Assessing Policy Support for Emissions Intensive and Trade Exposed Industries

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Abstract

Jurisdictions implementing emissions pricing often face concerns arising from emissions-intensive and trade exposed (EITE) industries. These industries face higher costs than counterparts in other jurisdictions without emissions pricing. There is also risk of emissions leakage, where economic activity from EITE industries in a jurisdiction with emissions pricing leaves for jurisdictions without pricing. When leakage occurs it leads to lower economic activity in the jurisdiction with an emissions price, as well as a lower net reduction in global emissions. As a result of these two concerns, jurisdictions implementing carbon pricing often implement complementary policy to mitigate the cost impacts on EITE industries. In this paper we provide an overview of the EITE definitions and support policies in place in Canada and compare those to definitions and policies in Australia, California and the European Union. We evaluate both domestic and international EITE support policies using the metrics of administrative costs, economic efficiency, emissions reduction incentive, and equity across and within sectors.

Keywords: emissions policy, energy-intensive and trade-exposed industries, output-based allocations

Policy Recommendations

- The goal of the EITE support policies is to limit carbon leakage – preventing declines in output as a result of emissions pricing – while maintaining emissions reductions.
- Output-based allocations are most effective and more equitable (of the policies examined) in mitigating costs of emissions pricing, reducing leakage while also maintaining the incentive of the emissions price.
- Standardized industry-level emissions-intensity benchmarks for determining the level of subsidy are preferable to facility-level benchmarks on efficiency and equity grounds, and are less administratively costly.
- The emissions-intensity benchmark should have a tightening rate that is independent of current production and emissions, to ensure firms do not limit their emissions reduction to gain higher free allocations in the future.
- Any EITE support policy should appropriately define what an EITE industry is, and apply the subsidy to only EITE industries.

Introduction

Numerous countries, including Canada, have implemented emissions-pricing regimes. Starting in January 2019, carbon pricing will be implemented in all Canadian provinces and territories. The introduction of carbon pricing within Canada, combined with limited adoption elsewhere in the world, has raised concerns about the competitiveness of Canadian industries in the presence of increased costs from carbon pricing. As a result, Canadian federal and provincial governments have implemented complementary policies designed to mitigate these competitiveness concerns. Similar policies are also common in international jurisdictions with emissions pricing. This paper summarises and evaluates existing policies – in Canada and internationally – that mitigate the costs of emissions pricing due to competitiveness concerns.

The goal of this paper is to serve as a reference guide for the broad details of policies designed to mitigate competitiveness concerns for emissions intensive and trade exposed (EITE) industries. We review policies in Canada, California, the European Union and Australia, outlining similarities and differences in policy structure (who it applies to and the level of policy support). We also discuss the pros and cons of the implementation choices from the perspective of administrative costs, effectiveness in reducing leakage, economic efficiency, and equity.

This paper informs policy-makers developing EITE support policies by identifying best practices in implementation that balance goals of emissions reductions and maintaining domestic competitiveness. An EITE policy that balances efficiency and equity and reduces emissions is one where free emissions permits are allocated based on output and emissions-intensity benchmarks defined at the sector level, with annual reductions in the subsidy level independent of emissions reductions, similar to Alberta. Importantly, the support should only be provided to EITE facilities, not economy-wide.

The remainder of this paper proceeds as follows. We start by providing a brief explanation of the rationale and theory behind EITE support policies, including an overview of output-based allocations, the most common policy tool used to support EITE industries. We next provide an overview of the EITE definitions and support policies in place in Canada and compare them to definitions and policies in international jurisdictions (California, the European Union and Australia). We then narrow our focus to currently implemented support policies accompanying a carbon price and evaluate these policies along the criteria of administrative costs, effectiveness in ameliorating leakage, economic efficiency, and equity across and within sectors. We conclude with a brief summary of best practices in targeting and implementing EITE support policies.

Rationale and Theory of EITE Support Policies

It is useful to briefly explore why specific policy for EITE industries is desirable in addition to emissions pricing or other environmental regulations. Greenhouse gas emissions are a global pollutant, meaning they have a negative effect on the global environment that is independent of the point source of emissions. That is, greenhouse gas emissions in Canada will have the same impact on the global environment as emissions of the same greenhouse gas emissions in South Africa.

The goal of climate change or emissions policy is to reduce greenhouse gas emissions and the associated negative impacts of rising global atmospheric carbon concentrations. Jurisdictions introducing climate change policy, however, must accept that achieving a reduction in domestic emissions will generally result in higher costs for emitters, a large share of which are often local industry.

Faced with increased carbon costs individual facilities or firms may physically relocate to a lower cost jurisdiction, or industry-wide activity (output) may decline as facilities that do not face higher carbon costs increase production elsewhere.[1] In both cases greenhouse gas emissions will relocate from the jurisdiction that implemented the climate policy to one with a weaker policy or none at all. This is referred to as carbon leakage. Although carbon leakage is not typically a one-to-one relationship – that is, a one tonne decrease in CO_2e in the jurisdiction implementing climate policy does not typically result in a one tonne increase elsewhere[2] – it still negatively impacts local industry while detracting from the objective of the climate policy. This is effectively a market failure of climate policy.

The only way to fully prevent carbon leakage is with global policies that impose equal costs – such as a global carbon price or regulations – regardless of jurisdiction. The lack of a global carbon price most negatively impacts EITE industries – high emitting and trade exposed industries that are most susceptible to being placed at a competitive disadvantage in response to higher costs of production. In economics parlance, this incomplete pricing creates a market failure *in addition to* the market failure from emissions. Lessening both this competitive disadvantage and the potential for carbon leakage is the motivation and justification for EITE support policies.

There are numerous options for implementing EITE support policies. The challenge for policy-makers is to implement EITE support policies that minimize carbon leakage while simultaneously maintaining the emissions-reduction incentive for domestic facilities. A frequent form of this policy support is reducing the costs imposed on firms from environmental policies while simultaneously maintaining the emissions-reduction incentive. In economics parlance, lowering average costs of production while keeping the marginal cost of emissions constant.[3]

It is easy to argue the most obvious and simplest form of EITE support is an exemption of EITE industries from carbon pricing policies. This clearly fulfills the objective of lowering average costs: facilities in EITE industries will no longer face the increased costs from emissions pricing. It also means, however, that these facilities will not face an emissions-reduction incentive. As a result, although there will be no leakage of activity, there will also be no reduction in domestic emissions. In addition, implementing pricing in some sectors of an economy but not others will result in leakage within a jurisdiction. That is, the exempt sectors will expand their production and emissions above what they otherwise would be. Despite its simplicity, an exemption of EITE

[1] Relocation of activity will only go to jurisdictions with less stringent pricing or regulations, and jurisdictions without a binding cap and trade system (i.e., total emissions are less than the cap). If the emissions cap in a cap and trade system is binding, increasing output requires reducing the emissions intensity of all units of output, and there will be no net increase in global emissions.

[2] A 2014 meta-analysis of 25 carbon leakage studies completed between 2004 and 2012 found carbon leakage estimates typically fell in the range of 5% to 25% with an average of 14% (Branger and Quirion 2014).

[3] Another mechanism that can be used to reduce carbon leakage is border tax adjustments (BTAs). A BTA typically applies an effective carbon price to imported goods by charging an import tax that is equal to the carbon costs that would have been incurred if the good was produced domestically. A BTA may also rebate the carbon cost to domestic producers exporting their product for sale in international markets. BTAs are not often used in practice, however, because of concerns about their validity under World Trade Organization law (Weber 2015).

industries from carbon pricing is therefore not desirable when considered within the overall objectives of climate policy.

Direct subsidies also lower average costs and, depending on their implementation, can also maintain the emissions reduction incentive. Intuitively, the subsidy lowers the cost of production, prompting increased production and helping domestic firms maintain market share. Direct subsidies can take the form of providing dollar transfers to firms per unit of production, subsidizing emissions-reduction technology investments, or provision of free emissions permits to firms.

A commonly used mechanism that achieves the policy goal – and the focus of the remainder of this paper – is the free allocation of emissions to facilities. This allocation generally takes one of two forms. Either it can be distributed directly to a facility as an emissions permit, which the facility then submits in lieu of paying a carbon price, or the facility can emit up to the allocation without facing a carbon price. The former is most common in cap-and-trade programs, while the latter is more common within a jurisdiction with a carbon tax, emissions intensity benchmarks, or a combination of the two. In the discussion that follows we use "free allocations" as a broad term that covers both mechanisms for allocating free emissions.

Free allocations can be distributed in two ways: lump-sum to regulated facilities based on pre-determined firm- or facility-specific characteristics such as historical production, emissions or market share (commonly known as "grandfathering"). Alternatively, the allocation can be based on current emissions, production or emissions intensity.

When a facility's free allocation is based on historical characteristics, current production decisions are independent of the level of subsidy. Accordingly, if a facility increases its production then in addition to its marginal cost of production, it also faces the full marginal cost of emissions (where the cost of each additional tonne of emissions is equal to the prevailing emissions price). Hahn and Stavins (2011) show that the final allocation of permits and the overall cost of achieving emissions reductions is efficient, regardless of the initial allocation of free permits amongst firms.[4] That is, free allocations based on historical characteristics reduce average costs while maintaining the full emissions-reduction incentive of the emissions pricing system.

When free allocations are provided according to current characteristics (emissions, production or emissions intensity), there is a relationship between these characteristics and the level of subsidy. A subsidy related to the current level of emissions will directly lower the cost of emissions. This mitigates leakage risk but it also undermines the strength of the emissions price. For example, if a facility receives a free allocation for 50 per cent of its emissions – regardless of its production or overall emissions level – then the strength of the emissions price is effectively reduced by half. A subsidy related to current emissions-intensity has a similar effect.

In contrast, a subsidy that is a function of current output – often referred to as an output-based allocation – maintains the full strength of the emissions price as it only rewards firms for increasing production. Specifically, with output-based allocations facilities will typically receive a fixed number of emissions allocations per unit of production. Correspondingly, if a facility increases its production by one more unit then it receives additional emissions allocations. This decreases a

[4] Hahn and Stavins also explore conditions under which this property does not hold, such as market power and uncertainty.

facility's marginal cost of production and therefore incents the facility to produce more than it would without the output-based allocation in place, helping to mitigate carbon leakage.

More importantly, however, the output-based allocation maintains the emissions reduction incentive of the emissions price. Specifically, if a facility decreases its emissions while maintaining production – equivalent to decreasing its emissions intensity – then its emissions allocation does not change. Rather it receives cost savings equal to the full carbon price on its reduced emissions. The facility is therefore incented to invest in emissions reductions until the marginal cost of decreasing its emissions intensity by one additional tonne is equal to the emissions price. In that sense, the outcome is efficient.

It is worth noting, however, that there are potential costs to output-based allocations. First, if the allocations are not tradable then the subsidy to output will result in leakage within a jurisdiction when there are differential subsidy levels at the facility- or sector-level (Tombe and Winter 2015). Second, Fowlie (2012) notes that with a cap and trade system and a binding cap, output-based allocations to trade-exposed industries will increase the emissions price and transfer more of the burden of meeting the cap to industries not given (or given fewer) free allocations.

EITE Definitions and Support Policies by Jurisdiction

With one exception[5], all of the jurisdictions we discuss price industrial greenhouse gas emissions through either an output-based pricing system (OBPS)[6] or a cap-and-trade program. In both cases, the primary means of supporting EITE industries is through free allocations. As discussed in the previous section, these allocations allow a facility to emit a certain amount of greenhouse gas emissions each year at zero cost. Further, if a facility's allocation exceeds its emissions then it will receive permits that it can either bank for future use or sell to other participants in the emissions market.

In this section we summarise, by jurisdiction, EITE definitions (where they exist) and policies to support EITE industries. Note that where possible, we endeavour to use similar terminology across jurisdictions in order to facilitate easier comparisons. This sometimes results in deviation from the official terminology of a particular jurisdiction. For example, what the Government of Canada refers to as an "output-based standard" we refer to as an "emissions intensity benchmark." We note these discrepancies in footnotes where they occur.

Depending on the jurisdiction, EITE status may be a simple "yes/no" categorization or it may be defined by tiers related to level of carbon leakage risk. As greenhouse gas emissions pricing is a relatively new policy in many jurisdictions, it is common for governments to provide support to all industries, regardless of EITE status. As a result, not all jurisdictions have a formal EITE definition.

Where EITE definitions exist, they are consistently characterized by two components – an emissions intensity calculation and a trade exposure calculation. The emissions intensity

[5] British Columbia is the only jurisdiction to price industrial emissions through a tax on a facility's CO_2e greenhouse gas combustion emissions.

[6] Output based pricing systems generally tax facilities designated as large emitters on their total emissions, and provide a per unit subsidy based on a benchmark emissions intensity (tonnes per unit or dollar value of output). For details on principles behind output-based pricing systems, see Dobson et al. (2017).

calculation estimates the cost burden that an emissions price will impose on industry. A higher emissions intensity implies a higher cost burden. The trade exposure calculation is typically interpreted as how open an industry is to trade and competition from other jurisdictions. A higher trade exposure typically means that the price for an industry's product is set globally. It will therefore have a more difficult time passing on the carbon costs to consumers and will likely lose both profit and market share.

