50
Paddys 12	188,269.83	30,046.63	176,536.05	146,424.13	206,046.51	176,997.16	198,346.18	725,126.74	722,053.31	531,286.34
Paddys 13	1,468,097.11	2,645,349.23	2,858,790.04	2,153,441.21	6,295,317.68	6,357,716.48	4,573,678.70	5,037,904.46	6,026,003.41	3,309,847.22
Trimble County 1	83,836,064.27	76,328,789.83	95,199,340.15	89,415,835.08	92,199,476.27	72,068,613.30	81,372,929.24	61,974,247.20	73,739,445.68	56,835,517.25
Trimble County 2	12,727,282.13	101,237,195.57	79,107,382.64	97,609,800.44	84,624,742.90	116,233,001.70	84,415,858.40	95,330,411.51	85,648,339.92	63,518,030.36
Trimble County 5	8,867,008.39	6,662,779.53	9,969,251.04	6,970,080.25	16,808,552.35	12,176,833.35	11,502,803.17	10,964,721.12	11,131,452.39	8,204,983.73
Trimble County 6	6,813,706.93	6,379,440.50	11,847,864.74	9,018,381.42	17,114,018.52	11,193,442.27	5,447,649.30	6,988,551.61	10,924,083.77	4,475,572.03
Trimble County 7	9,774,705.51	7,158,040.66	6,628,735.34	6,998,922.28	14,826,569.20	13,027,623.44	10,188,260.91	10,985,571.46	12,250,542.24	5,737,734.47
Trimble County 8	6,933,696.53	5,890,289.45	4,889,429.13	2,652,254.94	5,623,355.80	4,385,039.74	3,258,571.52	8,783,697.59	11,489,693.31	3,854,270.07
Trimble County 9	8,963,784.94	7,819,374.57	10,943,996.42	8,542,395.24	16,944,681.35	14,036,477.09	10,120,034.43	7,453,836.26	9,281,494.04	4,411,118.76
Trimble County 10	7,193,822.73	5,743,139.97	3,758,145.19	2,529,405.15	6,866,664.76	4,229,265.43	8,829,776.49	4,535,933.90	5,426,102.29	4,910,273.92
Zorn 1	22,832.71	4,727.45	42,669.94	22,690.85	14,336.50	82,407.57	7,513.70	18,528.28	12.76	1,021.27
	728,030,115.56	783,900,995.57	788,596,352.99	814,849,516.06	881,053,505.94	843,675,724.13	812,079,529.39	787,383,068.76	815,304,976.61	584,769,463.52

* Data presented is year-to-date through September 2019.

Unit		Capital Costs by Unit Year 2010	2011	2012	2013	2014	2015	2016	2017	2018	2019 *
KU Common Generation		623,492.33	1,064,087.36	199,340.26	593,754.54	(511,189.44)	430,986.12	447,521.03	496,800.91	86,735.71	46,527.57
Brown Common		79,739,027.66	4,449,842.51	6,505,352.61	5,317,423.46	1,510,366.50	2,682,876.74	1,728,717.59	1,662,786.48	8,363,916.22	12,774,832.00
Brown 3		32,622,223.52	55,842,482.35	54,994,799.44	29,745,834.47	70,896,556.72	88,431,108.76	16,055,936.28	5,393,393.97	17,445,984.71	25,693,757.95
Brown CT Common		303,836.53	319,413.74	2,000,534.72	293,232.09	216,262.15	385,206.46	231,733.84	708,874.21	112,079.23	25,441.13
Brown 5		3,579,546.07	128,012.78	62,632.29	6,915.83	-	405,002.52	2,508,620.00	5,931,731.94	200,030.64	3,019.17
Brown 6		1,740,769.42	(870,077.53)	134,378.78	878,133.80	337,179.33	93,058.27	25,002.37	47,143.13	441,435.85	19,114,966.03
Brown 7		(117,937.88)	142,153.98	1,285,602.47	401,559.70	760,602.08	(800,041.17)	239,698.28	-	21,816.35	1,013,851.10
Brown 8		483,972.65	742,428.91	(10,586.97)	245,647.05	157,583.32	33,179.57	74,993.07	128,840.76	-	-
Brown 10		277,999.47	-	-	8,055.94	2,638,942.08	5,860,313.83	49,051.58	202,103.07	15,542.00	-
Brown 11		1,099.15	-	-	1,525,306.83	(179,551.92)	(13,165.85)	118,770.48	2,527,772.59	5,172,489.06	24,262.63
Brown Solar		-	-	-	-	190,701.35	10,332,708.44	14,763,612.97	16,802.43	-	-
Cane Run 7		246,386.68	1,948,589.66	67,224,549.15	342,332,728.64	106,232,042.82	16,085,229.60	5,485,114.62	19,637,544.06	2,296,439.85	1,148,034.32
Ohio Falls		11,554,428.27	17,768,624.93	19,204,589.33	14,296,454.92	6,771,970.64	13,312,360.07	12,265,628.69	14,935,169.31	7,407,899.60	380,376.44
Dix Dam		3,585,532.75	14,773,046.26	3,648,586.19	1,069,166.70	234,671.10	2,317,374.33	272,047.05	976,578.36	810,941.72	148,703.42
Ghent Common		13,860,324.62	62,117,895.48	131,380,206.78	96,683,557.25	27,944,195.31	21,520,299.88	19,075,014.47	20,351,369.87	27,208,770.33	13,386,644.18
Ghent 1		10,841,385.53	3,031,056.84	13,309,739.32	50,299,996.65	77,725,906.75	40,995,982.12	7,240,179.84	12,344,230.15	7,309,708.46	6,484,478.31
Ghent 2		742,883.42	10,899,638.11	27,451,456.56	22,774,968.48	49,568,662.31	57,819,916.82	13,096,703.84	6,984,000.45	4,276,972.68	6,526,865.23
Ghent 3		6,539,280.00	7,117,764.07	25,383,525.12	99,845,613.11	53,404,914.80	14,771,790.42	7,409,811.24	14,587,528.04	29,600,965.22	3,417,618.63
Ghent 4		21,292,745.59	3,560,355.45	13,459,936.04	81,424,773.56	63,942,668.35	19,017,849.98	2,494,584.75	35,965,273.44	85,062,970.47	16,914,806.80
Haefling Common		-	868,292.98	-	71,133.56	(385.69)	-	-	-	17,015.38	65,175.28
Haefling 1		-	8,379.02	-	-	-	-	-	-	-	-
Mill Creek Common		(218,478.73)	1,118,689.68	(1,043,452.79)	362,680.93	718,236.24	131,932.16	406,605.93	65,570.75	748,924.07	751,027.22
Mill Creek 1		3,332,948.53	1,165,538.68	21,217,417.00	67,018,625.83	83,168,247.98	73,537,625.51	4,977,361.23	4,915,665.40	2,775,249.35	11,834,931.59
Mill Creek 2		5,280,002.85	8,643,868.18	21,446,081.32	36,708,688.89	83,213,216.35	70,997,431.88	460,510.60	2,160,496.59	11,995,946.64	2,690,986.32
Mill Creek 3		4,112,412.31	10,379,234.76	11,532,781.59	52,690,192.39	26,326,233.42	159,685,459.28	78,173,414.11	6,408,994.81	6,953,654.02	6,323,995.76
Mill Creek 4		15,719,974.87	12,029,707.19	36,786,149.37	125,501,730.18	215,785,762.69	29,218,574.36	18,871,748.28	126,703,245.32	162,108,494.10	37,409,898.86
Paddys 11		-	538,340.30	17,324.60	9,465.20	-	9,931.03	-	-	-	-
Paddys 12		841,413.69	125,629.29	6,943.28	199,081.84	12,443.76	-	-	-	20,589.44	-
Paddys 13		8,238,078.29	651,286.75	1,098,452.97	1,250,887.87	1,063,634.42	2,001,230.58	21,714,070.70	12,664,884.31	327,772.95	579,240.82
Trimble County Common	**	853,345.41	(94,732.25)	13,088.51	38,441.05	264,941.47	75,286.20	23,129,265.64	49,262,323.86	28,835,651.30	13,193,682.47
Trimble County 1	**	6,139,624.40	9,224,589.14	5,249,740.88	15,069,847.35	44,509,768.93	46,613,254.52	9,010,140.72	18,893,980.77	4,225,686.54	5,201,678.37
Trimble County 2	**	32,067,019.55	19,785,932.63	34,587,227.53	7,620,271.87	21,437,843.83	10,212,529.83	46,729,521.46	90,780,560.13	89,011,777.29	36,910,703.49
Trimble County 5 and 6 Common		176,622.73	(3,759.06)	16,228.42	2,206.37	5,639.04	409.99	306,670.85	44,864.22	11,287.05	47,689.37
Trimble County 5		848,392.43	5,657,118.97	88,836.76	1,918,519.23	583,063.90	192,938.49	2,371,152.93	2,362,723.34	1,199,039.90	901,832.09
Trimble County 6		5,105,573.48	1,158,140.01	16,459.02	41,048.17	228,015.89	143,574.14	2,747,895.71	8.82	-	-
Trimble County 7		702,616.36	1,161,875.04	4,217,824.97	22,203.83	221,454.39	144,835.12	537,028.24	716,940.67	2,909,168.06	6,915.78
Trimble County 8		711,254.02	5,583,391.17	33,952.36	419,884.34	223,406.62	31,705.63	9,024.14	15.16	8,568.30	397,060.29
Trimble County 9		702,616.36	1,161,875.04	4,106,542.91	(79,868.90)	223,392.48	32,775.99	1,643,231.91	344,260.35	743,389.12	630,759.81
Trimble County 10		702,616.36	1,206,073.86	12,399.74	4,577,610.48	(193,640.58)	(15,136.05)	2,319,381.66	5,694,175.00	478,264.18	17,143.56
Zorn 1		3,818.97	41,019.14	-	-	-	9,369.06	587.85	-	-	100,359.27
		273,236,847.66	263,445,805.42	505,638,640.53	1,061,185,773.50	939,633,759.39	686,705,764.63	316,990,353.95	463,916,652.67	508,205,175.79	224,167,265.26

* Data presented is year-to-date through September 2019.

