

# SOCIAL COST OF CARBON: ENRBRIDGE'S LINE 3

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## I. Executive Summary

The Final Environmental Impact Statement (FEIS) prepared by the Minnesota Department of Commerce (DOC) on the matter of Enbridge Energy's proposed Line 3 pipeline expansion lays out calculations pertaining to the social cost of carbon (SCC) for operation of the pipeline between present day and 2050. However, since FEIS p2-7 states "the economic life of the pipeline...is anticipated to be *no less than* 30 years," (emphasis added) I have taken the liberty of extrapolating the social cost of carbon for the years 2051-2080 based on the modeling and data used in the FEIS, and the current Line 3's operating lifetime of 60 years.

The social cost of carbon modeling utilizes multiple discount rate scenarios, as well as multiple product displacement scenarios, which are detailed later in this document. The overall results of my calculations for each scenario are presented in Table 1 below:

**Table 1: 60 Year Social Cost of Carbon for the Proposed Line 3 Expansion**

*as extrapolated from the Dept. of Commerce FEIS*

<b>3% Av. Discount Rate</b>			
	SCC 2020-2050	SCC 2051-2080	<b>Total SCC</b>
No displacement	\$287,000,000,000.00	\$663,081,762,560.40	<b>\$950,081,762,560.40</b>
Partial Displacement	\$52,000,000,000.00	\$280,021,731,538.30	<b>\$332,021,731,538.30</b>
<b>2.5% Av. Discount Rate</b>			
	SCC 2020-2050	SCC 2051-2080	<b>Total SCC</b>
No displacement	\$426,030,562,265.16	\$869,270,420,887.90	<b>\$1,295,300,984,153.06</b>
Partial displacement	\$77,259,428,571.40	\$367,095,918,144.60	<b>\$444,355,346,716.00</b>

These calculations demonstrate that even the most conservative estimates for the social cost of carbon over a 60-year operating lifetime for Line 3 reach more than \$330 billion dollars. Accounting for more costly climate impacts (still conservative by most scientific data, and with the acknowledgement that the impacts accounted for in the model are incomplete), yet still assuming only partial displacement, a more realistic cost estimate lands at **over \$440 billion** in climate impacts from the proposed Line 3 expansion. Upper estimates are greater than \$1 trillion.

## II. Social Cost of Carbon Modeling Parameters

The FEIS states on p5-447 that the SCC “includes changes in net agricultural productivity; human health; property damages from increased flood risk; and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning. Given current modeling and data limitation, however, it does not include all important damages. Nonetheless, EPA (2016h) reports that the SCC is a useful measure to assess the benefits of CO2 reductions.” The model used in the FEIS was developed by the Interagency Working Group, “a group comprised of scientific and economic experts from the White House and federal agencies, including the Council on Environmental Quality, National Economic Council, Office of Energy and Climate Change, and Office of Science and Technology Policy, EPA, and Departments of Agriculture, Commerce, Energy, Transportation, and Treasury.” This model is widely regarded as the most academically accredited model (although other studies<sup>1</sup> advocate that steeper pricing scenarios would be a more accurate representation of current scientific projections about climate impacts).

The FEIS draws on four discount rate scenarios, as calculated by three different SCC models, developed by the Interagency Working Group. “Three values are based on the average SCC from three integrated assessment models (IAMs), at discount rates of 2.5, 3, and 5 percent. The fourth value, which represents the 95<sup>th</sup> percentile SCC estimate across all three models at a 3 percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution,” (White House 2015, p2). The data provided in the FEIS from the Interagency Working Group study for the SCC from the present to 2050 are below.

**Table 2: Social Cost of Carbon (in 2007 dollars per metric-ton CO2)**

*from FEIS Table 5.2.7-9, p5-447*

Year	Discount Rate and Statistic			
	5% Average	3% Average	2.5% Average	3% 95 <sup>th</sup> Percentile
2015	\$11	\$36	\$56	\$105
2020	\$12	\$42	\$62	\$123
2025	\$14	\$46	\$68	\$138
2030	\$16	\$50	\$73	\$152
2035	\$18	\$55	\$78	\$168
2040	\$21	\$60	\$84	\$183
2045	\$23	\$64	\$89	\$197
2050	\$26	\$69	\$95	\$212

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[http://costofcarbon.org/files/Omitted\\_Damages\\_Whats\\_Missing\\_From\\_the\\_Social\\_Cost\\_of\\_Carbon.pdf](http://costofcarbon.org/files/Omitted_Damages_Whats_Missing_From_the_Social_Cost_of_Carbon.pdf)

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<http://www4.unfccc.int/ndcregistry/PublishedDocuments/United%20States%20of>

The Department of Commerce chose to use the 3% discount rate for their SCC calculations.

