

Impact Modelling and Analysis of Ontario Cap and Trade Program



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navius
research

DILLON
CONSULTING

Dave Sawyer | dave@enviroeconomics.ca
Jotham Peters | jotham@naviusresearch.com
Seton Stiebert | seton@enviroeconomics.ca

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COMMENTS OR QUESTIONS TO MOECC: YVES.MELESS@ONTARIO.CA

Summary

Analysis, Modelling and Reference Case

The Macroeconomic Implications

- Proposed Cap and Trade Design, Scenarios
- Macroeconomic Impacts
- Household Impact
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Facility Analysis: Impacts on Large Final Emitters

Emission Intensive, Trade Exposed Leakage Risk Ratings

Summary of Impact Assessment to 2020

The proposed Cap and Trade Program would likely not have a significant impact on Ontario's GDP.

Our analysis indicates that the provincial GDP impact in 2020 would be equivalent to a drop in growth of 0.03%:

- Ontario's GDP is projected to grow by ~11% between 2015 and 2020 without cap and trade.
- With the proposed Program, the economy will be 10.97% larger in 2020 relative to 2015.

Alternative policy options for Ontario to achieve its targets are costly relative to the proposed Program.

Compared to the proposed Program, an Ontario alone option with no WCI allowance trade or a carbon tax would result in:

- GDP impacts that are 8 to 14 times more, with carbon prices 4 to 9 times higher.
- Net global emission reductions lower than the proposed Program given production leakage to other jurisdictions.

With the proposed Program, household costs could rise in the order of \$13 per month to fuel houses and cars.

- With alternative options, household costs could be 4 to 8 times higher.

Overall facility financial impacts are small, but impacts on individual facilities will vary.

- The proposed Program's impact on profits is always less than 10%, averaging 1.5%.
- Costs relative to sales are estimated on average to be 0.12%, with a maximum of 0.78%.

Description of Policy Alternatives Assessed

Reference Case Forecast to 2020 serves as the baseline from which the options are compared on a consistent and incremental basis.

1. **Proposed Program**, with program start 2017 and linked to Western Climate Initiative (WCI) commencing 2018. Caps and coverage consistent with proposed Draft Regulation. Assumed average of third party carbon prices. Mixed use of proceeds to incent low emitting technology, mitigate electricity price impacts.
2. **Cap and Trade, Ontario Alone (unlinked to WCI)**. Only difference is all abatement occurs in Ontario, carbon price determined to achieve the Cap.
3. **Carbon Tax or C&T full auction to achieve target, mixed use of proceeds**. Carbon tax rate set to achieve reductions equivalent to cap with mixed use of carbon tax proceeds.
4. **Carbon Tax or C&T full auction to achieve target, tax cuts**. Carbon tax rate set to achieve reductions equivalent to cap with use of carbon tax proceeds to reduce personal and corporate income taxes.

	Linked	GHGs = Cap	Coverage	Allowance Distribution	Carbon Price	Proceeds
Linked WCI	Yes	Yes	82%	Auction, Transitional	3 rd party avg.	Mixed use of proceeds
Ontario Alone	No			Tax or full auction on 82% of GHGs	ON Alone	
Carbon Tax or C&T Full Auction (Mixed)						Reduce corporate and personal income tax
Carbon Tax or C&T Full Auction (Tax cuts)						

Summary of Impacts Across Policy Alternatives in 2020

In 2020	C&T WCI linked, Proposed Program: Transitional Assistance, Mixed use of Proceeds	Ontario Alone C&T, Unlinked: Transitional Assistance, Mixed use of Proceeds	Ontario Alone, Carbon Tax or C&T Full Auction: Mixed use of Proceeds	Ontario Alone, Carbon Tax or C&T Full Auction: Tax Reductions
Policy Effectiveness				
GHG reductions (Mt)				
Ontario abatement and offsets, WCI imports, Ontario offsets or Action Plan reductions	18.7	18.7	18.7	18.7
Leakage (Mt)	-0.28	-1.75	-5.84	-6.03
Net GHG Reductions (Mt)	18.42	16.95	12.9	12.7
Policy Cost				
Carbon price (\$2016)	\$18	\$157	\$69	\$72
Impact on GDP growth (%)	-0.03%	-0.39%	-0.40%	-0.21%
Trade impact (%) (net exports)	-0.51%	-8.4%	-7.0%	-2.5%
Distribution				
Household energy (\$/month; \$2016)	\$13	\$107	\$48	\$50

Analysis, Modelling and Reference Case

Overview of Approach and Modelling

Scenario and options analysis used to reveal implications

- A computable general equilibrium model (GEEM) simulating the evolution of Ontario's economy.
- Economy-wide model to determine economic, energy and emission forecasts.

A reference case to 2020

- Calibrated,
 - ✓ 2015 energy prices, close to new NEB, 2016,
 - ✓ Historical GDP, Ministry of Finance GDP forecast to 2020,
 - ✓ National Inventory Report (GHGs) for 2012-2013,
 - ✓ Long-Term Energy Plan (2013) generation mix, baseline electricity prices, imports and GHGs.
- Forecast GDP, emissions, output, investment, trade, energy use and labour income.

Use CIMS model and engineering validation for technology explicit view of abatement potentials and costs

- A deeper view on technology opportunities and roadmaps,
- Marginal Abatement Cost Curves.

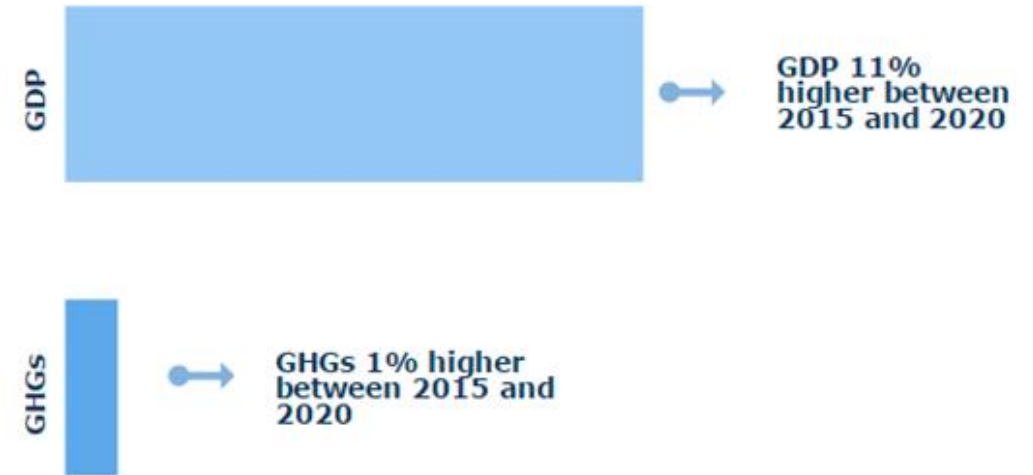
Reference Case: Change in Ontario's GHGs and GDP to 2020

GDP: Ministry of Finance forecasts ON's economy could grow at ~2% annually between 2015 & 2020.