** Annual amounts represent 75% ownership (capital only)

Case No. 2018-00348
Attachment to Response to AG-1 Question No. 58(d)
Garrett

		Net Capacity Factor by Unit										
		Year										
Unit		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	*
Brown 3		49%	43%	36%	44%	42%	33%	31%	29%	36%	33%	
Brown 5		1%	0%	1%	0%	4%	11%	4%	1%	10%	7%	
Brown 6		3%	2%	9%	4%	13%	15%	2%	2%	10%	10%	
Brown 7		3%	2%	7%	3%	15%	12%	2%	1%	9%	3%	
Brown 8		1%	0%	0%	0%	2%	7%	10%	6%	4%	1%	
Brown 9		0%	0%	1%	1%	2%	8%	12%	4%	3%	4%	
Brown 10		0%	0%	0%	0%	2%	8%	12%	5%	3%	2%	
Brown 11		1%	0%	1%	0%	2%	5%	6%	1%	2%	2%	
Brown Solar	***							20%	20%	19%	22%	
Cane Run 7							93%	81%	60%	79%	78%	
Cane Run 11		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Dix Dam 1	***	15%	34%	14%	27%	18%	34%	30%	23%	50%	36%	
Dix Dam 2	***	15%	13%	6%	41%	28%	35%	28%	22%	56%	36%	
Dix Dam 3	***	6%	35%	19%	41%	28%	31%	22%	15%	50%	33%	
Ghent 1		80%	82%	75%	79%	77%	60%	73%	74%	71%	57%	
Ghent 2		77%	80%	72%	83%	79%	60%	70%	68%	77%	66%	
Ghent 3		81%	68%	77%	77%	72%	71%	63%	60%	52%	57%	
Ghent 4		63%	69%	63%	72%	69%	78%	74%	78%	67%	52%	
Hafling 1		0%	0%	1%	0%	0%	1%	0%	0%	0%	0%	
Hafling 2		0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	
Mill Creek 1		76%	77%	76%	55%	74%	56%	68%	64%	74%	47%	
Mill Creek 2		80%	75%	55%	72%	67%	55%	63%	65%	60%	62%	
Mill Creek 3		84%	54%	76%	64%	78%	63%	58%	75%	72%	63%	
Mill Creek 4		79%	75%	54%	64%	55%	67%	58%	69%	63%	66%	
Ohio Falls 1	***	18%	14%	5%	0%	44%	38%	39%	28%	10%	4%	
Ohio Falls 2	***	25%	18%	12%	1%	0%	10%	54%	38%	15%	7%	
Ohio Falls 3	***	25%	16%	4%	22%	32%	34%	56%	47%	19%	11%	
Ohio Falls 4	***	41%	33%	26%	28%	53%	29%	2%	44%	18%	15%	
Ohio Falls 5	***	0%	0%	34%	26%	16%	50%	55%	44%	21%	16%	
Ohio Falls 6	***	47%	37%	38%	20%	52%	50%	61%	47%	26%	22%	
Ohio Falls 7	***	50%	38%	37%	36%	54%	44%	66%	33%	1%	24%	
Ohio Falls 8	***	39%	33%	31%	22%	54%	46%	55%	11%	28%	25%	
Paddys Run 11		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Paddys Run 12		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Paddys Run 13		1%	2%	4%	2%	7%	13%	7%	5%	6%	3%	
Trimble County 1	**	80%	72%	86%	78%	80%	64%	81%	66%	82%	77%	
Trimble County 2	**		69%	51%	64%	58%	83%	63%	73%	68%	60%	
Trimble County 5		9%	4%	15%	5%	13%	14%	14%	13%	11%	15%	
Trimble County 6		7%	5%	18%	6%	14%	13%	6%	6%	12%	5%	
Trimble County 7		8%	5%	7%	5%	11%	16%	12%	14%	16%	8%	
Trimble County 8		7%	4%	7%	2%	4%	5%	3%	10%	15%	3%	
Trimble County 9		8%	5%	18%	6%	13%	17%	12%	7%	10%	5%	
Trimble County 10		7%	3%	6%	2%	6%	4%	11%	2%	3%	6%	
Zorn 1		0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	

* Data presented is year-to-date through September 2019.
** Annual amounts calculated based upon 100% of generation.
*** Solar and Hydro NCF calculated using Name Plate ratings.

Case No. 2018-00348
Attachment to Response to AG-1 Question No. 58(e)
Wilson

		Net Generation by Unit (kWh)										
		Year										
Unit		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	*
Brown 3		1,828,361,000	1,563,842,000	1,323,503,000	1,599,752,000	1,510,830,000	1,204,770,000	1,104,792,000	1,046,730,000	1,306,545,000	879,216,000	
Brown 5		8,061,000	4,196,000	6,618,000	3,372,000	40,541,000	122,560,000	42,491,000	13,994,000	114,613,000	60,340,000	
Brown 6		48,131,000	29,200,000	127,748,000	50,307,000	175,310,000	207,502,000	27,163,000	27,668,000	138,775,000	105,865,000	
Brown 7		46,851,000	34,588,000	95,198,000	42,879,000	207,896,000	159,794,000	27,573,000	16,213,000	122,735,000	34,000,000	
Brown 8		7,864,000	4,835,000	2,561,000	2,834,000	22,988,000	77,225,000	107,213,000	58,620,000	42,267,000	9,007,000	
Brown 9		5,196,000	5,206,000	7,403,000	5,316,000	17,390,000	89,176,000	125,950,000	41,793,000	33,994,000	30,935,000	
Brown 10		4,365,000	2,162,000	2,188,000	875,000	19,036,000	83,035,000	125,598,000	54,273,000	32,062,000	17,686,000	
Brown 11		8,529,000	1,714,000	5,671,000	1,299,000	23,646,000	57,764,000	64,961,000	10,734,000	19,786,000	15,658,000	
Brown Solar								13,328,000	17,449,000	17,030,000	14,395,000	
Cane Run 7							2,809,444,000	4,882,121,000	3,567,734,000	4,711,119,000	3,868,677,700	
Cane Run 11		228,000	198,000	296,000	180,000	0	256,000	0	0	32,000	10,000	
Dix Dam 1		15,173,000	33,918,007	13,582,000	26,593,000	17,453,000	33,275,000	29,046,000	23,008,000	49,310,000	26,452,000	
Dix Dam 2		14,736,000	13,202,319	5,416,000	39,906,000	27,827,000	34,387,000	28,003,000	21,609,000	54,526,000	26,094,000	
Dix Dam 3		6,012,000	34,508,674	18,728,000	40,124,000	27,007,000	30,281,000	21,593,000	14,618,000	48,836,000	23,965,000	
Ghent 1		3,295,876,000	3,394,813,000	3,166,600,000	3,334,601,000	3,252,359,000	2,529,485,000	3,049,782,000	3,087,936,000	2,978,805,000	1,966,886,000	
Ghent 2		3,201,480,000	3,345,081,000	3,052,544,000	3,513,063,000	3,368,714,000	2,549,072,000	2,970,741,000	2,867,721,000	3,275,277,000	2,322,030,000	
Ghent 3		3,431,840,000	2,866,840,000	3,302,452,000	3,294,839,000	3,072,408,000	3,019,318,000	2,682,750,000	2,537,162,000	2,209,776,000	1,992,760,000	
Ghent 4		2,667,176,000	2,899,005,000	2,653,566,000	3,011,140,000	2,912,691,000	3,270,022,000	3,074,303,000	3,269,468,000	2,800,834,000	1,810,754,000	
Hafling 1		175,000	143,300	584,000	382,000	244,000	1,087,000	75,000	0	0	0	
Hafling 2		193,000	165,300	325,000	37,200	492,000	1,122,000	49,000	0	0	0	
Mill Creek 1		2,009,037,000	2,044,330,000	2,016,171,000	1,466,563,000	1,964,155,000	1,479,740,000	1,801,796,000	1,674,852,000	1,955,583,000	1,031,818,000	
Mill Creek 2		2,101,040,000	1,980,508,000	1,452,212,000	1,898,669,000	1,756,003,000	1,445,319,000	1,652,298,000	1,683,758,000	1,545,094,000	1,346,260,000	
Mill Creek 3		2,914,876,000	1,878,796,000	2,611,560,000	2,212,407,000	2,672,746,000	2,177,256,000	2,007,177,000	2,591,841,000	2,466,571,000	1,799,360,000	
Mill Creek 4		3,348,610,000	3,160,051,000	2,281,218,000	2,709,274,000	2,322,205,000	2,832,909,000	2,469,155,000	2,912,199,000	2,672,552,000	2,303,846,000	
Ohio Falls 1		16,038,203	14,155,436	4,817,103	0	39,802,000	36,675,866	32,765,104	26,761,904	14,285,925	5,118,967	
Ohio Falls 2		21,781,089	18,091,411	12,376,342	1,240,964	0	7,901,971	44,952,142	36,038,870	20,404,893	9,109,942	
Ohio Falls 3		21,504,857	15,660,659	3,877,907	26,567,293	30,761,000	32,989,880	46,946,148	45,348,837	26,774,860	13,265,915	
Ohio Falls 4		35,703,803	33,294,260	25,787,189	30,422,371	41,002,000	22,237,919	1,422,004	42,320,848	24,848,870	18,580,881	
Ohio Falls 5		0	0	40,061,780	35,231,355	15,490,000	48,649,822	46,510,147	41,777,849	28,603,850	20,129,871	
Ohio Falls 6		52,344,606	46,387,419	47,972,472	27,661,275	50,421,000	47,950,825	51,247,162	44,805,839	36,058,811	27,722,823	
Ohio Falls 7		55,227,846	47,885,706	46,003,734	48,660,011	52,358,000	42,215,846	55,566,176	31,871,885	1,343,993	30,899,803	
Ohio Falls 8		33,919,596	33,420,108	30,441,472	23,548,731	42,054,000	35,152,872	37,028,117	8,650,969	38,554,798	31,660,798	
Paddys Run 11		244,000	95,000	216,000	0	55,000	0	13,000	0	0	0	
Paddys Run 12		0	0	340,000	0	408,000	0	0	0	0	139,000	
Paddys Run 13		14,729,000	31,441,000	56,374,000	29,338,000	104,000,000	180,983,000	98,521,000	63,545,000	80,425,000	35,997,700	
Trimble County 1	**	3,615,363,000	3,212,039,000	3,866,646,000	3,472,838,000	3,578,489,000	2,879,113,000	3,564,930,000	2,857,759,000	3,548,429,000	2,767,804,000	
Trimble County 2	**	452,493,000	4,616,252,000	3,338,335,000	4,187,355,000	3,771,730,000	5,399,401,000	4,135,346,000	4,780,166,000	4,469,768,000	3,251,530,000	
Trimble County 5		129,014,000	60,379,000	225,981,000	66,373,000	184,281,000	202,532,000	206,990,000	192,633,000	169,546,000	181,472,451	
Trimble County 6		100,290,000	67,956,000	259,742,000	89,148,000	201,202,000	192,081,000	88,051,000	96,103,000	179,748,000	57,032,449	
Trimble County 7		125,685,000	74,261,000	100,025,000	72,123,000	167,502,000	228,365,000	180,137,000	207,896,000	241,449,000	96,429,530	
Trimble County 8		98,268,000	55,613,000	102,010,000	27,347,000	62,923,000	69,800,000	46,199,000	141,967,000	221,684,000	37,401,570	
Trimble County 9		125,067,000	76,445,000	259,734,000	84,646,000	196,204,000	243,615,000	176,880,000	108,786,000	153,041,000	57,787,238	
Trimble County 10		103,884,000	48,603,000	86,050,000	26,414,000	80,899,000	64,506,000	156,870,000	23,768,000	42,183,000	69,669,362	
Zorn 1		93,000	0	640,000	203,000	78,000	1,058,000	62,000	15,000	0	0	

