

The Social Cost of Carbon in the US and Canada

Summary

US (USD 2015\$)	Value in 2016	Annual Growth 2010-2020	Annual Growth 2020-2030	Annual Growth 2030-2040	Annual Growth 2040-2050	Discount Rate	Value in 2050	Base Year Conversion
Low	\$11	1.2%	3.4%	3.0%	2.6%	5%	\$26	CPI
Medium	\$38	3.2%	2.1%	1.9%	1.6%	3%	\$69	CPI
High	\$57	2.4%	1.7%	1.5%	1.3%	2.5%	\$95	CPI
95 th Percentile	\$108	4.3%	2.4%	2.0%	1.5%	3%	\$212	CPI

Canada (CAD 2015\$)	Value in 2016	Annual Growth 2010-2020	Annual Growth 2020-2030	Annual Growth 2030-2040	Annual Growth 2040-2050	Discount Rate	Value in 2050	Base Year Conversion
Medium	\$42	3.2%	2.1%	1.9%	1.6%	3%	\$77	GDP Deflator
95 th Percentile	\$172	4.5%	2.4%	2.0%	1.3%	3%	\$329	GDP Deflator

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The SCC Defined and Valued

The social cost of carbon (SCC)¹ is a conservative estimate of the negative effects of climate change. The number allows us to incorporate the benefits of reducing CO₂ emissions in our cost-benefit analyses of green infrastructure and sustainable buildings. The cost of carbon pollution is an estimate of the damages - of the economic cost of the health, agricultural losses, property flooding and the value of ecosystem services. The estimates, and there are many estimates, are conservative because they do not yet capture all of the identified impacts of rising levels of CO₂ in the atmosphere.

US

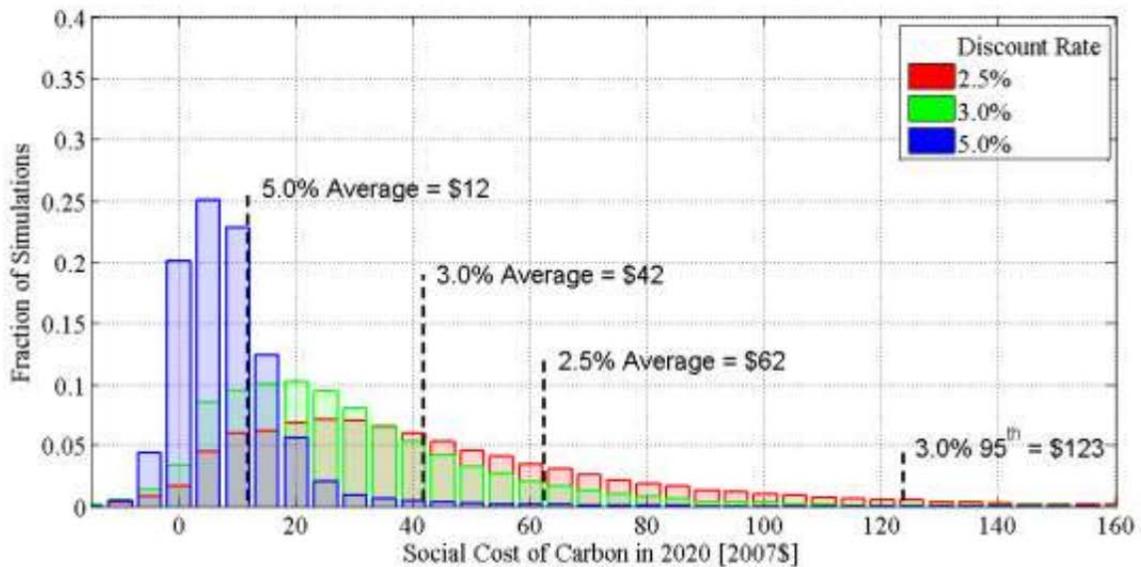
Significantly, in the US, the SCC was recently ratified by a federal appeals court.

