



# Low Carbon Industrial Strategy:

## GHG Benchmarking and Competitiveness Assessment of BC Industrial Sectors

### SECTOR RESULTS

August 2019

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## BACKGROUND AND STUDY PURPOSE

The Low Carbon Industrial Strategy is a joint initiative between the Province of British Columbia (“BC”) and the Business Council of BC to work collaboratively to unlock BC’s full economic potential, to transition to a low carbon economy, and to establish BC as a world leader in supplying low carbon goods and services to a world with a growing demand for low carbon solutions.

MNP LLP (“MNP”) and le-ef.com Consulting were engaged to support the development of a Low Carbon Industrial Strategy by providing technical support with respect to:

- Benchmarking the GHG intensity of commodities produced by select BC industries (e.g. coal, copper, lumber, pulp, natural gas, LNG and aluminum) against those produced in competing jurisdictions (or world averages if available).
- Assessing whether BC contributes to global emission reductions by providing lower carbon intensive products.
- Assessing the extent to which select BC industries face a competitiveness gap relative to competing jurisdictions and in light of recent policy changes.

## Study Limitations and Restrictions

Please note that the analysis in this report was based on a modelled investment, operation or facility within each sector and actual results across individual entities may differ. The findings should be viewed as directional in nature.

Please note that because tax rules can change regularly due to modifications in tax policy, the government payments produced by the competitiveness models in BC and competing jurisdictions are estimates only and subject to change. They should be viewed as approximate in nature.

The underlying data relied on for the study should be treated as confidential and should not be shared without the original owner's prior written consent.

Furthermore, it is our understanding that the Province is currently working with the Council of Forest Industries to undertake a more detailed supplemental analysis on the lumber sector that will be complete in Fall 2019. This analysis is expected to provide more definitive information to inform policy making. Additional work between the Province and the LNG Alliance is also being undertaken for the LNG sector that will further inform policy work.

## SUMMARY OF RESULTS

## SUMMARY OF GHG MODELLING RESULTS

Based on a product-on-product GHG emissions comparison, BC industries modelled showed an advantage of approximately **12 to 18 million tonnes of CO<sub>2</sub>e per year** in GHG emissions relative to competing jurisdictions by selling lower carbon intensive products.

### Estimated GHG Advantage Provided by BC Products (tonnes CO<sub>2</sub>e per year)

	COAL	COPPER	LNG	NATURAL GAS	LUMBER	PULP	ALUMINUM
BC Emissions <sup>1</sup>	3,300,000	476,000	3,800,000	Low volume: 7,500,000 to 8,800,000 High volume: 9,100,000 to 11,900,000	1,357,000	1,254,000	990,000
Average of Competing Jurisdictions <sup>2</sup>	6,700,000	614,000 to 1,156,000 <sup>3</sup>	7,400,000	Low volume: 10,700,000 High volume: 15,400,000	1,894,000	531,000	4,800,000 to 5,600,000 <sup>4</sup>
<b>Estimated GHG Advantage</b>	<b>3,400,000</b>	<b>138,000 to 680,000</b>	<b>3,600,000</b>	<b>1,900,000 to 6,300,000<sup>5</sup></b>	<b>537,000</b>	<b>(723,000)</b>	<b>3,800,000 to 4,600,000</b>

<sup>1</sup> Lifecycle GHG emissions intensity of BC facilities multiplied by BC production volume.

<sup>2</sup> Average lifecycle GHG intensity of key competing jurisdictions multiplied by BC production volume.

<sup>3</sup> Based on average emissions data from ICMM study (Scope 1 and Scope 2 only).

<sup>4</sup> Range based on comparison with Russia and Middle East (key competing jurisdictions in U.S. market) versus China (largest producer of aluminum).

<sup>5</sup> Range based on a set of scenarios that vary according to natural gas production volumes and electrification of BC facilities by 2022.

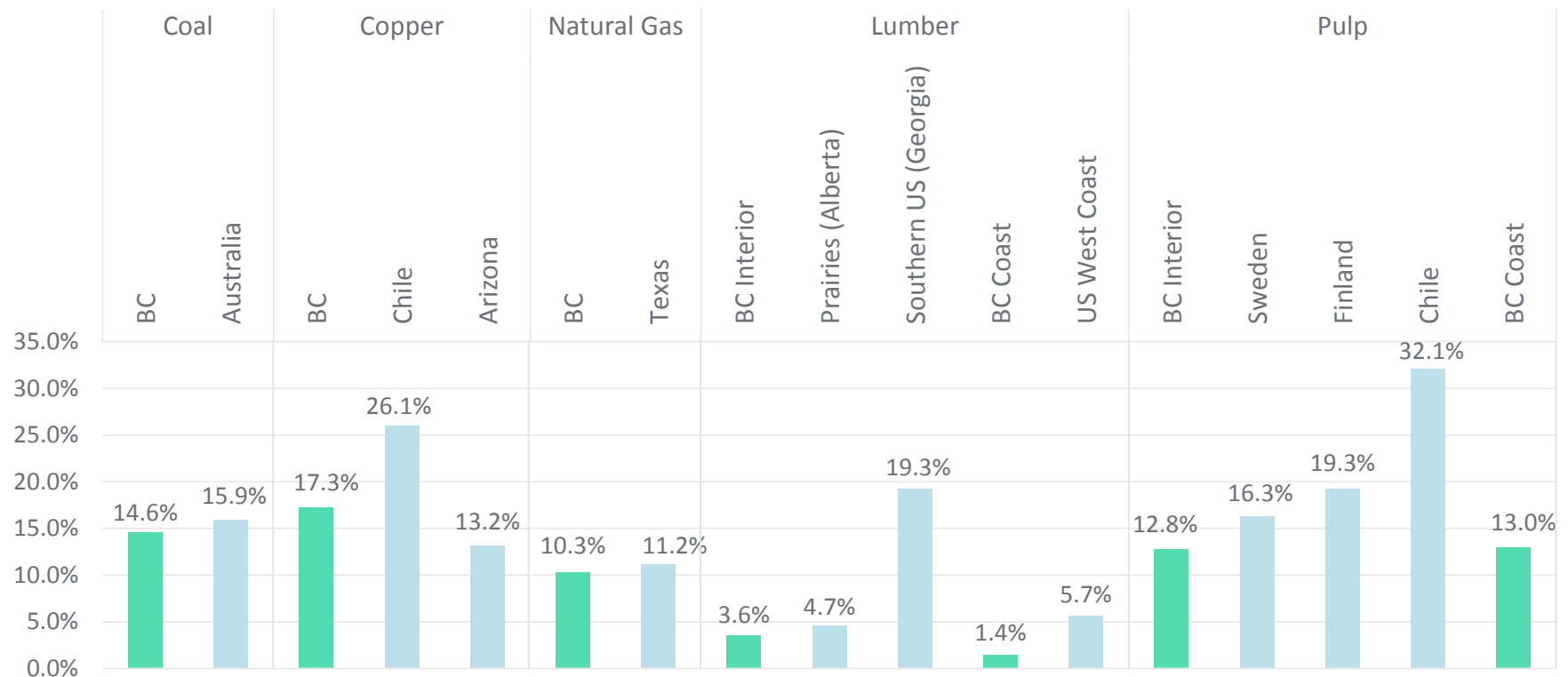
## Qualitative Factors that Result in GHG Advantage or Disadvantage for BC relative to Competing Jurisdictions

	Advantage to BC	Disadvantage to BC
Low emitting electricity	Metallurgical coal, Copper, LNG, Natural gas, Lumber, Pulp, Aluminum	
Provincial climate policies	Metallurgical coal, Copper, LNG, Natural gas, Lumber, Pulp, Aluminum	
Renewable fuel requirements for mobile equipment	Metallurgical coal, Copper, LNG, Natural gas, Pulp, Aluminum	
Resource quality (low CO <sub>2</sub> , low methane, ore quality)	Metallurgical coal, LNG, Natural gas	Copper
Energy for cooling reduced because of colder climate	LNG, Natural gas	
World class/world scale facilities	LNG, Aluminum	Copper, Pulp
Abundant fresh water	Copper	
Upstream and downstream transportation distances	Copper	Coal, Natural gas, Lumber, Aluminum
Biomass used for energy		Pulp, Lumber

## SUMMARY OF COMPETITIVENESS RESULTS: EXISTING OPERATIONS

### Profit Margin Comparison with Competing Jurisdictions Before Policy Changes

- The base case assessment (prior to any policy changes) showed that BC generally has competitiveness challenges relative to competing jurisdictions based on a comparison of costs/profit margins.

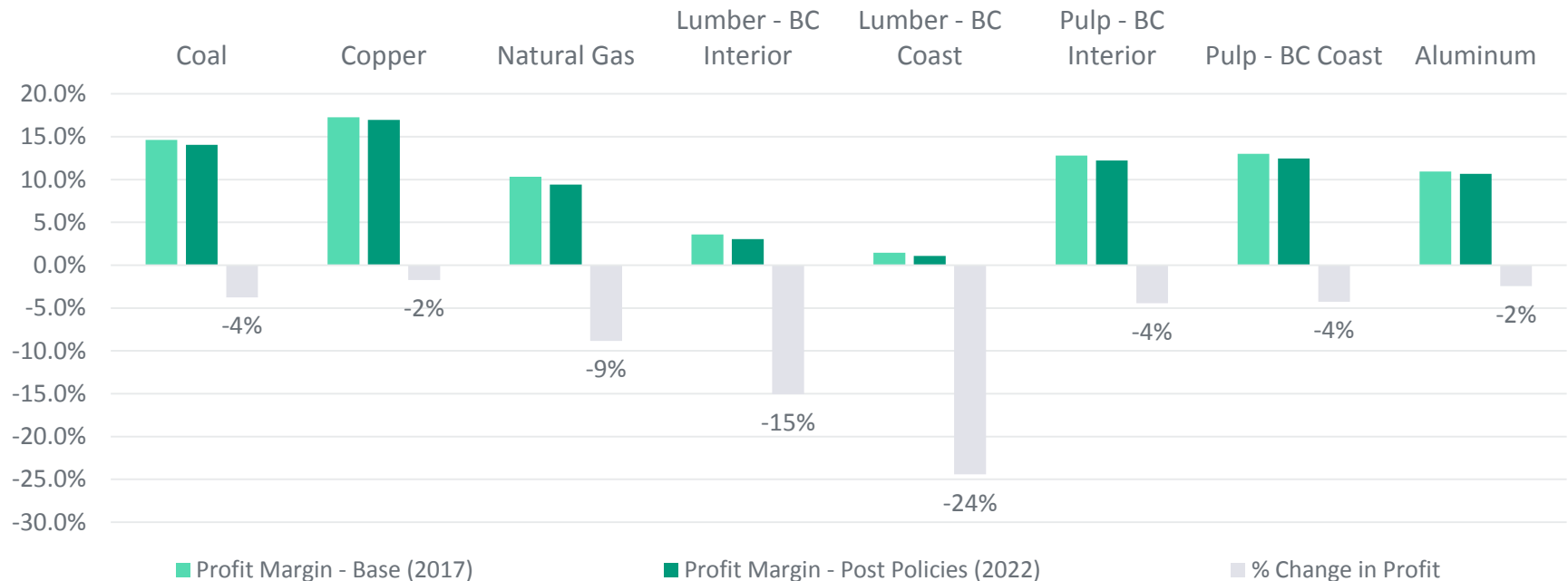




## SUMMARY OF COMPETITIVENESS RESULTS: EXISTING OPERATIONS

### BC Profit Margin Comparison Before and After Policy Changes

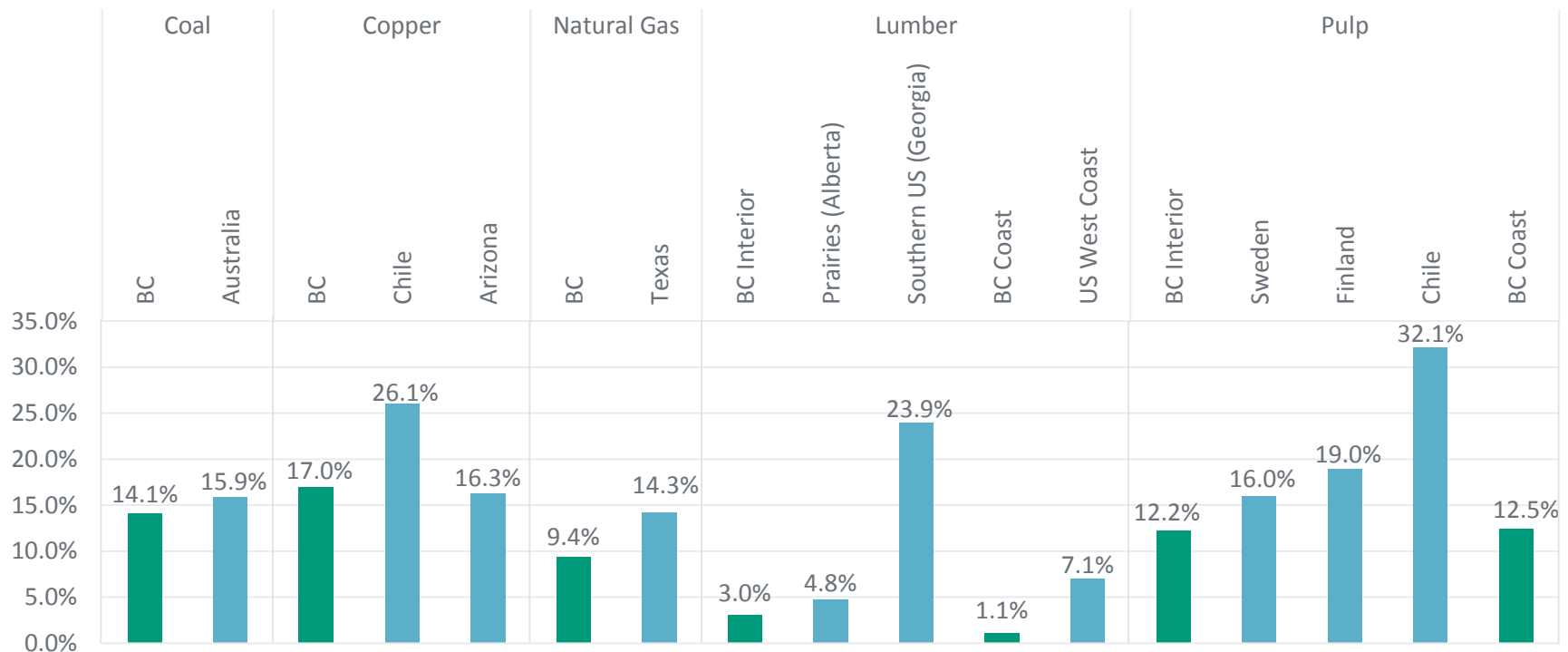
- Incremental policy changes modelled (including a net \$10/tonne increase in the carbon tax, incremental targets for the low carbon fuel standard, introduction of the employer health tax, an increase in the corporate income tax, removal of PST on electricity and methane regulations for upstream gas) resulted in a deterioration of competitiveness through a reduction in profit of between 2% to 24% across sectors.



## SUMMARY OF COMPETITIVENESS RESULTS: EXISTING OPERATIONS

### Profit Margin Comparison with Competing Jurisdictions Post Policy Changes

- While the policy changes modelled led to reduced profit margins in BC, policy changes in key competing jurisdictions (including reductions in the corporate income tax rate in the US and Alberta) resulted in an improvement in profit margins for many of BC's competing jurisdictions.



## SUMMARY OF COMPETITIVENESS RESULTS: EXISTING OPERATIONS

### Profit Margin Comparison: BC versus Competing Jurisdictions

- While BC is at a competitive disadvantage on the basis of profit margins prior to policy changes, this disadvantage increases once policy changes are considered.
- With one exception, profit margins in BC were estimated to be 12% to 87% lower than those in key competing jurisdictions post policy changes.

Sector	Jurisdiction	Percentage Differential of BC Profit Margin relative to Competing Jurisdiction – Post Policy Changes
Coal	BC vs Australia	-11%
Copper	BC vs Chile	-35%
	BC vs Arizona	+4%
Natural Gas	BC vs Texas	-34%
Lumber	BC Interior vs Prairies (Alberta)	-37%
	BC Interior vs Southern US (Georgia)	-87%
	BC Coast vs US West Coast (Oregon)	-85%
Pulp	BC vs Sweden	-24%
	BC vs Finland	-36%
	BC vs Chile	-62%

## SUMMARY OF COMPETITIVENESS RESULTS: EXISTING OPERATIONS

### Trends in Competing Jurisdictions

- While the policy changes modelled in BC resulted in lower profit margins, the modelled policy changes in most competing jurisdictions have either improved profit margins or stayed the same.

Trend in Competing Jurisdictions (Change in Profit Margin)		
Coal	Australia	→
Copper	Arizona	↑
	Chile	→
Lumber – BC Interior	Prairies (Alberta)	↑
	US South	↑
Lumber – BC Coast	US Pacific Northwest (Oregon)	↑
Pulp – BC Interior	Finland	↓
	Sweden	↓
	Chile	→
Natural Gas	US (Texas)	↑

Legend:	
→	No change
↑	Increase
↓	Decrease

## **SUMMARY OF COMPETITIVENESS RESULTS: NEW INVESTMENT**

- In addition to the policy changes modelled for existing operations, the new investment analysis considered the introduction of the accelerated capital cost allowances announced in the federal Fall 2018 economic update, as well as the renewable natural gas targets to 2030 announced as part of CleanBC.
- The scope of the analysis was limited in that it did not include comparisons with available investment opportunities in other jurisdictions. That is, the analysis simply assessed the relative impact of recent BC and federal policy changes on investment decisions, but did not assess BC's competitiveness position in attracting new investment prior to the policy changes.

## SUMMARY OF COMPETITIVENESS RESULTS: NEW INVESTMENT

### Internal Rate of Return (IRR) Analysis

- For new investment, modelling results indicate that the accelerated capital cost allowances may partially or fully offset the impact of recent policy changes in BC for metallurgical coal, copper and natural gas.

	BC – Base (2017)	Incremental Climate Policy <sup>1</sup>	Provincial Tax Changes <sup>2</sup>	Accelerated Capital Cost Allowance <sup>3</sup>	BC – Post Policies (2022)
Coal	23.1%	-0.5%	-0.3%	+0.4%	22.7%
Copper	12.5%	-0.2%	0.0%	+0.2%	12.5%
Natural Gas	15.0%	-0.7%	-0.6%	+1.8%	15.5%

<sup>1</sup> Incremental climate policy includes incremental carbon tax (\$10/tonne), renewable natural gas targets (applicable to coal and copper only), low carbon fuel standards (applicable to coal and copper only) and methane regulations (applicable to natural gas only).

<sup>2</sup> Provincial Tax Changes include the Employer Health Tax, PST exemption on electricity and increase in Corporate Income Tax.

<sup>3</sup> Accelerated Investment Incentive per the 2018 Federal Fall Economic Update.

## Key Themes from Competitiveness Analysis

Key themes arising from the competitiveness analysis, including MNP's review of background materials and discussions with industry stakeholders, are as follows:

- **Regulatory uncertainty** – growing level of uncertainty with respect to regulatory issues at both the provincial and federal level for existing operations and new investment.
- **Higher capital costs, smaller scale facilities and/or competing with new facilities** – relative to competing jurisdictions, some sectors have higher capital costs for attracting new investment or are competing with newer and larger scale facilities (e.g., copper, pulp).
- **Transportation/infrastructure challenges** – farther distances to port (e.g., metallurgical coal) or market access constraints (e.g., natural gas).
- **Resource quality/access** – lower quality resource (e.g., copper ore grades, liquids content in natural gas plays) or lack of supply (e.g. fibre supply constraints) affecting BC's competitiveness.
- **Competition for investment** – key competing jurisdictions (e.g., US, Alberta) are reducing their corporate income tax rates to attract investment.
- **Differences in climate policy** – lack of carbon pricing or repeal of carbon tax in key competing jurisdictions (e.g., Australia, Chile, US) or policies that are less stringent than BC.

## **GHG MODELLING – APPROACH**

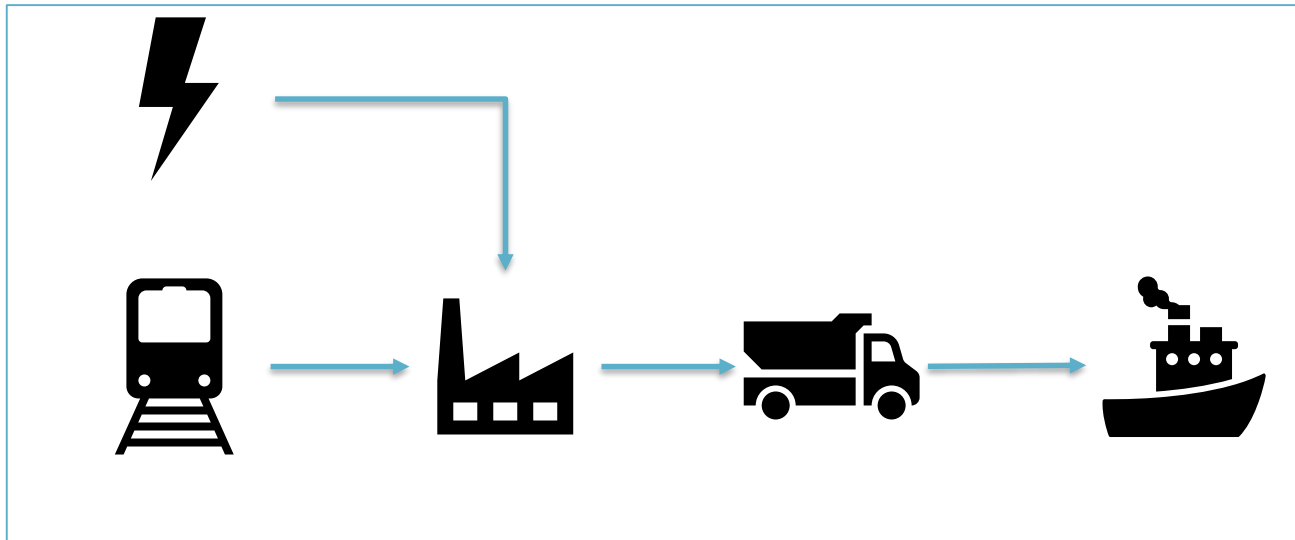


## APPROACH

The emissions associated with a “reference” capital project or operating facility in BC was benchmarked against a project or operating facility in defined competing jurisdictions.