* Data presented is year-to-date through September 2019

** Annual amounts represent 100% of generation

Case No. 2018-00348
Attachment to Response to AG-1 Question No. 58(f)
Wilson

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 59

Witness: Thomas A. Jessee

Q-59. State whether the Companies are still utilizing an Independent Transmission Operator, and if so, identify the entity performing this function.

A-59. Yes. TranServ International.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 60

Witness: Thomas A. Jessee / John K. Wolfe

Q-60. Provide the following for each year since the Companies' last IRP filing, for both the transmission and distribution systems: SAIDI, SAIFI, CAIDI, and outages per hundred line miles per year (OHMY).

A-60.

	LG&E Distribution Excluding Major Event Days		
	SAIDI	SAIFI	CAIDI
2014	73.75	0.897	82.23
2015	74.45	0.927	80.30
2016	73.03	0.861	84.82
2017	71.93	0.835	86.11
2018	85.00	0.853	99.63

	KU (Ky) Distribution Excluding Major Event Days		
	SAIDI	SAIFI	CAIDI
2014	79.28	0.752	105.46
2015	78.10	0.773	100.99
2016	99.40	0.858	115.85
2017	66.51	0.661	100.64
2018	88.89	0.761	116.81

Note 1: Major Event Day calculation is defined by IEEE Standard 1366.

Note 2: OHMY is a measure of transmission reliability and thus is not included above.

	LG&E Transmission Excluding Major Event Days			
	SAIDI	SAIFI	CAIDI	OHMY
2014	1.282	0.020	64.10	27.79
2015	1.007	0.031	32.48	12.39
2016	0.556	0.058	9.59	9.48
2017	4.445	0.083	53.55	9.59
2018	0.720	0.026	27.69	10.23

	KU (Ky) Transmission Excluding Major Event Days			
	SAIDI	SAIFI	CAIDI	OHMY
2014	20.39	0.248	82.22	10.40
2015	16.41	0.252	65.12	11.40
2016	21.33	0.274	77.85	12.09
2017	7.52	0.112	67.14	10.05
2018	11.25	0.169	66.57	9.51

Note 1: Major Event Day calculation is defined by IEEE Standard 1366.

Note 2: OHMY for KU is based on KU total, which includes ODP in VA.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 61

Witness: Stuart A. Wilson

Q-61. Explain whether the Companies continue to participate in the reserve sharing agreement with TVA. If so, provide an explanation of this agreement, including the annual cost of compliance and/or other expenses related to the agreement.

A-61. The Companies continue to participate in a Contingency Reserve Sharing Group ("CRSG") with TVA. The agreement enables the Companies to share reserves, based on their load ratio share of the CRSG participants, with other members of the group to reduce their reserve level below the largest generating unit's capacity, known as the Most Severe Single Contingency ("MSSC"). The Companies' largest generating unit is Trimble County 2, rated at 717 MW. Through participation in the CRSG, in 2019 the Companies are obligated to have reserves of 254 MW instead of the MSSC level of 717 MW that would be required if the Companies were not members of a CRSG.

LG&E/KU pay an annual fee to cover the CRSG administration and software maintenance costs. For 2019, that fee was $232,611. For 2020, the fee will be $236,872.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 62

Witness: Stuart A. Wilson

Q-62. Reference the Companies' prior IRP filing, Case No. 2014-00131, the Companies' response to Sierra Club 2.4, in which the Companies stated, "A capacity value for the Companies' existing units was not estimated or necessary for this analysis." Explain whether this remains the case in the instant IRP filing, and if so, why.

a. Have the Companies provided a capacity value in other cases since the conclusion of Case No. 2014-00131? If so, identify the docket(s) and the precise documents in which the capacity value was presented.

A-62. The statement continues to be true. No capacity value is necessary for this analysis because the Companies do not sell capacity into any market. The 2018 IRP Reserve Margin Analysis demonstrates the value of the Companies' capacity to its native load customers. If capacity were sold into a market, it would not be available to serve native load.

a. The Companies considered capacity value in its 2018 RTO Membership Analysis, which was provided as Exhibit LEB-2 to Mr. Bellar's testimony in the Case Nos. 2018-00294 and 2018-00295.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 63

Witness: Stuart A. Wilson

Q-63. Reference the Companies' prior IRP filing, Case No. 2014-00131, the Companies' response to Sierra Club 2.5, in which the Companies stated that Brown unit no. 3 was designated as must-run in all hours for all years. State whether Brown 3's status has changed in the instant IRP filing, and if so, why. If not, why not?

a. For all hours Brown unit no. 3 was dispatched in the last three (3) years, indicate how often the dispatch was on an economic basis.

A-63. In the 2018 IRP analyses, Brown 3 was not modeled as must-run. To best reflect current transmission system conditions, the previous modeling constraint that generally required at least one Brown unit to be dispatched at all times was removed.

a. Brown 3 was dispatched on an economic basis in all hours.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 64

Witness: Stuart A. Wilson

Q-64. Based on the referenced "High CO2 scenario," provide the projected capacity factors for each coal and gas-fired unit in the Companies' current fleet between 2020 and 2033.

A-64. As discussed in Section 4.3 of the "2018 IRP Long Term Resource Planning Analysis," new or replacement portfolios were developed to meet the Companies' summer and winter capacity needs through the end of 2033 and annual revenue requirements were evaluated for each portfolio over the five-year period from 2029 to 2033. The following tables show projected capacity factors for each coal and gas unit in the Companies' current fleet between 2029 and 2033 for the high CO_2 scenario. The first table is based on a 55-year operating life for the existing generation units. The second table reflects a 65-year operating life for the existing generation units.

