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ERRATA DOCUMENT
TENNESSEE VALLEY AUTHORITY
CUMBERLAND FOSSIL PLANT RETIREMENT
FINAL ENVIRONMENTAL IMPACT STATEMENT
JULY 2023

The Cumberland Fossil Plant (CUF) Final Environmental Impact Statement (FEIS) was released on December 2, 2022. In April 2023, TVA received a media inquiry about greenhouse gas (GHG) reductions associated with the Cumberland retirement/replacement that prompted TVA to review a discrete part of the Greenhouse Gas (GHG) Life Cycle Analysis (LCA) emissions calculations and associated social costs of GHG presented in the CUF FEIS. Based on TVA's review, TVA determined that two years of operational emissions (2027 and 2028) and associated social costs of GHG, from the retirement of the second CUF coal-fired unit were omitted from the LCA in the CUF FEIS in error and needed to be added to the LCA for each Action Alternative evaluated.

Under TVA's planned CUF retirement, one CUF coal-fired unit would retire at the end of 2026 and the remaining coal-fired unit would retire at the end of 2028. TVA's calculation of operational emissions from the project in the EIS released in December 2022, however, incorrectly assumed both units would be retired at the end of 2026 and, thus, did not account for the additional two years of operations of the second coal-fired unit. This means there is a two-year delay in the full GHG emissions reductions achieved by fully implementing all action alternatives. However, there will still be significant GHG emissions reductions under Alternative A, approximately 2.5 million tons per year of CO_2-e, compared to the No Action Alternative during these two years (2027 and 2028) but to a lesser degree.

In addition to its review of the GHG emissions calculations in the FEIS, TVA re-examined the resources evaluated in the FEIS to determine whether its corrected emissions calculations would alter the conclusions from the analysis of impacts on other resources analyzed in the FEIS. Even with the corrected calculations, it continues to be the case that effects to air quality due to the construction and operation of the CC/CT gas plant, as proposed under Alternatives A and B, would be reduced in comparison with existing conditions at the CUF plant. Additionally, air quality impacts would be minimized through permitting and monitoring and therefore the change in GHG life cycle analysis calculations would not result in significant impacts for the other resources analyzed.

With respect to the alternatives analysis, TVA's review determined that the error does not change the relative comparisons of LCA emissions and social costs among the action alternatives, because any change to correct the underlying analysis in the FEIS affects each of the three action alternatives in the same manner with respect to the degree of GHG effects from each action alternative. The GHG LCA emissions for each alternative, except the No Action Alternative, are increased by the same number of CO_2-e emissions over a 30-year life cycle period, approximately 10.6 million tons, and the same total GHG social costs, approximately $666 million nominal dollars under the Biden Administration social cost rates and approximately $74 million nominal dollars under the prior administration social cost rates. Therefore, the overall short-term and long-term GHG effects due to this correction, including beneficial effects, and the effects on public health and safety, are the same for each action alternative. Even with

the increase in LCA CO_2-e emissions, the overall GHG LCA effects for each action alternative are a net reduction of GHG emissions and net social benefit in dollars compared to the No Action Alternative. Those net GHG emissions reductions and GHG social benefits are 203.5 million tons and 1.8 billion nominal dollars (prior administration GHG social cost rates) to 22.1 billion nominal dollars (Biden Administration GHG social cost rates), respectively, for Alternative A; a 63 percent reduction. For Alternative B, the net GHG emissions reductions and GHG social benefits are 280 million tons and 2.5 billion nominal dollars (prior administration GHG social cost rates) to 30.7 billion nominal dollars (Biden Administration GHG social cost rates), respectively, for Alternative B; an 87 to 88 percent reduction. For Alternative C, the net GHG emissions reductions and GHG social benefits are 295 million tons and 2.6 billion nominal dollars (prior administration GHG social cost rates) to 32.6 billion nominal dollars (Biden Administration GHG social cost rates), respectively, for Alternative C; a 92 to 93 percent reduction. Accordingly, TVA's review determined this change does not significantly affect the general conclusions regarding the air quality and climate impacts from each alternative.

As a result of the error described above, under the Biden Administration social cost rates, the net operational social benefit of CO_2 emissions reductions at the point of steady state conditions, i.e., once both CUF coal units are fully retired starting in 2029, increased by 7.6 percent for each action alternative compared to the December 2022 Final EIS values, which were based on a 2027 steady state start date. The net operational social benefit of CO_2 emissions reductions under the prior administration social cost rates did not change because these social cost rates do not change from 2027 to 2029.

TVA is issuing this errata document to denote the places in the FEIS where the aforementioned revisions affect the text and tables. The updates to the CUF EIS and the entire revised Appendix I (Greenhouse Gas Emissions Life Cycle Analyses) of the CUF EIS for correcting the error described above are provided in Attachment A below. The original version of paragraphs where changes occurred and that same paragraph with revised text are included in the attachments. The revised/added text is shown in color. The Section number and page number where the change occurred is also provided. This same methodology is used for changes to tables.

The revisions made in the FEIS and the LCA (FEIS Appendix I) are summarized below, and the errata sheet will be posted on the TVA web site (at https://www.tva.com/environment/environmental-stewardship/environmental-reviews/nepa-detail/cumberland-fossil-plant-retirement), and will be distributed with future copies of the CUF FEIS. In accordance with 40 CFR § 1502.9(d)(4) of the regulations of the Council on Environmental Quality and consistent with TVA's own NEPA procedures at 18 CFR part 1318, this errata sheet supports the finding that the Cumberland EIS is not required to be supplemented.

Dawn Booker
Manager
NEPA Compliance

07/14/2023
Date Signed

Attachment A – Updates to the Cumberland Fossil Plant Retirement Final EIS

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ATTACHMENT A

Section 3.7.2.3.1, FEIS Page 269

Original Paragraph:

Operations Effects

The replacement of CUF coal-fired plant operations with natural gas-fired CC plant operations is expected to have long-term, moderate, beneficial effects on local air quality and on future regional GHG emissions in comparison to the No Action Alternative. The decrease in SO_2, NO_x, CO, PM (filterable only), PM_{10}, and $PM_{2.5}$ operational emissions at the CUF facility are estimated at 7,100+ tons/year, 3,800+ tons/year, 950+ tons/year, 222+ tons/year, 1,260+ tons/year, and 1,160+ tons/year, respectively. There would also be elimination of hydrogen fluoride and hydrogen chloride emissions and significant reductions in mercury and lead emissions along with reductions in other HAP emissions. Table 3.7-3 provides a comparison of estimated pollutant operational emissions for each alternative, both under the no action alternative and after implementation of each alternative, including the estimated net change in emissions. These emissions numbers are based on projected average annual lifetime electricity generation. Actual emissions could vary and at times be higher, but they would be accounted for during the construction air permitting process to ensure air quality ambient standards will be met.

Revised Paragraph:

Operations Effects

The replacement of CUF coal-fired plant operations with natural gas-fired CC plant operations is expected to have long-term, moderate, beneficial effects on local air quality and on future regional GHG emissions in comparison to the No Action Alternative. Beginning in 2029, the decrease in SO_2, NO_x, CO, PM (filterable only), PM_{10}, $PM_{2.5}$, and VOC[1] operational emissions at the CUF facility are estimated at 7,250+ tons/year, 3,860+ tons/year, 950+ tons/year, 223+ tons/year, 1,250+ tons/year, 1,150+ tons/year, and 68+ tons/year, respectively. In the interim period of 2027 to 2028 when the second retiring CUF coal unit is still operating, these reductions will be between approximately 6 and 50 percent of the above values, depending on the pollutant. The 6 percent reduction correlates to approximately 4 tons/yr reduction for VOC and the 50 percent reduction correlates to approximately 3,620 tons/yr reduction for SO_2. There would also be elimination of hydrogen fluoride and hydrogen chloride emissions and significant reductions in mercury and lead emissions along with reductions in other HAP emissions. Table 3.7-3 provides a comparison of estimated pollutant operational emissions for each alternative, both under the no action alternative and after implementation of each alternative, including the estimated net change in emissions. These emissions numbers are based on projected average annual lifetime electricity generation. Actual emissions could vary and at times be higher, but they would be accounted for during the construction air permitting process to ensure air quality ambient standards will be met.

[1] There was a decrease in VOC emissions in the original FEIS calculations and document; however, it was not previously indicated in the text.

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Section 3.7.2.3.1, FEIS Page 271
Original Table:

Table 3.7-1. Direct Estimated Air Emissions from TVA Facilities under Consideration

Pollutant	(Abbrev.)	CUF 3-Year Avg. Annual Emissions (2018-2020) (tons/yr)	Johnsonville 3-Year Avg. Annual Emissions (2018-2020) (tons/yr)	Gleason 3-Year Avg. Annual Emissions (2018-2020) (tons/yr)	Proposed CCs at CUF - Alternative A Emissions (tons/yr)	Proposed CTs at Johnsonville - Alternative B Emissions (tons/yr)	Proposed CTs at Gleason - Alternative B Emissions (tons/yr)	Net Change CUF Emissions - Alternative A (tons/yr)	Net Change Johnsonville Emissions - Alternative B (tons/yr) (1)	Net Change Gleason Emissions - Alternative B (tons/yr) (1)	Net Change Emissions - Alternative C - Solar/Battery Storage (tons/yr)
Particulate Matter/ Total Suspended Particulate (Filterable only)	PM/TSP	318.7	20.4	14.0	95.7	7.5	5.6	-223.0	7.5	5.6	-318.7
Total PM<10 microns (Filterable + Condensible)	PM_{10}	1,413.3	26.7	26.4	154.5	30.0	22.5	-1,258.8	30.0	22.5	-1,413.3
Total PM<2.5 microns (Filterable + Condensible)	$PM_{2.5}$	1,313.3	26.7	26.4	154.5	30.0	22.5	-1,158.8	30.0	22.5	-1,313.3
Sulfur Dioxide	SO_2	7,266.7	2.8	1.6	13.8	2.4	1.8	-7,252.9	2.4	1.8	-7,266.7
Nitrogen Oxides	NOx	4,050.0	135.1	188.7	185.6	131.2	98.5	-3,864.4	131.2	98.5	-4,050.0
Carbon Monoxide	CO	1,083.3	75.4	60.3	133.2	80.1	60.2	-950.1	80.1	60.2	-1,083.3
Volatile Organic Compounds	VOC	128.7	18.2	8.0	60.2	9.7	7.3	-68.5	9.7	7.3	-128.7
Sulfuric Acid	H_2SO_4	1,025.3	0.0	0.1	0.0	0.0	0.0	-1,025.3	0.0	0.0	-1,025.3
Ammonia	NH_3	4.0	2.3	0.0	154.3	0.0	0.0	150.3	0.0	0.0	-4.0
Carbon Dioxide	CO_2	10,500,000.0	476,000.0	315,000.0	2,760,529.8	474,460.7	355,990.4	-7,739,470.2	-4,775,539.3	-4,894,009.6	-10,500,000.0
Methane	CH_4	114.0	8.7	5.8	195.5	34.0	25.5	81.5	-23.0	-31.5	-114.0
Nitrous Oxide	N_2O	179.3	0.9	0.6	68.1	11.9	8.9	-111.2	-77.8	-80.8	-179.3
All GHGs	CO_2-e	10,566,666.7	478,000.0	315,666.7	2,785,716.4	478,841.3	359,276.2	-7,780,950.3	-4,804,492.0	-4,924,057.1	-10,566,666.7
Mercury	Hg	7.8E-03	1.6E-04	2.6E-06	No Data	No Data	No Data	-7.8E-03	-1.6E-04	-2.6E-06	-7.8E-03
Lead	Pb	1.0E-01	No Data	No Data	No Data	No Data	No Data	-1.0E-01	No Data	No Data	-1.0E-01

(1) = The Net Change in GHG operational emissions for Alternative B accounts for GHG emissions reductions from CUF coal retirement, due to GHG emissions having global impact, and those reductions are considered split evenly between Johnsonville and Gleason. Criteria/HAP pollutant emissions reductions from CUF coal retirement only have a more local region of influence and are not included in Alternative B Net Change in operational emissions.

Additional hazardous air pollutants are emitted but in negligible quantities, except for hydrogen fluoride (HF) and hydrogen chloride (HCl). HF and HCl emissions from coal burning would be eliminated with the switch to natural gas combustion turbines.
NA = Not Applicable

Section 3.7.2.3.1, FEIS Page 271
Revised Table:

Table 3.7-2. Direct Estimated Air Emissions from TVA Facilities under Consideration

Pollutant	(Abbrev.)	CUF 3-Year Avg. Annual Emissions (2018-2020) (tons/yr)	Johnsonville 3-Year Avg. Annual Emissions (2018-2020) (tons/yr)	Gleason 3-Year Avg. Annual Emissions (2018-2020) (tons/yr)	Proposed CCs at CUF - Alternative A Emissions (tons/yr)	Proposed CTs at Johnsonville - Alternative B Emissions (tons/yr)	Proposed CTs at Gleason - Alternative B Emissions (tons/yr)	Net Change CUF Emissions - Alternative A (tons/yr) (1)	Net Change Johnsonville Emissions - Alternative B (tons/yr) (2)	Net Change Gleason Emissions - Alternative B (tons/yr) (2)	Net Change Emissions - Alternative C - Solar/Battery Storage (tons/yr)
Particulate Matter/ Total Suspended Particulate (Filterable only)	PM/TSP	318.7	20.4	14.0	95.7	7.5	5.6	-223.0	7.5	5.6	-318.7
Total PM<10 microns (Filterable + Condensible)	PM_{10}	1,413.3	26.7	26.4	154.5	30.0	22.5	-1,258.8	30.0	22.5	-1,413.3
Total PM<2.5 microns (Filterable + Condensible)	$PM_{2.5}$	1,313.3	26.7	26.4	154.5	30.0	22.5	-1,158.8	30.0	22.5	-1,313.3
Sulfur Dioxide	SO_2	7,266.7	2.8	1.6	13.8	2.4	1.8	-7,252.9	2.4	1.8	-7,266.7
Nitrogen Oxides	NOx	4,050.0	135.1	188.7	185.6	131.2	98.5	-3,864.4	131.2	98.5	-4,050.0
Carbon Monoxide	CO	1,083.3	75.4	60.3	133.2	80.1	60.2	-950.1	80.1	60.2	-1,083.3
Volatile Organic Compounds	VOC	128.7	18.2	8.0	60.2	9.7	7.3	-68.5	9.7	7.3	-128.7
Sulfuric Acid	H_2SO_4	1,025.3	0.0	0.1	0.0	0.0	0.0	-1,025.3	0.0	0.0	-1,025.3
Ammonia	NH_3	4.0	2.3	0.0	154.3	0.0	0.0	150.3	0.0	0.0	-4.0
Carbon Dioxide	CO_2	10,500,000.0	476,000.0	315,000.0	2,760,529.8	474,460.7	355,990.4	-7,739,470.2	-4,775,539.3	-4,894,009.6	-10,500,000.0
Methane	CH_4	114.0	8.7	5.8	195.5	34.0	25.5	81.5	-23.0	-31.5	-114.0
Nitrous Oxide	N_2O	179.3	0.9	0.6	68.1	11.9	8.9	-111.2	-77.8	-80.8	-179.3
All GHGs	CO_2-e	10,566,666.7	478,000.0	315,666.7	2,785,716.4	478,841.3	359,276.2	-7,780,950.3	-4,804,492.0	-4,924,057.1	-10,566,666.7
Mercury	Hg	7.8E-03	1.6E-04	2.6E-06	No Data	No Data	No Data	-7.8E-03	-1.6E-04	-2.6E-06	-7.8E-03
Lead	Pb	1.0E-01	No Data	No Data	No Data	No Data	No Data	-1.0E-01	No Data	No Data	-1.0E-01

(1) = The Net Change in CUF operational emissions presented for Alternative A will occur in 2029. In the interim period of 2027 through 2028 while the second retiring CUF coal unit is still operating, these emissions reductions will be between approximately 6 and 50 percent (-4 tons/yr and -3,620 tons/yr) of the values in this table, depending on the pollutant (e.g., the reduction in SO_2 emissions in 2027/2028 is -3,620 tons/yr vs. -7,253 tons/yr in 2029 and thereafter). CO_2-e reductions will be approximately 32 percent of the values in this table in 2027 and 2028, i.e., -2,489,470 tons/yr in 2027/2028 vs. -7,739,470 tons/yr in 2029 and thereafter. Ammonia and methane increases in the interim period will be approximately 1 and 70 percent, i.e., 2 tons/yr and 57 tons/yr, respectively, above the values in this table.

(2) = The Net Change in GHG operational emissions for Alternative B accounts for GHG emissions reductions from CUF coal retirement, due to GHG emissions having global impact, and those reductions are considered split evenly between Johnsonville and Gleason. Criteria/HAP pollutant emissions reductions from CUF coal retirement only have a more local region of influence and are not included in Alternative B Net Change in operational emissions.

Additional hazardous air pollutants are emitted but in negligible quantities, except for hydrogen fluoride (HF) and hydrogen chloride (HCl). HF and HCl emissions from coal burning would be eliminated with the switch to natural gas combustion turbines.
NA = Not Applicable

Section 3.7.2.3.1, FEIS Page 274

Original Paragraphs:

GHG Effects from Direct Emissions

The estimated decrease in future CO_2-e operational emissions at the CUF facility from implementation of Alternative A would be 7,780,950 tons in the first full year of the CC plant operation (anticipated in 2027). Commercial operation is expected to begin approximately June 2026 with final acceptance expected in December 2026; however, the highest annual CO_2-e emissions reductions begin in 2027. Similar annual reductions in CO_2-e operational emissions relative to the No Action Alternative would be experienced from that point forward. Estimated operational CO_2-e emissions in 2027 due to Alternative A from generation at the Cumberland site would be 74 percent below 2020 emissions, exceeding the Biden Administration goal of 65 percent reduction in Scope 1 GHG emissions by 2035 from a 2008 baseline.