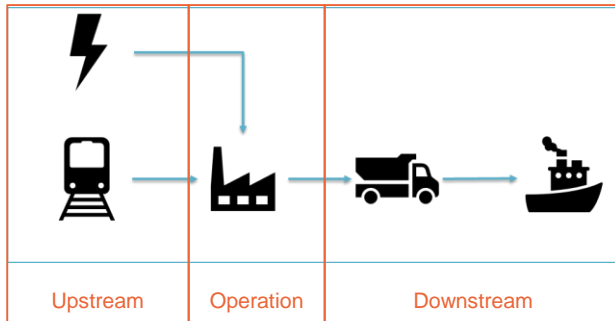
The assessment was not based on facility-level “best in class” assessments but on average assessments.

Abbreviated life-cycle – limited to GHGs.



## PROCESS – MODEL CREATION

BC

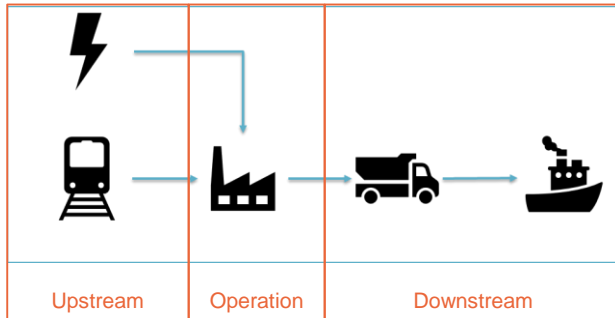


GHG models estimate the following categories of emissions:

- upstream (e.g., electricity and mobile emissions)
- operations (e.g., fixed and mobile combustion, methane emissions)
- downstream (e.g., FOB or shipping to designated jurisdictions)

Competing jurisdictions were selected by sector representatives.

### Competing Jurisdiction

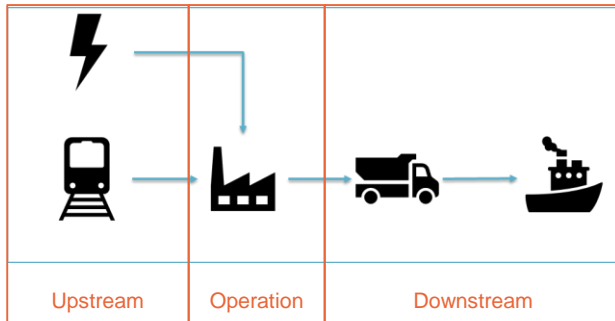


We used a “Model-to-Model” approach based on a “reference facility” that represents industry average production and/or specific facility emissions/operational information.

Industry relevant emissions or operational data (or sources for such data) was provided by sector representatives for BC and, where possible, for competing jurisdictions.

## PROCESS – STANDARDIZATION

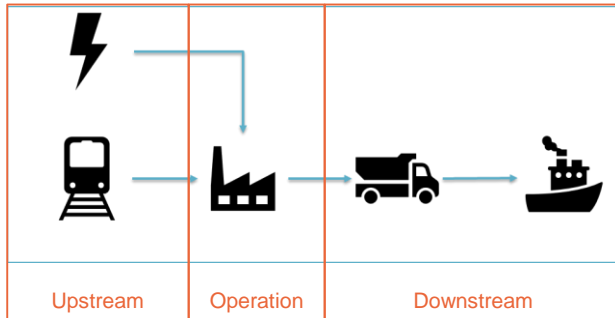
BC



Base years for the emissions estimates were set depending on availability and quality of GHG information (e.g., 2017 for coal, 2022 for natural gas).

Standardized “factors” are used to convert operational information into GHG emissions (e.g., heavy-duty off-road trucks: 0.0154 L per t km for diesel, Chile electricity grid: 470 kg CO<sub>2</sub>e per kWh).

### Competing Jurisdiction



Impact of current regulations (e.g., carbon tax, renewable fuel requirements, methane reductions) considered.

## APPROACH

- Differences across jurisdictions that are considered may include:
  - Resource characteristics (e.g., methane fugitive emissions, natural gas reservoir CO<sub>2</sub> content, copper ore quality)
  - Electricity grid emission intensities
  - Differing GHG related regulations (e.g., renewable energy, methane capture, carbon tax)
  - Transportation emissions in the upstream and downstream (e.g., distances to operations or to markets, rail vs. marine)
  - Geographic differences (e.g., average annual temperature, water availability)

## EMISSIONS DATA SOURCES AND COMPETING JURISDICTIONS BY SECTOR

Sector	Data source; BC	Competing Jurisdiction(s)	Data Source(s); Competing Jurisdictions
Metallurgical Coal	Aggregation of Teck Corp. energy and emissions data	Australia	BHP Caval Ridge Mine; Industry average methane emissions and utilization
Copper	Average of HVC and Taseko emissions, fuel type breakdown from Teck	Chile	Teck CDA mine operational data, E&Y benchmarking for capacity and ore quality adjustment and for desalination estimate
Aluminum	Rio Tinto – BC Works (Kitimat) intensity	Russia, Middle East, China	International Aluminum Association, Aluminum Association of Canada
Lumber	NRCAN Study	Alberta, US Pac NW, US SE	CORRIM database for US, NRCAN for Canada
Pulp	BC Emissions Report	Scandinavia, Chile	Independent study of modern facilities in Sweden, Finland and South America, RISI cost database
Natural Gas	CAPP, 2018 Industry Submission to JWG, adjustment for methane regulations, electrification and formation emissions	US Gulf Coast (Texas)	CAPP, Joint Working Group materials
LNG	Shell well-to-wire estimate, Delphi benchmarking study, Coastal Gas pipeline emissions, LNG Canada EAC	US Gulf Coast (Louisiana), Australia, Qatar	Shell “well to wire” assessment, Delphi benchmarking study

## **GHG MODELLING – SECTOR RESULTS**

## GHG MODELLING

### Metallurgical Coal

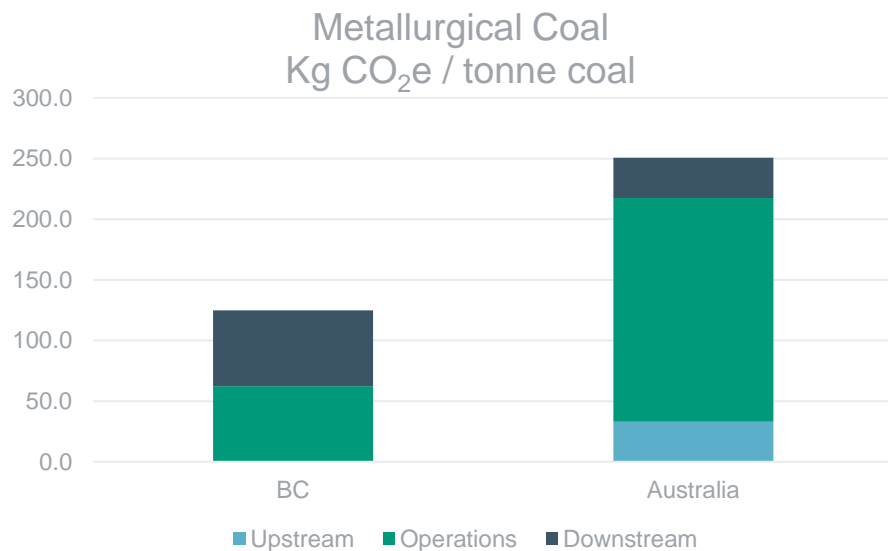
Assumptions	BC	Australia
Upstream	<ul style="list-style-type: none"> <li>Electrical grid intensity of 0.012 kg CO<sub>2</sub>e/kWh</li> </ul>	<ul style="list-style-type: none"> <li>Electrical grid intensity of 0.79 kg CO<sub>2</sub>e/kWh</li> <li>14% of fugitives captured and converted to electricity<sup>1</sup></li> </ul>
Operations	<ul style="list-style-type: none"> <li>Fugitive emissions equal to 0.021 t CO<sub>2</sub>e / t coal</li> </ul>	<ul style="list-style-type: none"> <li>Fugitive emissions equal to 0.057 t CO<sub>2</sub>e / t coal (average)</li> </ul>
Downstream	<ul style="list-style-type: none"> <li>Rail distance to port – 1,000 km</li> <li>Ship distance to market (Shanghai) – 10,200 km</li> <li>Port of Vancouver estimated emissions for coal</li> </ul>	<ul style="list-style-type: none"> <li>Rail distance to port – 260 km</li> <li>Ship distance to market (Shanghai) – 6,600 km</li> <li>Port of Vancouver estimated emissions for coal</li> </ul>

Regulatory Framework	BC	Australia
Carbon Tax	Combustion	N
Renewable Fuels	4% biodiesel	0.5% biodiesel
Methane Utilization	Carbon Credit purchase by Government	Carbon Credit purchase by Government

<sup>1</sup> Note that this applies to underground mines only, not surface mines.

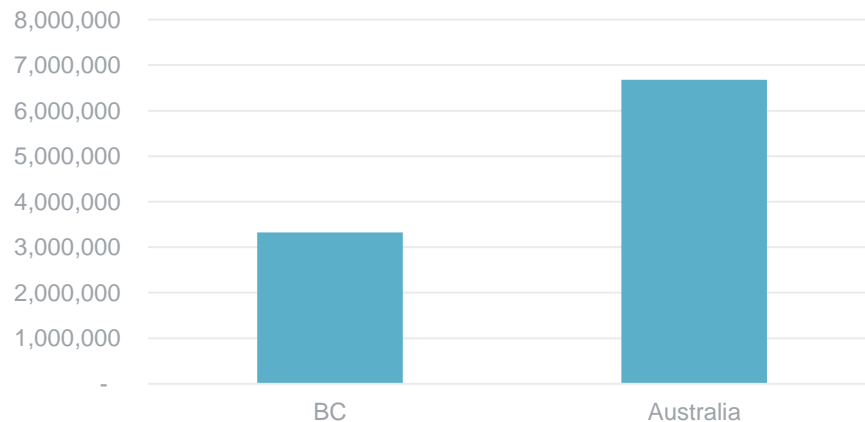
## GHG EMISSION COMPARISON

### Metallurgical Coal



- Upstream emissions include electricity consumed by the facility.
- Operations emissions include fixed and mobile combustion and methane emissions associated with operations.
- Downstream emissions include rail/marine shipping to designated markets.

### Metallurgical Coal Total Emissions based on BC Production\* (tonnes CO<sub>2</sub>e per year)



\* Note: Total Emissions for each jurisdiction represent lifecycle GHG emissions intensity multiplied by BC production volume.



## GHG MODELLING

### Copper

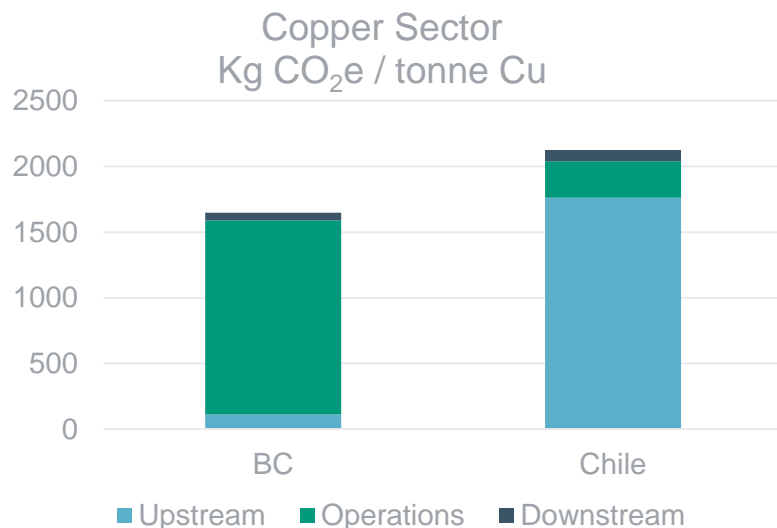
Assumptions	BC	Chile
Upstream	<ul style="list-style-type: none"> <li>Electrical grid intensity of 0.012 kg CO<sub>2</sub>e/kWh</li> </ul>	<ul style="list-style-type: none"> <li>Electrical grid intensity of 0.47 kg CO<sub>2</sub>e/kWh<sup>1</sup></li> <li>Desalination and water transport</li> </ul>
Operations		<ul style="list-style-type: none"> <li>Scale and ore body quality effects</li> </ul>
Downstream	<ul style="list-style-type: none"> <li>Rail distance to port – 360 km</li> <li>Ship distance to market (Shanghai) – 10,200 km</li> <li>Port of Vancouver estimated emissions</li> </ul>	<ul style="list-style-type: none"> <li>Rail distance to port – 340 km</li> <li>Ship distance to market (Shanghai) – 18,900 km</li> <li>Port of Vancouver estimated emissions</li> </ul>

Regulatory Framework	BC	Chile
Carbon Tax	Combustion	Electricity consumption charge
Renewable Fuels	4% biodiesel	N
Methane Utilization	DNA	DNA

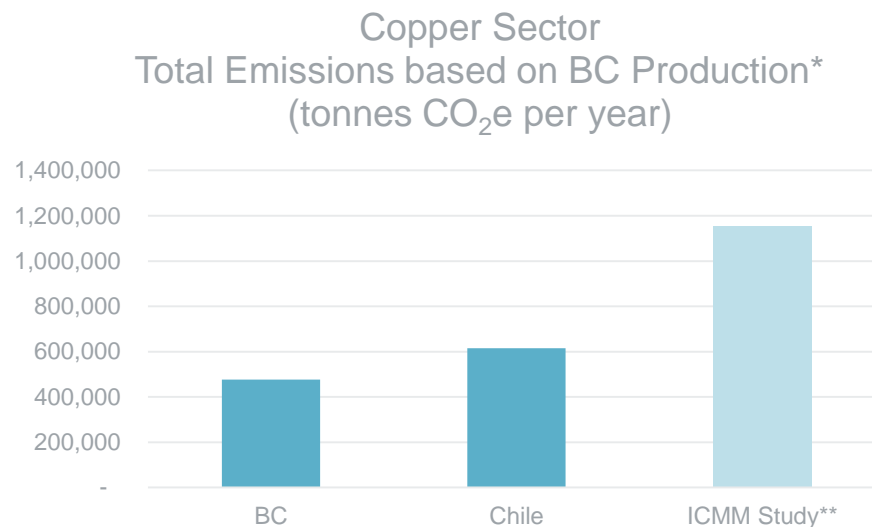
<sup>1</sup> Based on the average electrical grid intensity in Chile. Please note that the actual grid intensity for a particular mine may vary if a direct power purchase agreement is in place (e.g., this value would be higher if a coal based power purchase agreement is in place).

## GHG EMISSION COMPARISON

### Copper



- Upstream emissions include electricity consumed by the facility and water desalination and transportation to site (only applicable for Chile).
- Operations emissions include fixed and mobile combustion associated with operations with differences due to ore grades.
- Downstream emissions include rail/marine shipping to designated markets.



\* Total Emissions for each jurisdiction represent lifecycle GHG emissions intensity multiplied by BC production volume.

\*\* ICMM reports a production weighted emissions intensity for copper producers of 4 tonnes CO<sub>2</sub>e per tonne of production based on information provided by ICMM member companies. This includes Scope 1 and Scope 2 emissions only (fuel combustion, process and fugitive emissions and indirect emissions from electricity).

## GHG MODELLING

### Aluminum

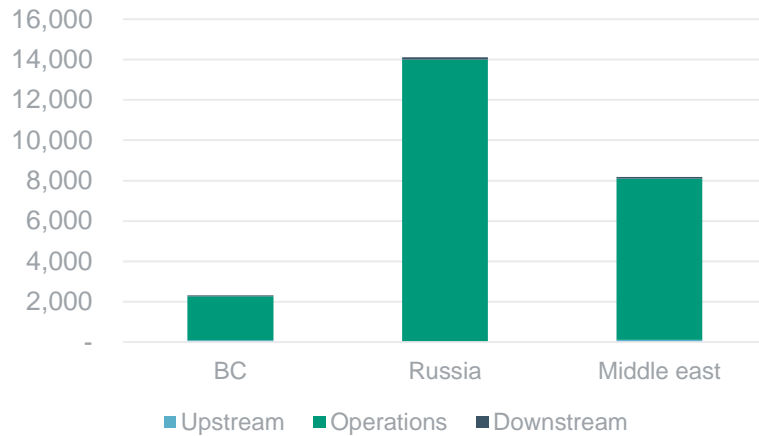
Assumptions	BC	Russia	Middle East
Upstream	<ul style="list-style-type: none"> <li>Alumina imported from Australia</li> <li>Facility electricity included in operations</li> </ul>	<ul style="list-style-type: none"> <li>Self sufficient in Bauxite</li> <li>Facility electricity included in operations</li> </ul>	<ul style="list-style-type: none"> <li>Bauxite imported from Australia</li> <li>Facility electricity included in operations</li> </ul>
Operations	<ul style="list-style-type: none"> <li>Rio Tinto – BC Works (Kitimat) overall intensity used</li> </ul>	<ul style="list-style-type: none"> <li>International Aluminum Institute estimate of overall intensity used</li> </ul>	<ul style="list-style-type: none"> <li>International Aluminum Institute estimate of overall intensity used</li> </ul>
Downstream	<ul style="list-style-type: none"> <li>50% shipping to Asia (Shanghai)</li> <li>50% shipping to LA</li> </ul>	<ul style="list-style-type: none"> <li>50% shipping to Asia (Shanghai)</li> <li>50% shipping to LA</li> </ul>	<ul style="list-style-type: none"> <li>50% shipping to Asia (Shanghai)</li> <li>50% shipping to LA</li> </ul>

Regulatory Framework	BC	Russia	Middle East
Carbon Tax	Combustion	N	N
Renewable Fuels	4% biodiesel		
Methane Utilization	DNA	DNA	DNA

## GHG EMISSION COMPARISON

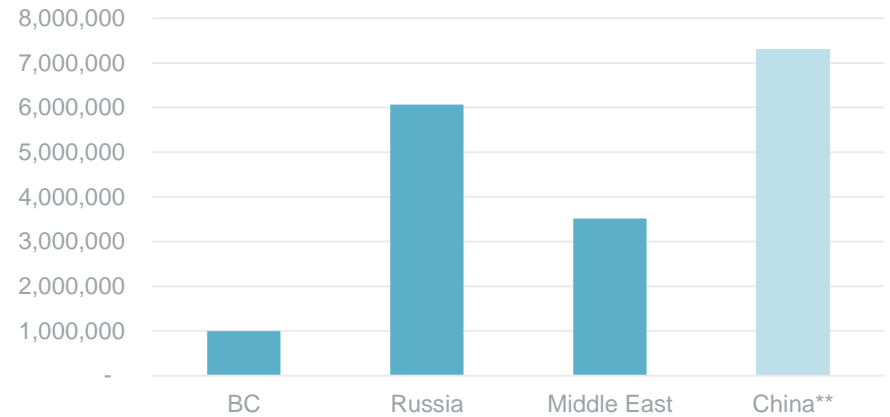
### Aluminum

Aluminum Sector  
Kg CO<sub>2</sub>e / tonne aluminum



- Upstream emissions include transportation of alumina/bauxite to site, but not processing of alumina/bauxite as common to all producers.
- Operations emissions include fixed and mobile combustion and process emissions associated with operations.
- Downstream emissions include rail/marine shipping to designated markets.

Total Emissions based on BC Production\*  
(tonnes CO<sub>2</sub>e per year)



\* Note: Total Emissions for each jurisdiction represent lifecycle GHG emissions intensity multiplied by BC production volume.

\*\* China emissions as estimated and reported by the International Aluminum Institute (includes Scope 1 and Scope 2 emissions only).

## GHG MODELLING

### Lumber

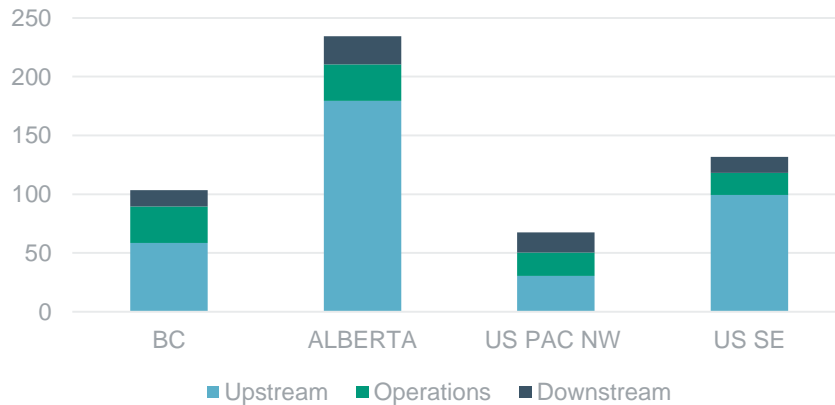
Assumptions	BC	ALBERTA	US PAC NW	US SE
Upstream	<ul style="list-style-type: none"> <li>Distance 88 km</li> <li>Electricity 113 kWh/MBF</li> <li>Electricity 10 Kg CO<sub>2</sub>e/ kWh</li> <li>23.32 l/MBF diesel</li> </ul>	<ul style="list-style-type: none"> <li>Distance 150 km</li> <li>Electricity 113 kWh/MBF</li> <li>Electricity 900 Kg CO<sub>2</sub>e/ kWh</li> <li>23.32 l/MBF diesel</li> </ul>	<ul style="list-style-type: none"> <li>Distance 108 km</li> <li>Electricity 88 kWh/MBF</li> <li>Electricity 143 Kg CO<sub>2</sub>e/ kWh</li> <li>6.6 l/MBF diesel</li> </ul>	<ul style="list-style-type: none"> <li>Distance 85 km</li> <li>Electricity 75 kWh/MBF</li> <li>Electricity 442 Kg CO<sub>2</sub>e/ kWh</li> <li>2.0 l/MBF diesel</li> </ul>
Operations	<ul style="list-style-type: none"> <li>9.7 M3 Natural gas/MBF</li> <li>4.1 l/MBF diesel</li> <li>0.1 l/MBF gasoline</li> </ul>	<ul style="list-style-type: none"> <li>9.7 M3 Natural gas/MBF</li> <li>4.1 l/MBF diesel</li> <li>0.1 l/MBF gasoline</li> </ul>	<ul style="list-style-type: none"> <li>4.1 M3 Natural gas/MBF</li> <li>2.4 l/MBF diesel</li> <li>0.06 l/MBF gasoline</li> </ul>	<ul style="list-style-type: none"> <li>1.25 M3 Natural gas/MBF</li> <li>2.5 l/MBF diesel</li> <li>0.5 l/MBF gasoline</li> </ul>
Downstream	<ul style="list-style-type: none"> <li>5.2 l/MBF diesel</li> </ul>	<ul style="list-style-type: none"> <li>8.9 l/MBF diesel</li> </ul>	<ul style="list-style-type: none"> <li>6.4 l/MBF diesel</li> </ul>	<ul style="list-style-type: none"> <li>5.0 l/MBF diesel</li> </ul>

Regulatory Framework	BC	ALBERTA	US PAC NW	US SE
Carbon Tax	Combustion	Cap and Trade	N	N
Renewable Fuels	4% biodiesel	2% biodiesel	0% biodiesel	N
Methane Utilization	DNA	DNA	DNA	DNA

## GHG EMISSION COMPARISON

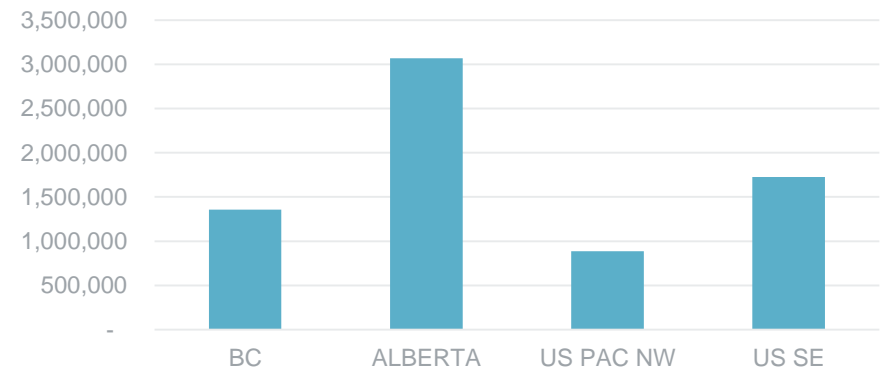
### Lumber

Lumber Sector  
Kg CO<sub>2</sub>e / MBF



- Upstream emissions include transportation to site (hauling activities) and electricity consumed by the facility.
- Operations emissions include fixed and mobile combustion associated with operations.
- Downstream emissions include transportation to designated markets.