Capacity Factors (%), 55-year operating life:

Generation units	2029	2030	2031	2032	2033
Brown 10	1	1	1	1	1
Brown 11	0	1	1	1	1
Brown 5	2	2	2	2	2
Brown 6	5	5	6	7	7
Brown 7	5	4	5	6	6
Brown 8	1	1	1	1	1
Brown 9	1	1	1	1	1
Cane Run 7	82	86	84	75	82
Ghent 3	27	25	22	22	21
Ghent 4	38	37	35	35	33
Mill Creek 4	50	45	50	48	49
Paddy's Run 13	11	12	11	13	13
Trimble Co 05	22	24	25	30	30
Trimble Co 06	17	19	20	23	24
Trimble Co 07	14	14	15	18	19
Trimble Co 08	4	4	4	5	5
Trimble Co 09	10	10	12	13	14
Trimble Co 10	2	2	3	3	3
Trimble County 1	46	47	43	48	40
Trimble County 2	57	57	56	57	56

Capacity Factors (%), 65-year operating life:

Generation units	**2029**	**2030**	**2031**	**2032**	**2033**
Brown 10	1	1	1	1	1
Brown 11	0	1	0	1	1
Brown 3	10	10	10	11	11
Brown 5	2	2	1	3	4
Brown 6	5	5	6	8	11
Brown 7	4	5	6	8	10
Brown 8	1	1	1	1	2
Brown 9	1	1	1	2	2
Cane Run 7	85	89	87	77	85
Ghent 1	56	54	53	51	50
Ghent 2	69	69	69	69	62
Ghent 3	34	31	30	26	26
Ghent 4	48	47	45	45	42
Mill Creek 1	62	63	61	64	59
Mill Creek 2	61	57	61	55	59
Mill Creek 3	63	67	64	67	61
Mill Creek 4	66	58	67	63	66
Paddy’s Run 13	11	12	12	13	14
Trimble Co 05	24	27	30	39	45
Trimble Co 06	19	21	23	33	40
Trimble Co 07	14	16	18	27	35
Trimble Co 08	4	4	3	5	5
Trimble Co 09	10	12	13	22	29
Trimble Co 10	2	2	2	3	3
Trimble County 1	66	68	64	68	56
Trimble County 2	69	69	70	69	69

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 65

Witness: Stuart A. Wilson

Q-65. Explain whether the IRP models scenarios for utilizing solar facilities pursuant to PPAs, and if so, how and where?

A-65. No, the IRP did not evaluate solar PPAs. As discussed on page 5-6 of Volume I, the Companies will evaluate market available alternatives before committing to a particular course of action.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 66

Witness: Stuart A. Wilson

Q-66. Based on the IRP modeling, describe under what scenarios, assumptions and constraints that the addition of any additional supply-side resources might become necessary.

A-66. Table 15 on page 24 of the 2018 IRP Long-Term Resource Planning Analysis in Volume III contains the expected supply-side resources that would be necessary under the full range of modeled scenarios. The addition of any supply-side resources beyond those provided in Table 15 would primarily be a result of earlier-than-expected retirement of one or more of the Companies' remaining generating units and/or higher-than-expected customer load growth.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 67

Witness: Stuart A. Wilson

Q-67. Reference the Companies' 2014-00131 IRP filing in general. Confirm that based on the Companies' assumptions and constraints, many optimal plans added additional supply-side resources in the form of a natural gas combined cycle or combustion turbine. Explain what changes have occurred between the conclusion of that case and the filing of the instant IRP to alter those conclusions.

A-67. Confirmed. There are two primary differences in resource plans between the 2014 IRP and the 2018 IRP. First, the 2018 IRP has fewer simple cycle combustion turbines due to the assumed retirement of baseload units; SCCTs are generally not a cost-effective source of baseload energy. Second, the 2018 IRP includes more renewables due to the assumed lower cost of renewables.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 68

Witness: Robert M. Conroy

Q-68. Provide the Companies' off-system sales for each of the past three (3) years.

A-68. The requested information is contained in the Companies' monthly FAC filing for the Off-System Sales Adjustment Clause. See attached for a summary of the off-system sales revenues, expenses, and margins by Company.

Year	Expense Month	Company	Off System Sales Revenue	Off System Sales Expenses	Off System Sales Margin	Customer Share of Off System Sales Margins (75% Customer Sharing)
1	2	3	4	5	6	7
					Col. 4 - Col. 6	75%
2016	January	Kentucky Utilities	$ 223,333	$ 218,023	$ 5,310	$ 3,983
		Louisville Gas & Electric	$ 1,048,667	$ 812,285	$ 236,382	$ 177,287
	February	Kentucky Utilities	$ 45,043	$ 43,056	$ 1,987	$ 1,490
		Louisville Gas & Electric	$ 204,884	$ 161,352	$ 43,532	$ 32,649
	March	Kentucky Utilities	$ 45,958	$ 34,340	$ 11,618	$ 8,714
		Louisville Gas & Electric	$ 89,481	$ 69,378	$ 20,103	$ 15,077
	April	Kentucky Utilities	$ 309,117	$ 260,762	$ 48,355	$ 36,266
		Louisville Gas & Electric	$ 561,164	$ 434,264	$ 126,900	$ 95,175
	May	Kentucky Utilities	$ 250,721	$ 216,741	$ 33,980	$ 25,485
		Louisville Gas & Electric	$ 116,919	$ 106,907	$ 10,012	$ 7,509
	June	Kentucky Utilities	$ 447,582	$ 424,537	$ 23,045	$ 17,284
		Louisville Gas & Electric	$ 219,724	$ 205,970	$ 13,754	$ 10,316
	July	Kentucky Utilities	$ 886,011	$ 778,115	$ 107,896	$ 80,922
		Louisville Gas & Electric	$ 587,033	$ 488,510	$ 98,523	$ 73,892
	August	Kentucky Utilities	$ 758,410	$ 635,078	$ 123,332	$ 92,499
		Louisville Gas & Electric	$ 280,479	$ 248,906	$ 31,573	$ 23,680
	September	Kentucky Utilities	$ 955,369	$ 695,952	$ 259,417	$ 194,563
		Louisville Gas & Electric	$ 417,444	$ 337,763	$ 79,681	$ 59,761
	October	Kentucky Utilities	$ 1,192,651	$ 838,812	$ 353,839	$ 265,379
		Louisville Gas & Electric	$ 516,564	$ 412,641	$ 103,923	$ 77,942
	November	Kentucky Utilities	$ 329,279	$ 274,547	$ 54,732	$ 41,049
		Louisville Gas & Electric	$ 566,046	$ 480,222	$ 85,824	$ 64,368
	December	Kentucky Utilities	$ 972,958	$ 825,177	$ 147,781	$ 110,836
		Louisville Gas & Electric	$ 3,381,365	$ 2,458,289	$ 923,076	$ 692,307
2017	January	Kentucky Utilities	$ 1,176,862	$ 1,094,263	$ 82,599	$ 61,949
		Louisville Gas & Electric	$ 2,475,932	$ 1,887,385	$ 588,547	$ 441,410
	February	Kentucky Utilities	$ 60,815	$ 61,120	$ (305)	$ (229)
		Louisville Gas & Electric	$ 213,814	$ 191,126	$ 22,688	$ 17,016
	March	Kentucky Utilities	$ 804,854	$ 768,555	$ 36,299	$ 27,224
		Louisville Gas & Electric	$ 2,062,075	$ 1,588,008	$ 474,067	$ 355,550
	April	Kentucky Utilities	$ 567,031	$ 480,413	$ 86,618	$ 64,964
		Louisville Gas & Electric	$ 542,566	$ 451,904	$ 90,662	$ 67,997
	May	Kentucky Utilities	$ 1,171,106	$ 942,033	$ 229,073	$ 171,805
		Louisville Gas & Electric	$ 1,368,230	$ 1,039,125	$ 329,105	$ 246,829
	June	Kentucky Utilities	$ 136,545	$ 135,845	$ 700	$ 525
		Louisville Gas & Electric	$ 121,794	$ 112,220	$ 9,574	$ 7,181
	July	Kentucky Utilities	$ 194,971	$ 163,924	$ 31,047	$ 23,285
		Louisville Gas & Electric	$ 134,387	$ 113,031	$ 21,356	$ 16,017
	August	Kentucky Utilities	$ 112,561	$ 104,233	$ 8,328	$ 6,246
		Louisville Gas & Electric	$ 47,000	$ 43,763	$ 3,237	$ 2,428
	September	Kentucky Utilities	$ 760,562	$ 525,217	$ 235,345	$ 176,509
		Louisville Gas & Electric	$ 400,824	$ 302,579	$ 98,245	$ 73,684
	October	Kentucky Utilities	$ 775,935	$ 690,796	$ 85,139	$ 63,854
		Louisville Gas & Electric	$ 767,228	$ 658,030	$ 109,198	$ 81,899
	November	Kentucky Utilities	$ 232,372	$ 216,229	$ 16,143	$ 12,107
		Louisville Gas & Electric	$ 72,351	$ 68,494	$ 3,857	$ 2,893
	December	Kentucky Utilities	$ 315,562	$ 308,632	$ 6,930	$ 5,198
		Louisville Gas & Electric	$ 1,195,581	$ 895,130	$ 300,451	$ 225,338