“One of the most significant court cases about climate change was decided this month by a federal appeals court in Chicago. Given that it was steeped in the enervating context of refrigerator regulations, you may have missed it. But amid the stultifying discussions of compressors and insulation foam was a crucial advance in our nation’s belated attempts to forestall global climate catastrophe.”²

The SCC is complicated. In the US, there are three climate models that spit out thousands of possible values. In addition, different discount rate scenarios are used; and, the SCC also increases in the future. The federal guidance is usually shown as an average value at three different discount rates at different dates in the future. An extreme (95th percentile) value (at the mid-point discount rate is also calculated) as a high value. The distribution of SCC Estimates for 2020 (in 2007\$ per metric ton CO₂):

¹ As an example of two of the nuances, the cost is measured in metric tons or tonnes (1,000 kg) of CO₂ - colloquially a ton of carbon (technically 3.67 tons of carbon dioxide is equivalent to 1 ton of carbon). Also, a tonne or metric ton is not the same as a UK ton (2,240 lb or 1,016.047 kg) or a US ton (2,000 lb or 907.1847 kg).

² “The ‘Social Cost of Carbon’ Is the Most Historic Climate Change Decision Yet” by Jay Michaelson, The Daily Beast, 30th August 2016, <http://www.thedailybeast.com/articles/2016/08/30/the-social-cost-of-carbon-is-the-most-historic-climate-change-decision-yet.html>



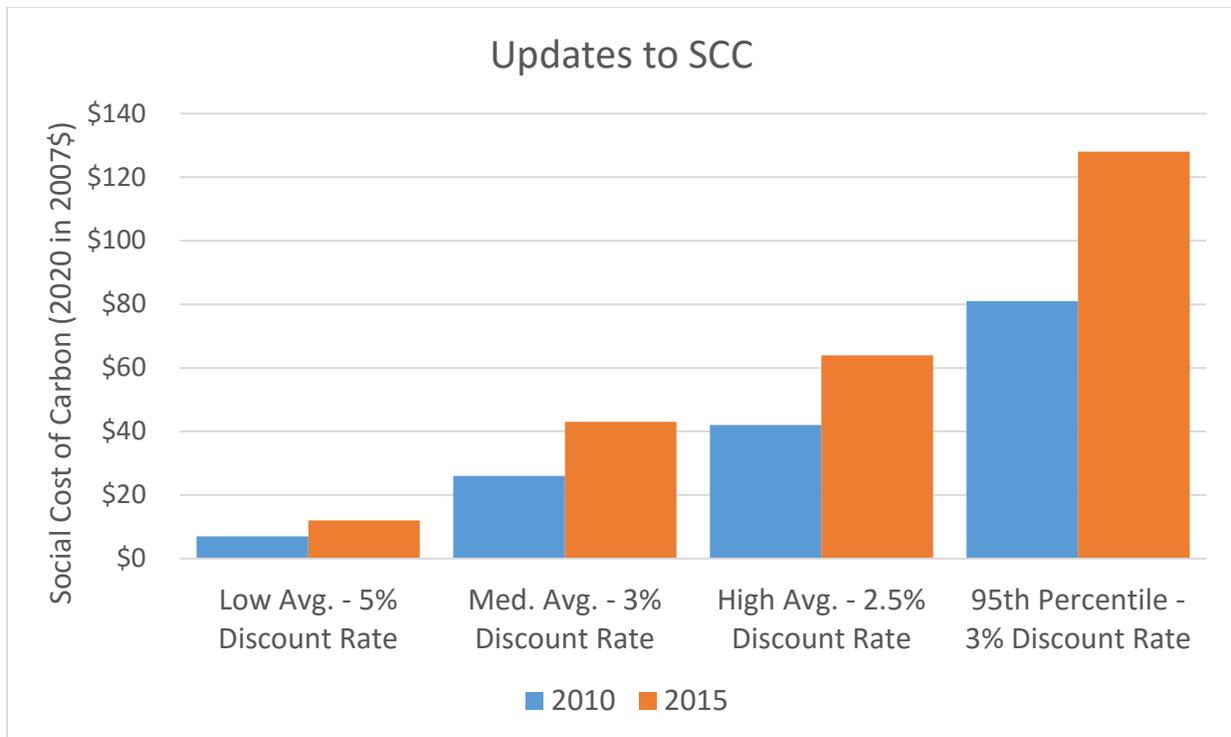
The chart is from the US guidance. A description of the chart (adapted from Canadian guidance) - The distribution of U.S. SCC estimates of 2020 is presented in terms of the share of total simulations at discount rates of 2.5%, 3% and 5%. The range covered in the figure ranges from -\$22 to \$160, where a large majority of the estimates lie. The maximum value is \$696. The averages for the three distributions are respectively \$12, \$42 and \$62 for the 5%, 3% and 2.5% distributions. The top of the bell (the value most often simulated) is slightly lower than the average value for all three distributions. The 95th percentile is estimated at \$123 at a 3% discount rate. The higher the discount rate, the more concentrated the estimates are around the average value. The distributions are characterized by right-skewed fat tails.

