CANADA'S **ECOFISCAL** COMMISSION
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Output-Based Pricing:

Theory and practice in the Canadian context

EnviroEconomics

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Tuesday, December 5, 2017

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INTRODUCTION

This paper is the work of Dave Sawyer and Seton Stiebert of EnviroEconomics. Staff members from Canada's Ecofiscal Commission provided comments and advice on an earlier draft of the paper, but it remains the work of EnviroEconomics.

The Ecofiscal Commission asked EnviroEconomics to prepare this report to provide practical guidance to governments designing and implementing output-based allocation systems. Well-designed output-based systems can protect the competitiveness of trade-exposed and emissions-intensive industries while maintaining incentives to reduce GHG emissions. This report shines light on the challenges in designing robust systems. More importantly, it provides practical advice for doing so.

1 THINKING ABOUT OUTPUT-BASED PRICING

As jurisdictions implement different carbon policies, some industries could face a competitive disadvantage, lost market share and production leakage. To address the leakage risk that arises with misaligned carbon costs between trading partners, economists formulated output-based pricing (OBP), typically referred to as output-based allocations (OBAs).

Competitiveness risks are reduced when OBP applies a carbon price to only a fraction of emissions,[1] thereby lowering the average cost of the policy relative to an alternative that prices all emissions, such as full auction under cap and trade or a carbon tax. Pricing only a fraction of emissions with OBP is just one approach to lower average carbon costs; other forms of rebating include technology subsidies (Ontario) or income tax reductions (B.C.). While OBP is broadly applicable within carbon-pricing regimes, it fits best with cap-and-trade and tradeable-intensity standard systems.[2]

OBP is but one of the policy choices that governments have to reduce the competitiveness risk of carbon policy. It typically targets large emission-intensive facilities that are highly traded.[3] OBP is an emission-intensity rate that reduces the share of priced emissions for a facility, expressed as emissions over output produced. For example, this could be GHGs per MWh or per tonne of cement. If the facility beats the OBP rate (has lower intensity), then credits may apply. If the facility does not meet the rate, compliance tonnes are owed.

OBP is now in vogue in Canada for the control of carbon emissions from large final emitters (LFEs). Examples include the following:

- Alberta is transitioning its *Specified Gas Emitter Regulation* — which currently uses facility emission baselines to calculate compliance tonnes — to product-based output-based allocations (synonymous with Output-based pricing) uniformly applicable across facilities with similar products.
- The federal government's backstop carbon-pricing policy proposes the use of OBP for calculating compliance for LFEs.
- Ontario's product-based emission benchmarks implemented under the cap-and-trade program that allocates emissions for free to LFEs.
- British Columbia's Green House Gas and Reporting Regulation identifies an emission-intensity limit for LNG operations based on production, which acts like OBP.

It is, therefore, a good time to look a little deeper at OBP and how it is being designed and implemented in Canada. This note provides initial insight related to setting the OBP rate (or level), which is just one policy choice necessary to design and implement a compliance regime built on OBP.
The question of how to achieve compliance requires numerous decisions. These include how internal reductions are tracked, verified and traded between facilities, if and how payments for compliance are to

[1] i.e., the difference between the facility emission intensity and the level of the OBAs, times production.
[2] Other allocation methods under cap and trade include allocating for free based on emissions (grandfathering) or fully pricing emissions (full auction or carbon tax).
[3] Often referred to as either the EITE (Emission Intensive Trade Exposed) or Large Final Emitters (LFEs).

be treated and if flexibility outside the regulated entities is allowed with offsets or tradeable units from other jurisdictions.

Setting the OBP rate requires considerable administrative effort within a solid policy package. This can be challenging, especially if industrial facilities are complex or unique or if there are widely diverging emissions performance between facilities or types of products produced. In the end, setting the OBP requires substantial knowledge about the regulated entities and can be complex even when good baseline emission and production data is available.

With that warning issued, both the theory and the practice indicate that OBP can be effective at balancing competitiveness and environmental tradeoffs. They are therefore worth the administrative effort to ensure carbon policy is built to last in the face of global competitiveness pressures.

2 SOME OBP THEORY

Emission rates are uniformly applied. The OBP is the average emission rate applicable to all firms in the same product grouping, with each firm receiving the same number of compliance tonnes per unit of production (OBP rate is applied equally across producers with similar products).

Figure 1 illustrates an electricity sector output-based allocation (i.e., OBP) set at 0.4 tonnes of GHGs (CO_2 equivalent) per megawatt hour. Individual firms in the figure are represented by bubbles and the size of the bubble represents total emissions. Moving the OBP up or down then changes the distance a firm is away from the OBP rate, which then alters compliance tonnes.

