

THE GREENHOUSE GAS EMISSIONS COVERAGE OF CARBON PRICING INSTRUMENTS FOR CANADIAN PROVINCES

Sarah Dobson, Jennifer Winter and Brendan Boyd

SUMMARY

The Government of Canada first announced its intention to implement a nation-wide carbon price in October 2016. After two years of announcements, retractions, discussions and debate, the rollout of carbon pricing in each province was finalized in October 2018: the federal government announced its assessment of proposed and implemented provincial carbon pricing plans. We now can compare the coverage, stringency and efficacy of provincial climate policies, and to consider how they measure up with each other and with the federal government's standards.

This paper focuses primarily on provincial systems' emissions coverage: the share of emissions subject to a carbon price. The federal government has set a pricing benchmark, the minimum level of emissions coverage that provincial pricing policies are required to meet. The federal backstop — consisting of a carbon tax and output-based pricing system (OBPS) for large emitters — is imposed on provinces whose policies don't measure up to the federal benchmark. We examine how the coverage of implemented, announced and former provincial pricing policies measure up to the benchmark and backstop. Using reported emissions data for each province from 2015, we provide an estimate of emissions coverage in each province from the policies in effect in 2019.

The federal benchmark is defined as covering substantively the same sources as British Columbia's economy-wide tax on combustion emissions. Part of the motivation for the benchmark was to tackle the consistency problem arising from disparate provincial pricing policies. The federal government, however, has opted not to consistently enforce the benchmark across the provinces. As a result, the carbon pricing scene in Canada resembles a patchwork quilt, with policies and coverage varying across the country.

Only two provinces — British Columbia and Quebec — have provincial pricing plans where coverage meets the federal benchmark. British Columbia's carbon

tax is the definition for the benchmark, while in Quebec the cap-and-trade system surpasses the benchmark and provides coverage comparable to the federal backstop.

Alberta, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador have all introduced provincial carbon pricing plans that fall short of the federal benchmark for coverage. Despite this, all four provinces received the federal government's endorsement. Alberta's shortcoming is the result of a targeted and short-term exemption of small oil and gas producers, while Nova Scotia's cap-and-trade program meets the federal benchmark's stringency requirement for overall emissions reductions. This likely explains the federal government's flexibility with these provinces. The justification for the exceptions provided to Prince Edward Island and Newfoundland and Labrador are less obvious, and may be a nod towards the relatively rural nature of both provinces, as well as more limited access to lower-emitting fossil fuel substitutes.

The remaining four provinces — Saskatchewan, Manitoba, Ontario and New Brunswick — will see the federal backstop imposed in whole or in part. In Saskatchewan the federal backstop will be a top-up to the province's proposed performance standards system. New Brunswick's proposed carbon pricing plan includes adoption of the federal backstop's OBPS for its large emitters. Its carbon tax, however, fell explicitly short of the federal benchmark. As a result, the backstop will be imposed in full in the province.

The federal backstop will also be imposed in full in Manitoba and Ontario, a result of both provinces reneging on their original carbon pricing plans. Coverage of the now defunct plans in both provinces exceeded the federal benchmark and were comparable to the federal backstop. With the federal backstop, both provinces now face higher carbon prices in the long run and have sacrificed control of carbon pricing revenue to the federal government.

When all is said and done, carbon pricing coverage differs substantially across the provinces. Due to variation in emission sources, as well as region-specific exemptions, carbon pricing coverage will range from 47 per cent of emissions in Prince Edward Island to 90 per cent in New Brunswick.

Some of the disparity in provincial coverage reflects differences in provinces' industrial profiles. This points to a need for complementary emissions-reduction policies for non-combustion emissions in these jurisdictions. Other disparities, however, can be traced to the federal government's inconsistent application of the coverage benchmark. The federal government will likely face increasing pressure on this point going forward, particularly from the growing number of provinces that are opposed to carbon pricing and expected to criticize any evidence of inequitable treatment.

INTRODUCTION

In a parliamentary speech in October 2016 Prime Minister Justin Trudeau introduced the federal government's carbon pricing plan, announcing that "... all Canadian jurisdictions will have put a price on carbon pollution by 2018" (Trudeau 2016).^{1,2} Provinces were given the option of implementing the price through a federal backstop system or designing their own pricing system that meets minimum thresholds — defined as "benchmarks" by the federal government — for the level of the carbon price and the types of emissions to which the carbon price applies. If a provincially designed system falls short of these benchmarks, then the federal backstop system will supplement or top up the provincial system by raising the carbon price or expanding its coverage (Environment and Climate Change Canada 2017c). On Oct. 23, 2018, provincial and territorial pricing plans were finalized, with some provinces and territories receiving the federal government's approval of their voluntary plans and others — Ontario, New Brunswick, Manitoba, and Saskatchewan — having the federal backstop imposed (Trudeau 2018).

When comparing carbon prices in Canada, much of the focus in political and policy circles has been on the dollar value assigned to greenhouse gas emissions, typically calculated per tonne of carbon dioxide equivalent (CO₂e) emissions. However, any carbon pricing policy's capacity to reduce emissions also depends on the proportion of a jurisdiction's emissions to which it applies. In this paper we provide a comparison between provincially announced pricing systems, the federal backstop and the federal benchmark, focusing on coverage of the carbon price in each system.³ We define coverage as the proportion and types of emissions priced under the various systems, by emissions source. For provinces that have introduced a pricing policy and subsequently withdrawn it, we compare the previously announced policy to the federal benchmark and backstop.

Our work expands and complements a rapidly growing literature examining Canadian emissions and climate policies. Most relevant to the analysis presented here is a study from Canada's Ecofiscal Commission, which compared the stringency of a subset of different provincial carbon pricing systems using five different metrics, including coverage (Beugin et al. 2016). We focus exclusively on coverage across provinces, undertaking a fine-grained analysis of coverage of different emission types and the details of provincial and federal policies. The results presented here are informative for policy development, as provinces decide on the relative merits of various options in implementing carbon pricing policy. In addition, our research builds on previous work by examining federal policies announced as part of the Pan-Canadian Framework on Clean Growth and Climate Change (PCF).

Variation in coverage across the provinces and with federal requirements will have important policy implications. This assessment could play into the already complex and controversial negotiations establishing pan-Canadian carbon pricing and equivalencies of provincial policies. Notably, coverage of the federal backstop exceeds the minimum threshold — the federal benchmark — for the types of emissions to which the carbon price must apply. Therefore, by developing their own carbon pricing system, some provinces have established a less onerous policy, in terms of coverage, than if they accepted the federal backstop. Finally, provinces with a higher share of unpriced emissions are more

¹ We note that the colloquial reference to a carbon price (or carbon tax) typically means a price (or tax) on greenhouse gas emissions, not just carbon. For ease of exposition, we will also use this term, unless additional precision is required.

² Although Prime Minister Justin Trudeau's speech clearly stated that a nationwide carbon price would be in place "by 2018", the federal legislation making provincial pricing a legal requirement was introduced in spring 2018 (as part of the Budget 2018 omnibus bill) and provinces were given until Sept. 1, 2018 to submit provincial carbon pricing plans for review by the federal government (McKenna and Morneau 2017). In provinces where the federal carbon pricing plan is being implemented, the carbon tax will take effect in April 2019.

³ We do not discuss the territories as earlier media reports suggested the federal government was examining them separately and a different backstop system could apply (Forrest 2017; Thomson 2017). The finalization of pricing plans on Oct. 23, 2018 revealed that Northwest Territories will adopt its own carbon pricing plan while most of the federal backstop will be implemented in Yukon and Nunavut. Three key differences in the territories relative to the provinces are that all aviation fuel will be excluded from the carbon price, fuel charge relief will be provided for diesel fuel used for electricity generation and implementation of the backstop will be delayed until July 2019 (Government of Canada 2018f).

likely to require additional complementary emissions-reduction policies that specifically target these sources to meet jurisdiction-wide emission reduction targets.

Part of our contribution is the calculation of estimated pricing coverage of different carbon pricing plans using currently accessible data on emissions; our methodology is described in Appendix A. We note, however, that the different datasets used do not always align in their reported estimates of emissions. Also, some of the relevant data for estimating coverage are only available publicly at the national level, meaning that we must extrapolate from this information in order to obtain provincial estimates. Accordingly, our results may differ from coverage estimates presented by federal and provincial governments.

The remainder of this paper proceeds as follows. First, we outline Canada's classification system for greenhouse gas emissions. Second, we present the details (current to December 2018) of the federal government's carbon pricing backstop and benchmark. We then compare coverage under these systems to previous, current or announced systems in each province. We conclude with a brief discussion of other considerations provinces may face as they move forward with implementation of a carbon pricing system.

TYPES OF GREENHOUSE GAS EMISSIONS

Canada reports its greenhouse gas emissions in Environment and Climate Change Canada's National Inventory Report (NIR). The NIR is issued in the spring of each year, with estimates of greenhouse gas emissions current to two years prior (that is, the 2017 NIR includes emissions estimates current to 2015). Canada's categorization of greenhouse gas emissions follows the United Nation's Framework Convention on Climate Change (UNFCCC), which in turn follows the emissions categorization guidelines of the Intergovernmental Panel on Climate Change (IPCC). Readers familiar with the IPCC categorization system and Canada's greenhouse gas emissions as reported in the NIR may wish to skip this section and proceed immediately to the discussion of the federal government's carbon pricing backstop and benchmark.

Greenhouse gas emissions can broadly be divided into combustion and non-combustion sources. Combustion emissions are those that are released from the burning of fossil fuels, including crude oil and refined petroleum products, natural gas and coal. This is the largest source of greenhouse gas emissions in Canada, accounting for 74 per cent of total emissions from 2000 to 2015 (Environment and Climate Change Canada 2017b). The IPCC classifies all combustion emissions in the Energy category (Figure 1), with most of these emissions in the stationary combustion and transportation subcategories. The stationary combustion subcategory accounts for combustion emissions from all fixed locations in Canada (for example, emissions from a natural-gas-fired electricity plant). In contrast, the transportation subcategory accounts for combustion emissions from all mobile sources including road and off-road vehicles, rail, air, marine and pipelines.⁴

Also included in the IPCC Energy category are fugitive emissions from oil and gas production and coal mining, which include combustion and non-combustion emissions. These are emissions that are released during the fossil fuel extraction process, most notably due to flaring, venting, coal mining, and oil and natural gas well or pipeline leakages.⁵ Fugitive emissions from flaring are combustion emissions, while the remaining sources of fugitive emissions are non-combustion.

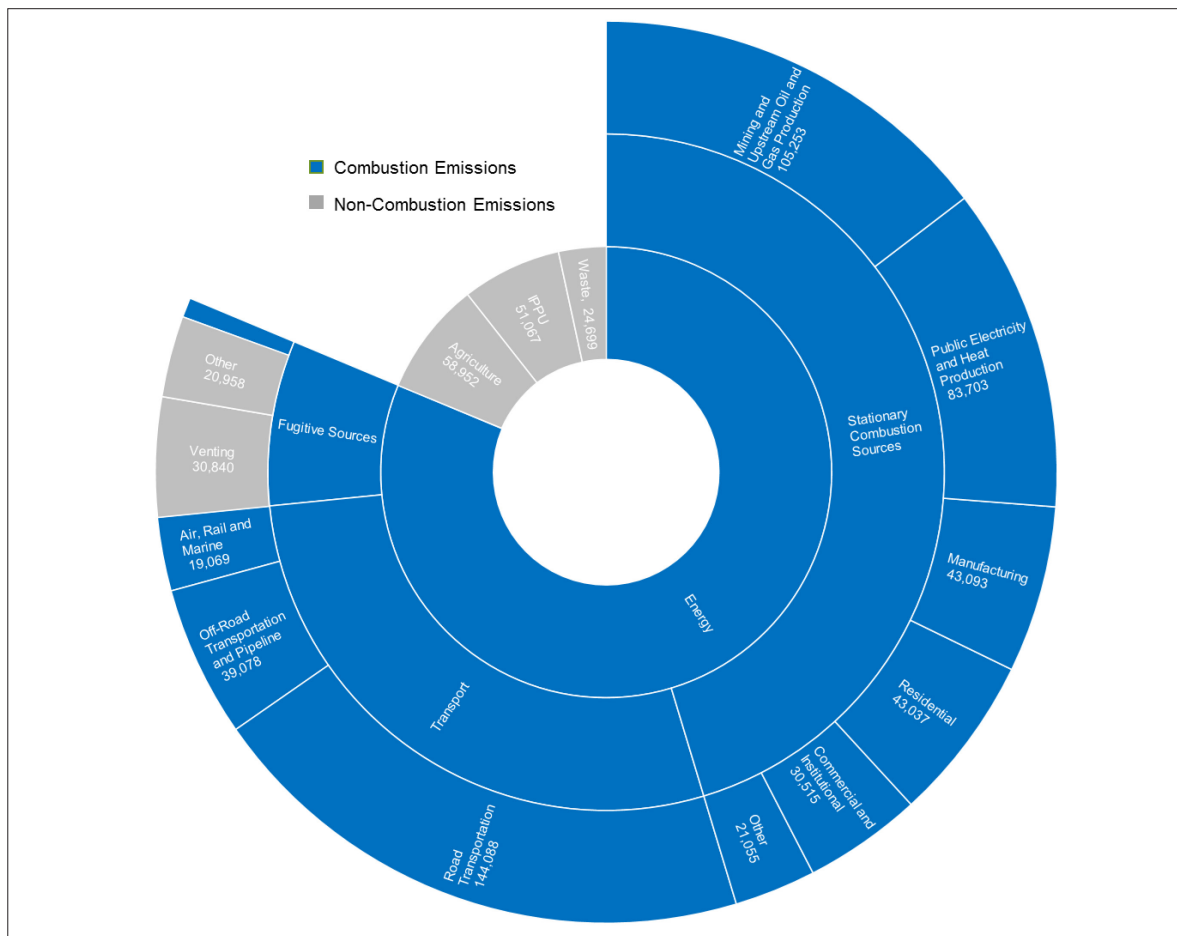
⁴ Although pipelines are included in the transportation category, the majority of greenhouse gas emissions from their operation are from fixed-location compressor stations.

⁵ Flaring and venting are both part of regular oil and gas operations. Specifically, flaring is the controlled burning of natural gas during operations and venting is the controlled release of gases to the atmosphere. Gases released during venting may include natural gas or other hydrocarbon vapours, water vapour and other gases such as carbon dioxide (Alberta Energy Regulator 2018).

In addition to the Energy category, the UNFCCC reporting framework also includes the following IPCC emissions categories: Industrial Processes and Product Use (IPPU); Agriculture; Waste; and Land Use, Land Use Change and Forestry (LULUCF). All greenhouse gas emissions in these categories are non-combustion emissions.

Emissions in the IPPU category are primarily attributable to the manufacturing sector, with a smaller share generated by the oil and gas sector, transportation, and residential and service sector buildings. Emissions in the Agriculture and Waste categories are entirely attributable to the agriculture and waste sectors respectively. Last, the LULUCF category reports the greenhouse gas emissions flows between the atmosphere and Canada’s managed lands. It includes both categories that are carbon sinks and those that are sources of greenhouse gas emissions, either as a result of biomass emissions or land conversions that reduced a carbon sink. LULUCF emissions are not tracked at the provincial level. Also, although Environment and Climate Change Canada reports a national estimate of LULUCF emissions to the UNFCCC each year, this estimate is not included in the summation of Canada’s total greenhouse gas emissions. Greenhouse gas emissions in the LULUCF category are also not subject to any existing emissions pricing policy in Canada. As a result, we do not include emissions from this category in our discussion of coverage (nor are they included in Figure 1).

FIGURE 1 2015 CANADIAN GREENHOUSE GAS EMISSIONS BY IPCC REPORTING CATEGORY



Source: Environment and Climate Change Canada (2017b)

Note: Totals may not add up due to rounding. All numbers are emissions reported in kilotonnes of carbon dioxide equivalent (CO₂e). The measure of CO₂e includes direct carbon dioxide emissions, as well as the carbon dioxide equivalent amounts of methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride. The “Other” category for Stationary Combustion Sources includes petroleum refining industries, construction and agriculture and forestry. The “Other” category for Fugitive Sources includes fugitive emissions associated with coal mining, oil and natural gas operations (including pipelines). A table with the full listing of emissions by category (including LULUCF emissions) is in Appendix B.

THE FEDERAL CARBON PRICING BENCHMARK AND BACKSTOP

The Government of Canada has introduced both a federal carbon pricing benchmark — which includes minimum emissions pricing coverage that provinces must achieve — and a federal carbon pricing backstop (hereafter referred to as the “federal benchmark” and the “federal backstop” respectively). The coverage portion of the federal benchmark is defined as “. . . substantively the same sources as British Columbia’s carbon tax” (Government of Canada 2016a). Provinces can meet the federal benchmark via a price-based system such as in British Columbia or Alberta, or via a cap-and-trade system such as in Quebec (Government of Canada 2016b).⁶

Price-based systems⁷ can take one of two forms. British Columbia’s system is an economy-wide tax on combustion emissions. Alberta’s hybrid system, in comparison, applies an economy-wide carbon tax to combustion emissions, while also implementing an output-based pricing system (OBPS) for large emitters. The OBPS is effectively a mechanism to help protect large emitters from the negative competitiveness impacts of carbon pricing. Specifically, it prices emissions from facilities while simultaneously providing a per unit subsidy based on a benchmark emissions intensity (tonnes per unit or dollar value of output).⁸

The federal benchmark also includes a requirement for increases in stringency. For a pricing system the stringency requirement is minimum price increases. For a cap-and-trade system, it is a declining annual cap in emissions that corresponds (at a minimum) to projected emissions reductions resulting from a pricing system. Notably, the cap-and-trade systems also need a 2030 emissions reduction target at least as ambitious as Canada’s 2030 target (a 30 per cent reduction in emissions relative to 2005), whereas pricing systems only need the annual increases in price.

The federal backstop is imposed on provinces whose pricing plans do not meet the benchmark. This includes provinces whose stringency does not meet the benchmark. Provinces may also opt in to the backstop, which the federal government will administer.

The federal backstop consists of two components: (1) a carbon tax that will apply to emissions from combustion and controlled (measured) flaring and venting emissions in a province; and (2) an output-based pricing system (OBPS) that applies to industrial facilities that emit 50 kt of CO₂e or greater per year.⁹ Smaller industrial facilities that emit fewer than 50 kt of CO₂e but which compete against facilities exceeding the 50 kt threshold will also be given the option of participating in the OBPS. In provinces where the federal backstop will apply, the carbon tax will be implemented starting in April 2019 while the OBPS took effect in January 2019.

⁶ A carbon tax and a cap-and-trade system are the two most common mechanisms for implementing a carbon price. A carbon tax applies a set price to emissions in a jurisdiction while allowing the total number of emissions to vary. A cap-and-trade system, in contrast, sets a maximum cap on emissions in a jurisdiction. Permits set equal to the emissions cap are distributed, typically either via free allocation or auctioning, and the carbon price is determined by the demand for permits. For details on a carbon tax versus cap-and-trade program see Ragan et al. (2014), Keohane and Olmstead (2016) or Wood (2018).

⁷ Both carbon taxes and cap-and-trade systems are price-based systems, though as noted in footnote 6, determination of the price differs. For ease of exposition, we use ‘pricing system’ and ‘price-based system’ to refer to explicit pricing systems like in BC or Alberta rather than the broader technical use of the term.

⁸ For details on the principles behind output-based pricing systems, see Dion (2017), Dobson et al. (2017), or Dobson and Winter (2018).

⁹ While not the focus of this paper, we briefly note the objective of the OBPS is to guard against the negative impacts of carbon pricing for industries exposed to international competition. Specifically, domestic industries that are exposed to international competition often have minimal, if any, control over the pricing of their output. As a result, they must typically absorb the full impact of any increase in costs attributable to the carbon price. This decreases their profitability relative to international competitors and raises the possibility of production leaving Canada and shifting to cheaper locales. This in turn can result in carbon leakage, which occurs when greenhouse gas emissions in an international jurisdiction increase in response to domestic climate policies. The goal of an OBPS is to reduce the likelihood of carbon leakage while maintaining the incentive for domestic facilities to invest in emissions reductions. For a more complete description of the rationale for, and economics of, output-based pricing systems, as well as recommendations for the design of the federal government’s system, see Dobson et al. (2017) or Dobson and Winter (2018).

Draft regulations for the OBPS were released in December 2018 (Environment and Climate Change Canada 2018b). As a high-level overview, an industrial facility participating in the system will have a per product emissions limit that is equal to an output-based emissions standard, expressed in tonnes of CO₂e emissions per unit of output, multiplied by its total output. The draft regulation specifies 38 industries that the OBPS will cover, and assigns output-based standards to 74 sub-activities (generally corresponding to the production of specific products) within these industries. The starting point for emissions standards is 80 per cent of the national production-weighted emissions intensity of the product.¹⁰ Products from seven industries that were identified as “high competitive risk” will be eligible for a higher emissions standard. Specifically, two industries will have an initial emissions standard of 95 per cent while the remaining five will have an initial emissions standard of 90 per cent.¹¹

If a facility produces more than one product, then its emissions limit will be equal to the sum of its output-based emissions allocation across all products. A facility’s emissions limit will apply to combustion emissions and certain categories of non-combustion emissions. Non-combustion emissions generally include IPPU emissions, fugitive emissions and emissions from venting. The only significant exception to this is fugitive and vented methane emissions from the oil and gas sector, including upstream oil and gas facilities and transmission pipelines (Government of Canada 2018a). These emissions are excluded from the OBPS as they are separately covered under the Government of Canada’s methane regulations for the oil and gas sector.

A facility faces no charge on greenhouse gas emissions up to its emissions limit. Additionally, if a facility’s emissions fall below its emissions limit then it will receive surplus credits that it can bank for future use, or which it can sell to other facilities participating in the system. Conversely, if a facility’s emissions exceed its limit then it must pay the prevailing carbon tax to the federal government on its excess emissions. It can alternatively cover these emissions by purchasing either surplus credits from other industrial facilities or offset credits from non-participants in the OBPS that achieve voluntary (non-regulated) and certified greenhouse gas emissions reductions.