Key data used in calculating emissions intensity are direct and indirect industry greenhouse gas emissions (measured in CO_2-equivalent (CO_2e)), industry gross value-added or revenues, and the CO_2e price. Direct emissions measure the greenhouse gas emissions generated by industry activity while indirect emissions are emissions generated in producing inputs to the industry, most notably electricity and heat. Gross value added (GVA) refers to the value of output minus the value of intermediate inputs. Revenues, in contrast, are simply equal to the industry's gross income. Higher emissions or a higher emissions price will increase an industry's measure of emissions intensity, while higher GVA or revenues will decrease the measure.

Key data used in the trade exposure calculation are the gross dollar values of exports, imports and domestic production. Higher imports or exports (more trade) will increase an industry's trade exposure measure while higher domestic production will decrease the measure.

We now turn to a description of emissions pricing policies, EITE definitions and policy supports by jurisdiction.

Canada

Federal Government

Background

Starting on January 1, 2019, Canada's federal carbon pricing backstop will be implemented in whole or in part in any province that is either lacking a provincial carbon pricing plan, or which has implemented a plan that falls short of the federal government's carbon pricing benchmark.[7] The backstop consists of two components – a carbon tax and an output-based pricing system (OBPS) for industrial facilities with emissions of 50,000 tonnes of CO_2e or greater. Facilities with annual emissions between 10,000 and 50,000 tonnes per year can apply to opt in to the OBPS. Greenhouse gases covered by the OBPS are carbon dioxide, methane,[8] nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride.

EITE Definition

In a description of the forthcoming regulatory framework of the OBPS, Environment and Climate Change Canada (ECCC) states the objective of the system is to ". . . minimize competitiveness risks for emissions-intensive trade-exposed industrial facilities, while retaining the carbon price signal and incentive to reduce GHG emissions" (Environment and Climate Change Canada 2018a).

[7] We do not delve into the details of the federal carbon pricing benchmark in this paper as it is not relevant to the discussion of EITE industries. Interested readers can refer to Environment and Climate Change Canada's report *Guidance on the pan-Canadian carbon pollution pricing benchmark* for full details (Environment and Climate Change Canada 2018b).

[8] Fugitive and vented methane emissions from the oil and gas sector are not covered by the OBPS as the Government of Canada is introducing separate methane reduction regulations for these sources.

Despite this, ECCC has not put forward a formal definition for EITE industries. This seems to suggest that, at least currently, ECCC is treating total emissions from an industrial facility as a proxy for EITE. That is, if a facility meets the minimum emissions threshold for participating in the OBPS then it is considered EITE and is eligible to receive a free allocation. In the federal OBPS the free allocation takes the form of an emissions intensity standard, which allows an EITE facility to emit a fixed number of emissions at zero charge.

Free Allocations

The federal government intends to calculate free allocations to a facility f in year t using the following formula:

$$Free\ Allocation_{f,t} = \sum_i \left[BE_{i,s} \times Production_{f,i,t}\right]$$

where i is the index of products produced by the facility, $BE_{i,s}$ is the emissions intensity benchmark for each product in sector s, and $Production_{f,i,t}$ is the total quantity of each product produced in the year (Environment and Climate Change Canada 2018a).[9]

Allocations are implemented via an intensity standard. A facility will receive tradeable credits for performance above the threshold or will be required to make tax payments on emissions above its allocation for performance below the threshold. The emissions intensity benchmarks will be defined at the sector-level using historical emissions and production data. The proposed starting point is 70 per cent of the national production-weighted average emissions intensity of the product.[10] This level may be further adjusted depending on the emissions intensity of Canada's "best in class" facility (that is, the facility with the lowest emissions intensity), the distribution of emissions intensities across all facilities in a sector and competitiveness considerations. ECCC has identified 12 initial sectors for which benchmarks will be defined (Environment and Climate Change Canada 2018a). These sectors vary from NAICS 3-digit classification level (sub-sectors) to NAICS 6-digit-level (Canadian industry). Although not clearly stated, based on the proposed benchmark metrics, it appears likely that a number of sectors will have multiple benchmarks that correspond to specific products within a sector.

Annual Adjustment to Free Allocations

Free allocations will change annually in response to a facility's production. Additionally, the federal government has indicated the emissions intensity benchmarks will decline over time. The exact schedule that the benchmarks will follow, however, is still under development.

Assignment of Free Allocations

Each facility participating in the OBPS is responsible for calculating its annual free allocation. This information is submitted to the federal government through a facility's annual compliance report.

[9] Note that "free allocation" and "emissions benchmark" (BE) is our standard terminology. The corresponding ECCC terminology is "annual facility emissions limit" and "output-based standard" respectively.

[10] The year for determining the benchmarks' emissions intensity is still under development.

Indirect Emissions

Recall that indirect emissions are the emissions from inputs into an industry's production, most frequently electricity and heat. As of June 2018, the federal government has not made a decision on how the OBPS will treat indirect emissions.[11]

Reviews

An interim review of the OBPS will be completed in 2020 while the system in its entirety will be reviewed by the end of 2022.

British Columbia

Background

British Columbia introduced an economy-wide carbon tax on greenhouse gas combustion emissions in 2008. Greenhouse gases subject to the tax are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.

EITE Definition

When British Columbia's carbon tax was first introduced there was little discussion of providing support to EITE industries.[12] Rather, in the section on "Carbon Tax Impact on Business" in British Columbia's 2008 budget, the Government states: "The low initial tax rate [$10 per tonne] is not expected to significantly affect the business community and the five-year phase-in will allow time for businesses to adjust. The province hopes that other jurisdictions will also put effective mechanisms in place that put a reasonable price on GHG emissions" (British Columbia Ministry of Finance 2008, 18).

Although not a specific policy to support EITE industries, it is also notable that the British Columbia carbon tax only applies to combustion emissions. As a result, EITE industries do not have to pay the carbon tax on any of their industrial process emissions, fugitive emissions or emissions from venting.

Concern around the impact of the carbon tax on EITE industries has started to rise in recent years, driven by discussions around further increases to the carbon tax (currently at $35 per tonne and scheduled to increase by $5 per year though to 2021), evidence that the carbon tax was negatively impacting some industries more than others (Murray and Rivers 2015), and the reality that other jurisdictions did not move as quickly as anticipated to place a similar price on carbon. In 2015, the BC Climate Leadership Team[13] recommended providing targeted support to EITE industries (Climate Leadership Team 2015). More recently, in October 2017, the Government of BC announced the appointment of a new Climate Solutions and Clean Growth Advisory Council and stated that its mandate will include ". . . working with industry and the federal government to

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[11] We include indirect emissions in our discussion of definitions and support policies as some jurisdictions have specific treatment of indirect emissions in evaluating whether an industry is EITE and/or determining the free allocations for which a facility is eligible.

[12] Although not specific to EITE industries, when the carbon tax was first introduced the general corporate income tax rate was lowered to from 12 to 11 per cent as part of the government's promise that the carbon tax would be revenue neutral. It was subsequently lowered further to 10.5 per cent in 2010 and 10 per cent in 2011. The reductions have been undone in recent years, however, with the general corporate income tax rate returning to 11 per cent in 2013 and to 12 per cent in 2018 (Government of British Columbia 2018).

[13] The BC Climate Leadership Team was formed in early 2015 with the mandate to provide recommendations to the BC government on how to update its Climate Action Plan.

address the competitiveness of emissions-intensive trade-exposed sectors, to help them reduce their emissions and continue to thrive economically" (British Columbia Ministry of Environment and Climate Change 2017).

Although British Columbia is now actively discussing the need to support EITE industries, it has not developed a formal definition for the sector that is based on quantitative criteria. Rather, analysis of EITE is currently done on the basis of the following qualitative criteria:[14]

1. High greenhouse gas emissions covered by the carbon price which an industry is unable to mitigate in a cost-effective manner.
2. Exposure to a competitive import and export market, making an industry unable to pass on costs to consumers without loss of market share.

Carbon Tax Relief for Industry

The only industry in British Columbia that currently receives any direct relief from the carbon tax is agriculture.[15] In its 2015 Budget, the Government of British Columbia also announced a three-year, $22 million support package to help the cement industry lower its emissions intensity (Cement Association of Canada 2015). Notably, the policy did not provide immediate carbon cost relief to British Columbia producers, but rather its goal was to lower the future burden of the carbon tax.

Alberta

Background

Alberta's Carbon Competiveness Incentive Regulation (CCIR) came into effect in 2018. The CCIR implements an OBPS for large emitters and is part of a new carbon pricing policy in Alberta that also includes an economy-wide carbon tax (introduced in 2016). The CCIR replaces the Specified Gas Emitters Regulation (SGER), Alberta's previous carbon pricing regulation for large industrial emitters.[16]

The CCIR applies to all facilities with emissions of 100,000 tonnes or greater of CO_2e in any year since 2003 (Province of Alberta 2017). A facility with emissions below this threshold can apply to opt in to the OBPS if it either competes with a facility that is automatically covered by the CCIR,[17] or if it competes in a "high" category EITE industry (as defined below) and has annual CO_2e emissions of at least 50,000 tonnes. Greenhouse gas emissions covered by the CCIR are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride.

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[14] These qualitative criteria were provided by British Columbia's Climate Action Secretariat through personal email correspondence in January 2018.

[15] British Columbia introduced the Greenhouse Carbon Tax Relief Program in 2012. The program allows commercial greenhouses to receive a rebate of 80 per cent of the carbon taxes paid on natural gas and propane used for greenhouse heating. The amount of the grant in any given year is based on fuel consumption in the previous year. Additionally, starting in 2014, farmers were provided with an exemption of the carbon tax on all coloured gasoline and diesel use in on-farm and off-road vehicles (Rivers and Schaufele 2015).

[16] SGER came into effect in 2007 and was Alberta's first regulation to price greenhouse gas emissions from large industrial emitters.

[17] A notable exception to this are conventional oil and gas facilities, which are exempt from the economy-wide carbon price until 2023. As a result, these facilities are not eligible to opt in to the CCIR (Alberta Government 2017b, 18).

EITE Definition

The equations Alberta uses to determine emissions intensity and trade exposure are:

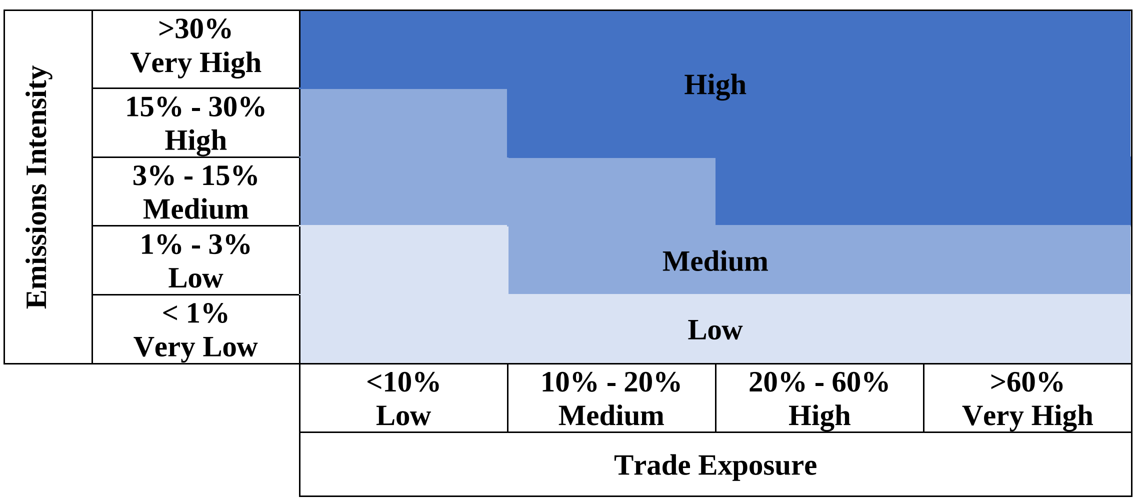
$$Emissions\ Intensity = \frac{Full\ Carbon\ Pricing\ Costs}{GVA}$$

$$Trade\ Exposure = \frac{Exports + Imports}{Production + Imports}$$

Roughly speaking, full carbon pricing costs are an estimate of the direct industry-level cost of Alberta's carbon pricing policy in the absence of the OBPS. For example, at the 2018 carbon tax level of $30 per tonne, the estimate of full carbon pricing costs is $30 multiplied by total direct greenhouse gas emissions from the sector.

Alberta uses the above emissions intensity and trade exposure calculations to define three categories of EITE – high, medium and low (Figure 1). For the purposes of the CCIR, it is only sectors meeting the high criteria that qualify for treatment as EITE.