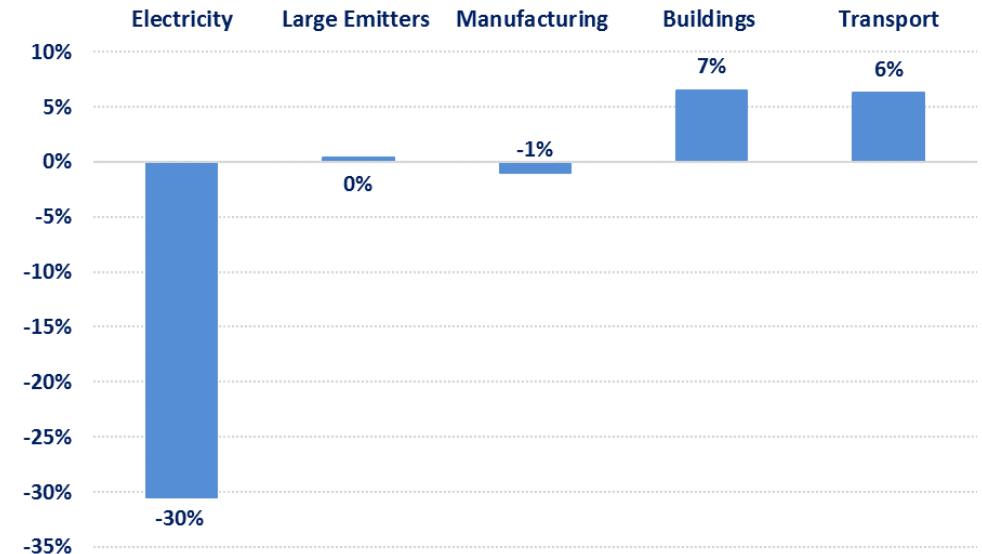
- ON's total economy ~11% larger in 2020 from 2015, absent proposed Program.

GHGs: Without new policy action, ON's GHGs could rise at an annual average rate of ~0.4% between 2015 and 2020,

- A rate significantly less than the rate of economic growth.



Change in GHGs by Sector, 2015 to 2020



Macroeconomics Implications: Proposed Cap and Trade Design, Scenarios

GHG Emission Forecast and Proposed Cap

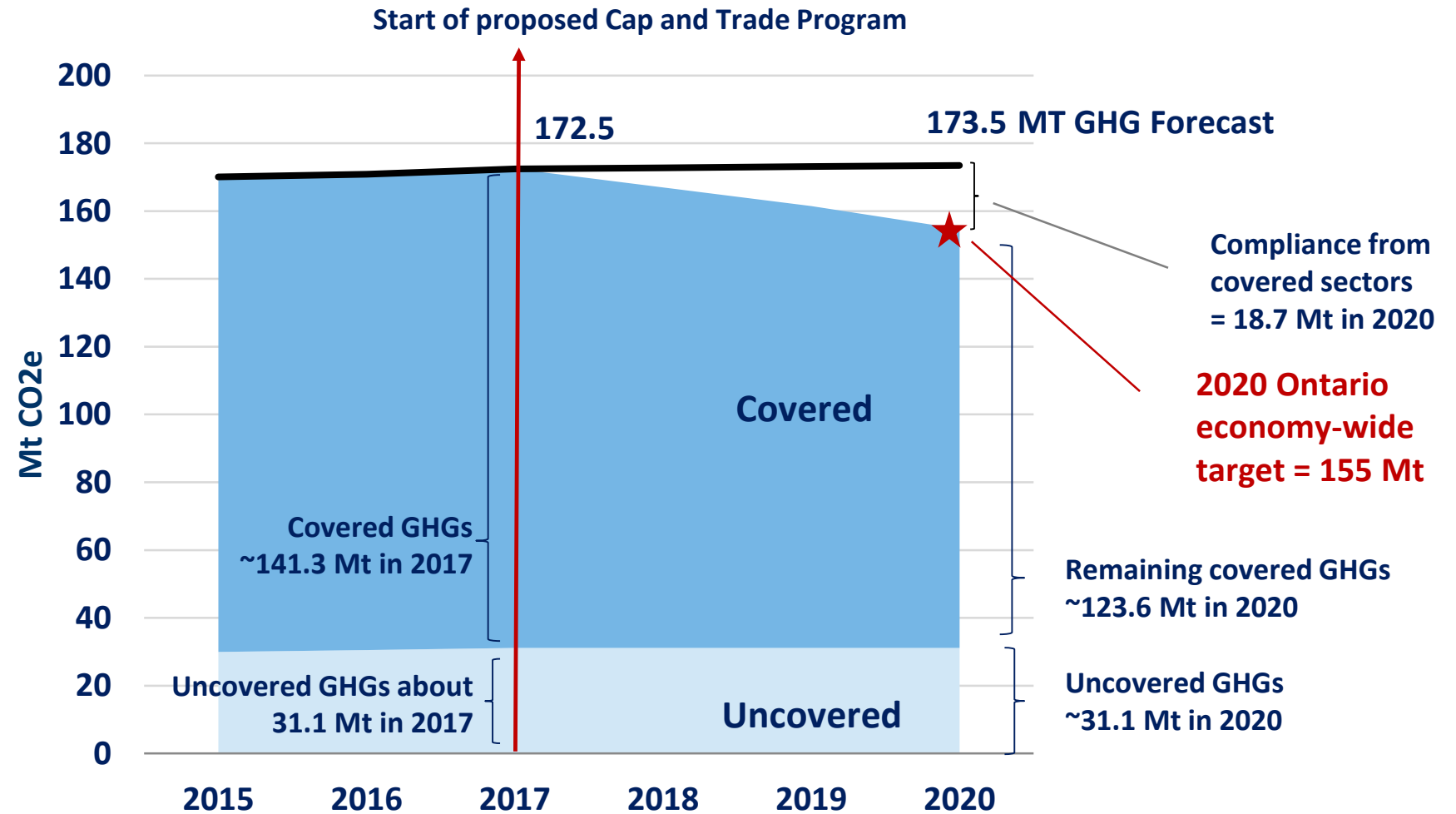
Program start, 2017.

Four year compliance period to 2020.

Cap declines from 141.3 Mt in 2017 to 123.6 Mt in 2020.

- Note, this does not include electricity imports of ~1 Mt.

Large emitters with transitional allowances have cap decline of 4.57% on combustion GHGs.