A key characteristic of a well-designed OBPS is that it allows a facility to emit a certain amount of greenhouse gas emissions at zero charge while maintaining the incentive for it to reduce its emissions intensity per unit of output. In other words, the OBPS will provide the same emissions reduction incentive while costing less to a facility than a carbon price that applies to all of its emissions.¹² For the purposes of discussing coverage, we therefore classify all emissions covered by the OBPS as covered by a carbon price.

The carbon tax component of the federal government’s carbon pricing backstop will apply to stationary and non-stationary combustion emissions that are not covered by the OBPS. As most stationary combustion emissions are generated by large industrial facilities, this leaves emissions associated with residential and commercial buildings (primarily for heating) as the largest source of stationary combustion emissions that will be subject to the carbon tax. The carbon tax will also apply to all combustion emissions from passenger and freight transport within a province, as well as combustion emissions from flaring. The only category of non-combustion emissions subject to the carbon tax are (non-methane) controlled venting emissions.

¹⁰ The original proposed starting point for the output-based emissions standards in January 2018 was 70 per cent of the national production-weighted emissions intensity of a product. Following feedback from industry, it was adjusted upwards to 80 per cent in the July 2018 update to the OBPS (Government of Canada 2018e).

¹¹ The two industries with an emissions standard equal to 95 per cent of the national production-weighted emissions intensity of their products are cement (from clinker) and lime production. The five industries with an emissions standard of 90 per cent are petrochemicals, steel, iron, nitric acid, and ammonia production (Environment and Climate Change Canada 2018b).

¹² By reducing costs to a facility, the OBPS also reduces the total revenues that the federal government collects from carbon pricing. The OBPS additionally results in increased domestic emissions as a result of providing a subsidy to output. The net cost to society of the OBPS is therefore ambiguous and will depend on whether the positive competitiveness benefits to facilities are high enough to offset the costs of decreased government revenues and increased emissions. See Dobson and Winter (2018) for further discussion of the costs of an OBPS (and similar support policies in other jurisdictions for emissions-intensive and trade-exposed industries).

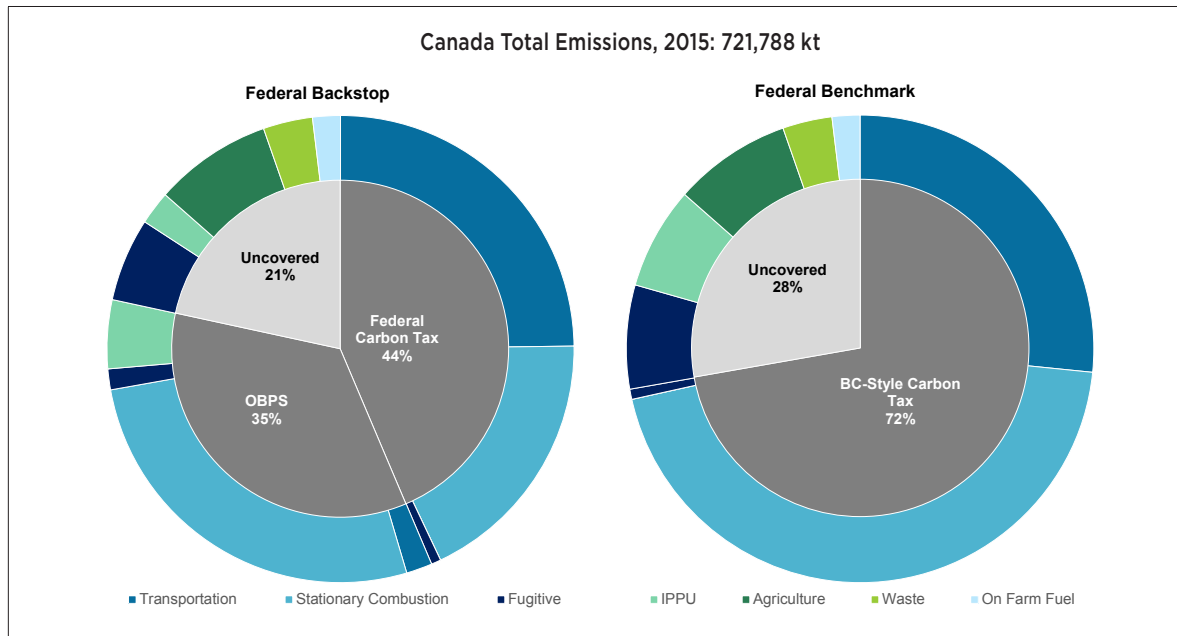
The federal government has also identified a limited number of domestic combustion emissions sources that are exempt from the tax. Most of these sources are unlikely to be significant, and are not reported separately in the NIR. As a result, we generally include these sources in the coverage estimates presented below, resulting in what is likely to be a small overestimate of true coverage.

One exception is the two exemptions the federal government is providing for agricultural combustion emissions. The first is a full (100 per cent exemption) from the carbon tax for emissions from coloured gasoline and diesel used by registered farmers in on-farm vehicles and machinery. The second is an 80 per cent exemption on natural gas and propane used by greenhouse growers for greenhouse heating. It is reasonable to expect these two exemptions account for most agricultural combustion emissions. Accordingly, we exclude all agricultural combustion emissions from our coverage estimates.¹³

A second notable emissions source that will be exempt from the carbon tax to start is fuel used for interprovincial airline travel.¹⁴ The federal government, however, has announced its intention to extend coverage to this source. Airline fuel used for intra-provincial travel will be immediately subject to the federal backstop, and the NIR does not allow us to distinguish between domestic aviation emissions from inter- and intra-provincial travel; therefore, we include all domestic aviation emissions in our coverage estimates.

As shown in Figure 2, based on 2015 emissions data, if the federal backstop were to be applied across the country then it would cover 78 per cent of national emissions. More specifically, 44 per cent of emissions would be subject to the federal carbon tax while the OBPS would cover 35 per cent.¹⁵ The largest source of uncovered emissions is non-combustion emissions from the agriculture sector (eight per cent of total emissions).

FIGURE 2 COVERAGE COMPARISON OF THE FEDERAL BACKSTOP AND BENCHMARK



¹³ See Appendix A for a description of our methodology in generating this estimate.

¹⁴ Emissions from fuel used in international airline travel are also exempt from the federal carbon tax. Notably, however, these emissions are not considered to be a domestic source and are therefore not included in the domestic aviation emissions reported in the NIR.

¹⁵ We note that the coverage estimates of the federal carbon tax and the OBPS do not add up to the national coverage estimate of 78 per cent due to rounding (the federal carbon tax coverage is 43.6 per cent while OBPS coverage is 34.8 per cent). This also occurs for a number of the provincial estimates. In general, unless otherwise noted, coverage numbers that appear to not add up throughout the remainder of the paper are due to rounding.

In comparison, Canada-wide coverage of the federal benchmark — that is, the minimum coverage that provincial carbon pricing plans must achieve — is lower than the federal backstop. British Columbia's carbon tax applies only to combustion emissions in the province, meaning the federal benchmark does not price emissions from controlled venting, nor does it price industrial process and fugitive emissions from facilities that meet the criteria for participating in the federal government's OBPS. Industrial process emissions from large industrial facilities account for just under five per cent of national emissions, while non-methane flaring, controlled venting and fugitive emissions from large facilities account for an additional 1.4 per cent. Coverage of the federal benchmark is therefore six percentage points lower than the federal carbon pricing backstop, covering 72 per cent of national emissions.

In the next section, we examine the coverage of the federal benchmark and federal backstop in each of the provinces, comparing these to the coverage of implemented, announced or former provincial pricing systems. We generally do not account for exemptions to provincial pricing systems unless they are from a significant source that we can identify or approximate with available data.

CARBON PRICING COVERAGE IN THE PROVINCES

British Columbia

British Columbia introduced a carbon tax on all combustion emissions in the province in 2008. Using 2015 emissions data, we estimate coverage of the tax at 75 per cent of the province's emissions (Figure 3).¹⁶ This estimate accounts for an exemption to coloured fuel purchased by farmers and delivered to farmland as well as British Columbia's carbon-tax-relief grant program for commercial greenhouse growers, which provides these facilities with a rebate of up to 80 per cent of the carbon tax paid on fuels used for heating in production greenhouses (Government of British Columbia 2018a, 2018b).

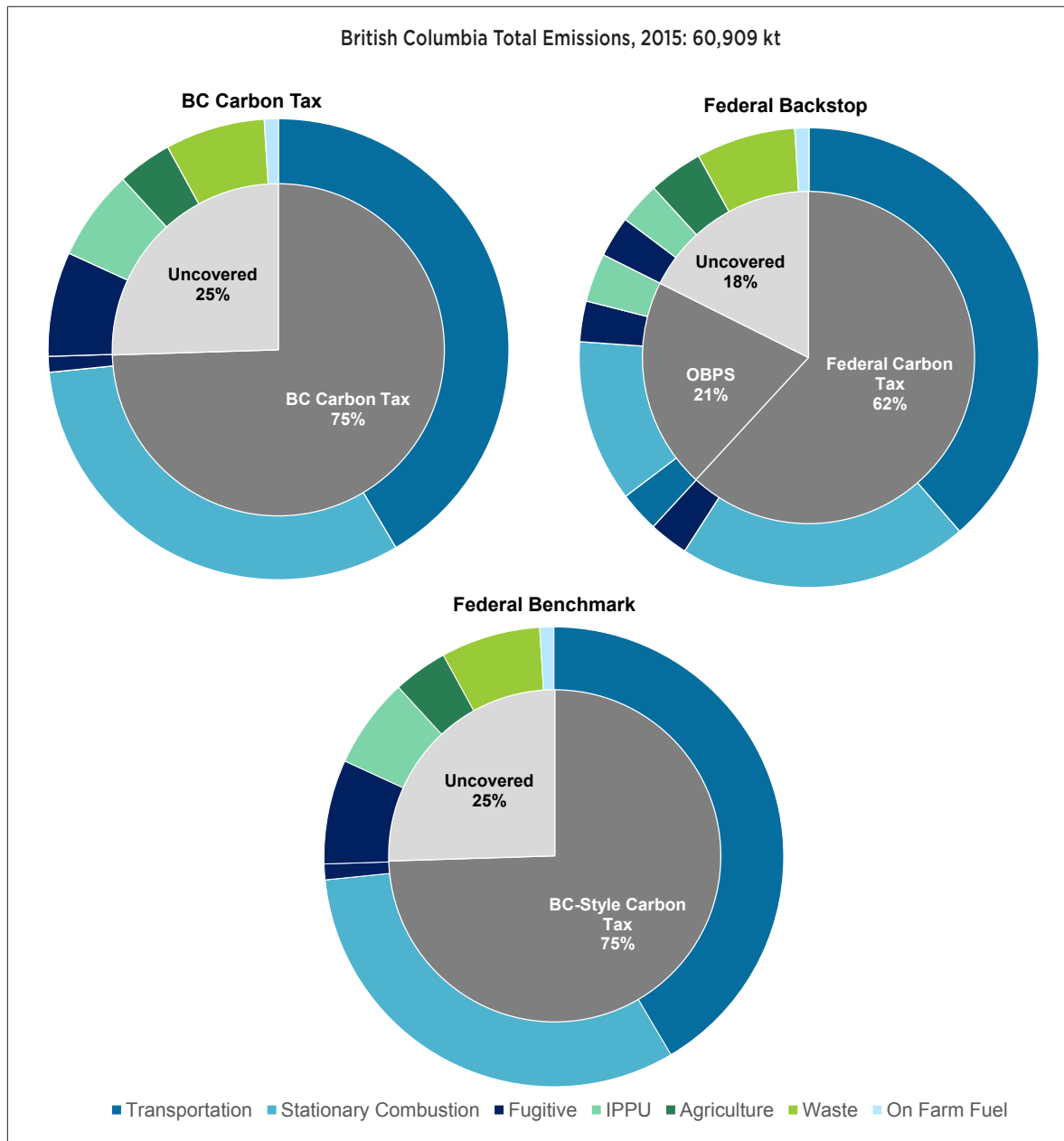
As noted in the previous section, the coverage of British Columbia's carbon tax is the basis for the federal benchmark. Accordingly, British Columbia's carbon tax meets the benchmark and the federal backstop will not be implemented in the province in any form.

It is still interesting to note, however, that coverage of British Columbia's carbon tax is less than coverage of the federal backstop. Specifically, the tax does not apply to non-methane emissions from controlled venting, nor does it apply to IPPU and fugitive emissions from industrial facilities that meet the threshold for participating in the federal government's OBPS. As a result, coverage of the British Columbia carbon tax is eight percentage points lower than the federal backstop. The largest sources of uncovered emissions are controlled venting and fugitive emissions from coal mining and oil and natural gas production and distribution (seven per cent of total emissions), non-combustion emissions from the waste sector (seven per cent of total emissions), and IPPU emissions from all sources (six per cent of total emissions).

In comparison, the federal backstop would result in 62 per cent of British Columbia's emissions being covered by a carbon tax and an additional 21 per cent of emissions covered by the OBPS. That is, fewer emissions would face a direct carbon price but as there is a market for emissions permits distributed through the OBPS, a larger share of total emissions would have a value attached to them. The largest source of uncovered emissions under the federal backstop is non-combustion emissions from the waste sector (still seven per cent of total emissions) and non-combustion emissions from the agriculture sector (four per cent of total emissions). Uncovered IPPU emissions and fugitive emissions both fall to three per cent.

¹⁶ Our estimates do not reflect policy changes in the CleanBC plan announced in December 2018.

FIGURE 3 COVERAGE COMPARISON OF BRITISH COLUMBIA'S CARBON TAX AND THE FEDERAL BACKSTOP AND BENCHMARK



Note: As the BC carbon tax forms the basis of the federal benchmark, coverage of the federal benchmark is identical to coverage of BC's carbon tax.

Alberta

Alberta first introduced a carbon price in 2007 through the Specified Gas Emitters Regulation (SGER). SGER applied to combustion emissions, fugitive emissions and non-combustion waste and wastewater emissions from large industrial facilities with emissions of 100 kt of CO₂e or greater in 2003 or any subsequent year (Province of Alberta 2014). The inclusion of non-combustion waste and wastewater emissions was notable as it made landfills and landfill gases — facilities and emissions that are typically excluded from carbon pricing — potentially subject to the regulation. In practice, however, the coverage of waste emissions was limited as there was only a single landfill in the province subject to SGER (Government of Alberta n.d.).

In January 2017, the Government of Alberta expanded coverage of carbon pricing through the introduction of a carbon tax on combustion emissions and controlled flaring and venting emissions. Similar to the federal backstop, the carbon tax does not apply to combustion emissions from large facilities, which remained subject to SGER through to the end of 2017. In 2018, SGER was replaced by the Carbon Competitiveness Incentive Regulation (CCIR), which implements an OBPS for large emitters. Similar to SGER, the CCIR applies to industrial facilities emitting at least 100 kt of CO₂e per year. It covers the same emissions sources as SGER and additionally expands coverage to include industrial process emissions, indirect emissions associated with facility imports of heat, electricity and hydrogen, methane and nitrous oxide biomass emissions and formation emissions (Government of Alberta 2017).

Using 2015 emissions data, we estimate coverage of Alberta's carbon pricing system at approximately 72 per cent of the province's emissions (Figure 4). More specifically, 50 per cent of emissions are covered by the CCIR while approximately 22 per cent of emissions are subject to the carbon tax. This estimate accounts for a carbon tax exemption for coloured fuel purchased by farmers and delivered to farmland, as well as a grant program for greenhouse growers that provides a rebate of up to 80 per cent of the carbon tax paid on heating fuels in production greenhouses (Alberta Agriculture and Forestry 2018; Government of Alberta 2018).

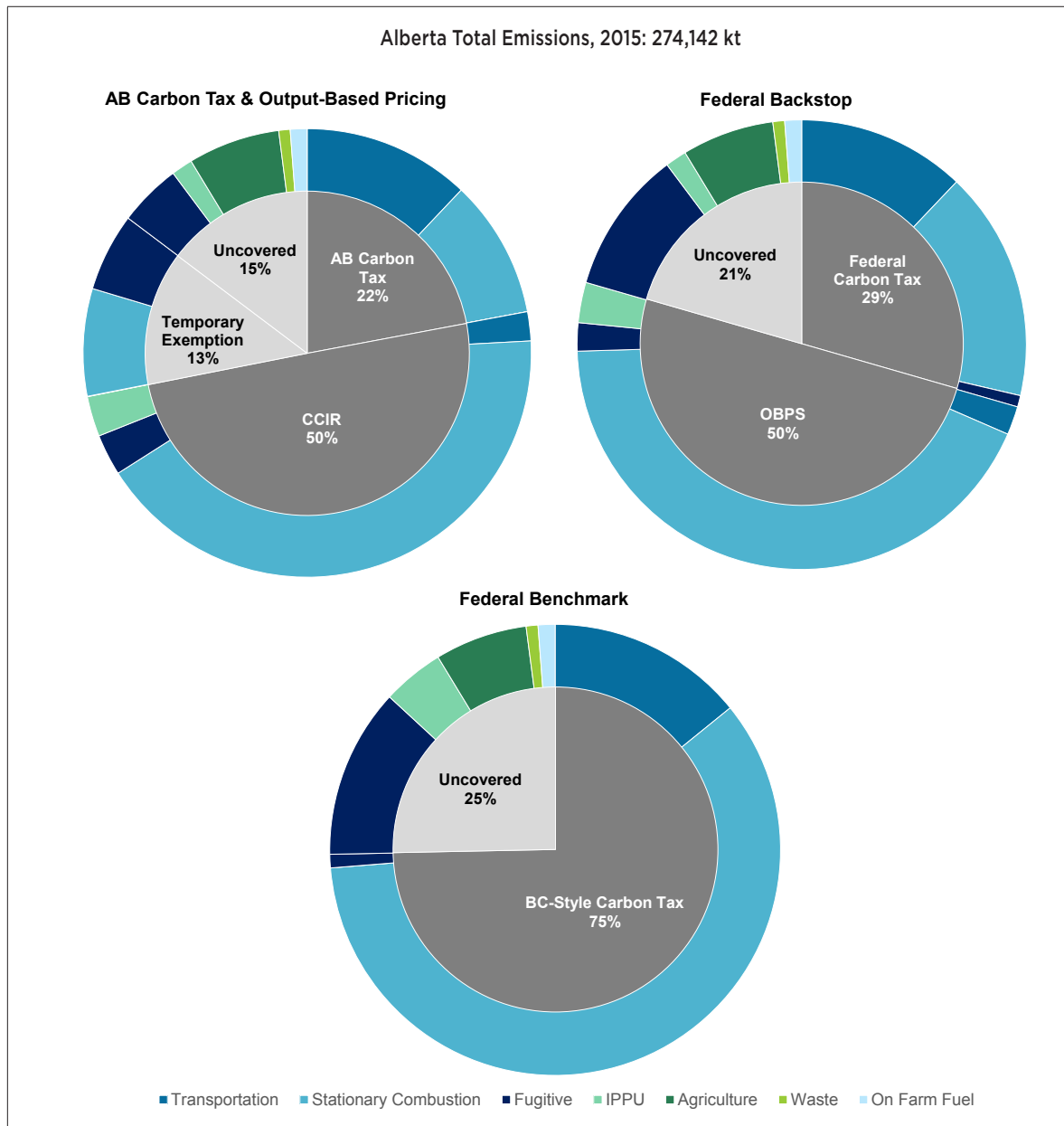
The uncertainty around the coverage of the carbon tax stems from a temporary exemption (until 2023) from the carbon tax for conventional oil and natural gas producers not subject to the CCIR. The exemption applies specifically to flared and vented emissions, as well as emissions that are generated during the production process. Notably, however, for gasoline and diesel, the exemption applies only if the fuel is marked fuel (that is, fuel that is eligible for a partial fuel tax exemption under the Fuel Tax Act). If the gasoline and diesel is unmarked then the carbon tax applies (Alberta Treasury Board and Finance, Tax and Revenue Administration 2016).

Based on NIR data that show Alberta's emissions by economic sector and Environment and Climate Change Canada's large emitters database, we estimate production process emissions from conventional oil and natural gas producers that are eligible for the exemption at approximately eight per cent of Alberta's total emissions (Environment and Climate Change Canada 2017a, 2017b). We estimate venting emissions at approximately five per cent and flaring emissions at zero. Until 2023, venting and production process emissions from Alberta's conventional oil and gas sector are therefore likely to be the largest source of unpriced emissions in the province, accounting for approximately 13 per cent of the province's total emissions.¹⁷ A second notable source of unpriced emissions is non-combustion and farm fuel emissions from the agriculture sector (eight per cent of total emissions).

Alberta's carbon pricing system is very similar to the federal backstop. Although not explicitly acknowledged, the Alberta system — introduced 18 months prior to the federal backstop — is widely viewed as the model for the federal system. The temporary exemption the Government of Alberta provides to emissions from the conventional oil and natural gas sector, however, is a key difference between the systems in the short term. Strictly speaking, as this exemption excludes a significant source of combustion emissions from carbon pricing, it causes Alberta's pricing system to fall short of the federal benchmark (which prices 75 per cent of the province's emissions).

¹⁷ See the end of Appendix A (Alberta Temporary Exemption) for a description of how we generate this estimate.

FIGURE 4 COVERAGE COMPARISON OF ALBERTA'S CARBON PRICING SYSTEM AND THE FEDERAL BACKSTOP AND BENCHMARK



Note: The Temporary Exemption category is an estimate of combustion and venting emissions from conventional oil and gas facilities. We estimate these emissions at approximately 13 per cent of Alberta's total emissions. See the end of Appendix A (Alberta Temporary Exemption) for details on our methodology.

Despite this, however, the federal government verified in October 2018 that Alberta's carbon pricing approach meets its standards and that the federal backstop will not be implemented in the province.¹⁸

¹⁸ Notably, the federal government's approval of Alberta's carbon pricing system also made no reference to Premier Rachel Notley's announcement in August 2018 that the province was withdrawing from the Pan-Canadian Framework on Clean Growth and Climate Change and would be freezing its carbon price at \$30 per tonne (Cryderman 2018). As the province does not have a cap on its total emissions, this means that it will not meet the stringency requirements of the federal benchmark starting in 2021 (when the federal carbon price reaches \$40 per tonne). Premier Notley's announcement was instigated by the Supreme Court overturning the federal government's approval of the Trans Mountain pipeline expansion. As the federal government remains committed to building the Trans Mountain expansion, it seems likely that they did not want to call further attention to the pipeline dispute and in particular, the possibility that construction may not proceed as planned.