Figure 1: Alberta EITE Criteria



Source: Reproduced based on Figure 3 from Alberta Government (2017b, 15)

Note: Alberta's Carbon Competitiveness Incentive Regulation specifies that only industries meeting the high criteria are categorized as EITE.

Free Allocations

All industrial facilities participating in Alberta's OBPS, including electricity generators, are eligible to receive free allocations. The allocations are implemented through an emissions intensity standard which allows facilities to emit up to a certain threshold of emissions at zero charge. Allocations for each facility *f* in year *t* are calculated using the following formula:

$$Free\ Allocation_{f,t} = \sum_i [BE_{s,i} \times Production_{f,i,t}] - \sum_j [BE_{s,j} \times Import_{f,j,t}]$$

In the first term, i is the index of products produced by a facility, $BE_{s,i}$ is the emissions intensity benchmark for each product *i* and sector *s*, and $Production_{f,i,t}$ is the total quantity of each product produced in the year. In the second term, j is the index of a facility's energy inputs, $BE_{s,j}$ is the emissions intensity benchmark for each energy input j, and $Import_{f,j,t}$ is the total quantity of each energy input the facility purchases from an external supplier in the year.

The subtraction of indirect emissions from a facility's free allocation is a consequence of two characteristics of Alberta's OBPS. First, the emissions intensity benchmarks include indirect emissions. This allows for application of the same benchmark to all facilities producing the same product, regardless of whether each individual facility produces its energy inputs onsite or purchases them from an external supplier. Second, Alberta provides free allocations to energy producers (most notably electricity generators). As a result, to prevent double compensation for the same emissions, facilities that purchase energy are not eligible for free allocations for their indirect emissions.

Typically, if there are two or more facilities in the province producing a product then the benchmark is defined at the sector level. Otherwise the benchmark is defined at the facility level.[18] There are currently 12 sector level benchmarks, most of which are defined at the NAICS 6-digit-level (Canadian industry) or below.

The starting point for both sector- and facility-level benchmarks is 80 per cent of the historical production-weighted emissions intensity of the product. If a facility or sector competes in an EITE industry then the 80 per cent benchmark may be adjusted upwards to 90 or 100 per cent. Additionally, sector benchmarks may instead be set at the emissions intensity of the "best-in-class" facility or a product-specific approach may be used. For example, in the electricity sector the emissions intensity benchmark is "good-as-best-gas."

Assignment of Free Allocations

Each facility participating in the OBPS is responsible for submitting an annual compliance report to the Alberta government. The compliance report must include the calculation of a facility's free allocation each year. If a facility emits greater than 1,000,000 tonnes of CO_2e per year then it must additionally submit three interim compliance reports each year and a forecasting report for the year ahead. If a facility's free allocation calculation is greater than its reported emissions for the year then it can include with its compliance report a request to receive the difference in emissions performance credits (EPCs) (Alberta Government 2017a, 22). EPCs can be banked for future use or sold to other facilities to meet their compliance obligation.

Annual Adjustment to Free Allocations

In 2018 and 2019 a facility's free allocation adjusts annually in response to current production levels only.[19] Starting on January 1, 2020 the emissions intensity benchmarks will tighten at a rate of one per cent per year.

[18] Facility benchmarks are also currently used in five subsectors – upgrading, natural gas processing, natural gas transmission networks, other fertilizer products and multi-product chemicals – with two or more facilities producing the product. For upgrading, natural gas processing, and multi-product chemicals, the use of assigned benchmarks is temporary and due to a temporary lack of data for defining sector benchmarks. For natural gas transmission and other fertilizers, the use of facility benchmarks is expected to continue.

[19] Facilities that were previously regulated under SGER are also eligible for transitional support which starts at 50 per cent of the compliance obligation for the facility in 2018 and declines to 25 per cent in 2019 and zero in 2020 (Alberta Government 2017b, 30).

Indirect Emissions

Indirect emissions associated with energy inputs to a product – specifically electricity, heat and hydrogen – are included in the estimate of a product's emissions intensity benchmark. The benchmark does not distinguish between whether these emissions are produced on the same site as the product or whether they are purchased from an external supplier. In the latter case, however, the indirect emissions associated with energy inputs are subtracted from a facility's free allocation. This accounts for the fact that external energy suppliers are eligible for free allocations for their direct emissions.

Reviews

The CCIR includes a provision that allows facility benchmarks to be reviewed and updated at any time. Additionally, the current regulations require an interim review to be completed by January 1, 2021 and a comprehensive review by January 1, 2023 and every five years thereafter. Among other elements, the reviews will include consideration of the tightening rate, the carbon price and all benchmarks.

Ontario

Background

Ontario implemented its cap-and-trade program in January 2017 and joined California and Québec's joint market in January 2018. In June 2018, Premier-designate Doug Ford announced that Ontario would dismantle its cap and trade system and withdraw from the joint market (Government of Ontario 2018). The regulation implementing the cap-and-trade program was subsequently revoked on July 3, one of Premier Ford's first actions after taking office. At the time of writing, no additional details are available. The federal government has indicated, however, its intention to impose the federal backstop carbon price in the province (Crawley 2018). In that case, EITE facilities in the province will be supported by the federal government OBPS as previously described.

Although Ontario's cap-and-trade program is no longer in effect, as it was previously a fully developed and functioning program, it is still informative to consider how it provided support to EITE industries. The cap-and-trade program required all facilities in the province with greenhouse gas emissions of 25,000 tonnes of CO_2e or greater to register in the cap-and-trade market. Additionally, a facility could apply to register as a voluntary participant in the market if it had emissions of at least 10,000 tonnes of CO_2e (Ontario Ministry of the Environment and Climate Change 2018a). Greenhouse gases covered by the cap-and-trade program were carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, perfluorocarbons, and nitrogen trifluoride.

EITE Definition

In a scoping document for the cap-and-trade program, published in 2015, Ontario discusses the need to provide support to EITE industries to minimize carbon leakage (Ontario Ministry of the Environment and Climate Change 2015, 18). It additionally outlines California's definition for EITE (discussed below) and in a separate analysis from consultancy EnviroEconomics, uses California's definition to classify Ontario's industry sectors according to carbon leakage risk (Sawyer, Peters, and Stiebert 2018).

The scoping document additionally proposes, however, that in the first compliance period of the cap-and-trade program (2017-2020), the number of free allocations a facility receives should be independent of its carbon leakage risk. This is the approach that was adopted, and accordingly, neither the Ontario cap-and-trade regulation, nor any of the current documentation on the program, provides a formal definition of EITE.

Free Allocations

With the exception of electricity generators and natural gas distributors, all mandatory and voluntary participants in Ontario's cap-and-trade market are eligible to receive free allocations. Free allocations are distributed in the form of emissions permits. The number of permits a facility receives is determined by one of six methodologies, with a facility's total permit allocation equal to the sum of its allocations through each of the individual methods.[20,21] Each method uses the same general formula for determining a facility's free allocation. Specifically:

$$Free\ Allocation_{f,t} = B_{f,t} \times AF_{f,t} \times C_t$$

where $B_{f,t}$ is the base number of free allocations for which a facility *f* in year *t* is eligible, $AF_{f,t}$ is the assistance factor, and C_t is the cap adjustment factor.

The base number of free allocations, $B_{f,t}$, is the key variable that differs across methods. For industrial facilities that are mandatory participants in the cap-and-trade program, we estimate that $B_{f,t}$ is most commonly calculated as a facility's production multiplied by either a sector- or facility-level emissions intensity benchmark.[22] Facility benchmarks are based on historical emissions and production data. The methodology for estimating sector benchmarks, in contrast, is not specified. There are currently 9 sector benchmarks which are generally defined at the NAICS 6-digit-level (Canadian industry) and below.

Although not as common, $B_{f,t}$ may also be independent of a facility's current production and equal either to a facility's historical or current absolute level of emissions. Lastly, for voluntary participants in the cap-and-trade program $B_{f,t}$ is most commonly calculated as a function of a facility's energy inputs and their corresponding emissions intensities.

The assistance factor ($AF_{f,t}$) is the variable that grants the government the flexibility to adjust a facility's free allocation in response to its EITE status. As noted earlier, however, in the first compliance period free allocations are assigned independently of an industry's carbon leakage risk. Accordingly, $AF_{f,t}$ is equal to one for all facilities. This means that prior to the application of the

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[20] The six methodologies are: product output benchmark, energy use based, history based, direct, indirect useful thermal energy and bilateral electricity. A full description of each methodology is available in the *Methodology for the Distribution of Ontario Emission Allowances Free of Charge* (Ontario Ministry of the Environment and Climate Change 2017).

[21] Unsurprisingly, however, these methods cannot overlap and provide multiple free allocations for the same emissions sources.

[22] Ontario does not indicate the relative prevalence of each methodology for calculating free allocations. However, by cross referencing the list of verified emissions from Ontario facilities in 2016 with the list of products and facilities for which for which sector-level and facility-level emissions intensity benchmarks have been defined, we estimate the majority of free allocations are distributed by this method (Ontario Ministry of the Environment and Climate Change 2017, 2018b).

cap adjustment factor, a facility is eligible to receive 100 per cent of its base number of free allocations in every year from 2017 through to 2020.

Finally, the cap adjustment factor ensures the distribution of free allocations declines in line with the overall cap on Ontario's emissions. It starts at unity in 2017 and subsequently declines by 4.57 percentage points each year through to 2020.

Assignment of Free Allocations

Facilities must submit an annual application to receive free allocations. The Ministry of the Environment and Climate Change subsequently distributes allocations to all eligible facilities. When applicable, the initial allocation of emissions is based on data (emissions, production or energy inputs) from two years prior. The allocation is subsequently adjusted when the final data for the year are available. These data are submitted in a facility's annual emissions report, as required under Ontario's *Quantification, Reporting and Verification of Greenhouse Gas Emissions* regulation.

Annual Adjustment to Free Allocations

Depending on the methodology used to assign free allocations, the allocation may change annually in response to a facility's production, energy inputs or absolute level of emissions. Additionally, starting in 2018, for all facilities the free allocation will be reduced each year by the cap adjustment factor referenced above.

Indirect Emissions

The treatment of indirect emissions in Ontario is not entirely clear. In particular, there is no reference to whether indirect emissions are accounted for in sector benchmarks. Facility-level benchmarks will sometimes be based on a facility's total emissions, which presumably includes emissions associated with energy inputs produced at a facility, and on other occasions is based only on emissions associated with a particular product.

If a facility purchases heat or electricity from an external supplier then it is eligible under specific conditions for free allocations associated with its indirect emissions. First, the external supplier of the heat or electricity cannot receive free allocations for its direct emissions. Second, in the case of electricity, the electricity must be distributed directly from the external supplier to the facility that is purchasing it. Indirect emissions associated with electricity that is distributed through Ontario's grid is not eligible for free allocations.

Reviews

The Ontario cap-and-trade regulation includes no formal reference to a required review of the regulation or its components. However, the values of the assistance factor and the cap adjustment factor have only been defined through to the end of 2020. At a minimum these components will therefore need to be revisited and updated within the next two years, depending on how Ontario's wind-down of the cap and trade system proceeds.

Québec

Background

Québec implemented its cap-and-trade program in January 2013 and linked its market with California in late 2014. All industrial facilities in the province with annual CO_2e emissions of

25,000 tonnes or greater are required to register in the cap-and-trade market. Facilities that do not have a regulatory requirement to participate in the market have the option of registering as voluntary participants if they have annual emissions of at least 10,000 tonnes of CO_2e. Greenhouse gases covered by the cap-and-trade program are carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, perfluorocarbons, and nitrogen trifluoride.

EITE Definition

Québec's cap-and-trade regulation specifies a list of industries that are eligible to receive free allocations (Province of Québec 2017). In the technical overview of its cap-and-trade program, Québec notes the objective of the allocations is to ". . . mitigate the repercussions of the C&T system on the competitiveness of Québec's industrial sector and avoid carbon leakage" (Gouvernement du Québec 2014, 8). There is no indication of how the list of industries eligible for support was developed, however, and no reference to, or definition of EITE, in the cap-and-trade regulation. Rather, the support seems to be broadly extended to nearly all industrial facilities that participate in the cap-and-trade program.

Free Allocations

Mandatory and voluntary participants in Québec's cap-and-trade program in the mining and quarrying, electricity generation, manufacturing, or steam and air-condition supply industries are eligible for free allocations.[23] Free allocations are distributed as emissions permits. Allocations for each product are based on an emissions intensity benchmark that is defined either at the facility or the sector level.