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Using the Biden Administration's 2021 SCC dollar per metric ton values, adjusted for inflation, the estimated net social benefit of CO_2 operational emissions reductions from implementing Alternative A in 2027 would be $475,973,587 for direct CO_2 effects. Table 3.7-4 provides the Biden Administration's social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2027, when full year operations would begin. Using the prior administration's 2019 SCC dollar per metric ton values, adjusted for inflation, the estimated social benefit of carbon emissions reductions from implementing Alternative A in 2027 would be $54,176,292 for direct CO_2 effects. Table 3.7-5 provides the prior administration's social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2027, when full year operations would begin. For both scenarios, beyond 2027 and at least through 2050, the net social benefit of CO_2 operational emissions reductions would increase year over year based on the increase in SCC rates ($/ton) between 2020 and 2050.

Revised Paragraphs:

GHG Effects from Direct Emissions

The estimated reduction in future CO_2-e operational emissions at the CUF facility from implementation of Alternative A would be 2,497,617 tons in 2027 and 2028 while the second retiring CUF coal unit is still operating and increase to 7,780,950 tons per year reduction in 2029 and thereafter. Commercial operation of the CC plant is expected to begin approximately June 2026 with final acceptance expected in December 2026; however, the highest annual CO_2-e emissions reductions begin in 2029 after the second CUF coal unit retires. Estimated operational CO_2-e emissions in 2029 due to Alternative A from generation at the Cumberland site would be 74 percent below 2020 emissions, exceeding the Biden Administration goal of 65 percent reduction in Scope 1 GHG emissions by 2035 from a 2008 baseline.

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Using the Biden Administration's 2021 SCC dollar per metric ton values, adjusted for inflation, the estimated net social benefit of CO_2 operational emissions reductions from implementing Alternative A would be $511,989,459 in 2029 for direct CO_2 effects. This benefit would be $153,101,186 in 2027 and slightly higher in 2028. Table 3.7-4 provides the Biden Administration's social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2029 after the second CUF coal unit retires. Using the prior administration's 2019 SCC dollar per metric ton values, adjusted for inflation, the estimated social benefit of carbon emissions reductions from implementing Alternative A would be $54,176,292 in 2029 for direct CO_2 effects. This benefit would be $17,426,292 in 2027 and slightly higher in 2028. Table 3.7-5 provides the prior administration's social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2029 after the second CUF coal unit retires. For both scenarios, beyond 2027 and at least through 2050, the net social benefit of CO_2 operational emissions reductions would increase year over year based on the increase in SCC rates ($/ton) between 2020 and 2050.

Section 3.7.2.3.1, FEIS Page 275
Original Paragraph:

GHG Effects from Direct and Indirect Emissions – Life Cycle Analyses

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In comparison to Alternatives B and C, Alternative A has the highest estimated CO_2-e life cycle emissions and associated estimated future social costs in nominal dollars. In comparison to the No Action Alternative, Alternative A has a 66 percent decrease in life cycle CO_2-e emissions and 65 percent decrease in associated estimated future social costs in nominal dollars. The total estimated life cycle SC-GHG for each alternative under Biden Administration values are: $34.92 billion – No Action Alternative; $12.15 billion – Alternative A; $3.54 billion – Alternative B; and $1.63 billion – Alternative C. The total estimated life cycle GHG social costs for each alternative under prior administration values are: $2.82 billion – No Action Alternative; $971.4 million – Alternative A; $282.9 million – Alternative B; and $135.2 million – Alternative C.

Revised Paragraph:

GHG Effects from Direct and Indirect Emissions – Life Cycle Analyses

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In comparison to Alternatives B and C, Alternative A has the highest estimated CO_2-e life cycle emissions and associated estimated future social costs in nominal dollars. In comparison to the No Action Alternative, Alternative A has a 63 percent decrease in life cycle CO_2-e emissions and in associated estimated future social costs in nominal dollars. The total estimated life cycle SC-GHG for each alternative under Biden Administration values are: $34.92 billion – No Action Alternative; $12.82 billion – Alternative A; $4.2 billion – Alternative B; and $2.3 billion – Alternative C. The total estimated life cycle GHG social costs for each alternative under prior administration values are: $2.82 billion – No Action Alternative; $1.05 billion – Alternative A; $357.3 million – Alternative B; and $210.1 million – Alternative C.

Section 3.7.2.3.1, FEIS Page 276

Original Tables:

Table 3.7-3. Estimated Net Social Benefit of CO_2 Operational Emissions Reductions for Alternatives A, B, and C - Only Direct Effects to TVA Facilities (2027) – Biden Administration SCC Values

GHG Pollutant	(Abbrev.)	Nominal SCC Rate ($/mt) (2027)	Nominal SCC Rate ($/ton) (2027)	Net SCC Benefit - Alternative A (2027, Dollars)	Net SCC Benefit - Alternative B - Johnsonville (2027, Dollars)	Net SCC Benefit - Alternative B - Gleason (2027, Dollars)	Net SCC Benefit - Alternative B - Total (2027, Dollars)	Net SCC Benefit - Alternative C (2027, Dollars)
Carbon Dioxide	CO_2	$ 68	$ 61	$ (475,973,587)	$ (293,693,305)	$ (300,979,166)	$ (594,672,470)	$ (645,744,801)
Notes: 2027 SCC is presented as this is the first full year that Alternatives A and B are planned to begin operation. 3% discount rate used. Costs based on global impacts.								
Social cost of Methane and Nitrous Oxide values are not presented because they are each insignificant, <1%, with regard to direct combustion emissions from all alternatives, when compared to the social cost of carbon, i.e., CO_2. However, they are calculated and presented in the GHG Life Cycle Analysis.								
$ = U.S. Dollars; mt = metric tons; SCC = Social Cost of Carbon								

Table 3.7-4 Estimated Net Social Benefit of CO_2 Operational Emissions Reductions for Alternatives A, B, and C - Only Direct Effects to TVA Facilities (2027) - Prior Administration SCC Values

GHG Pollutant	(Abbrev.)	Nominal SCC Rate ($/mt) (2027)	Nominal SCC Rate ($/ton) (2027)	Net SCC Benefit - Alternative A (2027, Dollars)	Net SCC Benefit - Alternative B - Johnsonville (2027, Dollars)	Net SCC Benefit - Alternative B - Gleason (2027, Dollars)	Net SCC Benefit - Alternative B - Total (2027, Dollars)	Net SCC Benefit - Alternative C (2027, Dollars)
Carbon Dioxide	CO2	$ 8	$ 7	$ (54,176,292)	$ (33,428,775)	$ (34,258,067)	$ (67,686,842)	$ (73,500,000)
Notes: 2027 SCC is presented as this is the first full year that Alternatives A and B are planned to begin operation. 3% discount rate used. Costs based on U.S. impacts only.								
Social cost of Methane and Nitrous Oxide values are not presented because they are each insignificant, <1%, with regard to direct combustion emissions from all alternatives, when compared to the social cost of carbon, i.e., CO_2. However, they are calculated and presented in the GHG Life Cycle Analysis.								
$ = U.S. Dollars; mt = metric tons; SCC = Social Cost of Carbon								

Revised Tables:

Table 3.7-5. Estimated Net Social Benefit of CO_2 Operational Emissions Reductions for Alternatives A, B, and C - Only Direct Effects to TVA Facilities (2029) – Biden Administration SCC Values

GHG Pollutant	(Abbrev.)	Nominal SCC Rate ($/mt) (2029)	Nominal SCC Rate ($/ton) (2029)	Net SCC Benefit - Alternative A (2029, Dollars)	Net SCC Benefit - Alternative B - Johnsonville (2029, Dollars)	Net SCC Benefit - Alternative B - Gleason (2029, Dollars)	Net SCC Benefit - Alternative B - Total (2029, Dollars)	Net SCC Benefit - Alternative C (2029, Dollars)
Carbon Dioxide	CO_2	$73	$66	**$(511,989,459)**	**$(315,916,430)**	**$(323,753,596)**	**$(639,670,026)**	**$(694,606,888)**

Notes: 2029 SCC is presented as this is the first full year after the second CUF coal unit retires. The interim period of 2027 and 2028 will have an approximate 54 to 70 percent lower SCC benefit depending on the alternative. 3% discount rate used. Costs based on global impacts.

Social cost of Methane and Nitrous Oxide values are not presented because they are each insignificant, <1%, with regard to direct combustion emissions from all alternatives, when compared to the social cost of carbon, i.e., CO_2. However, they are calculated and presented in the GHG Life Cycle Analysis.

$ = U.S. Dollars; mt = metric tons; SCC = Social Cost of Carbon

Table 3.7-6 Estimated Net Social Benefit of CO_2 Operational Emissions Reductions for Alternatives A, B, and C - Only Direct Effects to TVA Facilities (2029) - Prior Administration SCC Values

GHG Pollutant	(Abbrev.)	Nominal SCC Rate ($/mt) (2029)	Nominal SCC Rate ($/ton) (2029)	Net SCC Benefit - Alternative A (2029, Dollars)	Net SCC Benefit - Alternative B - Johnsonville (2029, Dollars)	Net SCC Benefit - Alternative B - Gleason (2029, Dollars)	Net SCC Benefit - Alternative B - Total (2029, Dollars)	Net SCC Benefit - Alternative C (2029, Dollars)
Carbon Dioxide	CO_2	$8	$7	**$(54,176,292)**	**$(33,428,775)**	**$(34,258,067)**	**$(67,686,842)**	**$(73,500,000)**

Notes: 2029 SCC is presented as this is the first full year after the second CUF coal unit retires. The interim period of 2027 and 2028 will have an approximate 50 to 68 percent lower SCC benefit depending on the alternative. 3% discount rate used. Costs based on global impacts.

Social cost of Methane and Nitrous Oxide values are not presented because they are each insignificant, <1%, with regard to direct combustion emissions from all alternatives, when compared to the social cost of carbon, i.e., CO2. However, they are calculated and presented in the GHG Life Cycle Analysis.

$ = U.S. Dollars; mt = metric tons; SCC = Social Cost of Carbon

Section 3.7.2.3.1, FEIS Page 277

Original Tables:

Table 3.7-7. Alternative A - Estimated Life Cycle GHG Emissions and Associated Social Costs (Biden Administration Values, 3% Discount Rate)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
97,327,461	415,573	2,043	108,325,747	$10,500,047,470	$1,568,340,006	$84,222,903	$12,152,610,379	$3,010,697,631

Note:
NPV = Net Present Value

Table 3.7-8. Alternative A - Estimated Life Cycle GHG Emissions and Associated Social Costs (Prior Administration Values, 3% Discount Rate)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
97,327,461	415,573	2,043	108,325,747	$849,687,925	$116,413,206	$5,326,501	$971,427,632	$266,322,092

Note:
NPV = Net Present Value

Revised Tables:

Table 3.7-9. Alternative A - Estimated Life Cycle GHG Emissions and Associated Social Costs (Biden Administration Values, 3% Discount Rate)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
107,887,946	415,816	2,225	118,946,306	$11,161,620,779	$1,568,812,549	$88,326,234	$12,818,759,562	$3,440,061,411

Note:
NPV = Net Present Value

Table 3.7-10. Alternative A - Estimated Life Cycle GHG Emissions and Associated Social Costs (Prior Administration Values, 3% Discount Rate)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
107,887,946	415,816	2,225	118,946,306	$923,611,325	$116,463,280	$5,706,335	$1,045,780,940	$314,246,218

Note:
NPV = Net Present Value

Section 3.7.2.3.4, FEIS Page 281

Original Paragraph:

Summary of Alternative A

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For Alternative A, the social cost benefit from CO_2 operational emissions reductions is estimated to be between $54 million and $476 million dollars the first year of operation, in nominal dollars, and would increase every year thereafter. On an individual replacement resource basis, the estimated total Alternative A life cycle social costs of GHG emissions ranges from approximately $971 million to $12 billion in nominal dollars. These values equate to between approximately $266 million and $3 billion in NPV to 2021 dollars. On a TVA system-wide basis, the estimated total Alternative A life cycle social costs of GHG emissions in comparison to the No Action Alternative, i.e., net savings/benefit, ranges from approximately $1.1 billion to $12 billion in nominal dollars. These savings/benefit values equate to between approximately $418 million and $4.4 billion in NPV to 2021 dollars.[18] In comparison to Alternatives B and C, Alternative A has the highest estimated GHG life cycle emissions and associated estimated future social costs; however, other considerations such as the need for firm, dispatchable power and the need to have this power in place by 2026, would still lead TVA to identify Alternative A as the preferred alternative. In addition, the design of Alternative A is such that future implementation of carbon capture and storage and of hydrogen fuel blending, as these technologies become viable, could result in further significant GHG emissions reductions.

Revised Paragraph:

Summary of Alternative A

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For Alternative A, the social cost benefit, in nominal dollars, from CO_2 operational emissions reductions is estimated to be between $17 million and $153 million dollars the first year of

[18] A range of social costs is provided to account for using prior administration SC values and Biden Administration SC values.

operation (2027), and between $54 million and $512 million in 2029 and would increase every year thereafter. On an individual replacement resource basis, the estimated total Alternative A life cycle social costs of GHG emissions ranges from approximately $1.05 billion to $12.8 billion in nominal dollars. These values equate to between approximately $314 million and $3.4 billion in NPV to 2021 dollars. On a TVA system-wide basis, the estimated total Alternative A life cycle social costs of GHG emissions in comparison to the No Action Alternative, i.e., net savings/benefit, ranges from approximately $1.1 billion to $12 billion in nominal dollars. These savings/benefit values equate to between approximately $418 million and $4.4 billion in NPV to 2021 dollars.[18] In comparison to Alternatives B and C, Alternative A has the highest estimated GHG life cycle emissions and associated estimated future social costs; however, other considerations such as the need for firm, dispatchable power and the need to have this power in place by 2026, would still lead TVA to identify Alternative A as the preferred alternative. In addition, the design of Alternative A is such that future implementation of carbon capture and storage and of hydrogen fuel blending, as these technologies become viable, could result in further significant GHG emissions reductions.

Section 3.7.2.4.1, FEIS Page 284

Original Paragraph:

Operations Effects

The addition of natural gas CT plant operations at the JCT reservation and Gleason reservation are expected to have long-term, minor effects on local air quality. These additions, along with the CUF plant retirement, are expected to have long-term, moderate, beneficial effects on regional climate change in comparison to the No Action Alternative. The net change (increases) in SO_2, NO_x, CO, PM (filterable only), PM_{10}, $PM_{2.5}$, and VOC operational emissions at the JCT reservation are estimated at 2+ tons/year, 131+ tons/year, 80+ tons/year, 7+ tons/year, 30+ tons/year, 30+ tons/year, and 9+ tons/year, respectively. The net change (increase) in SO_2, NO_x, CO, PM, PM_{10}, $PM_{2.5}$, and VOC operational emissions at the Gleason Reservation are estimated at 1+ tons/year, 98+ tons/year, 60+ tons/year, 5+ tons/year, 22+ tons/year, 22+ tons/year, and 7+ tons/year, respectively. Table 3.7-3 provides a comparison of estimated pollutant operational emissions for each alternative both before and after implementation of alternatives, including the estimated net change in facility emissions. Emissions presented are only due to directly impacted TVA facilities under each alternative. Emission calculations for the CTs were based on the following: ……

Revised Paragraph (Change is with addition of footnote #20):

Operations Effects

The addition of natural gas CT plant operations at the JCT reservation and Gleason reservation are expected to have long-term, minor effects on local air quality. These additions, along with the CUF plant retirement, are expected to have long-term, moderate, beneficial effects on regional climate change in comparison to the No Action Alternative. The net change (increases) in SO_2, NO_x, CO, PM (filterable only), PM_{10}, $PM_{2.5}$, and VOC operational emissions at the JCT

[18] A range of social costs is provided to account for using prior administration SC values and Biden Administration SC values.

reservation are estimated at 2+ tons/year, 131+ tons/year, 80+ tons/year, 7+ tons/year, 30+ tons/year, 30+ tons/year, and 9+ tons/year, respectively. The net change (increase) in SO_2, NO_x, CO, PM, PM_{10}, $PM_{2.5}$, and VOC operational emissions at the Gleason Reservation are estimated at 1+ tons/year, 98+ tons/year, 60+ tons/year, 5+ tons/year, 22+ tons/year, 22+ tons/year, and 7+ tons/year, respectively. Table 3.7-3 provides a comparison of estimated pollutant operational emissions for each alternative both before and after implementation of alternatives, including the estimated net change in facility emissions. Emissions presented are only due to directly impacted TVA facilities under each alternative.[20] Emission calculations for the CTs were based on the following: ……

[20] Operational emissions at CUF would still occur in 2027 and 2028 until the second coal unit retires but at an assumed 50 percent of the emission rates provided in Table 3.7-3 under the CUF 3-Year Avg. Annual rates.