Using the 3% discount rate, the FEIS includes data modeling the “life-cycle emission estimates.” This includes all greenhouse-gas (GHG) emission from the raw material acquisition, raw material transport, liquid fuels production/refining, product transportation and refueling, and combustion, of the product transported on the proposed Line 3 project. These stages of the product’s life cycle are outlined on page 5-449 of the FEIS.

In order to calculate the GHG emissions for the proposed Line 3 project, the FEIS employs three “displacement” scenarios, to represent multiple economic circumstances. “If no displacement occurs, [Enbridge]’s proposed Project would result in 760,000 [barrels per day (bpd)] of new [West Canada Sedimentary Basin (WCSB)] heavy crude entering the market, resulting in a 193 million ton CO<sub>2</sub>e/year incremental increase in emissions. If, rather the heavy crude transported on this line displaces lighter crude, for example the 390,000 bpd of WCSB light crude that the existing Line 3 provides to market as well as 370,000 bpd of another light crude (U.S. light tight), the result would be a 35 million ton CO<sub>2</sub>e/year incremental increase in emissions. If heavy crude transported on [Enbridge]’s proposed Project displaces other heavy Canadian crude (market-wide supply and demand are unaffected by the Project), no change in upstream of downstream emissions would occur,” (FEIS, p5-451). Based on these three displacement scenarios – no displacement, partial displacement, and full displacement – the FEIS gives the data provided below in Table 3 for the 30-year SCC for the proposed Line 3 project.

**Table 3: Average Life-Cycle Greenhouse Gas Emissions for Various Crude Oils**  
*from FEIS Table 5.2.7-12 p5-452*

Scenario	Annual Life-Cycle GHG Emissions (million tons CO <sub>2</sub> e)	Incremental Annual Life-Cycle GHG Emissions (million tons CO <sub>2</sub> e)	30-Year SCC for Incremental Life-Cycle GHG Emissions (2007 dollars)
Existing Line 3 (390,000 bpd WCSB light)	80.5	0	0 billion
Applicant’s Proposed Project (760,000 bpd WCSB Heavy) – No displacement	273.5	193	287 billion
Applicant’s Proposed Project (760,000 bpd WCSB Heavy – Displaces 390,000 bpd WCSB Heavy & 370,000 U.S. Light Tight Oil	115.5	35	52 billion

**III. Extrapolated 2051-2080 Social Cost of Carbon Data**

The White House 2015 paper states that “the SCC increases over time because future emissions are expected to produce larger incremental damages as physical and economic systems become more stressed in response to greater climate change,” (White House 2015, p13). This data is included here as Table 4.

**Table 4: Average Annual Growth Rates of SCC Estimates Between 2010 – 2050**  
*from White House 2015, p14*

Average Annual Growth Rate (%)	5% Av	3% Av	2.5% Av	3% 9 <sup>th</sup> Perc.
<b>2010-2020</b>	1.2%	3.2%	2.4%	4.4%
<b>2020-2030</b>	3.4%	2.1%	1.7%	2.3%
<b>2030-2040</b>	3.0%	1.9%	1.5%	2.0%
<b>2040-2050</b>	2.6%	1.6%	1.3%	1.6%

For my calculations, I chose to utilize both the 3% discount rate scenario (consistent with the FEIS), and the 2.5% discount rate scenario (consistent with more precautionary pricing).

Since there are no annual growth rates provided beyond 2050, I extrapolated using the 2040-2050 percent increase. As shown by the table above, this was a 1.6% increase for the 3% discount scenario, and 1.3% for the 2.5% discount scenario. Based on this information, I used the following calculations to produce a Social Cost of Carbon (in 2007 dollars per metric-ton CO<sub>2</sub>) for the years 2051-2080 for both discount scenarios:

$$3\% \text{ discount scenario: } (\text{Previous Year Cost}) \times (1.016) = \text{SCC in Current Year}$$

$$2.5\% \text{ discount scenario: } (\text{Previous Year Cost}) \times (1.013) = \text{SCC in Current Year}$$

The complete table of cost per year is attached as Appendix A.

The 2020-2050 data in the FEIS utilizes the “incremental” annual greenhouse gas emissions, therefore calculating the social cost of carbon for the *additional* capacity that would be brought online by the expansion, but not for the current emissions associated with the current 390,000 bpd of capacity on the existing line. Since the FEIS does not include the data for the 2020-2050 SCC for a 2.5% pricing scenario, I extrapolated that data, using the incremental annual greenhouse gas emission numbers in order to remain consistent (see Appendix B). However, for my 2051-2080 calculations, I employed the complete annual greenhouse gas emissions, under the assumption that in no scenario would the current Line 3 would not still be in operation. This likely still underestimates the social cost of carbon for the proposed

Project, because the old line would undoubtedly be decommissioned prior to 2050, but in order to remain consistent, I have relied upon the assumptions of the FEIS for the 2020-2050 modeling.