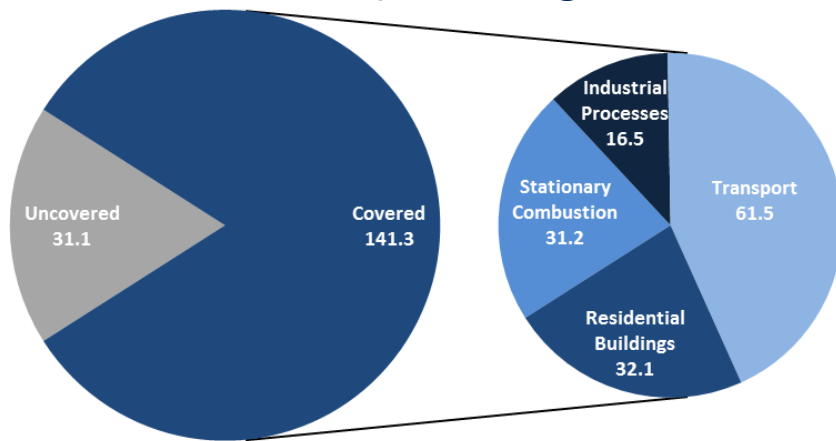


Coverage of Proposed Program

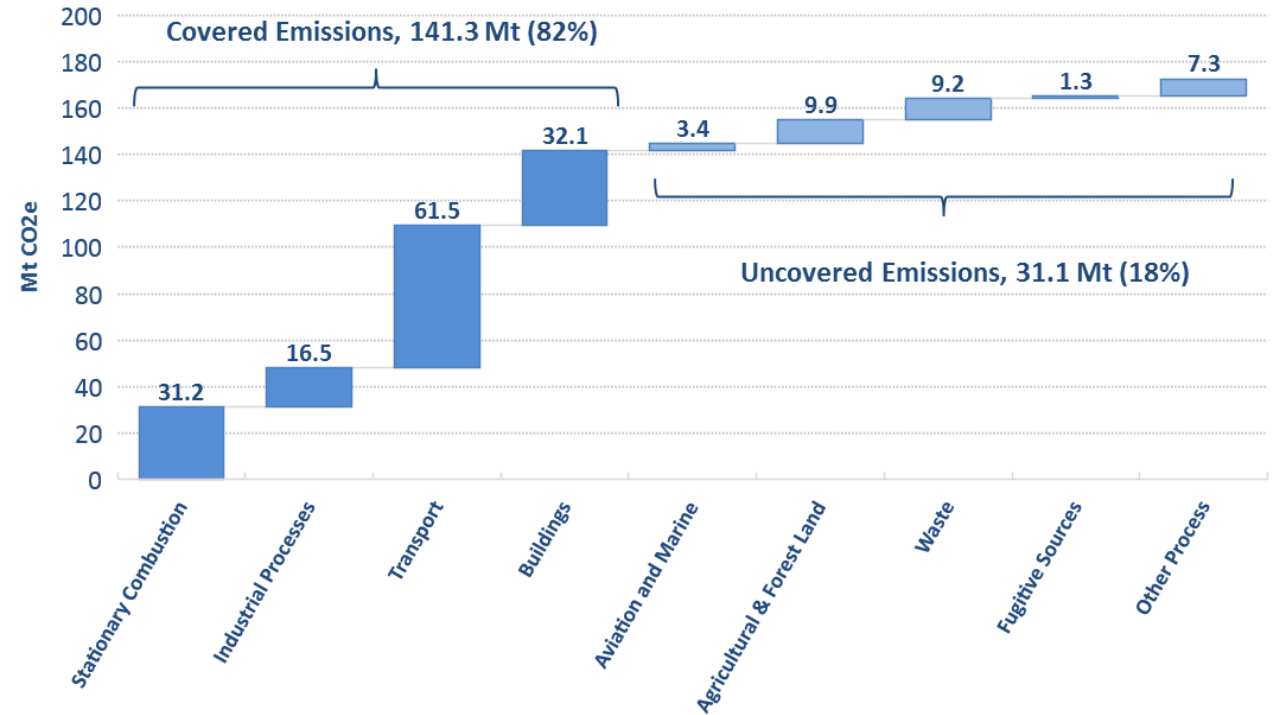
Covers 82% of baseline emissions through 2020,

- Stationary combustion,
- Industrial processes,
- Transport,
- Buildings.

2017 Forecast (NIR Categories)



Coverage: 2017 Forecast (NIR Categories)



Note: The categories are aligned with Canada's 2015 National Inventory Report Greenhouse Gas Emissions. Electricity and commercial buildings are included in stationary combustion.

Meeting the Cap in 2020

In our analysis, allowances equal to the cap are distributed through,

- Auctioning, 91.8 Mt
- Transitional allowances, 25.6 Mt

For large emitters >25Kt: transitional assistance and to mitigate the risk of emissions leakage (emissions fall in ON through output lost, rise elsewhere due to misaligned carbon prices).

Strategic Reserve 6.2 Mt, 5% of the cap, aligned with Quebec and California

Compliance,

- ON abatement 2.8 Mt.
- 16 Mt from ON Offsets, WCI Imports or Action Plan reductions

Allowance Price: Average of Third-party forecasts*

	2017	2018	2019	2020
Nominal (~2% inflation)	\$18.09	\$18.10	\$18.82	\$19.86
Real \$2016	\$17.74	\$17.40	\$17.73	\$18.33

*Assumes Ontario does not substantially impact the WCI allowance price



Macroeconomic Impacts

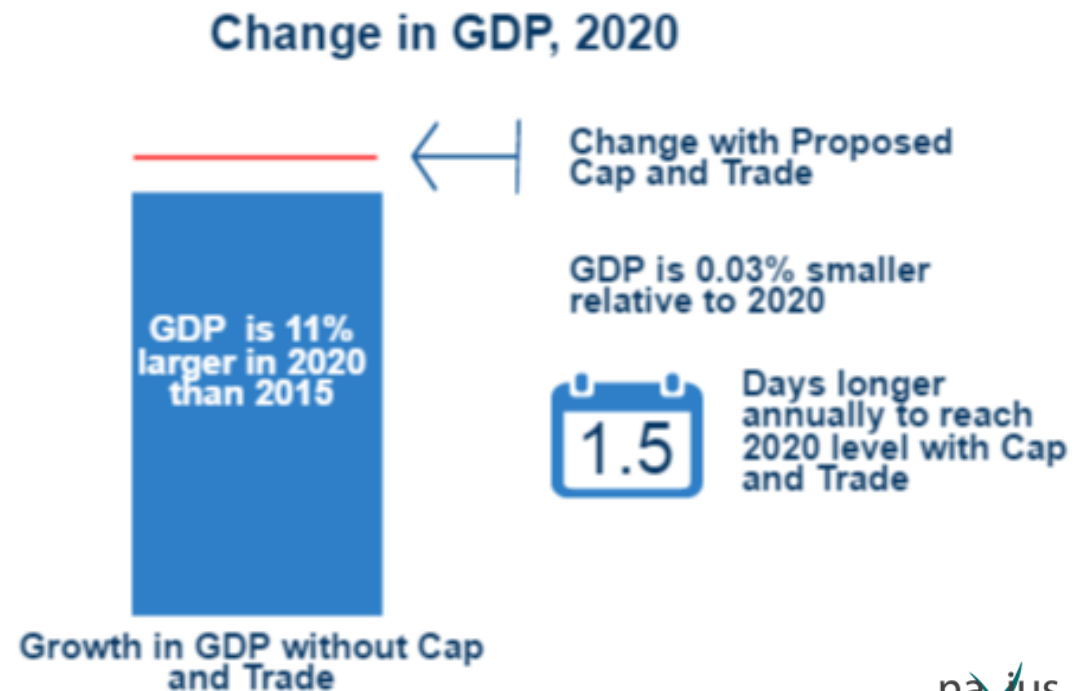
Overall Impact on Ontario's Economy Measured by GDP