Section 3.7.2.4.1, FEIS Page 285

Original Paragraphs:

GHG Effects from Direct Emissions

The estimated decrease in CO_2-e operational emissions based on the net changes at CUF and JCT and the net changes at the CUF and Gleason from implementation of Alternative B would be 4,775,539 tons and 4,894,009 respectively, in the first full year (2027) when the CT plants would be expected to operate. For purposes of this analysis, TVA assumes commercial operation to begin in mid-2026 with final acceptance in December 2026; however, the maximum annual CO_2-e emissions reductions begin in 2027. Similar annual reductions in CO_2-e operational emissions relative to the No Action Alternative would be experienced from that point forward. The estimated percent net reduction in actual operational CO_2-e emissions due to Alternative B would be 92 percent in 2027 from 2020, exceeding the Biden Administration goal of 65 percent reduction in Scope 1 GHG emissions by 2035 from a 2008 baseline.

For purposes of a general correlating measure of GHG effects, the estimated net decrease in emissions of 8.8 million metric tons of CO_2 per year associated with the implementation of Alternative B would represent approximately 9.3 percent of total statewide emissions in 2018, approximately 0.2 percent of the total U.S. emissions in 2020, and 0.03 percent of the total global GHG emissions for 2020. As such, the operation of Alternative B would represent a benefit to GHG emission reduction, particularly from Tennessee's contribution to GHG emissions reductions.

Using the Biden Administration's 2021 SCC dollar per metric ton values, adjusted for inflation, the estimated net social benefit of CO_2 operational emissions reductions from implementing Alternative B at JCT and Gleason in 2027 would be $293,693,305 and $300,979,166, respectively, and total $594,672,470 for direct CO_2 effects (Table 3.7-4). Using the 2019 SCC dollar per metric ton values from the prior administration, adjusted for inflation, the estimated social cost benefit of CO_2 emissions reductions from implementing Alternative B at JCT and Gleason in 2027 would be $33,428,775 and $34,258,067, respectively, and total $67,686,842 for direct CO_2 effects (Table 3.7-5). For both scenarios, beyond 2027 and at least through 2050, the net social benefit of CO_2 operational emissions reductions would increase year over year based on the increase in SCC rates ($/ton) between 2027 and 2050.

Revised Paragraphs:

GHG Effects from Direct Emissions

The estimated reduction in future CO_2-e operational emissions based on the net changes at CUF and JCT and the net changes at CUF and Gleason from implementation of Alternative B would be 2,150,539 tons for JCT and 2,430,009 tons for Gleason in 2027 and 2028 while the second CUF coal unit is still operating. These reductions would increase to 4,775,539 tons per year and 4,894,009 tons per year, respectively, in 2029 and thereafter. For purposes of this analysis, TVA assumes commercial operation of the CT plants to begin in mid-2026 with final acceptance in December 2026; however, the maximum annual CO_2-e emissions reductions begin in 2029 after the second CUF coal unit retires. The estimated percent net reduction in actual operational CO_2-e emissions due to Alternative B would be 92 percent in 2029 from 2020, exceeding the Biden Administration goal of 65 percent reduction in Scope 1 GHG emissions by 2035 from a 2008 baseline.

For purposes of a general correlating measure of GHG effects, the estimated net decrease in emissions of 8.8 million metric tons of CO_2 per year associated with the implementation of Alternative B (starting in 2029) would represent approximately 9.3 percent of total statewide emissions in 2018, approximately 0.2 percent of the total U.S. emissions in 2020, and 0.03 percent of the total global GHG emissions for 2020. As such, the operation of Alternative B would represent a benefit to GHG emission reduction, particularly from Tennessee's contribution to GHG emissions reductions.

Using the Biden Administration's 2021 SCC dollar per metric ton values, adjusted for inflation, the estimated net social benefit of CO_2 operational emissions reductions from implementing Alternative B at JCT and Gleason would be $315,916,430 and $323,753,596, respectively, and total $639,670,026 for direct CO_2 effects in 2029 (Table 3.7-4). This benefit would be $132,257,104 and $149,444,386, respectively, and total $281,701,490 in 2027 and slightly higher in 2028. Using the 2019 SCC dollar per metric ton values from the prior administration, adjusted for inflation, the estimated social cost benefit of CO_2 emissions reductions from implementing Alternative B at JCT and Gleason would be $33,428,775 and $34,258,067, respectively, and total $67,686,842 for direct CO_2 effects in 2029 (Table 3.7-5). This benefit would be $15,053,775 and $17,010,067, respectively, and total $32,063,842 in 2027 and slightly higher in 2028. For both scenarios, beyond 2027 and at least through 2050, the net social benefit of CO_2 operational emissions reductions would increase year over year based on the increase in SCC rates ($/ton) between 2027 and 2050.

Section 3.7.2.4.1, FEIS Page 286

Original Paragraph:

GHG Effects from Direct and Indirect Emissions – Life Cycle Analyses

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In summary, the Alternative B estimated life cycle analysis emissions of each GHG and their corresponding estimated future social costs are provided in Table 3.7-8 and Table 3.7-9. Table 3.7-8 provides the results using the Biden Administration social cost values and Table 3.7-9 provides the results using the prior administration social cost values. Both tables also provide a NPV of the total life cycle SC-GHG for Alternative B. In comparison to Alternatives A and C, Alternative B has higher estimated CO_2-e life cycle emissions and associated future social costs than Alternative C but lower CO_2-e life cycle emissions and associated future social costs than Alternative A, in nominal dollars. In comparison to the No Action Alternative, Alternative B has an estimated 90 percent decrease in both life cycle CO_2-e emissions and associated future social costs in nominal dollars. The total estimated life cycle GHG social costs for each alternative under Biden Administration values are: $34.92 billion – No Action Alternative; $12.15 billion – Alternative A; $3.54 billion – Alternative B; and $1.63 billion –

Alternative C. The total estimated life cycle GHG social costs for each alternative under prior administration values are: $2.82 billion – No Action Alternative; $971.4 million – Alternative A; $282.9 million – Alternative B; and $135.2 million – Alternative C.

Revised Paragraph:

GHG Effects from Direct and Indirect Emissions – Life Cycle Analyses

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In summary, the Alternative B estimated life cycle analysis emissions of each GHG and their corresponding estimated future social costs are provided in Table 3.7-8 and Table 3.7-9. Table 3.7-8 provides the results using the Biden Administration social cost values and Table 3.7-9 provides the results using the prior administration social cost values. Both tables also provide a NPV of the total life cycle SC-GHG for Alternative B. In comparison to Alternatives A and C, Alternative B has higher estimated CO_2-e life cycle emissions and associated future social costs than Alternative C but lower CO_2-e life cycle emissions and associated future social costs than Alternative A, in nominal dollars. In comparison to the No Action Alternative, Alternative B has an estimated 87 percent decrease in life cycle CO_2-e emissions and 88 percent decrease in associated future social costs in nominal dollars. The total estimated life cycle GHG social costs for each alternative under Biden Administration values are: $34.92 billion – No Action Alternative; $12.82 billion – Alternative A; $4.2 billion – Alternative B; and $2.3 billion – Alternative C. The total estimated life cycle GHG social costs for each alternative under prior administration values are: $2.82 billion – No Action Alternative; $1.05 billion – Alternative A; $357.3 million – Alternative B; and $210.1 million – Alternative C.

Section 3.7.2.4.1, FEIS Page 287

Original Tables:

Table 3.7-11. Alternative B - Estimated Life Cycle GHG Emissions and Associated Social Costs (Biden Administration Values, 3% Discount Rates)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
28,056,648	129,419	624	31,478,103	$3,029,113,658	$488,416,883	$25,722,718	$3,543,253,259	$876,316,344

Note:
NPV = Net Present Value

Table 3.7-12. Alternative B - Estimated Life Cycle GHG Emissions and Associated Social Costs (Prior Administration Values, 3% Discount Rates)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
28,056,648	129,419	624	31,478,103	$245,017,628	$36,253,719	$1,626,778	$282,898,125	$76,852,188

Note:
NPV = Net Present Value

Revised Tables:

Table 3.7-13. Alternative B - Estimated Life Cycle GHG Emissions and Associated Social Costs (Biden Administration Values, 3% Discount Rates)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
38,617,134	129,661	805	42,098,663	$3,690,686,967	$488,889,426	$29,826,050	$4,209,402,443	$1,305,680,124

Note:
NPV = Net Present Value

Table 3.7-14. Alternative B - Estimated Life Cycle GHG Emissions and Associated Social Costs (Prior Administration Values, 3% Discount Rates)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
38,617,134	129,661	805	42,098,663	$318,941,028	$36,303,793	$2,006,612	$357,251,433	$124,776,314

Note:
NPV = Net Present Value

Section 3.7.2.4.3, FEIS Page 289

Original Paragraph:

Summary of Alternative B

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For Alternative B, the social cost benefit from CO_2 operational emissions reductions is estimated to be between $67 million and $595 million dollars the first year of operation, in nominal dollars, and would increase every year thereafter. On an individual replacement resource basis, the estimated total Alternative A life cycle social costs of GHG emissions ranges from approximately $283 million to $3.5 billion in nominal dollars. These values are between approximately $77 million and $876 million in NPV to 2021 dollars. On a TVA system-wide basis, the estimated total Alternative A life cycle social costs of GHG emissions in comparison to the No Action Alternative, i.e., net savings/benefit, ranges from approximately $953 million to $10.4 billion in nominal dollars. These savings/benefit values are between approximately $361 million and $3.8 billion in NPV to 2021 dollars.[20] In comparison to Alternatives A and C on an individual replacement resource basis, Alternative B is between these two alternatives regarding GHG life cycle emissions and associated estimated future social costs. This same comparison on a TVA system-wide basis results in Alternative B with the least total life cycle social cost savings/benefit in comparison to the No Action Alternative.

Revised Paragraph:

Summary of Alternative B

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For Alternative B, the social cost benefit, in nominal dollars, from CO_2 operational emissions reductions is estimated to be between $32 million and $282 million dollars the first year of operation (2027), and between $68 million and $640 million in 2029 and would increase every year thereafter. On an individual replacement resource basis, the estimated total Alternative B life cycle social costs of GHG emissions ranges from approximately $357 million to $4.2 billion

[20] A range of social costs is provided to account for using prior administration SC values and Biden Administration SC values.

in nominal dollars. These values are between approximately $125 million and $1.3 billion in NPV to 2021 dollars. On a TVA system-wide basis, the estimated total Alternative B life cycle social costs of GHG emissions in comparison to the No Action Alternative, i.e., net savings/benefit, ranges from approximately $953 million to $10.4 billion in nominal dollars. These savings/benefit values are between approximately $361 million and $3.8 billion in NPV to 2021 dollars.[21] In comparison to Alternatives A and C on an individual replacement resource basis, Alternative B is between these two alternatives regarding GHG life cycle emissions and associated estimated future social costs. This same comparison on a TVA system-wide basis results in Alternative B with the least total life cycle social cost savings/benefit in comparison to the No Action Alternative.

Section 3.7.2.5.1, FEIS Page 292

Original Paragraph:

Operations Effects

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The solar and storage facility operations are expected to have long-term, moderate, beneficial effects on air quality and on regional climate change in comparison to the No Action Alternative. The decrease in SO_2, NO_x, CO, PM, PM_{10}, $PM_{2.5}$, and VOC operational emissions at the CUF facility are estimated at 7,260+ tons/year, 4,050+ tons/year, 1,080+ tons/year, 310+ tons/year, 1,400+ tons/year, 1,300+ tons/year, and 120+ tons/year, respectively. There would also be elimination of hydrogen fluoride, hydrogen chloride emissions, mercury, and lead emissions, along with other HAP emissions. The detailed emissions calculations are provided in Appendix H.

Revised Paragraph:

Operations Effects

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[21] A range of social costs is provided to account for using prior administration SC values and Biden Administration SC values.

The solar and storage facility operations are expected to have long-term, moderate, beneficial effects on air quality and on regional climate change in comparison to the No Action Alternative. Beginning in 2029, the decrease in SO_2, NO_x, CO, PM, PM_{10}, $PM_{2.5}$, and VOC operational emissions at the CUF facility are estimated at 7,260+ tons/year, 4,050+ tons/year, 1,080+ tons/year, 310+ tons/year, 1,400+ tons/year, 1,300+ tons/year, and 120+ tons/year, respectively. In the interim period of 2027 to 2028 when the second CUF coal unit is still operating before retirement, these reductions will be 50 percent of the above values. There would also be elimination of hydrogen fluoride, hydrogen chloride emissions, mercury, and lead emissions, along with other HAP emissions. The detailed emissions calculations are provided in Appendix H.

Section 3.7.2.5.1, FEIS Pages 292 and 293

Original Paragraphs:

GHG Effects from Direct Emissions

The estimated decrease in CO_2-e operational emissions at the CUF facility from the implementation of Alternative C would be 10,566,667 tons in the first full year when all solar and storage facilities would begin operation (anticipated in 2027). For modeling purposes, it was assumed that commercial operation would begin in mid-2026 (with final acceptance in December 2026 and the maximum annual CO_2-e emissions reductions beginning in 2027). Similar annual reductions in CO_2-e operational emissions would be experienced from that point forward. However, new solar facilities could not be built and operational within the modeled timeframe and would require additional time for completion of permitting, design, and construction phases. The percentage net reduction in actual operational CO_2-e emissions due to Alternative C would be 100 percent by 2035, exceeding the Biden Administration's goal of a 65 percent reduction in Scope 1 GHG emissions by 2035 from a 2008 baseline.

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Using the Biden Administration's 2021 SCC dollar per metric ton values, adjusted for inflation, the estimated net social benefit of CO_2 operational emissions reductions from implementing Alternative C in 2027 would be $645,744,801 for direct CO_2 effects. Table 3.7-4 provides the Biden Administration's net social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2027, when full year operations would begin. Using the 2019 SCC dollar per metric ton values from the prior administration, adjusted for inflation, the estimated net social benefit of carbon emissions reductions from implementing Alternative C in 2027 would be $73,500,000 for direct CO_2 effects. Table 3.7-5 provides the prior administration's net social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2027, when full year operations would begin. Beyond 2027 and at least through 2050, the net social benefit of CO_2 operational emissions reductions would increase year over year based on the increase in SCC rates ($/ton) between 2020 and 2050.

Revised Paragraphs:

GHG Effects from Direct Emissions

The estimated decrease in CO_2-e operational emissions at the CUF facility from the implementation of Alternative C would be 5,250,000 tons in 2027 and 2028 while the second CUF coal unit is still operating and increase to 10,566,667 tons per year thereafter. For modeling purposes, it was assumed that commercial operation of Alternative C would begin in mid-2026 with final acceptance in December 2026; however, the maximum annual CO_2-e emissions reductions beginning in 2029 after the second CUF coal unit retires. However, new solar facilities could not be built and operational within the modeled timeframe and would require additional time for completion of permitting, design, and construction phases. The percentage net reduction in actual operational CO_2-e emissions due to Alternative C would be 100 percent by 2035, exceeding the Biden Administration's goal of a 65 percent reduction in Scope 1 GHG emissions by 2035 from a 2008 baseline.

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Using the Biden Administration's 2021 SCC dollar per metric ton values, adjusted for inflation, the estimated net social benefit of CO_2 operational emissions reductions from implementing Alternative C would be $694,606,888 in 2029 for direct CO_2 effects. This benefit would be $322,872,401 in 2027 and slightly higher in 2028. Table 3.7-4 provides the Biden Administration's net social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2029 after the second CUF coal unit retires. Using the 2019 SCC dollar per metric ton values from the prior administration, adjusted for inflation, the estimated net social benefit of carbon emissions reductions from implementing Alternative C would be $73,500,000 in 2029 for direct CO_2 effects. This benefit would be $36,750,000 in 2027 and slightly higher in 2028. Table 3.7-5 provides the prior administration's net social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2029 after the second CUF coal unit retires. Beyond 2027 and at least through 2050, the net social benefit of CO_2 operational emissions reductions would increase year over year based on the increase in SCC rates ($/ton) between 2020 and 2050.

Section 3.7.2.5.1, FEIS Page 293

Original Paragraph:

GHG Effects from Direct and Indirect Emissions – Life Cycle Analyses

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In summary, the Alternative C estimated life cycle analysis emissions of each GHG and their corresponding estimated future social costs are provided in Table 3.7-10 and Table 3.7-11.

Table 3.7-10 provides the results using the Biden Administration social cost values and Table 3.7-11 provides the results using the prior administration social cost values. Both tables also provide a NPV of the total life cycle SC-GHG for Alternative C. In comparison to Alternatives A and B, Alternative C is below these two alternatives regarding estimated CO_2-e life cycle emissions and associated costs, in nominal dollars. In comparison to the No Action Alternative, Alternative C has an estimated 95 percent decrease in life cycle CO_2-e emissions and 95 percent decrease in associated estimated future social costs, in nominal dollars. The total estimated life cycle SC-GHG for each alternative under Biden Administration values are: $34.92 billion – No Action Alternative; $12.15 billion – Alternative A; $3.54 billion – Alternative B; and $1.63 billion – Alternative C. The total estimated life cycle SC-GHG for each alternative under prior administration values are: $2.82 billion – No Action Alternative; $971.4 million – Alternative A; $282.9 million – Alternative B; and $135.2 million – Alternative C.