The annual free allocation to a facility *f* in year *t* producing product *i* with a facility-level emissions intensity benchmark is:

$$Free\ Allocation_{f,i,t} = BE_{f,i,t} \times Production_{f,i,t}$$

where $BE_{f,i,t}$ is the facility's emissions intensity benchmark for the product i and $Production_{f,i,t}$ is the facility's annual output. In 2013 and 2014 – the first two years of Québec's cap-and-trade program – $BE_{f,i,t}$ was equal to 80 per cent of the facility's historical emissions intensity of the product. Starting in 2015, the value of $BE_{f,i,t}$ declines linearly towards a target facility-level emissions intensity for 2020.[24] The target level is again a function of the facility's historical emissions intensity.[25]

By contrast, the annual free allocation to a facility producing product i with a sector-level emissions intensity benchmark is:

$$Free\ Allocation_{f,i,t} = \max\{BE_{f,i,t,}, BE_{Sector,2020}\} \times Production_{f,i,t}$$

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[23] Electric power generation is included on the list of industries eligible for free allocations but facilities are assessed on an individual basis and are only eligible if they sell power under a fixed price contract that was established prior to January 1, 2008.

[24] For example, if a facility's starting benchmark emissions intensity is $BE_{2013,i}$ = $BE_{2014,i}$ = 20 and its target emissions intensity is $BE_{2020,i}$ = 14 then its benchmark emissions intensity from 2015 through to 2019 will decline by one unit per year. That is, $BE_{2015,i}$ = 19, $BE_{2016,i}$ = 18, etc.

[25] The target emissions intensity is roughly equal to 80 per cent of the minimum of two possible historical emissions intensities. These are: (i) 95 per cent of the facility's minimum annual emissions intensity from 2007 to 2010; or (ii) 90 per cent of the cumulative emissions intensity of the facility from 2007 to 2010.

where $Production_{f,i,t}$ is defined the same as above. $BE_{f,i,t}$ is again equal to 80 per cent of the facility's historical emissions intensity of the product in 2013 and 2014. Starting in 2015, however, the value of $BE_{f,i,t}$ declines linearly towards $BE_{Sector,2020}$, which is the target emissions intensity for the sector in 2020. This value is defined as a function of the sector's historical emissions.[26] This allocation rule effectively transitions Quebec to Alberta's allocation rule, where the default benchmark for a facility is the sector's emissions intensity.

Notably, the inclusion of the "max" function in the free allocation equation means that if a facility's value of $BE_{i,t}$ in 2013 is less than the target emissions intensity for the sector in 2020 then the facility's free allocation in all years will be based on the sector target. That is, the most efficient facility (facilities) in a sector are effectively rewarded for having a lower emissions intensity relative to its (their) peers.

There are currently only three sector-level benchmarks in Québec. The sectors are defined at the NAICS 6-digit-level (Canadian industry) and below.

Assignment of Free Allocations

Free allocations to mandatory cap-and-trade participants are calculated by the ministry. Seventy-five per cent of the estimated annual allocation to a facility, calculated using facility production data from two years prior, is placed into the emissions account of the facility at the start of each year. The free allocation is subsequently adjusted when final production data for the year are submitted. These data are submitted in a facility's annual emissions report, as required under Quebec's *Regulation respecting mandatory reporting of certain emissions of contaminants into the atmosphere*.

Annual Adjustment to Free Allocations

Free allocations to a facility adjust annually both in response to a facility's production level and in most cases, its emissions intensity benchmark. The tightening rates for the emissions intensity benchmark are specific to each facility and are determined by the facility's starting emissions intensity benchmark in 2013, and either the facility or the sector's target emissions intensity benchmark in 2020. The 2013 and 2020 target benchmarks are each a function of a facility's or sector's historical emissions intensity.

Indirect Emissions

There is no reference to indirect emissions in Québec's cap-and-trade regulation and indirect emissions do not appear to be included in the calculation of emissions intensity benchmarks. The lack of attention to indirect emissions likely stems from the fact that 99 per cent of Québec's total electricity generation – and 96 per cent of electricity generation from industrial facilities – was from renewable sources in 2016 (Statistics Canada 2018). Industrial facilities are therefore unlikely to face significant energy input cost increases as a result of the cap-and-trade market.

Reviews

The Québec cap-and-trade regulation includes no formal reference to a required review of the regulation or its components. However, the emissions intensity benchmarks are currently only

[26] The 2020 sector target emissions intensity is defined analogously to the 2020 facility target emissions intensity described in footnote 25 but uses sector-level emissions in place of facility-level emissions.

defined through to the end of 2020. At a minimum these components will therefore need to be revisited and updated within the next two years.

California

Background

California implemented a cap-and-trade program for greenhouse gas emissions in 2013 and linked its market with Québec in late 2014. All industrial facilities with annual emissions of 25,000 tonnes of CO_2e or greater in any year since 2009 are required to participate in the program. Facilities with emissions below this threshold can apply to opt in to the program. Greenhouse gases covered by the cap-and-trade program are carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, perfluorocarbons, nitrogen trifluoride and other fluorinated greenhouse gases (California Air Resources Board 2017b, 25).

EITE Definition

The equations California uses to determine emissions intensity and trade exposure[27] are:

$$Emissions\ Intensity = \frac{Direct\ Emissions\ (t\ of\ CO_2e)}{GVA\ (\$USD\ million)}$$

$$Trade\ Exposure = \frac{Imports + Exports}{Production + Imports}$$

A notable characteristic of California's emissions intensity measure is that it does not include the carbon price. Rather, the only term in the numerator of the equation is direct industry emissions. This is in contrast to the numerator of Alberta's emissions intensity measure which estimates the industry-level cost of its carbon pricing policy by multiplying direct industry emissions by the carbon price. California's approach is likely due to the fact that it does not have a set carbon price. Rather, the price that facilities must pay for permits is determined by an auction and is not known when the leakage calculations are completed.

Similar to Alberta, California uses the emissions intensity and trade exposure calculations in combination to define three levels of leakage risk – high, medium and low (Figure 2). The initial intent of identifying the level of leakage risk was to determine the level of support that industries would receive to ease the financial burden of increasing costs attributable to the state's cap-and-trade program (California Air Resources Board 2010). However, support policies have been largely independent of leakage risk.

Figure 2: California EITE Criteria

[27] California's official equation for trade exposure lists "*Shipments*" in place of "*Production*" in the denominator of the trade exposure equation. Shipments are defined as ". . . products manufactured, plus receipts for services rendered, approximately revenue" (California Air Resources Board 2010, 9).

	< 100 Very Low	**Low**		
		< 10% Low	**10% - 19% Medium**	**> 19 % High**
		Trade Exposure		

Source: Reproduced based on Table 1 from California Air Resources Board (2013a, 4).

Free Allocations

With the exception of electricity generators, the majority of industrial facilities participating in California's cap-and-trade program on a mandatory or opt-in basis are eligible to receive free allocations. Allocations are distributed as emissions permits and are most commonly calculated using the following formula:

$$Free\ Allocation_{f,t} = \sum_{i} Production_{f,i,t} \times BE_{s,i} \times AF_{s,i,t} \times C_{i,t}$$

where i is the index of products produced by facility f in year t, $Production_{f,i,t}$ is the total quantity of the product produced by the facility, $BE_{s,i}$ is the emissions intensity benchmark for the product, $AF_{s,i,t}$ is the assistance factor and $C_{i,t}$ is the cap adjustment factor.

The emissions intensity benchmark is defined at the sector-level (s) using historical emissions and production data. The default value is 90 per cent of the state-wide production-weighted average emissions intensity of the product. However, if this value falls below the best-performing facility in the state – that is, the facility with the lowest emissions intensity – then the emissions intensity of this facility is instead used as a "best-in-class" benchmark. Sectors are typically defined at the NAICS 6-digit-level (U.S. industry) and below, with a large number of sectors having separate emissions intensity benchmarks for different products. California currently has 83 benchmarks in total.

As was the case in Ontario, EITE status is supposed to impact a facility's free allocation primarily through the value of the assistance factor ($AF_{s,i,t}$).[28] To aid with the transition to the cap-and-trade program all industries were originally assigned an assistance factor of 1 in the first two compliance periods (2013-2014 and 2015-2017). For the third compliance period (2018-2020) the current regulation assigns an assistance factor of 1 only to industries with a high risk of carbon leakage. For industries with a medium and low risk of carbon leakage the assistance factor declines to 0.75 and 0.5 respectively.[29] This change is at best temporary, however, as starting in 2021 the assistance

[28] It is worth noting that the order of our discussion, which places Ontario ahead of California, may make it appear as though California's system was based on Ontario's. In actuality it is the opposite scenario. California's system was developed and implemented between 2006 and 2012, well before Ontario announced its intention to develop a cap-and-trade market in April 2015. Ontario announced at the outset its plan to link its market with Québec and California and its market design subsequently drew on numerous aspects of California's system.

[29] The current assistance factors are the result of an amendment to the original cap-and-trade regulation. Originally the assistance factor was set at 1 for all industries in the first compliance period only. For industries at a medium and low risk of carbon leakage the assistance factor was subsequently scheduled to decrease to 0.75 and 0.5 respectively in the second compliance period, and then 0.5 and 0.3 respectively in the third. CARB noted the reason for extending the higher assistance factors through the second compliance period was to ". . . ensure consumers are not negatively impacted by the Program while providing time for industry to transition to lower-carbon production methods" (California Air Resources Board 2013b, 26).

factor will again revert to 1 for all industries.[30] Further, the California Air Resources Board (CARB) is considering amending the current regulation so that the declines to 0.75 and 0.5 are retroactively eliminated (California Air Resources Board 2017a, 10). In this scenario all industries – regardless of EITE status – will be assigned an assistance factor of 1 in all compliance periods.

The cap adjustment factor ($C_{i,t}$) ensures the number of free allocations declines in step with the overall decline in California's emissions cap. For a subset of EITE industries with both a high leakage risk and a large share of emissions from industrial processes, the cap adjustment factor declines at a slower rate.

Assignment of Free Allocations

The CARB annually distributes free allocations to eligible facilities. A facility's original allocation for an upcoming year is based on its production two years prior. The allocation is subsequently adjusted when final production data for the year are available. These data are submitted in a facility's annual emissions report.

Annual Adjustment to Free Allocations

Free allocations adjust annually in response to a facility's production and the cap adjustment factor. For the majority of industries the cap adjustment factor is scheduled to tighten at 1.8 per cent annually from 2013 to 2020 and at 3.4 per cent annually from 2021 to 2030. For the small subset of EITE industries eligible for a less aggressive cap adjustment factor, the tightening rate is approximately one per cent from 2013 to 2020. The tightening rate post-2020 for these industries has not yet been set, although it will continue to be lower than the standard rate.

Indirect Emissions

Indirect emissions associated with heat purchased, as well as heat and electricity sold, are included in the calculation of an industry's emissions intensity benchmark. In the former case facility emissions are adjusted upwards – to reflect the indirect carbon costs associated with heat purchased – while in the latter case they are adjusted downwards – to reflect the cost recovery available to a facility when selling heat or electricity.

Indirect emissions associated with purchased electricity are not included in the emissions intensity benchmarks. Instead, California cushions potential electricity price increases by distributing free allocations to electricity distribution utilities and requiring that the value of these allocations is passed down to ratepayers (California Air Resources Board 2017b, 195).

Reviews

CARB does not appear to have a set schedule for reviewing and updating its EITE list or its emissions intensity benchmarks. Rather, changes appear to occur on an ad hoc basis, typically driven either by the availability of improved data or at the request of industry.

[30] This provision was part of Assembly Bill 398, the legislation extending California cap-and-trade program through to 2030, which was passed by the California State Assembly in July 2017 (State of California 2017).

European Union

Background

The EU's Emissions Trading System (ETS) – a cap-and-trade program – has been in effect since 2005. Participating countries in the ETS include the 28 EU members, as well as Iceland, Liechtenstein and Norway, which joined in 2008. Unlike the North American emissions pricing markets that determine participation based on emissions thresholds, the EU tends to use a combination of capacity and output thresholds, many of which are industry-specific. The most common is a threshold of 20 MW for the combined thermal energy input of all technical units at a facility (European Commission 2014b).[31,32] Carbon dioxide is the primary greenhouse gas covered by the ETS. Nitrous oxide and perflourocarbons are also covered in specific sectors.

Starting in 2013 the ETS introduced an EITE definition and consistent rules for determining free allocations to facilities in all participating countries. If an industry meets the criteria outlined in the EITE definition then it is added to the EU's carbon leakage list and facilities in the industry are eligible to receive the maximum level of carbon pricing support.[33] Both the definition and rules have recently been updated and new versions will be implemented starting in 2021. We provide an overview of both definitions in the discussion below.

EITE Definition

The EU's original equations for measuring emissions intensity and trade exposure were:

$$Emissions\ Intensity = \frac{Direct\ Costs + Indirect\ Costs}{GVA}$$

$$Trade\ Exposure = \frac{Imports + Exports}{Production + Imports}$$

In the emissions intensity calculation, direct costs are defined as:

$$Direct\ costs = Direct\ Emissions\ \times\ Auctioning\ Factor \times CO_2e\ Price$$

where the auctioning factor is the share of industry emissions that are subject to the carbon price if the industry is not included on the carbon leakage list. This accounts for the fact that even industries not deemed at risk of carbon leakage are eligible for carbon pricing support. Also of note in this equation is the inclusion of the CO_2e price. As is the case in California, the carbon

[31] Technical units can include boilers, burners, turbines, heaters, furnaces, incinerators, calciners, kilns, ovens, dryers, engines, fuel cells, chemical looping combustion units, flares and thermal or catalytic post-combustion units. Units with a thermal input under 3 MW and those that use exclusively biomass are excluded from the calculation of the 20 MW threshold.