Small negative change in GDP with proposed Program.

- Total GDP ~0.03% lower in 2020 relative to the economic forecast without the cap and trade program.

To put this into context,

- Ontario's GDP is projected to grow by ~**11%** between 2015 and 2020 without cap and trade.
- With the proposed program, the economy will be **10.97%** larger in 2020 relative to 2015.
 - 0.03% smaller than without cap and trade.
- Conceptually, the economy will reach the same level 1.5 days later in each year with cap and trade or 6 days cumulatively by 2020.
- Targeted and balanced approach to investing proceeds can mitigate risk of carbon leakage, economic impacts.



Impact on Ontario's Trade, Leakage Risk

Imports remain virtually unchanged.

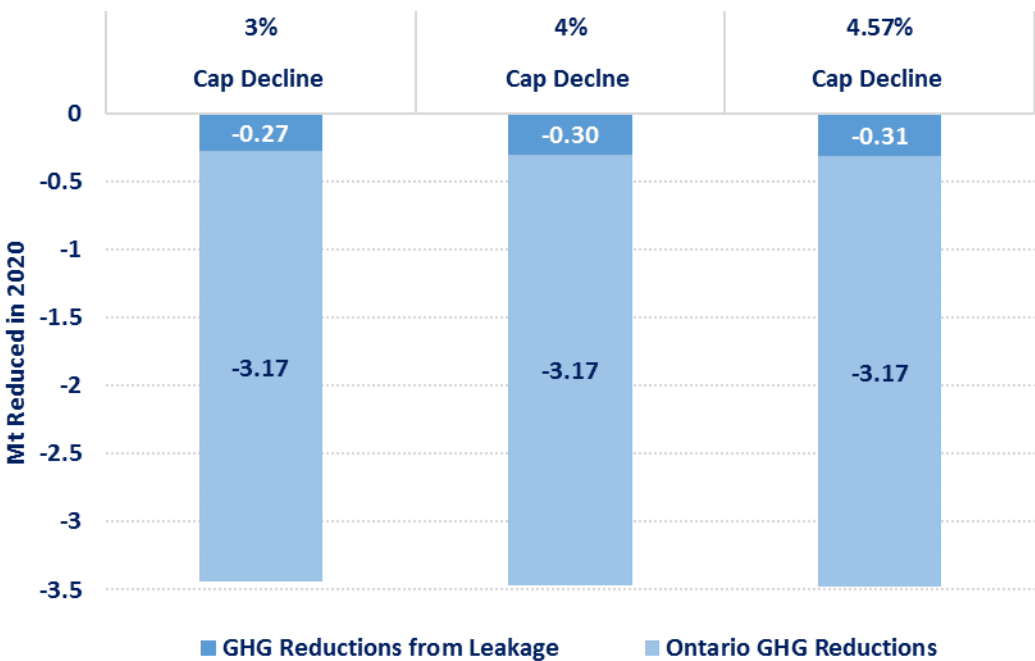
Exports fall by a small margin.

Individual entities may experience more or less impact.



Leakage Risk Sensitivity (Production leakage, represented by emissions)

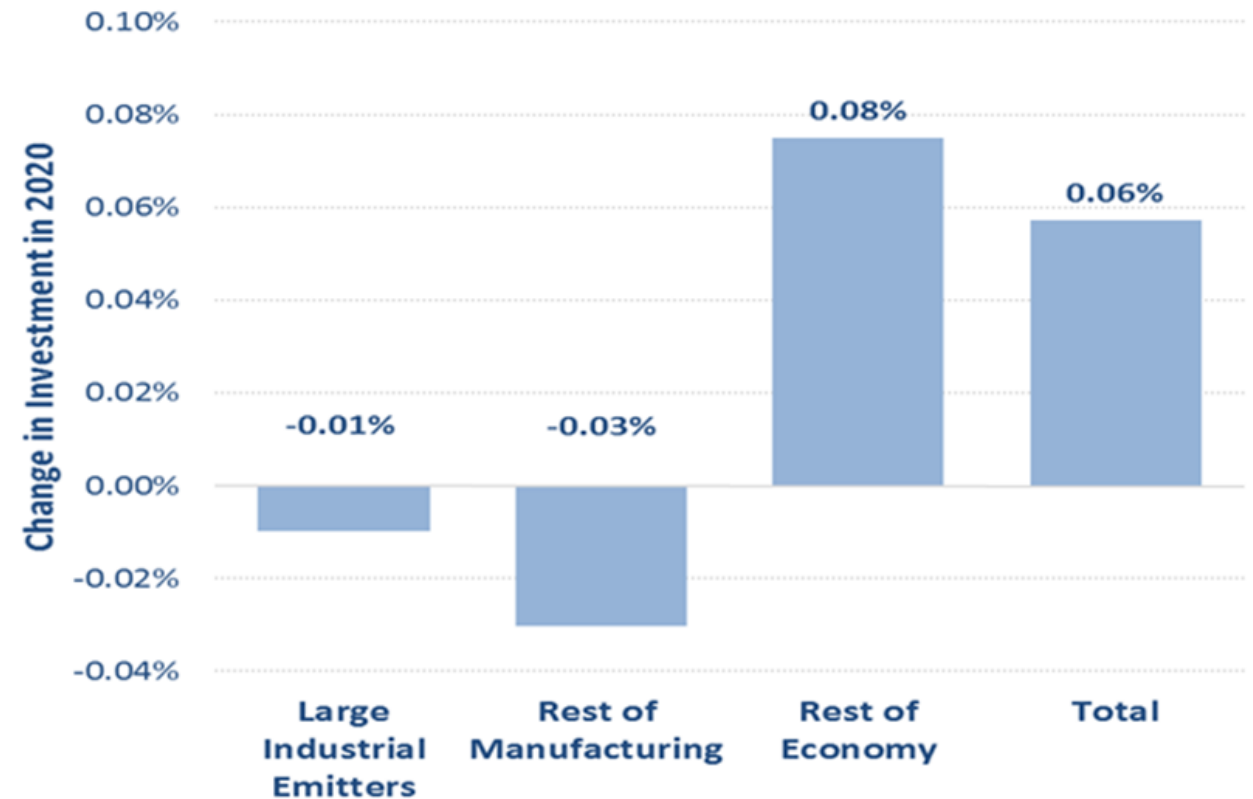
Cap decline factor has small impact on the risk of leakage.