Revised Paragraph:

GHG Effects from Direct and Indirect Emissions – Life Cycle Analyses

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In summary, the Alternative C estimated life cycle analysis emissions of each GHG and their corresponding estimated future social costs are provided in Table 3.7-10 and Table 3.7-11. Table 3.7-10 provides the results using the Biden Administration social cost values and Table 3.7-11 provides the results using the prior administration social cost values. Both tables also provide a NPV of the total life cycle SC-GHG for Alternative C. In comparison to Alternatives A and B, Alternative C is below these two alternatives regarding estimated CO_2-e life cycle emissions and associated costs, in nominal dollars. In comparison to the No Action Alternative, Alternative C has an estimated 91.5 percent decrease in life cycle CO_2-e emissions and 93.4 percent decrease in associated estimated future social costs, in nominal dollars using Biden social cost rates. The total estimated life cycle SC-GHG for each alternative under Biden Administration values are: $34.92 billion – No Action Alternative; $12.82 billion – Alternative A; $4.2 billion – Alternative B; and $2.3 billion – Alternative C. The total estimated life cycle SC-GHG for each alternative under prior administration values are: $2.82 billion – No Action Alternative; $1.05 billion – Alternative A; $357.2 million – Alternative B; and $210.1 million – Alternative C.

Section 3.7.2.5.1, FEIS Page 294

Original Tables:

Table 3.7-15. Alternative C - Estimated Life Cycle GHG Emissions and Associated Social Costs (Biden Administration Values, 3% Discount Rates)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
16,767,825	60	0.6	16,769,502	$1,633,945,043	$203,337	$20,897	$1,634,169,277	$1,051,019,292

Note:
NPV = Net Present Value

Table 3.7-16. Alternative C - Estimated Life Cycle GHG Emissions and Associated Social Costs (Prior Administration Values, 3% Discount Rates)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
16,767,825	60	0.6	16,769,502	$135,163,159	$15,462	$1,353	$135,179,973	$87,738,699

Note:
NPV = Net Present Value

Revised Tables:

Table 3.7-17. Alternative C - Estimated Life Cycle GHG Emissions and Associated Social Costs (Biden Administration Values, 3% Discount Rates)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
27,328,311	303	181.8	27,390,061	$2,295,518,366	$677,172	$4,124,228	$2,300319,766	$1,480,383,195

Note:
NPV = Net Present Value

Table 3.7-18. Alternative C - Estimated Life Cycle GHG Emissions and Associated Social Costs (Prior Administration Values, 3% Discount Rates)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
27,328,311	303	181.8	27,390,061	$209,644,635	$65,571	$381,190	$210,091,397	$135,711,821

Note:
NPV = Net Present Value

Section 3.7.2.5.3, FEIS Page 296

Original Paragraph:

Summary of Alternative C

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For Alternative C, the social cost benefit from CO_2 operational emissions reductions is estimated to be between $73.5 million and $646 million dollars the first year of operation, in nominal dollars, and would increase every year thereafter. On an individual replacement resource basis, the estimated total Alternative C life cycle social costs of GHG emissions ranges from approximately $135 million to $1.6 billion in nominal dollars. These values equate to between approximately $88 million and $1.1 billion in NPV to 2021 dollars. On a TVA system-wide basis, the estimated total Alternative C life cycle social costs of GHG emissions in comparison to the No Action Alternative, i.e., net savings/benefit, ranges from approximately $1.2 billion to $13.3 billion in nominal dollars. These savings/benefit values equate to between approximately $436 million and $4.8 billion in NPV to 2021 dollars.[21] In comparison to Alternatives A and B on an individual replacement resource basis, Alternative C has the lowest GHG life cycle emissions and associated estimated future social costs in nominal dollars. However, the NPV of Alternative C to 2021 dollars is larger than the Alternative B NPV because the majority of Alternative C GHG social costs are estimated to occur prior to its operation. This same comparison on a TVA system-wide basis results in Alternative C with the highest total life cycle social cost savings/benefit in comparison to the No Action Alternative.

Revised Paragraph:

Summary of Alternative C

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For Alternative C, the social cost benefit, in nominal dollars, from CO_2 operational emissions reductions is estimated to be between $37 million and $323 million dollars the first year of operation (2027). In 2029, those values would be between 73.5 million and $695 million and would increase every year thereafter. On an individual replacement resource basis, the estimated total Alternative C life cycle social costs of GHG emissions ranges from approximately $210 million to $2.3 billion in nominal dollars. These values equate to between

[21] A range of social costs is provided to account for using prior administration SC values and Biden Administration SC values.

approximately $136 million and $1.5 billion in NPV to 2021 dollars. On a TVA system-wide basis, the estimated total Alternative C life cycle social costs of GHG emissions in comparison to the No Action Alternative, i.e., net savings/benefit, ranges from approximately $1.2 billion to $13.3 billion in nominal dollars. These savings/benefit values equate to between approximately $436 million and $4.8 billion in NPV to 2021 dollars.[22] In comparison to Alternatives A and B on an individual replacement resource basis, Alternative C has the lowest GHG life cycle emissions and associated estimated future social costs in nominal dollars. However, the NPV of Alternative C to 2021 dollars is larger than the Alternative B NPV because the majority of Alternative C GHG social costs are estimated to occur at the beginning of its life cycle. This same comparison on a TVA system-wide basis results in Alternative C with the highest total life cycle social cost savings/benefit in comparison to the No Action Alternative.

Revisions to Appendix I – Greenhouse Gas Emissions Life Cycle Analysis (LCA)

TVA has updated the following tables in the CUF FEIS, Appendix I – Greenhouse Gas Emissions Life Cycle Analysis (LCA) at the referenced page numbers:

- **Table I.4.1 – p. I-5**
- **Table I.4.2 and prefaced text – p. I-6**
- **Table I.6.6 – p. I-14**
- **Table I.6.7 – p. I-15**
- **Table I.6.10 – p. I-17**
- **Table I.6.11 – p. I-18**
- **Table I.6.13 – p. I-21**
- **Table I.6.15 – p. I-24**
- **Table I.6.17 – p. I-27**
- **Table I.6.18 – p. I-28**
- **Table I.6.20 – p. I-31**
- **Table I.6.22 – p. I-34**
- **Table I.6.24 – p. I-37**

The revised Appendix I with changes identified in colored font is provided below.

[22] A range of social costs is provided to account for using prior administration SC values and Biden Administration SC values.

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APPENDIX I
GREENHOUSE GAS EMISSIONS LIFE CYCLE ANALYSES OF CUMBERLAND RETIREMENT ALTERNATIVES

This appendix explains the methodology and provides the emissions calculations and results of the Life Cycle Analyses (LCAs) of greenhouse gases (GHGs) emissions for each of the four alternative actions, on both an individual replacement resource by alternative basis (henceforth "individual") and a TVA system-wide portfolio basis with simulated generation dispatch (henceforth "system-wide"). The GHGs included in this analysis are carbon dioxide (CO_2), methane (CH_4), and nitrous dioxide (N_2O) as these are the GHGs of concern in association with the Proposed Action. Additionally, these three GHGs are the ones specifically emphasized in the January 2021 Executive Order 13990 regarding capturing the social costs of GHGs. The life cycle GHG emissions results were used to calculate the social cost of carbon (SCC), social cost of methane (SCM), and social cost of nitrous oxide (SCN) values for each alternative, as well as the total social cost of the three GHGs for each alternative (SC-GHG). Social costs were calculated and presented in nominal dollars and in terms of Net Present Value (NPV) in 2021 dollars.

The life cycle emissions and SC-GHG emissions for each alternative, calculated as described in this Appendix for both the individual replacement resource by alternative basis and the TVA system-wide portfolio basis, are summarized in Section 3.7.2 of this EIS.

All tables referenced below are provided in Section I.6 of this Appendix, except for four summary tables provided in Section I.4 for the total SC-GHGs for each alternative for both the individual basis LCA and TVA system-wide basis LCA.

The basis for these LCAs is National Renewable Energy Laboratory (NREL) publications that provide harmonized CO_2-equivalent (CO_2-e) life cycle emission factors for each of the different life cycle segments of the generating technologies being considered. The NREL's LCA harmonization process included reviews of approximately 3,000 published LCA studies of a variety of utility-scale electrical generation and storage technologies. The NREL harmonization process included three rounds of screening by multiple experts to select references that met strict criteria for quality, relevance, and transparency. The NREL references provided a range of life cycle emission factors for each technology; the median published life cycle emission factors were used in the calculations described here. These NREL references were considered the most appropriate and complete references currently available for calculating emissions from all life cycle segments for the electricity generation technologies in this EIS.

The life cycle segments included in the NREL publications include the following with their descriptions:

- One-Time Upstream includes GHG emissions from resource extraction/production, processing/conversion, material manufacturing, component manufacturing, delivery to site, and construction for plant/technology components. This LCA assumes One-Time Upstream costs are all for the year 2026.

- Ongoing Annual Combustion includes GHG emissions from combustion of fuels at the proposed facilities over the entire operational life cycle of the technology.[2]
- Ongoing Annual Non-Combustion includes GHG emissions from plant operations activities other than fuel combustion, plant maintenance activities, and the fuel cycle GHG emissions, i.e., fuel extraction/processing/distribution/transport (includes pipelines) and coal bed methane.
- One-Time Downstream includes dismantling, decommissioning, disposal, and recycling of the plant/technology. This LCA assumes One-Time Downstream costs are all in 2057 for Alternatives A and B and 2047 for Alternative C.

Although data on methane leaks from natural gas technologies is provided in the NREL publications, this parameter was not harmonized by NREL. However, the natural gas LCAs reviewed by NREL that passed their strict criteria included methane leakage in terms of a percent of total natural gas production and use. These values for LCAs conducted in the U.S. were averaged to obtain a representative cumulative methane leakage rate of 1.6 percent over the life cycle of the proposed CC and CT plants. This 1.6 percent of total natural gas flow leakage rate was used to calculate methane emissions from the natural gas technologies in Alternatives A and B. A separate line item for methane leak emissions from natural gas technologies is provided in this LCA because it is not included in the Ongoing Annual Non-Combustion emission factor per interpretation of the natural gas NREL LCA harmonization publication.

The life cycle emission factors in the NREL publications were only provided in terms of CO_2-equivalent emissions (in grams) per kilowatt-hour of electricity production. To disaggregate the CO_2-e emission factors into emission factors for each of the three individual GHGs, the individual GWP-weighted contributions of CO_2, CH_4, and N_2O to their total CO_2-e emission factors are prorated based on their relative contribution from the *USEPA Emission Factors for GHG Inventories, Table 6 - Electricity under Total Output Emission Factors for the eGRID Subregion of SERC Tennessee Valley*. These emission factors are 834.2 lb/MW-hr for CO_2, 0.075 lb/MW-hr for CH_4, and 0.011 lb/MW-hr for N_2O. Using these values, the percent contribution of CO_2, CH_4, and N_2O to the CO_2-e emission factor is 99.99%, 0.009%, and 0.001%, respectively. For the coal technology, this prorating was not necessary as the NREL coal LCA publication provided the mean GWP-weighted contribution of CH_4 and N_2O to CO_2-e as approximately 5% and <1% (assumed 0.9%), respectively, so that the CO_2 contribution is 94.1%. The emission factors used for the LCAs are provided in Tables I.6.1 through I.6.4 for CO_2-e, CO_2, CH_4 and N_2O emissions, respectively.

None of the emission factors in the NREL LCA harmonization publications include transmission and distribution (T&D) electricity losses as they were outside the scope of the NREL studies and are not considered appreciably different for each EIS alternative.

The assumptions and conditions defining the electricity generation rates for supporting each alternative's life cycle emissions calculations are provided below. These generation rates are based on the projected average annual lifetime electricity generation. Table I.6.5 provides the assumptions, conditions, and projected average annual electricity generation lifetime rates in kw-hours per year. The maximum capacity annual electricity generation rates are provided for coal and natural gas technologies only to show the basis for calculating the average annual lifetime rates.

[2] The Ongoing Annual Combustion emission factors in the NREL references were not used because those combustion emissions were calculated using alternative-specific design, operational, and regulatory information. These emission factors were instead based on the specifications of the proposed CC and CT plants.

- No Action Alternative – Coal Technology
  - Plant size – 2,470 Megawatts (MW)
  - Projected average annual lifetime generation – assumed approximately 55% capacity factor based on U.S. Energy Information Administration (EIA) industry averages over the last 10 years; obtained from EIA website: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_a.

- Alternative A – Natural Gas Combined Cycle Combustion Turbine Technology
  - Plant size – 1,450 MW
  - Projected average annual lifetime generation – assumed approximately 55% capacity factor based on EIA industry averages over the last 10 years; obtained from EIA website: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_a. Based on TVA's experience and industry knowledge, actual CC capacity factors for any given plant in any given year may vary between about 35% and about 90% depending on factors such as load growth, natural gas prices, composition of the balance of TVA's generating fleet in any given year, outages, or other unforeseen circumstances.

- Alternative B – Natural Gas Simple Cycle Combustion Turbine Technology
  - Plant sizes – 884 MW at Johnsonville; 663 MW at Gleason
  - Projected average annual lifetime generation – assumed approximately 10% capacity factor based on EIA industry averages over the last 10 years; obtained from EIA website: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_a. Based on TVA's experience and industry knowledge, actual CT capacity factors for any given plant in any given year may vary between about 1% and about 35 % depending on factors such as load growth, natural gas prices, composition of the balance of TVA's generating fleet in any given year, outages, or other unforeseen circumstances.

- Alternative C – Solar Panel/Battey Storage Technology
  - Plant sizes – 3,000 MW Solar; 1,700 MW battery storage
  - Projected average annual lifetime generation – assumed 25% capacity factor for solar and 16.7% capacity factor for battery storage. Solar basis is based on typical responses to recent TVA RFPs for utility-scale, single axis tracking solar facilities. Battery basis is from an NREL publication on 4-hour duration utility scale battery energy storage systems: https://atb.nrel.gov/electricity/2021/utility-scale_battery_storage.
  - Additional assumptions – battery storage calculations assume 1 full cycle/day (5 hours to charge from the grid and 4 hours to discharge to grid = 9 hours/cycle). Battery efficiency is assumed to be 85% based on typical responses to recent TVA RFPs for utility-scale battery storage systems.

Life cycle operational time for CC turbines under Alternative A and CT turbines under Alternative B is 30 years. TVA typically models solar and battery storage as 20-year Power Purchase Agreements and assumes operational time for solar panels/battery storage under Alternative C is 20 years. However, to provide a consistent life cycle comparison across all alternatives, the solar/battery storage alternative was prorated to 30 years by scaling up 20-year emissions by a factor of 1.5; 20 x 1.5 = 30. The life cycle operational time for the No Action

Alternative was extended to the same 30-year period as the other alternatives but only for obtaining an equivalent comparison. It is expected the coal plant would be retired by the end of 2028; the first unit in 2026 and the other unit in 2028.

The system-wide lifecycle analysis builds off the assumptions presented above, while also considering net changes in generation supplied by the remaining TVA fleet on an ongoing basis as compared to the No Action Alternative for 20 years. Carbon dioxide emissions are pulled directly from TVA models, while nitrous oxide and methane emissions use factors based on annual electricity generation by resource type. One-time upstream emissions are assumed to occur in 2026, while one-time downstream emissions occur in 2057 (the first year following the 30-year asset life) and are discounted to the year 2042, which is the end of the 20-year study period. Ongoing annual combustion and non-combustion emissions are accounted for in the year emitted.

On an individual basis, the estimated life cycle CO_2 emissions for each alternative are provided in Table I.6.6. The estimated life cycle CH_4 emissions for each alternative are provided in Tables I.6.7. The estimated methane leakage emissions for Alternative A and B are provided in Table I.6.8 and I.6.9, respectively. The estimated life cycle N_2O emissions for each alternative are provided in Table I.6.10. Tables I.6.6, I.6.7, and I.6.10 also show the emissions for each life cycle segment.

On a system-wide basis, as a delta compared to the No Action Alternative, the estimated change in life cycle CO_2 emissions for each alternative are provided in Table I.6.25. The estimated change in life cycle CH_4 emissions, including methane leakage, for each alternative are provided in Table I.6.26. The estimated life cycle N_2O emissions for each alternative are provided in Table I.6.27.

The GHG life cycle emissions described above were multiplied by social cost values[3], in dollars per short ton (converted from dollars per metric ton), under the following Biden Administration Interagency Working Group on Social Cost of GHGs document (IWG 2021): Technical Support Document, Social Cost of Carbon - Interim Estimates under Biden Administration Executive Order 13990, February 2021 (Appendix A, Table A-1, 3% discount rates). The social costs for each of the three GHGs were calculated in this manner using their individual values for the years covering the life cycle period. The social costs for each GHG were summed to obtain a total GHG life cycle social cost. For each alternative, on an individual basis, Table I.6.11 provides the estimated life cycle social costs of CO_2 emissions, including for each life cycle segment. Tables I.6.13 and I.6.15 provide the same information for CH_4 and N_2O, respectively and on an individual basis. Table I.6.17 provides the summary of life cycle GHG social costs (based on IWG 2021 social cost values) for each of the alternatives, on an individual basis. Tables I.6.12, I.6.14, and I.6.16 provide the Biden Administration social cost value tables by year for CO_2, CH_4, and N_2O respectively, on an individual basis. The main information in Table I.6.17 is summarized below in Table I.4.1.

[3] The social cost values in the Technical Support Document were converted to nominal values using a 2% per year inflation rate.