Year	Expense Month	Company	Off System Sales Revenue	Off System Sales Expenses	Off System Sales Margin	Customer Share of Off System Sales Margins (75% Customer Sharing)
1	2	3	4	5	6	7
					Col. 4 - Col. 6	75%
2018	January	Kentucky Utilities	$ 6,947,173	$ 5,272,203	$ 1,674,970	$ 1,256,228
		Louisville Gas & Electric	$ 18,801,374	$ 7,349,602	$ 11,451,772	$ 8,588,829
	February	Kentucky Utilities	$ 367,119	$ 340,420	$ 26,699	$ 20,024
		Louisville Gas & Electric	$ 460,739	$ 406,795	$ 53,944	$ 40,458
	March	Kentucky Utilities	$ 333,072	$ 322,040	$ 11,032	$ 8,274
		Louisville Gas & Electric	$ 532,575	$ 416,156	$ 116,419	$ 87,314
	April	Kentucky Utilities	$ 1,264,765	$ 1,059,390	$ 205,375	$ 154,031
		Louisville Gas & Electric	$ 1,433,214	$ 1,074,269	$ 358,945	$ 269,209
	May	Kentucky Utilities	$ 909,552	$ 740,953	$ 168,599	$ 126,449
		Louisville Gas & Electric	$ 901,101	$ 701,932	$ 199,169	$ 149,377
	June	Kentucky Utilities	$ 659,596	$ 503,246	$ 156,350	$ 117,263
		Louisville Gas & Electric	$ 529,943	$ 386,678	$ 143,265	$ 107,449
	July	Kentucky Utilities	$ 1,031,856	$ 796,670	$ 235,186	$ 176,390
		Louisville Gas & Electric	$ 666,011	$ 529,000	$ 137,011	$ 102,758
	August	Kentucky Utilities	$ 621,239	$ 475,776	$ 145,463	$ 109,097
		Louisville Gas & Electric	$ 665,606	$ 508,163	$ 157,443	$ 118,082
	September	Kentucky Utilities	$ 2,357,673	$ 1,352,016	$ 1,005,657	$ 754,243
		Louisville Gas & Electric	$ 1,827,183	$ 1,005,716	$ 821,467	$ 616,100
	October	Kentucky Utilities	$ 1,969,334	$ 1,463,405	$ 505,929	$ 379,447
		Louisville Gas & Electric	$ 1,376,362	$ 980,836	$ 395,526	$ 296,645
	November	Kentucky Utilities	$ 854,144	$ 679,701	$ 174,443	$ 130,832
		Louisville Gas & Electric	$ 1,271,799	$ 1,047,368	$ 224,431	$ 168,323
	December	Kentucky Utilities	$ 265,883	$ 258,544	$ 7,339	$ 5,504
		Louisville Gas & Electric	$ 1,735,436	$ 1,328,210	$ 407,226	$ 305,420
2019	January	Kentucky Utilities	$ 900,714	$ 809,361	$ 91,353	$ 68,515
		Louisville Gas & Electric	$ 1,897,848	$ 1,275,683	$ 622,165	$ 466,624
	February	Kentucky Utilities	$ 606,089	$ 555,833	$ 50,256	$ 37,692
		Louisville Gas & Electric	$ 1,043,643	$ 840,163	$ 203,480	$ 152,610
	March	Kentucky Utilities	$ 280,820	$ 275,066	$ 5,754	$ 4,316
		Louisville Gas & Electric	$ 601,014	$ 528,865	$ 72,149	$ 54,112
	April	Kentucky Utilities	$ 227,019	$ 222,408	$ 4,611	$ 3,458
		Louisville Gas & Electric	$ 416,752	$ 424,486	$ (7,734)	$ (5,801)
	May	Kentucky Utilities	$ 438,622	$ 369,449	$ 69,173	$ 51,880
		Louisville Gas & Electric	$ 599,419	$ 414,522	$ 184,897	$ 138,673
	June	Kentucky Utilities	$ 446,991	$ 338,197	$ 108,794	$ 81,596
		Louisville Gas & Electric	$ 365,322	$ 298,188	$ 67,134	$ 50,351
	July	Kentucky Utilities	$ 1,339,052	$ 1,010,436	$ 328,616	$ 246,462
		Louisville Gas & Electric	$ 571,220	$ 484,430	$ 86,790	$ 65,093
	August	Kentucky Utilities	$ 349,161	$ 298,145	$ 51,016	$ 38,262
		Louisville Gas & Electric	$ 232,107	$ 203,765	$ 28,342	$ 21,257

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 69

Witness: Stuart A. Wilson

Q-69. Provide the Companies' current order of economic dispatch.

A-69. The following table shows the general dispatch order as of October 1, 2019.

CANE RUN 7
TRIMBLE 2
GHENT 2
MILL CREEK 4
MILL CREEK 1
MILL CREEK 3
MILL CREEK 2
TRIMBLE 1
GHENT 1
GHENT 4
GHENT 3
OVEC
BROWN 3
TRIMBLE 5
TRIMBLE 6
TRIMBLE 7
TRIMBLE 8
TRIMBLE 9
TRIMBLE 10
BROWN 6
BROWN 7
PADDYS RUN 13
BROWN 5
BROWN 8
BROWN 9
BROWN 10
BROWN 11
CANE RUN 11
HAEFLING
PADDYS RUN 11
PADDYS RUN 12
ZORN 1

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 70

Witness: Stuart A. Wilson

Q-70. Reference the Staff Report in Case No. 2014-00131, pp. 13-14, wherein Staff noted that in order to evaluate GHG regulation, the Companies developed two approaches: establishing a price per ton of CO2 and establishing a cap on CO2 mass emissions. Under the first approach, "mid" and "zero" price scenarios were considered, while under the second approach, the Companies' emissions were capped at 29.4 million tons of CO2 annually. Explain whether in the instant IRP filing, the Companies evaluated the potential for revised GHG regulation based on similar "mid" and "zero" price scenarios. If not, why not?

A-70 Yes, the Companies' 2018 IRP evaluated similar scenarios. See discussion of CO_2 scenarios in Section 3.5.2 (CO_2 Prices) beginning on page 15 of the 2018 IRP Long-Term Resource Planning Analysis in Volume III.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 71

Witness: Stuart A. Wilson

Q-71. Explain whether the current IRP filing utilizes "low," "mid," and "high" natural gas price scenarios from EIA, as the last IRP filing did.

A-71. Yes, the Companies' 2018 IRP evaluated similar scenarios. See discussion of natural gas price scenarios in Section 3.5.1 (Natural Gas and Coal) beginning on page 13 of the 2018 IRP Long-Term Resource Planning Analysis in Volume III.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 72

Witness: Stuart A. Wilson

Q-72. Reference the Staff Report in Case No. 2014-00131, p. 36, wherein Staff states: "The viability of the plants in its fleet hinges equally on the possibility of more stringent future environmental regulations, as opposed to significant mechanical failure, causing premature plant retirement." Do the Companies believe this statement remains true? If not, explain why not.

A-72. For clarity, the footnote in the referenced 2014 IRP Staff Report referred to the following passage from a section regarding "aging units" in the Companies' 2014 IRP (Volume I at 5-48), which continues to be true.

> "The economics surrounding the continued operation of the Companies' older units will continue to be reviewed periodically to ensure the efficiency of the overall system. More stringent environmental regulations could result in the retirement of these units even without a significant mechanical failure."

The "aging units" specified in this section were E.W. Brown Units 1 and 2, which were retired in February 2019 due to environmental regulations, and the Companies' six small-frame combustion turbines ("CTs"), including Zorn 1 (14 MW), which is planned to be retired in 2021, and Cane Run 11 (14 MW), which was placed in mothball status in October 2019 due to a mechanical failure. The small-frame CTs are more likely to be retired due to mechanical failures than due to environmental regulations.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 73

Witness: Stuart A. Wilson

Q-73. Reference the Staff Report in Case No. 2014-00131, pp. 36-37, wherein Staff references the Bluegrass Unit no. 3 tolling agreement that allowed the Companies to use 165 MW of firm generation capacity and output from that unit up through April 30, 2019. Now that the tolling agreement has ended, describe the impact on the Companies' supply side resources, including any higher dispatch rates for other units, or any additional off-system power purchases.

A-73. The end of the tolling agreement has not had a material impact on the dispatch rates of the Companies' supply side resources or to off-system power purchases. Bluegrass Unit 3 was used primarily for peaking capacity needs, and typically ran at a capacity factor of less than 5 percent. The end of the tolling agreement also coincided with the departure of eight municipal customers and loss of approximately 285 MW of peak load.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 74

Witness: David E. Huff

Q-74. Discuss to what extent, if any, the Companies utilized Strategist to evaluate DSM alternatives.

A-74. The Companies did not use Strategist to evaluate DSM alternatives. The Companies used PortfolioPro, a PC-based software package developed by Cadmus, to conduct the benefit/cost analysis for the DSM-EE Program Plan. Though prior plans utilized the DSMore® software tool purchased from Integral Analytics, Cadmus' in-house tool, DSM Portfolio Pro (PortfolioPro) offers greater flexibility, allowing users to integrate individual measures into programs and combine programs into portfolios to calculate cost effectiveness.[20]

[20] Kentucky Public Service Case No. 2017-000441, Exhibit GSL-1, page 20 of 182.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 75

Witness: David E. Huff

Q-75. Provide the amount of energy savings attributable to the Companies' AMS programs.

A-75. Consistent with the most current Demand Side Management (DSM) case, Case No. 2017-00441, no energy savings are currently attributable to the Companies' AMS programs. In Case 2018-00005, the Companies proposed a 0.5% energy savings attributable to customers participating in the AMS programs. This savings was supported by the Tetra Tech analysis included in that case. In August 2018, the commission's order in Case 2018-00005 denied the Companies CPCN request for full deployment of AMI. The Companies plan to continue evaluating energy savings attained by participants.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 76

Witness: Stuart A. Wilson / Thomas A. Jessee

Q-76. In Case No. 2017-00441, the Companies stated that at that time, they were engaged in an "on-going" analysis of whether it would be cost effective to join a regional transmission organization (RTO).[21] Provide the most recent such study, or if it is already provided in the record of another case, provide a citation to that case, and its precise location in the record of that case.

a. Provide the level of the Companies' sales into and purchases from PJM, TVA and MISO for each of the past four (4) years.

b. Explain to what degree congestion cost within an RTO contributes to any decisions regarding the cost effectiveness of joining an RTO. Explain also if the Companies are aware of PJM's near record low total congestion costs for 2019, at $254 million (footprint-wide).