Lumber Sector  
Total Emissions based on BC Production\*  
(tonnes CO<sub>2</sub>e per year)



\* Note: Total Emissions for each jurisdiction represent lifecycle GHG emissions intensity multiplied by BC production volume.

## GHG MODELLING

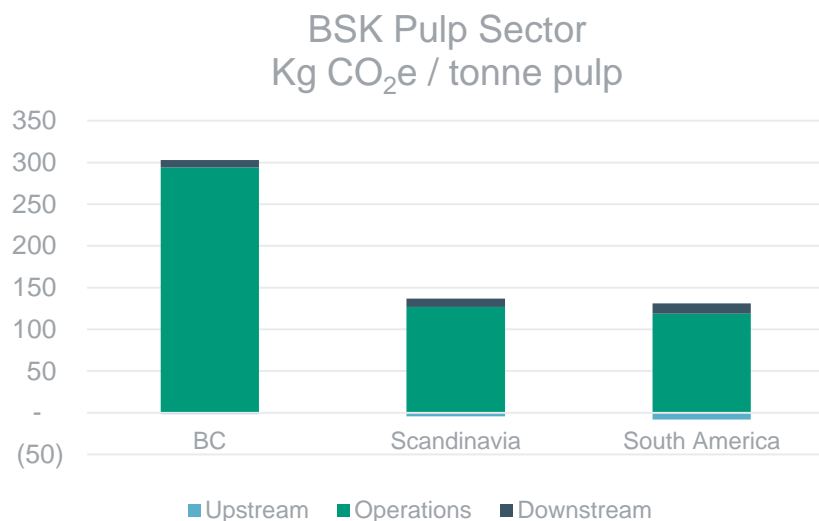
### Pulp (BSK – Bleached Softwood Kraft)

Assumptions	BC	Scandinavia (Finland and Sweden)	South America (Chile)
Upstream	<ul style="list-style-type: none"> <li>Significant surplus electricity sales</li> </ul>	<ul style="list-style-type: none"> <li>Significant surplus electricity sales</li> </ul>	<ul style="list-style-type: none"> <li>Significant surplus electricity sales</li> </ul>
Operations	<ul style="list-style-type: none"> <li>Significant fossil consumption in boilers</li> <li>Kiln assumed to be operating with fossil fuel</li> </ul>	<ul style="list-style-type: none"> <li>Recovery and power boilers 100% biomass</li> <li>Kiln assumed to be operating with fossil fuel</li> </ul>	<ul style="list-style-type: none"> <li>Recovery and power boilers 100% biomass</li> <li>Kiln assumed to be operating with fossil fuel</li> </ul>
Downstream	<ul style="list-style-type: none"> <li>Rail to Vancouver</li> </ul>	<ul style="list-style-type: none"> <li>Rail to port</li> </ul>	<ul style="list-style-type: none"> <li>Rail to port</li> </ul>

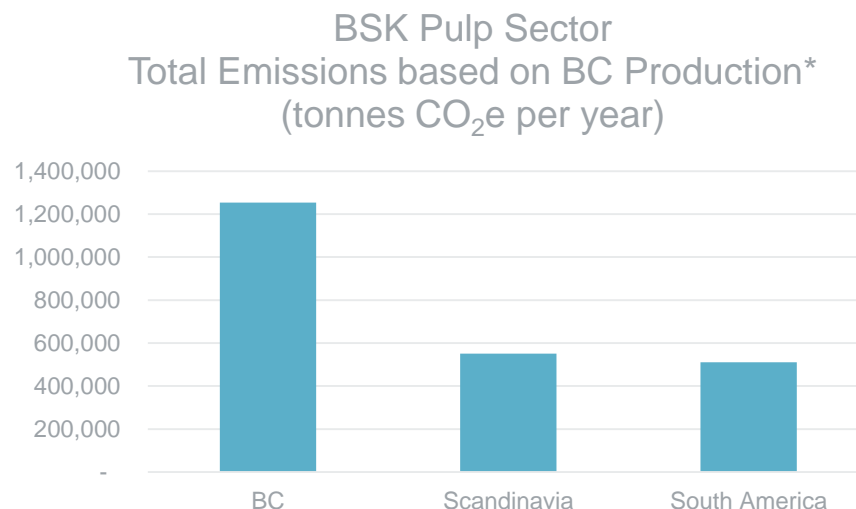
Regulatory Framework	BC	Scandinavia (Finland and Sweden)	South America (Chile)
Carbon Tax	Combustion	Carbon tax and cap and trade	Carbon tax on electricity
Renewable Fuels	4% biodiesel	N	N
Methane Utilization	Carbon Credit purchase by Government	DNA	DNA

## GHG EMISSION COMPARISON

### Pulp (BSK – Bleached Softwood Kraft)



- Upstream emissions include net electricity use/production.
- Operations emissions include fossil fuel combustion associated with operations.
- Downstream emissions include rail to port.



\* Note: Total Emissions for each jurisdiction represent lifecycle GHG emissions intensity multiplied by BC production volume.



## GHG MODELLING

### Natural Gas

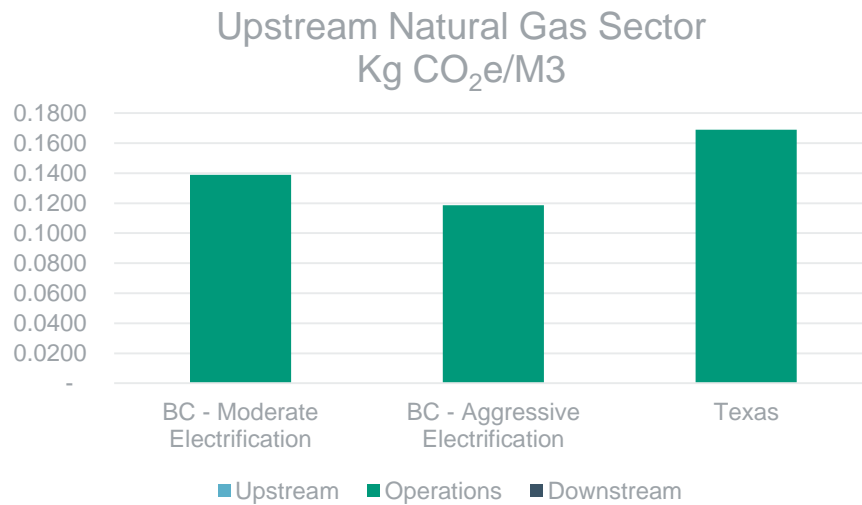
The natural gas GHG modelling is based on a set of scenarios that considers growth in production, retirement of existing facilities and assumptions with respect to electrification and methane reductions by 2022.

Assumptions	BC	Texas
Upstream	<ul style="list-style-type: none"> <li>No upstream emissions</li> </ul>	<ul style="list-style-type: none"> <li>No upstream emissions</li> </ul>
Operations	<ul style="list-style-type: none"> <li>Basis is BC 2016 GHG emissions report (8% fuel consumption)</li> <li><b>Two production volume scenarios:</b> 6.14 bcf/day per BC Budget Forecast ("low volume") and 9.03 bcf/day per industry forecast ("high volume", based on BC capturing 60% of incremental growth in Canadian natural gas)</li> <li><b>Two electrification scenarios:</b> 45% of new facilities (needed for growth and to offset declines) electrify ("moderate electrification"); 90% of all new facilities in BC electrify ("aggressive electrification"); electrification results in 85% reduction in combustion emissions</li> <li>Industry meets methane reduction targets by 2025; For leak detection and repair: 50% reduction achieved by 2022 over 2019 levels for new and existing facilities; For pneumatics: 40% reduction on existing facilities and 50% reduction on new facilities by 2022 over 2016 levels</li> <li>No Horn River production/emissions in 2022 volume</li> </ul>	<ul style="list-style-type: none"> <li>Basis is BC 2016 GHG emissions report (8% fuel consumption)</li> <li>Industry complies with federal and state methane regulations; For leak detection and repair, 25% reduction achieved by 2022 over 2019 levels for existing facilities and 40% reduction for new facilities; For pneumatics, 0% reduction on existing facilities and 50% reduction on new facilities by 2022 over 2016 levels</li> <li>No electrification of facilities (would not result in reductions because grid average is very close to gas fired emissions intensity)</li> </ul>
Downstream	<ul style="list-style-type: none"> <li>No downstream (pipeline) emissions to avoid double counting with LNG</li> </ul>	<ul style="list-style-type: none"> <li>No downstream (pipeline) emissions</li> </ul>

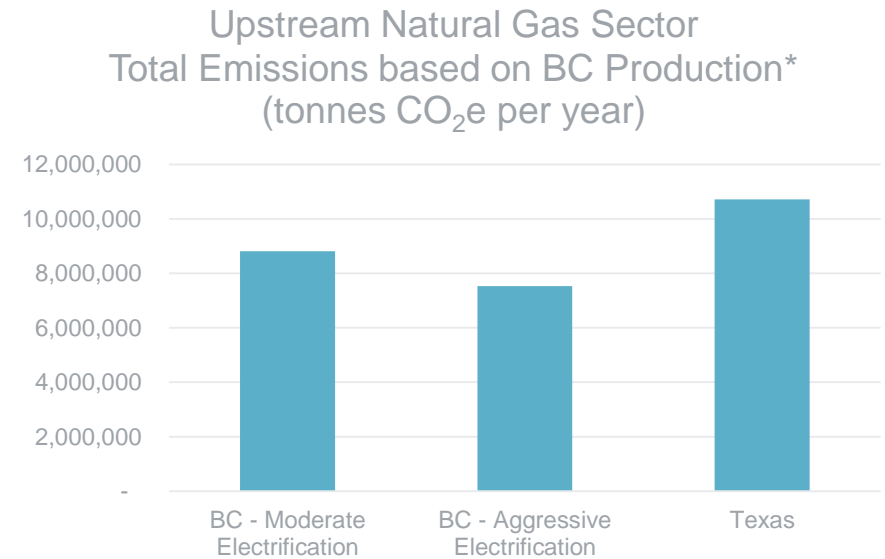
Regulatory Framework	BC	Texas
Carbon Tax	Combustion	N
Renewable Fuels	4% biodiesel	N
Methane Utilization	Carbon Credit purchase by Government	N

## GHG EMISSION COMPARISON

### Natural Gas (2022) – Low Production Volume (BC Budget Forecast)



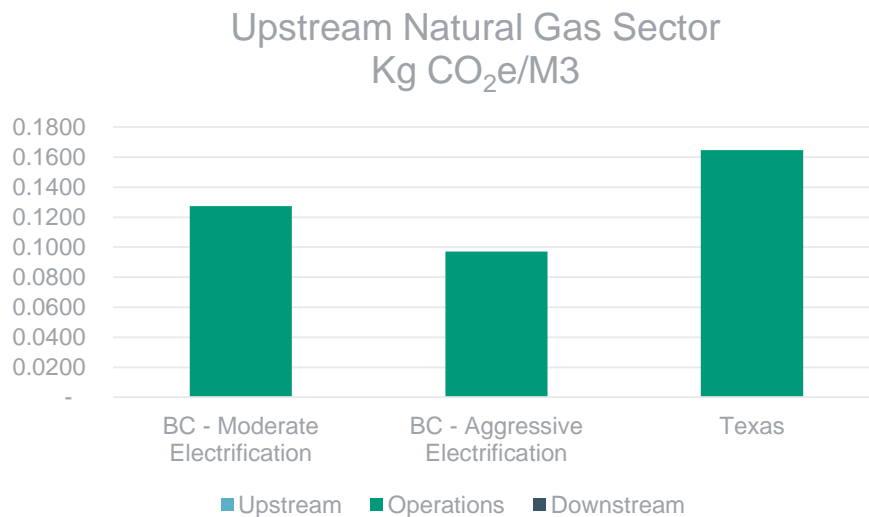
- No upstream emissions.
- Operations emissions include fixed and mobile combustion and methane emissions associated with operations.
- No downstream emissions to designated markets.



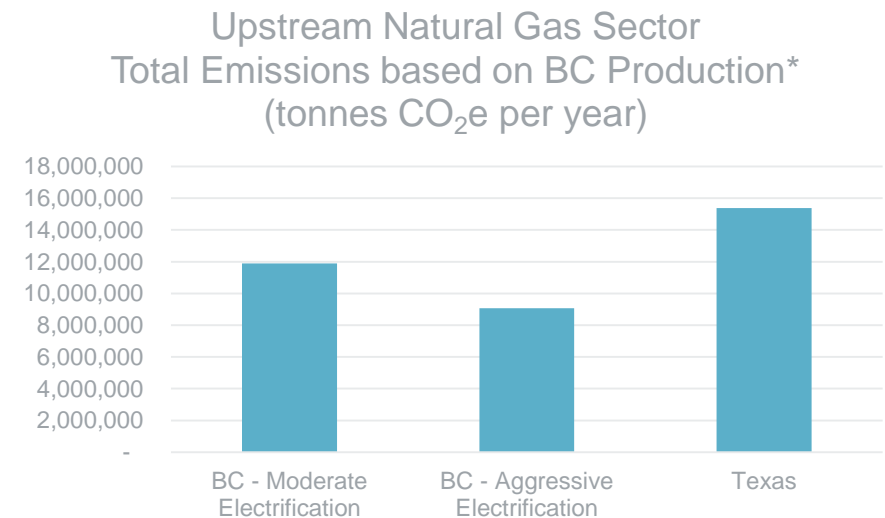
\* Note: Total Emissions for each jurisdiction represent lifecycle GHG emissions intensity multiplied by BC production volume.

## GHG EMISSION COMPARISON

### Natural Gas (2022) – High Production Volume (Industry Forecast)



- No upstream emissions.
- Operations emissions include fixed and mobile combustion and methane emissions associated with operations.
- No downstream emissions to designated markets.



\* Note: Total Emissions for each jurisdiction represent lifecycle GHG emissions intensity multiplied by BC production volume.

## GHG MODELLING

### LNG

The LNG GHG modelling is based on a scenario that considers 14 million tonnes of LNG production in 2022.

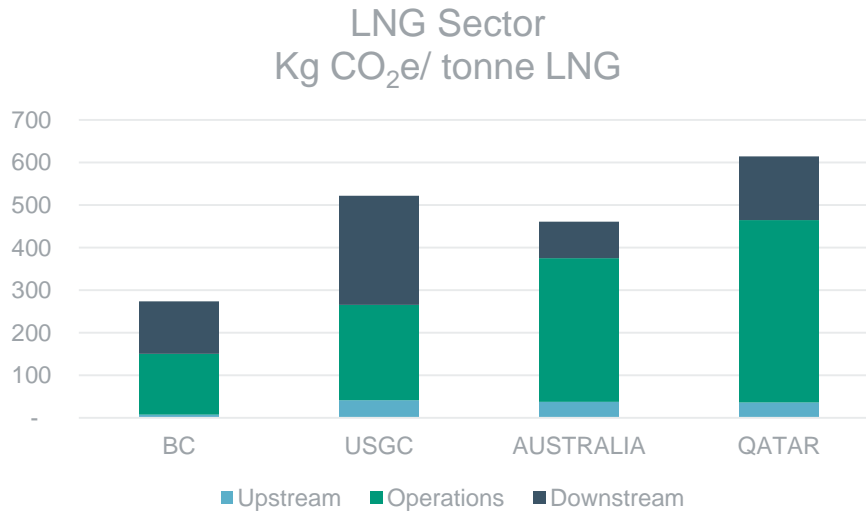
Assumptions	BC	USGC	AUSTRALIA	QATAR
Upstream (pipeline combustion and electricity use)*	<ul style="list-style-type: none"> <li>Includes facility electricity at grid average</li> <li>Coastal Gas Link estimated emissions for pipeline</li> </ul>	<ul style="list-style-type: none"> <li>Includes facility electricity at grid average</li> </ul>	<ul style="list-style-type: none"> <li>Includes facility electricity at grid average</li> </ul>	<ul style="list-style-type: none"> <li>Includes facility electricity assuming natural gas based electricity</li> </ul>
Operations	<ul style="list-style-type: none"> <li>Partial electrification of LNG plant (LNG Canada EIA)</li> <li>Montney CO<sub>2</sub>. Flare and vent prorated from total emissions</li> </ul>	<ul style="list-style-type: none"> <li>Predominantly natural gas for energy</li> </ul>	<ul style="list-style-type: none"> <li>Predominantly natural gas for energy</li> </ul>	<ul style="list-style-type: none"> <li>Large methane venting</li> <li>Predominantly natural gas for energy</li> </ul>
Downstream	<ul style="list-style-type: none"> <li>Marine to Shanghai</li> </ul>	<ul style="list-style-type: none"> <li>Marine to Shanghai</li> </ul>	<ul style="list-style-type: none"> <li>Marine to Shanghai</li> </ul>	<ul style="list-style-type: none"> <li>Marine to Shanghai</li> </ul>

\* Note: upstream emissions do not include emissions from the upstream gas production sector.

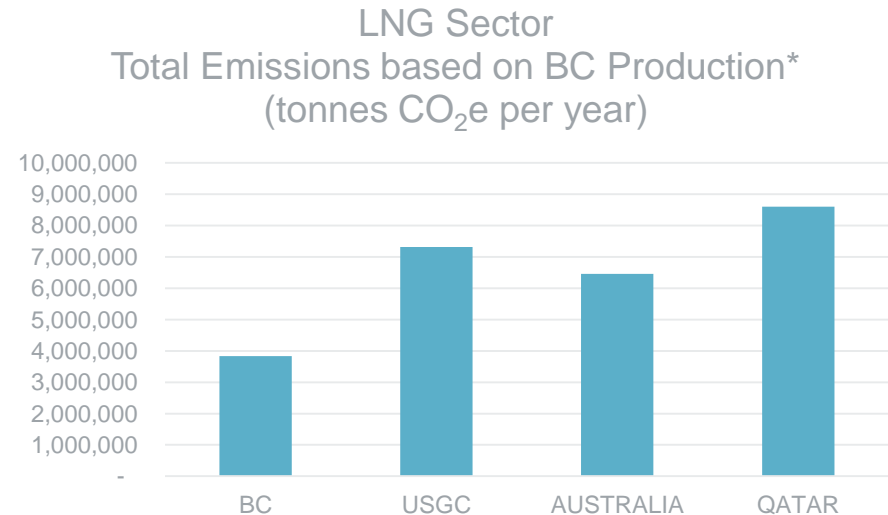
Regulatory Framework	BC	USGC	AUSTRALIA	QATAR
Carbon Tax	Intensity based regulation	N	N	N
Renewable Fuels	4% biodiesel	N	0.5% biodiesel	N
Methane Utilization	Carbon Credit Creation	DNA	Carbon Credits Purchased by Government	World Bank Voluntary reduction program

## GHG EMISSION COMPARISON

### LNG



- Upstream emissions include transportation to site (pipeline) and electricity consumed by the liquefaction facility. It does not include emissions associated with upstream gas extraction and production activities.
- Operations emissions include fixed and mobile combustion and methane emissions associated with operations.
- Downstream emissions include marine shipping to designated markets.



\* Note: Total Emissions for each jurisdiction represent lifecycle GHG emissions intensity multiplied by BC production volume.

## SUMMARY OF GHG MODELLING RESULTS

Based on a product-on-product GHG emissions comparison, BC industries modelled showed an advantage of approximately **12 to 18 million tonnes of CO<sub>2</sub>e per year** in GHG emissions relative to competing jurisdictions by selling lower carbon intensive products.

### Estimated GHG Advantage Provided by BC Products (tonnes CO<sub>2</sub>e per year)

	COAL	COPPER	LNG	NATURAL GAS	LUMBER	PULP	ALUMINUM
BC Emissions <sup>1</sup>	3,300,000	476,000	3,800,000	Low volume: 7,500,000 to 8,800,000 High volume: 9,100,000 to 11,900,000	1,357,000	1,254,000	990,000
Average of Competing Jurisdictions <sup>2</sup>	6,700,000	614,000 to 1,156,000 <sup>3</sup>	7,400,000	Low volume: 10,700,000 High volume: 15,400,000	1,894,000	531,000	4,800,000 to 5,600,000 <sup>4</sup>
<b>Estimated GHG Advantage</b>	<b>3,400,000</b>	<b>138,000 to 680,000</b>	<b>3,600,000</b>	<b>1,900,000 to 6,300,000<sup>5</sup></b>	<b>537,000</b>	<b>(723,000)</b>	<b>3,800,000 to 4,600,000</b>

<sup>1</sup> Lifecycle GHG emissions intensity of BC facilities multiplied by BC production volume.

<sup>2</sup> Average lifecycle GHG intensity of key competing jurisdictions multiplied by BC production volume.