Table I.4.19 – Individual Basis Total Life Cycle Social Cost of GHG Emissions under Biden Administration SC-GHG Values

Electricity Power Technology	Total Life Cycle Social Cost of GHG Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency in comparing alternatives	**$34,917,574,550**	**$8,667,836,231**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	**$12,818,759,562**	**$3,440,061,411**
Alternative B - Natural Gas - CTs (30-year Life Cycle)	**$4,209,402,443**	**$1,305,680,124**
Alternative C - Solar (20-year Life Cycle, prorated to 30-years for consistency in comparing alternatives)	$1,834,522,883	$1,191,285,579
Alternative C - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years for consistency in comparing alternatives)	$465,796,883	$289,097,616
Alternative C - Total Life Cycle Social Cost of GHG Emissions, $	**$2,300,319,766**	**$1,480,183,195**

Due to legal uncertainties surrounding the use of social cost values for GHGs, TVA has decided to provide a range for GHG life cycle social costs using the current and previous presidential administration's social cost values for GHGs. Presenting social costs as a range of values, as estimated by two different administrations, provides decisionmakers and the public with better information to make an informed decision. Under the prior administration, federal estimates of the SCC were originally reported in 2016 U.S. dollars in the USEPA's regulatory impact analysis for the 2019 Affordable Clean Energy Rule. The Government Accountability Office (GAO) adjusted the values for inflation and expressed them in 2018 U.S. dollars at a 3% discount rate using the United States Gross Domestic Product Price Index from the U.S. Department of Commerce, Bureau of Economic Analysis. In a similar manner, federal estimates of the SCM were originally reported in 2016 U.S. dollars in the Bureau of Land Management's (BLM's) regulatory impact analysis for the 2018 Final Rule to Rescind or Revise Certain Requirements of the 2016 Waste Prevention Rule. The GAO adjusted the values for inflation and expressed them in 2018 U.S. dollars at a 3% discount rate in the same manner as for CO_2; however, the estimates were only provided to 2030. These values were then interpolated through the life cycle period, which is to 2057. The GAO did not find a recent rulemaking that used monetary estimates for N_2O that were based directly on the SCC approach. Instead, GAO used a National Highway Traffic Safety Administration (NHTSA) rulemaking where the N_2O Global Warming Potential factor, i.e., 298, was used to convert USEPA's SCC value estimates to monetary value estimates for N_2O.

Using the prior administration values, the social costs for each of the three GHGs were calculated using their individual values for the years covering the life cycle period. The social costs for each GHG were summed to obtain a total GHG life cycle social cost. For each alternative, Table I.6.18 provides the estimated life cycle SCC emissions, on an individual basis. Tables I.6.20 and I.6.22 provide the same information but for SCM and SCN, respectively and on an individual basis. Tables I.6.18, I.6.20, and I.6.22 also show the SCC, SCM, and SCN, respectively, for each life cycle segment, on an individual basis. Table I.6.24 provides the summary of SC-GHG (based on prior administration cost values) for each of the alternatives on an individual basis. The main information in Table I.6.24 is summarized below in Table I.4.2. Tables I.6.19, I.6.21, and I.6.23 provide the prior administration social cost value tables by year for CO_2, CH_4, and N_2O, respectively.

The one-time upstream SC-GHGs conservatively assumed they were all incurred in the year 2026. The one-time downstream SC-GHGs assumed they were all incurred in the year 2057 for all alternatives.

Table I.4.2 – Individual Basis Total Life Cycle Social Cost of GHG Emissions under Prior Administration SC-GHG Values

Electricity Power Technology	Total Life Cycle Social Cost of GHG Emissions, Nominal $	NPV of Total Life Cycle Social Costs of CHG Emissions, 2021 $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency in comparing alternatives	**$2,820,017,291**	**$766,912,309**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	**$1,045,780,940**	**$314,246,218**
Alternative B - Natural Gas - CTs (30-year Life Cycle)	**$357,251,433**	**$124,776,314**
Alternative C - Solar (20-year Life Cycle, prorated to 30-years for consistency in comparing alternatives)	$158,616,576	$102,951,699
Alternative C - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years for consistency in comparing alternatives)	$51,474,821	$32,760,122
Alternative C - Total Life Cycle Social Cost of GHG Emissions, $	**$210,091,397**	**$135,711,821**

As stated in Section 3.7, a system-wide view provides critical context to how the specific resource retirements and replacements, underpinning the assumptions of each proposed action alternatives, integrates to the system overall, and completes the overall characterization of total system impact and performance. Developing a system-wide life cycle analysis reflects TVA's broader asset strategy and target power supply mix set by the 2019 IRP. A TVA system-wide comparison of emissions, shown as a delta compared to No Action Alternative, is the most effective way to accurately identify incremental emission differences between the alternatives because it illustrates how the entire TVA system is expected to operate with each alternative. Using the same Biden Administration costs described previously for each emission type, the social costs for each of the three GHGs were calculated using their individual values for the years covering the 20-year life cycle period modeled. The social costs for each GHG were summed to obtain a total GHG life cycle social cost. For each alternative, Table I.6.28 provides the estimated life cycle SCC emissions, including for each life cycle segment. Tables I.6.29 and I.6.30 provides the same information for SCM and SCN, respectively. Table I.4.3 below provides the summary of life cycle SC-GHG (based on IWG 2021 social cost values) for each of the alternatives.

Using the prior administration values, the social costs of the system-wide delta compared to the No Action Alternative for each of the three GHGs were calculated for the years covering the 20-year life cycle period. The social costs for each GHG were summed to obtain a total GHG life cycle social cost. For each alternative, Table I.6.31 provides the estimated life cycle SCC emissions on a system-wide delta compared to the No Action Alternative basis. Tables I.6.32 and I.6.33 provide the same information but for SCM and SCN, respectively and on a system-wide delta compared to No Action Alternative basis. Table I.4.4 below provides the summary of life cycle GHG social costs (based on prior administration estimates) for each of the alternatives.

Table I.4.3 – TVA System-Wide Estimated Social Cost of Life Cycle GHG Emissions for Action Alternatives Compared to the No Action Alternative, by Life Cycle Phase (Biden)

Proposed Action Alternatives	One-Time Upstream (Nominal $)	Ongoing Combustion (Nominal $)	Ongoing Non-Combustion (Nominal $)	Methane Leakage (Nominal $)	One-Time Downstream (Nominal $)	Total (Nominal $)	NPV (2021 $)
Alternative A							
CO2	840,414,483	(12,697,868,888)	408,465,812	NA	802,526	(11,448,186,067)	(4,267,500,566)
CH4	1,224	11	(162,002,783)	806	107	(162,000,636)	(59,564,383)
N2O	133	(36)	(330,819,345)	NA	0	(330,819,248)	(122,244,047)
Alternative A Total	**840,415,840**	**(12,697,868,913)**	**(84,356,316)**	**806**	**802,632**	**(11,941,005,950)**	**(4,449,308,996)**
Alternative B							
CO2	365,425	(11,181,511,584)	1,217,967,896	NA	23,351	(9,963,154,911)	(3,688,176,474)
CH4	42	10	(158,472,409)	878	3	(158,471,476)	(57,632,610)
N2O	5	(38)	(323,449,682)	NA	0	(323,449,715)	(118,190,865)
Alternative B Total	**365,471**	**(11,181,511,612)**	**736,045,805**	**878**	**23,354**	**(10,445,076,103)**	**(3,863,999,949)**
Alternative C							
CO2	829,284,390	(14,479,093,167)	706,500,635	NA	101,883,394	(12,841,424,749)	(4,598,965,759)
CH4	94,286	4	(161,453,920)	546	36,434	(161,322,649)	(58,996,039)
N2O	10,254	(64)	(328,384,852)	NA	1,001	(328,373,661)	(120,686,463)
Alternative C Total	**829,388,929**	**(14,479,093,227)**	**216,661,863**	**546**	**101,920,830**	**(13,331,121,059)**	**(4,778,648,261)**

Table I.4.4 – TVA System-Wide Estimated Social Cost of Life Cycle GHG Emissions for Action Alternatives Compared to the No Action Alternative, by Life Cycle Phase (Prior Administration)

Proposed Action Alternatives	One-Time Upstream (Nominal $)	Ongoing Combustion (Nominal $)	Ongoing Non-Combustion (Nominal $)	Methane Leakage (Nominal $)	One-Time Downstream (Nominal $)	Total (Nominal $)	NPV (2021 $)
Alternative A							
CO2	1,293,613	(1,168,887,271)	114,072,562	NA	55,441	(1,053,465,655)	(403,144,217)
CH4	132	1	(14,208,849)	71	6	(14,208,640)	(5,364,757)
N2O	13	(3)	(24,054,600)	NA	0	(24,054,590)	(9,179,479)
Alternative A Total	**1,293,758**	**(1,168,887,272)**	**75,809,113**	**71**	**55,447**	**(1,091,728,884)**	**(417,688,452)**
Alternative B							
CO2	43,914	(1,027,028,763)	111,505,266	NA	1,613	(915,477,970)	(347,415,882)
CH4	4	1	(13,853,682)	76	0	(13,853,600)	(5,168,655)
N2O	0	(3)	(23,418,288)	NA	0	(23,418,290)	(8,825,692)
Alternative B Total	**43,919**	**(1,027,028,764)**	**74,233,296**	**76**	**1,613**	**(952,749,860)**	**(361,410,229)**
Alternative C							
CO2	99,656,869	(1,335,434,809)	64,027,933	NA	11,964,811	(1,159,785,196)	(421,438,970)
CH4	10,177	0	(14,138,712)	47	2,053	(14,126,435)	(5,302,767)
N2O	982	(5)	(23,827,906)	NA	96	(23,826,833)	(9,039,876)
Alternative C Total	**99,668,028**	**(1,335,434,813)**	**26,061,315**	**47**	**11,966,959**	**(1,197,738,464)**	**(435,781,614)**

I.5 LCA References

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U.S. Government Accountability Office, Report to Congressional Requesters, Social Cost of Carbon, Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis (GAO-20-254), June 2020.

Whitaker, M., Heath, G. A., O'Donoughue, P., and M. Vorum. 2012. Life Cycle Greenhouse Gas Emissions of Coal-Fired Electricity Generation, Systematic Review and Harmonization. Journal of Industrial Ecology. https://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2012.00465.x.

I.6. Tables with Estimated LCA GHG Emission Factors, GHG Emissions, and Social Cost of GHG Emissions, for Individual and System-Wide Analyses

Table I.6.20. Median Published Life Cycle CO_2 Equivalent Emission Factors for Electricity Generation Technologies, by Life Cycle Phase

Electric Power Technology	One-Time Upstream GHG (CO_2 equivalent), g/kW-hr	Ongoing Annual Combustion GHG (CO_2 equivalent), g/kW-hr	Ongoing Annual Non-Combustion GHG (CO_2 equivalent), g/kW-hr	One-Time Downstream GHG (CO_2 equivalent), g/kW-hr	Total Life Cycle (CO_2 equivalent), g/kW-hr
Coal (Supercritical pulverized)(1)	4.9	NU	4.9	4.9	NA1
Natural Gas - CCs	0.8	NU	62	0.02	NA1
Natural Gas - CTs	0.14	NU	70	0.003	NA1
Solar Panels (2)	NR	NA2	NR	NR	64
Li-Ion Battery Storage	31.5	NA2	NR	3.4	34.9

Sources: Nicholson et al. 2021, Whitaker et al. 2012, O'Donoughue et al. 2014, and Hsu et al. 2012.

g = grams; kW = kilowatts; hr = hours
CC = Combined Cycle Gas Turbine Plant
CT = Simple-Cycle Gas Turbine Plant
NU = Emission factors in NREL references were Not Used; GHG emissions from ongoing annual combustion were calculated separately using proposed action alternatives and existing coal plant specific design/operating information.
NA1 = Not Applicable; emission factors/rates for each applicable life cycle segment were used instead of the total life cycle emission factor in the NREL reference.
NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative C solar and battery operations.
NR = Not Reported in the NREL references.

NOTES:
None of the emission factors in the NREL LCA harmonization reference documents include Transmission and Distribution (T&D) electricity losses as they were outside the scope of the NREL studies and are not considered appreciably different for each Alternative.
(1) = Assumed <5 g/kW-hr values in the source document table are 4.9 g/kW-hr
(2) = Assumed Solar panels are Mono-Silicon type technology.

Table I.6.21. Estimated Life Cycle CO_2 Emission Factors for Electricity Generation Technologies, by Life Cycle Phase

Electric Power Technology	One-Time Upstream CO_2, g/kW-hr	Ongoing Annual Combustion CO_2, g/kW-hr	Ongoing Annual Non-Combustion CO_2, g/kW-hr	One-Time Downstream CO_2, g/kW-hr	Total Life Cycle CO_2, g/kW-hr
Coal (Supercritical pulverized)	4.61	NU	4.61	4.61	NA1
Natural Gas - CCs	7.999E-01	NU	6.199E+01	1.9998E-02	NA1
Natural Gas - CTs	1.3999E-01	NU	6.9993E+01	2.9997E-03	NA1
Solar	NR	NA2	NR	NR	63.99
Li-Ion Battery Storage	31.4969	NA2	NR	3.3997	34.8965

Source: Calculated based on sources footnoted in Table I.6-1

g = grams; kW = kilowatts; hr = hours
CC = Combined Cycle Gas Turbine Plant
CT = Simple-Cycle Gas Turbine Plant
NU = Emission factors in NREL references were Not Used; GHG emissions from ongoing annual combustion were calculated separately using proposed action alternatives and existing coal plant specific design/operating information.
NA1 = Not Applicable; emission factors/rates for each applicable life cycle segment were used instead of the total life cycle emission factor in the NREL reference.
NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative C solar and battery operations.
NR = Not Reported in the NREL references.

NOTES:
See text for assumptions on GSP-weighted contributions of CO_2, CH_4, and N_2O to CO_2-e.

Table I.6.22. Estimated Life Cycle CH_4 Emission Factors for Electricity Generation Technologies, by Life Cycle Phase

Electric Power Technology	One-Time Upstream CH_4, g/kW-hr (GWP-weighted)	Ongoing Annual Combustion CH_4, g/kW-hr (GWP-weighted)	Ongoing Annual Non-Combustion CH_4, g/kW-hr (GWP-weighted)	One-Time Downstream CH_4, g/kW-hr (GWP-weighted)	Total Life Cycle CH_4, g/kW-hr (GWP-weighted)	Methane Leakage (% of NG Production)
Coal (Supercritical pulverized)	0.25	NU	0.25	0.25	NA1	NA3
Natural Gas - CCs	7.200E-05	NU	5.580E-03	1.800E-06	NA1	1.6
Natural Gas - CTs	1.260E-05	NU	6.300E-03	2.700E-07	NA1	1.6
Solar	NR	NA2	NR	NR	0.01	NA3
Li-Ion Battery Storage	2.84E-03	NA2	NR	3.06E-04	3.14E-03	NA3

Source: Calculated based on sources footnoted in Table I.6-1

NA3 = Not Applicable: methane leakage due to direct natural gas use is not applicable to coal, solar, and battery storage; coal bed methane releases is accounted for under the ongoing annual non-combustion emission factor.

The Natural Gas NREL reference above lists Methane Leakage rates in percent of natural gas production for various Life Cycle Analyses (LCAs) in the U.S. and their average value, based on 21 LCAs, is rounded to 1.6 based on data in Table 1. Assumed this leakage is not included in the Ongoing Annual Non-Combustion emission factor per interpretation of the Natural Gas NREL LCA harmonization reference.

Table I.6.23. Estimated Life Cycle N_2O Emission Factors for Electricity Generation Technologies, by Life Cycle Phase

Electric Power Technology	One-Time Upstream N_2O, g/kW-hr (GWP-weighted)	Ongoing Annual Combustion N_2O, g/kW-hr (GWP-weighted)	Ongoing Annual Non-Combustion N_2O, g/kW-hr (GWP-weighted)	One-Time Downstream N_2O, g/kW-hr (GWP-weighted)	Total Life Cycle N_2O, g/kW-hr (GWP-weighted)
Coal (Supercritical pulverized)	0.04	NU	0.04	0.04	NA1
Natural Gas - CCs	8.000E-06	NU	6.200E-04	2.000E-07	NA1
Natural Gas - CTs	1.400E-06	NU	7.000E-04	3.000E-08	NA1
Solar	NR	NA2	NR	NR	6.40E-04
Li-Ion Battery Storage	3.15E-04	NA2	NR	3.40E-05	3.49E-04

Source: Calculated based on sources footnoted in Table I.6-1

Table I.6.24. Electricity Generation Assumptions for Each Alternative

Electricity Generation Technology	Electricity Generation Annual Rate (kW-hr/year)	Plant Size (MW)	Alternative
Coal kW-hr/year (max. capacity generation)	21,637,200,000	2470	No Action
Coal kW-hr/year (projected average annual lifetime generation)	11,900,460,000		
CC kW-hr/year (max. capacity generation)	12,702,000,000	1450	A
CC kW-hr/year (projected average annual lifetime generation)	6,986,100,000		
4x CT kW-hr/year (max. capacity generation)	2,942,659,200	884	B
4x CT kW-hr/year (projected average annual lifetime generation)	774,384,000		B
3x CT kW-hr/year (max. capacity generation)	2,206,994,400	663	
3x CT kW-hr/year (projected average annual lifetime generation)	580,788,000		
Solar kW-hr/year (projected average annual lifetime generation)	6,570,000,000	3000	C
Li-Ion Battery Storage kW-hr/year (projected average annual lifetime generation discharged)	2,482,000,000	1700	C

Supporting Information: Conversion, Acronyms, Capacity Factors

grams to lbs conversion: 0.00220462

CC = Natural Gas Turbine Combined Cycle

CF = Capacity Factor

CT = Natural Gas Turbine Simple Cycle

Max. Generation for CC/Coal @ 100% CF, CTs @ 38% CF, Solar/Battery @ 30% CF

Projected Average Annual Lifetime Generation CC/Coal @ 55% CF, CTs @ 10% CF, Solar @ 25% CF, Battery @ 16.7% CF

Batteries assume max. of 2 full cycles/day (5 hours to charge from the grid and 4 hours to discharge to grid = 9 hours/cycle). 1 cycle/day is assumed to be the predicted actual operation. Battery efficiency is assumed to be 85% based on TVA historical model data.