[32] It is challenging to translate the 20 MW thermal energy input threshold into a corresponding annual emissions threshold as the emissions generated will depend, among other things, on the type of fuel that is used in the facilities, the efficiency of the facilities and how many hours per year the facilities operate. Data on verified emissions and free allocations in the EU ETS shows, however, that numerous facilities with emissions below 1,000 tonnes per year have surpassed the 20 MW threshold and correspondingly receive free allocations. It is worth noting, however, that a member state may exclude a facility from the ETS if the facility's annual emissions fall below 25,000 tonnes of CO_2e and if it's combined thermal energy input from all installations is less than 35 MW. The member state must also be able to demonstrate the facility is subject to other emissions reductions measures that will achieve an outcome equivalent to participation in the ETS.

[33] As outlined later in the main text, facilities operating in industries not on the carbon leakage list are also eligible to receive carbon pricing support but at a reduced rate. Support to industries not on the carbon leakage list will not be fully phased out until 2030 (European Commission 2018, 8).

price is not fixed and is determined in the auctions for emissions permits. As the emissions intensity calculation is completed prior to the auctions taking place, it requires an assumption or forecast as to what the prevailing emissions price is likely to be.

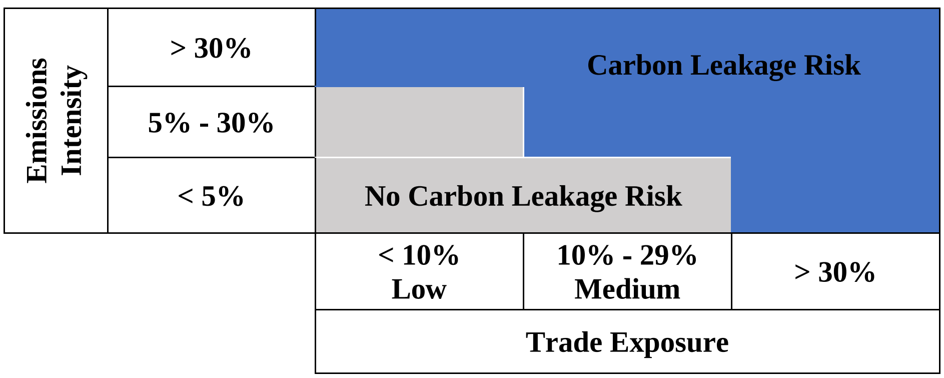
Indirect costs are defined as:

$$Indirect\ costs = Electricity\ Consumpion\ \times Emission\ Factor\ for\ Electricity\ \times CO_2e\ price,$$

where electricity consumption is an estimate of electricity use at the industry level and the emission factor for electricity is a measure of the emissions intensity of electricity generation in the EU.

The EU is the only jurisdiction that uses a simple "yes/no" categorization for carbon leakage risk (Figure 3). The carbon leakage assessment is primarily based on the quantitative criteria outlined above. If an industry fails to meet the quantitative criteria, however, then it can also be added to the carbon leakage list following a qualitative assessment.

Figure 3: EU EITE Criteria for Phase 3 of the ETS (2013-2020)



Source: European Commission (2009)

As noted above, the EU will use a new EITE definition starting in 2021. Specifically, it has updated both the emissions intensity calculation and carbon leakage criteria. The new emissions intensity calculation is:

$$Emissions\ Intensity = \frac{Emissions\ (kg\ of\ CO_2e)}{GVA\ (€)}$$

This calculation is described in an amendment to the directive implementing the ETS (European Commission 2018, 43). The amendment does not specify whether the measure of emissions includes only direct emissions from an industry, or if it will continue to be the sum of direct and indirect emissions.

The new carbon leakage criteria outlined in the amendment is:

$$Emissions\ Intensity \times Trade\ Exposure \geq 0.2$$

Sectors can additionally be added to the carbon leakage list based on an evaluation of qualitative criteria if the above calculation is greater than or equal to 0.15, or if the emissions intensity calculation exceeds 1.5 (European Commission 2018, 43)

Generally speaking, the new EITE criteria removes from the carbon leakage list industries that are currently on the list based solely on high trade exposure or high emissions intensity. Conversely, industries that were previously borderline when evaluating the combination of both criteria will now, in most cases, automatically be classified as at risk of carbon leakage.

Free Allocations

The large majority of industrial facilities in the EU are eligible for free allocations, which are distributed as emissions permits. The only major exception is electricity generators, which can receive free allocations for emissions associated with heat production but not electricity generation (in most cases).[34] The standard formula for determining the free allocation to a facility f in a particular year, t, is:

$$Free\ Allocation_{f,t} = \sum_{i} Production_{f,i} \times BE_{s,i} \times AF_{s,i,t} \times C_{i,t}$$

where i is the index of products produced by a facility, $Production_{f,i}$ is the historical quantity of the product produced by the facility, $BE_{s,i}$ is the emissions intensity benchmark for the product, $AF_{s,i,t}$ is the assistance factor and $C_{i,t}$ is the cap adjustment factor.[35]

In comparison to other jurisdictions, the EU's current free allocation methodology is based on an historical baseline and does not change in response to current production. Starting in 2021, however, the production level used in the free allocation formula will update if a facility's rolling average of production over a two-year period differs from its historical baseline by greater than 15 per cent.

The emissions intensity benchmark is defined at the sector level and uses historical facility-level emissions intensity data. Specifically, the emissions intensity for each facility producing the product is calculated and the sector benchmark is set equal to the unweighted average emissions intensity of the top 10 per cent of these facilities (i.e., those with the lowest emissions intensity). The benchmarks will be updated to reflect industry-specific technological improvements in 2021 and 2026. The EU currently has 52 emissions intensity benchmarks, which are largely defined at the equivalent of the NAICS 6-digit-level (Canadian/U.S. industry) and below.

The assistance factor is again the variable that adjusts a facility's free allocation in response to the carbon leakage risk of its industry. Industries on the carbon leakage list are always assigned an assistance factor of 1. In contrast, if an industry is not on the carbon leakage list then it receives an assistance factor of 0.8 in 2013, declining linearly to 0.3 in 2020. It remains at 0.3 through to 2026 and then declines linearly to reach zero in 2030.

As was the case in California and Ontario, the cap adjustment factor ensures the total number of free allocations in the EU declines in line with the overall cap on emissions. A key difference, however, is that the EU does not have a pre-determined schedule for the cap adjustment factor. Rather, it has a pre-determined cap on the total number of free allocations that can be distributed

[34] The cap-and-trade directive allows an exception to this in eight countries that have joined the EU since 2004 – Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Poland and Romania. Each of these countries is allowed to assign a limited number of free emission permit allocations to power plants as a form of transitional assistance. In return for this allowance, each country must also make an investment, equal to the value of these allocations, in modernizing the electricity sector (European Commission 2016, 3). Additionally, electricity generators in any country are eligible to receive free allocations for heat production.

[35] Note that "assistance factor" ($AF_{i,t}$) and "cap adjustment factor" ($C_{i,t}$) is our standard terminology. The EU terminology for these variables is "carbon leakage factor" and "correction factor" respectively.

each year. This cap, divided by the total number of requested free allocations, then determines the cap adjustment factor each year. Starting in 2021, however, the EU is introducing additional flexibility to the free allocation cap with the aim of reducing the use of the cap adjustment factor.

Assignment of Free Allocations

Free allocations are annually distributed from the European Commission to countries participating in the ETS. These participating countries then in turn distribute their share of the free allocations to facilities within their respective jurisdictions. As each facility's allocation is based on historical production data, the allocation only needs to be calculated and assigned on a single occasion.

Annual Adjustment to Free Allocations

From 2013 to 2020 free allocations to facilities in an industry on the carbon leakage list adjust on an annual basis in response to declines in the cap adjustment factor. Although the cap adjustment factor does not have a specific schedule, it is forecast to decline by just over one per cent per year from 2013 to 2020 (European Commission, 2015a). For facilities in industries not on the carbon leakage list, free allocations adjust both in response to the cap adjustment factor and the assistance factor.

Starting in 2021, free allocations to all facilities will adjust in response to production changes of greater than 15 per cent. The cap adjustment factor may also continue to play a role in adjusting free allocations post 2021, although as previously noted, the EU is aiming to minimize its use in this period.

In both 2021 and 2026 free allocations will additionally adjust in response to updates to the emissions intensity benchmarks for all industries. Relative to the original benchmark value, the range of possible tightening rates is three to 24 per cent in 2021, and an additional one to eight per cent in 2026. The exact values will reflect realized efficiency improvements in each industry.

Last, when the new EITE definition is implemented in 2021, a large number of industries may find themselves no longer on the carbon leakage list. As a result of being removed from the list, their assistance factors will fall from 1.0 to 0.3, reducing free allocations by 70 per cent.

Indirect Emissions

The EU's current EITE definition includes indirect emissions in its emissions intensity calculation. High indirect emissions therefore increase the likelihood of an industry being classified as at risk of carbon leakage.

The emissions intensity benchmarks include direct and indirect emissions from measurable heat used in the production process (European Commission 2014a). In contrast, indirect emissions associated with electricity generation are not included in the benchmark. Further, direct emissions associated with electricity that is generated on site, as well as heat that is exported, are subtracted from the emissions intensity estimate of a facility. Compensation for increased costs related to electricity purchases remains largely country-specific, with the ETS directive stating that, subject to EU-wide guidelines, countries may adopt financial measures to support industries deemed at risk of carbon leakage from carbon costs embedded in electricity prices (European Commission 2014b).

Reviews

The EU's EITE definition was first introduced in 2009 in an amendment to the directive implementing the ETS. The amendment required an initial carbon leakage list to be released by

December 31, 2009, and subsequent lists to be released every five years thereafter. The most recent amendment to the ETS directive removes this requirement. Details on future versions of the carbon leakage list, which will employ the new EITE definition, will likely be announced by the end of 2019.

Lastly, the EU ETS directive also includes a provision for reviewing the competitiveness and carbon leakage risk of manufacturing industries following the EU becoming a signatory to any new international agreements on climate change. This provision allows for decreasing support to EITE industries if competing international jurisdictions implement comparable carbon pricing policies.

Australia

Background

By its own admission, Australia has had an inconsistent approach to climate policy (Talberg, Hui, and Loynes 2016, 1). This is perhaps most evident in its revolving door of proposed and short-lived carbon pricing policies over the past decade.[36] In the absence of a consistent economy-wide carbon price, the main climate policy in Australia that has the potential to increase costs for EITE industries is the Renewable Energy Target (RET). The RET was first introduced in 2001 and sets yearly targets for renewable electricity generation. Responsibility for meeting the targets falls largely on electricity retailers, which are legally required to ensure that a certain percentage of the electricity they acquire and sell each year is from renewable energy sources (Clean Energy Regulator 2018).

EITE Definition

Although Australia has yet to implement a consistent carbon price it has been consistently aware of the potential impact of its climate policies on EITE industries. It first established a definition for EITE activities (production processes) when developing the legislation for a proposed cap-and-trade program in 2008. This same definition is currently used to support EITE activities from potential cost increases as a result of the RET. It is notable that Australia's reference to EITE activities is both unique and deliberate. Specifically, it does not want the policy to influence the physical or corporate structure of a company by providing EITE support at the industry level. As a result, within an industry, support is targeted to specific *processes* identified as EITE.[37]

[36] Australia's first legislative attempt to introduce a carbon price was the Carbon Pollution Reduction Scheme (CPRS) in 2008. Following three attempts to pass the CPRS legislation into law it was ultimately abandoned in 2010.[36] In 2011 the Government of Australia successfully passed the Clean Energy Act. The Clean Energy Act introduced a 3-year carbon tax in Australia, effective July 1, 2012, which was intended to precede the introduction of a cap-and-trade program. Only two years after it was introduced, however, the Act was repealed. The current government remains opposed to an economy wide carbon price of any kind (Hutchens 2016). Instead, it recently announced its National Energy Guarantee, a policy that will require energy retailers and large energy users to meet specific reliability and emissions reduction obligations.

[37] From the Carbon Pollution Reduction Scheme (the cap and trade program proposed in 2008) white paper, the motivation for using an activity-level approach is: ". . . an activity-level approach will allow the Government to target assistance most effectively and equitably. Provision of assistance to an entire company or facility, in contrast, may provide a relative benefit to some entities based purely on their physical or corporate structure. Targeting assistance to a specific activity will ensure that the provision of EITE assistance does not provide incentives to alter a company or facility structure to maximize the receipt of assistance." (Commonwealth of Australia 2008, 19).