<sup>3</sup> Based on average emissions data from ICMM study (Scope 1 and Scope 2 only).

<sup>4</sup> Range based on comparison with Russia and Middle East (key competing jurisdictions in U.S. market) versus China (largest producer of aluminum).

<sup>5</sup> Range based on a set of scenarios that vary according to natural gas production volumes and electrification of BC facilities by 2022.

## Qualitative Factors that Result in GHG Advantage or Disadvantage for BC relative to Competing Jurisdictions

Advantage to BC		Disadvantage to BC
Low emitting electricity	Metallurgical coal, Copper, LNG, Natural gas, Lumber, Pulp, Aluminum	
Provincial climate policies	Metallurgical coal, Copper, LNG, Natural gas, Lumber, Pulp, Aluminum	
Renewable fuel requirements for mobile equipment	Metallurgical coal, Copper, LNG, Natural gas, Pulp, Aluminum	
Resource quality (low CO <sub>2</sub> , low methane, ore quality)	Metallurgical coal, LNG, Natural gas	Copper
Energy for cooling reduced because of colder climate	LNG, Natural gas	
World class/world scale facilities	LNG, Aluminum	Copper, Pulp
Abundant fresh water	Copper	
Upstream and downstream transportation distances	Copper	Coal, Natural gas, Lumber, Aluminum
Biomass used for energy		Pulp, Lumber

## COMPETITIVENESS MODELLING – APPROACH



## SECTOR COMPETITIVENESS MODELS

### Approach

- Gather best available cost data for each sector using broad averages (or weighted averages) to represent the reference facility/investment
- Supplement data gaps with data from other sources/subject matter experts (SMEs)
- Agreement on foundational assumptions with respect to treatment of:
  - Carbon Tax and Low Carbon Fuel Standard
  - Renewable Natural Gas Targets (for new investment, post-2022)
  - Employer Health Tax
  - PST and Mineral Tax
  - Accelerated Investment Allowance announced in Federal Fall Economic Update (for new investment)
- On a sector basis and based on available cost data, model the impact of policy changes from 2017 to 2022 on the profit margin for existing facilities and from 2017 to 2030 on project internal rate of return (IRR) for new investment
- Validate findings with SMEs

## Policy Change Assumptions

Policy changes modelled in BC that apply broadly across sectors.

<b>BC Carbon Tax</b>	<ul style="list-style-type: none"><li>• Increase from \$30/tonne to \$50/tonne. Assumes 75% rebate of incremental carbon tax in 2019 and 50% rebate in subsequent years based on performance benchmarks established through the Clean Growth Incentive Program for industry.</li></ul>
<b>Renewable and Low Carbon Fuel Standard</b>	<ul style="list-style-type: none"><li>• For liquid fuels consumed and purchased in BC, incremental emission reductions over 2017 levels of 7% by 2022 and 15% by 2030. Assumes a marginal compliance cost of \$135/tonne.</li><li>• Renewable natural gas target of 15% by 2030 as outlined in CleanBC. Assumes an increase in the cost of RNG from \$15/GJ in 2022 to \$30/GJ in 2030 with the 15% target applied gradually over this time period. Price will remain at \$30/GJ for the balance of the project timeframe. <i>Note: RNG targets will not apply to “own gas” used as feedstock for LNG or natural gas producers, only natural gas purchased by industrial users directly from utilities.</i></li></ul>
<b>Corporate Income Tax</b>	<ul style="list-style-type: none"><li>• 1% increase in corporate income tax in 2018 resulting in an increase in the combined federal and provincial rate from 26% to 27%.</li></ul>
<b>PST Exemption on Electricity</b>	<ul style="list-style-type: none"><li>• Exemption of 7% PST on electricity expenditures for business starting in 2019.</li></ul>
<b>Employer Health Tax</b>	<ul style="list-style-type: none"><li>• 1.95% employer health tax applied to a proportion of labour that is indirect to the facility or project. No impact assumed on direct payroll costs.</li></ul>
<b>Accelerated Investment Allowance</b>	<ul style="list-style-type: none"><li>• Enhanced first-year capital cost allowance equal to one-and-a-half times the normal first year allowance until 2022 and half-year rule suspended until 2027. (Included in new investment model only.)</li></ul>

## COMPETITIVENESS MODELLING – SECTOR RESULTS

## MINING

### Key Factors Affecting Competitiveness

A recent study commissioned by the BC Mining Jobs Task Force assessed how well BC performs across three major drivers of investment returns in the mining sector:

- (1) geology and geography;
- (2) fiscal policy; and
- (3) regulatory framework.

Relative to jurisdictions BC competes with for investment in metallurgical coal and copper (namely, Chile, Queensland, Australia and Western Australia), it was reported that the comparator jurisdictions generally hold an advantage over BC with respect to geology (grade, depth, scale of deposits) and geography (proximity to infrastructure and end-markets).

While the study suggests that BC's fiscal policy is competitive on a global basis, it does note that BC mining companies pay substantially more in carbon tax relative to competitors in other jurisdictions. The study also concludes that actions to increase the efficiency, transparency and predictability of the regulatory framework would encourage investment by decreasing investment risk.

Source: EY (2018, September). [Assessment of the performance, impact and competitiveness of BC's Mining and Exploration Industry.](#)

# COMPETITIVENESS MODELLING

## Metallurgical Coal

Cost Inputs (USD per tonne of coal production) for Existing Facilities

	BC	Australia
<b>Labour</b>	\$14.96	\$26.48
<b>Energy<sup>1</sup></b>	\$8.05	\$9.50
<b>Other Mine Costs</b>	\$19.20	\$27.36
<b>Off-site Transportation</b>	\$29.31	\$6.74
<b>Seaborne Shipping</b>	\$10.96	\$8.99
<b>Corporate Overhead<sup>2</sup></b>	\$2.19	\$1.58
<b>Exploration, Development and Expansion Costs<sup>3</sup></b>	\$5.98	\$3.12
<b>Sustaining Capital<sup>4</sup></b>	\$17.32	\$11.50

Source: S&P Market Intelligence weighted average modelled costs for 2018.

<sup>1</sup> Cost breakdown by energy source provided by industry representatives.

<sup>2</sup> Sum of corporate overhead and interest payments.

<sup>3</sup> Sum of exploration, development and expansion costs.

<sup>4</sup> Five year average (2013 to 2017).

## COMPETITIVENESS MODELLING

### Metallurgical Coal

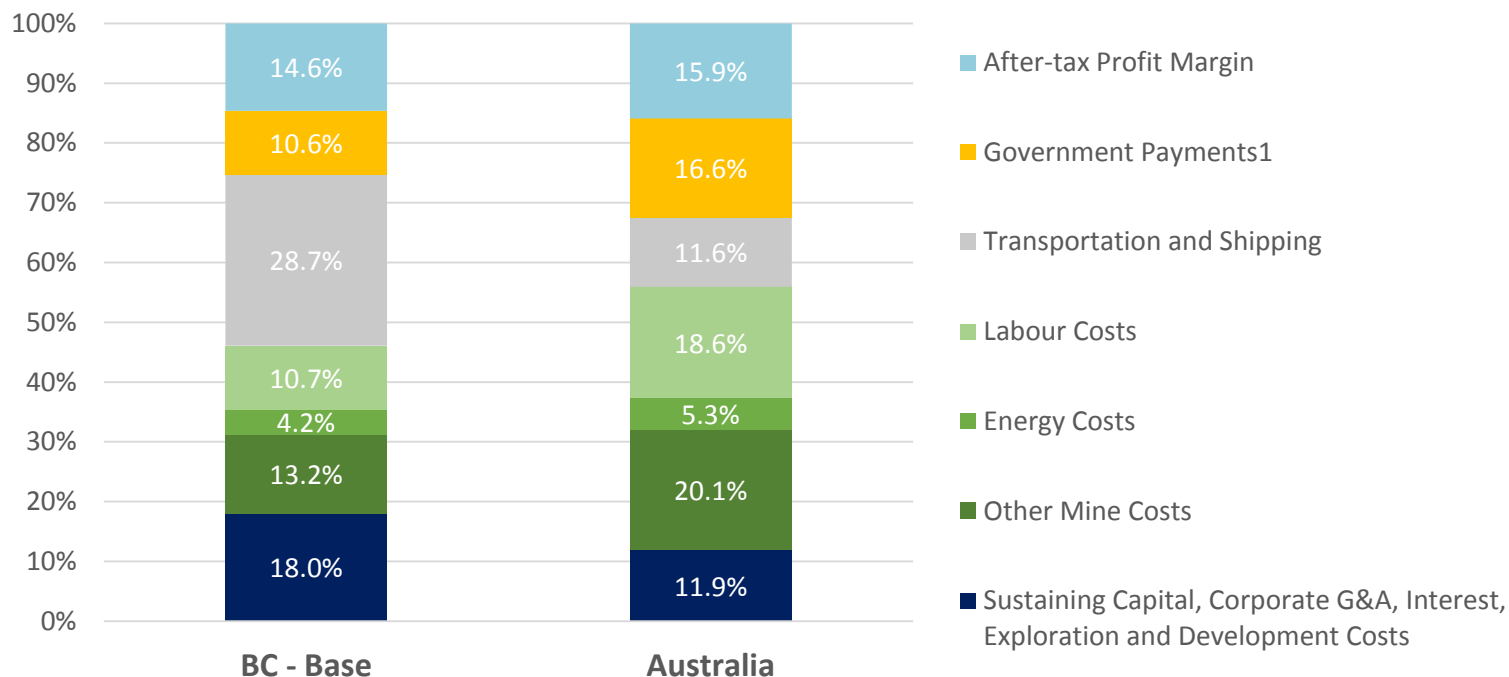
Key Assumptions (for 2017 base year and 2022 policy change year, unless previously noted)

	BC	Australia
<b>Commodity Price (USD)</b>	\$145/tonne	\$145/tonne
<b>Realized price over benchmark price</b>	96%, based on data from S&P	94%, based on data from S&P
<b>Corporate Income Tax</b>	26% (2017)	30%
<b>Carbon tax (USD)</b>	\$23.08/tonne CO <sub>2</sub> e	No tax on industry
<b>Mineral Tax/Royalties</b>	2% on "net current proceeds"; 13% on "net revenue"; 13% tax rate assumed for existing facilities	7% of value up to \$100/tonne, 12.5% on incremental value up to \$150/tonne, 15% on incremental value above \$150/tonne
<b>Motor Fuel Tax – gasoline (USD)</b>	\$0.11/L	\$0.32/L
<b>Motor Fuel Tax – diesel (USD)</b>	\$0.12/L	\$0.32/L
<b>Sales tax on goods and services</b>	7%	Australia only has a federal value-added sales tax.
<b>Percent of capital costs subject to sales tax</b>	28% based on spending pattern per Statistics Canada Supply Use Tables for "other engineering construction"	
<b>Payroll Tax</b>		In Queensland companies with annual taxable wages of \$5.5 million or more pay 4.75% on taxable wages.

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## Metallurgical Coal

**BC and Australia Comparison of After-tax Profit Margin**  
**(at \$145/tonne benchmark coal price, shown as share of revenue)**

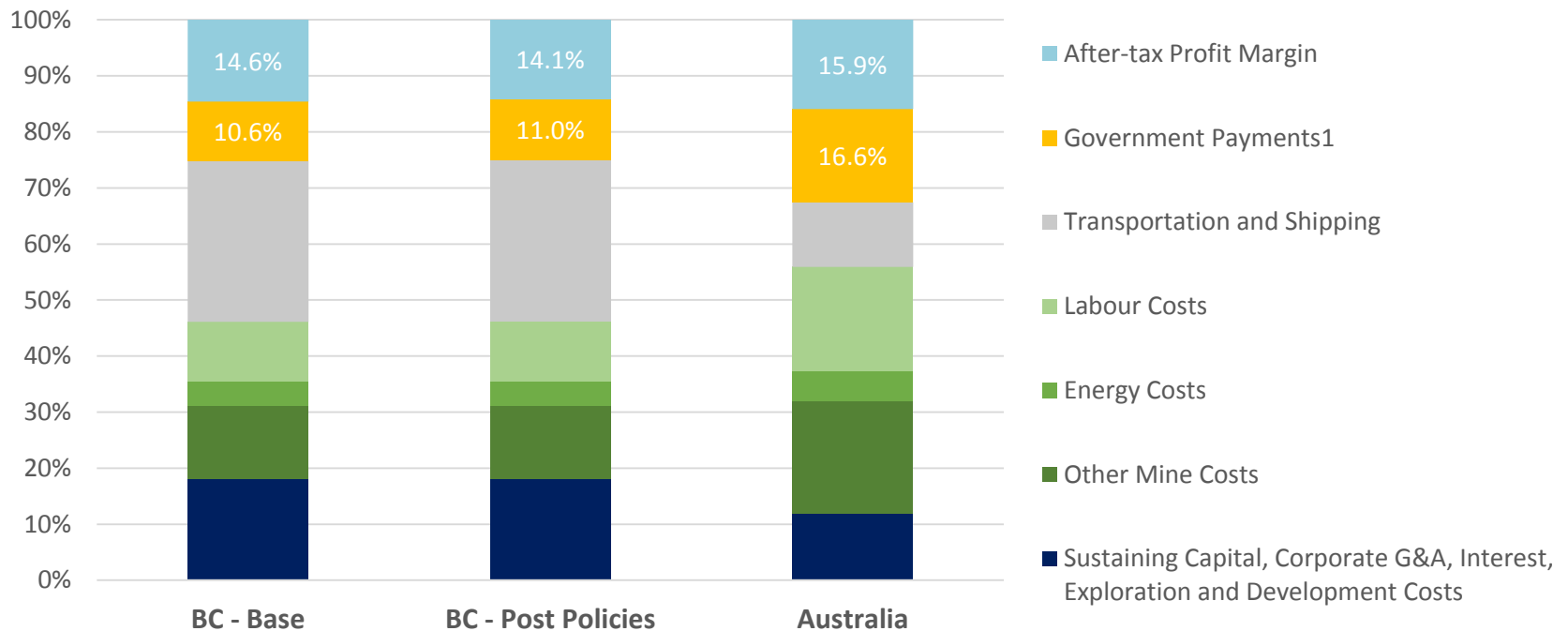


<sup>1</sup> Includes carbon tax, PST, mineral tax/royalties, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## Metallurgical Coal

**After-tax Profit Margin: Pre and Post Policy Changes**  
**(at \$145/tonne benchmark coal price, shown as share of revenue)**



<sup>1</sup> Includes carbon tax, PST, mineral tax/royalties, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.



## COMPETITIVENESS MODELLING

### Metallurgical Coal

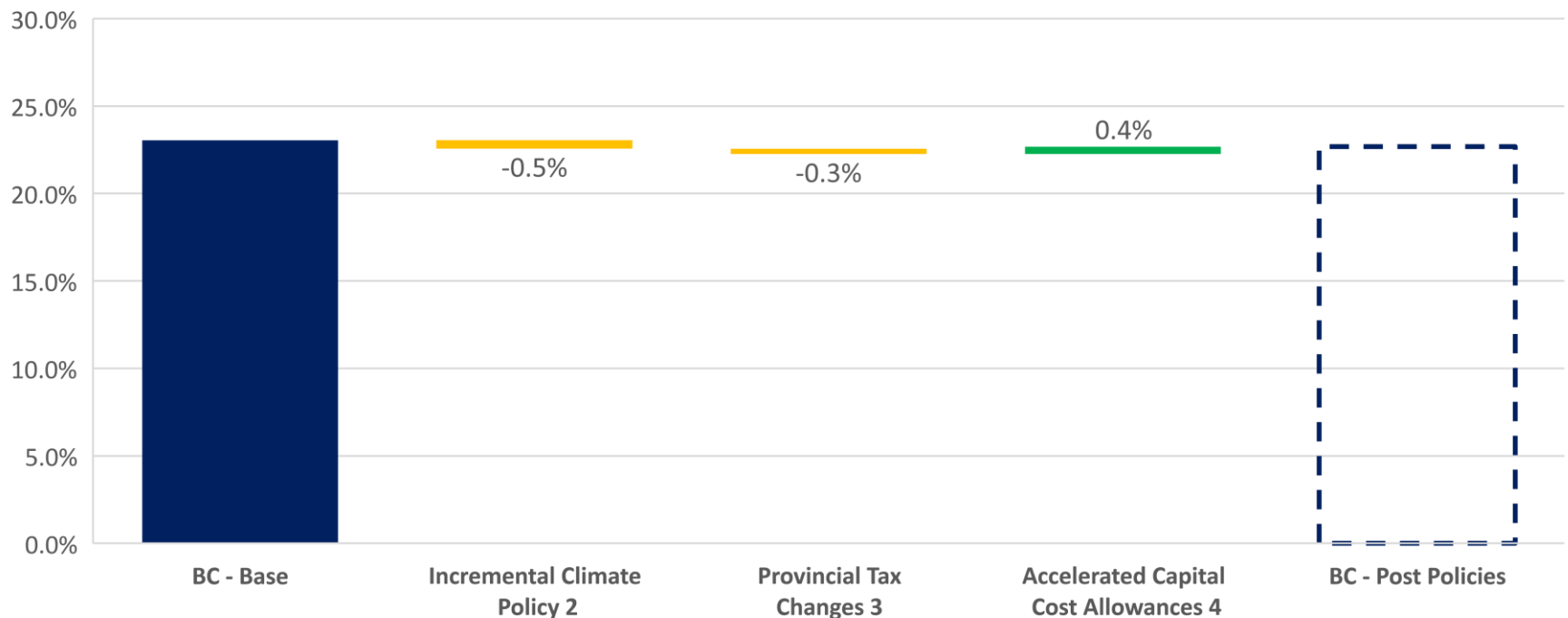
Key Assumptions – New Investment Model

Modelling Assumptions	
Annual Production	5,000,000 tonnes
Estimated Mine Life	25 years
Capital Cost (USD)	\$505.4 million, based on data from BC Major Projects Inventory inflated to 2018
Construction Period	Three Years
Depreciation Rate	25%
Operating Costs	Based on data for existing facilities (S&P)

# PROJECT IRR ANALYSIS (NEW INVESTMENT)

## Metallurgical Coal

**After-tax Project IRR<sup>1</sup>: New Coal Mine**  
**(at \$145/tonne benchmark coal price)**



<sup>1</sup> After-tax Project IRR excludes corporate overhead expenses from net cash flow.

<sup>2</sup> Carbon tax at \$30/tonne includes reduction in Corporate Income Tax. Incremental Climate Policy includes incremental carbon tax (above \$30/tonne), renewable and low carbon fuel standard and renewable natural gas targets

<sup>3</sup> Provincial Tax Changes includes PST exemption on electricity, Employer Health Tax and increase in Corporate Income Tax

<sup>4</sup> Accelerated Investment Incentive per the 2018 Federal Fall Economic Update

## COMPETITIVENESS MODELLING

### Copper

Cost Inputs (USD per lb of copper) for Existing Facilities<sup>1</sup>

	BC	Chile	Arizona
Labour	\$0.48	\$0.38	\$0.46
Energy <sup>2</sup>	\$0.37	\$0.22	\$0.31
Reagents and Other Site Costs	\$0.58	\$0.47	\$1.05
Off-site Transportation	\$0.11	\$0.08	\$0.06
Smelting and Refining Costs	\$0.19	\$0.18	\$0.20
Corporate Overhead <sup>3</sup>	\$0.07	0.05	\$0.06
Exploration, Development and Expansion Costs <sup>4</sup>	\$0.02	0.17	\$0.01
Sustaining Capital <sup>5</sup>	\$0.38	\$0.31	\$0.18

Source: S&P Market Intelligence weighted average costs for 2017.

<sup>1</sup> All shared costs in the production of commodities are apportioned to each metal by its share of net revenue. Data relates to primary copper mines only.

<sup>2</sup> Cost breakdown by energy source provided by industry representatives.

<sup>3</sup> Sum of corporate overhead and interest payments.

<sup>4</sup> Sum of exploration, development and expansion costs.

<sup>5</sup> Five year average (2013 to 2017).