Updates

The SCC has been updated twice; most recently in July 2015. The first estimates, published in 2010, for the four 2020 SCC estimates were \$7, \$26, \$42 and \$81 (2007\$). The corresponding four updated SCC estimates for 2020 are \$12, \$43, \$64, and \$128 (2007\$)³.

³ in a 2013 update they were \$12, \$43, \$65, and \$129 -

https://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf



Discount Rates

The discount rates used for discounting carbon costs is different from the US federal guidance of 7% real for other costs and benefits. In calculating the SCC, the stream of future damages is discounted to its present value in the year when the additional unit of emissions was released using a selected discount rate which reflects society's marginal rate of substitution between consumption in different time periods.

The US DOT is explicit in their TIGER Cost Benefit Guidance⁴ that all benefits and costs (that exclude carbon dioxide emissions) should be discounted at 7% (and 3% as a sensitivity) and the net value of carbon dioxide emissions at the 3% discount rate.

When using the lower or higher carbon numbers the federal guidance says to use the 2.5% or 5% discount rate: "While the SCC estimate grows over time, the future monetized value of emissions reductions in each year (the SCC in year t multiplied by the change in emissions in year t) must be discounted to the present to determine its total net present value for use in regulatory analysis.

Damages from future emissions should be discounted at the same rate as that used to calculate the

⁴ "The Federal interagency Social Cost of Carbon (SCC) guidance states that the value of carbon dioxide emissions changes over time and should be discounted at the lower discount rates of 2.5%, 3%, or 5%. However, the lack of 7% SCC values does not mean that applicants should ignore 7% discounting for the BCA. The document and its findings imply that carbon emissions are valued differently from other benefits and costs from the perspective of discount rate. Applicants should continue to calculate discounted present values for all benefits and costs (that exclude carbon dioxide emissions) at 7% and 3%, as recommended by OMB Circular A-941 . To these non-carbon NPV benefits, the Applicant should then add the corresponding net value of carbon dioxide emissions, as calculated from the 3% SCC value." TIGER BCA Resource Guide p. 8 Updated 3/27/15
https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

SCC estimates themselves to ensure internal consistency—i.e., future damages from climate change, whether they result from emissions today or emissions in a later year, should be discounted using the same rate. For example, climate damages in the year 2020 that are calculated using a SCC based on a 5 percent discount rate also should be discounted back to the analysis year using a 5 percent discount rate."⁵

So, we will be discounting carbon emissions and savings by 5% when using the low value (generated using a 5% discount rate) and when using the high (2.5%) value we will discount by 2.5%. Note that Canada is different, as we point out below.

Base Year

In the US, the numbers in every update have been shown in a 2007 base year (2007\$). There is not guidance in these documents on how to convert to other base years. Usually this is done with an inflation index. The US DOT in the TIGER guidance says to use the CPI to convert to another base year.⁶