Rather, the exemption is one of several that the federal government allowed in its announcement of the set of provincial and territorial pricing policies consistent with the PCF (Trudeau 2018). Allowing the exemption is also consistent with the federal government's initial announcement of the national carbon price in October 2016, where it outlined a number of principles that it supported, including a flexible approach, recognition of provincial policies already implemented or under development, and minimizing competitiveness impacts and carbon leakage (Government of Canada 2016). All of these principles align with the federal government accepting the Alberta government's decision and acknowledging the exemption as a transitional measure to help maintain the competitiveness of conventional oil and natural gas producers.

Also worth noting, however, is that in allowing the exemption, the federal government created an inconsistency in what is supposed to be consistent coverage across the provinces. Conventional oil and natural gas producers in British Columbia, for example, do not — and have not — received a similar exemption. Similarly, all conventional oil and gas producers in Saskatchewan will be subject to a carbon price starting in 2019.

A second small difference between Alberta's carbon pricing system and the federal OBPS is that Alberta's CCIR defines large emitters as those with emissions of 100 kt or greater while the federal OBPS applies to facilities with emissions of 50 kt or greater. This difference does not impact total coverage of the two pricing systems, but when comparing Alberta's system to the federal OBPS, it does result in a small number of emissions (less than one per cent) shifting from coverage under a carbon tax to coverage under an OBPS.

Implemented on its own, the federal backstop system would result in 29 per cent of Alberta emissions being covered by a carbon tax and an additional 50 per cent of emissions covered by the OBPS. Relative to Alberta's system, this would increase total coverage of the carbon price in the short term by up to seven percentage points. The largest sources of unpriced emissions under the federal backstop are venting and uncontrolled fugitive emissions from the oil and gas sector (10 per cent of total emissions) and non-combustion and farm fuel emissions from the agriculture sector (eight per cent of total emissions).

Saskatchewan

Saskatchewan has been the most consistently vocal of the provinces in its opposition to a national carbon price. It released its climate change strategy in December 2017 and made only a single reference to carbon pricing, stating “the conversation around climate change must be broader” (Government of Saskatchewan 2017). Although not calling it a carbon price, the province is introducing performance-based standards for large industrial emitters in the upstream oil and gas (stationary combustion emissions only), refining and upgrading, mining, and manufacturing sectors (Government of Saskatchewan n.d.). The system is similar to the OBPS component of the federal backstop. Specifically, facilities with annual emissions of 25 kt of CO₂e or greater will be required to meet sector-specific performance-based standards for their emissions. Facilities emitting below this standard will receive “best performance” credits, while those emitting above the standard will have to meet their compliance obligation by paying into a provincial technology fund, purchasing offset credits from non-regulated entities, purchasing best performance credits from regulated facilities or engaging under the UNFCCC Paris Agreement in “internationally transferred mitigation outcomes.”¹⁹

¹⁹ Internationally transferred mitigation outcomes are a provision in the Paris Agreement that allow a developed country (or sub-national jurisdiction) to finance inexpensive emissions reductions in another country as a means of lowering the cost of meeting its own emissions reduction target (Tolman and Kerr 2017).

Based on 2015 emissions data, we estimate coverage of Saskatchewan's performance-based standards system at just over nine per cent of the province's emissions.²⁰ The plan leaves numerous significant sources of emissions largely unpriced including the majority of stationary combustion emissions (33 per cent of total emissions), transportation emissions (16 per cent of total emissions), all sources of fugitive emissions (17 per cent of total emissions), and non-combustion and farm fuel emissions in the agriculture sector (24 per cent of total emissions).

By leaving large sources of combustion emissions unpriced, Saskatchewan's carbon pricing plan falls far short of the federal government's benchmark, which requires pricing of 58 per cent of the province's emissions. Accordingly, the federal government announced in October 2018 that the federal backstop will be implemented as a top-up to Saskatchewan's pricing plan. The result is a hybrid system where Saskatchewan's performance-based system will be supplemented by both the federal government's OBPS, which will extend to large facilities not covered by Saskatchewan's plan (specifically, electricity generators and natural gas transmission pipelines), and a carbon tax (Government of Canada 2018d).

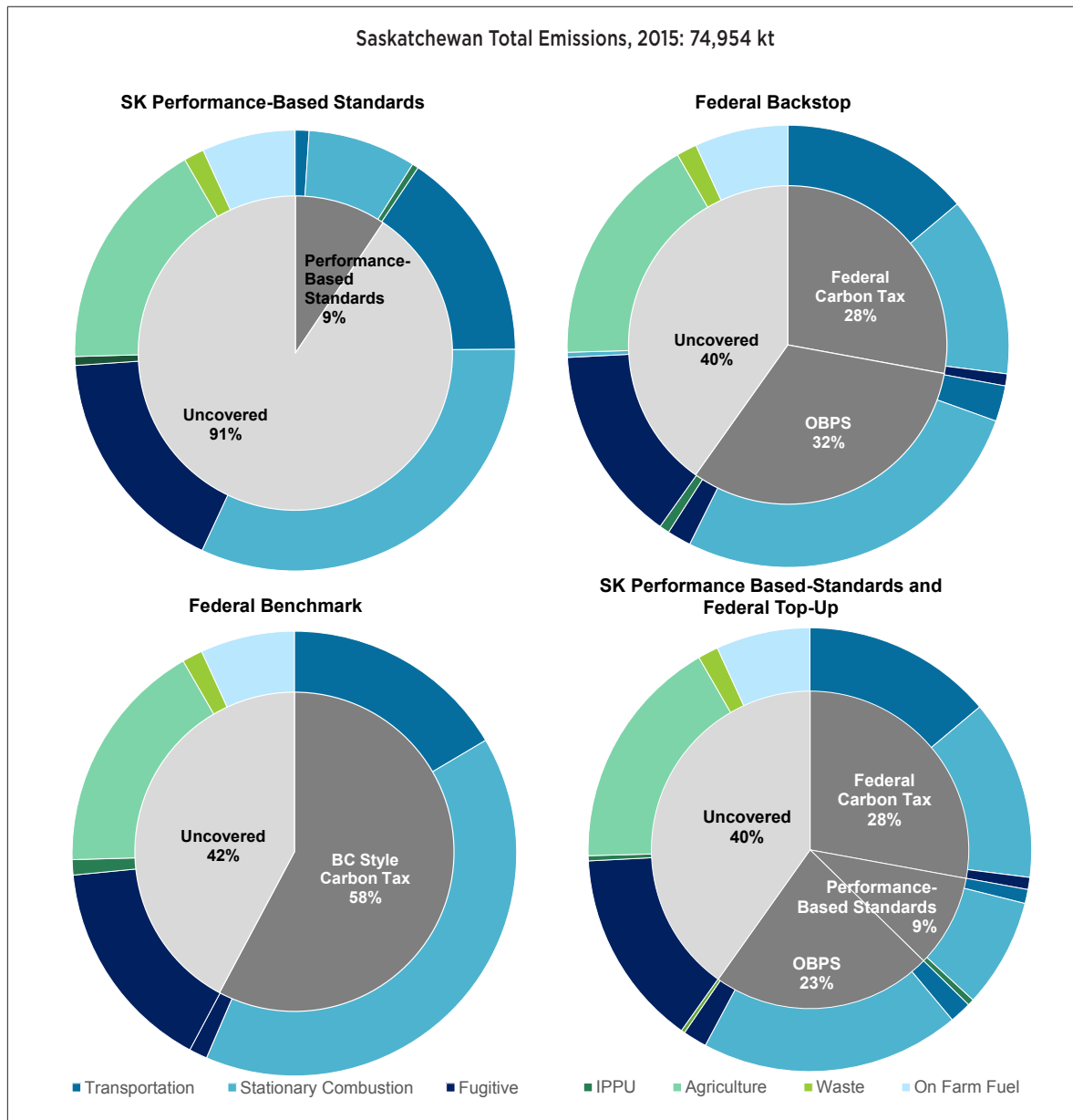
Implementation of the federal backstop will expand coverage of the carbon price to 60 per cent of the province's emissions. Specifically, 28 per cent of Saskatchewan's emissions will be subject to the federal carbon tax and an additional 23 per cent of emissions will be covered by the OBPS (Figure 5). This leaves 40 per cent of emissions in the province still unpriced. The largest source of unpriced emissions is non-combustion and farm fuel emissions in the agriculture sector (24 per cent of total emissions). Fugitive emissions (14 per cent of total emissions), the majority of which are methane emissions from small oil and gas producers, are also a significant source of unpriced emissions.

The Government of Saskatchewan has stated its opposition to the federal carbon pricing plan numerous times and referred a constitutional reference case to the Saskatchewan Court of Appeal, questioning whether the federal government has the authority to impose a carbon price on the province (Government of Saskatchewan 2018b). The significant difference in coverage between the Saskatchewan policy and the federal benchmark and backstop underscores the potential benefits to Saskatchewan — avoided carbon tax costs — from contesting the federal policy.

Interestingly, we find the federal benchmark requires only 58 per cent of Saskatchewan's emissions be priced. This is two percentage points lower than coverage under the federal backstop. The difference is driven primarily by the exclusion from the federal benchmark of IPPU emissions, as well as non-methane controlled venting emissions and non-methane oil and gas fugitive emissions from large facilities. That is, the federal benchmark does not require these emissions sources to be priced while the federal backstop includes these sources in its pricing system. By declining to implement its own carbon pricing system, Saskatchewan has therefore exposed itself to having a slightly higher share of emissions priced than is strictly necessary.

²⁰ This estimate is lower than the Saskatchewan government's estimate of 11 per cent (Government of Saskatchewan 2018a). Most of this difference likely stems from the fact that our estimate is generated using data from Environment and Climate Change Canada's facility greenhouse gas reporting database (Environment and Climate Change Canada 2017a). Mandatory reporting to this database is only required by facilities with emissions in excess of 50 kt per year, meaning that we do not have comprehensive emissions data for facilities with emissions between 25 kt and 50 kt per year. More specifically, the facility reporting database lists emissions from 26 facilities in Saskatchewan that fall within the sectors to be governed by the province's performance-based standards. The province, however, states that more than 40 facilities will be subject to the standards.

FIGURE 5 COVERAGE COMPARISON OF SASKATCHEWAN'S CARBON PRICING SYSTEM AND THE FEDERAL BACKSTOP AND BENCHMARK



Further, Alberta's example highlights an even more significant opportunity for Saskatchewan to reduce carbon pricing coverage. By developing its own pricing system, Alberta was able to secure a temporary exemption to the carbon tax for its smaller conventional oil and gas producers. Had Saskatchewan adopted a similar approach — and similarly received the federal government's approval for an exemption to small oil and gas producers — then carbon pricing coverage in the province could conceivably be reduced by up to an additional six per cent.²¹ This would bring total carbon pricing coverage in the province down to only 54 per cent (eight percentage points lower than what the province is currently facing).

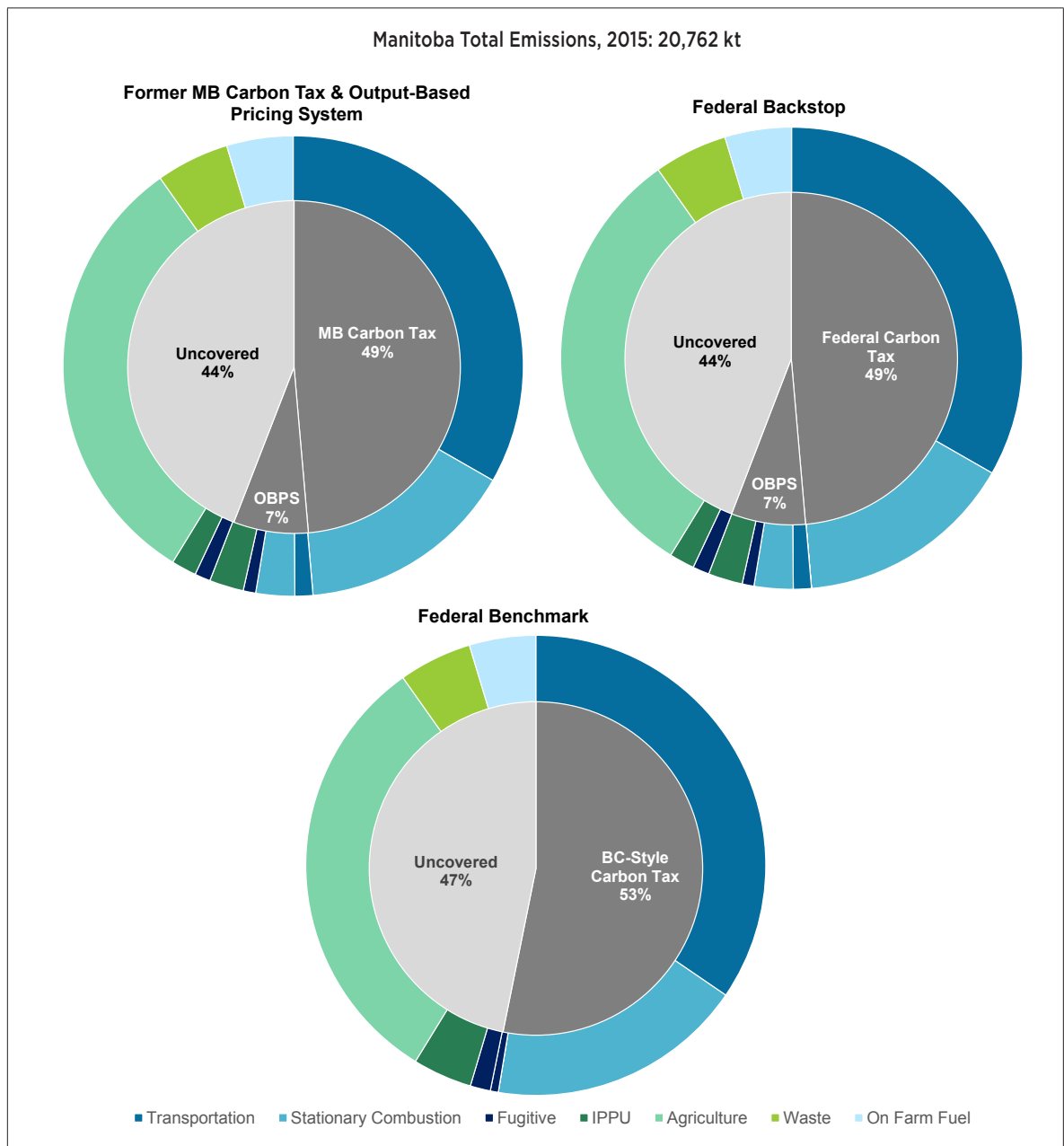
²¹ See the end of Appendix A (Alberta Temporary Exemption) for a discussion of how we derive an estimate of Alberta's exempt emissions from small oil and gas producers. The estimate of six per cent for Saskatchewan follows an analogous approach.

Manitoba

Manitoba announced a carbon pricing system in October 2017. One year later, however, in October 2018, Premier Brian Pallister announced the province would not be proceeding with a provincial pricing plan (Lambert 2018).

Coverage of the previously announced system closely followed the federal backstop, consisting of a carbon tax that was intended to be introduced in September 2018 and an OBPS for large industrial emitters to be introduced in 2019 (Manitoba Sustainable Development 2017). Similar to the federal backstop, Manitoba would have exempted marked fuels used in farm vehicles from the carbon tax. The OBPS also followed the federal backstop in applying to large industrial emitters with emissions of 50 kt of CO₂e or greater.

FIGURE 6 COVERAGE COMPARISON OF MANITOBA'S FORMER (PROPOSED) CARBON PRICING SYSTEM AND THE FEDERAL BACKSTOP AND BENCHMARK



Using 2015 emissions data, we estimate coverage of Manitoba's previously announced carbon pricing system at 56 per cent of the province's emissions (Figure 6). This is identical to coverage of Manitoba's emissions under the federal backstop and slightly higher than the minimum coverage required by the federal benchmark (53 per cent). The primary source of unpriced emissions is the agriculture sector, which accounted for 36 per cent of Manitoba's emissions in 2015. This includes both combustion (five per cent of total emissions) and non-combustion emissions (31 per cent of total emissions).

Although Manitoba's carbon pricing plan met the federal government's benchmark for coverage, it did not meet the benchmark for stringency of the carbon price. Specifically, Manitoba planned to introduce, and subsequently maintain, a constant carbon tax of \$25 per tonne. In contrast, the federal government's benchmark requires that provincial carbon prices start at \$10 per tonne in 2018 and rise by \$10 per tonne increments each year, reaching \$50 per tonne in 2022.

The Government of Manitoba argued that its Made-In-Manitoba plan would result in greater emissions reductions than the federal backstop (Manitoba Sustainable Development 2017). Despite this, however, the federal government would not provide the province with assurance that it would accept the constant price (Rabson 2018). This in turn motivated Premier Pallister's announcement at the start of October 2018 that the province would backtrack on its plan.

Without a provincial plan in place, the federal backstop is now imposed in the province. As noted earlier, the backstop will provide identical coverage to Manitoba's previously announced plan. The key difference is that the carbon price will now follow the federal government's schedule, starting at \$20 per tonne in 2019 and subsequently exceeding Manitoba's proposed price when it rises to \$30 per tonne in 2020. Additionally, control of the revenues from carbon pricing now lies with the federal government.

Ontario

The Government of Ontario, led by Liberal Premier Kathleen Wynne, introduced a cap-and-trade program in January 2017. In June 2018, Progressive Conservative Premier-designate Doug Ford announced that his government would follow through on its election promise and dismantle the program (Government of Ontario 2018c). The regulation implementing the cap-and-trade program was subsequently revoked on July 3, 2018.

Mandatory participants in Ontario's former cap-and-trade program included industrial and institutional facilities with CO₂e emissions of 25 kt or greater each year, electricity importers, fuel suppliers that sold greater than 200 litres of fuel per year, and natural gas distributors selling natural gas that would emit at least 25 kt CO₂e per year if consumed (Government of Ontario 2017). Through the inclusion of fuel distributors, Ontario's cap-and-trade program covered virtually all combustion emissions in the province. Notably, unlike the federal government and most other provinces, it did not provide an exemption to marked fuels used by farm vehicles (Lynch 2017). The cap-and-trade program also covered industrial process emissions and fugitive emissions from refineries and oil and gas facilities.²²

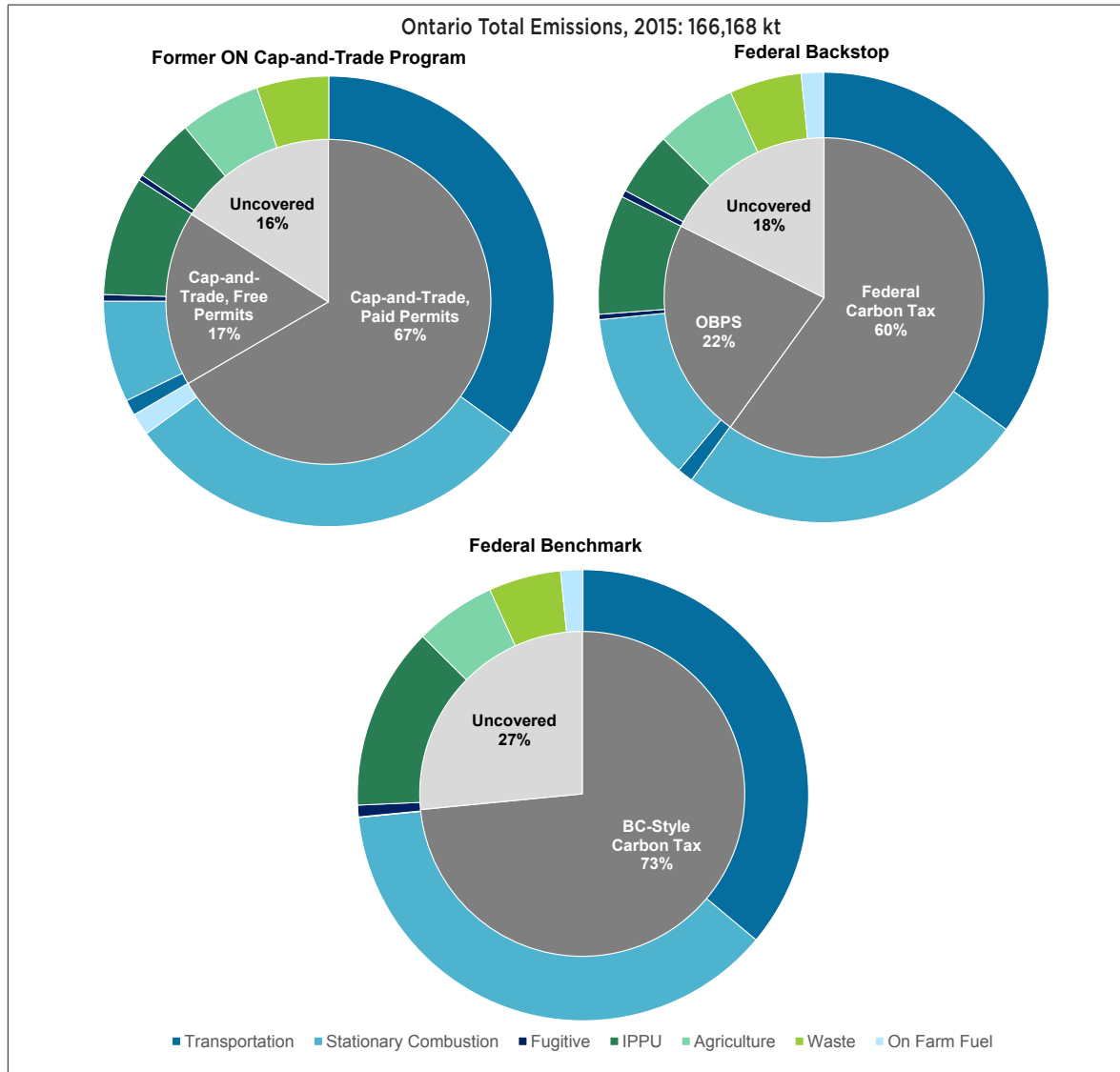
Using 2015 emissions data, we estimate coverage of Ontario's former cap-and-trade program at 84 per cent of the province's emissions (Figure 7). This estimate can be further divided into emissions that required paid permits (67 per cent) versus those that were eligible for free allocations (17 per cent). Free allocations were primarily a transitional measure that the Ontario government made available to institutions (notably universities and hospitals) and facilities in the manufacturing and mining and quarrying sectors with emissions of at least 25 kt CO₂e per year (i.e., those that had a mandatory participation requirement in the cap-and-trade program). Institutions and facilities in the manufacturing and mining and quarrying sectors with emissions between 10 and 25 kt CO₂e per year could apply to voluntarily participate in the cap-and-trade program and would then also be eligible to receive free

²² Fugitive emissions from natural gas distribution pipelines were excluded from the cap-and-trade program.

allocations.²³ Most institutions and facilities eligible for free allocations were expected to receive sufficient permits to cover all of their emissions in 2017 (Reusing 2017).