Table I.6.25. Estimated Life Cycle CO_2 Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production

Electricity Generation Technology	One-Time Upstream CO_2 Emissions, tons	Ongoing Annual Combustion CO_2 Emissions, tons/yr	Ongoing Annual Non-Combustion CO_2 Emissions, tons/yr	2027 and 2028 Single CUF Coal Unit CO_2 Combustion Emissions, tons/yr	2027 and 2028 Single CUF Coal Unit CO_2 Non-Combustion Emissions, tons/yr	One-Time Downstream CO_2 Emissions, tons	Total Life Cycle CO_2 Emissions, tons
No Action Alternative – Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	1,814,573	10,500,000	60,486	NA	NA	1,814,573	320,443,719
Alternative A – Natural Gas – CCs (30-year Life Cycle)	184,802	2,760,530	477,405	5,250,000	30,243	4,620	107,887,946
Alternative B – Natural Gas – CTs (30-year Life Cycle)	6,273	830,451	104,557	5,250,000	30,243	134	38,617,134
Alternative C – Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	2,625,000	15,122	NC	19,183,833
Alternative C – Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	1,723,466	NA2	NC	2,625,000	15,121	186,025	8,144,478
Alternative C – Total Life Cycle CO_2 Emissions, tons							27,328,311

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative C solar and battery operations.

NC = Not Calculated separately; incorporated in the total life cycle emissions.

See text for assumptions on GSP-weighted contributions of CO_2, CH_4, and N_2O to CO_2-e.

Table I.6.26. Estimated Life Cycle CH_4 Emissions for Electricity Generation Technologies, by Life Cycle Phase – Based on Projected Average Annual Lifetime Electricity Production

Electricity Generation Technology	One-Time Upstream CH_4 Emissions, tons	Ongoing Annual Combustion CH_4 Emissions, tons/yr	Ongoing Annual Non-Combustion CH_4 Emissions, tons/yr	2027 and 2028 Single CUF Coal Combustion CH_4 Emissions, tons/yr	2027 and 2028 Single CUF Coal Unit Non-Combustion CH_4 Emissions, tons/yr	One-Time Downstream CH_4 Emissions, tons	Methane Life Cycle Leakage, tons	Total Life Cycle CH_4 Emissions, tons
No Action Alternative -Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	3,856.7	114	128.6	NA	NA	3,856.7	NA3	14,990
Alternative A - Natural Gas - CCs (30-year Life Cycle)	0.7	196	1.7	57	64.3	0.02	409,656	415,816
Alternative B - Natural Gas - CTs (30-year Life Cycle)	0.02	60	0.4	57	64.3	4.840E-04	127,623	129,661
Alternative C - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	28.5	32.1	NC	NA3	171
Alternative C - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	6	NA2	NC	28.5	32.1	0.7	NC2	132
Alternative C - Total Life Cycle CH_4 Emissions, tons								303

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative C solar and battery operations.

NA3 = Not Applicable: methane leakage due to natural gas use is not applicable to coal and solar; coal bed methane releases is accounted for under the ongoing annual non-combustion emissions.

NC = Not Calculated separately; incorporated in the total life cycle emissions.

NC2 = Not Calculated separately; Methane leak emissions due to grid power generation from natural gas plants for charging the batteries is incorporated into TVA system wide GHG emissions analysis.

See text for assumptions on GSP-weighted contributions of CO_2, CH_4, and N_2O to CO_2-e.

Table I.6.27. Estimated Methane Leak Emissions, Average Annual Lifetime - Alternative A

121,550,000	NG scf/day use at Cumberland CCGT
94	Estimated Methane portion of NG (percent)
114,257,000	Methane scf/day use at Cumberland CCGT
0.657	Methane density (kg/m3)
0.0283168	conversion, 1 cubic foot = 0.0283168 cubic meters
27,310,389	Methane Release Emissions (lbs/yr) from NG use at Cumberland CCGT
13,655	**Methane Release Emissions (tons/yr) from NG use at Cumberland CCGT**

Table I.6.28. Estimated Methane Leak Emissions, Average Annual Lifetime - Alternative B

1,578	NG MMBtu/hr (Johnsonville + Gleason CTs)
37,867,200	NG scf/day use at Johnsonville + Gleason CTs
94	Estimated Methane portion of NG (percent)
35,595,168	Methane scf/day use at Johnsonville + Gleason CTs
0.657	Methane density (kg/m3)
0.0283168	conversion, 1 cubic foot = 0.0283168 cubic meters
8,508,169	Methane Release Emissions (lbs/yr) from NG use at Johnsonville + Gleason CTs
4,254	**Methane Release Emissions (tons/yr) from NG use at Johnsonville + Gleason CTs**

Table I.6.29. Estimated Life Cycle N_2O Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production

Electricity Generation Technology	One-Time Upstream N_2O Emissions, tons	Ongoing Annual Combustion N_2O Emissions, tons/yr	Ongoing Annual Non-Combustion N_2O Emissions, tons/yr	2027 and 2028 Single CUF Coal Unit Combustion N_2O Emissions, tons/yr	2027 and 2028 Single CUF Coal Unit Non-Combustion N_2O Emissions, tons/yr	One-Time Downstream N_2O Emissions, tons	Total Life Cycle N_2O Emissions, tons
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	58.24	179	1.94	NA	NA	58	5,554
Alternative A - Natural Gas - CCs (30-year Life Cycle)	6.20E-03	68	0.02	89.7	0.97	1.55E-04	2,225
Alternative B - Natural Gas - CTs (30-year Life Cycle)	2.11E-04	21	3.51E-03	89.7	0.97	4.51E-06	805
Alternative C - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	44.8	0.49	NC	91.1
Alternative C - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	0.1	NA2	NC	44.8	0.49	0.01	90.7
Alternative C - Total Life Cycle N_2O Emissions, tons							181.8

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative C solar and battery operations.

NC = Not Calculated separately; incorporated in the total life cycle emissions.

See text for assumptions on GSP-weighted contributions of CO_2, CH_4, and N_2O to CO_2-e.

Table I.6.30. Estimated Social Cost of Life Cycle CO_2 Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Biden Administration EO 13990 Interim Rates, 3% Discount Rates)

Electricity Generation Technology	One-Time Upstream Social Cost of CO_2 Emissions, $	Ongoing Combustion Social Cost of CO_2 Emissions, $/LC	Ongoing Non-Combustion Social Cost of CO_2 Emissions, $/LC	2027 and 2028 Single CUF Unit Combustion Social Cost of CO2 Emissions, $	2027 and 2028 Single CUF Unit Non-Combustion Social Cost of CO2 Emissions, $	One-Time Downstream Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CO_2 Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$105,698,481	$34,012,126,769	$195,928,534	NA	NA	$315,200,605	$34,628,954,389
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$10,764,668	$8,942,046,620	$1,546,433,657	$657,784,111	$3,789,198	$802,526	$11,161,620,779
Alternative B - Natural Gas - CTs (30-year Life Cycle)	$365,425	$2,690,038,866	$338,686,016	$657,784,111	$3,789,198	$23,351	$3,690,686,967
Alternative C - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	$328,892,056	$1,894,669	NC	$1,832,026,800
Alternative C - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$100,391,498	NA2	NC	$328,892,056	$1,894,544	$32,313,470	$463,491,567
Alternative C Total Life Cycle Social Cost of CO_2 Emissions, $							$2,295,518,366

LC = Life Cycle period

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative C solar and battery operations.

NC = Not Calculated separately; incorporated in the total life cycle emissions.

NPV = Net Present Value

Assumed One-Time Upstream costs are all in 2026.

Assumed One-Time Downstream costs are all in 2057 for all alternatives.

For Solar NPV calculations, assumed 90% of total life cycle costs are the Upstream costs and 10% are the Downstream costs based on approximate relative comparison in emissions for these segments under Battery Storage.

Table I.6.31. Technical Support Document: Social Cost of Carbon - Interim Estimates under Biden Administration Executive Order 13990 - Feb. 2021 (Appendix A, Table A-1, 3% Discount Rate)

Year	2% Inflation Adjustor	Real SC-CO_2 ($/mt)	Nominal SC-CO_2 ($/mt)	Nominal SC-CO_2 ($/ton)
2020	1.00	$ 51	$ 51	$ 46
2021	1.02	$ 52	$ 53	$ 48
2022	1.04	$ 53	$ 55	$ 50
2023	1.06	$ 54	$ 57	$ 52
2024	1.08	$ 55	$ 60	$ 54
2025	1.10	$ 56	$ 62	$ 56
2026	1.13	$ 57	$ 64	$ 58
2027	1.15	$ 59	$ 68	$ 61
2028	1.17	$ 60	$ 70	$ 64
2029	1.20	$ 61	$ 73	$ 66
2030	1.22	$ 62	$ 76	$ 69
2031	1.24	$ 63	$ 78	$ 71
2032	1.27	$ 64	$ 81	$ 74
2033	1.29	$ 65	$ 84	$ 76
2034	1.32	$ 66	$ 87	$ 79
2035	1.35	$ 67	$ 90	$ 82
2036	1.37	$ 69	$ 95	$ 86
2037	1.40	$ 70	$ 98	$ 89
2038	1.43	$ 71	$ 101	$ 92
2039	1.46	$ 72	$ 105	$ 95
2040	1.49	$ 73	$ 108	$ 98
2041	1.52	$ 74	$ 112	$ 102
2042	1.55	$ 75	$ 116	$ 105
2043	1.58	$ 77	$ 121	$ 110
2044	1.61	$ 78	$ 125	$ 114
2045	1.64	$ 79	$ 130	$ 118
2046	1.67	$ 80	$ 134	$ 121
2047	1.71	$ 81	$ 138	$ 125
2048	1.74	$ 82	$ 143	$ 130
2049	1.78	$ 84	$ 149	$ 135
2050	1.81	$ 85	$ 154	$ 140
2051	1.85	$ 86	$ 159	$ 144
2052	1.88	$ 87	$ 164	$ 149

Year	2% Inflation Adjustor	Real SC-CO_2 ($/mt)	Nominal SC-CO_2 ($/mt)	Nominal SC-CO_2 ($/ton)
2053	1.92	$ 88	$ 169	$ 153
2054	1.96	$ 89	$ 175	$ 158
2055	2.00	$ 90	$ 180	$ 163
2056	2.04	$ 91	$ 186	$ 168
2057	2.08	$ 92	$ 191	$ 174

Converted to Nominal Dollars using 2% inflation annual rate approximation; then converted those values to $/short ton (ton)

$ = U.S. Dollars; mt = metric tons; SC-CO_2 = Social Cost of Carbon Dioxide; SC-CH_4 = Social Cost of Methane; SC-N_2O = Social Cost of Nitrous Oxide

Real CO_2 values for years 2051 through 2057 were assumed to increase $1/mt per year based on a similar rate of increase in previous years.

Table I.6.32. Estimated Social Cost of Life Cycle CH_4 Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Biden Administration EO 13990 Interim Values, 3% Discount Rates)

Electricity Power Technology	One-Time Upstream Social Cost of CH_4 Emissions, $	Ongoing Combustion Social Cost of CH_4 Emissions, $/LC	Ongoing Non-Combustion Social Cost of CH_4 Emissions, $/LC	2027 and 2028 CUF Single Unit Combustion Social Cost of CH_4 Emissions, $	2027 and 2028 CUF Single Unit Non-Combustion Social Cost of CH_4 Emissions, $	One-Time Downstream Social Cost of CH_4 Emissions, $	Methane Leakage Social Cost of CH_4, $	Total Life Cycle Social Cost of CH_4 Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$7,094,255	$12,906,820	$14,554,858	NA	NA	$24,758,168	NA3	**$59,314,101**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$1,224	$22,134,064	$194,602	$222,092	$250,451	$107	$1,546,010,009	**$1,568,812,549**
Alternative B - Natural Gas - CTs (30-year Life Cycle)	$42	$6,736,454	$42,620	$222,092	$250,451	$3	$481,637,764	**$488,889,426**
Alternative C - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	$111,046	$125,225	NC	NA3	$425,186
Alternative C - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$11,414	NA2	NC	$111,046	$125,225	$4,300	NC2	$251,985
Alternative C Total Life Cycle Social Cost of CH_4 Emissions, $								**$677,172**

LC = Life Cycle period
NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative C solar and battery operations.

NA3 = Not Applicable: methane leakage due to natural gas use is not applicable to coal and solar; coal bed methane releases is accounted for under the ongoing annual non-combustion emissions.
NC = Not Calculated separately; incorporated in the total life cycle emissions.
NC2 = Not Calculated separately; Methane leak emissions due to grid power generation from natural gas plants for charging the batteries is incorporated into TVA system wide GHG emissions analysis.
Assumed One-Time Upstream costs are all in 2026.
Assumed One-Time Downstream costs are all in 2057 for all alternatives.
For Solar NPV calculations, assumed 90% of total life cycle costs are the Upstream costs and 10% are the Downstream costs based on approximate relative comparison in emissions for these segments under Battery Storage.

Table I.6.33. Technical Support Document: Social Cost of Methane - Interim Estimates under Biden Administration Executive Order 13990 - Feb. 2021 (Appendix A, Table A-2, 3% Discount Rate)

Year	2% Inflation Adjustor	Real SC-CH_4 ($/mt)	Nominal SC-CH_4 ($/mt)	Nominal SC-CH_4 ($/ton)
2020	1.00	$1,500	$ 1,500	$ 1,361
2021	1.02	$1,500	$ 1,530	$ 1,388
2022	1.04	$1,600	$ 1,665	$ 1,511
2023	1.06	$1,600	$ 1,698	$ 1,541
2024	1.08	$1,700	$ 1,840	$ 1,670
2025	1.10	$1,700	$ 1,877	$ 1,703
2026	1.13	$1,800	$ 2,027	$ 1,839
2027	1.15	$1,800	$ 2,068	$ 1,876
2028	1.17	$1,900	$ 2,226	$ 2,020
2029	1.20	$1,900	$ 2,271	$ 2,061
2030	1.22	$2,000	$ 2,438	$ 2,212
2031	1.24	$2,000	$ 2,487	$ 2,257
2032	1.27	$2,100	$ 2,663	$ 2,417
2033	1.29	$2,100	$ 2,717	$ 2,465
2034	1.32	$2,200	$ 2,903	$ 2,634
2035	1.35	$2,200	$ 2,961	$ 2,687
2036	1.37	$2,300	$ 3,157	$ 2,865
2037	1.40	$2,300	$ 3,221	$ 2,922
2038	1.43	$2,400	$ 3,428	$ 3,111
2039	1.46	$2,500	$ 3,642	$ 3,305
2040	1.49	$2,500	$ 3,715	$ 3,371
2041	1.52	$2,600	$ 3,941	$ 3,576
2042	1.55	$2,600	$ 4,020	$ 3,648
2043	1.58	$2,700	$ 4,258	$ 3,864
2044	1.61	$2,700	$ 4,343	$ 3,941
2045	1.64	$2,800	$ 4,594	$ 4,169
2046	1.67	$2,800	$ 4,686	$ 4,252
2047	1.71	$2,900	$ 4,950	$ 4,492
2048	1.74	$3,000	$ 5,223	$ 4,740
2049	1.78	$3,000	$ 5,328	$ 4,834
2050	1.81	$3,100	$ 5,615	$ 5,095

Year	2% Inflation Adjustor	Real SC-CH_4 ($/mt)	Nominal SC-CH_4 ($/mt)	Nominal SC-CH_4 ($/ton)
2051	1.85	$3,100	$ 5,728	$ 5,197
2052	1.88	$3,200	$ 6,031	$ 5,472
2053	1.92	$3,200	$ 6,151	$ 5,582
2054	1.96	$3,300	$ 6,470	$ 5,871
2055	2.00	$3,300	$ 6,600	$ 5,989
2056	2.04	$3,400	$ 6,936	$ 6,294
2057	2.08	$3,400	$ 7,074	$ 6,420

Converted to Nominal Dollars using 2% inflation annual rate approximation; then converted those values to $/short ton (ton)

$ = U.S. Dollars; mt = metric tons; SC-CO_2 = Social Cost of Carbon Dioxide; SC-CH_4 = Social Cost of Methane; SC-N_2O = Social Cost of Nitrous Oxide

Real CH_4 values for years 2051 through 2057 were assumed to increase by $100/mt every two years based on a similar rate of increase in previous years.

Table I.6.34. Estimated Social Cost of Life Cycle N_2O Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Biden Administration EO 13990 Interim Values, 3% Discount Rates)

Electricity Power Technology	One-Time Upstream Social Cost of N_2O Emissions, $/LC	Ongoing Combustion Social Cost of N_2O Emissions, $/LC	Ongoing Non-Combustion Social Cost of N_2O Emissions, $/LC	2027 and 2028 Single CUF Unit Combustion Social Cost of N_2O Emissions, $	2027 and 2028 Single CUF Unit Non-Combustion Social Cost of N_2O Emissions, $	One-Time Downstream Social Cost of N_2O Emissions, $/LC	Total Life Cycle Social Cost of N_2O Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$1,249,827	$221,697,338	$2,400,325	NA	NA	$3,958,570	**$229,306,059**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$133	$84,202,949	$19,810	$4,059,380	$43,951	$11	**$88,326,234**
Alternative B - Natural Gas - CTs (30-year Life Cycle)	$5	$25,718,375	$4,339	$4,059,380	$43,951	$0	**$29,826,050**
Alternative C - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	$2,029,690	$21,976	NC	$2,070,897
Alternative C - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$1,241	NA2	NC	$2,029,690	$21,976	$424	$2,053,331
Alternative C Total Life Cycle Social Cost of N_2O Emissions, $							**$4,124,228**

LC = Life Cycle period

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative C solar and battery operations.