Annual Estimates

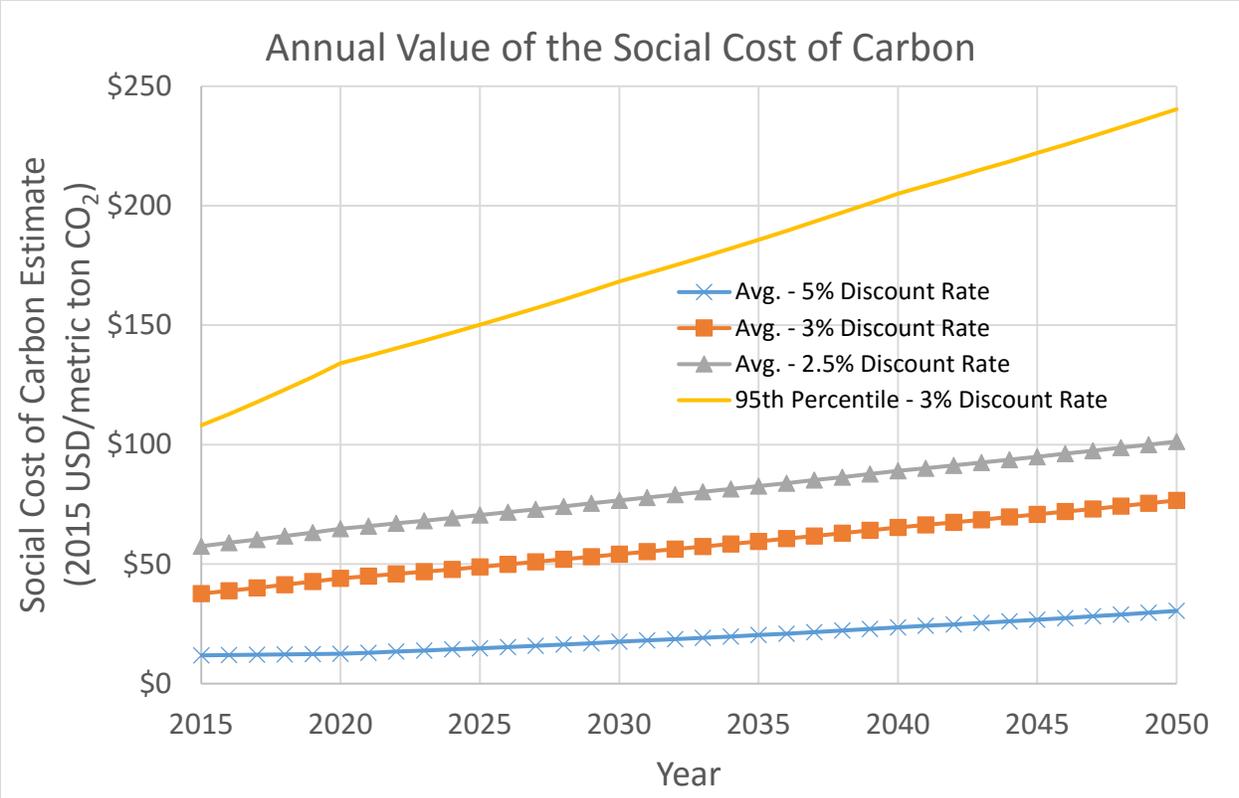
So, here is the recommended social cost of carbon (SCC) values in the US over time, in 2015\$:

⁵ Technical Support Document: - Social Cost of Carbon for Regulatory Impact Analysis - Under Executive Order 12866 - Interagency Working Group on Social Cost of Carbon, United States Government, February 2010

<https://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf>

⁶ "The SCC values are given in 2007 dollars. We convert these to 2013 base year dollars by multiplying by the corresponding CPI ratio." TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE,