Primarily through its inclusion of IPPU emissions, coverage of Ontario’s cap-and-trade program exceeded coverage of the federal benchmark by 11 percentage points. That is, the program surpassed the minimum coverage requirements and there was no expectation the federal government would impose the backstop in the province. Rather, Ontario was listed as an example of acceptable provincial pricing systems by Environment and Climate Change Canada (2017c).

FIGURE 7 COVERAGE COMPARISON OF ONTARIO’S FORMER CAP-AND-TRADE PROGRAM AND THE FEDERAL BACKSTOP AND BENCHMARK



Note: Our estimate of emissions eligible for free permits under Ontario’s former cap-and-trade program uses facility reported data from both Environment and Climate Change Canada’s and the Government of Ontario’s facility reporting programs (Environment and Climate Change Canada 2017a; Government of Ontario 2018a). Ontario’s facility reporting data includes additional facilities with emissions between 25 kt and 50 kt of CO₂e annually. The estimate does not include emissions from institutions and facilities that were eligible to opt-in to the cap-and-trade program (i.e., those with annual emissions between 10 kt and 25 kt of CO₂e). As a result, we likely underestimate the actual quantity of emissions eligible for free allocations.

²³ Emissions from potential voluntary participants in Ontario’s cap-and-trade program are not included our estimate of emissions eligible for free allocations. As a result, we likely underestimate the free allocations (17 per cent of Ontario’s emissions) that would have been distributed to facilities and institutions.

With the cap-and-trade regulation now revoked — and no alternative carbon pricing system in place — the federal backstop is imposed in Ontario. Coverage of the federal backstop will be very close to coverage of the province’s cap-and-trade program. Specifically, the federal backstop will cover 82 per cent of the province’s total emissions, with 60 per cent of emissions subject to the carbon tax and 22 per cent covered by the OBPS. Emissions eligible for free allocations are higher under the federal backstop as the OBPS covers electricity generators and natural gas transmission pipelines. Despite covering a larger share of emissions, however, the OBPS will most likely distribute a lower total number of free allocations than former Ontario’s cap-and-trade system, which intended to provide sufficient permits to cover the majority of emissions from eligible facilities over the 2017 to 2020 period. In contrast, as noted earlier, the federal government will generally distribute permits based on output-based emissions standards set equal to 80 per cent of the national production-weighted emissions intensity of an industry (with standards of 90 or 95 per cent for industries identified at high competitive risk).

The small difference in total coverage between Ontario’s former cap-and-trade system and the federal backstop is primarily due to the exemption that the backstop provides to on-farm fuel use for farmers and greenhouse growers. Under both systems the largest source of uncovered emissions is non-combustion emissions from the agriculture sector (six per cent of total emissions), followed by emissions from the waste sector (five per cent of total emissions).

Premier Ford remains opposed to a carbon price of any kind in Ontario.²⁴ Accordingly, the province has filed as an intervenor in Saskatchewan’s court challenge of the federal backstop and has also filed its own challenge in the Ontario Court of Appeal (Government of Ontario 2018b, 2018d). Of note, however, is that by adopting this position the Government of Ontario is forgoing an opportunity to lower overall coverage of carbon pricing in the province. Specifically, by moving from the former cap-and-trade system to a BC-style carbon tax that only meets the federal benchmark, the government could lower carbon pricing coverage from 82 to 73 per cent. Most of this decrease would come from the removal of a carbon price on IPPU emissions from the manufacturing sector.

Despite a BC-style carbon tax having lower coverage, however, it is not immediately obvious that the overall cost to the Ontario economy would be lower than the province’s former cap-and-trade program. This is due in part to the removal of the cap-and-trade program’s free allocations. Given the use of free allocations within the federal backstop, however, it is not unreasonable to assume the federal government would provide some flexibility for Ontario to design and implement a similar support mechanism for large emitters as part of a broad-based carbon tax on combustion emissions. Additionally, if Ontario adopted British Columbia’s original approach of full revenue recycling of carbon tax proceeds then the potential for lower corporate tax rates, among other initiatives, could also offset the loss of free allocations.

More significantly, under the federal benchmark a BC-style carbon tax requires a higher carbon price than the prevailing market price that was expected under Ontario’s former cap-and-trade program. It is worth noting, however, that Ontario residents and businesses will also face this higher price when the federal backstop is introduced. That is, by cancelling the province’s cap-and-trade program, Premier Ford has positioned the province to face a higher carbon price without the benefit of a reduction in coverage of the province’s emissions sources. One upside for individuals and businesses in Ontario, however, is the federal government’s commitment to return all revenues from the federal backstop to the province. The planned household rebates and support for businesses and institutions will therefore

²⁴ The Ontario Progressive Conservative government released its “Made in Ontario” environment plan at the end of November 2018. Unsurprisingly, it does not include any explicit reference to a carbon price. Industry performance standards for large emitters, similar to the federal government’s OBPS, are a component of the plan and can be considered a form of carbon pricing. Information on how they will be implemented, however, is limited. In particular, although there is mention of payment to achieve compliance, there is no indication of what the price level may be. There is also no indication of how the government intends to define a large emitter or what industrial sectors will be included in the program. The reach of the program is of particular uncertainty as the government lists the possibility of “across-the-board exemptions for industries of particular concern” (Ontario Ministry of the Environment, Conservation and Parks 2018).

play an important role in determining the overall cost of the federal backstop relative to the province's former cap-and-trade program.

Quebec

Quebec introduced its cap-and-trade program in January 2013. The program originally applied only to industrial facilities with annual CO₂e emissions of 25 kt or greater, including electricity importers. Facility emissions covered by the cap-and-trade program include combustion, IPPU and fugitive emissions. In January 2015 the cap-and-trade program was expanded to include fuel distributors. Fuel distributors originally faced the same threshold for inclusion — emissions of 25 kt CO₂e or greater — but with the calculation based on the embedded emissions in the fuels they sell. Starting in January 2016, the threshold was lowered to include fuel suppliers that sell more than 200 litres of fuel per year (Vérificateur Général du Québec 2016). As a result, Quebec's cap-and-trade program now covers nearly all combustion emissions in the province. In contrast to the federal government and most other provinces, Quebec does not appear to provide an exemption to marked fuels used by farm vehicles.

Using 2015 emissions data, we estimate coverage of Quebec's cap-and-trade program at 81 per cent of the province's emissions (Figure 8). As was the case in Ontario, this estimate can be further divided into emissions that require paid permits (59 per cent) versus those that are eligible for free allocations (22 per cent). Free allocations are distributed to facilities in the manufacturing and mining and quarrying sectors, facilities supplying steam and air conditioning for industrial facilities, and electricity generation plants selling power under fixed-price contracts signed prior to Jan. 1, 2008. Institutions (primarily universities, hospitals and service-sector buildings) do not participate directly in the cap-and-trade program and therefore are not eligible for free allocations. Similar to Ontario, Quebec also extends free allocations to voluntary participants in the cap-and-trade program. Industrial facilities are eligible for voluntary participation if they have annual emissions between 10 and 25 kt CO₂e.

In 2015, the number of free emissions permits distributed by the Quebec government exceeded the verified emissions of the facilities that received them.²⁵ Further, the quantity of free permits issued annually is currently being reduced by only one to two per cent per year. This suggests that covered facilities will continue to receive most of their permits at zero cost.

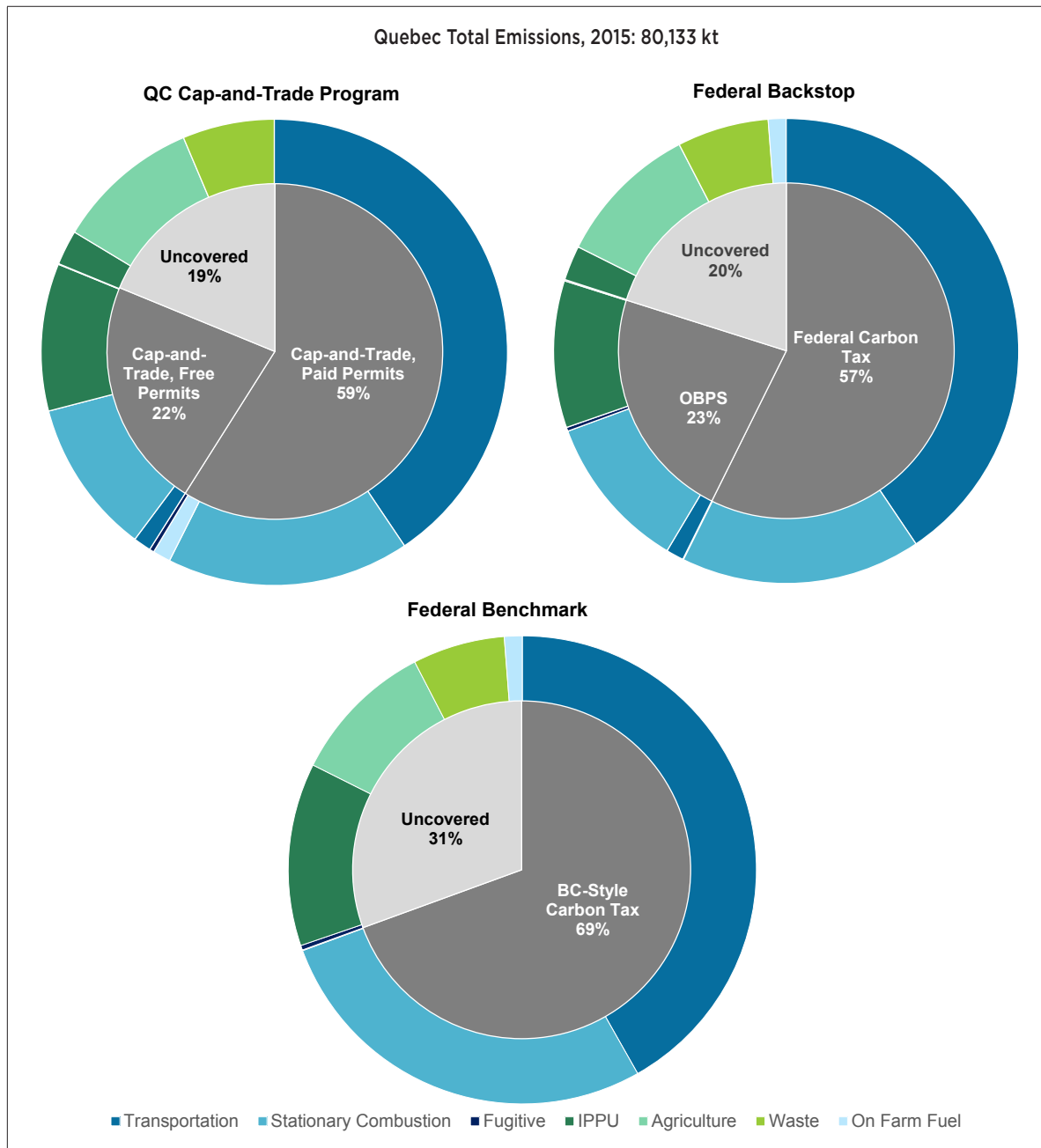
Primarily through the inclusion of IPPU emissions, coverage of Quebec's cap-and-trade program exceeds the federal benchmark by 12 percentage points. It additionally aligns closely with coverage of the federal backstop. Accordingly, the federal backstop will not be implemented in the province in any form.

The only small difference between Quebec's cap-and-trade program and the federal backstop is that the backstop provides an exemption for on-farm fuel use. This difference is not significant, however, accounting for only one per cent of emissions. The federal backstop therefore covers nearly the same total quantity of emissions in Quebec (80 per cent). There is also a similar division between emissions that are covered by a direct carbon price (57 per cent) and those that are eligible for support through the OBPS (23 per cent). For the same reasons as in Ontario, however, the number of free permits that would be distributed through the OBPS is likely to be smaller than those distributed through Quebec's cap-and-trade program.

Under both Quebec's cap-and-trade program and the federal backstop, the largest source of uncovered emissions is non-combustion emissions from the agriculture sector (10 per cent of total emissions), followed by emissions from the waste sector (six per cent of total emissions).

²⁵ Specifically, in 2015 Quebec distributed 18,743,474 emissions permits to 53 emitters with verified emissions of approximately 17,996,597 tonnes (Environnement et Lutte Contre les Changements Climatiques Québec 2018, 2019).

FIGURE 8 COVERAGE COMPARISON OF QUEBEC'S CAP-AND-TRADE PROGRAM AND THE FEDERAL BACKSTOP AND BENCHMARK



Note: Our estimate of emissions eligible for free permits under Quebec's cap-and-trade program uses data from Environment and Climate Change Canada's facility reporting program (Environment and Climate Change Canada 2017a), supplemented by the Government of Quebec's record of reported and verified emissions under the cap-and-trade program (Environnement et Lutte Contre les Changements Climatiques Québec 2018). We primarily use Quebec's data to capture facilities with emissions between 25 kt and 50 kt of CO₂e annually that did not report to Environment and Climate Change Canada in 2015. As was the case for Ontario, we do not include in our estimate emissions from facilities that are eligible to opt in to the cap-and-trade program (i.e., those with annual emissions between 10 kt and 25 kt of CO₂e) as emissions from these facilities do not appear to be reported in cap-and-trade documentation for 2015. As a result, our estimate of 22 per cent of emissions eligible for free allocations is likely an underestimate.

New Brunswick

New Brunswick's previous Liberal government announced a proposed carbon pricing plan for the province in December 2017. In releasing the plan, the government indicated its primary goal was to reduce emissions, not to raise revenues (Government of New Brunswick 2017). As a result, rather

than introducing a new carbon tax, the government announced that revenue from existing fuel taxes would be redirected towards a newly established Climate Change Fund (New Brunswick Department of Environment and Local Government 2017). Revenues from the fund would be restricted to use on climate change mitigation and adaptation measures. In addition to the redirection of existing fuel taxes, the government also announced that the federal government's OBPS would be implemented in the province.

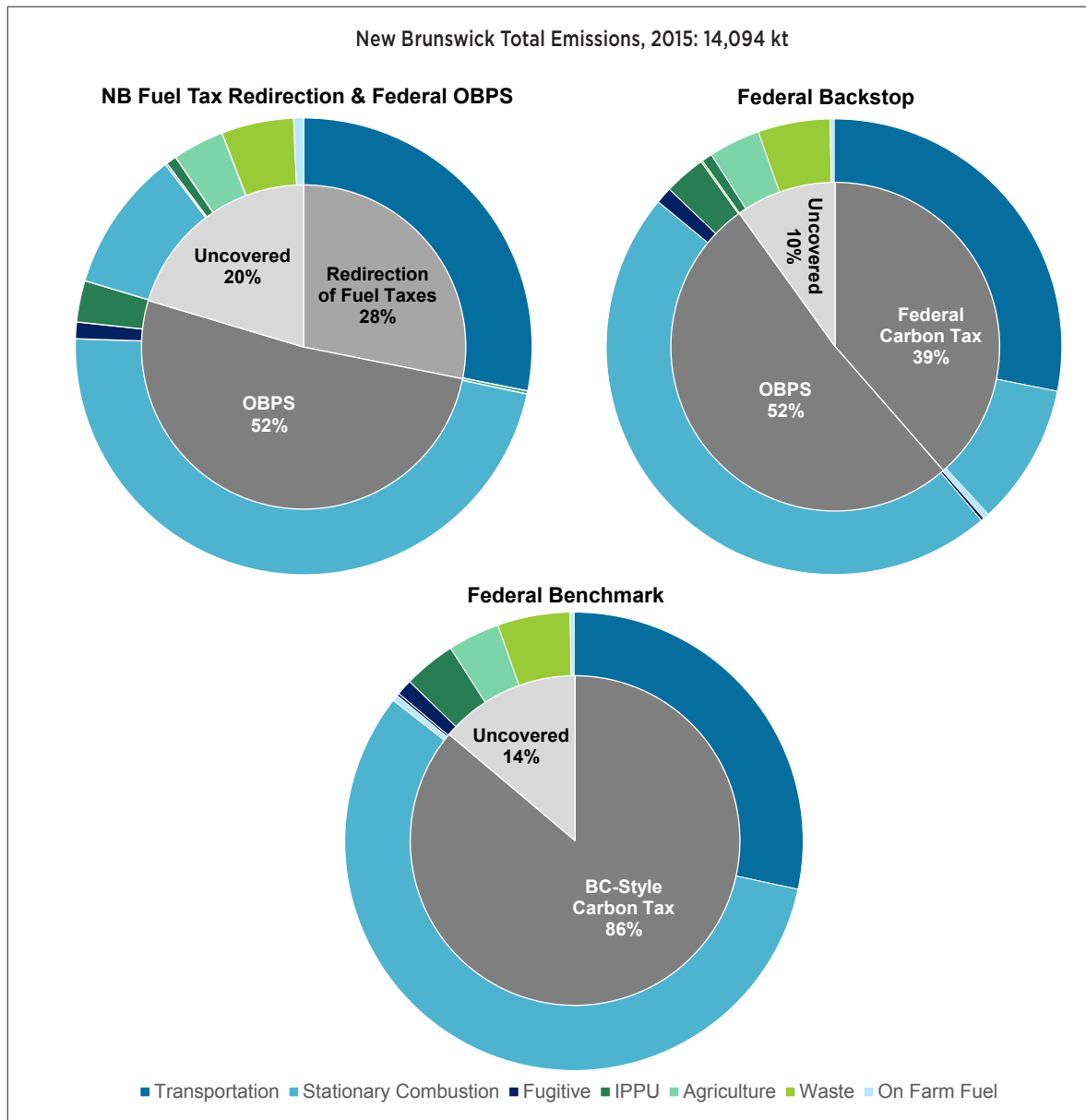
The *Climate Change Act* introduced in December 2017 identified only gasoline and diesel as the fuels for which a portion of the existing fuel tax would be redirected to the Climate Change Fund. This suggested coverage of the redirected tax would extend only to transportation emissions. Using 2015 emissions data, we estimate this coverage at a maximum of 28 per cent of New Brunswick's emissions (Figure 9). This estimate accounts for the fuel tax exemption to farm vehicles but does not account for additional exemptions provided under the *Fuel Tax Act*, most notably for off-road vehicles used in the fisheries, forestry, manufacturing, and mining and quarrying sectors (Government of New Brunswick 2018a). Our estimate of coverage of the federal government's OBPS is substantially higher at 52 per cent of New Brunswick's emissions. These emissions are primarily from stationary combustion and additionally cover small amounts of IPPU, fugitive and transportation emissions. Combined, New Brunswick's proposed carbon pricing system would therefore cover, at most, 80 per cent of emissions in the province.

We say "at most" as the federal government disputed the 28 per cent coverage of the fuel tax from the time it was announced. Specifically, in a December 2017 post on her Facebook page, Environment and Climate Change Canada Minister Catherine McKenna suggested that a redirection of existing revenues was not sufficient to meet the federal requirements for carbon pricing, stating that ". . . New Brunswick proposes to take revenues from existing fuel taxes and invest them in climate action instead of putting a price on carbon across the economy, which does not create a new incentive to cut carbon pollution" (McKenna 2017). Notably, the federal government's position is supported by academic research, which suggests that a tax to correct an environmental externality (the carbon price) should generally be additional to an excise tax (the existing fuel tax) that has the separate goal of raising revenues, assuming the excise tax has been set at an optimal rate (Sandmo 1975; Parry and Small 2005).²⁶ Under this interpretation, as the redirection of the fuel tax was not additional, coverage of the former New Brunswick Liberal government's proposed carbon pricing plan would be limited to the OBPS, or 52 per cent of the province's emissions.

The redirected fuel tax component of New Brunswick's carbon price also fell explicitly short of the federal benchmark by only applying to fuels used for transportation. It therefore did not ensure that a carbon price covered all sources of combustion emissions in the province. Most notably, 18 per cent of New Brunswick's stationary combustion emissions (accounting for 10 per cent of the province's total emissions), corresponding largely to emissions associated with commercial, institutional and residential heating, were left unpriced. As a result, the province's plan fell explicitly short of the federal benchmark, which covers 86 per cent of the province's emissions. Accordingly, the federal government announced in October 2018 that the federal backstop would apply in its entirety in New Brunswick.

²⁶ Whether the existing fuel tax in New Brunswick is set optimally, or is too high or too low, is an empirical question that is outside of our scope. However, it does indicate that governments should be careful in interpreting the coverage of fuel taxes.

FIGURE 9 COVERAGE COMPARISON OF NEW BRUNSWICK'S FORMER (PROPOSED) CARBON PRICING PLAN AND THE FEDERAL BACKSTOP AND BENCHMARK



With the federal government imposing the carbon tax component of its pricing system, the share of emissions subject to a direct carbon price in New Brunswick will increase to 39 per cent. With the OBPS still covering 52 per cent of emissions, total carbon pricing coverage in New Brunswick rises to 90 per cent of the province's emissions. The largest source of uncovered emissions in New Brunswick are from the province's waste sector (five per cent of total emissions), followed by non-combustion emissions from the agriculture sector (four per cent of total emissions).

