First Steps to a Carbon Neutral Nova Scotia: Scoping Analysis of Carbon Capture and Storage (CCS) Costs and Funding

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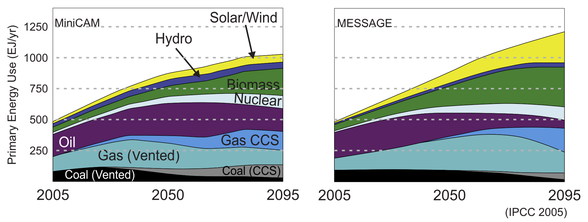
Summary

This presentation describes the costs and revenue associated with a CCS pilot project offshore Nova Scotia. This pilot project consists of two wells each injecting 1.25Mt/yr CO2 into the subsurface Misissauga Formation. Costs include capital expenditures ($2.2B with +$1B sensitivity) and annual operation expenditures ($40/tonne to $60/tonne CO2). Revenue is estimated using the sale of carbon credits ($50/tonne) and a surcharge applied to the sale of refined petroleum products ($0.05 to $0.20/L) in Nova Scotia. This project identifies commercial potential and regulatory framework for future CCS.

CCS and Fossil Fuel Use: Global Context

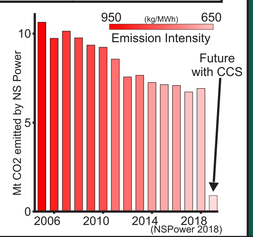
Carbon capture and storage (CCS) is widely recognized as the best technique for mitigating anthropogenic CO2 emissions if large scale fossil fuel use is to continue. According to many reports, including the 2005 IPCC report on CO2 Capture and Storage, in the coming century the percent of global primary energy derived from fossil fuels is predicted to be between 62-72% in 2050 and 42-57% by 2100, suggesting that continued large-scale use of fossil fuels is a certainty.



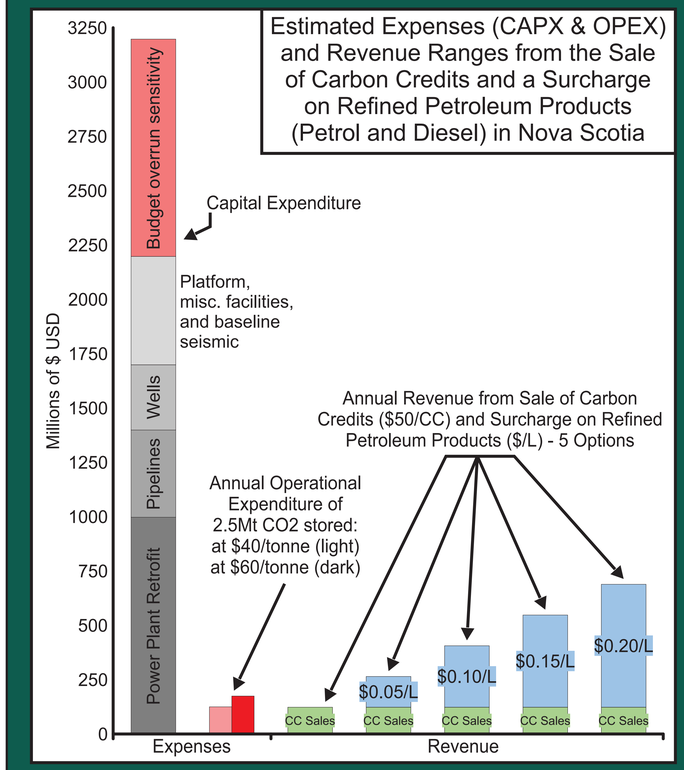
CCS and CO2 Emissions: Nova Scotia

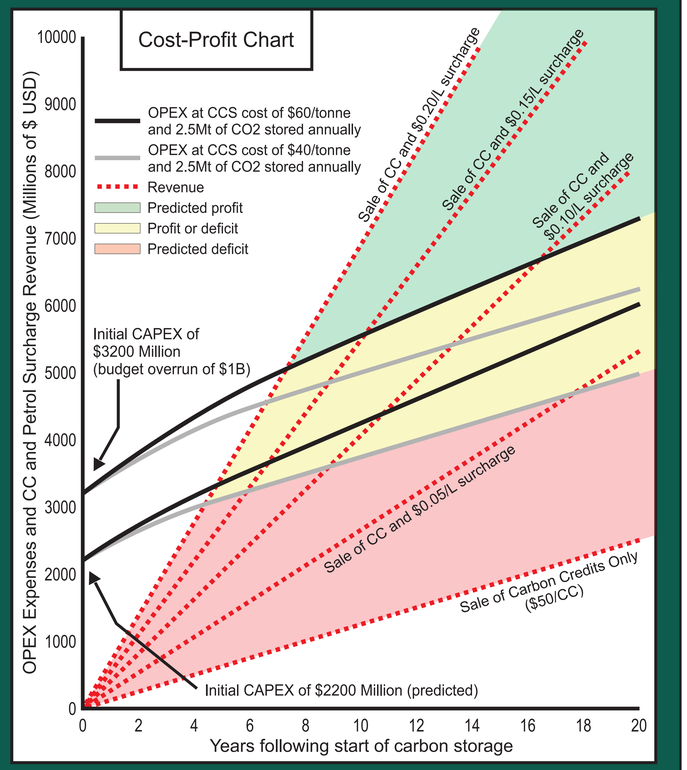
The 2005 IPCC CCS report identified the Scotian Basin as highly perspective for geologic storage of CO2.