NC = Not Calculated separately; incorporated in the total life cycle emissions.

Assumed One-Time Upstream costs are all in 2026.

Assumed One-Time Downstream costs are all in 2057 for all alternatives.
For Solar NPV calculations, assumed 90% of total life cycle costs are the Upstream costs and 10% are the Downstream costs based on approximate relative comparison in emissions for these segments under Battery Storage.

Table I.6.35. Technical Support Document: Social Cost of Nitrous Oxide - Interim Estimates under Biden Administration Executive Order 13990 - Feb. 2021 (Appendix A, Table A-3, 3% Discount Rate)

Year	2% Inflation Adjustor	Real SC-N_2O ($/mt)	Nominal SC-N_2O ($/mt)	Nominal SC-N_2O ($/ton)
2020	1.00	$18,000	$18,000	$16,334
2021	1.02	$19,000	$19,380	$17,586
2022	1.04	$19,000	$19,768	$17,938
2023	1.06	$20,000	$21,224	$19,260
2024	1.08	$20,000	$21,649	$19,645
2025	1.10	$21,000	$23,186	$21,040
2026	1.13	$21,000	$23,649	$21,460
2027	1.15	$21,000	$24,122	$21,890
2028	1.17	$22,000	$25,777	$23,391
2029	1.20	$22,000	$26,292	$23,858
2030	1.22	$23,000	$28,037	$25,442
2031	1.24	$23,000	$28,598	$25,951
2032	1.27	$24,000	$30,438	$27,621
2033	1.29	$24,000	$31,047	$28,173
2034	1.32	$25,000	$32,987	$29,934
2035	1.35	$25,000	$33,647	$30,532
2036	1.37	$26,000	$35,692	$32,389
2037	1.40	$26,000	$36,406	$33,037
2038	1.43	$27,000	$38,563	$34,993
2039	1.46	$27,000	$39,334	$35,693
2040	1.49	$28,000	$41,607	$37,755
2041	1.52	$28,000	$42,439	$38,511
2042	1.55	$29,000	$44,833	$40,684
2043	1.58	$29,000	$45,730	$41,497
2044	1.61	$30,000	$48,253	$43,787
2045	1.64	$30,000	$49,218	$44,663
2046	1.67	$31,000	$51,876	$47,074
2047	1.71	$31,000	$52,913	$48,016
2048	1.74	$32,000	$55,713	$50,556
2049	1.78	$32,000	$56,827	$51,567
2050	1.81	$33,000	$59,775	$54,242
2051	1.85	$33,000	$60,970	$55,327
2052	1.88	$34,000	$64,074	$58,144

Year	2% Inflation Adjustor	Real SC-N_2O ($/mt)	Nominal SC-N_2O ($/mt)	Nominal SC-N_2O ($/ton)
2053	1.92	$34,000	$65,356	$59,307
2054	1.96	$35,000	$68,624	$62,272
2055	2.00	$35,000	$69,996	$63,517
2056	2.04	$36,000	$73,436	$66,639
2057	2.08	$36,000	$74,905	$67,972

Converted to Nominal Dollars using 2% inflation annual rate approximation; then converted those values to $/short ton (ton)

$ = U.S. Dollars; mt = metric tons; SC-CO_2 = Social Cost of Carbon Dioxide; SC-CH_4 = Social Cost of Methane; SC-N_2O = Social Cost of Nitrous Oxide

Real N_2O values for years 2051 through 2057 were assumed to increase by $1,000/mt every two years based on a similar rate of increase in previous years.

Table I.6.36. Estimated Social Cost of Life Cycle GHG Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Biden Administration EO 13990 Interim Values, 3% Discount Rates)

Electricity Power Technology	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHG Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$34,628,954,389	$59,314,101	$229,306,059	**$34,917,574,550**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$11,161,620,779	$1,568,812,549	$88,326,234	**$12,818,759,562**
Alternative B - Natural Gas - CTs (30-year Life Cycle)	$3,690,686,967	$488,889,426	$29,826,050	**4,209,402,443**
Alternative C - Solar (20-year Life Cycle, prorated to 30-years)	$1,832,026,800	$425,186	$2,070,897	$1,834,522,883
Alternative C - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$463,491,567	$251,985	$2,053,331	$465,796,883
Alternative C Total Life Cycle Social Cost of GHG Emissions, $	$2,295,518,366	$677,172	$4,124,228	**$2,300,319,766**

Table I.6.37. Estimated Social Cost of Life Cycle CO_2 Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Prior Administration Values, 2020, 3% Discount Rates)

Electricity Power Technology	One-Time Upstream Social Cost of CO_2 Emissions, $	Ongoing Combustion Social Cost of CO_2 Emissions, $/LC	Ongoing Non-Combustion Social Cost of CO_2 Emissions, $/LC	2027 and 2028 CUF Single Unit Combustion Social Cost of CO2 Emissions, $	2027 and 2028 CUF Single Unit Non-Combustion Social Cost of CO2 Emissions, $	One-Time Downstream Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CO_2 Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$12,702,011	$2,751,000,000	$15,847,271	NA	NA	$21,774,876	**$2,801,324,159**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$1,293,613	$723,258,808	$125,080,064	$73,500,000	$423,400	$55,441	**$923,611,325**
Alternative B - Natural Gas - CTs (30-year Life Cycle)	$43,914	$217,578,712	$27,393,913	$73,500,000	$423,400	$1,613	**$318,941,028**
Alternative C - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	$36,750,000	$211,708	NC	$158,386,383
Alternative C - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$12,064,260	NA2	NC	$36,750,000	$211,694	$2,232,298	$51,258,252
Alternative C Total Life Cycle Social Cost of CO_2 Emissions, $							**$209,644,635**

LC = Life Cycle period

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative C solar and battery operations.

NC = Not Calculated separately; incorporated in the total life cycle emissions.

Assumed One-Time Upstream costs are all in 2026.

Assumed One-Time Downstream costs are all in 2057 for all alternatives.

Table I.6.38. Federal Government's Social Cost of Carbon - Estimates Used in Conducting Regulatory Impact Analyses under Prior EPA Administration, 2020 (3% Discount Rate)

Year	Nominal SC-CO_2 [1] ($/mt)	Nominal SC-CO_2 ($/ton)
2020	$7.0	$ 6
2021	$7.1	$ 6
2022	$7.2	$ 7
2023	$7.3	$ 7
2024	$7.4	$ 7
2025	$7.5	$ 7
2026	$7.6	$ 7
2027	$7.7	$ 7
2028	$7.8	$ 7
2029	$7.9	$ 7
2030	$8.0	$ 7
2031	$8.1	$ 7
2032	$8.2	$ 7
2033	$8.3	$ 8
2034	$8.4	$ 8
2035	$8.5	$ 8
2036	$8.6	$ 8
2037	$8.7	$ 8
2038	$8.8	$ 8
2039	$8.9	$ 8
2040	$9.0	$ 8
2041	$9.2	$ 8
2042	$9.4	$ 9
2043	$9.6	$ 9
2044	$9.8	$ 9
2045	$10.0	$ 9
2046	$10.2	$ 9
2047	$10.4	$ 9
2048	$10.6	$ 10

Year	Nominal SC-CO_2 [1] ($/mt)	Nominal SC-CO_2 ($/ton)
2049	$10.8	$ 10
2050	$11.0	$ 10
2051	$11.2	$ 10
2052	$11.5	$ 10
2053	$11.7	$ 11
2054	$12.0	$ 11
2055	$12.3	$ 11
2056	$12.5	$ 11
2057	$12.8	$ 12

$ = U.S. Dollars; mt = metric tons; SC-CO_2 = Social Cost of Carbon Dioxide

1 Under the prior administration, federal estimates of the social cost of carbon dioxide were originally reported in 2016 U.S. dollars in EPA's regulatory impact analysis for the 2019 Affordable Clean Energy Rule. The Government Accountability Office (GAO) adjusted the values for inflation and expressed them in 2018 U.S. dollars using the United States Gross Domestic Product Price Index from the U.S. Department of Commerce, Bureau of Economic Analysis. The GAO source document is cited as: U.S. Government Accountability Office, Report to Congressional Requesters, Social Cost of Carbon, Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis (GAO-20-254), June 2020.

CO_2 values for years between 2020 and 2030, between 2030 and 2040, and between 2040 and 2050 were interpolated as only 2020, 2030, 2040, and 2050 values were provided in the reference.

Table I.6.39. Estimated Social Cost of Life Cycle CH_4 Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Prior Administration Values, 2020, 3% Discount Rates)

Electricity Power Technology	One-Time Upstream Social Cost of CH_4 Emissions, $	Ongoing Combustion Social Cost of CH_4 Emissions, $/LC	Ongoing Non-Combustion Social Cost of CH_4 Emissions, $/LC	2027 and 2028 Single CUF Unit Combustion Social Cost of CH_4 Emissions, $	2027 and 2028 Single CUF Unit Non-Combustion Social Cost of CH_4 Emissions, $	One-Time Downstream Social Cost of CH_4 Emissions, $	Methane Leakage Social Cost of CH_4, $	Total Life Cycle Social Cost of CH_4 Emissions, $
No Action Alternative – Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$765,739	$958,034	$1,080,363	NA	NA	$1,394,988	NA3	**$4,199,125**
Alternative A – Natural Gas – CCs (30-year Life Cycle)	$132	$1,642,945	$14,445	$23,534	$26,540	$6	$114,755,678	**$116,463,280**
Alternative B – Natural Gas – CTs (30-year Life Cycle)	$4	$500,027	$3,164	$23,534	$26,540	$0	$35,750,524	**$36,303,793**
Alternative C – Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	$11,767	$13,270	NC	NA3	$39,060
Alternative C – Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$1,232	NA2	NC	$11,767	$13,270	$242	NC2	$26,511
Alternative C Total Life Cycle Social Cost of CH_4 Emissions, $								**$65,571**

LC = Life Cycle period

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative C solar and battery operations.

NA3 = Not Applicable: methane leakage due to natural gas use is not applicable to coal and solar; coal bed methane releases is accounted for under the ongoing annual non-combustion emissions.

NC = Not Calculated separately; incorporated in the total life cycle emissions.

NC2 = Not Calculated separately; Methane leak emissions due to grid power generation from natural gas plants for charging the batteries is incorporated into TVA system wide GHG emissions analysis.

Assumed One-Time Upstream costs are all in 2026.

Assumed One-Time Downstream costs are all in 2057 for all alternatives.

Table I.6.40. Federal Government's Social Cost of Methane – Estimates Used in Conducting Regulatory Impact Analyses under the Prior EPA Administration, 2020 (3% Discount Rate)

Year	Nominal SC-CH4 [1] ($/mt)	Nominal SC-CH4 ($/ton)
2020	$ 184	$ 167
2021	$ 190	$ 172
2022	$ 196	$ 177
2023	$ 201	$ 183
2024	$ 207	$ 188
2025	$ 213	$ 193
2026	$ 219	$ 199
2027	$ 225	$ 204
2028	$ 230	$ 209
2029	$ 236	$ 214
2030	$ 242	$ 220
2031	$ 248	$ 225
2032	$ 254	$ 230
2033	$ 259	$ 235
2034	$ 265	$ 241
2035	$ 271	$ 246
2036	$ 277	$ 251
2037	$ 283	$ 256
2038	$ 288	$ 262
2039	$ 294	$ 267
2040	$ 300	$ 272
2041	$ 306	$ 277
2042	$ 312	$ 283
2043	$ 317	$ 288
2044	$ 323	$ 293
2045	$ 329	$ 299
2046	$ 335	$ 304
2047	$ 341	$ 309
2048	$ 346	$ 314
2049	$ 352	$ 320
2050	$ 358	$ 325
2051	$ 364	$ 330
2052	$ 370	$ 335

Year	Nominal SC-CH4 [1] ($/mt)	Nominal SC-CH4 ($/ton)
2053	$ 375	$ 341
2054	$ 381	$ 346
2055	$ 387	$ 351
2056	$ 393	$ 356
2057	$ 399	$ 362

1 Under the prior administration, federal estimates of the social cost of methane were originally reported in 2016 U.S. dollars in BLM's regulatory impact analysis for the 2018 Final Rule to Rescind or Revise Certain Requirements of the 2016 Waste Prevention Rule. The Government Accountability Office (GAO) adjusted the values for inflation and expressed them in 2018 U.S. dollars using the United States Gross Domestic Product Price Index from the U.S. Department of Commerce, Bureau of Economic Analysis. Unlike EPA, BLM included estimates only to 2030. The GAO source document is cited as: U.S. Government Accountability Office, Report to Congressional Requesters, Social Cost of Carbon, Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis (GAO-20-254), June 2020.

$ = U.S. Dollars; mt = metric tons; SC-CH_4 = Social Cost of Methane

CH_4 values for years between 2020 and 2030 and thereafter were interpolated based on the change in rates between the 2020 and 2030 rates provided.

Table I.6.41. Estimated Social Cost of Life Cycle N_2O Emissions for Electricity Generation Technologies, by Life Cycle Phase – Based on Projected Average Annual Lifetime Electricity Production (Prior Administration Values, 2020, 3% Discount Rates)

Electricity Power Technology	One-Time Upstream Social Cost of N_2O Emissions, $/LC	Ongoing Combustion Social Cost of N_2O Emissions, $/LC	Ongoing Non-Combustion Social Cost of N_2O Emissions, $/LC	2027 and 2028 Single CUF Unit Combustion Social Cost of N_2O Emissions, $	2027 and 2028 Single CUF Unit Non-Combustion Social Cost of N_2O Emissions, $	One-Time Downstream Social Cost of N_2O Emissions, $/LC	Total Life Cycle Social Cost of N_2O Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$119,690	$14,020,772	$151,803	NA	NA	$201,741	**$14,494,007**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$13	$5,325,235	$1,253	$375,765	$4,068	$1	**$5,706,335**
Alternative B - Natural Gas - CTs (30-year Life Cycle)	$0	$1,626,503	$274	$375,765	$4,068	$0	**$2,006,612**
Alternative C - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	$187,883	$2,034	NC	$191,133
Alternative C - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$119	NA2	NC	$187,883	$2,034	$22	$190,057
Alternative C Total Life Cycle Social Cost of N_2O Emissions, $							**$381,190**

LC = Life Cycle period

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative C solar and battery operations.

NC = Not Calculated separately; incorporated in the total life cycle emissions.

Assumed One-Time Upstream costs are all in 2026.

Assumed One-Time Downstream costs are all in 2057 for all alternatives.

Table I.6.42. Federal Government's Social Cost of Nitrous Oxide - Estimates Used in Conducting Regulatory Impact Analyses under the Prior EPA Administration, 2020 (3% Discount Rate)

Year	Nominal SC-N_2O [1] ($/mt)	Nominal SC-N_2O ($/ton)
2020	$ 2,086	$ 1,893
2021	$ 2,116	$ 1,920
2022	$ 2,146	$ 1,947
2023	$ 2,175	$ 1,974
2024	$ 2,205	$ 2,001
2025	$ 2,235	$ 2,028
2026	$ 2,265	$ 2,055
2027	$ 2,295	$ 2,082
2028	$ 2,324	$ 2,109
2029	$ 2,354	$ 2,136
2030	$ 2,384	$ 2,163
2031	$ 2,414	$ 2,190
2032	$ 2,444	$ 2,217
2033	$ 2,473	$ 2,244
2034	$ 2,503	$ 2,272
2035	$ 2,533	$ 2,299
2036	$ 2,563	$ 2,326
2037	$ 2,593	$ 2,353
2038	$ 2,622	$ 2,380
2039	$ 2,652	$ 2,407
2040	$ 2,682	$ 2,434
2041	$ 2,742	$ 2,488
2042	$ 2,801	$ 2,542
2043	$ 2,861	$ 2,596
2044	$ 2,920	$ 2,650
2045	$ 2,980	$ 2,704
2046	$ 3,040	$ 2,758
2047	$ 3,099	$ 2,812
2048	$ 3,159	$ 2,866
2049	$ 3,218	$ 2,921
2050	$ 3,278	$ 2,975
2051	$ 3,350	$ 3,040

Year	Nominal SC-N_2O [1] ($/mt)	Nominal SC-N_2O ($/ton)
2052	$ 3,424	$ 3,107
2053	$ 3,499	$ 3,175
2054	$ 3,576	$ 3,245
2055	$ 3,655	$ 3,317
2056	$ 3,735	$ 3,389
2057	$ 3,817	$ 3,464

1 Under the prior administration, the U.S. Government Accountability Office (GAO) did not find a recent rulemaking that used monetary estimates for nitrous oxide that were based on the social cost of carbon approach. Instead, the National Highway Traffic Safety Administration (NHTSA) used a Global Warming Potential factor to convert EPA's social cost carbon dioxide estimates to monetary estimates for nitrous oxide. Monetary estimates the agency used in sensitivity analyses involving nitrous oxide were estimated by applying the 100-year Global Warming Potential factor for nitrous oxide (which is 298) to the central estimates of the social cost of carbon dioxide for each future year. The source document for this information is: The GAO source document is cited as: U.S. Government Accountability Office, Report to Congressional Requesters, Social Cost of Carbon, Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis (GAO-20-254), June 2020.