Less than two weeks after the federal government's announcement that the backstop would be implemented in New Brunswick, the provincial Liberal government — a minority after an election earlier in the fall — was defeated in a non-confidence vote. The Progressive Conservatives have since formed government under Premier Blaine Higgs. As per his campaign promise, Premier Higgs confirmed shortly after assuming office that New Brunswick will join Saskatchewan and Ontario in a constitutional

challenge of the federal backstop.²⁷ He also stated that his government would submit an alternative carbon pricing plan for New Brunswick to the federal government by Jan. 1, 2019, although he indicated it was unlikely that the plan would meet minimum federal requirements (Bissett 2018a). In early December 2018, Premier Higgs stated his government would “endorse the recommendations of the New Brunswick Climate Change Action Plan” and develop regulations for large emitters (Bissett 2018b).²⁸

Nova Scotia

Nova Scotia announced in December 2016 that it would implement a provincial carbon price through a cap-and-trade program starting in 2018. Although subsequently delayed, the program came into effect on Jan. 1, 2019. The threshold for industrial facilities’ mandatory participation in the program is 50 kt CO₂e (Nova Scotia Environment 2018). Other mandatory participants in the cap-and-trade program include fuel suppliers that distribute greater than 200 litres of fuel within Nova Scotia each year, and electricity importers and natural gas distributors with sales of electricity or natural gas with embodied emissions equalling 10 kt CO₂e or more (Nova Scotia Environment 2018). Unlike Quebec, and Ontario’s former system, Nova Scotia will not include a voluntary participation option for facilities that do not meet the mandatory thresholds.

The regulation implementing Nova Scotia’s cap-and-trade program was finalized in November 2018. The program extends to most combustion emissions in the province, although some specific sources are excluded, including emissions from offshore oil and gas production and those from fuels used in aviation and marine activities.²⁹ The cap-and-trade program additionally exempts industrial process emissions, as well as fugitive emissions from natural gas pipelines and coal storage (Nova Scotia Environment 2018). Taking most of these exemptions into account, we estimate coverage of Nova Scotia’s cap-and-trade program at 86 per cent of the province’s emissions. This is six percentage points higher than the province’s estimate of 80 per cent coverage (Nova Scotia Environment 2018). Part of this discrepancy is due to data limitations. Specifically, for the exemption to aviation and marine activities we are only able to account for emissions associated with fuel used in freight transport. We estimate fuel used for aviation and marine passenger transport may account for up to an additional two per cent of Nova Scotia’s emissions. The remaining source of this discrepancy is not immediately evident.³⁰

In comparison to Nova Scotia’s cap-and-trade program, the federal benchmark requires that 90 per cent of the province’s emissions be priced. By both our estimate, and that of the provincial government, Nova Scotia’s program therefore falls short of the federal government’s minimum threshold for carbon pricing coverage.

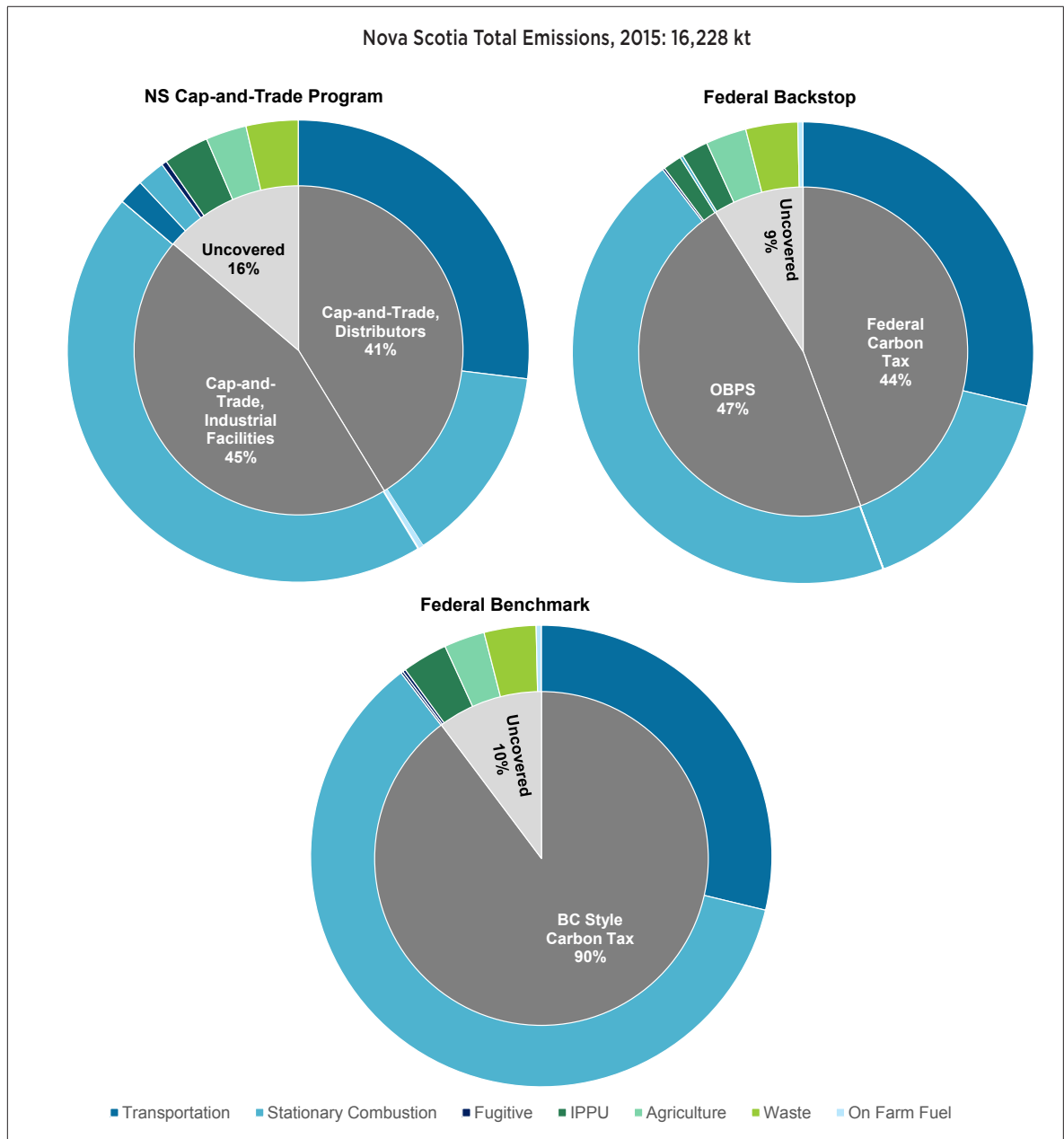
²⁷ New Brunswick filed a notice of intervention in Saskatchewan’s court challenge against the federal carbon price at the end of November 2018. When this intervention was announced, the province also indicated that it would file a notice of intervention in Ontario’s challenge “in the coming weeks” (Government of New Brunswick 2018b).

²⁸ As of the end of January 2019, no further details on an alternative carbon pricing plan for New Brunswick are publicly available.

²⁹ Although both of Nova Scotia’s offshore natural gas facilities had emissions above the 50 kt threshold in 2015, both facilities ceased natural gas production in 2018 and are now in the process of decommissioning (Beswick 2018). With the advent of onshore hydraulic fracturing and the accompanying production boom in oil and gas making offshore oil and gas less competitive, it is unlikely that offshore oil and gas production will be a significant source of emissions in Nova Scotia moving forward.

³⁰ Our estimate of uncovered stationary combustion emissions under Nova Scotia’s cap-and-trade program is entirely attributable to emissions from the province’s two offshore natural gas facilities in 2015. As described in footnote 29, both facilities ceased production in 2018, suggesting that any future emissions are likely to be nominal. Excluding emissions from these facilities, our coverage estimate for Nova Scotia’s cap-and-trade program increases to 88 per cent.

FIGURE 10 COVERAGE COMPARISON OF NOVA SCOTIA'S CAP-AND-TRADE PROGRAM AND THE FEDERAL BACKSTOP AND BENCHMARK



The Government of Nova Scotia has also indicated that it will distribute the majority of emissions permits for free. This includes free allocations to industrial facilities, a free allocation to Nova Scotia Power Inc. that is expected to cover approximately 90 per cent of the projected business-as-usual emissions from electricity generation, and free allocations to fuel distributors that will cover 80 per cent of the distributors’ verified emissions (Nova Scotia Environment 2018).

The widespread use of free allocations can be attributed to the government stating that part of the motivation for the cap-and-trade program is to “minimize impacts to consumers” and to have Nova Scotians “... avoid a carbon tax or paying much more at the pumps or to heat their homes” (Government of Nova Scotia n.d.). On the surface this suggests that Nova Scotia could face a similar challenge as New Brunswick in obtaining federal approval for its program. That is, given that the large majority of

permits are being handed out for free with the objective of minimizing price increases, the province exposes itself to the same criticism of failing to create a new incentive for reducing carbon emissions.³¹

Despite these apparent shortcomings in Nova Scotia's cap-and-trade program, in October 2018 the Government of Canada provided its full endorsement and indicated the federal backstop would not be imposed in the province in any form. The key difference likely lies in the cap component of Nova Scotia's program. In particular, the federal government has likely determined that Nova Scotia is meeting the stringency requirements of the benchmark by ensuring that its annual cap aligns with the emissions reductions that would have been achieved via implementation of the federal government's benchmark carbon price (Government of Canada 2018b). In addition, Nova Scotia has already met Canada's 2030 reduction goal, with emissions in 2015 that were 30 per cent lower than those in 2005.

With Nova Scotia's cap-and-trade program moving forward, the largest source of uncovered emissions in the province will be the waste sector (four per cent of total emissions), followed by non-combustion emissions from the agriculture sector (three per cent of total emissions).

Prince Edward Island

Prince Edward Island's initial Climate Change Action Plan was released in May 2018. Notably, it did not include a broad-based carbon tax. Instead, the province committed only to implementing the federal OBPS for large industrial emitters. The plan also committed to lower pricing on clean energy options, most explicitly electric heating for homes, which is significantly less emissions-intensive than the traditional heating oil used widely across the province (Government of Prince Edward Island 2018b).³²

On October Oct. 23, 2018 — the same day the federal government announced its assessments of provincial pricing plans — Prince Edward Island announced a two-year agreement with the federal government (Government of Prince Edward Island 2018a). Details are limited, but the primary development is Prince Edward Island agreeing to supplement the federal OBPS with a carbon tax on gasoline and diesel. Notably, however, in the same press release announcing the agreement, the Government of PEI also announced its intention to reduce the province's excise tax on gasoline and diesel, thereby decreasing the carbon tax price increase to one cent in 2019 and an additional one cent in 2020.

Prince Edward Island's agreement with the federal government also includes an exemption from carbon pricing for home heating fuels. The agreement does not appear to address whether and how carbon pricing will be applied to the remaining sources of combustion emissions in the province (for example, emissions from smaller industrial facilities not required to participate in the federal OBPS or emissions from the heating of service industry buildings), making treatment of these emissions unclear.

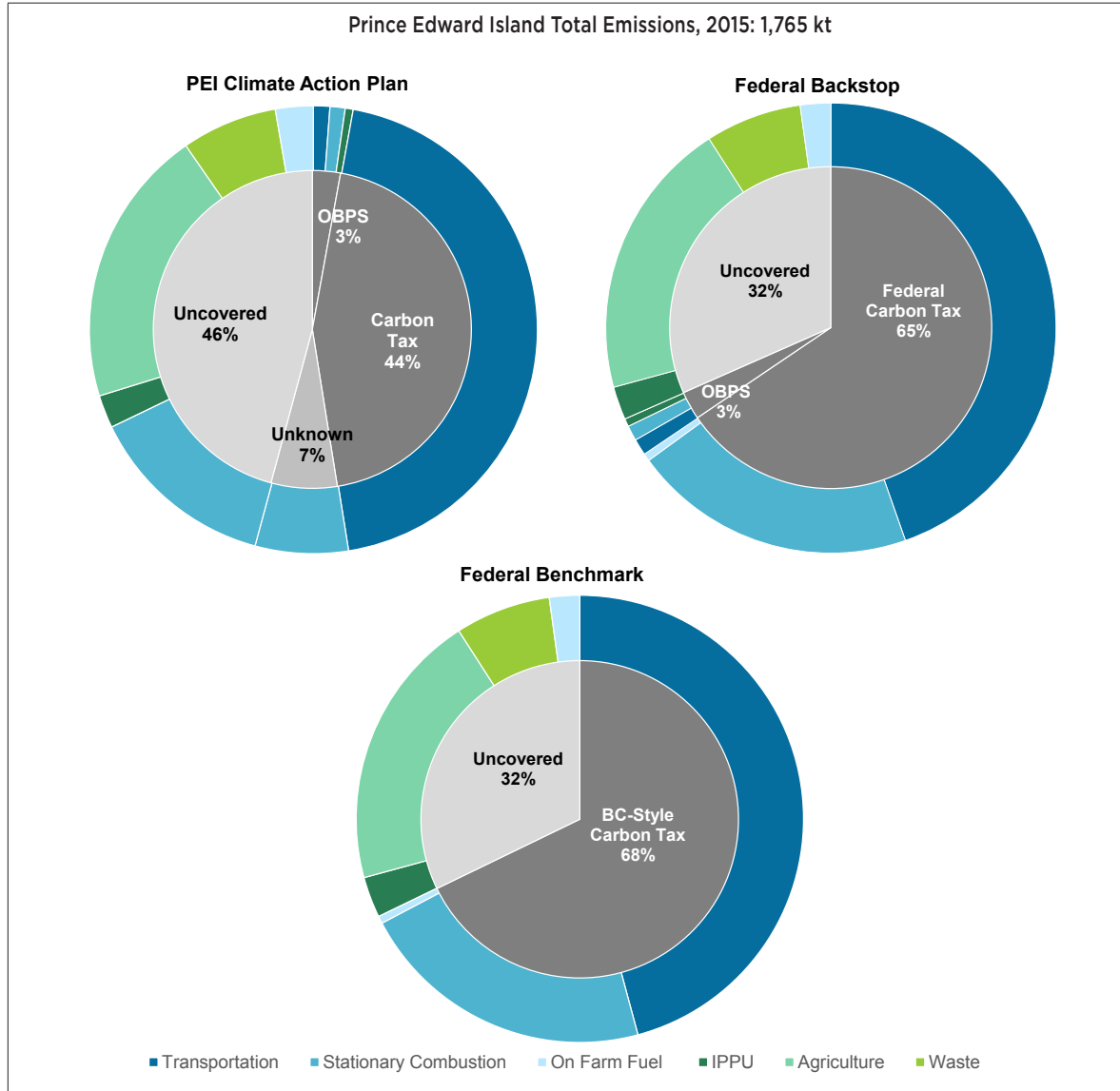
Prince Edward Island's carbon pricing announcement shares significant similarities with the previously proposed carbon pricing plan of New Brunswick's former Liberal government. Whereas the federal government deemed New Brunswick's plan insufficient, however, it has indicated that Prince Edward

³¹ As outlined in an Ecofiscal Commission blog post, providing emissions permits to electricity producers and fuel distributors at zero charge does not ensure that consumers will face only minimal price increases (Beugin 2017). As the permits have value in the cap-and-trade market, there is an opportunity cost associated with them. This cost may be passed down to consumers through higher prices for electricity, natural gas, and transportation fuel (gasoline and diesel), creating "windfall profits" for electricity generators and fuel distributors.

³² Natural Resources Canada's Comprehensive Energy Use database for 2015 indicates that heating oil continues to be the most common source of household heating in Prince Edward Island. Specifically, exclusive heating oil systems were used in 66 per cent of homes in the province while dual wood/heating oil systems were used in an additional 17 per cent (Natural Resources Canada 2018).

Island’s revised plan is on track to meet the federal benchmark stringency requirements and that the federal backstop will not be imposed in the province in any form (Government of Canada 2018c).³³

FIGURE 11 COVERAGE COMPARISON OF PRINCE EDWARD ISLAND’S CARBON PRICING SYSTEM AND THE FEDERAL BACKSTOP AND BENCHMARK



Currently available details on Prince Edward Island’s revised climate change plan suggest that it will result in coverage of up to 47 per cent of the province’s emissions (Figure 11).³⁴ Prince Edward Island

³³ Prince Edward Island’s plan notes the province has the second lowest per capita emissions in Canada and promotes the predominantly renewable nature of in-province electricity generation. Electrification of home heating and transportation is cited as a major source of action. However, Dobson and Fellows (2017) find Prince Edward Island’s imports of electricity are significant and also emissions-intensive, putting pause to the notion that electrification will result in substantial emissions reductions on net.

³⁴ We say “up to” as Prince Edward Island’s initial climate change plan from May 2018 indicated that coloured fuels in both the agriculture and fisheries sectors would be exempt from any carbon price (Government of Prince Edward Island 2018b). Although this was not confirmed in the October 2018 announcement, it seems likely this will still be the case. Our 47 per cent coverage estimate excludes agricultural combustion emissions but includes emissions from the fisheries sector. This is a potentially significant source, with Environment and Climate Change Canada’s NIR data indicating that domestic navigation emissions accounted for seven per cent of total emissions in Prince Edward Island in 2015.

has only a single industrial facility with emissions that exceed 50 kt of CO₂e per year, limiting coverage of the federal OBPS to three per cent of emissions. In comparison, the carbon tax on gasoline and diesel will cover up to 44 per cent of emissions. Forty-six per cent of emissions in the province will not be priced while treatment of the remaining seven per cent of emissions is currently unclear. The largest sources of unpriced emissions in the province are non-combustion emissions from the agriculture sector (20 per cent of total emissions), followed by stationary combustion emissions from the residential sector (14 per cent of total emissions).³⁵

In comparison, the federal benchmark requires pricing all combustion emissions in the province. This would result in coverage of 68 per cent of the province's total emissions. The federal backstop would similarly cover 69 per cent of emissions. With Prince Edward Island's carbon pricing plan falling short of the benchmark for emissions coverage, and also not including a cap on total emissions, it seems most likely that the province's relative rurality — and a corresponding lack of alternative options for transportation and home heating — provides the justification for the federal government choosing not to implement the backstop in the province.

Newfoundland and Labrador

At the end of October 2017 Newfoundland and Labrador Premier Dwight Ball announced that his province's carbon pricing plan would be released in spring 2018 (The Telegram 2017). He stated that the province was working with the federal government on a “made in Newfoundland and Labrador” plan but declined to say whether a carbon tax or a cap-and-trade system was under development.

The Government of Newfoundland and Labrador proceeded to reveal small glimpses of its carbon pricing approach throughout 2018. It was not until the end of October, however, that its full carbon pricing plan was announced. Similar to both Alberta and the federal backstop, the province's plan is a combination of a broad-based carbon tax and a performance standards system (effectively an OBPS) for large emitters. The performance standards system will apply to all large industrial facilities, including electricity generators and offshore oil and gas producers, with emissions in excess of 25 kt CO₂e per year. The province is also exploring establishing an opt-in program for facilities with minimum annual emissions of 15 kt CO₂e (Government of Newfoundland and Labrador 2018a).

The carbon tax will apply to both stationary and transportation combustion emissions in the province. Significantly, however, the province will offset the price increases on gasoline and diesel through reductions in the current fuel taxes of four and five cents per litre respectively. This will reduce the initial price increase on gasoline to 0.42 cents per litre and the initial price increase on diesel to 0.37 cents per litre (Government of Newfoundland and Labrador 2018b).³⁶

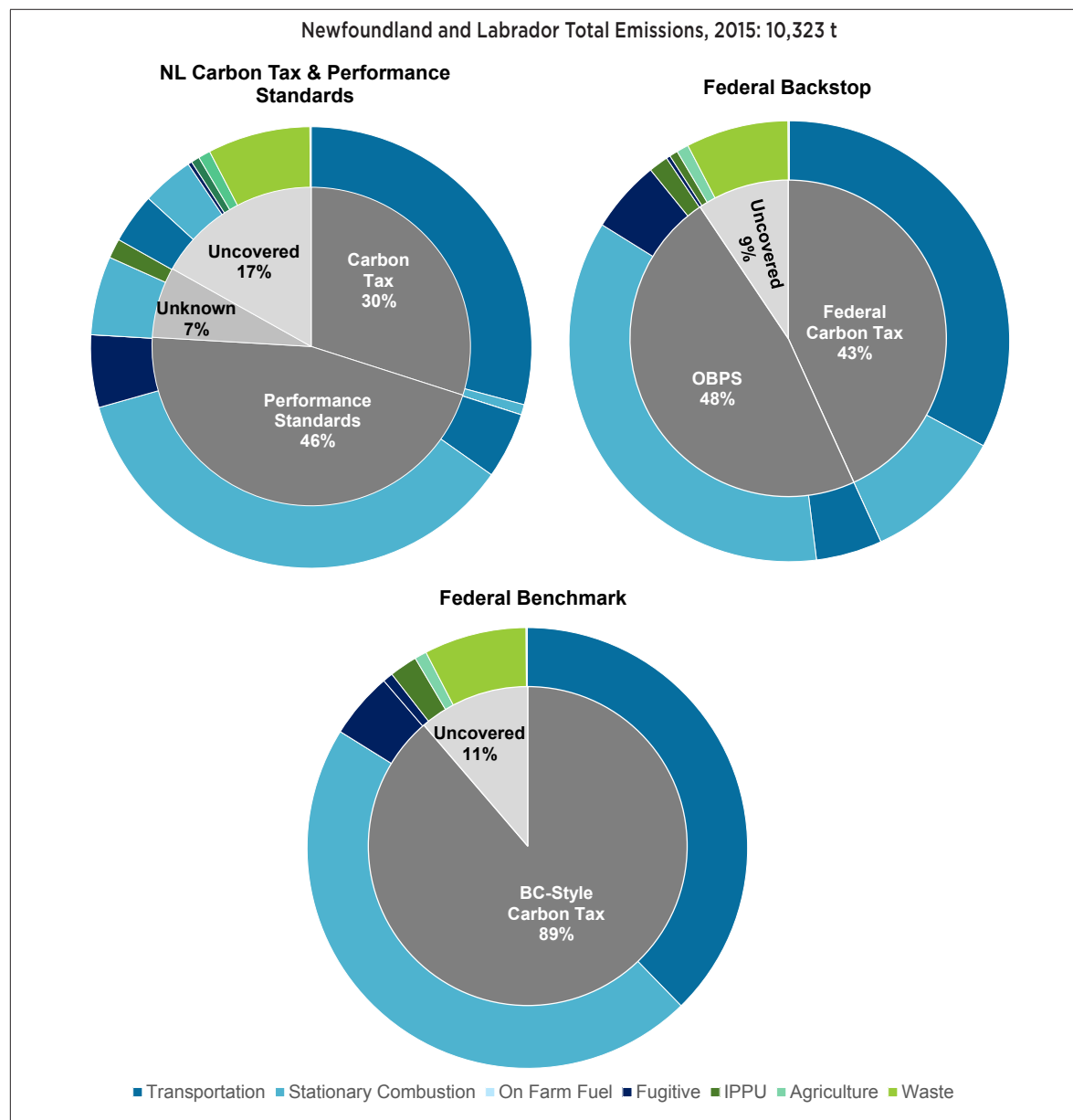
Similar to Prince Edward Island, Newfoundland and Labrador has received approval from the federal government to exempt fuels used for household heating from the carbon tax. Other notable exemptions to the carbon tax include diesel fuel used for off-grid electricity generation, aviation fuel, fuel for interprovincial marine transport and fuel use by municipalities. The province is also providing

³⁵ Environment and Climate Change Canada's NIR data report residential emissions of 241 kt for Prince Edward Island in 2015 (Environment and Climate Change Canada 2017b). This is slightly lower than Natural Resources Canada's Comprehensive Energy Use database which reports residential household emissions of 251 kt in 2015. Natural Resources Canada's database further disaggregates this amount into emissions by end use, which indicates that emissions for household heating were 190 kt and emissions for water heating were 61 kt (Natural Resources Canada 2018). Prince Edward Island does not make explicit whether fuel for water heating is also excluded from the carbon tax. However, as it seems unlikely that the government would be able to distinguish a fuel's end use within the household, we expect the exemption will apply to all household fuels and thereby all residential emissions.