A-76. The Companies' "2018 RTO Membership Analysis" was provided in Case Nos. 2018-00294 and 2018-00295 as Exhibit LEB-2, which was attached to the direct testimony of Lonnie E. Bellar.

a. See the following table.

Power Sales (MWh)				Power Purchases (MWh)			
Year	PJM	TVA	MISO	Year	PJM	TVA	MISO
2015	183,890	20,724	71,109	2015	3,006	16,689	-
2016	138,014	31,881	74,606	2016	6,788	10,138	-
2017	148,007	32,166	100,937	2017	975	2,567	-
2018	335,439	66,853	173,795	2018	-	676	-

b. The Companies assumed the total financial impact of Firm Transmission Rights ("FTR"), Auction Revenue Rights ("ARR"), and congestion costs over the ten-year period have net zero cost. When the Companies were MISO members, the congestion management strategy was to hedge congestion costs, seeking to minimize such costs and not speculate. It is assumed this will be the approach if the Companies were RTO members in the future. The Companies are aware of PJM's $254M in congestion costs for the first six months of 2019.

[21] Case No. 2017-00441, Companies' response to AG 2-6.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 77

Witness: David E. Huff

Q-77. State whether the Companies have filed any more recent DSM/EE potential studies since the 2014 Cadmus EE Potential Study filed in Case No. 2014-00003. If so, provide a copy in the record of the instant case.

a. Provide the level of actual DSM savings achieved by the end of 2018, as well as the level of savings the 2014 Cadmus study had projected by 2018.

b. Provide the level of DSM-EE programming customers actually consumed through 2018, as well as the projected "achievable potential" of DSM-EE programming projected in the 2014 Cadmus study through 2018.

c. If any additional or different EM&V methodologies or analyses were conducted regarding the Companies' DSM/EE portfolio since the time of the last IRP or the 2014 Cadmus study, provide the results of both actual dollar and energy savings.

A-77. The Companies filed an Industrial DSM/EE Potential Study as part of Case No. 2014-00003 on May 26, 2016[22]. As described in Case No. 2017-00441, the Companies in 2016 and 2017 worked again with Cadmus to conduct a broader study of residential and commercial achievable potential over a 20-year time horizon, from 2019 to 2038. This report can be found in Exhibit GSL-3 to the Testimony of Gregory S. Lawson, pages 261-366 of 529[23].

[22] The Cadmus Industrial Sector DSM Potential Assessment for 2016-2035, April 2016, https://psc.ky.gov/pscecf/2014-00003/rick.lovekamp@lge-ku.com/05262016071923/Closed/LGE_KU_Ind_DSM_Potential_Study_2014-00003_05-26-16.pdf

[23] The Cadmus Demand-Side Management Potential Study 2019-2038, March 2017 https://psc.ky.gov/pscecf/2017-00441/rick.lovekamp%40lge-ku.com/12062017050458/LGE_KU_Testimony_and_Exhibits.pdf, page 262.

a. The cumulative savings for 2014-2018 is 769 GWh of energy and 120 MW of incremental demand. Table 38 of the December 2013 Cadmus Study[24] lists a cumulative discretionary savings[25] of 1,060 GWh and 160 MW of demand by 2033. The Companies achieved 73% of the 20-year energy savings and 75% of the demand savings in just 25% of the time. Cadmus states, "The Company's 2012-2018 demand-side management plan currently targets average annual electricity savings of 140,000 MWh for the residential and 60,000 MWh for the commercial sector. Maintaining existing target would mean the Company would exhaust achievable electric efficiency potential in less than six years."[26].

b. Programming customers actually consume is measured in energy and demand savings. See the response to part a above.

c. The Companies filed additional studies as discussed above in response to this question in the Kentucky PSC Case No. 2017-00441. Additional EM&V is included in that case for the purpose of submitting DSM programing.

[24] The Cadmus Energy Efficiency Potential Study, December 2013, https://psc.ky.gov/pscecf/2014-00003/rick.lovekamp%40lge-ku.com/01172014092917/LGE_KU_DSM_EE_App_1-17-14.pdf, page 525
[25] "Discretionary measures (e.g. lighting upgrades in the commercial sector) may be implemented immediately, financial and practical considerations notwithstanding. Non-discretionary measures include measures that are typically implemented only on burnout of the existing equipment (normal turn-over) and new construction. The key difference between the two measures types is that unlike retrofit measures, the availability of lost-opportunity resources is determined by market forces that are outside the program administrator's control." IBID, page 524.
[26] IBID, page 525

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 78

Witness: David E. Huff

Q-78. If not already provided in the instant IRP, provide the results of the Cadmus industrial DSM/EE potential study. If those results are already provided in the record of another case, provide a citation to that case, and its precise location in the record of that case.

A-78. The Cadmus Industrial DSM/EE Potential Study was filed as part of Case No. 2014-00003 on May 26, 2016.[27]

The results were summarized in Case No. 2017-000441, page 7 of Greg Lawson's testimony. The table is shown below for convenience.

Medium Scenario - 20-year Cumulative Achievable Potential	**Residential**	**Commercial**	**Industrial**
Study Period	*2019-2038*	*2019-2038*	*2016-2035*
Energy (% of baseline)			
LGE	5.5%	5.4%	7.3%
KU	5.5%	6.7%	6.5%
Total	5.5%	6.1%	6.7%
Demand (MWs)			
LGE	26	47	24
KU	48	65	51
Total	74	112	74

[27] https://psc.ky.gov/PSC_WebNet/ViewCaseFilings.aspx?case=2014-00003). This is a direct link to the PDF https://psc.ky.gov/pscecf/2014-00003/rick.lovekamp@lge-ku.com/05262016071923/Closed/LGE_KU_Ind_DSM_Potential_Study_2014-00003_05-26-16.pdf

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

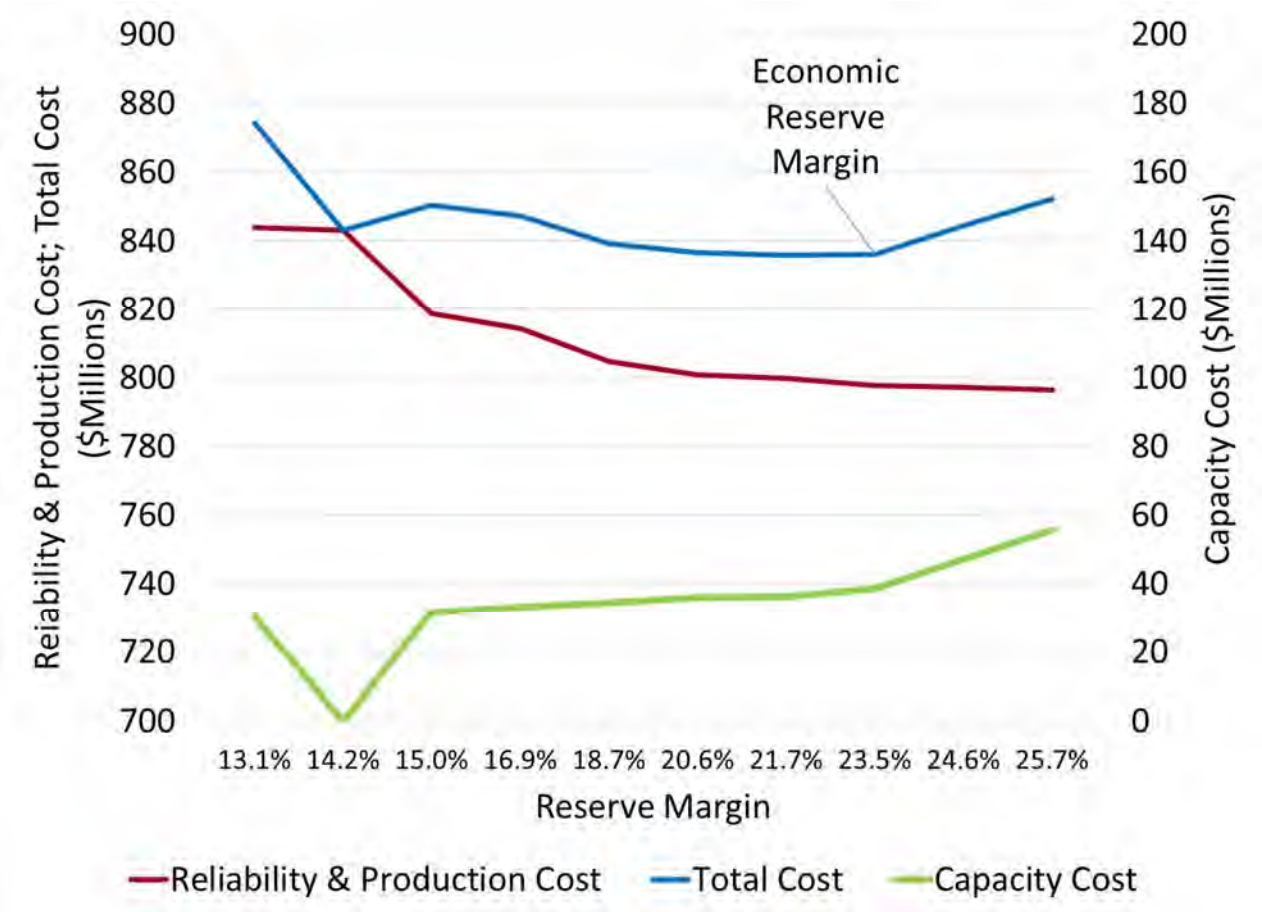
Case No. 2018-00348

Question No. 79

Witness: Stuart A. Wilson

Q-79. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," p. 7, Figure 3. The figure indicates it is illustrative only. Provide the chart evidencing the Companies' actual Economic Reserve Margin of 23.5%, based on Capacity Costs and Reliability and Production Cost, for 2021.