The FEIS states that the Annual Life-Cycle GHG Emissions for a no displacement scenario is 273.5 million tons (248,115,026.39 metric tons) CO<sub>2</sub>e, and the Annual Life-Cycle GHG Emissions for a partial displacement scenario is 115.5 million tons (104,779,837.47 metric tons) CO<sub>2</sub>e.

By multiplying the Annual Social Cost of Carbon (in 2007 dollars per metric-ton CO<sub>2</sub>) from Appendix A with the corresponding Annual Life-Cycle GHG Emissions for each discount scenario and displacement scenario, I calculated the results in Table 1 (replicated below):

**Table 1: 60 Year Social Cost of Carbon for the Proposed Line 3 Expansion**  
*as extrapolated from the Dept. of Commerce FEIS*

<b>3% Av. Discount Rate</b>			
	SCC 2020-2050	SCC 2051-2080	<b>Total SCC</b>
No displacement	\$287,000,000,000.00	\$663,081,762,560.40	<b>\$950,081,762,560.40</b>
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Partial displacement	\$77,259,428,571.40	\$367,095,918,144.60	<b>\$444,355,346,716.00</b>

The full table of extrapolated Annual Life Cycle Social Cost of Carbon Per Year for 2051-2080 can be found in Appendix A.

#### **IV. Greenhouse Gas Emissions and Minnesota Climate Regulations**

The FEIS summarizes Minnesota’s current greenhouse gas emission and climate change reduction policies. First, it outlines the 2007 Next Generation Energy Act, which “set a goal that would reduce GHG emissions in 2015 to a level 15% below the 2005 level, and also for 2025 and 2050 emissions levels to be 30% and 80%, respectively, below the 2005 emission levels (Minnesota Statutes 216H.02 Greenhouse Gas Emissions Control),” (FEIS p5-440).

They also outline Governor Mark Dayton’s commitment to the U.S. Climate Alliance, “a coalition launched after President Trump announced (June 1, 2017) plans to withdraw the United States from the Paris Agreement. The Paris Agreement,

reached in 2016 by 195 countries, aims to reduce the greenhouse gas emissions that are driving climate change. The U.S. Climate Alliance is a coalition of states that are committed to upholding the objectives of the Paris Agreement on climate change within their borders,” (FEIS, p5-441).

The United States’ Nationally Determined Contribution to the Paris Agreement pledged to reduce greenhouse gas emissions economy-wide 26-28% below 2005 levels by 2025.<sup>2</sup>

The FEIS states that the proposed Line 3 expansion would increase greenhouse gas emissions by 35 to 193 million tons of CO<sub>2</sub>e per year. Minnesota retains jurisdiction over the permitting for a substantial portion of this pipeline, including a Certificate of Need for the project. The Certificate of Need requires consideration of whether the project “will fail to comply with those relevant policies, rules, and regulations of other state and federal agencies and local governments.”<sup>3</sup> The increase in greenhouse gas emissions that would result from the proposed Line 3 expansion are clearly inconsistent with both Minnesota’s Next Generation Energy Act and commitment to the U.S. Climate Alliance.

## **V. Conclusions**

Simple mathematic extrapolation based on the data provided by the FEIS to complete the social cost of carbon modeling to reflect a more realistic 60-year operating lifetime of the proposed Line 3 expansion demonstrates that the cost of associated climate impacts would likely range from \$330 billion to \$440 billion. Upper estimates would be over \$1 trillion, even by what is considered a moderate pricing model.

Given the Certificate of Need mandate to examine both the project’s compliance with existing policies and its potential consequences to society, I conclude that the proposed Line 3 expansion fails to meet two out of the four criteria for granting the Certificate of Need, and recommend denial of the permit.