## COMPETITIVENESS MODELLING

### Copper

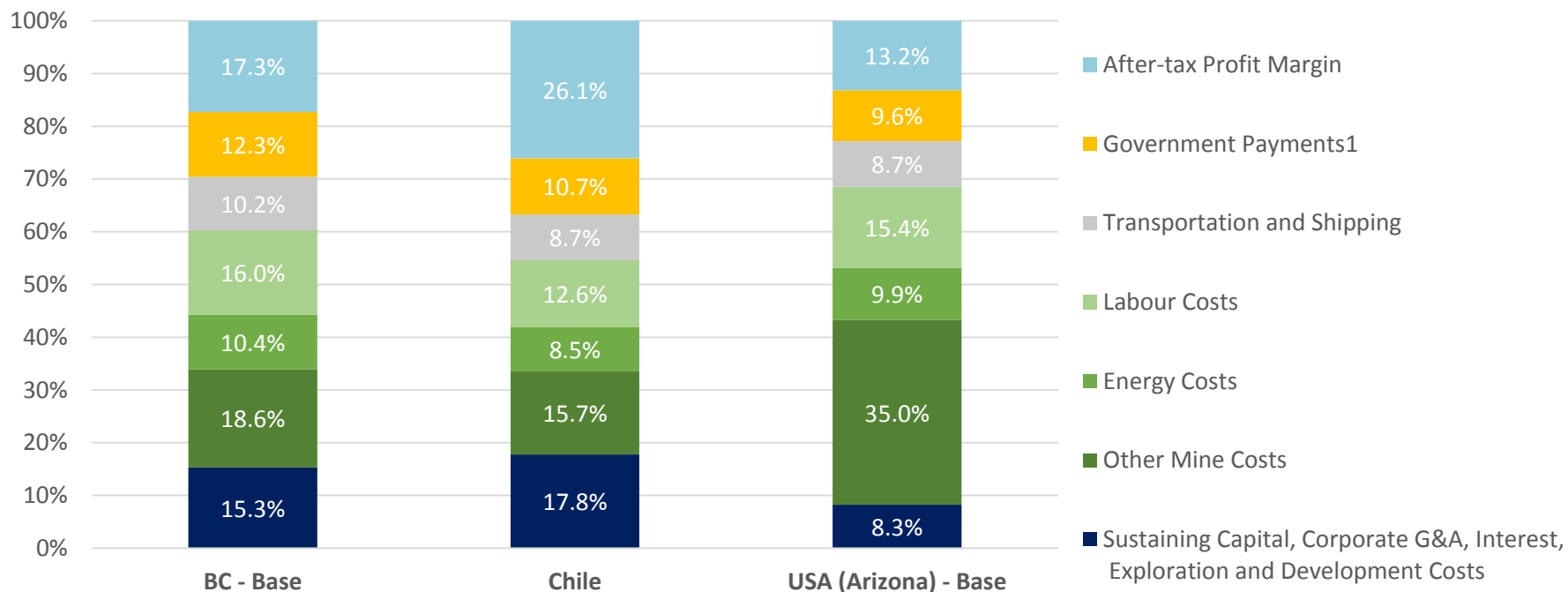
Key Assumptions (for 2017 base year and 2022 policy change year, unless previously noted)

	BC	Chile	Arizona
<b>Commodity Price (USD)</b>	\$3.00/lb	\$3.00/lb	\$3.00/lb
<b>Corporate Income Tax</b>	26% (2017) 27% (2022)	25%	40% (2017) 26% (2022)
<b>Carbon tax (USD)</b>	\$23.08/tonne CO <sub>2</sub> e	No tax on industry	No tax on industry
<b>Mineral Tax/Royalties</b>	2% on "net current proceeds"; 13% on "net revenue"; 13% tax rate assumed for existing facilities	0 to 14% depending of volume of sales and mining operational margin	2.5% of the difference between the gross value of production and production costs.
<b>Motor Fuel Tax – gasoline (USD)</b>	\$0.11/L	\$0.41/L	\$0.05/L
<b>Motor Fuel Tax – diesel (USD)</b>	\$0.12/L	\$0.10/L	\$0.07/L
<b>Sales tax on goods and services</b>	7%	Chile has a value-added sales tax.	Arizona state taxes are levied on the seller.
<b>Percent of capital costs subject to sales tax</b>	28% based on spending pattern per Statistics Canada Supply Use Tables for "other engineering construction"		

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## Copper

**BC, Chile and Arizona Comparison of After-tax Profit Margin  
(at \$3.00/lb copper price, shown as share of revenue)**

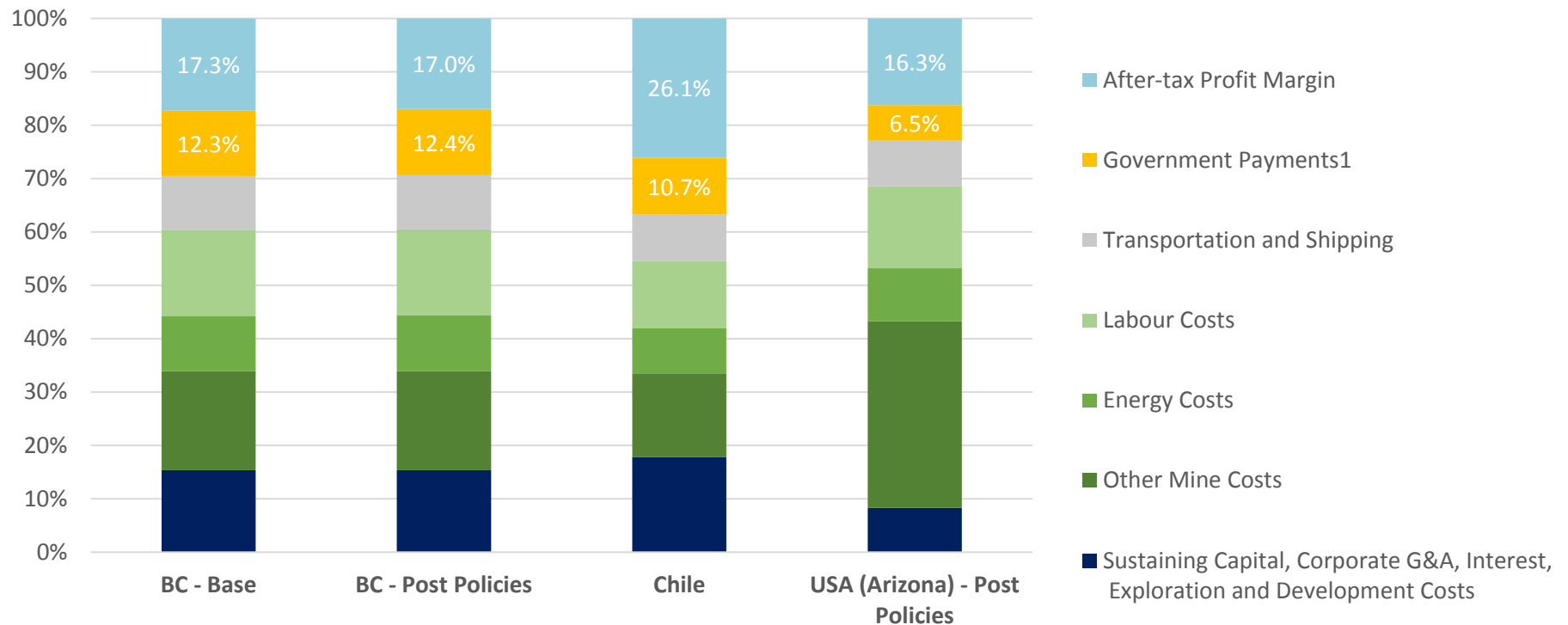


<sup>1</sup> Includes carbon tax, PST, mineral tax/royalties, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## Copper

**After-tax Profit Margin: Pre and Post Policy Changes**  
(at \$3.00/lb copper price, shown as share of revenue)



<sup>1</sup> Includes carbon tax, PST, mineral tax/royalties, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

## COMPETITIVENESS MODELLING

### Copper

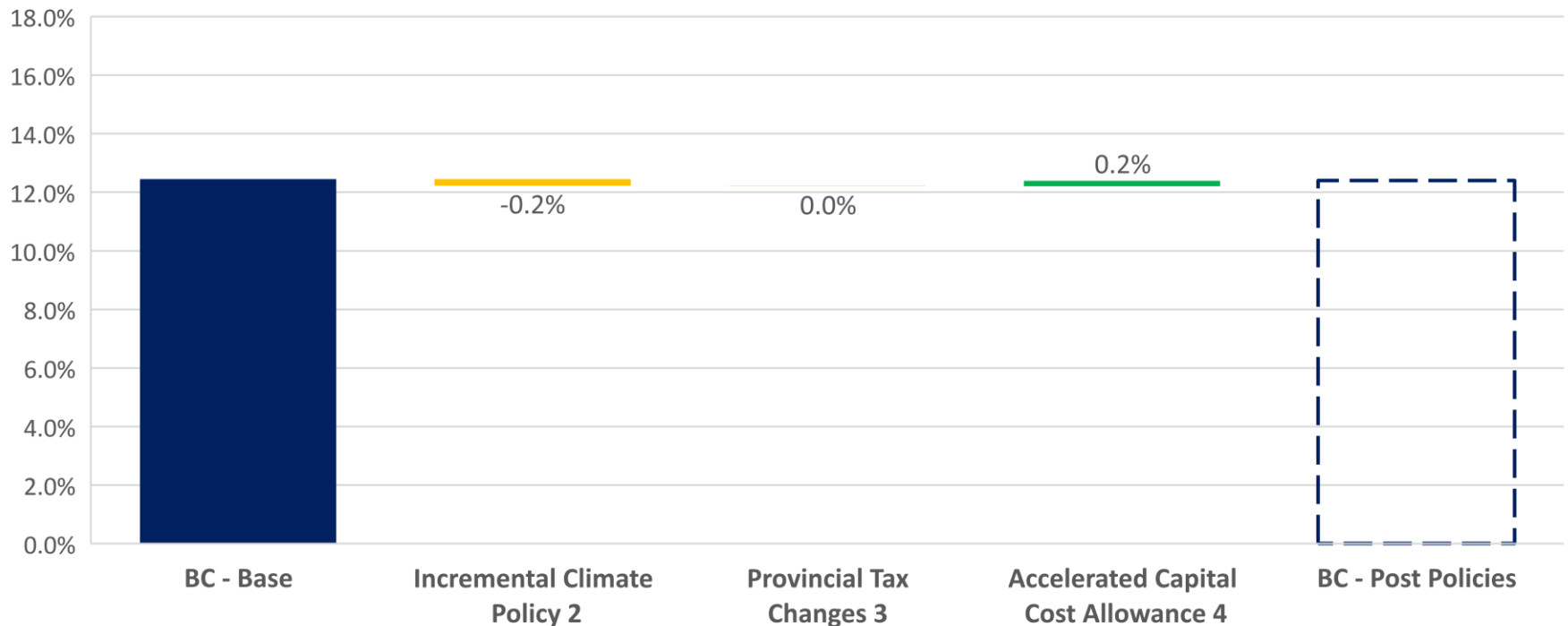
Key Assumptions – New Investment Model

Modelling Assumptions	
Annual Production	40,000 tonnes
Estimated Mine Life	25 years
Capital Cost (USD)	\$460.2 million USD (or \$0.21/lb), based on data from BC Major Projects Inventory inflated to 2017, apportioned to copper and converted to USD
Construction Period	Two Years
Depreciation Rate	25%
Operating Costs	Based on data for existing facilities (S&P)

# PROJECT IRR ANALYSIS (NEW INVESTMENT)

## Copper

**After-tax Project IRR<sup>1</sup>: Copper Mine Expansion/Extension**  
**(at \$3.00/lb copper price)**



<sup>1</sup> After-tax Project IRR excludes corporate overhead expenses from net cash flow

<sup>2</sup> Carbon tax at \$30/tonne includes reduction in Corporate Income Tax. Incremental Climate Policy includes incremental carbon tax (above \$30/tonne), renewable and low carbon fuel standard and renewable natural gas targets

<sup>3</sup> Provincial Tax Changes includes PST exemption on electricity, Employer Health Tax and increase in Corporate Income Tax

<sup>4</sup> Accelerated Investment Incentive per the 2018 Federal Fall Economic Update



## ALUMINUM

### Key Factors Affecting Competitiveness

#### Import Tariffs

- On March 1, 2018, the US government announced a 10% tariff on US imports of aluminum from Canada, which it implemented on June 1. As a result of US tariffs, Rio Tinto reported that the mid-West premium rose 111% between 2017 and 2018.<sup>1</sup>

#### Capital Costs

- Compared with key competing jurisdictions, Canada is generally competitive with respect to electricity prices and consumption, but much less competitive with respect to capital costs. For example, the Rio Tinto – BC Works modernization project was associated with capital expenditures of \$9,000 USD/tonne compared with \$2,500 USD/tonne for new capacity in China.<sup>2</sup> As a result, new production capacity is expected to come from lower cost jurisdictions (e.g. Middle East, India, SE Asia and China).

#### Energy Costs

- China and the Middle East benefit from government support on energy costs, while Canada and Europe are the only two aluminum production jurisdictions with carbon pricing.<sup>3</sup>

<sup>1</sup> Rio Tinto. 2018 Annual Report.

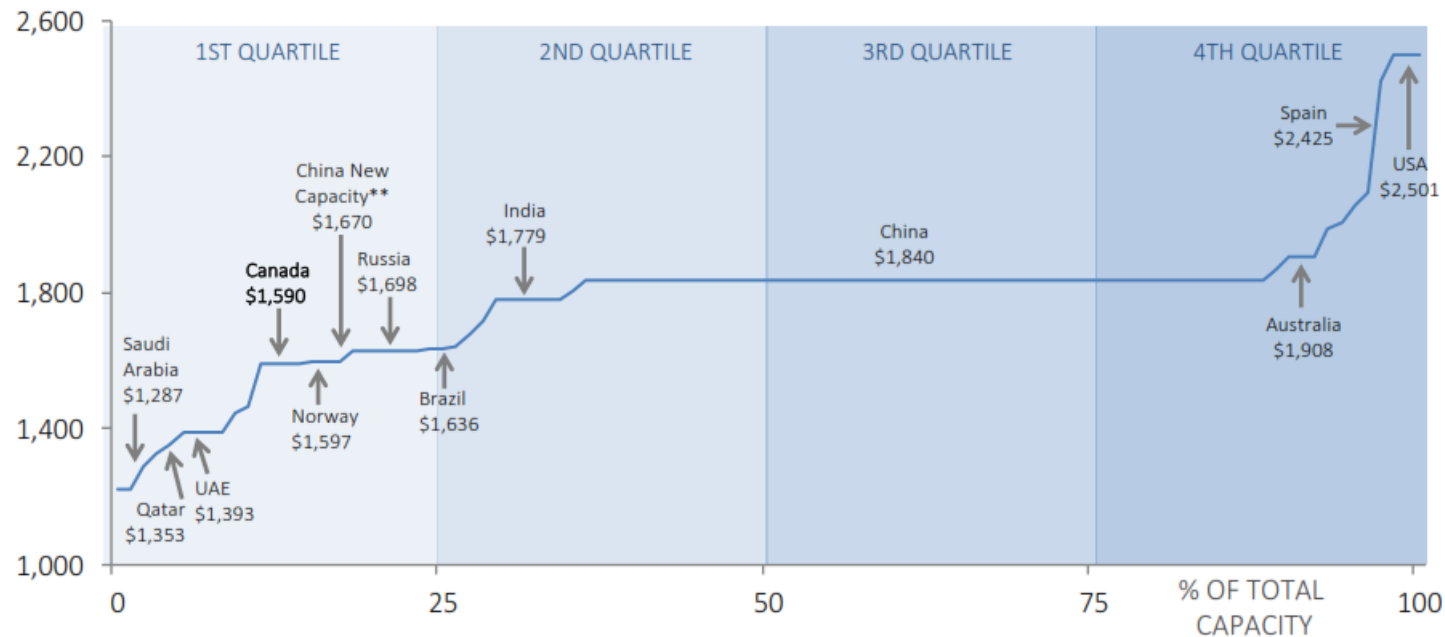
<sup>2</sup> Aluminum Association of Canada (2019, April 4), Competitiveness of the Aluminum Industry.

<sup>3</sup> Ibid.

## ALUMINUM

- Among the primary exporters of aluminum (i.e., excluding India and China), Canada ranks between the Middle East and Norway and Russia on a cash cost of production basis.

### WORLD'S PRIMARY ALUMINUM PRODUCTION CASH COST CURVE BEFORE CASTING BY COUNTRY\* (Aug 2018, \$/mton)



\*LME Cash price + applicable P1020/VAP premium given smelter product mix – production cash cost after casting. Cash cost does not include interest payments, depreciation and working capital.

\*\*Xinjiang with captive coal-fired power

Source: HARBOR Aluminum

Source: Harbor Aluminum (obtained from Aluminum Association of Canada, April 4, 2019 Presentation). Cash cost does not include interest payments, depreciation and working capital.

## COMPETITIVENESS MODELLING

### Aluminum

Cost Inputs (USD per tonne of aluminum) for Existing Facilities

	BC
Labour and Admin	\$127
Energy <sup>1</sup>	\$318
Alumina	\$651
Other Raw Materials	\$318
Other Costs	\$176
Interest, Depreciation and Working Capital <sup>2</sup>	\$410

Source: Aluminum Association of Canada (April 4, 2019 Presentation). Based on 2018 data from Harbor Aluminum for Canadian facilities unless otherwise noted.

<sup>1</sup> Energy breakdown provided by industry representatives.

<sup>2</sup> Difference between Rio Tinto – BC Works (Kitimat) Total Cost of Production (including interest, depreciation and working capital) and Cash Cost of Production for Canadian facilities.

## COMPETITIVENESS MODELLING

### Aluminum

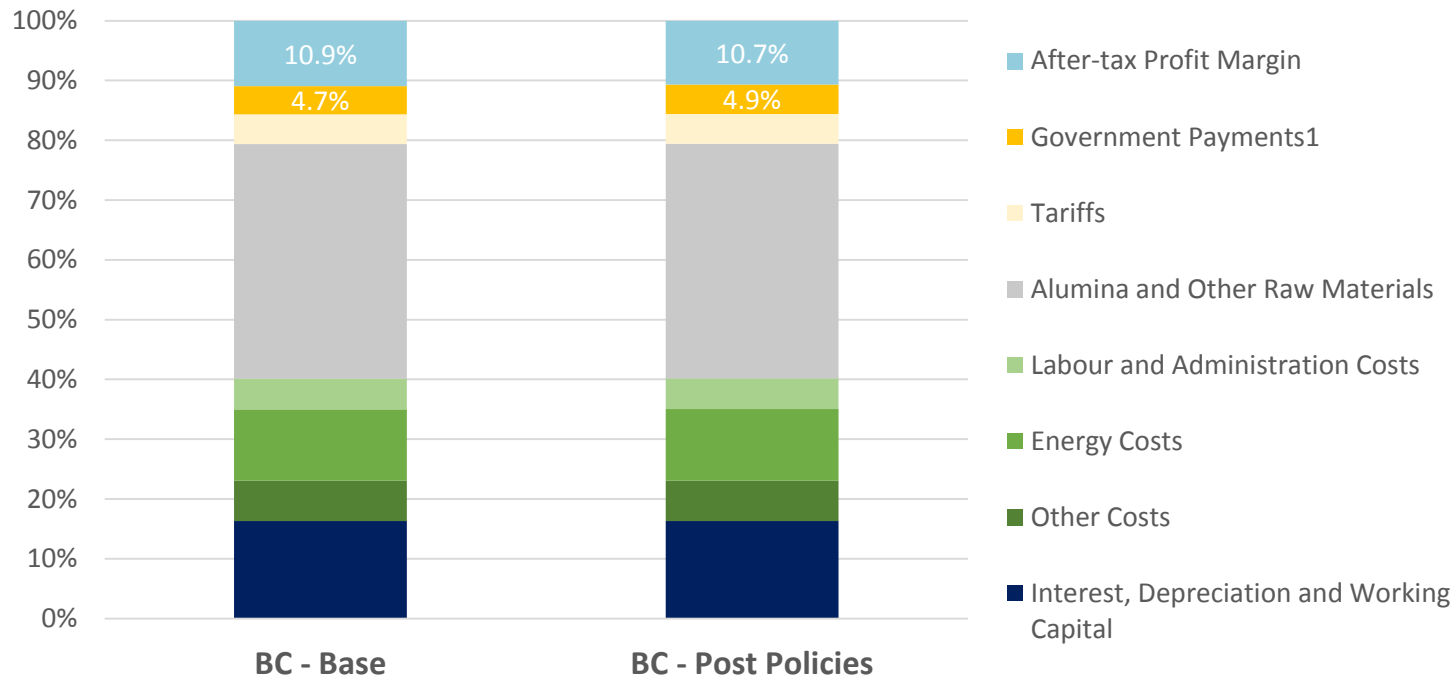
Key Assumptions (for 2017 base year and 2022 policy change year, unless previously noted)

BC	
<b>Commodity Price (USD) – cash LME price</b>	\$2,110/tonne (average 2018 price, per Rio Tinto Annual Report)
<b>Realized Price (USD)</b>	\$2,470/tonne (includes the LME price, a market premium and value added product premium, per Rio Tinto 2018 Annual Report)
<b>Corporate Income Tax</b>	26% (2017)
<b>Carbon tax (USD)</b>	\$23.08/tonne CO <sub>2</sub> e
<b>Motor Fuel Tax – gasoline (USD)</b>	\$0.11/L
<b>Motor Fuel Tax – diesel (USD)</b>	\$0.12/L
<b>Sales tax on goods and services</b>	7%
<b>Percent of capital costs subject to sales tax</b>	28% based on spending pattern per Statistics Canada Supply Use Tables for "other engineering construction"

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## Aluminum

**BC After-tax Profit Margin: Pre and Post Policy Changes**  
(at \$2,470 USD/tonne realized price, shown as share of revenue)



<sup>1</sup> Includes carbon tax, PST, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes. Note that the facility generates its own electricity, and therefore is not subject to PST.

## LUMBER

### Notes regarding Competitiveness Assessment

- The best source of competitiveness data available at the time of the study reflects modelled costs based on 2016 and 2017 data from Forest Economic Advisors (FEA) and Wood Markets
- Based on more recent information shared publicly by BC lumber companies, BC mills were starting to see negative margins starting in Q4 of 2018 due to a combination of high log costs and declining lumber prices
  - As a result, BC companies have recently announced both temporary and permanent curtailments in production
- To better reflect current conditions, 2018 modelled costs were used along with actual stumpage rates and lumber prices for 2019 YTD (Jan to March)
- The analysis will continue to be updated as more recent cost data becomes available

## LUMBER

### Key Factors Affecting Competitiveness

#### Fibre Supply

- Unlike competing jurisdictions, BC fibre supply is shrinking due the mountain pine beetle infestation and forest fires with the annual allowable cut (AAC) on a downward trend
- As a result, net log costs as a percentage of mill net revenue have been increasing in BC over the last decade, while decreasing in the US South
- In Canada, the majority of forest tenure is publicly owned whereas just over half of forest land in the US is privately owned
- In response to dwindling supply and increasing costs, BC-based lumber companies are no longer expanding operations in BC and instead are shifting capacity to the US

## LUMBER

### Key Factors Affecting Competitiveness (cont'd)

#### Softwood Lumber Duties

- With the expiration of the Softwood Lumber Agreement, duties on Canadian softwood lumber exports to the US are now in effect. When market prices are low as they are currently, the duties are absorbed by the producer, putting downward pressure on margins.
  - The average combined duty rate is 20.83% and applies to most Canadian lumber exporters

#### Other Considerations

- Concerns with respect to regulatory issues (including caribou range management and the *Species at Risk Act*), as well as access to/allocation of forest tenure
- Advantages in US South with respect to growing conditions, regeneration rates, private land and better ability to grow fibre
- Southern US states may also offer incentives (e.g. tax holidays/rural incentives) on a project-by-project basis
- Property taxes in BC viewed as a competitiveness issue, though not quantified in the analysis



## COMPETITIVENESS MODELLING

### Lumber – BC Interior

Cost Inputs (USD per MBF) for Existing Facilities

	BC Interior	Prairies	US South
<b>Labour</b>	\$50.19	\$53.23	\$61.65
<b>Stumpage</b>	\$54.84 <sup>1</sup>	\$37.13	\$91.69
<b>Harvest and delivery</b>	\$173.33	\$129.97	\$77.57
<b>Energy</b>	\$10.38	\$8.50	\$12.46
<b>Miscellaneous costs</b>	\$26.82	\$33.45	\$44.01
<b>Overhead<sup>2</sup></b>	\$11.00	\$11.64	\$18.87
<b>Capital<sup>3</sup></b>	\$13.57	\$20.37	\$10.85

Source: Forest Economic Advisors (FEA) 2018 modelled costs for BC Interior and US South, unless otherwise noted. Cost inputs were calculated for the Prairies based on costs relative to BC Interior from 2016 Wood Markets data.