Impact on Investment (% Change in 2020)

Changes in investment are driven by,

1. Small decrease in returns on investment as carbon costs rise and some sectors may experience falling investment.
2. Impact is offset somewhat as investment realigns towards low emitting, lower carbon cost sectors such as services.
3. Auction proceeds to energy saving and low emitting GHG technologies trigger investments,
 - Technologies are capital intensive, leading to a surge in investment in the sectors which have abatement potential.



Household Impacts

Household Impacts

- Households will experience some cost increases related to carbon pricing.
- The average energy costs to households for building energy and transport could rise in the order \$13 per month in 2017.
- Investing proceeds will mitigate these impacts.



Policy Alternatives Analysis

Description of Approach

Used GEEM baseline to estimate future GHG trajectory to 2020.

Add in each policy to assess outcomes:

1. **Environmental Effectiveness.** Attainment of emissions cap aligned with 2020 target, including total GHGs reduced in Ontario and outside Ontario. Also assess possible GHG leakage via production lost.
2. **Economic Efficiency.** Carbon price, GDP and trade.
3. **Distribution.** Household energy cost impacts.

Environmental Effectiveness

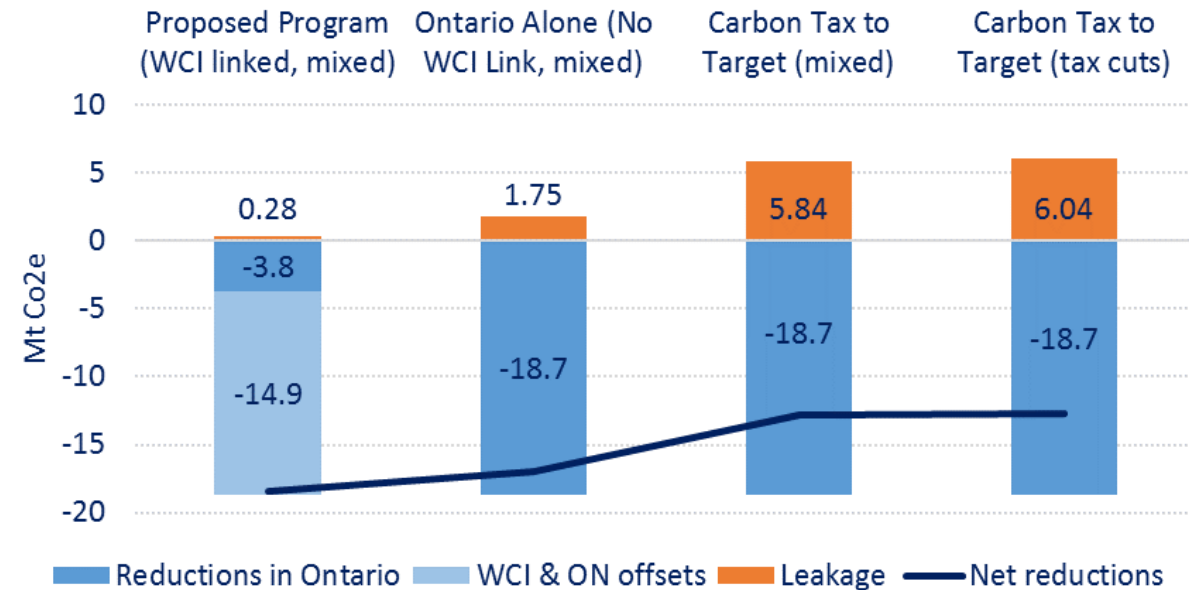
Ontario's 2020 target met by all scenarios.

Total GHG reductions, net of leakage, reductions are highest in Proposed Program.

- Leakage highest in both carbon tax scenarios.
- Net global GHG reductions lowest in both carbon tax scenarios.

Ontario GHG reductions highest in Ontario Alone and both carbon tax scenarios.

Change in GHGs 2020



Economic Efficiency: GDP

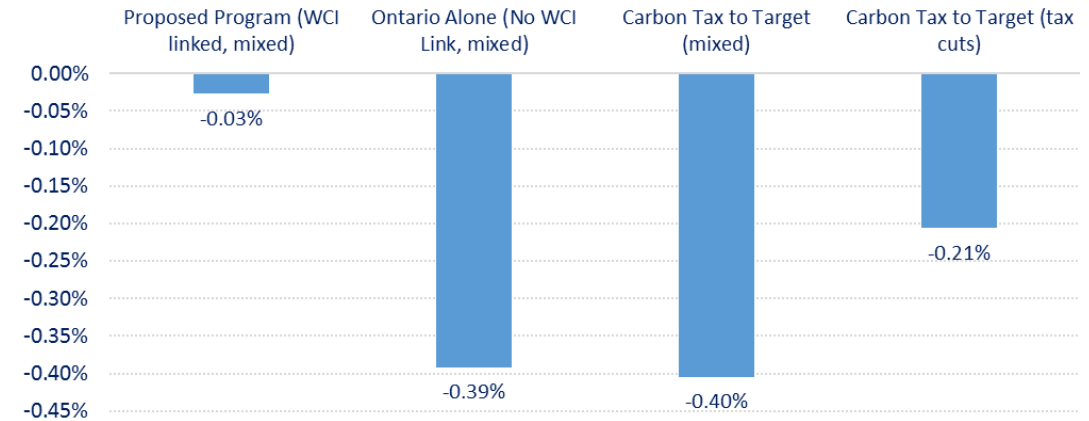
Lowest GDP impact with Proposed Program

- GDP impact in Ontario alone and Carbon Tax, mixed scenarios is 14x larger than Proposed Program.
- Carbon tax, tax cuts GDP impact is 7.5x more.