³⁶ Newfoundland and Labrador's plan to roll back its fuel tax on gasoline and diesel as the carbon tax is phased in appears similar to New Brunswick's plan, which, as noted earlier, Minister McKenna criticized for not being additional to current taxes. Newfoundland and Labrador's scenario is unique, however, in that the rollback is primarily on a temporary fuel tax of 16.5 cents per litre that was introduced in the province's 2016/2017 fiscal year budget. The temporary tax has since been rolled back by 12.5 cents per litre (CBC News 2017). This leaves four cents per litre that the government could argue is additional and relabel as a carbon tax.

industry exemptions to agriculture, fishing, forestry, and offshore oil and gas and mineral exploration. Last, venting and fugitive methane emissions from the oil and gas sector will also be exempt from carbon pricing as they are separately covered by the federal methane regulations (Government of Newfoundland and Labrador 2018b).

FIGURE 12 COVERAGE COMPARISON OF NEWFOUNDLAND AND LABRADOR'S CARBON PRICING SYSTEM AND THE FEDERAL BACKSTOP AND BENCHMARK



We estimate coverage of Newfoundland and Labrador's carbon pricing system at 76 per cent of the province's total emissions. This breaks down into 30 per cent coverage by the carbon tax and 46 per cent coverage by the performance standards system.³⁷ These estimates account for the exemptions to emissions from household heating, aviation fuel, agriculture and forestry, as well as venting and

³⁷ Our estimate of total pricing coverage (76 per cent) matches the estimate from the Government of Newfoundland and Labrador (2018a). The disaggregation, however, differs slightly, with the province estimating that 33 per cent of emissions will be covered by the carbon tax and 44 per cent by the performance standards. The difference is from the province's estimate that without exemptions the performance standards would cover 45 per cent of the province's emissions. In contrast, we estimate that without exemptions the performance standards would cover 47 per cent of emissions.

fugitive methane emissions from the oil and gas sector. We are unable to account for the remaining exemptions as we cannot separate them from other reported emissions in the NIR.³⁸ Taking these exemptions into account, the largest sources of uncovered emissions are the waste sector (eight per cent of total emissions); the transportation sector, including aviation fuels and fuels for forestry and agricultural vehicles (four per cent of total emissions); and fuels for household heating (four per cent of total emissions).³⁹

There is an additional seven per cent of emissions in Newfoundland and Labrador for which coverage is currently unclear. The majority of these are heating emissions from the commercial and institutional sector. Newfoundland and Labrador's press release only explicitly states that home heating fuels will not be taxed. In its full carbon plan, however, the province states the heating fuel exemption covers 9.5 per cent of total emissions, suggesting it includes both the residential sector (3.6 per cent of total emissions) and the commercial and institutional sector (5.8 per cent) (Environment and Climate Change Canada 2017b; Government of Newfoundland and Labrador 2018a). The remaining one per cent of emissions for which coverage is unclear is IPPU emissions from large facilities. Newfoundland and Labrador is allowing facilities to choose one of two methods for calculating baseline performance standards (equivalent to output-based emissions standards), only one of which includes IPPU emissions (Government of Newfoundland and Labrador 2018b). As a result, it appears that coverage of IPPU emissions may depend on a facility's choice of standard.

Although endorsed by the federal government, Newfoundland and Labrador's carbon pricing plan falls short of the federal benchmark, which requires pricing of 89 per cent of emissions in the province. The federal backstop would similarly cover 91 per cent of the province's emissions. As was the case in Prince Edward Island, it seems most likely that the federal government took the relative rurality of Newfoundland and Labrador into account when approving a provincial plan that does not meet the minimum thresholds for coverage.

Last, we also note that although Newfoundland and Labrador is moving forward with a carbon pricing plan, Premier Ball stated in August 2018 that if the Ontario and Saskatchewan court challenges are successful, then the province will not proceed with carbon pricing (Quinn 2018). Unlike New Brunswick, however, there has been no indication that Newfoundland and Labrador is planning to actively support the court challenges.

COMPARISON AND SUMMARY OF CARBON PRICING COVERAGE ACROSS THE PROVINCES

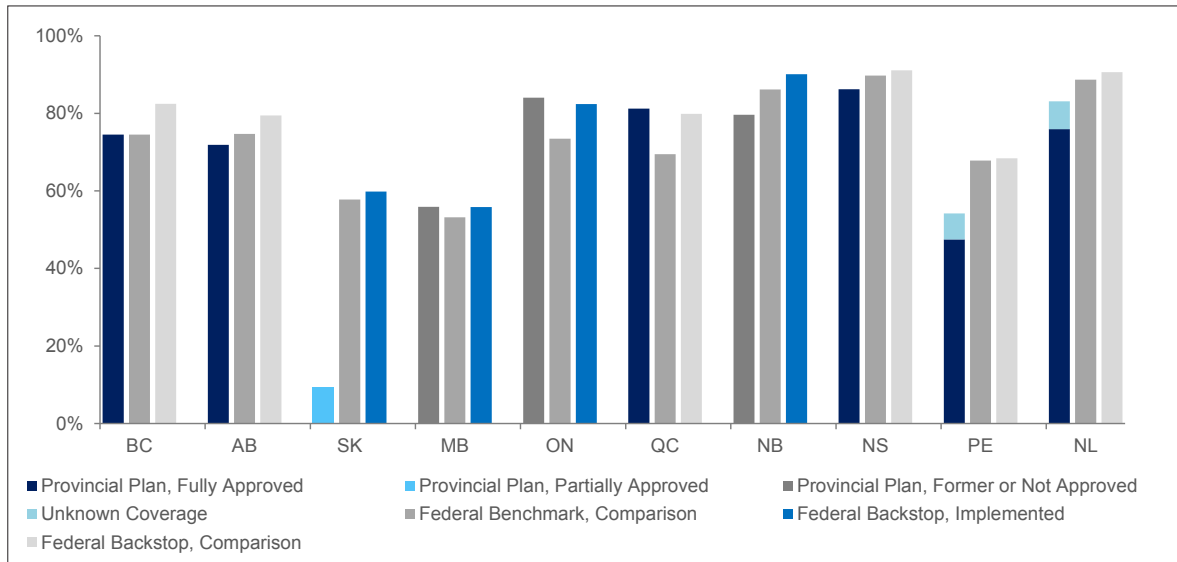
Figure 13 summarizes the coverage of provincial carbon pricing plans and compares them to coverage of the federal benchmark and the federal backstop. Currently, only the provincial pricing plans in British Columbia and Quebec meet the federal benchmark. Correspondingly, these plans have received federal government approval and the backstop will not be implemented.

Although falling short of the benchmark, the provincial plans in Alberta, Nova Scotia, Prince Edward Island and Newfoundland and Labrador have also received federal approval.

³⁸ Newfoundland and Labrador's carbon pricing plan states the exemption to marine transportation covers one per cent of emissions while the exemption to diesel for off-grid electricity generation covers 0.4 per cent (Government of Newfoundland and Labrador 2018a). There is no specific reference to the exemption to fuel used by municipalities although this amount is likely grouped in with the general heating fuel exemption estimate of 9.5 per cent.

³⁹ As was the case in Prince Edward Island (see footnote 35), data from Natural Resources Canada's Comprehensive Energy Use database allows the residential emissions estimate to be divided into the end uses of household heating (362 kt) and water heating (32 kt). In the case of Newfoundland and Labrador, there is a 17 kt discrepancy between residential emissions estimates in 2015, with the NIR reporting total emissions of 377 kt and Natural Resources Canada reporting total emissions of 394 kt (Environment and Climate Change Canada 2017b; Natural Resources Canada 2018). We again assume the household heating exemption applies to all household fuels and thereby all residential emissions.

FIGURE 13 COVERAGE COMPARISON OF CARBON PRICING POLICIES ACROSS THE PROVINCES



Alberta’s hybrid system will only exceed the federal benchmark once the carbon price is fully implemented across the province. The temporary exemption provided to conventional oil and gas producers decreases current coverage by up to 13 percentage points, causing the system to fall short of the federal benchmark through to 2023. Post-2023, however, Alberta’s system will exceed the federal benchmark by five percentage points.

Our estimate of the coverage of Nova Scotia’s cap-and-trade program suggests that it falls short of the benchmark primarily as a result of its exclusion of aviation and marine fuels.⁴⁰ While there is no time limit on Nova Scotia’s exemptions, its declining cap ensures that its program meets the federal stringency requirement for absolute emissions reductions.

With no time limit on their exemptions and no cap on emissions, Prince Edward Island and Newfoundland and Labrador have arguably received the largest concessions from the federal government. The most significant exemption in both provinces is home heating fuels (an exemption that may also extend to the heating of commercial and institutional facilities). Although the federal government has not stated an explicit reason for allowing these exemptions, one possible explanation is that it is acknowledging the heavy reliance of households in both provinces on heating oil, as well as the lack of alternative options that households can turn to (due in part to neither province having a natural gas distribution network).

In comparison, Saskatchewan and New Brunswick both announced pricing systems that explicitly fall short of the federal benchmark. In Saskatchewan, the federal government has accepted the province’s proposed performance standards system, and will implement the federal backstop as a top-up, increasing emissions coverage from nine to 60 per cent. In New Brunswick, which included adoption of the federal OBPS as part of its provincial plan, the federal government dismissed the province’s proposal to relabel a portion of its fuel excise tax as a carbon tax. The federal backstop will therefore be implemented in full in the province, raising coverage from 80 to 90 per cent.

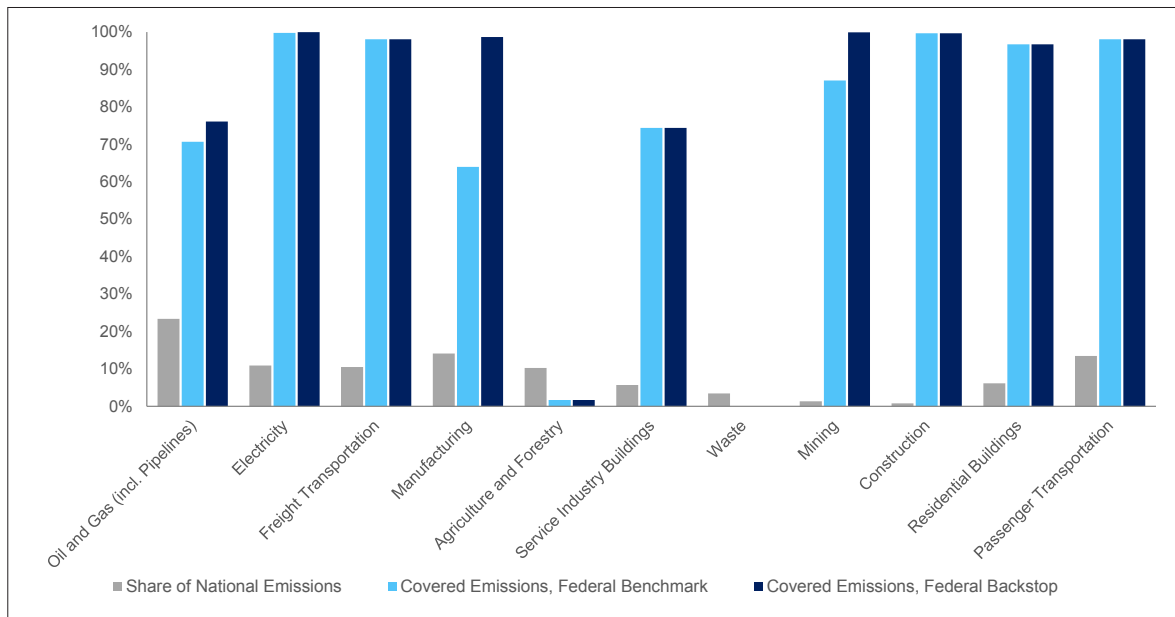
Manitoba and Ontario previously had carbon pricing plans that met the federal benchmark for coverage. Both, however, withdrew their plans prior to the completion of the federal government’s assessment. Without provincial plans in place, the federal backstop will be implemented in full in both provinces.

⁴⁰ We note again, however, that Nova Scotia’s official coverage estimate, however, is six percentage points lower than ours. This suggests there may be additional exemptions we are not accounting for.

Although the federal benchmark and backstop are intended to level the playing field regarding priced greenhouse gas emissions across the provinces, coverage as a share of total provincial emissions will still vary substantially. Specifically, following implementation of the carbon tax component of the federal backstop on April 1, 2019, carbon pricing coverage in the provinces will range from a low of 47 per cent of emissions in Prince Edward Island to a high of 90 per cent of emissions in New Brunswick.

These provincial differences can in part be explained by the various provincial-level exemptions approved by the federal government. They are also largely a result of differences in the industrial profiles of the provinces. As Figure 14 shows, carbon pricing coverage under the federal benchmark and backstop differs significantly by industry. This is due to the fact that emissions of certain industries are characterized nearly entirely by combustion emissions, which are consistently priced under both the benchmark and backstop. These industries include electricity, freight transportation, construction, residential buildings and passenger transportation.

FIGURE 14 COVERAGE OF FEDERAL BENCHMARK AND FEDERAL BACKSTOP BY INDUSTRY



Other industries, in contrast, are characterized by larger shares of non-combustion emissions. Non-combustion emissions are not priced by the federal benchmark, while the federal backstop extends carbon pricing coverage to only the following sources: IPPU emissions from large industrial facilities; venting and fugitive emissions from large facilities (with an exclusion for methane emissions from large oil and gas facilities and transmission pipelines); and non-methane venting emissions from small oil and gas producers. Accordingly, coverage of emissions from the manufacturing sector increases significantly when moving from the federal benchmark to the federal backstop. There is also a notable increase in emissions coverage in the mining sector. In comparison, the increase in emissions coverage in the oil and gas sector is negligible (reflecting the fact that the majority of non-combustion emissions in the sector are methane). Last, in the agriculture and forestry, service-industry buildings, and waste sectors there is no change in coverage as the federal backstop does not price non-combustion emissions in these sectors.

Also of note when considering how a province's industrial profile determines overall coverage are the gross emissions from an industry (proxied by national shares of industry emissions in Figure 14). Specifically, low carbon-pricing coverage in an industry with relatively low emissions will have less of an effect in dampening overall coverage in a province than low coverage in an industry with relatively

high emissions. For example, under the federal backstop emissions coverage in the oil and gas sector and the service sector are relatively comparable at just under 75 per cent. Gross emissions from the oil and gas sector, however, are nearly seven times higher than gross emissions from service-industry buildings. Accordingly, provinces with a relatively large oil and gas sector will generally have lower overall coverage than provinces with a relatively large service sector.

Turning to expected coverage of carbon pricing across the provinces, as of April 1, 2019 the highest rates of coverage are expected in New Brunswick (90 per cent) and Nova Scotia (86 per cent). These high rates are because these provinces have relatively few sources of non-combustion emissions. This in turn is largely because agriculture and oil and gas are not a major industries in either province.

In the middle of the pack for coverage is Ontario (83 per cent) and Quebec (81 per cent). These are both more diversified provinces that have large quantities of covered emissions, primarily in the manufacturing, buildings, and transportation sectors, as well as small but still notable quantities of uncovered emissions, primarily in the agriculture and waste sectors.

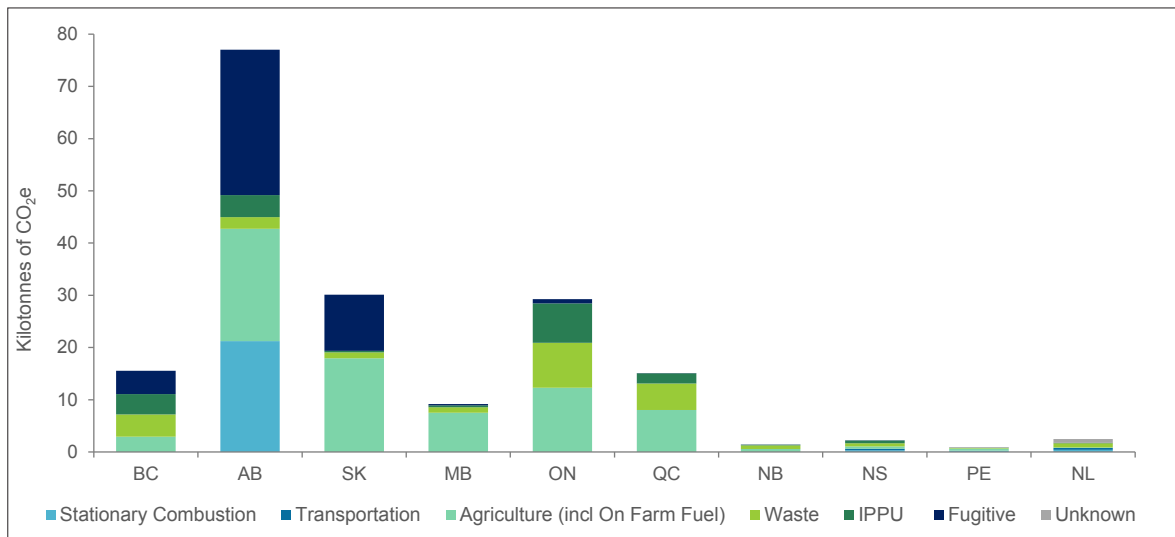
Coverage in Newfoundland and Labrador (76 per cent), British Columbia (75 per cent), Saskatchewan (73 per cent) and Alberta (72 per cent) falls below the middle of the pack. Newfoundland and Labrador's position is largely due to its exemptions (most notably on home heating fuels) and the ambiguities in its current coverage. Absence these exemptions and uncertainty, coverage would be near the top of the provinces at nearly 90 per cent. Somewhat similarly, British Columbia's position is due to the fact that its carbon tax only meets the federal benchmark and does not price non-combustion IPPU emissions. If these emissions were included under British Columbia's carbon tax then its coverage would rise to 85 per cent, comparable to Ontario and Quebec. Saskatchewan's position is due to the combination of both a large oil and gas sector and a large agriculture sector. Last, as noted earlier, Alberta's position is primarily attributable to its exemption to conventional oil and gas producers. Without this exemption the province's coverage would rise to 85 per cent. Notably, this coverage level would exceed the federal backstop (79 per cent) as Alberta's carbon pricing program does not include an exemption for methane emissions.

Carbon pricing coverage is lowest in Manitoba (53 per cent) and Prince Edward Island (47 per cent). In both provinces the relative importance of the agriculture sector — which correspondingly accounts for a large share of provincial emissions — significantly dampens carbon pricing coverage. Prince Edward Island's coverage is further decreased as a result of its negotiated exemptions.

Although Prince Edward Island and Manitoba have the highest shares of uncovered emissions, they are not the largest sources of uncovered emissions on a national basis. This is because these provinces have relatively low absolute emissions. Rather, the largest source of uncovered emissions in Canada through to 2023 will likely be uncovered fugitive emissions (primarily methane) from Alberta's oil and gas sector, followed by exempt combustion emissions from conventional oil and gas producers (Figure 15).⁴¹ Unpriced agriculture emissions in Alberta are roughly equal to the exempt emissions from conventional oil and gas producers, making them another significant source of unpriced national emissions. Other notable sources nationally of uncovered emissions are agriculture emissions in Saskatchewan and Ontario and fugitive emissions from the oil and gas sector in Saskatchewan.

⁴¹ We say “likely” here because we do not have an exact measure of combustion emissions from the conventional oil and gas sector in Alberta. As noted in the main text, we estimate this amount at a maximum of 13 per cent of Alberta's emissions in 2015.

FIGURE 15 UNPRICED CO₂e EMISSIONS SOURCES BY PROVINCE



DISCUSSION AND CONCLUSIONS

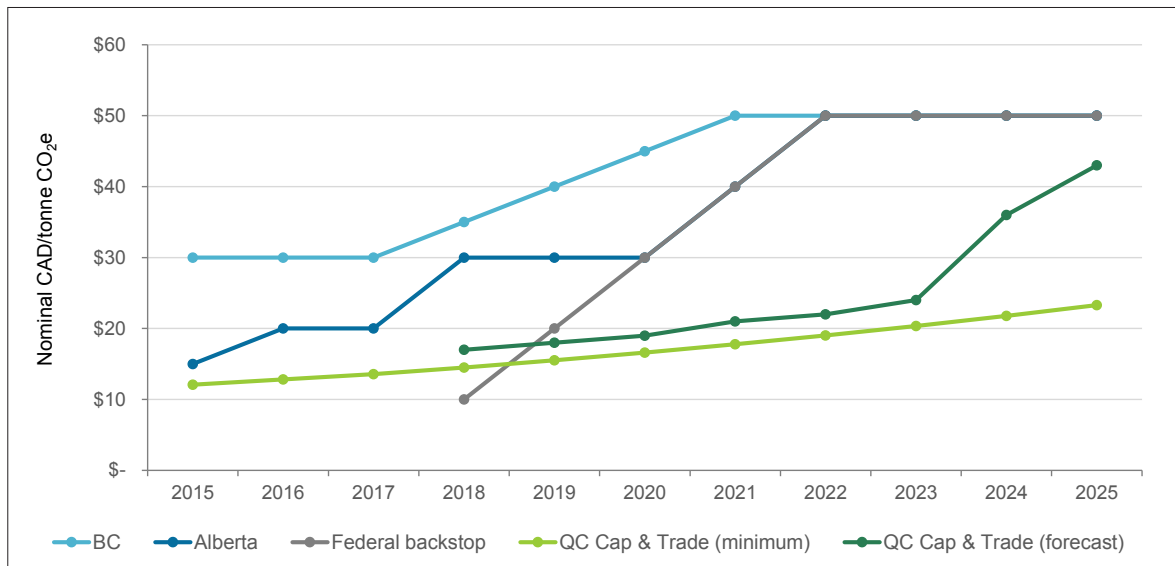
We have demonstrated the differences in emissions coverage between the federal benchmark, the federal backstop and provincial pricing plans. The coverage of different carbon pricing instruments, however, is only one part of the decision-making process in developing emissions pricing plans. Other considerations include the overall stringency of the instruments, cost effectiveness, transparency, the role of complementary policies, provincial legal challenges of the federal backstop, the federal government’s role in ensuring equitable treatment of the provinces and the outlook for future emissions. These additional considerations may be particularly important for provinces currently under the federal backstop and looking to develop their own plans in the future, as well as in upcoming reviews of the Pan-Canadian Framework on Clean Growth and Climate Change (PCF).