A-79. The figure below is based on data from Table 14 on page 22 of the 2018 IRP Reserve Margin Analysis. Reliability and generation production costs are evaluated based on the 90th percentile of the distribution.



Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 80

Witness: Stuart A. Wilson

Q-80. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," p.11.

a. Explain to what degree the Companies took into account the forced outage rate of each resource.

b. Do the Companies use the ICAP or UCAP value of capacity (in MWs) in resource planning?

A-80.

a. Uncertainty related to the performance and availability of generating units is a key consideration in resource planning. The Companies used the Equivalent Load Duration Curve Model ("ELDCM") and Strategic Energy Risk Valuation Model ("SERVM") to estimate reliability and generation production costs. In the ELDCM, forced outage rate is used to create the equivalent load duration curve. In SERVM, forced outage rate is used to simulate each generation resource's availability.

b. ICAP (installed capacity) is used in conjunction with forecasted outage rates to model resource availability.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 81

Witness: Stuart A. Wilson

Q-81. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," p. 10.

a. Based on actual experiences, explain why it is reasonable to assume neighboring regions are "at their target levels," particularly PJM, where the reserve margin has consistently been well in excess of target levels.

b. Explain what impact using observed reserve margins of neighboring utilities as a proxy moving forward as compared to target reserve margins in the Companies' planning.

A-81.

a. Target levels are used because they represent expected levels in the long-term.

b. The Companies have not performed this analysis.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 82

Witness: Stuart A. Wilson

Q-82. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," p. 13. Explain what the sentence "The Companies' import capability is assumed to be negatively correlated with load" means.

A-82. This means that when the Companies' load is projected to be high, the projected export capability from neighboring regions tends to be low. This is because weather conditions generally impact load in the Companies' service territories and neighboring regions similarly.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 83

Witness: Stuart A. Wilson / David E. Huff

Q-83. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," p. 23, in which the Companies state that beginning in 2019, they will begin operating the Demand Conservation Programs (DCP) in maintenance mode, and that under several modelling scenarios, the DCP could be retired.

a. Are the Companies able to bid the DCP into any wholesale markets? Explain. If the Companies are so able but have not done so, explain why not.

b. Explain whether any retirement of the DCP could include curtailable load. Are the Companies able to bid curtailable load into any wholesale markets? Explain. If the Companies are so able but have not done so, explain why not.

c. Explain whether any of the Companies' future modelling takes into consideration any aspects of load flexibility, as discussed in more detail in a recent Brattle Group study entitled, "The National Potential for Load Flexibility: Value and Market Potential Through 2030," a summary of which is accessible at the below link.[28] If so, discuss any options that load flexibility could bring to reduce the Companies' all-in costs. Include also a discussion of whether adoption of any elements of load flexibility could yield the type of demand response that could be bid into a wholesale market(s).

A-83.

a. No. The Companies' load is not located in a wholesale market. A wholesale market would not benefit from, nor pay for, load reduction outside of its footprint.

b. As detailed in the Companies' IRP in Volume 1, Table 5-13 at page 36, DCP is counted as a reduction in load while curtailable load is counted as an increase in supply, per KPSC guidelines. For the same reasons noted in the response to part (a.), the Companies are also not able to bid curtailable load into a wholesale market.

c. For the same reasons noted in the response to part (a.), the Companies are also not able to bid demand response into a wholesale market. The Companies have not specifically evaluated the referenced "emerging load flexibility opportunities" conceptualized in

[28] https://www.brattle.com/news-and-knowledge/publications/the-national-potential-for-load-flexibility-value-and-market-potential-through-2030

the Brattle Group's June 2019 study. Any consideration of this concept would require thorough evaluation by the Companies.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 84

Witness: Stuart A. Wilson

Q-84. Reference IRP vol. 1, Table 5-3. Identify any counties in the KU service territories which are projected to lose population, and provide the projected losses.

A-84. The data below is computed from the most recent IHS County Level projections as of July 1, 2019.

County	CAGR (2018-2033)
Ballard County, KY	-0.11%
Bell County, KY	-0.60%
Bourbon County, KY	-0.14%
Bracken County, KY	-0.27%
Carlisle County, KY	-0.56%
Clay County, KY	-0.93%
Crittenden County, KY	-0.27%
Edmonson County, KY	-0.49%
Estill County, KY	-0.34%
Fulton County, KY	-1.00%
Green County, KY	-0.32%
Harlan County, KY	-0.88%
Henderson County, KY	-0.07%
Hickman County, KY	-0.90%
Hopkins County, KY	-0.22%
Knox County, KY	-0.11%
Larue County, KY	-0.01%
Lee County, KY	-0.47%
Leslie County, KY	-0.92%
Lincoln County, KY	-0.01%
Livingston County, KY	-0.28%
Lyon County, KY	-0.20%
Mclean County, KY	-0.68%
Muhlenberg County, KY	-0.20%
Owen County, KY	-0.06%
Pendleton County, KY	-0.16%
Robertson County, KY	-0.33%

Rockcastle County, KY	-0.04%
Trimble County, KY	-0.32%
Union County, KY	-0.31%
Wayne County, KY	-0.10%
Webster County, KY	-0.43%
Whitley County, KY	-0.12%

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 85

Witness: Stuart A. Wilson

Q-85. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," p. 23. Identify the three coal units which have not been retrofitted with SCRs, together with their respective power output ratings.

A-85.

	Net Summer Rating (MW)
Mill Creek 1	300 MW
Mill Creek 2	297 MW
Ghent 2	485 MW

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 86

Witness: Stuart A. Wilson / Gary H. Revlett

Q-86. Reference IRP vol. 3, "2018 IRP Long-Term Resource Planning Analysis," p. 8, paragraph 3.2, wherein it is stated that because three of the Companies' coal units have not retrofitted with SCR, future changes to the NAAQS may require one or more of the following compliance actions within the next 3-7 years: (i) additional NOX emissions investments; (ii) changes in plant operations in ozone season; or (iii) unit retirements and acquisition of new generation.

a. Describe the nature of the NOX investments, and provide an estimate or projection of potential costs associated therewith.

b. Describe the measures the Companies would have to take to deal with any potential changes in plant operations during the ozone season, for example, what costs could be associated with obtaining replacement power.

c. Explain whether the Companies have any modelling or projections depicting a rank-order of the unit(s) that are most likely to have to be replaced under the scenario in (iii), above.

d. Explain whether retrofitting one or more of these three units to natural-gas firing would be cost-effective, given their remaining life span. If so, have the Companies modelled such a possibility? Explain.

e. If any of the three units have to be retired prematurely, state whether any emissions allowances can be credited to other units.

f. Explain what effect(s), if any, the following rulings from the U.S. Court of Appeals for District of Columbia Circuit will or could have on the Companies' decisions in this regard. Explain if the ruling(s) will or could trigger one or more of the three compliance actions the Companies identified, and if so, which option(s):

(i) the August 23, 2019 ruling in Murray Energy Corp. v. Environmental Protection Agency, et al.,[29] which upheld most of the EPA's 2015 thresholds

[29] Case No. 15-1385.

for ground-level ozone and which set 70 parts per billion as the highest acceptable ozone level; and

(ii) the September 13, 2019 ruling in Wisconsin v. EPA,[30] which will require EPA to revise portions of the Cross-State Air Pollution Rule (CSAPR) to add deadlines for upwind states such as Kentucky to reduce NOx emissions so that downwind states can satisfy federal ozone standards.

g. If one or more of the three units have to be replaced, explain what effect this will or may have on the remaining lives of the remainder of the Companies' coal-fired fleet, i.e., with regard to the issue of the 55-year life span vs. the 65-year life span.

(i) If two or three of these units have to be retired, would those retirements make it more likely that the life span of the remaining coal units will be 55 years?