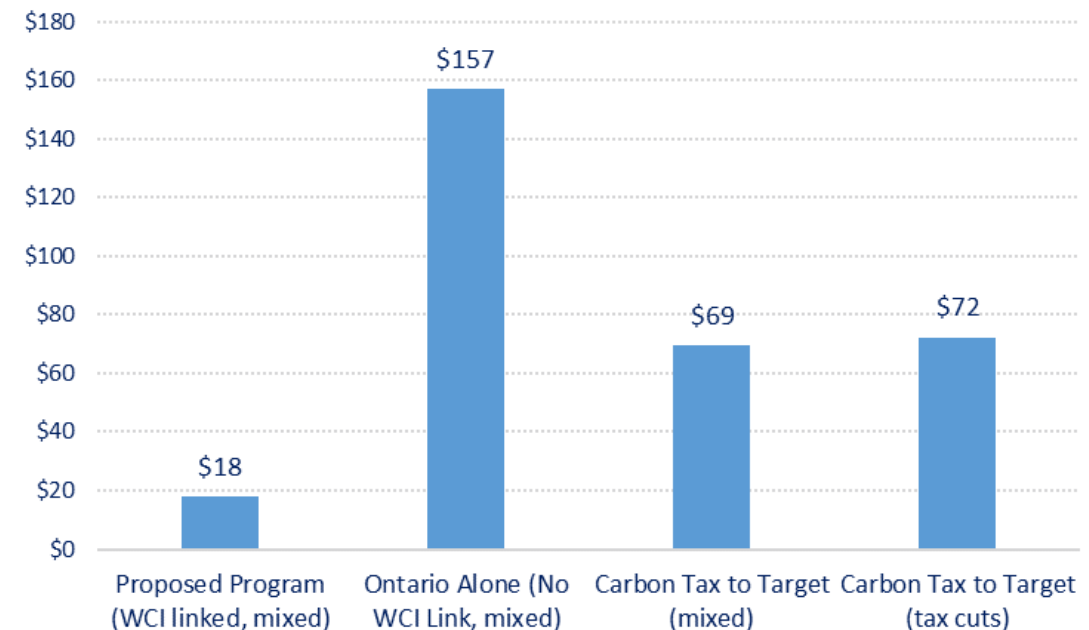
Carbon price. Ontario Alone carbon price is \$157 per tonne, or ~9x larger than third party average price of \$18 (\$2016 real; \$19.86 nominal).

- Carbon tax to achieve target prices are \$69 for mixed use of proceeds and \$72 for tax reduction scenario (~4x Proposed Program scenario)
- Lower carbon price relative to Ontario Alone scenario is a direct function of leakage, where more abatement comes from lost output. There is no free allocations for EITE and the carbon tax on all emissions drives down output and hence GHGs.

Change in GDP Growth, 2020



Carbon Price, 2020 (real \$2016)

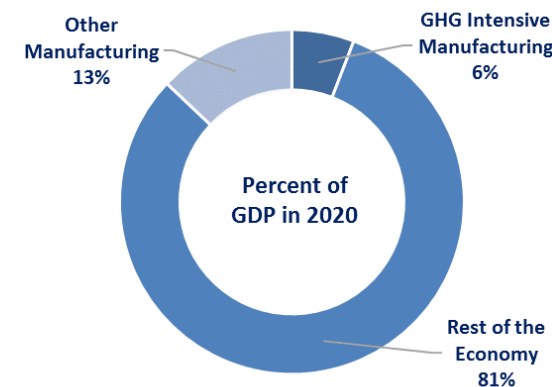
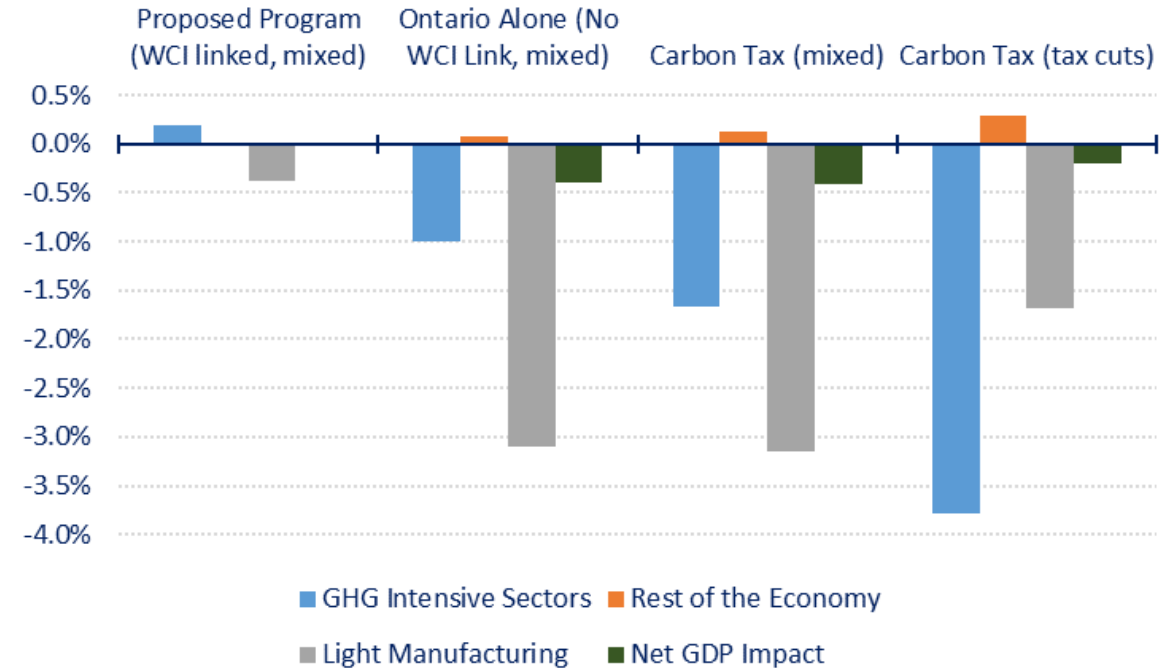


Economic Efficiency: GDP by Sector

GDP by GHG intensive manufacturing, light manufacturing and rest of economy:

- Transitional allowances help GHG intensive in the cap and trade scenarios relative to carbon tax scenarios.
 - Also help some light manufacturing.
- “Mixed” use of proceeds to abatement technology mutes income impact on GHG intensive sectors.
- Tax cuts benefit light manufacturing > mixed use of proceeds given relatively less abatement uptake (and efficiency gains from tax shifting).
- Rest of the economy benefits in all scenarios as economy realigns towards low emitting goods and services.