Overall stringency of the instruments

Regardless of the instrument chosen, where the actual price is set will also determine its efficacy. The PCF indicates that provinces choosing to implement a carbon tax must have a price floor equal to the federal benchmark, while those that implement a cap-and-trade system must set a cap that equals projected emission reductions from the benchmark price, rather than the price itself. Comparing the price of carbon across different jurisdictions with different systems is complicated and should include whether free allocation of permits occurs within a cap-and-trade system or OBPS (which reduce costs to large emitters), as well as whether permits⁴² can be purchased from outside domestic borders.

⁴² When cap-and-trade systems are linked across jurisdictions, as Quebec’s is with California’s, emitters can purchase permits from outside their own systems to meet their obligations. This means the carbon price achieves greater reductions at a lower price, even though some of these reductions will occur in another jurisdiction, because more low-cost options are available. For more details, see Beugin et al. (2016).

FIGURE 16 CURRENT CANADIAN CARBON PRICING POLICIES, 2015 - 2025



Note: Quebec’s cap-and-trade price forecast is the mid-range scenario from ICF Consulting Canada (2017). Alberta’s price forecast ends at \$30 in 2020 as the province has not committed to further price increases beyond this point. See footnote 18 for further information.

As noted above, part of the federal benchmark is increasing stringency, either through an increased price in carbon tax systems, or a tightened cap in cap-and-trade systems. One of the challenges this creates, however, is the possibility of significant differences in prices across the provinces. As an example, in comparing Quebec to provinces with a carbon tax, there is a divergence in prices, which is projected to continue through to at least 2025 (Figure 16). While Quebec’s cap-and-trade program may have equivalent stringency in terms of overall emissions reductions, the difference in price level will be contentious as provinces speak to the distribution of burden and economic impact. This is likely to be an important point of discussion in 2020 when the federal government is scheduled to review the equivalency of provincial pricing systems.

The cost effectiveness of the instruments

A cap-and-trade system may provide more emissions coverage than a carbon tax. But if that increase is relatively small and the costs of developing and operating the system are high, it may be more cost effective to institute a carbon tax.⁴³ This may be particularly pertinent for small jurisdictions like Manitoba, New Brunswick, Nova Scotia, Newfoundland and Labrador and PEI that have a small number of large final emitters and less bureaucratic capacity compared to larger provinces like Alberta and Quebec.

Transparency

By its very nature, a carbon tax is transparent — households and businesses know exactly the cost associated with the tax, and where there are exemptions. By contrast, a cap-and-trade system is more complex and opaque, both in terms of sectors potentially subject to the system and how permits are allocated. An explicit system like a tax can be more politically costly because of the transparency of costs imposed on voters. The complexity of a cap-and-trade system can also be more sensitive to lobbying, as it is more difficult for voters to see and police special treatment of certain types of firms.

⁴³ While there are administrative costs associated with a carbon tax as well, these are likely to be less than a cap-and-trade system. A tax can be implemented through existing infrastructure, such as motor fuel taxes, while cap-and-trade requires capacity for allocating permits, monitoring compliance and verifying emission reductions inside the system as well as emission offsets sold into the system (Frank 2014).

Complementary policies

Many provinces in announcing their climate change strategies also included regulations in specific sectors that place an implicit price on emissions, in addition to that already created by a carbon price. Jaccard (2016) argues that governments should consider complementary regulations that would reduce emissions in areas like coal-fired electricity generation, vehicles and fuel. Combining pricing and regulations, Jaccard argues, is a more politically viable approach to achieving the reductions required to meet government-established targets. However, the implicit carbon price is often much higher than the market carbon price, imposing further costs on provincial economies, and do not always result in additional emissions reductions (Ragan et al. 2017). That said, there is a role for complementary non-pricing policies to improve coverage, particularly when other market failures are present (Keohane and Olmstead 2016).

This issue is of particular importance for Manitoba and Prince Edward Island with the highest proportions of uncovered emissions within-province.

Legal challenges

Legal challenges are threatening to slow the PCF's implementation and could create political challenges for the Trudeau government leading into the 2019 federal election. As noted earlier, Saskatchewan and Ontario have launched reference cases in their respective courts of appeal, asking whether the federal government has the authority to impose a system on recalcitrant provinces. New Brunswick has indicated it plans to support these cases while Newfoundland and Labrador is waiting on the decision, and will withdraw its carbon pricing plan if the ruling is in favour of the provinces.

Manitoba has not yet decided whether it will actively participate in the current legal challenges, although in spring 2018 Premier Pallister stated that the province was prepared to take the federal government to court if a higher carbon price were imposed (CBC News 2018; MacLean 2018). This statement came despite an earlier legal opinion Manitoba received which indicated that imposition of a carbon price on the provinces is likely within federal jurisdiction unless an equivalent provincial system is in place (Schwartz 2017). Alberta United Conservative Party leader Jason Kenney has also made clear his opposition to carbon pricing. If elected in 2019, he plans to repeal Alberta's economy-wide carbon tax and challenge implementation of the federal backstop (Johnson 2018).

Equitable treatment of the provinces

The federal benchmark and backstop's goal is to ensure equal treatment of greenhouse gas emissions across the provinces and to minimize any coverage gaps that may result from purely independent provincial policies. In allowing numerous exemptions to the minimum coverage thresholds, however, the federal government has created challenges in equitably enforcing the benchmark and backstop. Alberta's temporary exemption to small oil and gas producers, for example, causes the province to fall short of the benchmark. This could create tensions with British Columbia and Saskatchewan, where comparably sized oil and gas producers do not receive a similar exemption. Differences in coverage across the provinces are likely to be a source of pressure for the federal government going forward as provinces, particularly those that are not supportive of carbon pricing, are likely to protest against any indication of an uneven playing field.

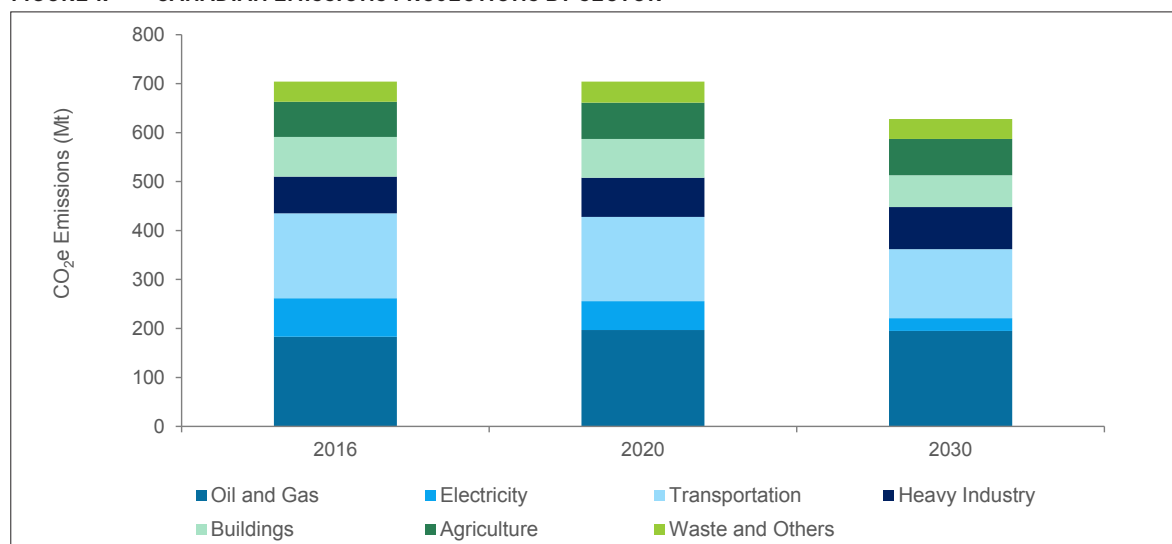
Outlook for future emissions and coverage

The above analysis provides a snapshot of expected carbon pricing emissions coverage based on historical emissions from 2015. We recognize that actual coverage — both in 2019 when a carbon price is implemented across the country, and beyond — will vary with changes in Canada's emissions profile and industrial structure. For a sense of how coverage may change, we use Canada's future emissions projections (Figure 17). Environment and Climate Change Canada's most recent projection, from late 2018, forecasts that between 2016 and 2030, the largest growth in emissions (+12 Mt) will be in the oil

and gas sector. This is followed by heavy industry (+11 Mt) and agriculture (+2 Mt). In comparison, decreases in emissions are forecast in the electricity (-53 Mt), transportation (-32 Mt) and buildings (-16 Mt) sectors. Last, there is no forecast change in emissions in the waste and others sector⁴⁴ (Environment and Climate Change Canada 2018a).

Referring back to Figure 14, we note that with the exception of the waste and others sector, the sectors with anticipated growth in emissions are generally those with the lowest rates of coverage, while those with anticipated declines in emissions are those with the highest rates of coverage. This result is unsurprising and in part attributable to the impact of the carbon price itself.

FIGURE 17 CANADIAN EMISSIONS PROJECTIONS BY SECTOR



Source: Environment and Climate Change Canada (2018a)

Note: The “others” in the “waste and others” sector includes coal production, light manufacturing, construction and forest resources. Reported emissions correspond to the “Additional Measures Case” in Environment and Climate Change Canada (2018a). This case accounts for emissions reductions corresponding to policies that had been announced as of fall 2018 but not necessarily implemented. Accordingly, this scenario accounts for the expected emissions reductions from the 2019 implementation of the federal carbon pricing backstop and approved provincial carbon pricing plans.

A consequence of emissions reductions being concentrated in the sectors with the highest rates of carbon pricing coverage, however, is a likely shift in Canada’s emissions profile toward sectors with lower coverage. That is, it seems likely that over the next five to 10 years, the carbon price’s coverage as a share of total provincial and federal emissions will decline.

This again emphasises the need for complementary policies to address gaps in carbon pricing coverage. It also highlights the possibility of increasing divergence in coverage across the provinces, particularly if the forecast growth in emissions in the oil and gas sector is realized. This in turn may create increasing pressure on the federal government to expand the emissions sources covered by the federal benchmark and backstop and to narrow the existing gaps in coverage across the provinces.

Concluding Thoughts

Provinces have a unique opportunity to assess their climate strategies’ coverage, stringency and efficacy. Our analysis presented above provides a starting point which allows provincial decision-makers to balance coverage concerns with additional policy considerations. It also highlights the need for additional policies to address the remaining unpriced emissions. Future research can aid provincial decision-making in developing these policies, and include aspects of climate policy broader than the strict coverage of the pricing instruments.

⁴⁴ The “others” in the “waste and others” sector includes coal mining, light manufacturing, construction and forest resources.

APPENDIX A: METHODOLOGY

We disaggregate available data on emissions for each province into covered and uncovered emissions within each sector. The data set we use to derive our coverage estimates is taken from Environment and Climate Change Canada's (ECCC) 2017 National Inventory Report (NIR). The NIR is part of Canada's submission to the United Nations Framework Convention on Climate Change (UNFCCC) each year and is the official estimate of national and provincial greenhouse gas emissions. It is therefore our primary source for deriving coverage estimates. Additionally, we set total national emissions, and emissions in each province in our analysis, equal to the totals reported in the NIR.

The publicly available NIR data consist of three datasets. The first provides national- and provincial-level estimates of CO₂e emissions by greenhouse gas type and the Intergovernmental Panel on Climate Change (IPCC) emissions categories. The second dataset provides a national estimate of total CO₂e emissions by economic sector, as well as a mapping of national emissions from IPCC category to economic sector. Last, the third dataset provides provincial estimates of CO₂e emissions by economic sector. Notably, the economic sectors in the NIR datasets appear to be defined by ECCC and do not match the NAICS sectors that Statistics Canada typically uses.

We supplement the NIR data with two additional datasets. The first, provided on request from ECCC, provides provincial-level NIR fugitive emissions separated into the coal, oil, natural gas, flaring and venting subcategories. This dataset provides more detail than the NIR data but is otherwise consistent with it. Last, we also use ECCC's facility greenhouse gas reporting database from 2015. This consists of facility-reported data and therefore does not perfectly align with the NIR dataset.

We refer to these five datasets hereafter as the IPCC, mapping (MAP), provincial economic sector (PES), supplementary fugitive (SF), and facility reporting (FR) datasets. The abbreviations of each dataset are used as superscripts in the formulas presented below to identify data sources. In the discussion that follows, if a variable has a superscript then it can be taken or calculated directly from one of these datasets. Variables that do not have a superscript are values that we calculate.

Last, we also make use of the following indices:

- i : Facilities reporting to ECCC's facility greenhouse gas reporting database and covered by the OBPS;⁴⁵
- j : Canadian provinces;
- k : Industrial economic sectors from the economic sector datasets (MAP and PES);⁴⁶ and
- l : Subcategories of industrial process and product use (IPPU) emissions from the IPCC dataset.⁴⁷

⁴⁵ We exclude from this index facilities in the following NAICS sectors as they are not covered by the OBPS: Sewage Treatment Facilities; Waste Treatment and Disposal; All Other Waste Management Services; Other Federal Government Public Administration; Community Colleges and CEGEPS; Universities; Other Support Activities for Air Transportation; and Natural Gas Distribution. We also exclude facilities that report to ECCC's database but have emissions below 50 kt per year as these facilities do not have a mandatory participation requirement in the OBPS.

⁴⁶ Industrial economic sectors include the following (from the PES dataset): Natural Gas Production and Processing; Conventional Oil Extraction; Oil Sands Mining and Extraction; Oil Sands In Situ; Oil Sands Upgrading; Petroleum Refining; Oil and Natural Gas Transmission; Electricity; Mining; Smelting and Refining (Non-Ferrous Metals); Pulp and Paper; Iron and Steel; Cement; Lime and Gypsum; Chemicals and Fertilizers; Coal Production; and Light Manufacturing.

⁴⁷ IPPU emissions have the following six subcategories (from the IPCC dataset): Mineral Production; Chemical Industry; Metal Production; Consumption of Halocarbons; SF₆ and NF₃; Non-Energy Products from Fuels and Solvent Use; and Other Product Manufacture and Use.

As described below, in order to obtain provincial estimates of covered emissions we disaggregate specific IPCC categories (most notably IPPU and fugitive) into emissions by economic sector. We then aggregate back up to IPCC category when reporting covered and uncovered emissions. Specific methodologies for each disaggregation and re-aggregation are covered in the discussion that follows.

Benchmark Coverage Estimates

Coverage estimates of the federal benchmark are largely straightforward as combustion emissions are the only emissions that are priced. These emissions are reported in the IPCC Stationary Combustion (SC), Transportation, and Fugitive Emissions-Flaring subcategories. They are therefore taken directly from the IPCC and the supplementary fugitive datasets.

The only significant change we make from the IPCC categorization is disaggregating the estimate of farm fuel emissions. This estimate is directly reported as *On Farm Fuel Use* in the PES dataset. Its value, however, consists of both stationary combustion and transportation emissions. To estimate the quantity of these emissions covered by the federal benchmark we must divide the *On Farm Fuel Use* estimate into its stationary combustion and transportation components. We do this through the following steps:

1. Estimate provincial forestry sector emissions attributable to transportation:⁴⁸

$$\begin{aligned} & \text{Forestry Transport}_j \\ &= \left(\frac{\text{Forest Resources Transport}^{MAP}}{\text{Forest Resources Transport}^{MAP} + \text{Forest Resources SC}^{MAP}} \right) \times \text{Forest Resources}_j^{PES} \end{aligned}$$

2. Estimate provincial agriculture transportation emissions from off-road farm vehicles:

$$\begin{aligned} \text{Agriculture Transport}_j &= \text{Off Road Agriculture \& Forestry Transportation}_j^{IPCC} \\ &\quad - \text{Forestry Transport}_j \end{aligned}$$

3. Estimate provincial farm fuel emissions from stationary combustion:

$$\text{Agriculture SC}_j = \text{On Farm Fuel Use}_j^{PES} - \text{Agriculture Transport}_j$$

With the *On Farm Fuel Use* estimate separated we calculate our estimates of covered and uncovered emissions under the federal benchmark as:

$$\begin{aligned} & \text{Benchmark Covered Emissions}_j \\ &= (\text{SC}_j^{IPCC} - \text{Agriculture SC}_j) \\ &\quad + (\text{Transport}_j^{IPCC} - \text{Agriculture Transport}_j) + \text{Flare}_j^{SF} \\ \text{Benchmark Uncovered Emissions}_j &= \text{On Farm Fuel}_j^{PES} + \text{IPPU}_j^{IPCC} \\ &\quad + \text{Agriculture}_j^{IPCC} + \text{Waste}_j^{IPCC} \\ &\quad + (\text{Fugitive}_j^{IPCC} - \text{Flare}_j^{SF}). \end{aligned}$$

⁴⁸ We assume provincial shares of forestry transportation emissions do not differ from the national share. We opt to assume the national share of forestry transport emissions holds across the provinces because it is both higher than the national share of agriculture transport emissions (91 per cent versus 74 per cent, which suggests less variation across the provinces) and total forestry combustion emissions are lower than total agriculture combustion emissions (1,276 kt versus 13,850 kt). Combined, these two factors suggest that assuming a constant share of forestry transportation emissions will introduce less error than assuming a constant share of agriculture transportation emissions.

Backstop Coverage Estimates

Coverage estimates of the federal backstop are more complex as they require separating emissions that are covered by a carbon tax and those that are covered by the federal government's output-based pricing system (OBPS), the latter of which applies to industrial facilities with annual emissions of 50 kt of CO₂e and above.⁴⁹ We start by discussing how we obtain estimates of coverage under the OBPS and then we move on to a discussion of coverage estimates under the carbon tax.

Backstop: Output-Based Pricing System (OBPS)

To approximate total emissions covered by the OBPS in each province j we use the following formula:

$$OBPS\ Emissions_j = \sum_i Reported\ Emissions_{i,j}^{FR}$$

The next step is disaggregating the total OBPS emissions estimate by the IPCC categories of stationary combustion, transportation, total fugitive (including venting, flaring and uncontrolled fugitive sources), and IPPU emissions. Facilities report emissions by these categories to ECCC but this information is not made public at either the facility or the provincial level. Rather, ECCC only releases the shares of emissions by IPCC category at the national level. Specifically, the 2015 summary report indicates that 77 per cent of reported emissions are from stationary combustion, 13 per cent are from IPPU, two per cent are from venting, two per cent are from flaring, two per cent are from uncontrolled fugitive sources, two per cent are from on-site transportation and two per cent are from waste.

We construct estimates of national emissions from large emitters for the IPPU, venting, flaring, and fugitive IPCC categories by multiplying these shares by total reported emissions from all facilities for 2015 (264,163 kt of CO₂e). We refer to these amounts as *IPPU LE*, *Vent LE*, *Flare LE* and *Fugitive LE* where *LE* stands for large emitter.

To estimate emissions from large emitters in the transportation IPCC category we need to reallocate pipeline emissions, as these emissions are categorized as stationary combustion emissions in the facility reporting dataset and as transportation emissions in the IPCC dataset. Specifically, we estimate national transportation emissions from large emitters as:

$$Transport\ LE = (Onsite\ Transport\ Share\ of\ Total\ Emissions^{FR} \times Total\ Emissions^{FR}) \\ + Oil\ and\ Natural\ Gas\ Transmission\ Transport\ Emissions^{MAP}$$

Our next step is to distribute the estimates of national emissions by IPCC categories across the provinces.

⁴⁹ Though facilities with emissions of 10 kt of CO₂e or greater are eligible to opt in to the OBPS, we abstract from this in our estimation of coverage as we do not have complete emissions data for these facilities, nor do we know how many will choose to opt in. Specifically, a facility will presumably only opt in if the benefit of doing so (eligibility for free allocations) is less than the cost (primarily stricter reporting requirements, including verification of emissions). Although we have no method of estimating the number of facilities that will opt in, it is reasonable to assume that some number will choose to do so. As we do not capture this decision, we will underestimate the coverage of emissions under the federal OBPS and overestimate the coverage of emissions under the federal carbon tax.

OBPS: IPPU Emissions

To obtain provincial estimates of IPPU emissions covered by the OBPS we follow the steps below:

1. Calculate the national share of IPPU subcategory emissions attributable to industrial economic sectors:

$$\text{National Industrial Share, } IPPU_l = \frac{\sum_k IPPU_{k,l}^{MAP}}{IPPU_l^{IPCC}}$$

2. Estimate provincial IPPU subcategory emissions attributable to industrial economic sectors:
 - a) If *National Industrial Share, $IPPU_l = 1.0$* then:⁵⁰

$$\text{Industrial } IPPU_{j,l} = IPPU_{j,l}^{IPCC}$$

- b) If *National Industrial Share, $IPPU_l < 1.0$* then:

$$\text{Industrial } IPPU_{j,l} = \sum_k \left(\frac{\sum_i \text{Reported Emissions}_{i,j,k}^{FR}}{\sum_i \sum_j \text{Reported Emissions}_{i,j,k}^{FR}} \times IPPU_{k,l}^{MAP} \right)$$

where the first term in the summation is a province's share of total large-facility emissions in an industrial economic sector.⁵¹ Multiplying this share by national IPPU emissions, disaggregated by industrial economic sector and IPPU subcategory, provides an estimate of provincial-level IPPU emissions at this same level. Last, we sum over industrial economic sectors to obtain an estimate of total IPPU emissions of subcategory l in a province.