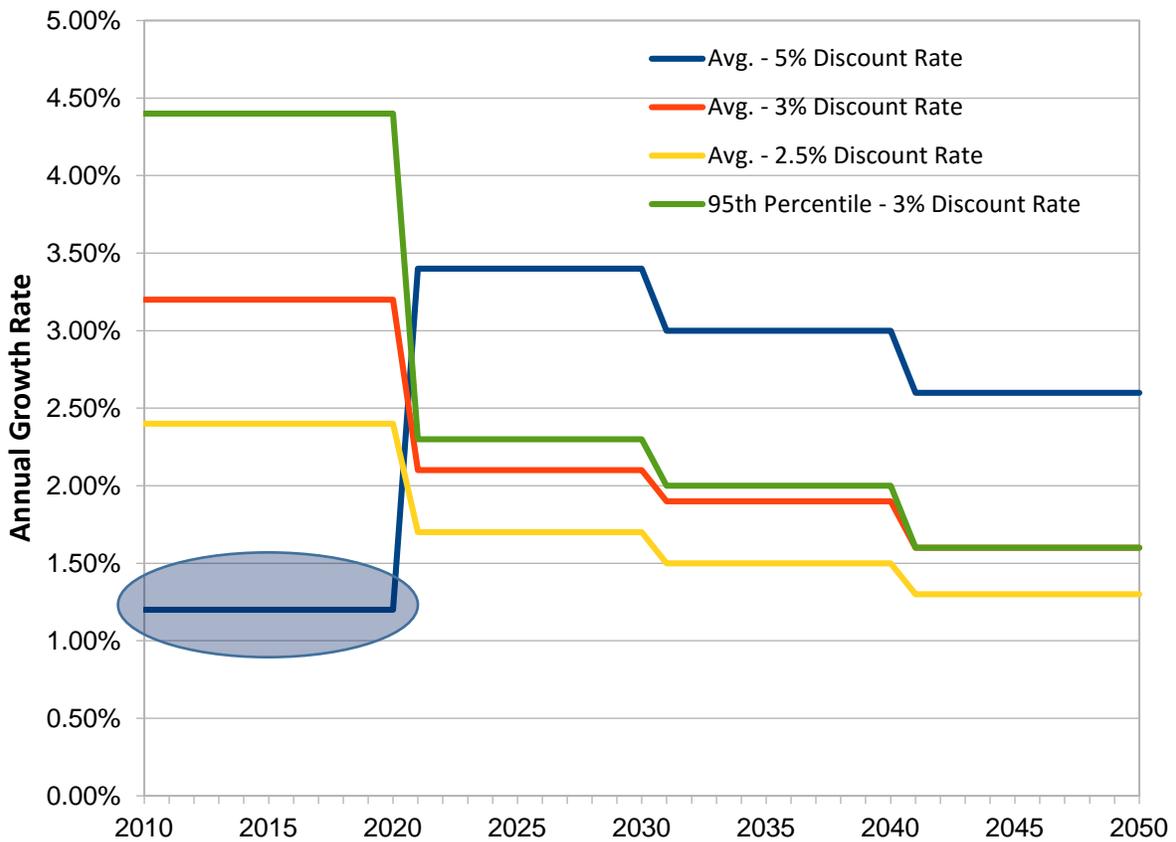
https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf



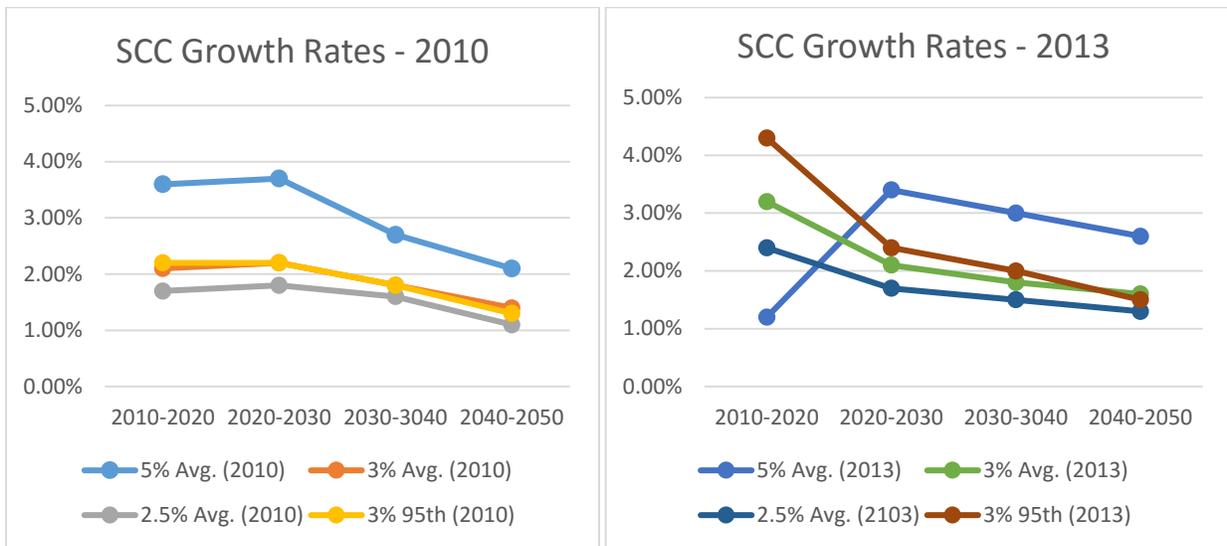
Growth Rates

Apart from the complexity, when you start digging into the numbers there are some odd things going on. Take for instance the growth rate which, for some reason looks low for the initial period from the 5% discount rate scenarios:

Annual Growth Rate in Social Cost of Carbon (SCC)



Here's what the changes look like from 2010 to 2013:



As shown in the charts, the update in 2013 reduced the growth rate from 3.5% for 2010-2020 (2010 estimate) to 1.2%. These growth rates were maintained in the 2015 update. We'll monitor for updates.

Canada

Canada is in a state of flux. There are many numbers floating around. The first set are provincial and political. The second are just the US SCC numbers adopted and slightly adapted for Canada.

On the provincial/political front, the federal government recently said it would impose a floor SCC which has annoyed some of the provinces – especially Saskatchewan. It has proposed a carbon price of \$10 per tonne in 2018, reaching \$50 per tonne by 2022. British Columbia introduced a carbon tax in 2008 and it now stands at \$30 a tonne. Alberta announced last November it will have a \$20-per-tonne carbon levy in place next year, rising to \$30 a tonne in 2018⁷. “Quebec joined California in a cap-and-trade carbon market in 2014, and Ontario is set to start trading in the same market next year. ... The federal government says provinces that go this route have to set emissions caps that correspond to how much a specific carbon price is expected to reduce emissions.” “Some 80% of Canada’s population is covered by a carbon-pricing scheme of some kind.”⁸

Discount Rate

On the SCC for cost-benefit analyses of regulatory proposals, Canada, in a wonderful show of independence (We are not the US), in March 2016, adopted the US numbers but converted the numbers to Canadian dollars and defiantly used the 3% discount rate only.

“Canada's interdepartmental working group recommended the adoption of the U.S. values in 2011, with a few minor adjustments. Instead of four different values, the group recommended two estimates using the same discount rate.”⁹

So, the Canadian numbers have an average and a 95th percentile both using the “3% social discount rate recommended by Canada's Treasury Board Secretariat Analysis Guide.”¹⁰ Note that the Treasury Board recommends that a real rate of 8 per cent be used as the discount rate in Canada, whereas the social time preference rate, which is based on the rate at which individuals discount future consumption and projected growth rate in consumption and is a component of this discount rate, has been estimated to be around 3 per cent. (I have discussed the appropriate discount rate - such as whether to use the social discount rate, the rate of time preference, or even a declining discount rate [here](#).)

For the Canadian calculation of the 95th percentile estimates, the results of the one of the three models used in the US estimates are not included. It was felt that one model (the FUND model) did not incorporate the low-probability, high-cost events. For reference the FUND model gives up to a \$65 value at the 95th percentile and 3% discount rate whereas the PAGE model estimates up to \$90 and the DICE model up to \$369. By excluding the model with the lower estimates the 95th percentile is higher in Canada than in the US.

⁷ 5 things to know about Canada’s carbon pricing plans, The Toronto Star <https://www.thestar.com/news/canada/2016/10/03/5-things-to-know-about-canadas-carbon-pricing-plans.html>

⁸ Let the haggling begin, The Economist, Oct 22nd 2016 <http://www.economist.com/news/americas/21709058-announcement-national-carbon-price-justin-trudeau-opens-new-phase-his>

⁹ Technical Update to Environment and Climate Change Canada's Social Cost of Greenhouse Gas Estimates, Environment and Climate Change Canada, March 2016 <http://ec.gc.ca/cc/default.asp?lang=En&n=BE705779-1>

¹⁰ Ibid.