<sup>1</sup> Estimate provided by Ministry of Forests, Lands, Natural Resource Operations and Rural Development for 2019 YTD (March).

<sup>2</sup> Calculated as a percentage of variable costs for all jurisdictions per 2016 data from Wood Markets.

<sup>3</sup> Ibid.

## COMPETITIVENESS MODELLING

### Lumber – BC Coast

Cost Inputs (USD per MBF) for Existing Facilities

	BC Coast	US West Coast
<b>Labour</b>	\$84.50	\$50.19
<b>Stumpage</b>	\$81.74 <sup>1</sup>	\$164.43
<b>Harvest and delivery</b>	\$245.05	\$137.61
<b>Energy</b>	\$16.56	\$9.19
<b>Miscellaneous costs</b>	\$42.79	\$32.07
<b>Overhead<sup>2</sup></b>	\$18.21	\$18.20
<b>Capital<sup>3</sup></b>	\$16.51	\$12.33

Source: Forest Economic Advisors (FEA) 2018 modelled costs for US West Coast. Cost inputs were calculated for the BC Coast based on costs relative to BC Interior from 2016 Wood Markets data.

<sup>1</sup> Estimate provided by Ministry of Forests, Lands, Natural Resource Operations and Rural Development for 2019 YTD (March).

<sup>2</sup> Calculated as a percentage of variable costs for all jurisdictions per 2016 data from Wood Markets.

<sup>3</sup> Ibid.

## COMPETITIVENESS MODELLING

### Lumber – BC Interior

Key Assumptions (for 2017 base year and 2022 policy change year, unless previously noted)

	BC Interior	Prairies (Alberta) <sup>1</sup>	US South (Georgia) <sup>2</sup>
<b>Commodity Price (SPF 2x4 lumber price in USD)<sup>3</sup></b>	\$377/MBF	\$377/MBF	\$377/MBF
<b>Average lumber revenue (FOB mill) relative to SPF price<sup>4</sup></b>	94%	79%	113%
<b>Corporate Income Tax</b>	26% (2017) 27% (2022)	27% (2017) 23% (2022)	41% (2017) 27% (2022)
<b>Softwood Duties</b>	Calculated as 20.83% of lumber revenue, applied to share of production exported to US		n/a
<b>Carbon tax (USD per tonne CO<sub>2</sub>e)</b>	\$23.08 (2017)	\$15.38	No tax on industry
<b>Motor Fuel Tax – gasoline (USD)</b>	\$0.11/L	\$0.10/L	\$0.07/L
<b>Motor Fuel Tax – diesel (USD)</b>	\$0.12/L	\$0.00/L	\$0.08/L
<b>Provincial/state sales tax</b>	7%		7%
<b>Payroll Tax</b>			1.45% employer-paid portion of Medicare

<sup>1</sup> Taxes for the region are based on those applied in Alberta. Although Alberta recently repealed its carbon levy, as of January 1, 2020, heavy emitters are expected to be subject to a \$20/tonne carbon price through the TIER program, while consumers and businesses may be subject to the federal backstop.

<sup>2</sup> Taxes for the region are based on those applied in Georgia.

<sup>3</sup> SPF 2x4 lumber price (FOB mill) 2019 YTD (March). Source: Province of BC. Weekly Price Report for the week ending 29-Mar-19.

<sup>4</sup> Based on ratio of 2016 average lumber revenue (Wood Markets) to 2016 average SPF 2x4 lumber price for each jurisdiction.

## COMPETITIVENESS MODELLING

### Lumber – BC Coast

Key Assumptions (for 2017 base year and 2022 policy change year, unless previously noted)

	BC Coast	US West Coast (Oregon) <sup>1</sup>
<b>Commodity Price (SPF 2x4 lumber price in USD)<sup>2</sup></b>	\$377/MBF	\$377/MBF
<b>Average lumber revenue (FOB mill) relative to SPF price<sup>3</sup></b>	148%	110%
<b>Corporate Income Tax</b>	26% (2017) 27% (2022)	43% (2017) 29% (2022)
<b>Softwood Duties</b>	Calculated as 20.83% of lumber revenue, applied to share of production exported to US	n/a
<b>Carbon tax (USD)</b>	\$23.08/ tonne CO <sub>2</sub> e (2017)	No tax on industry
<b>Motor Fuel Tax – gasoline (USD)</b>	\$0.11/L	\$0.08/L
<b>Motor Fuel Tax – diesel (USD)</b>	\$0.12/L	\$0.08/L
<b>Sales tax on goods and services</b>	7%	0%
<b>Payroll Tax</b>		1.45% employer-paid portion of Medicare

<sup>1</sup> Taxes for the region are based on those applied in Oregon.

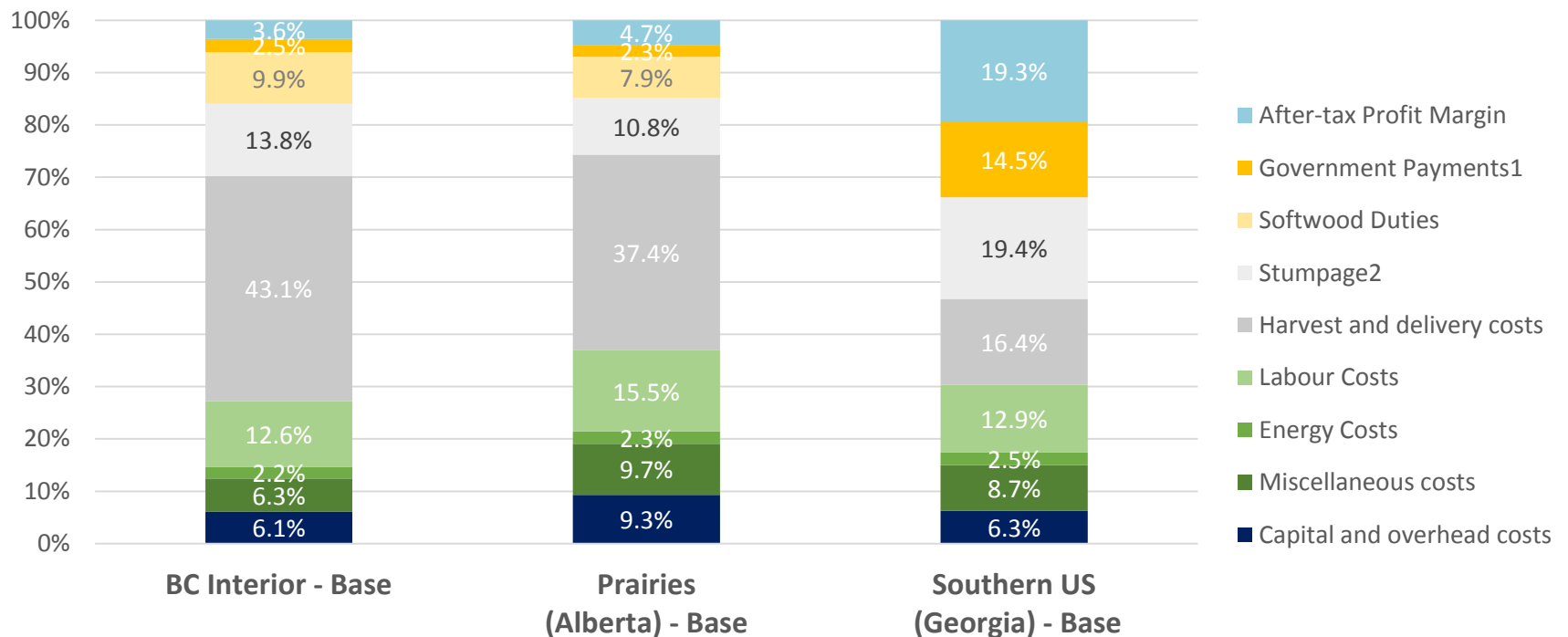
<sup>2</sup> SPF 2x4 lumber price (FOB mill) 2019 YTD (March). Source: Province of BC. Weekly Price Report for the week ending 29-Mar-19.

<sup>3</sup> Based on ratio of 2016 average lumber revenue (Wood Markets) to 2016 average SPF 2x4 lumber price for each jurisdiction.

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## Lumber – BC Interior

**Comparison of BC Interior and Competing Jurisdictions After-tax Profit Margin  
(at \$377 USD SPF 2x4 Lumber Price)**



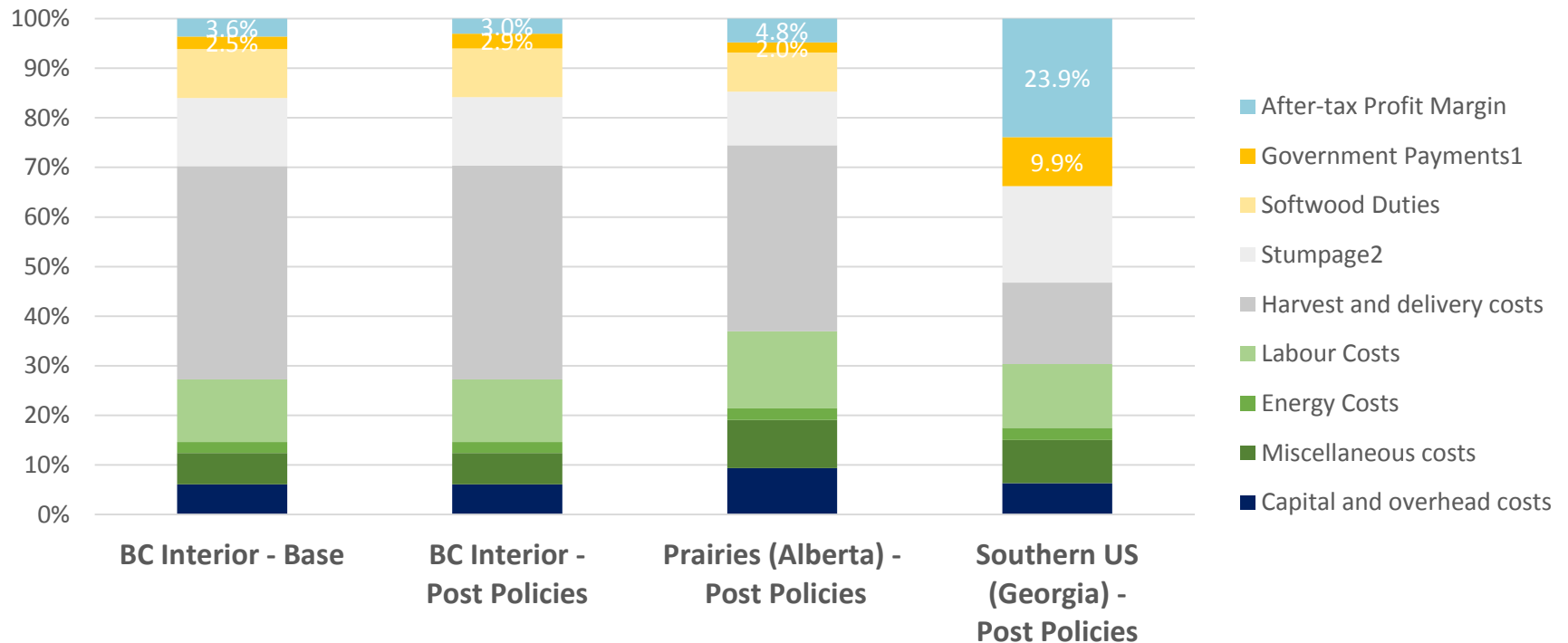
<sup>1</sup> Includes carbon tax, PST, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

<sup>2</sup> In BC and Alberta, stumpage fees are payments to government as landowner for access to wood supply. In the US South, it is our understanding that stumpage is paid to private land owners.

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## Lumber – BC Interior

**Comparison of BC Interior and Competing Jurisdictions: Post Policy Changes**  
**(at \$377 USD SPF 2x4 Lumber Price)**



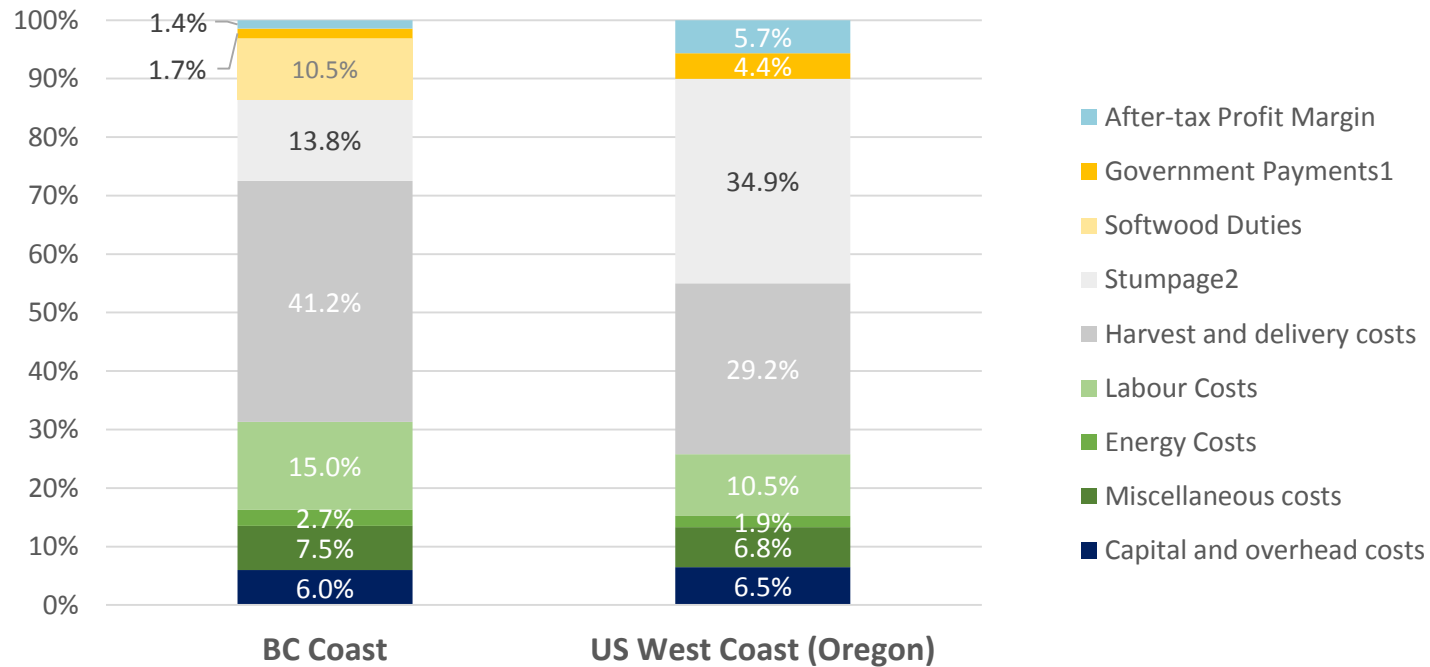
<sup>1</sup> Includes carbon tax, PST, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

<sup>2</sup> In BC and Alberta, stumpage fees are payments to government as landowner for access to wood supply. In the US South, it is our understanding that stumpage is paid to private land owners.

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## Lumber – BC Coast

**Comparison of BC Coast and US West Coast After-tax Profit Margin  
(at \$377 USD SPF 2x4 Lumber Price)**



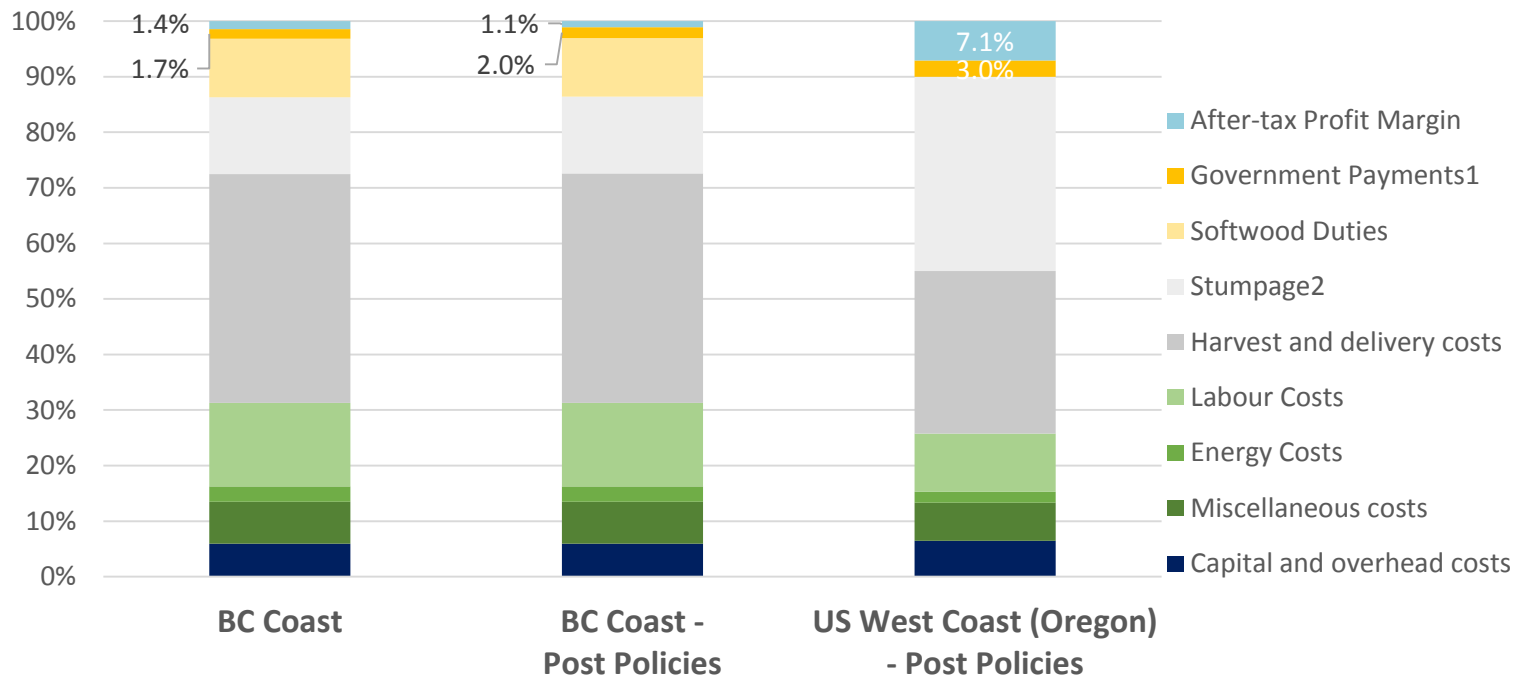
<sup>1</sup> Includes carbon tax, PST, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

<sup>2</sup> In BC, stumpage fees are payments to government as landowner for access to wood supply. In the US West Coast, it is our understanding that stumpage is paid to private land owners.

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## Lumber – BC Coast

**Comparison of BC Coast and US West Coast: Post Policy Changes  
(at \$377 USD SPF 2x4 Lumber Price)**



<sup>1</sup> Includes carbon tax, PST, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

<sup>2</sup> In BC, stumpage fees are payments to government as landowner for access to wood supply. In the US West Coast, it is our understanding that stumpage is paid to private land owners.



## **PULP AND PAPER**

### **Key Factors Affecting Competitiveness**

#### **Sawmills**

- As sawmills are the main suppliers of wood chips to pulp producers, challenges faced by the BC lumber sector, mainly fibre supply constraints, softwood lumber duties and regulatory issues, also impact the pulp industry
- BC fibre supply is shrinking due the mountain pine beetle infestation and forest fires with the annual allowable cut (AAC) on a downward trend

#### **Substitution effects**

- Lower cost hardwood pulps (e.g. BHK) are increasing in market share and are generally produced by lower cost jurisdictions such as Brazil and Indonesia

#### **Other considerations**

- Property taxes in BC viewed as a competitiveness issue, though not quantified in the analysis
- Uncertainty surrounding value of Electricity Purchase Agreement renewals, which act as a supplemental revenue source for many pulp mills

## COMPETITIVENESS MODELLING

### Northern Bleached Softwood Kraft (NBSK) Pulp

Cost Inputs (USD per ADMT) for Existing Facilities

	BC Interior	BC Coast	Finland	Sweden	Chile
<b>Delivered fibre costs</b>	\$265.96	\$277.01	\$296.94	\$281.70	\$168.26
<b>Chemical costs</b>	\$65.17	\$63.55	\$69.61	\$68.14	\$75.28
<b>Labour</b>	\$63.94	\$64.17	\$30.46	\$56.95	\$18.82
<b>Energy</b>	\$18.82	\$32.56	-\$4.13	\$7.02	-\$17.98
<b>Other materials</b>	\$43.00	\$50.83	\$45.68	\$46.78	\$57.56
<b>Transportation costs</b>	\$65.46	\$32.81	\$39.16	\$39.66	\$42.07
<b>Overhead<sup>1</sup></b>	\$10.42	\$10.45	\$9.55	\$10.01	\$6.88
<b>Capital costs<sup>2</sup></b>	\$52.09	\$52.24	\$47.77	\$50.03	\$34.40

Source: Data on average variable costs for the BC Interior and BC Coast reflect RISI 2018 Q4 Market Cash Cost Curve Report obtained through the BC Ministry of Forests, Lands and Natural Resource Operations. Data for Finland, Sweden and Chile were estimated from 2015 RISI data, inflated to 2018 based on CPI and energy price inflation in each jurisdiction. Transportation costs are delivered to Shanghai.

<sup>1,2</sup> Please note that due to data limitations, overhead costs and capital costs were calculated as a percentage of total variable costs (at 2% and 10%, respectively) based on a review of company annual reports. This assumption was applied across jurisdictions.

## COMPETITIVENESS MODELLING

### NBSK Pulp

Key Assumptions (for 2017 base year and 2022 policy change year, unless previously noted)

	BC	Finland	Sweden	Chile
<b>Commodity Price (USD per ADMT)<sup>1</sup></b>	\$708/ADMT	\$708/ADMT	\$708/ADMT	\$708/ADMT
<b>Corporate Income Tax</b>	26% (2017) 27% (2022)	20%	22%	25%
<b>Payroll Tax</b>		0.86%		
<b>Carbon tax (USD per tonne CO<sub>2</sub>e)<sup>2</sup></b>	\$23.08 (2017)	\$6.50 (2017) \$28.69 (2022)	\$6.50 (2017) \$28.69 (2022)	No tax on industry
<b>Sales tax on goods and services</b>	7%	Finland has a value-added sales tax.	Sweden has a value-added sales tax.	Chile has a value-added sales tax.