The equations Australia uses to determine emissions intensity and trade exposure are:

$$Emissions\ Intensity = \frac{Direct\ Emissions\ + Indirect\ Emissions\ (t\ of\ CO_2e)}{Revenue\ or\ GVA\ (\$AUS\ million)}$$

$$Trade\ Exposure = \frac{Imports + Exports}{Production}$$

Australia's emissions intensity calculation differs from other jurisdictions on two grounds. First, its measure of indirect emissions is the broadest, including emissions associated with the production of electricity, steam and natural gas used as inputs by the production activity or process. Second, it is the only jurisdiction to use revenue as the default income measure. This was a controversial choice among numerous industries that felt the revenue measure failed to capture the fact that many high-revenue activities also have high input costs (Commonwealth of Australia 2008, 32). In response to this concern the government of Australia provided the option for certain activities to request assessment based on GVA instead.[38]

Australia's trade exposure calculation is also unique in that it is the only jurisdiction that does not include imports in both the numerator and the denominator of the equation. Accordingly, for any given values of imports, exports and production, Australia's equation will result in a higher estimate of trade exposure relative to other jurisdictions. Similar to the EU, Australia also does not rely strictly on the trade exposure equation for determining EITE status. Rather, if trade data for an activity is lacking, or if the calculation falls just below the trade exposure threshold for EITE classification, then the activity is eligible for a qualitative assessment. It will subsequently be classified as trade exposed if the assessment demonstrates that producers are constrained in their ability to pass on carbon costs to customers due to the potential for international competition.

Australia has two EITE categories – moderate and high – which depend primarily on an activity's emissions intensity (Figure 4). When the EITE categories were first introduced they were intended to impact the number of free allocations for which a facility would be eligible under Australia's proposed cap-and-trade program. Support provided to EITE activities for the RET, however, is independent of an activity's EITE categorization.

Figure 4: Australia EITE Criteria

Emissions Intensity (t of CO_2e/\$M of Revenue or GVA)	**> 2,000 (Revenue-based) > 6,000 (GVA-based)**		**High**
	1,000 – 1,999 (Revenue-based) 3,000 – 5,999 (GVA-based)		**Moderate**

[38] The Australian government resisted changing the income measurement for all activities to GVA due to a lack of readily available data. Specifically, the CPRS white paper notes that estimates of GVA are available from the Australian Bureau of Statistics for industries and sub-industries but that these data rarely correspond to activities that are eligible for EITE classification (Commonwealth of Australia 2008, 33).

	< 2,000 (Revenue-based) < 6,000 (GVA-based)		
		< 10%	**> 10%**
		Trade Exposure	

Source: Government of Australia (2008)

RET Exemption Certificates

A facility’s use of electricity in an EITE activity is eligible to receive an exemption certificate from the RET. Historically the amounts of the exemption certificates were calculated using a product calculation method, in which a facility’s output was multiplied by a product specific electricity intensity benchmark. In most cases this would result in an exemption certificate that was greater or less than the facility’s actual electricity use. To better align the exemption certificate amount with a facility’s actual electricity use, the Government of Australia introduced the electricity use method starting in 2018. Under the electricity use method facilities are issued an exemption certificate for the measured amount of electricity used in their EITE activities. With the introduction of the electricity use method the product calculation method is being phased out and will no longer be used starting in 2020.

Summary of EITE Definitions and Support Policies

Jurisdiction	Emissions Intensity Calculation	Trade Exposure Calculation	EITE Definition	Free Allocation
Canada	N/A	N/A	No formal definition. Current policy suggests facilities with emissions greater than 50,000 t CO_2e are automatically classified as EITE.	Allocation for each product produced by a facility. Allocation takes the form of an emissions limit. Allocation determined using a facility's annual production and a sector-level emissions intensity benchmark for each product. Proposed benchmark is 70% of the historical national production-weighted average emissions intensity of each product. May be adjusted further.
British Columbia	N/A	N/A	Qualitative assessment based on: (1) Large proportion of priced GHGs which industry is unable to mitigate in a cost-effective manner; and (2) Exposure to a competitive import and export market.	N/A
Alberta	"Full" carbon pricing costs (if all direct emissions from a facility were priced) as share of gross value added.	Trade (exports and imports) as share of domestic production and imports.	Three levels of leakage risk but only facilities designated as High qualify as EITE. High: EI greater than 30%, or EI between 15-30% and TE between 10-20%, or EI between 3-15% and TE above 20%.	Allocation for each product produced by a facility, less energy inputs used in production. Allocation takes the form of an emissions limit. Allocation determined using facility's annual production and a sector- or facility-level emissions intensity benchmark for each product. Standard benchmark is 80% of the historical production-weighted average emissions intensity of the product or "best in class." Benchmark for EITE industries may be adjusted upwards to 90% or 100% of the historical average.

				Benchmark includes emissions associated with energy inputs used in production.
Ontario	N/A	N/A	No formal definition. Nearly all participants in the cap and trade market are eligible for free allocations (key exceptions are electricity generators and natural gas distributors). Policy documents use California's definition for analysis purposes.	All facilities assigned a base allocation, which may be independent of production. Allocation is distributed as emissions permits. Six different definitions of the base number; most common is a facility's production multiplied by a sector- or facility-level intensity benchmark. The Base Number is adjusted by an Assistance Factor (between 0 and 1) and a Cap Adjustment Factor. The current Assistance Factor (through to 2020) is one. The Cap Adjustment Factor is one in 2018. Starting in 2019 it declines annually according to the overall cap on Ontario's emissions.
Quebec	N/A	N/A	No formal definition. Currently policy applies to nearly all facilities required to participate in the cap and trade program (key exception is natural gas distributors).	Allocation for each product produced by a facility. Allocation is distributed as emissions permits. Allocation determined using a facility's annual production and either a sector-level or a facility-level emissions benchmark for each product. Facility-level benchmark determined by historical facility-level emissions each product. Sector-level benchmark: benchmark for a facility is the larger of its own emissions intensity in a given year or a sector-level intensity target in 2020. Benchmark is approximately 80% of the historical emissions intensity of each product. Benchmark declines annually to a 2020 target intensity.
California	Emissions (tonnes) per million dollars ($USD) of gross value added.	Trade (imports and exports) as share of domestic	Three levels of leakage risk. Support policies have been largely independent of leakage risk.	Allocation for each product produced by a facility. Allocation is distributed as emissions permits. Allocation determined using a facility's annual production and a sector-level emissions benchmark for

		production and imports.	High: EI greater than 5,000, or EI between 1,000-4,999 and TE greater than 19%. Medium: EI between 1,000-4,999 and TE less than or equal to 19%, or EI between 100-999 and TE greater than 10%. Low: EI less than 1,000 and TE less than 10%, or EI < 100.	each product, modified by an Assistance Factor (between 0 and 1) and a Cap Adjustment Factor. Current Assistance Factor is 1 for High leakage risk, 0.75 for Medium and 0.5 for Low. Reverts to 1 for all industries in 2021 (current lower values may also be retroactively reversed). The Cap Adjustment Factor declines annually according to the overall cap on California's emissions. Standard benchmark is 90 per cent of the historical state-wide production-weighted average emissions intensity of the product or "best in class."
European Union	<u>Until 2021</u> Direct and indirect costs as a share of gross value added. Direct costs are priced emissions multiplied by emissions price. Indirect costs are estimated emissions costs associated with electricity use. <u>2021 and Later</u> Emissions (kg) per euro (€) of gross value added.	Trade (imports and exports) as share of domestic production and imports.	Yes/no categorization. <u>Until 2021</u> Yes: EI greater than 30%, or TE greater than 30%, or EI between 5-30% and TE between 10-29%. Sectors can be added to the carbon leakage list based on a qualitative assessment.<u>2021 and Later</u> Yes: EI multiplied by TE greater than or equal to 0.2.Sectors can be added to the carbon leakage list based on a qualitative assessment.	Allocation for each product produced by a facility. Allocation is distributed as emissions permits. Allocation determined using a facility's historical production and an industry-level emissions benchmark for each product, modified by an Assistance Factor (between 0 and 1) and a Cap Adjustment Factor. Sector benchmark is equal to the historical unweighted average emissions intensity of the 10 per cent of facilities with the lowest emissions intensity. The Assistance Factor is 1 for facilities on the leakage risk list. For facilities not on the list, the Assistance Factor declines from 0.8 in 2013 to 0 in 2020. The Cap Adjustment Factor is set annually and is equal to the emissions cap divided by the total number of requested free allocations.

Australia	Direct and indirect emissions (tonnes) per million dollars ($AUS) of revenue. Alternative definition: Direct and indirect emissions (tonnes) per million dollars of gross value added.	Trade (imports and exports) as a share of domestic production.	Two categories: High and Moderate. High: TE greater than 10% and EI greater than 2,000 (if revenue-based) or greater than 6,000 (if GVA-based). Moderate: TE greater than 10% and EI between 1,000-1,999 (if revenue-based) or between 3,000-5,999 (if GVA-based).	No free allocations. Use of electricity in an EITE activity is eligible for exemption certificates for the measured amount of electricity used in facilities' EITE activities. This exempts distributors from sourcing more expensive renewable electricity for these facilities.

Assessment of EITE Support Policies

In this section we assess the EITE support policies described above on the basis of four criteria: administrative costs, effectiveness of ameliorating leakage, economic efficiency, and equity across facilities and sectors. Our goal is to provide an overview of the extent to which EITE policies are effective in minimizing the negative competitiveness impacts of carbon pricing while still supporting the goal of achieving a global reduction in greenhouse gas emissions.[39] We focus our discussion on a subset of the jurisdictions discussed above – specifically Alberta, Ontario, Quebec, California and the European Union – as these are the jurisdictions that have implemented some form of carbon pricing and which have fully developed support policies for industrial facilities. We organize this section by assessment criteria to facilitate an easier comparison of each across jurisdictions.

Administrative Costs

Administrative costs refer to the costs incurred by government in implementing the EITE support policy, and firms in ensuring eligibility to receive it.[40] As outlined in detail in the previous section, Alberta, Ontario, Quebec, California and the EU all use free allocations to support EITE industries.

Administrative costs of free allocations are largely weighted towards the government. Upfront costs include the initial EITE assessment and defining the government-set parameters of the free allocation equation. Alberta, California and the EU are the three jurisdictions with formal EITE definitions, with administrative costs of the assessment likely being slightly higher in the EU as it uses both quantitative and qualitative criteria in defining its carbon leakage list. In comparison, Ontario and Quebec have opted not to define specific EITE criteria at this time.

There are three potential parameters in the free allocation formulas that are set by government: the assistance factor, the cap adjustment factor and the emissions intensity benchmark. The assistance factor and the cap adjustment factor are only used in Ontario, California and the EU while emissions intensity benchmarks are used in all five jurisdictions.

Setting the emissions intensity benchmarks incurs the highest administrative costs due to the data requirements and the large number of products and facilities for which benchmarks are defined. Administrative costs will increase with the number of benchmarks being defined. Importantly, however, a trade-off is required – up to a certain point – to ensure benchmarks are defined broadly enough to provide an emissions reduction incentive and specifically enough to not distort a facility's production decision.[41]

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[39] We note that it is possible to design an EITE policy to fully offset the costs of emissions pricing, but this would undermine the principle behind the price instrument, and it would be simpler to exempt large emitters if the objective is to provide full protection.

[40] Our focus in this discussion is primarily on the administrative costs of the EITE support policies, and except in areas of overlap, we do not discuss governments' costs of implementing the underlying emissions pricing plan or facilities' costs of complying with it.

[41] The danger if benchmarks are defined too specifically – that is, at the facility level – is that a facility will have a reduced incentive to achieve a best-in-class emissions intensity for its output. Alternatively, however, if benchmarks are defined too broadly – that is, at a high-level sector classification such as food product manufacturing – then a facility may have an incentive to change its product mix. Most jurisdictions adequately address this concern by defining benchmarks that are specific to a particular product within a sector. That is, as discussed in the jurisdictional review section of the main text, sector-level benchmarks are typically defined at the NAICS 6-digit-

Quebec, California and the EU simplify the process of defining emissions intensity benchmarks and reduce their administrative costs by using a largely standard methodology. California and the EU additionally reduce costs by defining benchmarks at the sector level whereas in Quebec benchmarks are largely facility specific. Alberta and Ontario use a combination of facility- and sector-specific benchmarks. Alberta has a standard methodology for defining benchmarks but also frequently deviates to alternative approaches, likely raising its administrative costs. Ontario does not describe the derivation of its sector-specific benchmarks, and for facility-level benchmarks it uses a combination of emissions intensity and historical-based benchmarks over varying years. Similar to Alberta, the lack of a consistent approach likely raises its administrative costs.

The most significant ongoing administrative cost to government from the EITE support policies is the annual calculation of free allocations. This cost is incurred in every jurisdiction except Alberta, where facilities are required to calculate and report the number of free allocations for which they are eligible in their compliance reports each year. The administrative cost is likely comparatively lower in the EU, where free allocations are based on historical production and distributed only once per year. In contrast, in California, Ontario and Quebec free allocations for each year are originally distributed based on an estimate of production, and subsequently updated once actual production data is available.