Since 2005 NS Power has reduced its annual CO2 emissions by ~37% and emission intensity of CO2 (kg/MWh) by 28.7%. However, the rate of decrease has slowed, suggesting the need for alternate methods for mitigating CO2 emissions moving into the future.



Carbon Capture and Storage could lower carbon emissions in NS by 20% in 4 years at the cost of $1.70/day/person





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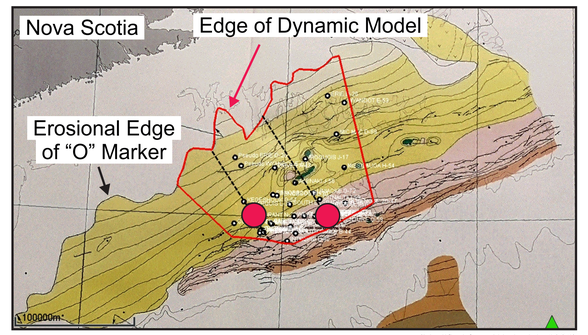
Methods

This presentation amalgamates CAPEX and OPEX cost estimates from 10+ CCS studies and projects from around the world. OPEX costs are calculated by averaging values from referenced studies. In addition, we included a $1B overrun sensitivity to the CAPEX (~45% of CAPEX).

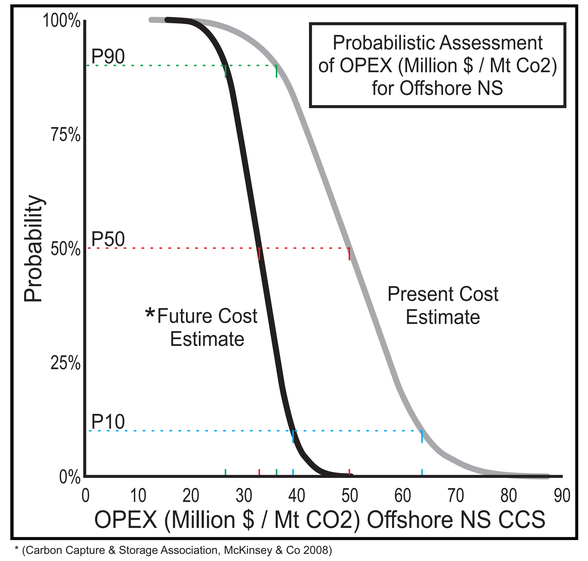
Study/Project	Capture ($/tCO2)	Transport ($/tCO2)	Storage ($/tCO2)	Total ($/tCO2)
IPCC (2005)	15-75	1.0-8.0	0.6-8.3	16.6-91.3
McCoy & Rubin (2005)		0.44	1.44	
Vosbeek & Warmenhoven (2007)	28.4	1.1	2.2	31.7
Ploumen et al. (2007)	35-46			
Hendriks et al (2007)		1.0-1.6		
Poyry Energy Consulting (2007)	26-33	1.2-11.1	1.23-24.7	26-54
IEA		2.0-6.0	10.0-25.0	
BCG (2008)	27.3	2.2-3.3	4.4-5.5	33.9-36
McKinsey & Co (2008)	25-32	4.0-6.0	4.0-12.0	35-50
Hildebrand (2009)	30-40	5.0-15.0		35-55
Midale-Weyburn (Shand Report)				45
Loy Yang Power Station (2019 CCS workshop)				39
AVERAGE	33.46	3.16	7.36	39.74

CCS studies and Projects reviewed for cost estimate (above). Potential injection well sites (in red) (below).



(Modified from Wade J.A. 1991)

Results



* (Carbon Capture & Storage Association, McKinsey & Co 2008)

References

(Alcalde et al. 2004), (BCG 2008), (CCSa 2011), (CCSknowledge 2018), (CCS Workshop 2019), (Ferenc L. Toth 2011), (Hendriks et al. 2007), (Hildebrand 2009), (IEA 2008), (IPCC 2005), (Jansen et al. 2011), (McCoy & Rubin 2005), (McKinsey & Co 2008), (NSPower 2019), (Ploumen et al. 2007), (Poyry Energy Consulting 2007), (Shell UK ltd 2015), (Torp & Brown 2004) (Wade, J.A. 1991)