3. Estimate total provincial IPPU emissions attributable to industrial economic sectors:

$$\text{Industrial } IPPU_j = \sum_l \text{Industrial } IPPU_{j,l}$$

4. Estimate total provincial IPPU emissions subject to the OBPS:

$$IPPU_{OBPS_j} = \frac{IPPU_{LE}}{\sum_k IPPU_k^{MAP}} \times \text{Industrial } IPPU_j$$

where the first term in the multiplication is the share of national IPPU emissions in industrial economic sectors that are attributable to large emitters.

⁵⁰ Emissions in the IPPU subcategory of Chemical Emissions are entirely attributable to the chemical industry. That is, *National Industrial Share, $IPPU_{\text{Chemical Industry}} = 1$* . Chemical Industry IPPU emissions, however, are the only subcategory of IPPU emissions not reported at the provincial level in the IPCC dataset. As a result, we estimate provincial IPPU Chemical Emissions using the equation in Step 2, part (b).

⁵¹ Industrial economic sectors from the facility reporting dataset do not map directly to the industrial economic sectors in the NIR as ECCC classifies facilities according to NAICS. As a result, we must map the NAICS economic sectors to the NIR economic sectors. This mapping is available upon request.

OBPS: Transportation Emissions

To obtain provincial estimates of transportation emissions covered by the OBPS we follow a similar process to IPPU emissions but without the subcategories. Specifically, we follow the steps below:

1. Estimate provincial transportation emissions attributable to industrial economic sectors:

$$Industrial\ Transport_j = \sum_k \left(\frac{\sum_i Reported\ Emissions_{i,j,k}^{FR}}{\sum_{i,j} Reported\ Emissions_{i,j,k}^{FR}} \times Transport_k^{MAP} \right)$$

2. Estimate total provincial transport emissions subject to the OBPS:

$$Transport\ OBPS_j = \frac{Transport\ LE}{\sum_k Transport_k^{MAP}} \times Industrial\ Transport_j$$

OBPS: Fugitive Emissions

Coverage of total fugitive emissions under the OBPS is equal to the sum of emissions coverage across the subcategories of flaring, venting, and uncontrolled fugitive emissions. The allocation of flaring emissions is the most straightforward as the estimate of flaring emissions in the facility reporting dataset is greater than the estimate of flaring emissions in the IPCC dataset. This suggests that large industrial facilities account for 100 per cent of flaring emissions. We therefore take provincial estimates of flaring emissions covered by the OBPS directly from the supplementary fugitive dataset. That is:

$$Flare_j^{OBPS} = Flare_j^{SF}$$

The final two categories of emissions that we must allocate across the provinces are venting emissions and uncontrolled fugitive emissions from solid fuel (coal), oil, and natural gas. This is complicated by the federal government's announcement in January 2018 that methane emissions from the oil and gas sector are exempt from carbon pricing. The oil and gas sector includes upstream oil and gas facilities as well as transmission pipelines. To account for this exemption we must separate venting and fugitive methane emissions from the oil and gas sector from venting and fugitive emissions of all other large emitters.

The mapping dataset indicates there are five industrial sectors with venting and uncontrolled fugitive emissions: oil and gas (*OG*), coal mining (*C*), petroleum refining (*R*), oil and natural gas transmission pipelines (*TP*), and natural gas distribution pipelines (*DP*). The first four sectors are all subject to the OBPS while the natural gas distribution pipeline sector is excluded.

The coal mining sector only has uncontrolled fugitive emissions, which are directly reported at the provincial level in the solid fuel subcategory of the supplementary fugitive dataset. That is:

$$Fugitive_{j,C} = Solid\ Fuels_j^{SF}$$

For the petroleum refining, oil and natural gas transmission pipeline, and natural gas distribution pipeline sectors we estimate provincial venting and uncontrolled fugitive emissions as:⁵²

$$Vent_{j,R} = \frac{Petroleum\ Refining\ Emissions_j^{PES}}{\sum_j Petroleum\ Refining\ Emissions_j^{PES}} \times Vent_R^{MAP}$$

$$Fugitive_{j,R} = \frac{Petroleum\ Refining\ Emissions_j^{PES}}{\sum_j Petroleum\ Refining\ Emissions_j^{PES}} \times Fugitive_R^{MAP}$$

$$Vent_{j,TP} = \frac{Oil\ and\ Natural\ Gas\ Transmission\ Emissions_j^{PES}}{\sum_j Oil\ and\ Natural\ Gas\ Transmission\ Emissions_j^{PES}} \times Vent_{TP}^{MAP}$$

$$Fugitive_{j,TP} = \frac{Oil\ and\ Natural\ Gas\ Transmission\ Emissions_j^{PES}}{\sum_j Oil\ and\ Natural\ Gas\ Transmission\ Emissions_j^{PES}} \times Fugitive_{TP}^{MAP}$$

$$Vent_{j,DP} = \frac{Natural\ Gas\ Distribution\ Emissions_j^{PES}}{\sum_j Natural\ Gas\ Distribution\ Emissions_j^{PES}} \times Vent_{DP}^{MAP}$$

$$Fugitive_{j,DP} = \frac{Natural\ Gas\ Distribution\ Emissions_j^{PES}}{\sum_j Natural\ Gas\ Distribution\ Emissions_j^{PES}} \times Fugitive_{DP}^{MAP}$$

For the coal mining and refining sectors we assume all venting and fugitive emissions are covered by the OBPS if sector emissions in the province are above 50 kt. We denote these amounts as *Fugitive OBPS_{j,C}*, *Fugitive OBPS_{j,R}* and *Venting OBPS_{j,R}*. We note this is not a perfect assumption, as it is possible that a province with sectoral emissions above this threshold will not have any individual facilities with emissions that exceed the threshold. We do not believe this will generally be the case, however, as coal mining and refining are both sectors that tend to be characterized by a relatively small number of large facilities. That is, if a province has emissions that exceed the 50 kt threshold then it most likely has at least one facility that exceeds this threshold.⁵³

For the oil and natural gas transmission pipeline and the natural gas distribution sectors we similarly assume all venting and fugitive emissions are from large emitters if sector emissions in the province are above 50 kt. We denote these amounts as *Vent LE_{j,TP}*, *Fugitive LE_{j,TP}*, *Vent LE_{j,DP}* and *Fugitive LE_{j,DP}*. Of these amounts, non-methane venting and fugitive emissions from transmission pipelines are the only sources included in the OBPS. To estimate this amount we first use the facility reporting dataset to estimate methane venting and fugitive emissions from transmission pipelines. Specifically:

$$Methane_{j,TP} = \sum_i Methane_{i,j,TP}^{FR}$$

⁵² As natural gas distribution pipelines are excluded from the OBPS, the carbon price does not cover venting and fugitive emissions from this sector. Large distribution pipelines with emissions in excess of 50 kt per year, however, still report venting and fugitive emissions in the facility reporting dataset. That is, the amounts *Vent LE* and *Fugitive LE* include emissions from the natural gas distribution pipeline sector. We must therefore estimate these emissions so that we can subsequently exclude them from our coverage estimates.

⁵³ Cross-referencing the list of provinces with emissions above 50 kt in each sector with the large facility reporting database generally confirms this assumption. That is, with only one exception (see footnote 54 below), if the NIR economic sector database reports emissions above 50 kt for a province in the coal production or petroleum refining sectors, then the large facility reporting database includes at least one facility in the province with emissions above 50 kt.

Non-methane venting and fugitive emissions from transmissions pipelines covered by the OBPS are then estimated as:⁵⁴

$$(Vent\ OBPS_{j,TP} + Fugitive\ OBPS_{j,TP}) = (Vent\ LE_{j,TP} + Fugitive\ LE_{j,TP}) - Methane_{j,TP}$$

We next take the following steps to calculate an estimate of non-methane venting and uncontrolled fugitive emissions from large oil and gas facilities subject to the OBPS.⁵⁵

1. Estimate provincial venting and uncontrolled fugitive emissions from large oil and gas facilities (OGL):

$$Vent\ LE_{j,OGL} = \frac{\sum_i Reported\ Emissions_{i,j,OGL}^{FR}}{\sum_{i,j} Reported\ Emissions_{i,j,OGL}^{FR}} \times \left[Vent\ LE - \sum_j Vent\ OBPS_{j,R} - \sum_j Vent\ LE_{j,TP} - \sum_j Vent\ LE_{j,DP} \right]$$

$$Fugitive\ LE_{j,OGL} = \frac{\sum_i Reported\ Emissions_{i,j,OGL}^{FR}}{\sum_{i,j} Reported\ Emissions_{i,j,OGL}^{FR}} \times \left[Fugitive\ LE - \sum_j Fugitive\ OBPS_{j,C} - \sum_j Fugitive\ OBPS_{j,R} - \sum_j Fugitive\ LE_{j,TP} - \sum_j Fugitive\ LE_{j,DP} \right]$$

where the second term in each multiplication operation is the national estimate, respectively, of venting and fugitive emissions attributable to large oil and gas facilities.

2. Calculate methane emissions from large oil and gas facilities in each province (as reported by each facility in the facility reporting dataset):

$$Methane_{j,OGL} = \sum_i Methane_{i,j,OGL}^{FR}$$

3. Calculate the estimate of non-methane venting and uncontrolled fugitive emissions from large oil and gas facilities covered by the OBPS:

$$(Vent\ OBPS_{j,OGL} + Fugitive\ OBPS_{j,OGL}) = (Vent\ LE_{j,OGL} + Fugitive\ LE_{j,OGL}) - Methane_{j,OGL}$$

⁵⁴ The oil and natural gas transmission pipeline sector in Quebec is the only case in which the NIR reports emissions above 50 kt (191 kt specifically) while the large facility database does not report any individual pipelines with emissions in excess of 50 kt. The source of this discrepancy is not clear. However, as Quebec has only three transmission pipelines (two oil and one natural gas), by the NIR's accounting, at least one must have emissions in excess of the 50 kt threshold. Without the large facility data, we are unable to obtain a direct estimate of methane emissions from these pipelines. To account for this, we instead multiply our estimates of fugitive and venting emissions from transmission pipelines in Quebec by the methane shares of total fugitive and total venting emissions in the province.

⁵⁵ After completing these steps we also compare the sum of estimated venting emissions in a province (from all sectors) to actual venting emissions in a province (as reported in the IPCC dataset). If estimated venting emissions are greater than actual emissions, then we adjust the venting emissions estimate for each sector by a factor of "actual venting emissions" divided by "estimated venting emissions". We do the same for fugitive emissions.

Last, our estimate of total fugitive emissions covered by the OBPS in each province is equal to the following:

$$\begin{aligned} \text{Total Fugitive OBPS}_j &= \text{Flare}_j^{\text{OBPS}} + \text{Fugitive OBPS}_{j,C} \\ &\quad + (\text{Vent OBPS}_{j,R} + \text{Fugitive OBPS}_{j,R}) \\ &\quad + (\text{Vent OBPS}_{j,TP} + \text{Fugitive OBPS}_{j,TP}) \\ &\quad + (\text{Vent OBPS}_{j,OGI} + \text{Fugitive OBPS}_{j,OGI}) \end{aligned}$$

OBPS: Stationary Combustion Emissions

Last, we calculate provincial SC emissions covered by the OBPS as:

$$\begin{aligned} \text{SC OBPS}_j &= \sum_i \text{Reported Emissions}_{i,j}^{\text{FR}} - \text{IPPU OBPS}_j - \text{Transport OBPS}_j \\ &\quad - \text{Total Fugitive OBPS}_j - \text{Methane}_{j,TP} - \text{Methane}_{j,OGI} \end{aligned}$$

Backstop: Carbon Tax

Calculating emissions covered by the carbon tax in the federal backstop is generally more straightforward than calculating those covered by the OBPS. Coverage of stationary combustion and transportation emissions is equal to the following:

$$\begin{aligned} \text{SC Tax}_j &= \text{SC}_j^{\text{IPCC}} - \text{SC OBPS}_j - \text{Agriculture SC}_j \\ \text{Transport Tax}_j &= \text{Transport}_j^{\text{IPCC}} - \text{Transport OBPS}_j - \text{Agriculture Transport}_j \end{aligned}$$

The last step is estimating non-methane venting emissions from small oil and gas facilities, as these are the only source of fugitive emissions subject to the federal carbon tax. We obtain this estimate through the following steps:

1. Calculate uncontrolled fugitive and venting emissions from small oil and gas producers (OGS):

$$\begin{aligned} \text{Fugitive}_{j,OGS} &= \text{Fugitive Oil}_j^{\text{SF}} + \text{Fugitive Natural Gas}_j^{\text{SF}} - \text{Fugitive}_{j,R} \\ &\quad - \text{Fugitive}_{j,TP} - \text{Fugitive}_{j,DP} - \text{Fugitive}_{j,OGI} \\ \text{Venting}_{j,OGS} &= \text{Venting}_j^{\text{SF}} - \text{Venting}_{j,R} - \text{Venting}_{j,TP} - \text{Venting}_{j,DP} - \text{Venting}_{j,OGI} \end{aligned}$$

2. Estimate provincial methane emissions attributable to pipelines and refineries:

$$\begin{aligned} \text{Methane}_{j,R+DP+TP} &= \left[\left(\frac{\text{Fugitive Oil Methane}_j^{\text{SF}} + \text{Fugitive Natural Gas Methane}_j^{\text{SF}}}{\text{Fugitive Oil}_j^{\text{SF}} + \text{Fugitive Natural Gas}_j^{\text{SF}}} \right) \right. \\ &\quad \times (\text{Fugitive}_{j,R} + \text{Fugitive}_{j,TP} + \text{Fugitive}_{j,DP}) \left. \right] \\ &\quad + \left[\left(\frac{\text{Venting Methane}_j^{\text{SF}}}{\text{Venting}_j^{\text{SF}}} \right) \times (\text{Vent}_{j,R} + \text{Vent}_{j,TP} + \text{Vent}_{j,DP}) \right] \end{aligned}$$

3. Estimate provincial fugitive and venting methane emissions attributable to small oil and gas producers (OGS):

$$\begin{aligned} & \text{Fugitive Methane}_{j,OGS} \\ &= \left[\left(\frac{\text{Fugitive Oil Methane}_j^{SF} + \text{Fugitive Natural Gas Methane}_j^{SF}}{\text{Fugitive Oil}_j^{SF} + \text{Fugitive Natural Gas}_j^{SF}} \right) \right] \\ & \times \text{Fugitive}_{j,OGS} \end{aligned}$$

$$\begin{aligned} & \text{Venting Methane}_{j,OGS} \\ &= (\text{Venting Methane}_j^{SF} + \text{Fugitive Oil Methane}_j^{SF} \\ & + \text{Fugitive Natural Gas Methane}_j^{SF}) \\ & - \text{Methane}_{j,R+TP+DP} - \text{Methane}_{j,OGL} - \text{Fugitive Methane}_{j,OGS} \end{aligned}$$

Note that in the first equation immediately above (*Fugitive Methane_{j,OGS}*) we opt to use the provincial share of fugitive methane emissions to estimate fugitive methane emissions from small oil and gas producers. In contrast, in the second equation (*Venting Methane_{j,OGS}*), we back out the estimate of venting methane emissions from small oil and gas producers. This is because methane emissions account for close to 100 per cent of fugitive emissions in each province. This suggests that the share of fugitive emissions that are methane in each individual sector (pipelines, refineries, small oil and gas producers and large oil and gas producers) must also be close to 100 per cent. In contrast, the share of venting emissions that are methane in each province tends to be lower. This suggests the possibility for a greater variance in methane shares among the individual sectors.

4. Estimate provincial non-methane venting emissions attributable to small oil and gas producers and covered by the carbon tax:

$$\text{Non Methane Venting}_{j,OGS} = \text{Venting}_{j,OGS} - \text{Venting Methane}_{j,OGS}$$

Emissions Not Priced by the Federal Backstop

Finally, uncovered emissions under the federal backstop are equal to all agricultural combustion emissions, all agriculture and waste emissions (as reported in the IPCC dataset), IPPU emissions minus the estimate of those covered by the OBPS, and fugitive emissions minus the estimate of those covered by the OBPS and those covered by the carbon tax. Specifically, we calculate uncovered emissions as:

$$\begin{aligned} & \text{Backstop Uncovered Emissions}_j \\ &= \text{On Farm Fuel}_j + \text{Agriculture}_j^{IPCC} + \text{Waste}_j^{IPCC} + (\text{IPPU}_j^{IPCC} - \text{IPPU}_j^{OBPS}) \\ & + (\text{Fugitive Sources}_j^{IPCC} - \text{Total Fugitive OBPS}_j - \text{Non Methane Venting}_{j,OGS}) \end{aligned}$$

Provincial Pricing Programs

With the exception of Alberta's carbon tax exemption to small oil and gas producers (discussed immediately below), we do describe in detail our methodology for coverage estimates of each individual provincial pricing program. The approach is generally similar to the methodologies described above, with small changes made to adjust for attributes specific to each provincial program. Specific details are available upon request.

Alberta Temporary Exemption

Based on the PES and the FR datasets, we estimate production process emissions from Alberta's small oil and gas producers at approximately eight per cent of the province's total emissions (Environment and Climate Change Canada 2017a, 2017b). Specifically, the PES data provide an estimate of total CO₂e emissions from Alberta's natural gas production and processing and conventional oil production sectors, a combined total of 54,794 kt (Environment and Climate Change Canada 2017b). We then subtract the emissions reported in the FR dataset by all Alberta facilities with a NAICS classification of conventional oil and gas extraction and emissions above 100 kt, a combined total of 6,040 kt (Environment and Climate Change Canada 2017a). The remaining quantity (48,754 kt) is the exempt quantity of emissions that we attribute to conventional oil and gas producers not subject to the CCIR.

Using the methodology for deriving fugitive emissions estimates for small oil and gas producers (discussed previously in the appendix), we estimate approximately 15,300 kt are from venting and approximately 12,200 kt are from fugitive sources. This leaves approximately 21,250 kt — corresponding to eight per cent of Alberta's total emissions — as production process emissions.

We note these estimates are approximate for three reasons. First, ECCC generates the NIR economic sector estimates in the PES dataset while the facilities self-report the large emitter amounts in the FR dataset. As the estimates are from different sources they are unlikely to perfectly align. Second, the NIR economic sector estimate includes both stationary combustion and transportation emissions, the latter of which is not necessarily exempt (specifically, only emissions from marked fuel are included in the exemption). This discrepancy is unlikely to be significant, however, as nationally, transportation emissions account for less than one per cent of total emissions from the natural gas production and processing and conventional oil production sectors (Environment and Climate Change Canada 2017b). Last, as described above, our estimate of venting and fugitive emissions from small oil and gas emitters is an extrapolation based on national shares of fugitive and oil and gas sector emissions, as well as reported emissions in the FR database.

APPENDIX B: GREENHOUSE GAS EMISSIONS ESTIMATES

TABLE 1 NATIONAL INVENTORY REPORT 2015 GREENHOUSE GAS EMISSIONS ESTIMATES BY IPCC EMISSIONS CATEGORY

Emissions Categories	2015 Emissions (t of CO ₂ e)	Share of 2015 Emissions
Energy	587,072	81.3%
Stationary Combustion	327,951	45.4%
Transport	202,235	28.0%
Fugitive Sources	56,886	7.9%
Industrial Processes and Product Use (IPPU)	51,067	7.1%
Mineral Products	8,036	1.1%
Chemical Industry	6,506	0.9%
Metal Production	14,230	2.0%
Production and Consumption of Halocarbons	11,016	1.5%
Non-Energy Products from Fuels and Solvent Use	10,798	1.5%
Other Product Manufacture and Use	481	0.1%
Agriculture	58,952	8.2%
Enteric Fermentation	25,005	3.5%
Manure Management	8,513	1.2%
Agriculture Soils	22,703	3.1%
Field Burning of Agricultural Residues	55	0.0%
Liming, Urea Application and Other Carbon-containing Fertilizer	2,676	0.4%
Waste	24,699	3.4%
Solid Waste Disposal	22,147	3.1%
Biological Treatment of Solid Waste	929	0.1%
Wastewater Treatment and Discharge	1,061	0.1%
Incineration and Open Burning of Waste	552	0.1%
Total Canada Emissions	721,788	100.0%
Land Use, Land Use Change and Forestry	-33,544	N/A
Forest Land	-164,499	
Cropland	-10,907	
Grassland	681	
Wetlands	2,720	
Settlements	3,584	
Harvested wood products	134,877	

Note: Totals may not add up due to rounding. Further, Land Use, Land Use Change and Forestry sector emissions are not included in the annual total of Canada's greenhouse gas emissions. As a result, these emissions are not represented in Figure 1.

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About the Authors

Sarah Dobson (PhD, UC Berkeley) is a Research Associate at The School of Public Policy, University of Calgary. Her research interests are focused on studying the design, implementation and evaluation of energy and environmental regulatory policy. In prior work she has considered such issues as the welfare implications of climate change policy, and the optimal design of regulatory policy to take into account the trade-off between the economic benefits of resource development and the ecological consequences of management decisions. Sarah's work with The School of Public Policy covers a range of topics including carbon pricing, climate change policy design, political response to hydraulic fracturing, and markets for Canadian oil and LNG.

Jennifer Winter (PhD, Calgary) is an Assistant Professor and the Scientific Director of the Energy and Environmental Policy research division at The School of Public Policy, University of Calgary. Her research evaluates climate policies, and examines the effects of government regulation and policy on energy development and the associated consequences and trade-offs. She has testified to the Senate of Canada on emissions pricing policies based on her work in this area, and has advised the Government of Alberta and Government of Canada in several capacities. Dr. Winter is actively engaged in increasing public understanding of energy and environmental policy issues; recognition of her efforts include a 2014 Young Women in Energy Award, being named one of *Alberta Oil Magazine's* Top 35 Under 35 in 2016, one of *Avenue* magazine's Calgary Top 40 Under 40 in 2017, and one of Canada's Clean50 and Clean16 in 2019. Dr. Winter serves on the Future Leaders Board of Directors of the World Petroleum Council Canada, the advisory committee of the Alberta Narratives Project, and the City of Calgary Climate Panel, and is a member of Global Affairs Canada's Environmental Assessment Advisory Group.

Brendan Boyd is an assistant professor of political science and economics at MacEwan University. His research examines provincial policy innovation in Canada's federal system.

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