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<http://www4.unfccc.int/ndcregistry/PublishedDocuments/United%20States%20of%20America%20First/U.S.A.%20First%20NDC%20Submission.pdf>

<sup>3</sup> Minnesota Administrative Rule 7853.0130

<https://www.revisor.mn.gov/rules/?id=7853.0130>

# Appendices

## Appendix A: Extrapolated Annual Life Cycle Social Cost of Carbon Per Year 2051-2080

Year	3% Av.	Total Cost/Yr Partial Displacement	Total Cost/Yr No Displacement	2.5% Av.	Total Cost/Yr Partial Displacement	Total Cost/Yr No Displacement
Inc. Rate:	1.6%	104,779,837.47	248,115,026.39	1.30%	104,779,837.47	248,115,026.39
2050	\$69	\$7,229,808,785.4	\$17,119,936,820.9	\$95.000	\$9,954,084,559.7	\$23,570,927,507.1
2051	\$70.104	\$7,345,485,726.0	\$17,393,855,810.0	\$96.235	\$10,083,487,658.9	\$23,877,349,564.6
2052	\$71.226	\$7,463,013,497.6	\$17,672,157,503.0	\$97.486	\$10,214,572,998.5	\$24,187,755,109.0
2053	\$72.365	\$7,582,421,713.6	\$17,954,912,023.1	\$98.753	\$10,347,362,447.5	\$24,502,195,925.4
2054	\$73.523	\$7,703,740,461.0	\$18,242,190,615.4	\$100.037	\$10,481,878,159.3	\$24,820,724,472.4
2055	\$74.699	\$7,827,000,308.4	\$18,534,065,665.3	\$101.338	\$10,618,142,575.4	\$25,143,393,890.6
2056	\$75.895	\$7,952,232,313.3	\$18,830,610,715.9	\$102.655	\$10,756,178,428.8	\$25,470,258,011.1
2057	\$77.109	\$8,079,468,030.3	\$19,131,900,487.4	\$103.990	\$10,896,008,748.4	\$25,801,371,365.3
2058	\$78.343	\$8,208,739,518.8	\$19,438,010,895.2	\$105.341	\$11,037,656,862.1	\$26,136,789,193.0
2059	\$79.596	\$8,340,079,351.1	\$19,749,019,069.5	\$106.711	\$11,181,146,401.4	\$26,476,567,452.6
2060	\$80.870	\$8,473,520,620.7	\$20,065,003,374.6	\$108.098	\$11,326,501,304.6	\$26,820,762,829.4
2061	\$82.164	\$8,609,096,950.6	\$20,386,043,428.6	\$109.503	\$11,473,745,821.5	\$27,169,432,746.2
2062	\$83.478	\$8,746,842,501.9	\$20,712,220,123.5	\$110.927	\$11,622,904,517.2	\$27,522,635,371.9
2063	\$84.814	\$8,886,791,981.9	\$21,043,615,645.4	\$112.369	\$11,774,002,275.9	\$27,880,429,631.8
2064	\$86.171	\$9,028,980,653.6	\$21,380,313,495.8	\$113.830	\$11,927,064,305.5	\$28,242,875,217.0
2065	\$87.550	\$9,173,444,344.1	\$21,722,398,511.7	\$115.310	\$12,082,116,141.5	\$28,610,032,594.8
2066	\$88.951	\$9,320,219,453.6	\$22,069,956,887.9	\$116.809	\$12,239,183,651.3	\$28,981,963,018.5
2067	\$90.374	\$9,469,342,964.8	\$22,423,076,198.1	\$118.327	\$12,398,293,038.8	\$29,358,728,537.8
2068	\$91.820	\$9,620,852,452.3	\$22,781,845,417.2	\$119.865	\$12,559,470,848.3	\$29,740,392,008.7
2069	\$93.289	\$9,774,786,091.5	\$23,146,354,943.9	\$121.424	\$12,722,743,969.3	\$30,127,017,104.9
2070	\$94.781	\$9,931,182,669.0	\$23,516,696,623.0	\$123.002	\$12,888,139,640.9	\$30,518,668,327.2
2071	\$96.298	\$10,090,081,591.7	\$23,892,963,769.0	\$124.601	\$13,055,685,456.3	\$30,915,411,015.5
2072	\$97.839	\$10,251,522,897.1	\$24,275,251,189.3	\$126.221	\$13,225,409,367.2	\$31,317,311,358.7
2073	\$99.404	\$10,415,547,263.5	\$24,663,655,208.3	\$127.862	\$13,397,339,689.0	\$31,724,436,406.3
2074	\$100.995	\$10,582,196,019.7	\$25,058,273,691.7	\$129.524	\$13,571,505,104.9	\$32,136,854,079.6
2075	\$102.610	\$10,751,511,156.0	\$25,459,206,070.7	\$131.208	\$13,747,934,671.3	\$32,554,633,182.7
2076	\$104.252	\$10,923,535,334.5	\$25,866,553,367.9	\$132.914	\$13,926,657,822.0	\$32,977,843,414.0