In Quebec, California and the EU, the government calculates and distributes free allocations based on a facility's report of its annual verified emissions, which is required under separate regulation. As a result, for mandatory cap-and-trade program participants in these jurisdictions the free allocations impose no additional administrative costs on the facility. Ontario, in contrast, imposes a small administrative cost by requiring facilities to submit an application for free allocations each year. Facility administrative costs are highest in Alberta where facilities must submit at least one – and for large emitters, five – reports per year. Additionally, facilities must complete and submit a request form to receive any surplus emissions credits for which they are eligible.

In Alberta, Ontario, Québec and California, voluntary participants in the carbon pricing programs have higher administrative costs by virtue of the opt-in paperwork requirements. In Ontario, Québec and California opt-in facilities must additionally incur costs to have their reported emissions verified each year, a requirement that doesn't exist for facilities that are covered by the respective reporting regulations, but which do not participate in the cap-and-trade program. The EU does not appear to have a voluntary participation option at the facility level. Rather, decisions to extend the scope of the EU ETS are made at the country level.

Allowing voluntary participants in carbon pricing programs to receive EITE support helps to protect smaller producers from the negative competitive impacts of carbon pricing (discussed further in the equity section) and further guards against carbon leakage. The trade-off, however, is an increase in government administrative costs as a larger number of free allocations must be processed each year. It may also be necessary to establish additional emissions intensity benchmarks. The EU ETS minimizes these costs by not allowing facilities to opt in on their own accord. Countries therefore maintain control over the scope of the ETS and hopefully will only extend the scope if they determine the reduced carbon leakage benefit offsets the additional administrative costs.

level and below. For example, California has five different emissions intensity benchmarks within the snack food manufacturing sector (California Air Resources Board 2017b, 174).

California has minimal mechanisms in place to ensure the higher administrative costs associated with opt-in participants are offset by reduced carbon leakage. Rather, facilities of any size that operate in broadly defined industries covered by the cap-and-trade program are eligible to opt in. Ontario and Québec take a similar approach, although both provinces establish a minimum threshold of 10,000 tonnes of CO_2e annually to be eligible to opt-in. Last, Alberta arguably strikes the best balance by limiting voluntary participation to facilities in EITE industries with minimum annual emissions of 50,000 tonnes of CO_2e, or to facilities of any size that produce the same product (typically defined at the 7-digit level of the North American Product Classification System) as a facility that has a mandatory participation requirement under the CCIR.

Effectiveness in Ameliorating Leakage

As noted above in the section *Rationale and Theory of EITE Support Policies*, historical-based free allocations do not impact a facility's decision on how much to produce. This is because the allocation a facility receives is independent of a facility's current production decision. In contrast, with output-based free allocations, the allocation a facility receives is directly determined by its current production decision. By effectively providing a subsidy to output, output-based free allocations therefore provide a stronger incentive to increase output than historical-based free allocations (Fowlie 2012).

This suggests that output-based allocations – that is, the system used by Alberta, California, Quebec and Ontario – should be more effective at minimizing carbon leakage than historical-based free allocations – the system currently used in the EU. This is largely supported in the modelling literature that directly compares estimates of emissions leakage under the two allocation methods.[42]

Examining the European cement industry, Demailly and Quirion (2006) find that historical-based allocations will result in carbon leakage of approximately 50 per cent while OBAs set at 90 per cent of a facility's historical emissions intensity will result in a leakage rate of just under 10 per cent. As the benchmark for the OBA decreases – that is, falls below 90 per cent – the leakage rate associated with OBAs moves closer to that of grandfathering. Extending the analysis to a larger number of sectors, Demailly and Quirion (2008) similarly find that allocating emissions by OBA will result in less leakage than an allocation via historical-based allocations and auctioning. Further, the advantage of OBAs over historical allocations generally increases the more stringent the emissions reduction target.[43]

Meunier, Ponssard and Quirion (2014) present a contrasting result for the EU cement sector, finding the historical-based allocation is approximately equal to or superior to OBAs at preventing carbon leakage (although in the latter case the OBAs result in higher domestic emissions reductions). However, they note the set-up of their model – a partial equilibrium analysis that does

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[42] As noted above, another mechanism that can be used to reduce carbon leakage is border tax adjustments (BTAs). Studies comparing EITE support policies generally find that a BTA is more effective at reducing carbon leakage than historical or output-based allocations to domestic producers (Demailly and Quirion 2008, Meunier, Ponssard, and Quirion 2014, Fowlie, Reguant, and Ryan 2016, Fischer and Fox 2012).

[43] Interestingly, in contrast to their 2006 result, the exception to this is the cement sector. This differing result is attributed to limitations of the 2008 model, which assumes the cement sector has restricted options for reducing its emissions (Quirion 2009).

not account for the EU's economy-wide emissions cap – contributes to the leakage rate being a poor comparator between the different scenarios.

Studies comparing free allocation mechanisms in the U.S. similarly find that OBAs are more effective than historical allocations at limiting carbon leakage. Fischer and Fox (2007) find a carbon leakage rate of just over 14 per cent with historical allocations and just under 12 per cent with OBAs that are allocated according to historical sector-level emissions and current output shares.[44] In a working paper that looks specifically at EITE industries, Fischer and Fox (2010) find that OBAs allocated based on current production reduce the leakage rate relative to historical allocations by greater than half, falling from 28 per cent to approximately 12 per cent. Lastly, in an analysis specific to the U.S. cement industry, Fowlie, Reguant and Ryan (2016) similarly find that estimates of total carbon leakage tend to be over 50 per cent lower when using OBAs versus historical allocations. The differential between leakage rates is also found to increase as the carbon price increases.

Consistent with the theory, the modelling literature strongly suggests OBAs, a lower carbon price and higher benchmarks will all contribute to reducing carbon leakage. Under these criteria, among the jurisdictions that use OBAs, California and Québec seem likely to have the lowest rates of carbon leakage. As they participate in a joint carbon market they have the same carbon price, which in the most recent auctions has hovered around $19 per tonne. Potential leakage in California is reduced by the state having the highest standard benchmark – 90 per cent of historical sector-level emissions – while in Québec it is likely reduced by extensive use of facility-level benchmarks.

While Ontario also shares the same carbon price as California and Québec, it is more difficult to assess potential leakage due to the lack of information over how sector-level benchmarks are defined. Further, when facility-level allocations are used they favour both higher and lower leakage rates. Specifically, facility-level OBAs are based on 100 per cent of a facility's historical emissions intensity, suggesting lower leakage. In contrast, however, higher leakage is likely to result among facilities that receive absolute allocations based only on their historical emissions.

Alberta is likely susceptible to slightly higher rates of carbon leakage, simply because its carbon price of $30 per tonne is 50 per cent higher than the current prevailing price in Ontario, Québec and California. Alberta's standard emissions intensity benchmark, at both the sector- and facility-level, is also slightly lower at 80 per cent of historical emissions intensities. Notably, however, EITE industries are eligible for higher rates of 90 and 100 per cent.

As noted earlier, the EU's system of historical-based allocations is most susceptible to higher rates of carbon leakage. It is worth noting, however, that the EU permit price has been depressed for much of the time since the current system of free allocations was first introduced (in 2013) and has only started to reach prices comparable to other jurisdictions in the second quarter of 2018. As these lower prices will have limited the negative cost impact on facilities from participation in the EU ETS, it will also have helped reduce carbon leakage in recent years.

Last, the treatment of indirect emissions may also play a role in determining carbon leakage. In particular, EITE industries may face negative competitiveness impacts if increased carbon costs

[44] Specifically, Fischer and Fox (2007) consider a cap-and-trade program in which the entire cap is distributed as OBAs. The cap for each sector is determined by a sector's share of total historical emissions while the allocation to each facility is based on its current share of output in the sector.

related to electricity generation emissions are not compensated in some form. Unsurprisingly, the risk for increased carbon leakage is highest in industries that are electricity intensive and trade exposed. Demailly and Quirion (2008), for example, show that in the European aluminium sector, extending OBAs to the electricity sector reduces leakage by approximately 10 to 25 per cent. In contrast, leakage in the cement sector, which has a low electricity intensity and a relatively low trade exposure, is virtually unchanged.

This result suggests compensation for indirect emissions can reduce carbon leakage but support should be targeted towards industries that are most at risk. This intuition is enforced by Fischer and Fox (2010). Looking at a scenario in which EITE facilities receive OBAs for indirect emissions versus one in which the entire electricity sector receives OBAs, they find virtually no change in carbon leakage rates for either the cumulative EITE sectors or the economy as a whole.

The European Union arguably comes closest to targeting support for indirect emissions only to industries at risk of increased carbon leakage from increased electricity costs. It lacks, however, a formal mechanism for doing so. Rather, as noted earlier, it generally does not provide any free allocations to the electricity industry and financial support for industries facing increased electricity costs is left as a country-level decision.

In Alberta and California, in contrast, support for indirect emissions appears to go beyond what is required to minimize carbon leakage from EITE industries. Specifically, in Alberta electricity generators are eligible to receive direct free allocations, while in California electricity distributors receive free allocations with the requirement that they be used to offset price increases to all consumers. Both jurisdictions therefore have a formal mechanism to offset increased electricity costs from carbon pricing but they do so without regard to whether the increased costs are likely to result in increased carbon leakage.

Lastly, Ontario and Quebec fall on the opposite side of the spectrum from Alberta and California, with both provinces providing only limited support for indirect emissions under specific conditions. Both jurisdictions, however, rely primarily on non-carbon emitting sources of electricity generation. As a result, electricity cost increases from the introduction of carbon pricing are likely to be minimal.

Economic Efficiency

Policies that support EITE industries by combatting carbon leakage can be welfare improving for a jurisdiction when they redirect consumer spending that might otherwise be spent on international goods towards domestic producers. This causes domestic producer surplus to increase relative to a scenario in which there are no support policies in place. Importantly, however, this welfare gain from increased domestic sales is only achieved when the danger of carbon leakage exists.

From an economic efficiency perspective, the *appropriate* targeting of free allocations to industries at risk of carbon leakage is therefore important. This is because there are definitive costs of EITE support policies that accompany this potential welfare gain.

The most significant of these costs is foregone government revenues. Specifically, the opportunity cost to government of EITE support policies is the total number of free allocations distributed in a year multiplied by the carbon price. For example, in Quebec in 2016, the government distributed just under 18,500,000 emissions permits free of charge. The settlement price in the 2016 permit auctions hovered around $17 per tonne, representing a revenue cost to the Quebec government of over $300 million.

It is not surprising, then, that in an analysis that compares economic outcomes in a cap-and-trade system with economy-wide free allocations, versus one in which all emissions permits are sold and the revenues are used to reduce labour taxes, Fischer and Fox (2007, 594) find that only the latter scenario results in a welfare improvement, as well as positive changes in employment and the real wage. In contrast, however, analyses that look at free allocations targeted specifically to EITE industries regularly find that by reducing carbon leakage, the free allocations result in higher welfare relative to a scenario in which all emissions permits are sold (Fischer and Fox 2010, Fowlie, Reguant, and Ryan 2016). Notably, welfare tends to be highest when the allocations are output-based as opposed to historical.

While output-based allocations are generally preferred from an efficiency perspective to historical-based allocations, it is even more important that they are targeted appropriately as they incent an increase in domestic output which is accompanied by one of two costs. First, if the OBAs are implemented alongside emissions intensity standards or a carbon price then the higher level of domestic output will result in higher emissions than what is optimal. Conversely, if the OBAs are implemented alongside a cap-and-trade program then there is no room for domestic emissions to increase. Rather, in order to allow for higher production while remaining under the emissions cap, the emissions intensity of production will be lower than what is optimal. Further, as marginal abatement costs are decreasing in emissions intensity – that is, the lower a facility's emissions intensity the higher cost it will be to achieve additional reductions – this implies that marginal abatement costs, and correspondingly the carbon price, are higher than is optimal.

The targeting of free allocations to industries at risk of carbon leakage is an area in which all jurisdictions currently fall short. This is most obvious in Ontario and Quebec, which do not have an EITE definition and instead provide free allocations to nearly all industrial facilities without any formal assessment of their emissions intensiveness or trade exposure. Alberta has a formal definition, but among mandatory participants in the province's pricing program, it at best makes only a small difference to the number of free allocations – and thereby the value of the output subsidy – for which a facility is eligible. California similarly has a formal EITE definition but only recently started to provide differentiated support to facilities based on carbon leakage risk. At best, however, this is only a temporary change. Starting in 2021 all facilities will receive the same level of support, regardless of EITE status. At worst, the CARB may proceed with a proposal that will retroactively reverse the current policy of differentiated support.