Base Year

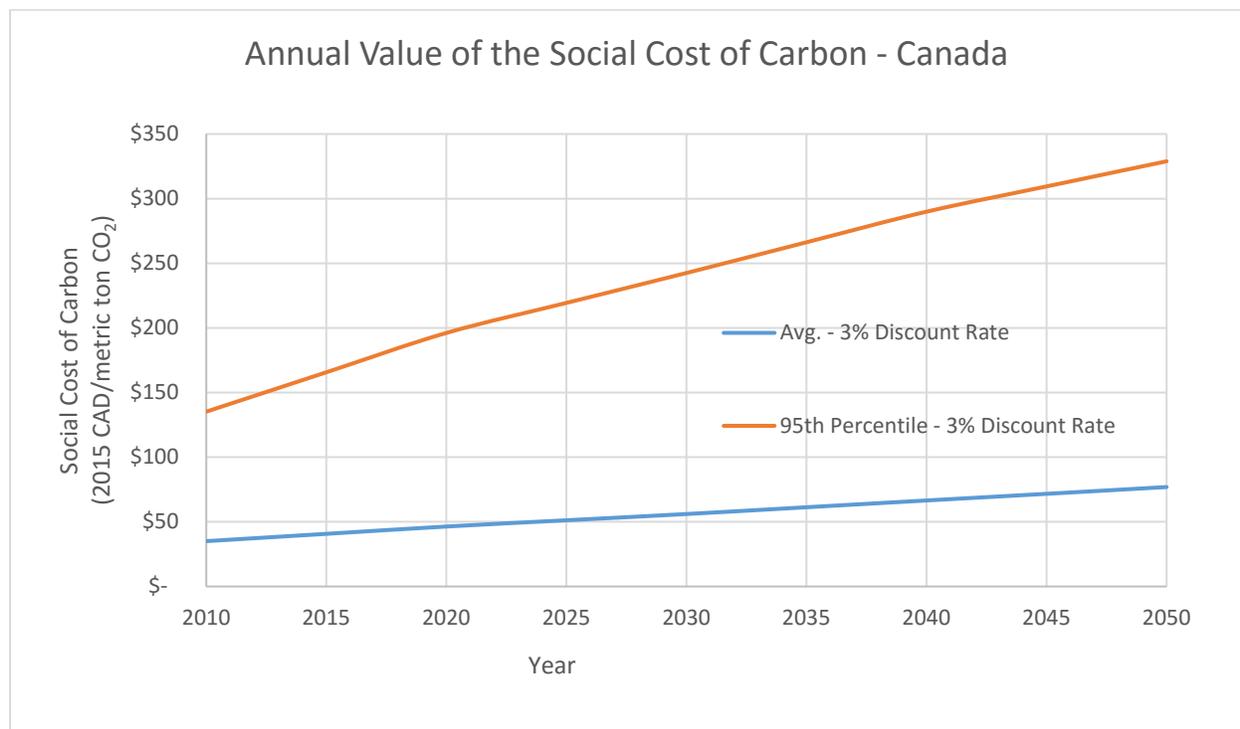
Also, the Canadian values differ from the US in converting from 2007\$ to another base year using the GDP deflator. As noted above the US DOT recommends using the CPI. While we tend to agree with Canada on this one we have stuck with the US federal guidance from the US DOT for the US and will use the GDP deflator for Canada. In Canada 2012\$ are reported and we convert to the current year – 2015 at time of writing - to be consistent with Autocase’s database. The Canadian document states: “U.S. SCC estimates are then updated to reflect inflation through to 2012 using the U.S. GDP deflator and then converted into Canadian dollars. The Canadian values are updated regularly with the Canadian GDP deflator in order to correct for ongoing inflation.”

The 2018 floor value, which is likely politically motivated rather than science-based. The political 2018 floor value is much lower than estimated SCC for Canada. In fact, it is below the low average value. Whereas the political \$50 floor in 2022 is close to the mid-average value. That the feds chose a low range number in the near term and an average value in the mid-term was likely to placate the laggard provinces while appeasing the climate change policy leaders.

In Autocase, we are going to implement the SCC Estimates from Environment and Climate Change Canada from March 2016¹¹ and let the provincial and federal ministers duke it out. We’ll update based on any decision.

Annual Estimates

So, here is the recommended social cost of carbon (SCC) values in the Canada over time, in 2015\$:



¹¹ Ibid.