A-86.

a. NO_x emissions would most likely be controlled through the installation of a Selective Catalytic Reduction (SCR) system. An order-of-magnitude estimate for an SCR is $135 million per generating unit (in 2024 dollars).

b. In the event the Companies modify plant operations by curtailing generation output of coal units without NO_x controls in the ozone season, generation from the Companies' other resources would likely increase, and the Companies might need to seek replacement capacity and energy from third parties.

c. The Companies do not have this information.

d. The Companies have not performed this analysis.

e. The Cross-State Air Pollution Rule (CSAPR) has mechanisms which re-allocate allowances from retired units. CSAPR's new unit set aside (NUSA) program will take allowances from retired units (and any other allowance that are set aside to this program) and re-allocate them to new units (as defined in CSAPR) in the state. If the NUSA program does not allocate all the allowances that windup in that program to new units in the state, the remaining allowances would be allocated to existing units in the state. Therefore, even though direct crediting/re-allocation of allowances is not allowed, it is possible for some of the allowances from retired units will be given to new and/or existing units.

f.

i. The Louisville Air Pollution Control District's current modeling for the 2015 ozone NAAQS standard is based upon a 70 parts per billion threshold. No compliance

[30] Case No. 16-1406.

measure will be triggered until after the modeling is complete and stakeholder meetings are initiated. This ruling will not trigger a compliance action.

ii. Kentucky currently has an approved Good Neighbor State Implementation Plan for interstate transport. No compliance action will be triggered until such time as EPA proposes a revision to the CSAPR regulations.

g. The effect that retirement of one or more of the three units would have on the remaining lives of the remainder of the Companies' coal-fired fleet is unknown. The use of fixed 55-year and 65-year operating lives are designed for purposes of long-term resource planning, and actual retirement decisions would be based on specific unit factors (including performance and costs), system needs, replacement costs as applicable, and then-current regulations.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 87

Witness: Stuart A. Wilson

Q-87. Reference IRP vol. 3, "2018 IRP Long-Term Resource Planning Analysis," p. 22, near-term replacement analysis. Here, the Companies evaluated replacing Brown 3 with 500 MW of solar generation coupled with 400 MW of battery storage.

a. State whether under this particular analysis, the battery storage would be utilized for peak load, or to augment or replace solar generation on a real-time basis due to the inherent intermittency of solar generation (e.g., cloudy weather, drop-off following sundown).

b. In any scenario / analysis in which solar generation was considered as a resource, did the Companies also consider an alternative power source (e.g., gas, or wind) as a back-up due to the intermittency of solar generation?

A-87.

a. In this particular analysis, battery storage is primarily intended to provide winter peaking capacity, but would also be available to augment solar generation on a real-time basis due to solar's inherent intermittency.

b. See the response to PSC 1-13e.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 88

Witness: Stuart A. Wilson

Q-88. Reference IRP vol. 3, "2018 IRP Long-Term Resource Planning Analysis," p. 3, Executive Summary, wherein it is stated, ". . . the Companies evaluated whether – in the near-term – existing resources should be replaced with a combination of battery storage and renewables. Several of the cases required significant amounts of replacement capacity in the latter part of the 15-year planning period."

a. Explain whether this means that analyses involving battery storage and renewables are more likely to be deployed under a 65-year life scenario, or the 55-year scenario.

A-88.

a. While the cost of renewables and battery storage is forecasted to decline through the analysis period, the likelihood of deploying battery storage and renewables is not materially affected by the operating life of the existing fleet.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 89

Witness: Stuart A. Wilson

Q-89. Reference IRP vol. 3, "2018 IRP Long-Term Resource Planning Analysis," p. 4, wherein it is stated that in both the 55-year and 65-year life scenarios, natural gas combined cycle (NGCC) capacity consistently appears as the least-cost source of replacement capacity in the longer-term, even under high gas and high CO2 scenarios.

a. Are there any situations in which a high CO2 scenario would indicate a NGCC would not be the least-cost resource?

b. What is the second-least cost resource in both the 55-year and 65-year life span scenarios, under alternatively a high gas cost, or high CO2 cost scenario?

A-89.

a. See Table 15 on page 24 of the 2018 IRP Long-Term Resource Planning Analysis in Volume III. Given the assumed retirement of baseload units, the predominant source of replacement capacity is NGCC in all scenarios, even in those with high CO_2 prices.

b. The top 10 resource plans for the 55-year operating life scenario are shown in Tables 16 through 21 beginning on page 26 of the above-referenced document. In the less favorable resource plans, NGCC capacity and energy are generally replaced with a combination of SCCTs and solar. Similar tables do not exist for the 65-year operating life scenario because no replacement resources are needed in this scenario.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 90

Witness: Stuart A. Wilson

Q-90. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," p. 17, Table 9. Are the "Stay-Open Cost" inclusive of capital costs necessary to comply with environmental rules?

A-90. See the response to Question No. 16b. Stay-open costs include all environmental costs required to operate a unit through at least 2021.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 91

Witness: Stuart A. Wilson

Q-91. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," p. 20, wherein the IRP provides an operating reserve demand curve. Explain the basis for the shape of the curve, including providing the "market purchase data" used to determine the remainder of the curve not charted by the spinning reserve requirement and the mean value of unserved energy. Any response should indicate whether the tail of the curve ever meets zero, or merely approaches it. If the tail of the demand curve meets zero, provide the Reserve Capacity in Excess of Hourly Load at which it does so.

A-91. The scarcity price curve was derived by escalating the scarcity price curve used in the Companies' 2014 IRP, which was developed by Astrape Consulting, who provides the SERVM model used in this analysis. This curve is based on Astrape's experience in other jurisdictions and reflects the fact that as operating reserves on the system decrease, prices will increase above the marginal cost of generation. This curve assumes the price is capped at the value of unserved energy. The scarcity price is zero when Reserve Capacity in Excess of Hourly Load is greater than 16%.

The Companies used the actual cost of market electricity purchases to validate the reasonableness of the curve. For example, in January 2014 when PJM's reserve was near 7.5%, the Companies purchased power at approximately $1,700/MWh. Furthermore, the weighted average scarcity price for all modeled purchases is around $15/MWh, which is reasonable relative to the Companies' average purchase price.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 92

Witness: Stuart A. Wilson

Q-92. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," p. 21 & 22. Explain how the Companies determined an LOLE of five (5) to be the screen to measure reliability viability for the analyses.

A-92. LOLE of five is equal to five times of the 1-in-10 LOLE physical reliability guideline. It was used as a proxy assumption for a conservatively large number to represent poor reliability.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 93

Witness: Stuart A. Wilson

Q-93. Reference IRP vol. 3, "2018 IRP Reserve Margin Analysis," p. 22. Explain what the amounts included in column A, "Capacity Cost" in Tables 13 and 14 represent. For instance, do the deltas between the "existing" capacity cost and other scenarios represent the increment (or decrement) cost to customers for each choice as modeled?

A-93. In Tables 13 and 14, capacity cost for each generation portfolio represents the annual difference between the portfolio's capacity cost and capacity cost for the portfolio that includes the retirement of DCP, the secondary SCCTs, and Brown 3 (this portfolio is labeled Ret B3* in Tables 13 and 14). Compared to the Ret B3* portfolio, for example, the Existing generation portfolio was modeled with a $38.5 million higher capacity cost. Compared to the Ret DCP portfolio, the Existing generation portfolio was modeled with a $2.4 million higher capacity cost.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 94

Witness: Stuart A. Wilson

Q-94. Reference IRP vol. 3, "2018 IRP Long-Term Resource Planning Analysis," p. 4, wherein it is stated that wind generation is optimal only under the 65-year life scenario with the following additional scenarios: high energy requirement, high gas and CO2 prices. Explain whether this modelling took into consideration the transmission capacity necessary to import wind generation, and any potential additional costs associated therewith.

A-94. Yes. As shown in Tables 1 and 2 of the 2018 Resource Screening Analysis, the Companies included transmission costs of $12/MWh for the wind generation option.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 95

Witness: Stuart A. Wilson

Q-95. In all modelling and analyses in which solar and wind generation were considered, explain whether applicable Tax Credits were included or excluded in analyzing energy production costs.

A-95. As stated in the 2018 Long-Term Resource Planning Analysis on page 23, "new solar generation includes the long-term impact of the federal investment tax credit ("ITC"), valued at 10%." No investment tax credit was included for wind generation, as the ITC for wind is expected to be phased out by 2020. No production tax credits were included for solar or wind generation.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 96

Witness: Stuart A. Wilson

Q-96. In all modelling and analyses in which wind generation were considered, explain whether cost analyses took into consideration the fact that, according to the U.S. Department of Energy's 2018 Wind Technologies Market Report,[31] prices for wind generation in long-term contracts are at an all-time low.

A-96. As stated in the 2018 Resource Screening Analysis, the Companies used NREL's 2018 ATB for capital costs, which shows a significantly lower wind capital cost of $1,515/kW in 2018 dollars (see Table 1 in the 2019 Resource Screening Analysis) compared to the 2014 IRP wind capital cost of $2,201/kW in 2013 dollars (see Case No. 2014-00131, Volume III, 2014 Resource Assessment, Table 8). In addition, NREL's 2018 ATB projects declining wind capital costs (see Figure 1 in the 2018 Resource Screening Analysis).

[31] https://emp.lbl.gov/wind-technologies-market-report

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 97

Witness: Stuart A. Wilson

Q-97. Confirm that Trimble 2 has load-following capability. Explain whether this unit is more appropriately classified as base load, or intermediate.

A-97. Trimble 2 has load-following capability and is appropriately classified as base load.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Attorney General's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 98

Witness: Stuart A. Wilson

Q-98. Reference IRP vol. 3, "2018 IRP Long-Term Resource Planning Analysis," p. 20, Table 11, Key Financial Inputs. Explain whether using the Companies' most-recently approved Return on Equity and cost of debt would trigger any significant changes or conclusions in the current IRP.

A-98. The Companies have not performed this analysis; however, the Companies do not expect that using the most recently approved return on equity and the current average cost of debt would have a material effect on the results and conclusions in the IRP.