Lastly, the EU has a formal definition for industries at risk of carbon leakage, and the free allocation to a facility in an industry not on the carbon leakage list is significantly smaller than the allocation to a facility in an industry on the carbon leakage list. The EITE definition, however, is currently very broad. Looking only at the emissions from industrial facilities eligible for free allocations, 97 per cent of emissions are from industries on the carbon leakage list (European Commission, 2015a).

How the benchmarks for the free allocations are defined can also have important efficiency implications. Free allocations are effectively a subsidy to firms, with the monetary value of each individual allocation equal to the carbon price. This in turn implies that when free allocations are distributed according to facility-level emissions intensity benchmarks, facilities producing the same product will receive a different monetary subsidy per unit of output, lowering the efficiency of the policy. Further, the largest absolute subsidies per unit of output will go to facilities with the highest historical emissions intensities. In contrast, with sector-level emissions intensity benchmarks, all facilities producing the same product will receive the same subsidy per unit of output. As sector-level benchmarks provide a stronger incentive to facilities to improve their emissions intensities, they are more consistent with the goals of carbon pricing.

Under this criteria the free allocations in California and the EU are most efficient, as they are assigned exclusively according to sector-level benchmarks. Alberta similarly tends to use sector-level benchmarks for any industry with at least two or more facilities operating in the province. However, there are a small number of sectors for which Alberta makes exceptions and assigns facility-level benchmarks instead. Ontario appears to follow a similar approach to Alberta, although it is less explicit in explaining when and why facility-level benchmarks are used. Last, Quebec's emissions intensity benchmarks nearly all start at the facility-level, with only a subset converging to sector-level benchmarks in 2020.

Other factors that impact the relative efficiencies of historical- and output-based free allocations include the presence of labour taxes, the elasticity of the labour supply, the level of competition (perfect or imperfect) within a market, the coverage of the carbon price, uncertainty around future demand, and in the case of a cap-and-trade program, the stringency of the emissions reduction target (Bernard et al, 2007; Fischer and Fox, 2007; Fischer, 2011; Meunier al, 2014). When these additional factors are added to a model with carbon leakage, it is no longer the case that output-based free allocations will be immediately preferred. Rather, the relative efficiencies of historical- and output-based free allocations will depend on how these different factors interact together in a general equilibrium setting. As research exploring these complexities is ongoing, governments should remain flexible and regularly review and adjust policies as needed.

Lastly, it is worth noting the above discussion focuses largely on the static relationship between free allocations and economic efficiency. In all jurisdictions, however, it is also important to recognize that how the subsidy changes over time may also impact a facility's current decision on emissions intensity improvements. Specifically, if a higher reduction in a facility's emissions intensity results in a higher tightening rate – which thereby reduces the free allocations for which a facility is eligible – then this can negate the incentive for a facility to invest in achieving this reduction.

The only jurisdiction that is currently exposed to this risk is the EU, which starting in 2021 will tie the tightening rates on emissions intensity benchmarks to observed sector-level emissions intensity improvements. As the EU benchmarks are based only on the emissions intensities of the top 10 per cent of facilities in a sector, however, the negative incentive will not directly extend to all facilities in a sector. The EU is also softening the negative incentive on the top performing facilities by imposing both a minimum and maximum level on the potential range of tightening rates.

In contrast to the EU, Alberta, Ontario and California employ what is arguably the best practice of using tightening rates that are defined exogenously and are in no way related to facility- or sector-level emissions intensities. As a result, there is no incentive for facilities to hold back on emissions intensity improvements in order to preserve current subsidy levels. In Quebec, current tightening rates are based on historical emissions intensities from prior to the cap-and-trade program being introduced. While technically this satisfies the criteria of being independent of current emissions intensities, Quebec has only defined tightening rates through to 2020, and the current method sets the precedent for future tightening rates to be based on current emissions. This precedent may in turn influence a facility's current decision around its investments in emissions intensity improvement. It is arguably preferable, therefore, for tightening rates to be completely divorced from emissions from the outset of a carbon pricing program.

Equity Across and Within Sectors

The equity of EITE policies is closely related to the efficiency of the policies. In considering equity, what is most common is a desire for equal treatment of facilities within and across sectors.

Assigning free allocations via historical or current production has implications for equity. Specifically, historical-based allocations are more likely to provide "windfall profits" to facilities. This is particularly relevant in a scenario where a facility decreases its production relative to the historical baseline used to calculate its allocation. In this scenario the facility effectively continues to be compensated for emissions that it no longer produces. Historical allocations also have a distributional implication for firms that enter after allocations have been assigned – they may not receive any allocation and are therefore disadvantaged relative to incumbents (notably, however, this is not the case in the EU which established a New Entrants Reserve that provides allocations to new firms).

In contrast, output-based allocations can result in a windfall to low emissions-intensity facilities, relative to facilities with higher emissions intensities which suffer most of the cost impacts of increasingly stringent environmental policy (Bushnell and Chen 2012) . As the value of a facility's subsidy is tethered to its current production, output-based allocations reward production and penalize emissions through the emissions price. However, while a negative from the perspective of facilities with high emissions intensities, 'rewarding' lower-emitting firms through this windfall is not an objectively bad outcome when one recalls the overall purpose of emissions pricing and complementary EITE policies. If a facility adjusts its output – up or down – then the value of the OBA it receives will move in the same direction. Further, new facilities are similarly eligible to receive the same OBA as an existing facility as it is calculated based on current period production. Along the metric of equity in allocation of free permits, the EITE support policies in Alberta, Ontario, Québec and California are therefore more equitable than in the EU.

Independent of how the allocations are distributed, how the benchmarks are defined is also an important equity consideration, particularly within a sector. Of particular note is whether the benchmarks are defined at the facility- or sector level. In the former case, facilities producing the same product will receive a different monetary subsidy per unit of output. Further, the largest absolute subsidies per unit of output will go to facilities with the highest historical emissions intensities. In contrast, with sector-level emissions intensity benchmarks, all facilities producing the same product will receive the same subsidy per unit of output. On this basis, the free allocations in California, the EU, and Alberta are most equitable as they are mainly assigned according to sector-level benchmarks.

It is worth noting, however, that "softening the blow" is often a political consideration, particularly in generating buy-in for the emissions pricing system itself. Facility-level benchmarks that provide greater compensation to more emissions-intensive facilities may therefore be desirable for that reason.

A third distributional consideration is whether all facilities competing in an EITE industry are eligible for carbon pricing support, regardless of size. The EU ETS cap-and-trade program only covers industrial facilities and it additionally has the broadest direct participation requirements, often requiring mandatory participation in the cap-and-trade program by all facilities in a sector, regardless of size. Accordingly, this also means that free allocations are often extended to all facilities in a sector, once again regardless of size. In industries where minimum thresholds exist, however, smaller facilities may face a cost disadvantage from increased electricity prices, particularly as the majority of fossil-fuel electricity generators in the ETS are not eligible for free allocations.

The carbon pricing systems in Alberta, Ontario, Quebec and California cover both industrial facilities and fossil fuel distributors. As a result, small industrial facilities that are not required to participate in the pricing system may still face increased costs for purchased electricity, heat, and fossil fuels.

The mandatory participation threshold for the cap-and-trade programs in Ontario, Quebec and California is 25,000 tonnes of CO_2e emissions per year. In California, however, any facility with emissions below this level, and which competes in an industry that is eligible for mandatory participation, may opt in to the cap-and-trade program and is then eligible to receive free allocations. Additionally, as noted earlier, California provides free allocations to electricity distributors, and requires these allocations be used to offset electricity price increases. This further ensures that all industrial facilities – regardless of size – are protected from electricity cost increases attributable to carbon pricing.

In contrast to California, Ontario and Quebec require opt-in facilities to have a minimum emissions level of 10,000 tonnes of CO_2e. This effectively establishes a threshold for carbon pricing support in both provinces and poses the risk of incenting facilities falling below this threshold to increase their emissions in the short-term. A facility can increase its emissions either by increasing its production, or in a much less desirable scenario, increasing its emissions intensity (that is, generating more greenhouse gas emissions per unit of output).

The motivation to increase emissions stems from the lack of free allocations potentially creating a competitive disadvantage for smaller facilities with emissions falling below the eligibility thresholds. In particular, these facilities are likely to face increased costs associated with fuel consumption, passed down by fossil fuel distributors. Electricity price increases, however, are likely to be nominal as both Ontario and Quebec generate the majority of their electricity from non-fossil fuel sources.

Lastly, Alberta's minimum threshold for mandatory participation in its OBPS is 100,000 tonnes of CO_2e per year. Opt-in participation is available to a facility of any size competing in an industry with at least one mandatory participant in the CCIR, or a facility in an EITE industry with emissions in excess of 50,000 tonnes of CO_2e per year. With this approach Alberta arguably accomplishes both equity and efficiency objectives. First, it does not create any competitive disadvantages among facilities of different sizes in the same sector. Second, among smaller facilities in sectors not automatically covered by the CCIR, support is available only to those that are at risk of carbon leakage.[45] Facilities that do not receive free allocations – either because they are not eligible or do not opt-in to the CCIR – will almost certainly face increased costs for fossil fuel purchases. The likely change in electricity prices, however, is less clear. Alberta is the only jurisdiction where all fossil fuel electricity generators are eligible for free allocations. While these allocations offset the increased cost to generators of supplying fossil-fuel electricity, there is no requirement in the regulation that the value of the allocations get passed down to consumers. Rather, the change in consumer prices will depend on the competitiveness of the electricity market.

Conclusions

The introduction of more stringent environmental policy – frequently in the form of pricing greenhouse gas emissions – carries with it the risk of posing negative competitiveness impacts on domestic firms and carbon leakage. As a result, domestic production declines while domestic emissions reductions are not fully realized on a global scale. Support for EITE industries can mitigate these impacts and is therefore a valid and needed component of climate policy packages in the absence of consistent and equivalent global action.

Most of the jurisdictions we consider support EITE industries through free allocations that allow a facility to emit a certain amount of emissions at zero charge. There are a number of different components that determine the number of free allocations a facility is eligible to receive. The two most important, however, are typically an emissions intensity benchmark for a facility's product and a measure of a facility's current or historical production.

Our analysis identifies a number of best practices for defining the emissions intensity benchmarks. First, standardized sector-level emissions-intensity benchmarks are preferable to facility-level benchmarks on efficiency and equity grounds, as they result in an equal subsidy per unit of output across all firms within a sector. They are also less administratively costly as there are fewer benchmarks to track and update over time. Second, looking ahead, it is preferable for the emissions-intensity benchmarks to have a tightening rate that is independent of current production and emissions. This ensures firms do not limit their current emissions reductions in order to gain higher free allocations in the future.

The question of whether it is preferable to base free allocations on current or historical production can be answered by recalling that the goal of EITE support policies is to limit carbon leakage – preventing declines in output as a result of emissions pricing – while maintaining emissions reductions. In this, output-based allocations are more effective and more equitable than historical allocations as they only compensate facilities for what they actually produce, rewarding production and penalizing emissions. When designing EITE support policies it is also important for policy makes to remember that free allocations come with distinct costs. First, there is the foregone revenue from emissions on which the carbon price is not paid. This is further compounded when considering governments have constrained or fixed budgets for EITE support. Too broad a definition of EITE will mean a greater reduction in revenues and more limited support being spread across more facilities and industries. As a result, industries at true risk of carbon leakage may not

[45] With the minimum threshold of 50,000 tonnes of CO_2e annually Alberta does risk, however, a similar situation to Ontario and Québec where a facility in an EITE industry not covered by the CCIR is incented to increase emissions above this threshold in order to receive support.

receive ‘adequate’ support.[46] Second, with output-based free allocations, production and emissions will be higher than is optimal. This in turn results in either emissions or a carbon price that is higher than optimal. Additionally, when governments have constrained or fixed budgets for support, too broad a definition of EITE will mean support is spread across more facilities and industries, again resulting in industries at risk of leakage not receiving adequate support.

Appropriate targeting of EITE support policies has largely been overlooked in most jurisdictions. Even when the time has been taken to develop EITE definitions that distinguish sectors according to leakage risk, these definitions are generally either too broad or they are not applied in a way that will better target support policies to those industries at highest risk of carbon leakage. Rather, in virtually all jurisdictions, a facility’s current eligibility to receive EITE support tends to depend more heavily on a basic accounting of its total annual emissions rather than on an assessment of its emissions intensiveness and trade exposure.

There is a fine line for policy makers between reducing carbon leakage and introducing additional costs into an economy as a result of EITE support policies. Unsurprisingly then, the design and implementation of EITE support policy is non-trivial. The effectiveness, efficiency and equity of the policy depends on two components – how the support is provided and where the support is targeted. If either is not given due consideration, then the EITE support policy is unlikely to lead to an efficient outcome. It is therefore essential for policy makers to look at best practices within both components. This gives a jurisdiction the best opportunity to support industries at true risk of carbon leakage while maximizing the effectiveness of its climate change policy.

[46] We note that while the appropriate level of compensation is an important question, it is beyond the scope of this paper.

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