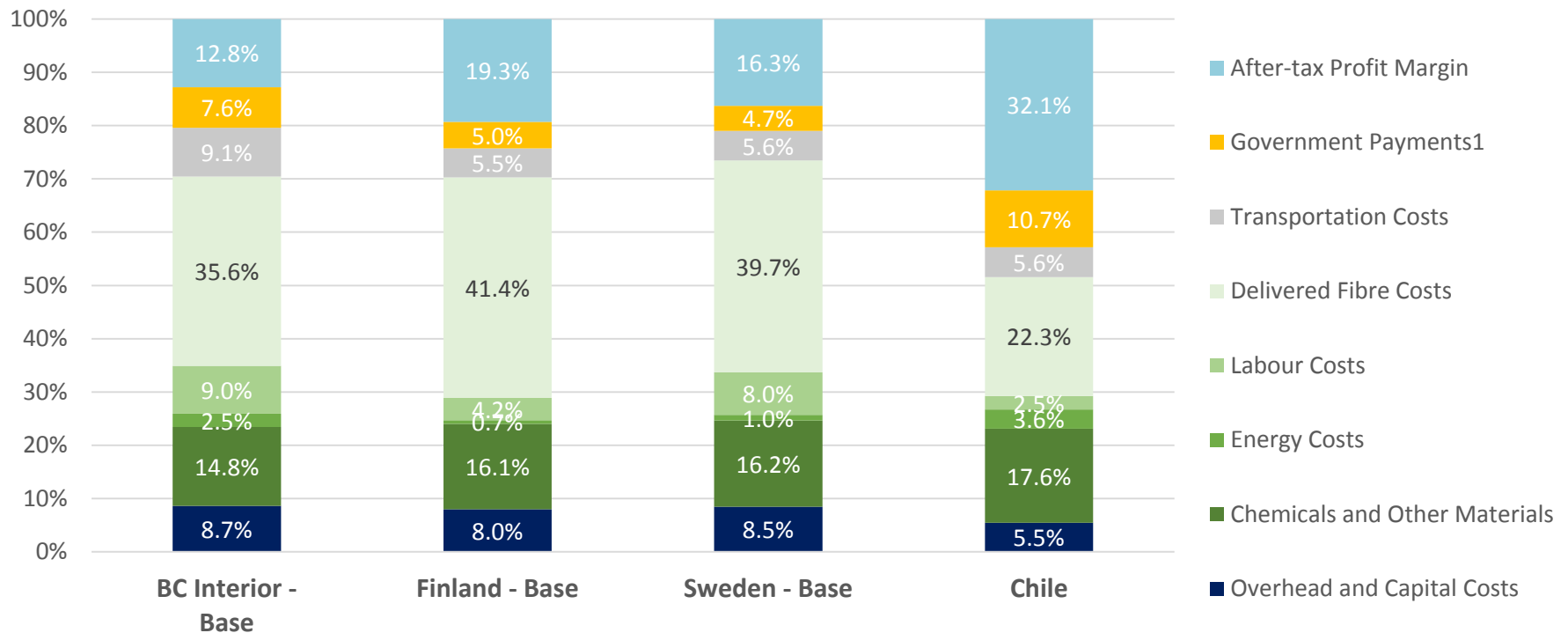
<sup>1</sup> Four year historical average NBSK pulp price delivered to China (2015 to 2018). Source: Resource Information Systems, Inc. as reported in Canfor Pulp 2018 Annual Report

<sup>2</sup> The pulp sectors in Finland and Sweden are subject to the EU Emissions Trading System (ETS). The average price of emissions allowances in the ETS was 5.76 euros (\$6.50 USD) in 2017. The 2022 futures price of emissions allowances is currently 25.49 euros (\$28.69 USD). Sources: EU Emissions Trading System, [https://ec.europa.eu/clima/policies/ets\\_en](https://ec.europa.eu/clima/policies/ets_en); Markets Insider, CO2 European Emission Allowances Historical Prices [https://markets.businessinsider.com/commodities/historical-prices/co2-emissionsrechte/euro/1.1.2017\\_31.12.2017](https://markets.businessinsider.com/commodities/historical-prices/co2-emissionsrechte/euro/1.1.2017_31.12.2017); EUA Futures, accessed June 4, 2019: <https://www.theice.com/products/197/EUA-Futures/data?marketId=5115270>

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## NBSK Pulp

**Comparison of BC Interior and Competing Jurisdictions After-tax Profit Margin  
(at \$708 USD per ADMT average NBSK Pulp Price delivered to China)**

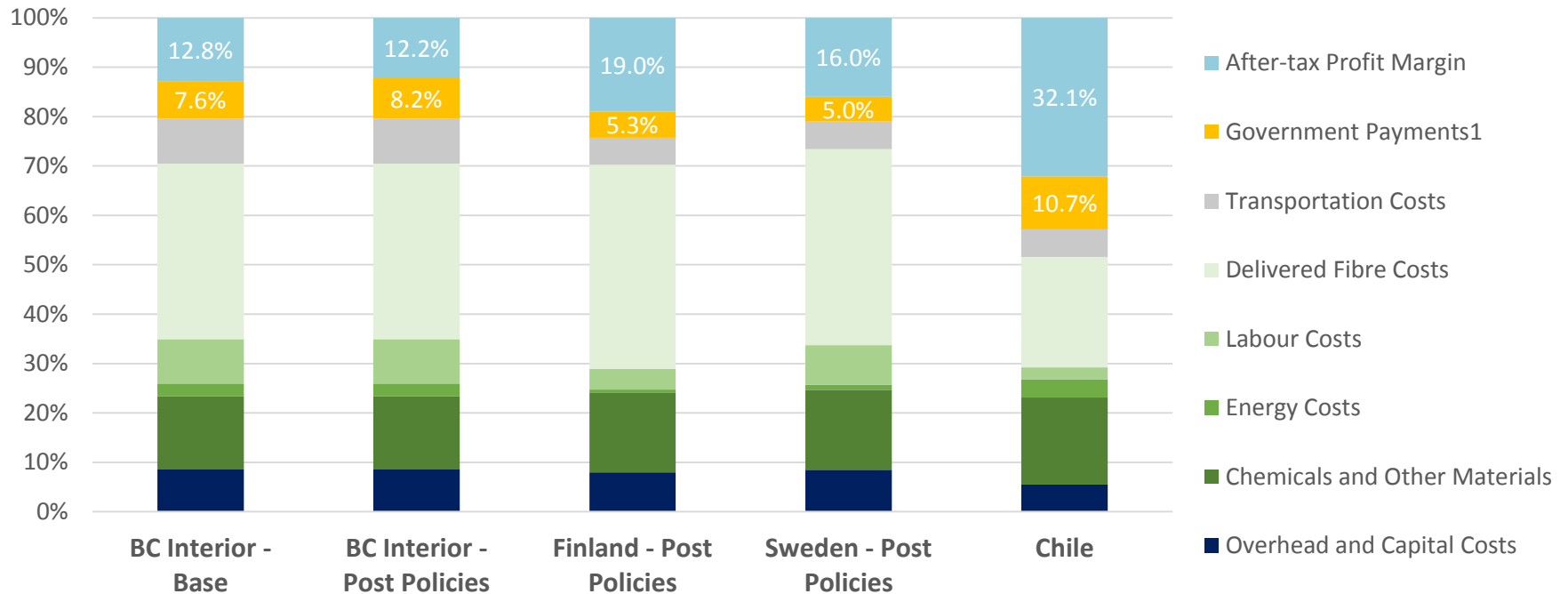


<sup>1</sup> Includes carbon tax, sales taxes, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## NBSK Pulp

**Comparison of BC Interior and Competing Jurisdictions: Post Policy Changes**  
**(at \$708 USD per ADMT average NBSK Pulp Price delivered to China)**

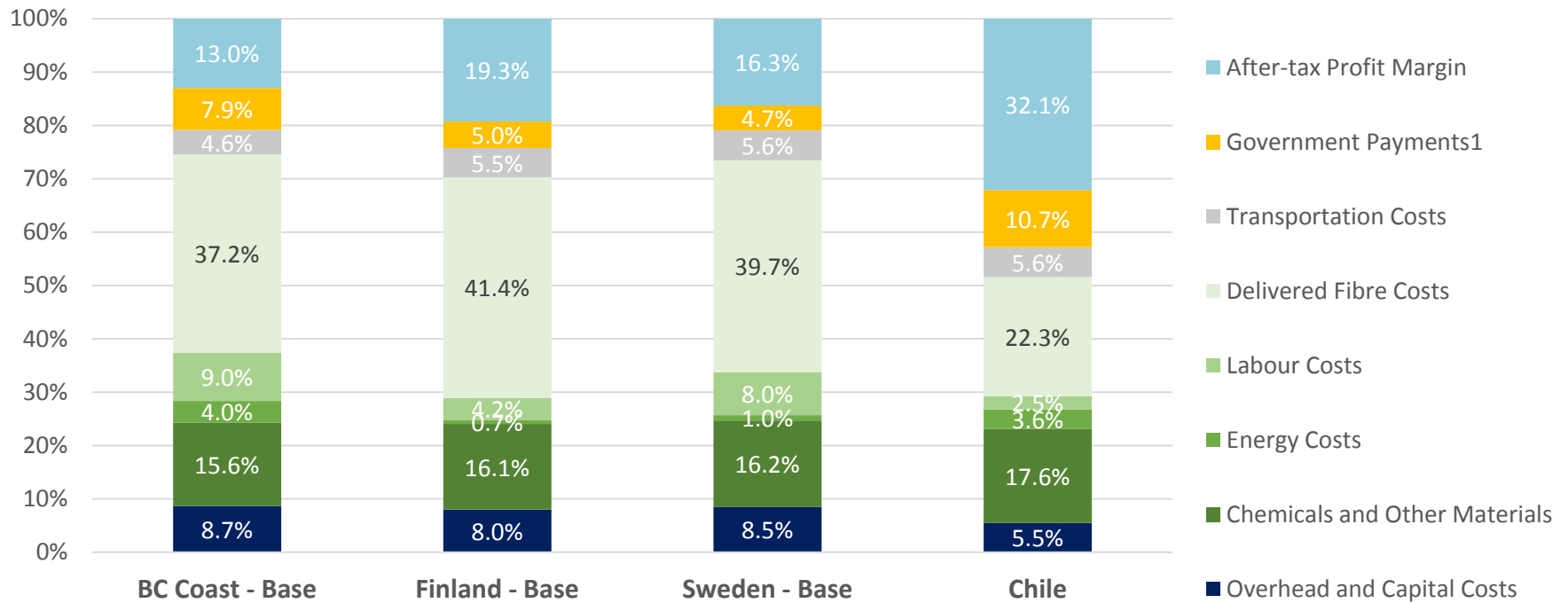


<sup>1</sup> Includes carbon tax, sales taxes, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## NBSK Pulp

**Comparison of BC Coast and Competing Jurisdictions After-tax Profit Margin  
(at \$708 USD per ADMT average NBSK Pulp Price delivered to China)**

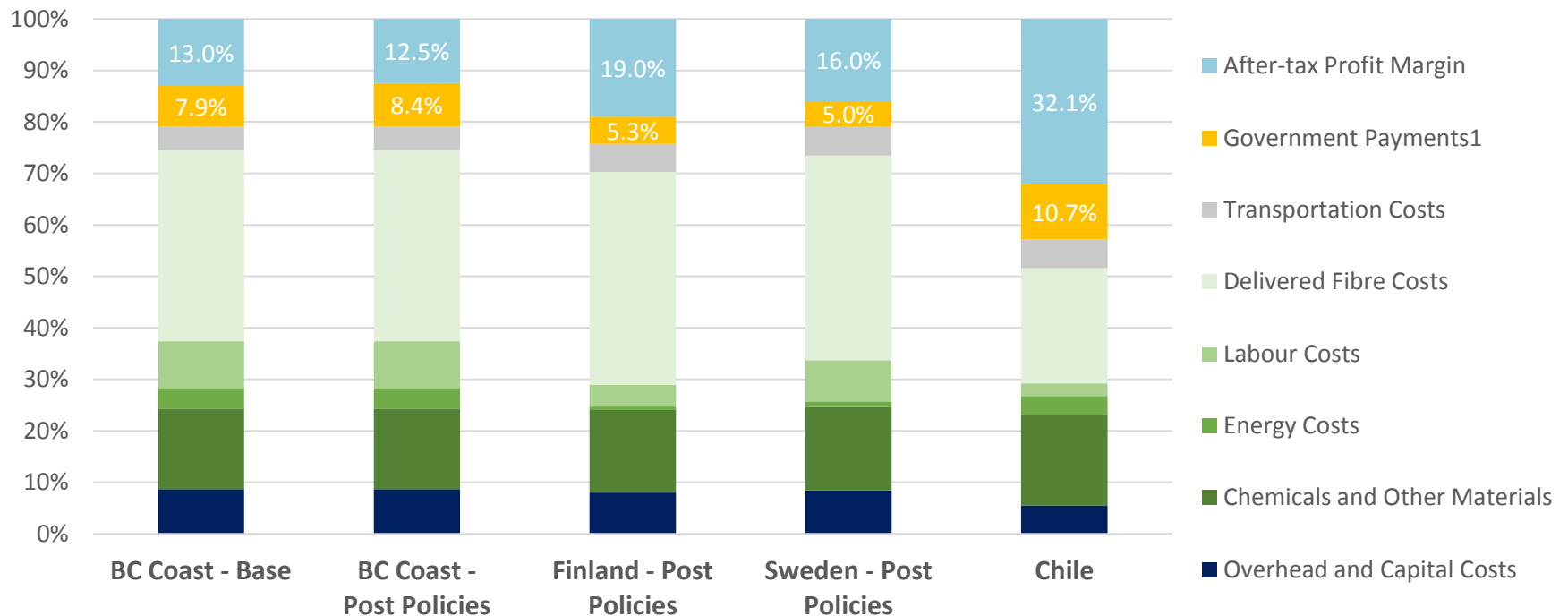


<sup>1</sup> Includes carbon tax, sales taxes, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

# PROFIT MARGIN ANALYSIS (EXISTING FACILITIES)

## NBSK Pulp

**Comparison of BC Coast and Competing Jurisdictions: Post Policy Changes**  
**(at \$708 USD per ADMT average NBSK Pulp Price delivered to China)**



<sup>1</sup> Includes carbon tax, sales taxes, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

## COMPETITIVENESS MODELLING

### Upstream Liquids Rich Natural Gas

Cost and Revenue Inputs (CAD per produced mcf) for New Investment

	BC (Montney)	Texas (Permian)
Energy Operating Expenditures <sup>1</sup>	\$0.16	\$0.22
Non-energy Operating Expenditures	\$1.19	\$0.90
Transportation	\$0.71	\$0.75
Corporate Overhead and Capital Expenditures	\$2.13	\$4.94
Realized Revenue <sup>2</sup>	\$5.83	\$12.00

Source: Wood Mackenzie averages across representative liquids rich natural gas plays for each jurisdiction provided through the Canadian Association of Petroleum Producers.

<sup>1</sup> The difference in energy cost reflects the higher realized natural gas prices in the US.

<sup>2</sup> The higher realized price per produced mcf in the US is a result of greater gas percentage in Montney / higher liquids content in US wells modelled and higher US commodity prices.



# COMPETITIVENESS MODELLING

## Upstream Liquids Rich Natural Gas

Key Assumptions (for 2017 base year and 2022 policy change year, unless previously noted)

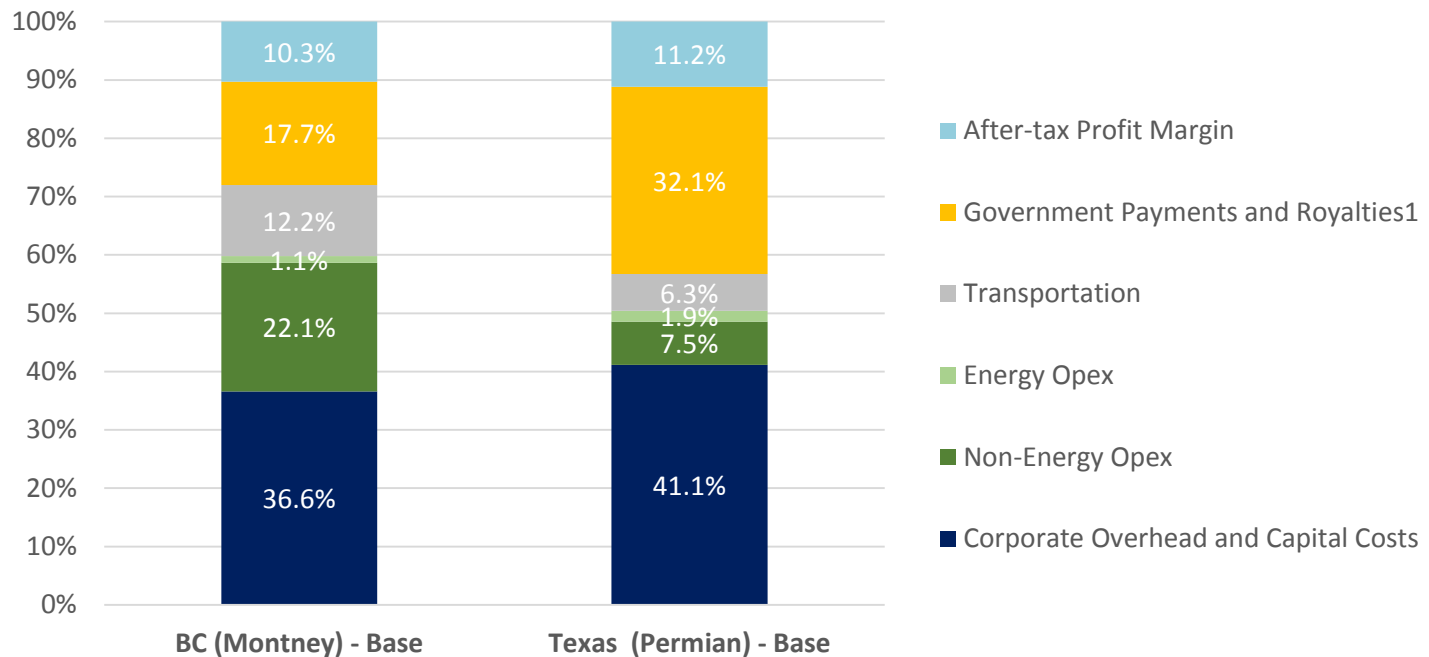
	BC (Montney)	Texas (Permian)
<b>Corporate Income Tax<sup>1</sup></b>	26% (Base) 27% (Post Policies)	35% (Base) 21% (Post Policies)
<b>Carbon tax (CAD)</b>	\$30/tonne (Base) \$40/tonne (Post Policies)	No carbon tax
<b>Royalties</b>	11.5% effective rate	20.3% effective rate (mostly paid to private land owners)
<b>Methane Regulations</b>	1.5 cents per mcf	0.375 cents per mcf (25% of BC costs)
<b>Accelerated Capital Cost Allowances</b>	Elimination of half-year rule and 50% capital cost uplift on first year depreciation. (Post Policies)	Temporary immediate deductibility of capital cost for certain tangible capital investments. (Post Policies)
<b>Electrification</b>	Increase in energy opex from \$0.16/mcf to \$0.41/mcf at \$65/MWh Reduction in carbon combustion emissions (and carbon tax payable) by 85%	n/a

<sup>1</sup> While Texas does not have a state corporate income tax, it does have a Severance Tax of 7.5% on the value of natural gas produced and a Franchise Tax of 0.75%.

# PROFIT MARGIN ANALYSIS (NEW INVESTMENT)

## Upstream Liquids Rich Natural Gas

**BC and Texas Comparison of After-tax Profit Margin**  
(shown as share of revenue over life of investment)



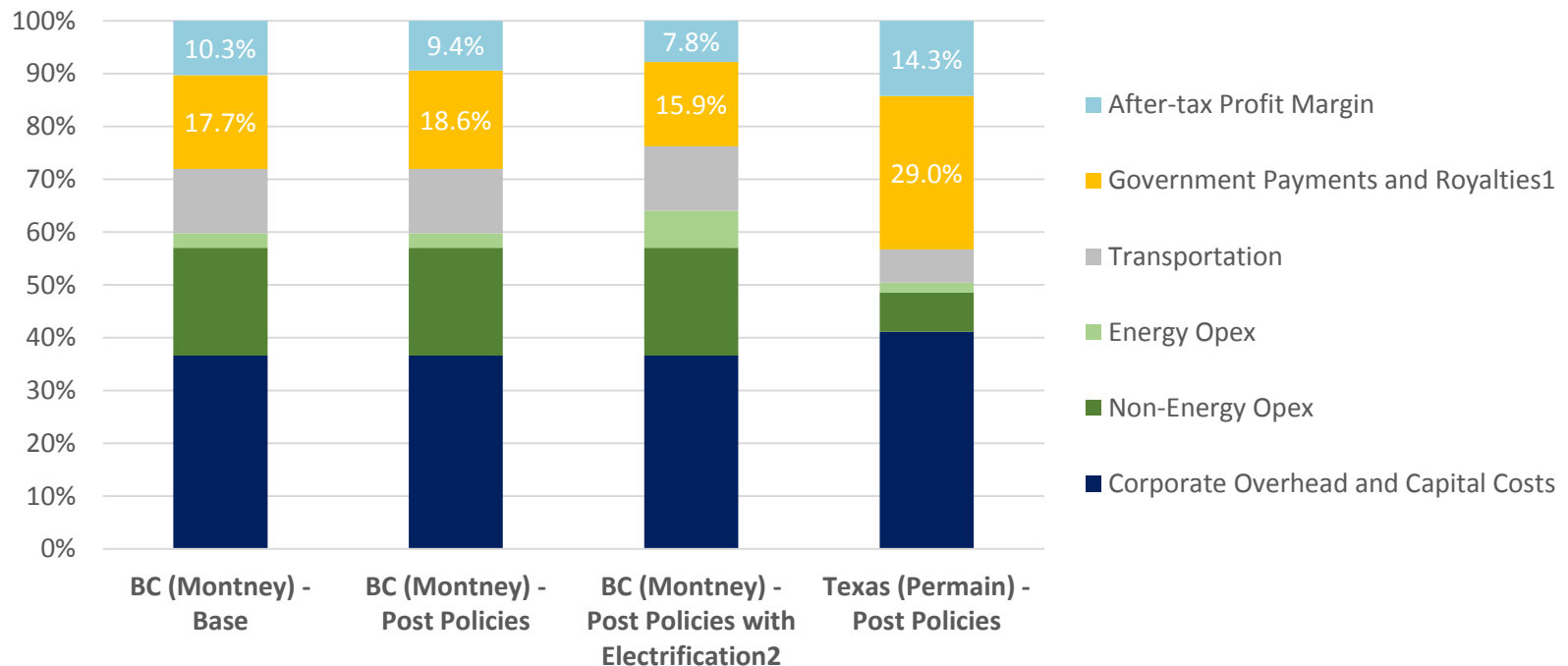
<sup>1</sup> Government payments and royalties include corporate income tax and public and private royalties. It does not include state or provincial sales taxes or property taxes.