$ = U.S. Dollars; mt = metric tons; SC-N_2O = Social Cost of Nitrous Oxide

Table I.6.43. Estimated Social Cost of Life Cycle GHG Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Prior Administration Values, 2020, 3% Discount Rates)

Electricity Power Technology	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHG Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$2,801,324,159	$4,199,125	$14,494,007	**$2,820,017,291**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$923,611,325	$116,463,280	$5,706,335	**$1,045,780,940**
Alternative B - Natural Gas - CTs (30-year Life Cycle)	$318,941,028	$36,303,793	$2,006,612	**$357,251,433**
Alternative C - Solar (20-year Life Cycle, prorated to 30-years)	$158,386,383	$39,060	$191,133	$158,616,576
Alternative C - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$51,258,252	$26,511	$190,057	$51,474,821
Alternative C Total Life Cycle Social Cost of GHG Emissions, $	$209,644,635	$65,571	$381,190	**$210,091,397**

Table I.6.445. TVA System-Wide Estimated 20-Year Life Cycle CO_2 Emissions Compared to the No Action Alternative, by Life Cycle Phase

Electric Power Technology	One-Time Upstream CO_2 Emissions, tons	Cumulative Combustion CO_2 Emissions, tons	Cumulative Non-Combustion CO_2 Emissions, tons	One-Time Downstream CO_2 Emissions, tons	Life Cycle CO_2 Emissions, tons	Total CO_2 Emissions, tons
Alternative A Total						**-134,993,818**
Coal		-232,577,737	-1,099,817			**-233,677,554**
Natural Gas - Combined Cycle	184,802	63,574,149	13,015,659	4,620		**76,779,230**
Natural Gas - Simple Cycle		19,208,658	2,554,129			**21,762,787**
Hydroelectric		0	-6			**-6**
Nuclear		0	0			**0**
Wind & Solar		0	NR			**0**
Battery Storage (Generation)		0	NR			**0**
Pumped Hydro (Generation)		0	5,276			**5,276**
Market Purchases		2,017	134,430			**136,447**
Alternative B Total						**-117,072,024**
Coal		-225,747,170	-1,068,563			**-226,815,733**
Natural Gas - Combined Cycle		49,041,105	8,622,152			**57,663,257**
Natural Gas - Simple Cycle	6,273	45,387,831	6,000,899	134		**51,395,138**
Hydroelectric		0	0			**0**
Nuclear		0	0			**0**
Wind & Solar		0	NR			**0**
Battery Storage (Generation)		0	NR			**0**
Pumped Hydro (Generation)		0	6,838			**6,838**
Market Purchases		16,849	661,627			**678,477**
Alternative C Total						**-155,559,077**
Coal		-229,623,435	-1,086,693			**-230,710,129**
Natural Gas - Combined Cycle		24,871,332	4,504,314			**29,375,646**
Natural Gas - Simple Cycle		30,261,683	4,036,059			**34,297,743**
Hydroelectric		0	0			**0**
Nuclear		0	0			**0**
Wind & Solar		0	NR		9,269,059	**9,269,059**
Battery Storage (Generation)	1,723,466	0	NR	186,025		**1,909,491**
Pumped Hydro (Generation)		0	1,400			**1,400**
Market Purchases		11,603	286,110			**297,714**

Table I.6.456. TVA System-Wide Estimated 20-Year Life Cycle CH_4 Emissions Compared to the No Action Alternative, by Life Cycle Phase

Electric Power Technology	One-Time Upstream CH_4 Emissions, tons	Cumulative Combustion CH_4 Emissions, tons	Cumulative Non-Combustion CH_4 Emissions, tons	One-Time Downstream CH_4 Emissions, tons	Life Cycle CH_4 Emissions, tons	Natural Gas Related Methane Life Cycle Leakage, tons	Total CH_4 Emissions, tons
Alternative A Total							**-57,024**
Coal		-2.07E-03	-58,439				**-58,439**
Natural Gas - Combined Cycle	0.7	5.22E-03	1,172	0.02		2.19E-01	**1,172**
Natural Gas - Simple Cycle		8.59E-04	229.9			6.06E-02	**230**
Hydroelectric		0	0				**0**
Nuclear		0	0				**0**
Wind & Solar		0	NR				**0**
Battery Storage (Generation)		0	NR				**0**
Pumped Hydro (Generation)		0	4.75E-01				**0**
Market Purchases		4.52E-05	12.10			3.19E-03	**12**
Alternative B Total							**-55,401**
Coal		-2.01E-03	-56,778				**-56,778**
Natural Gas - Combined Cycle		3.46E-03	776			1.45E-01	**776**
Natural Gas - Simple Cycle	0.02	2.02E-03	540	4.84E-04		1.42E-01	**540**
Hydroelectric		0	0				**0**
Nuclear		0	0				**0**
Wind & Solar		0	NR				**0**
Battery Storage (Generation)		0	NR				**0**
Pumped Hydro (Generation)		0	6.15E-01				**1**
Market Purchases		2.23E-04	59.6			1.57E-02	**60**
Alternative C Total							**-56,906**
Coal		-2.05E-03	-57,741				**-57,741**
Natural Gas - Combined Cycle		1.81E-03	405.4			7.56E-02	**406**
Natural Gas - Simple Cycle		1.36E-03	363.3			9.58E-02	**363**
Hydroelectric		0	0				**0**
Nuclear		0	0				**0**
Wind & Solar		0	NR		33		**33**
Battery Storage (Generation)	6	0	NR	0.7			**7**
Pumped Hydro (Generation)		0	1.26E-01				**0**
Market Purchases		9.63E-05	26			6.79E-03	**26**

Table I.6.467. TVA System-Wide Estimated 20-Year Life Cycle N_2O Emissions Compared to the No Action Alternative, by Life Cycle Phase

Electric Power Technology	One-Time Upstream N_2O Emissions, tons	Cumulative Combustion N_2O Emissions, tons	Cumulative Non-Combustion N_2O Emissions, tons	One-Time Downstream N_2O Emissions, tons	Life Cycle N_2O Emissions, tons	Total N_2O Emissions, tons
Alternative A Total						**-10,362**
Coal		-3.26E-03	-10,519			**-10,519**
Natural Gas - Combined Cycle	0.006	1.82E-03	130.2	1.55E-04		**130**
Natural Gas - Simple Cycle		2.99E-04	25.54			**26**
Hydroelectric		0	-5.52E-05			**0**
Nuclear		0	0			**0**
Wind & Solar		0	NR			**0**
Battery Storage (Generation)		0	NR			**0**
Pumped Hydro (Generation)		0	5.28E-02			**0**
Market Purchases		1.57E-05	1.344			**1**
Alternative B Total						**-10,067**
Coal		-3.17E-03	-10,220			**-10,220**
Natural Gas - Combined Cycle		1.21E-03	86.2			**86**
Natural Gas - Simple Cycle	2.11E-04	7.03E-04	60.0	4.51E-06		**60**
Hydroelectric		0	-4.20E-05			**0**
Nuclear		0	0			**0**
Wind & Solar		0	NR			**0**
Battery Storage (Generation)		0	NR			**0**
Pumped Hydro (Generation)		0	6.84E-02			**0**
Market Purchases		7.75E-05	6.62			**7**
Alternative C Total						**-10,305**
Coal		-3.22E-03	-10,393			**-10,393**
Natural Gas - Combined Cycle		6.30E-04	45.05			**45**
Natural Gas - Simple Cycle		4.73E-04	40.36			**40**
Hydroelectric		0	3.98E-05			**0**
Nuclear		0	0			**0**
Wind & Solar		0	NR		0.5	**0**
Battery Storage (Generation)	0.1	0	NR	0.006		**0**
Pumped Hydro (Generation)		0	1.40E-02			**0**
Market Purchases		3.35E-05	2.861			**3**

Table I.6.478. TVA System-Wide Estimated 20-Year Life Cycle CO_2 Costs, Biden Administration, compared to the No Action Alternative, by Life Cycle Phase (Biden Administration EO 13990 Interim Rates, 3% Discount Rates)

Electric Power Technology	One-Time Upstream CO_2 Cost	Yearly Ongoing Combustion and Non-Combustion CO2 Cost									
	2026	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Alternative A	10,764,668	0	0	0	0	-199,434,119	-257,169,541	-429,106,690	-482,491,449	-500,908,157	-647,159,156
Alternative B	365,425	0	0	0	0	-118,044,925	-168,401,564	-337,367,870	-408,343,060	-454,253,029	-599,533,601
Alternative C	829,284,390	0	0	0	0	-327,812,186	-379,592,416	-548,919,108	-609,630,037	-631,226,313	-759,966,096

Yearly Ongoing Combustion and Non-Combustion CO2 Cost										Downstream CO_2 Cost	Total Cost (Nominal $)
2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057	
-712,486,609	-715,056,462	-792,196,591	-853,518,536	-891,101,899	-922,721,702	-955,886,340	-1,002,590,005	-1,040,461,919	-1,057,464,087	802,526	**-11,448,186,067**
-654,166,520	-661,502,344	-709,939,107	-751,082,210	-771,855,580	-806,981,743	-826,606,247	-870,047,270	-902,457,176	-922,961,442	23,351	**-9,963,154,911**
-812,655,101	-827,912,281	-910,956,598	-1,007,718,648	-1,054,207,793	-1,093,268,565	-1,129,105,329	-1,188,146,241	-1,235,530,274	-1,255,945,547	101,883,394	**-12,841,424,749**

Table I.6.29. TVA System-Wide Estimated 20-Year Life Cycle CH_4 Costs, Biden Administration, Compared to the No Action Alternative, by Life Cycle Phase (Biden Administration EO 13990 Interim Rates, 3% Discount Rates)

Electric Power Technology	One-Time Upstream CH_4 Cost	Yearly Combined Ongoing Combustion and Non-Combustion CH_4 Cost and Leakage Cost									
	2026	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Alternative A	1,224	0	0	0	0	-2,294,850	-2,927,754	-5,162,895	-6,339,296	-6,804,598	-9,249,104
Alternative B	42	0	0	0	0	-1,687,271	-2,364,267	-4,677,537	-5,925,604	-6,387,368	-8,880,219
Alternative C	94,286	0	0	0	0	-2,212,100	-2,726,192	-4,914,359	-6,137,840	-6,600,557	-9,035,449

Yearly Combined Ongoing Combustion and Non-Combustion CH_4 Cost and Leakage Cost										One-Time Downstream CH_4 Cost	Total Cost (Nominal $)
2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057	
-10,087,428	-10,649,512	-11,085,808	-12,049,816	-12,311,416	-13,237,131	-14,107,881	-14,556,041	-15,480,120	-15,658,316	107	**-162,000,636**
-9,635,110	-10,515,604	-11,087,292	-12,041,178	-12,299,470	-13,225,874	-14,094,252	-14,541,548	-15,464,277	-15,644,646	3	**-158,471,476**
-9,816,227	-10,619,618	-11,167,747	-12,148,594	-12,416,568	-13,350,392	-14,228,071	-14,678,931	-15,609,783	-15,790,942	36,434	**-161,322,649**

Table I.6.30. TVA System-Wide Estimated 20-Year Life Cycle N_2O Costs, Biden Administration, Compared to the No Action Alternative, by Life Cycle Phase (Biden Administration EO 13990 Interim Rates, 3% Discount Rates)

Electric Power Technology	One-Time Upstream N_2O Cost	Yearly Ongoing Combustion and Non-Combustion N_2O Cost									
	2026	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Alternative A	133	0	0	0	0	-4,862,404	-6,156,528	-10,857,650	-13,248,547	-14,230,324	-19,219,209
Alternative B	5	0	0	0	0	-3,576,221	-4,972,905	-9,838,527	-12,381,019	-13,346,308	-18,438,951
Alternative C	10,254	0	0	0	0	-4,630,773	-5,669,478	-10,270,952	-12,759,341	-13,734,455	-18,710,283

Yearly Ongoing Combustion and Non-Combustion N_2O Cost										Downstream N_2O Cost	Total Cost (Nominal $)
2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057	
-20,960,216	-22,004,123	-22,891,429	-24,745,884	-25,282,217	-27,052,808	-27,679,214	-29,615,463	-30,284,788	-31,728,578	0	**-330,819,248**
-20,007,876	-21,715,768	-22,893,311	-24,735,045	-25,267,226	-27,038,749	-27,662,873	-29,597,443	-30,265,847	-31,711,652	0	**-323,449,715**
-20,334,444	-21,877,114	-22,994,873	-24,869,935	-25,414,275	-27,194,363	-27,823,421	-29,768,371	-30,439,918	-31,892,920	1,001	**-328,373,661**

Table I.6.31. TVA System-Wide Estimated 20-Year Life Cycle CO_2 Costs, Prior Administration, Compared to the No Action Alternative, by Life Cycle Phase (Estimates Used in Conducting Regulatory Impact Analyses under Prior EPA Administration, 2020 (3% Discount Rate))

Electric Power Technology	One-Time Upstream CO_2 Cost	Yearly Ongoing Combustion and Non-Combustion CO2 Cost									
	2026	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Alternative A	1,293,613	0	0	0	0	-22,700,001	-28,219,320	-45,406,031	-49,246,554	-49,328,204	-61,504,756
Alternative B	43,914	0	0	0	0	-13,436,116	-18,478,773	-35,698,665	-41,678,435	-44,733,721	-56,978,515
Alternative C	99,656,869	0	0	0	0	-37,312,256	-41,652,832	-58,084,011	-62,223,235	-62,161,615	-72,225,710

Yearly Ongoing Combustion and Non-Combustion CO2 Cost										Downstream CO_2 Cost	Total Cost (Nominal $)
2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057	
-74,702,081	-72,387,833	-77,451,025	-79,438,805	-80,148,978	-80,219,671	-80,341,896	-81,483,309	-81,782,888	-90,453,357	55,441	**-1,053,465,655**
-68,587,395	-66,966,350	-69,408,922	-69,904,836	-69,423,526	-70,157,459	-69,475,952	-70,711,188	-70,935,373	-78,948,270	1,613	**-915,477,970**
-85,204,446	-83,812,649	-89,061,886	-93,790,540	-94,819,322	-95,046,691	-94,900,889	-96,563,986	-97,115,745	-107,431,063	11,964,811	**-1,159,785,196**

Table I.6.32. TVA System-Wide Estimated 20-Year Life Cycle CH_4 Costs, Prior Administration, Compared to the No Action Alternative, by Life Cycle Phase (Estimates Used in Conducting Regulatory Impact Analyses under Prior EPA Administration, 2020 (3% Discount Rate))

Electric Power Technology	One-Time Upstream CH_4 Cost	Yearly Combined Ongoing Combustion and Non-Combustion CH_4 Cost and Leakage Cost									
	2026	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Alternative A	132	0	0	0	0	-249,282	-303,014	-537,054	-629,252	-678,066	-880,699
Alternative B	4	0	0	0	0	-183,283	-244,694	-486,566	-588,188	-636,490	-845,574
Alternative C	10,177	0	0	0	0	-240,293	-282,153	-511,201	-609,255	-657,734	-860,355

Yearly Combined Ongoing Combustion and Non-Combustion CH_4 Cost and Leakage Cost										One-Time Downstream CH_4 Cost	Total Cost (Nominal $)
2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057	
-963,228	-972,922	-1,014,639	-1,056,370	-1,080,312	-1,113,717	-1,139,623	-1,175,496	-1,201,254	-1,213,851	6	**-14,208,640**
-920,037	-960,689	-1,014,774	-1,055,612	-1,079,264	-1,112,770	-1,138,522	-1,174,325	-1,200,025	-1,212,791	0	**-13,853,600**
-937,331	-970,191	-1,022,138	-1,065,029	-1,089,540	-1,123,246	-1,149,332	-1,185,420	-1,211,316	-1,224,132	2,053	**-14,126,435**

Table I.6.33. TVA System-Wide Estimated 20-Year Life Cycle N_2O Costs, Prior Administration, Compared to the No Action Alternative, by Life Cycle Phase (Estimates Used in Conducting Regulatory Impact Analyses under Prior EPA Administration, 2020 (3% Discount Rate))

Electric Power Technology	One-Time Upstream N_2O Cost	Yearly Ongoing Combustion and Non-Combustion N_2O Cost									
	2026	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Alternative A	13	0	0	0	0	-462,527	-555,166	-972,199	-1,126,536	-1,201,120	-1,542,952
Alternative B	0	0	0	0	0	-340,182	-448,432	-880,946	-1,052,769	-1,126,504	-1,480,311
Alternative C	982	0	0	0	0	-440,494	-511,246	-919,665	-1,084,938	-1,159,266	-1,502,094

Yearly Ongoing Combustion and Non-Combustion N_2O Cost										Downstream N_2O Cost	Total Cost (Nominal $)
2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057	
-1,669,847	-1,669,772	-1,723,318	-1,776,812	-1,800,422	-1,839,689	-1,866,350	-1,909,044	-1,956,442	-1,982,408	0	**-24,054,590**
-1,593,976	-1,647,890	-1,723,460	-1,776,034	-1,799,355	-1,838,733	-1,865,248	-1,907,882	-1,955,218	-1,981,350	0	**-23,418,290**
-1,619,993	-1,660,134	-1,731,106	-1,785,720	-1,809,827	-1,849,315	-1,876,073	-1,918,900	-1,966,464	-1,992,676	96	**-23,826,833**

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