2077	\$105.920	\$11,098,311,899.9	\$26,280,418,221.7	\$134.641	\$14,107,704,373.7	\$33,406,555,378.4
2078	\$107.615	\$11,275,884,890.3	\$26,700,904,913.3	\$136.392	\$14,291,104,530.6	\$33,840,840,598.3
2079	\$109.337	\$11,456,299,048.5	\$27,128,119,391.9	\$138.165	\$14,476,888,889.5	\$34,280,771,526.1
2080	\$111.086	\$11,639,599,833.3	\$27,562,169,302.2	\$139.961	\$14,665,088,445.0	\$34,726,421,556.0
Totals		<b>\$280,021,731,538.3</b>	<b>\$663,081,762,560.4</b>		<b>\$367,095,918,144.6</b>	<b>\$869,270,420,887.9</b>

### Appendix B: Extrapolated Annual Life Cycle Social Cost of Carbon Per Year 2020-2050, 2.5% Discount Rate

Year	2.5% Av. Price	Annual Price Inc.	Total Cost/Yr Partial Displacement	Total Cost/Yr No Displacement
			31,751,465.90	175,086,654.82
2015	\$56.00	2.40%	\$1,778,082,090.40	\$9,804,852,669.92
2016	\$57.34	2.40%	\$1,820,756,060.57	\$10,040,169,134.00
2017	\$58.72	2.40%	\$1,864,454,206.02	\$10,281,133,193.21
2018	\$60.13	2.40%	\$1,909,201,106.97	\$10,527,880,389.85
2019	\$61.57	2.40%	\$1,955,021,933.54	\$10,780,549,519.21
2020	\$62.00	1.70%	\$1,968,590,885.80	\$10,855,372,598.84
2021	\$63.05	1.70%	\$2,002,056,930.86	\$11,039,913,933.02
2022	\$64.13	1.70%	\$2,036,091,898.68	\$11,227,592,469.88
2023	\$65.22	1.70%	\$2,070,705,460.96	\$11,418,461,541.87
2024	\$66.32	1.70%	\$2,105,907,453.80	\$11,612,575,388.08
2025	\$68.00	1.70%	\$2,159,099,681.20	\$11,905,892,527.76
2026	\$69.16	1.70%	\$2,195,804,375.78	\$12,108,292,700.73
2027	\$70.33	1.70%	\$2,233,133,050.17	\$12,314,133,676.64
2028	\$71.53	1.70%	\$2,271,096,312.02	\$12,523,473,949.15
2029	\$72.74	1.70%	\$2,309,704,949.33	\$12,736,373,006.28
2030	\$73.00	1.50%	\$2,317,857,010.70	\$12,781,325,801.86
2031	\$74.10	1.50%	\$2,352,624,865.86	\$12,973,045,688.89
2032	\$75.21	1.50%	\$2,387,914,238.85	\$13,167,641,374.22
2033	\$76.33	1.50%	\$2,423,732,952.43	\$13,365,155,994.83
2034	\$77.48	1.50%	\$2,460,088,946.72	\$13,565,633,334.76
2035	\$78.00	1.50%	\$2,476,614,340.20	\$13,656,759,075.96
2036	\$79.17	1.50%	\$2,513,763,555.30	\$13,861,610,462.10



2037	\$80.36	1.50%	\$2,551,470,008.63	\$14,069,534,619.03
2038	\$81.56	1.50%	\$2,589,742,058.76	\$14,280,577,638.32
2039	\$82.79	1.50%	\$2,628,588,189.64	\$14,494,786,302.89
2040	\$84.00	1.30%	\$2,667,123,135.60	\$14,707,279,004.88
2041	\$85.09	1.30%	\$2,701,795,736.36	\$14,898,473,631.94
2042	\$86.20	1.30%	\$2,736,919,080.94	\$15,092,153,789.16
2043	\$87.32	1.30%	\$2,772,499,028.99	\$15,288,351,788.42
2044	\$88.45	1.30%	\$2,808,541,516.36	\$15,487,100,361.67
2045	\$89.00	1.30%	\$2,825,880,465.10	\$15,582,712,278.98
2046	\$90.16	1.30%	\$2,862,616,911.15	\$15,785,287,538.61
2047	\$91.33	1.30%	\$2,899,830,930.99	\$15,990,496,276.61
2048	\$92.52	1.30%	\$2,937,528,733.09	\$16,198,372,728.20
2049	\$93.72	1.30%	\$2,975,716,606.62	\$16,408,951,573.67
2050	\$95.00	1.30%	\$3,016,389,260.50	\$16,633,232,207.90
<b>2020-2050 Totals</b>			<b>\$77,259,428,571.40</b>	<b>\$426,030,563,265.16</b>