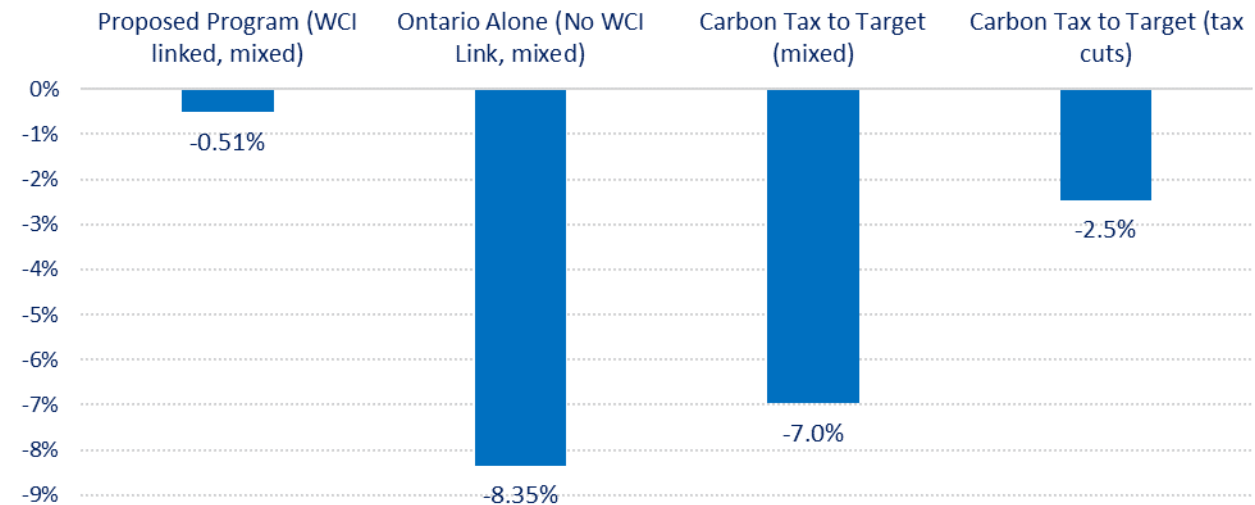
Sectoral Change in GDP 2020 (% change)



Economic Efficiency: Net Exports

- Trade impact is smallest with Proposed Program.
- High carbon price in Ontario Alone scenario results in largest impact to trade. Somewhat distributed across economy.
- Both carbon tax scenarios have more leakage primarily due to acute cost impacts on EITE sectors.

Change in Net Exports, 2020



Facility Analysis: Impacts on Large Final Emitters

Facility Analysis: Approach

Assess fully loaded carbon costs against forecasts of firm profit and sales

- Facility level forecasts to 2020 for revenue, profit, operating costs, energy use and GHGs,
 - 86 profiles developed for large industrial, non-electricity generating facilities,
 - MOECC reported GHG data complemented with financial information from macroeconomic modeling (Phase 1 modeling), Statistics Canada and annual reports of publically traded companies,
 - 45 facilities engaged, with firms choosing which data and information to validate,
 - We accepted information provided and updated the analysis.

Allocation formula and proposed benchmarks used:

- An **assistance factor** of 100% from January 1, 2017 to December 31, 2020,
- A **base allocation** for the facility based on production, energy use, or historical emissions,
- A **cap adjustment factor** declining on average 4.57% per year for combustion emissions and not declining for process emissions until at least 2020 (Table 5 in Regulation).

Facility Analysis: Results

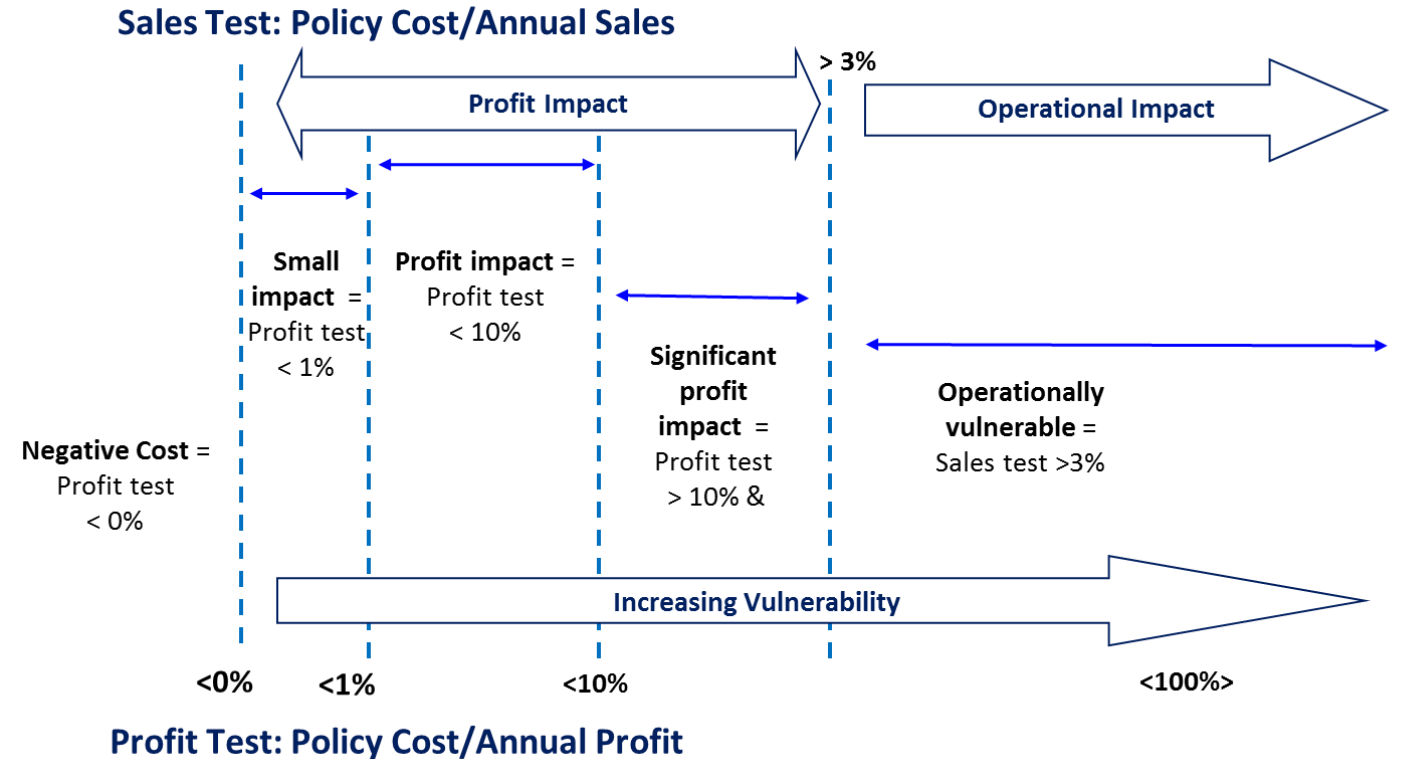
All **direct compliance costs and indirect supply chain carbon costs** for the facilities, including:

- **Allowance costs, net of any abatement** and driven primarily by the carbon price, the allocation method, the cap decline factor and forecast emissions,
- **Abatement costs made to avoid allowance purchases** when the costs of abatement are cheaper than the allowance price,
- **Electricity and transportation fuel costs** not covered by the allocation that are purchased directly by the facilities and that can be expected to rise as the carbon price works its way through the economy,
- **Intermediate inputs or supply chain costs** that can be expected to increase as the carbon price works its way through the economy.