Please note that natural gas results were generated using the Wood Mackenzie Global Economic Model by the Canadian Association of Petroleum Producers.

# PROFIT MARGIN ANALYSIS (NEW INVESTMENT)

## Upstream Liquids Rich Natural Gas

**After-tax Profit Margin: Pre and Post Policy Changes**  
(shown as share of revenue over life of investment)



<sup>1</sup> Government payments and royalties include corporate income tax and public and private royalties. It does not include state or provincial sales taxes or property taxes.

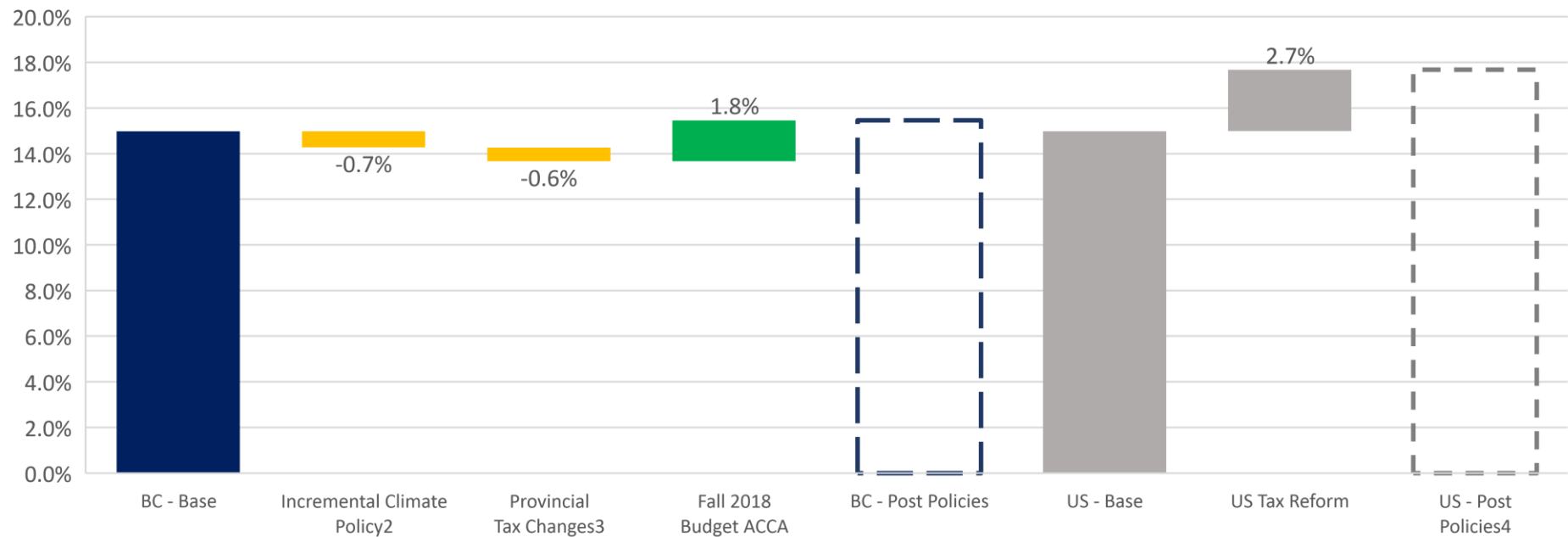
<sup>2</sup> Electrification scenario results in higher energy operating expenditures based on the cost differential between natural gas and electricity.

Please note that natural gas results were generated using the Wood Mackenzie Global Economic Model by the Canadian Association of Petroleum Producers.

# PROJECT IRR ANALYSIS (NEW INVESTMENT)

## Upstream Liquids Rich Natural Gas

**Impacts on After-tax IRR<sup>1</sup>**  
(at \$2 AECO USD/mcf, \$59 WTI USD/bbl)



<sup>1</sup> Includes corporate overhead costs.

<sup>2</sup> Incremental climate policy includes incremental carbon tax (above \$30/tonne) and methane regulations.

<sup>3</sup> Provincial Tax Changes includes Employer Health Tax, PST exemption on electricity and increase in Corporate Income Tax.

<sup>4</sup> Shown for illustration purposes. Assuming a similar base IRR as BC of 15% based on similar margins, this shows the impact of the US Tax Reform on competitiveness (2.7%).

Please note that the IRR results were generated using the Wood Mackenzie Global Economic Model by the Canadian Association of Petroleum Producers.

## COMPETITIVENESS MODELLING

### LNG

- A study completed by IHS Markit on behalf of the BC LNG Alliance (September 2017 and April 2018 Update) assessed the competitiveness of BC LNG projects and the impact of policy changes on competitiveness
- The Province (EMPR) and industry (LNG Alliance) are in current discussions regarding updating this analysis based on more recent data and assumptions.

## SUMMARY OF COMPETITIVENESS RESULTS

- Base case assessment (prior to any policy changes) showed that BC generally has competitiveness challenges relative to competing jurisdictions based on a comparison of costs/profit margins.
- For existing facilities, the incremental policy changes that were modelled resulted in a deterioration of competitiveness through a reduction in profit of between 2% to 24% across sectors.
- While the policy changes modelled led to reduced profit margins in BC, policy changes in key competing jurisdictions resulted in an improvement in profit margins for many of BC's competing jurisdictions.
- The differentials in profit margins widened as a result of policy changes occurring both in BC and in competing jurisdictions. With only one exception, profit margins were estimated to be 12% to 87% lower in BC than those in key competing jurisdictions, post policy changes.
- For new investment, modelling results indicate that the accelerated capital cost allowances may partially or fully offset the impact of recent policy changes in BC for metallurgical coal, copper and natural gas.

## Key Themes from Competitiveness Analysis

Key themes arising from the competitiveness analysis, including MNP's review of background materials and discussions with industry stakeholders, are as follows:

- **Regulatory uncertainty** – growing level of uncertainty with respect to regulatory issues at both the provincial and federal level for existing operations and new investment.
- **Higher capital costs, smaller scale facilities and/or competing with new facilities** – relative to competing jurisdictions, some sectors have higher capital costs for attracting new investment or are competing with newer and larger scale facilities (e.g., copper, pulp).
- **Transportation/infrastructure challenges** – farther distances to port (e.g., metallurgical coal) or market access constraints (e.g., natural gas).
- **Resource quality/access** – lower quality resource (e.g., copper ore grades, liquids content in natural gas plays) or lack of supply (e.g. fibre supply constraints) affecting BC's competitiveness.
- **Competition for investment** – key competing jurisdictions (e.g., US, Alberta) are reducing their corporate income tax rates to attract investment.
- **Differences in climate policy** – lack of carbon pricing or repeal of carbon tax in key competing jurisdictions (e.g., Australia, Chile, US) or policies that are less stringent than BC.

## APPENDIX A: SENSITIVITY ANALYSIS



## SENSITIVITY ANALYSIS

The following slides show examples of the impact of climate policy over time and under a range of commodity price scenarios.

The climate policy scenarios included in the modelling are noted below:

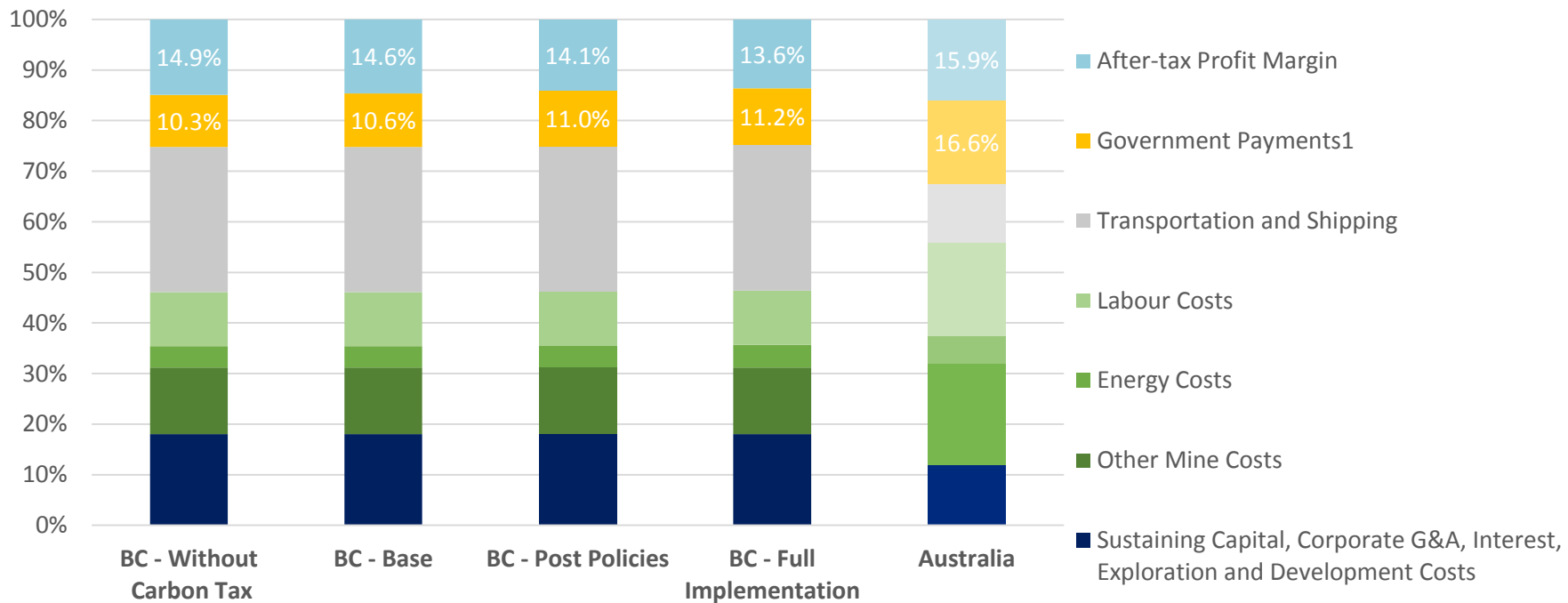
Scenario	Carbon Tax	Corporate Income Tax	Low Carbon Fuel Standard	Renewable Natural Gas
<b>BC – Without Carbon Tax</b>	-	27%	-	-
<b>BC – Base</b>	\$30/tonne	26%	No impact	-
<b>BC – Post Policies</b>	\$40/tonne <sup>1</sup>	27%	\$135/tonne based on 7% incremental reduction	-
<b>BC – Full Implementation</b>	\$40/tonne	27%	\$135/tonne based on 15% incremental reduction	\$30/GJ based on 15% renewable natural gas target

<sup>1</sup> Incremental \$20/tonne assuming a 50% rebate through the Clean Growth Incentive Program for Industry.

## SENSITIVITY ON CLIMATE POLICY

### Metallurgical Coal (Existing Operations)

**Sensitivity Analysis: Climate Policy Scenarios**  
(at \$145/tonne benchmark coal price, shown as share of revenue)

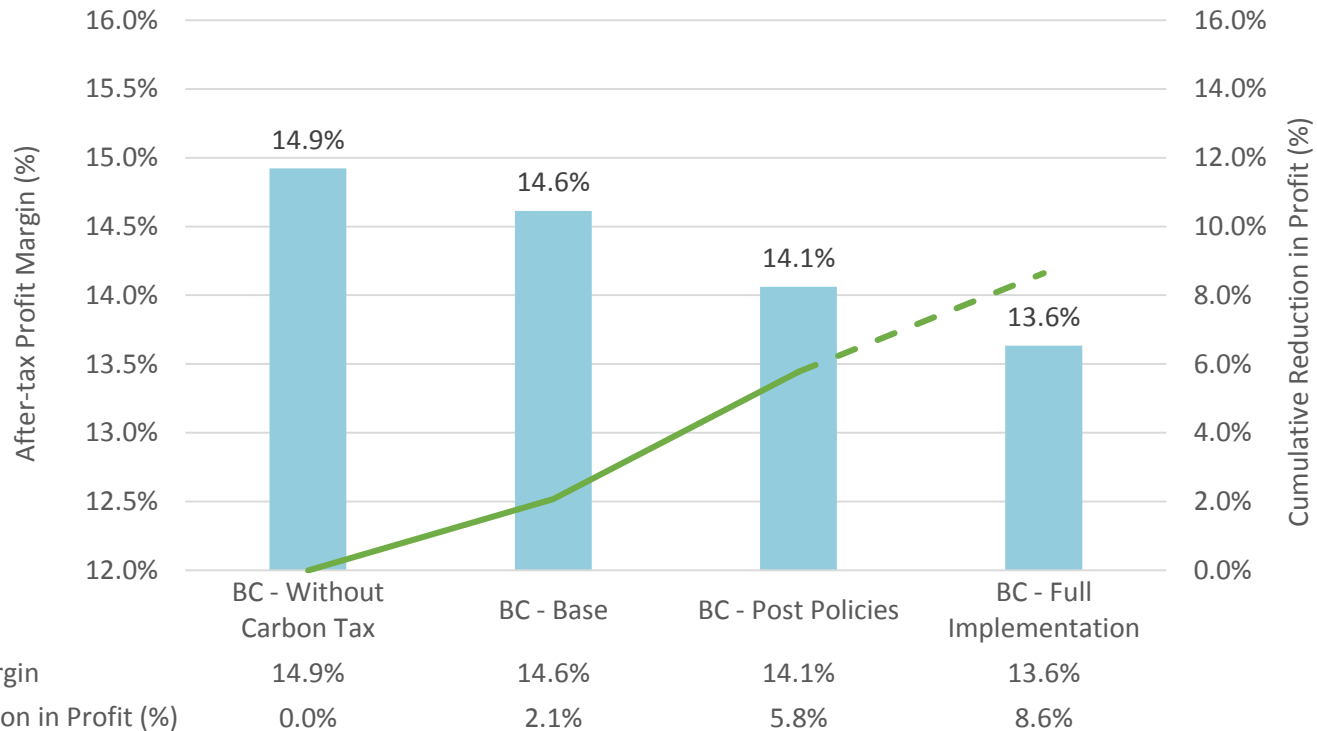


<sup>1</sup> Includes carbon tax, PST, mineral tax/royalties, payroll tax and corporate income tax. Does not include property taxes or any other provincial/municipal taxes.

# SENSITIVITY ON CLIMATE POLICY

## Metallurgical Coal (Existing Facilities)

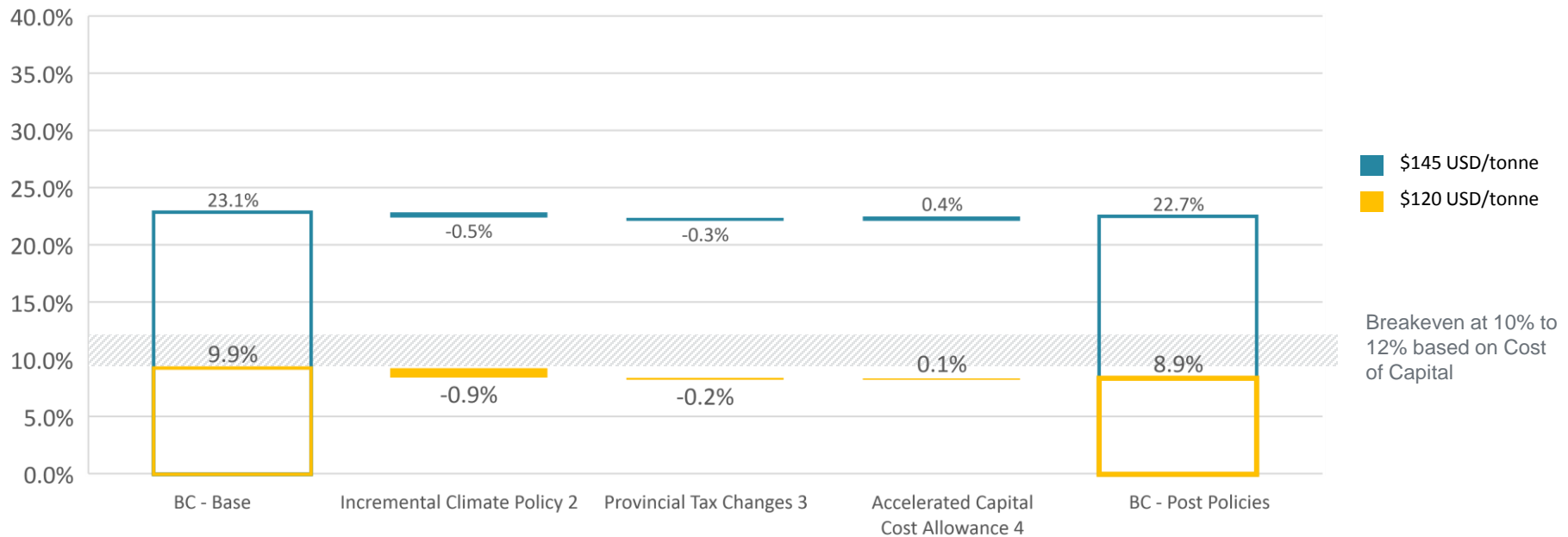
**Sensitivity Analysis: Impact of Policy Changes on BC After-tax Profit Margin  
(at \$145/tonne benchmark coal price)**



# SENSITIVITY ON COMMODITY PRICE

## Metallurgical Coal (New Investment)

### Greater Impact of Incremental Climate Policy in Commodity Price Downturns: After-Tax Project IRR<sup>1</sup>



<sup>1</sup> After-tax Project IRR excludes corporate overhead expenses from net cash flow.

<sup>2</sup> Incremental Climate Policy includes incremental carbon tax (above \$30/tonne), renewable and low carbon fuel standard and renewable natural gas targets.

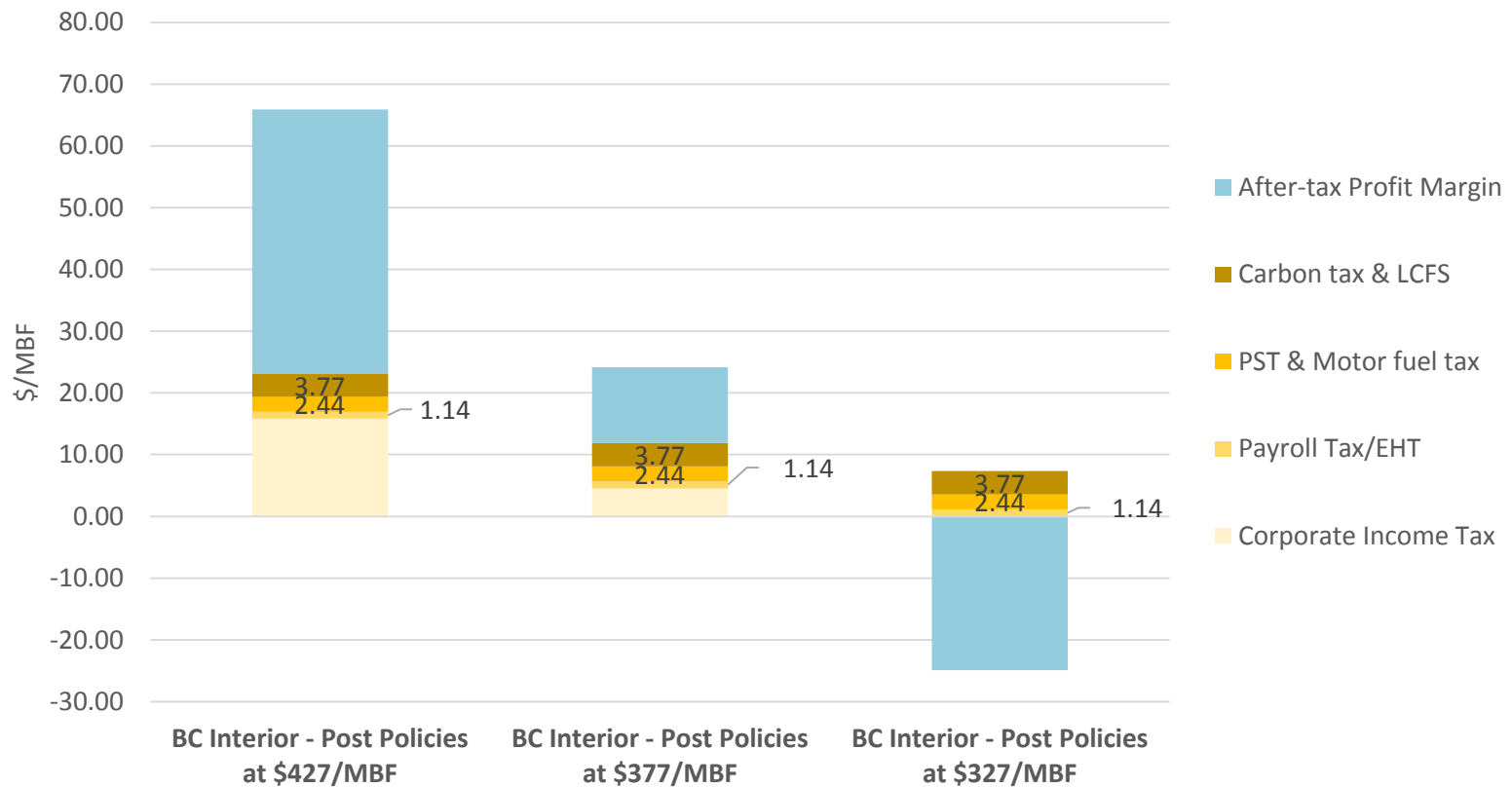
<sup>3</sup> Provincial Tax Changes includes PST exemption on electricity, Employer Health Tax and increase in Corporate Income Tax.

<sup>4</sup> Accelerated Investment Incentive per the 2018 Federal Fall Economic Update.

# SENSITIVITY ON COMMODITY PRICE

## Lumber (Existing Operations)

Incremental Policy Changes Insensitive to Commodity Price Cycles  
(shown as costs per unit of production)



## SUMMARY OF SENSITIVITY ANALYSIS

- Over time, trends in climate policy have increased, or are expected to increase, the cost of doing business in BC. All else equal, this will result in a continued deterioration of profit margins for BC businesses in emissions intensive and trade exposed (EITE) sectors.
- As most of the incremental costs to industry are tied to production or activity levels (rather than to profitability), the modelled policy impacts are shown to be greater in a low commodity price environment.

## APPENDIX B: REPORT LIMITATIONS

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