Facility Analysis: Results

US EPA regulatory analysis and MOECC's *Guideline for the Implementation of Air Standards* (GIASO) use profit and sales tests to define a continuum of financial impact:

- **Negative cost impact** implies the allocation scheme overcompensates some facilities or they profit from allowance sales,
- **Small profit impact** if the estimated regulatory cost as a share of profits is $<1\%$,
- **Profit Impact** if the estimated regulatory cost as a share of profit is $>1\%$ and $<10\%$,
- **Significant profit impact** if the estimated regulatory cost as a share of profit is $>10\%$,
- **Operational impact (threat of closure)** if sales test $>3\%$.



Facility Analysis: Results

Overall facility profit impacts are small, but impacts on individual facilities will vary:

- The proposed program’s impact on profits would be less than 10%, averaging 1.5%,
- Some **facilities are better off due to allowance sales and allocations**,
- Transitional allocations significantly mitigate potential income impacts.

Operational impacts are unlikely, with profit impacts greater than 10%:

- Compliance costs as a share of sales always less than 1%,
- A low probability of an operational impact.

Range of Impact on Facilities 4.57% Cap Decline on Combustion in 2020			
	Better Off (Profit increase)	Average Impact	Worse Off (Profit Decrease)
Profit Test	-35.34%	1.46%	9.78%
Sales Test	-0.72%	0.12%	0.78%

Emission Intensive, Trade Exposed Leakage Risk Ratings

Results developed and calculated by MOECC with EnviroEconomics Support

EITE Test and Data

- Leakage risk assistance is one factor in transitional assistance, alongside industry/facility eligibility, industry emission benchmark(s), cap decline factor and allowance availability.
- Ranking of leakage recognizes varying abilities to pass on carbon costs.

Formula for Ontario EITE calculation developed by MOECC

Leakage Risk	Emission Intensity (EI)	Trade Exposure (TE)
High	$\frac{\text{Emissions (t CO}_2\text{e)}}{\text{Value added (million \$)}} \geq 1000$	$\frac{\text{Value of exports + imports}}{\text{Value of domestic shipments + imports}} \geq 10\%$
Medium	$\frac{\text{Emissions (t CO}_2\text{e)}}{\text{Value added (million \$)}} < 1000$	Same as for high ($\geq 10\%$)
Low/Non-EITE	Same as for medium (< 1000)	$\frac{\text{Value of exports + imports}}{\text{Value of domestic shipments + imports}} < 10\%$

Data Sources for EITE Calculation for Ontario Facilities

Key Statistics	Data Source	Range/Period coverage
GHG Emissions	MOECC (Ontario's greenhouse Gas emissions regulation), Environment Canada, Greenhouse gas emissions reporting program (GHGRP).	2005-2013
Shipments	Statistics Canada, CANSIM 301-0006, Revenue from goods manufactured (or if available Shipments (CANSIM 304-0015))	2005-2012
Value Added	Statistics Canada, CANSIM 301-0006, Value Added	2005-2012
Exports and Imports	Industry Canada, Trade Data Online	2005-2014

Ontario EITE Leakage Risk Ranking, High

NAICS code	NAICS Sector definition	Leakage Risk Ranking
2111	Oil and gas extraction	High
3241	Petroleum and coal product manufacturing	High
3251	Basic chemical manufacturing	High
3253	Pesticide, fertilizer and other agricultural chemical manufacturing	High
3273	Cement and concrete product manufacturing	High
3274	Lime and gypsum product manufacturing	High
3311	Iron and steel mills and ferro-alloy manufacturing	High
32211	Pulp mills	High
32213	Paperboard mills	High
32411	Petroleum refineries	High
32419	Other petroleum and coal product manufacturing	High
32511	Petrochemical manufacturing	High
32512	Industrial gas manufacturing	High
32518	Other basic inorganic chemical manufacturing	High
32519	Other basic organic chemical manufacturing	High
32531	Fertilizer manufacturing	High
32731	Cement manufacturing	High
33111	Iron and steel mills and ferro-alloy manufacturing	High

Ontario EITE Leakage Risk Ranking, Medium

NAICS code	NAICS Sector definition	Leakage Risk Ranking
2122	Metal ore mining	Medium
3112	Grain and oilseed milling	Medium
3113	Sugar and confectionery product manufacturing	Medium
3114	Fruit and vegetable preserving and specialty food manufacturing	Medium
3212	Veneer, plywood and engineered wood product manufacturing	Medium
3221	Pulp, paper and paperboard mills	Medium
3252	Resin, synthetic rubber, and artificial and synthetic fibres and filaments manufacturing	Medium
3254	Pharmaceutical and medicine manufacturing	Medium
3271	Clay product and refractory manufacturing	Medium
3272	Glass and glass product manufacturing	Medium
3279	Other non-metallic mineral product manufacturing	Medium
3312	Steel product manufacturing from purchased steel	Medium
3314	Non-ferrous metal (except aluminum) production and processing	Medium
3315	Foundries	Medium
3361	Motor vehicle manufacturing	Medium
3372	Office furniture (including fixtures) manufacturing	Medium
3399	Other miscellaneous manufacturing	Medium

Ontario EITE Leakage Risk Ranking, Medium

NAICS code	NAICS Sector definition	Leakage Risk Ranking
21222	Gold and silver ore mining	Medium
31122	Starch and vegetable fat and oil manufacturing	Medium
31142	Fruit and vegetable canning, pickling and drying	Medium
31214	Distilleries	Medium
32121	Veneer, plywood and engineered wood product manufacturing	Medium
32212	Paper mills	Medium
32521	Resin and synthetic rubber manufacturing	Medium
32522	Artificial and synthetic fibres and filaments manufacturing	Medium
32541	Pharmaceutical and medicine manufacturing	Medium
32712	Clay building material and refractory manufacturing	Medium
32721	Glass and glass product manufacturing	Medium
32799	All other non-metallic mineral product manufacturing	Medium
33121	Iron and steel pipes and tubes manufacturing from purchased steel	Medium
33141	Non-ferrous metal (except aluminum) smelting and refining	Medium
33152	Non-ferrous metal foundries	Medium
33611	Automobile and light-duty motor vehicle manufacturing	Medium
33721	Office furniture (including fixtures) manufacturing	Medium
33999	All other miscellaneous manufacturing	Medium

Thank you
Questions or comments?