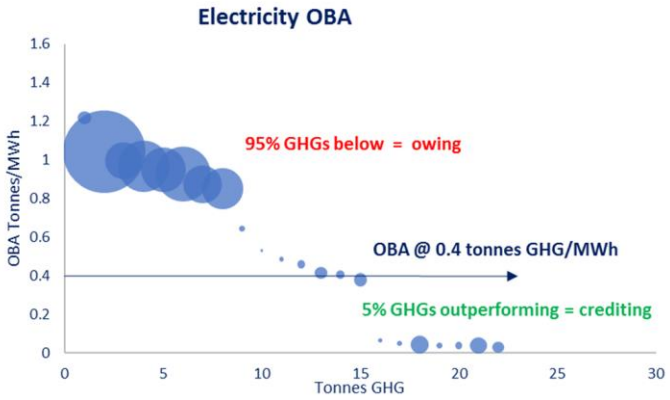

Figure 1: Illustrative example of compliance crediting and owing under an Electricity OBA

OBP has a strong theoretical basis in environmental economics, with good evidence that OBP can both reduce emissions and protect competitiveness. OBP does this by tying the compliance obligation to emissions and production, which means that compliance scales with emissions intensity, thereby updating the compliance obligation as production moves up or down. This feature is particularly important for globally traded commodities that are cyclical in nature, with production ramping up and down in response to market conditions. Further, OBP provides an implicit subsidy to production where more production is met with compliance tonnes sufficient to cover the expanded emissions.

OBP reduces the average cost of the policy for the emitter through stipulating the rate at which emissions will be priced across a product category. The (marginal) carbon price sets the incentive to abate since any reductions have a market value and can be used for compliance. The OBP lowers the average cost of the policy by pricing only a fraction of facility emissions, thereby helping to maintain firm competitiveness.

However, the OBP rate can be set to price most emissions, either through setting a very low OBP rate (high stringency) or if a firm's emission intensity is significantly worse than the OBP rate.

Under OBP, compliance tonnes vary with production and the distance a firm is away from the level of the OBP rate, calculated as the firms' emission intensity less the OBP rate multiplied by production, or as shown in equation 1 (below):

$$C_{i...n} = (\mu_i - \mu_{OBPi})\, P_i \qquad (1)$$

Where,

$C_{i...n} = compliance\ tonnes\ for\ products\ i\ to\ n$

μ_i = *emission intensity for firm i, calculated as covered emissions for product i over production for product i*

$\mu_{OBP} = OBP\ rate\ for\ product\ i$

$P_i\ is\ firm\ production\ for\ product\ i$

Equation 1

Equation 1 can be scaled to cover a wide range of emissions including combustion, industrial process and indirect emissions from energy imports. Multiproduct facilities can also be accommodated in equation 1, with total compliance equalling the sum of the compliance tonnes for the different OBP product groups.

In a cap-and-trade system, the firm must come up with allowances to cover all its emissions, with the OBP determining the quantity of free allocations transferred to the facility. If the firm has the same intensity as the OBP, it is granted all the allowances it needs to match all covered emissions. To the extent the firm diverges from the OBP, compliance tonnes are either owed or granted to reward superior performance. In an intensity-based system using OBP, such as the one emerging in Alberta or the federal benchmark, the OBP is not used to allocate allowances to cover all emissions at the OBP rate. Instead, the firm is made responsible for the difference between the OBP and its own emission intensity.

With compliance tonnes calculated, the maximum compliance costs can then be estimated by multiplying the compliance tonnes by the carbon price. Some compliance flexibility mechanisms could supply compliance tonnes at prices below the carbon price set by the regulator. These flexibility mechanisms include facility reductions, offsets and instruments such as tradeable units.

OBP maintains production and absorbs market volatility. By linking the compliance obligation such as tonnes owned to production, OBP sends a signal to maintain production. This keeps GHGs somewhat higher relative to a policy that prices all emissions. Because OBP is tied to production, with global supply shocks and volatility, the compliance obligation can scale as market conditions impact production. The ability of OBP to automatically update compliance is particularly well suited to the group of globally trade-exposed emitters typically targeted by OBP such as oil, pulp, coal and some chemicals.

It's not all bad news for emissions. While OBP lowers the average cost of the policy to the emitter, the carbon price continues to incent emission reductions at the (marginal) carbon price of say, $30 per tonne. There is, therefore, still an incentive to abate emissions up to the level of the carbon price since any emission reductions can typically be banked for future compliance or sold.

Still, with the OBP lowering the average cost relative to a fully priced emission system, two emission-reduction pathways can be compromised. First, the OBP maintains the longer-term incentive to invest in high emitting capital by reducing the profit hit due to a wedge between the marginal price (carbon price) and the average cost of the policy (i.e., not all emissions are priced at the carbon price). Second, when firms can pass on some share of the carbon cost, the lower average cost means there is a lower incentive on downstream consumption to conserve or switch to lower-carbon alternatives.

The importance of the tradeoff in setting a more stringent OBP level is essentially between maintaining production and reducing emissions. This tradeoff will be a function of many things, including the spread of emission intensities and hence compliance obligations between firms and the degree of compliance flexibility to contain costs. Political considerations will, of course, dictate the relative importance of minimizing costs versus achieving emission reductions.

When compliance flexibility options include payments capped at a price ceiling (or the carbon price set by regulator) to contain costs, as in Alberta under the Specified Greenhouse Gas Emitters Regulation and its update to OBP, revenue considerations may also come into play. A less stringent OBP rate will result in fewer carbon proceeds.

3 OBP IN PRACTICE

Interrogating the emission-intensity data, or pairing of product emissions and production, is a first objective in understanding the outcomes of proposed OBP options. Choices must be made about the facilities to be covered, their emissions and the associated production. Each of these is discussed below.

What facilities are to receive OBP? Typically, emission thresholds determine if a facility is a large final emitter and therefore eligible for OBP treatment to reduce the carbon costs relative to the carbon levy (Alberta) or full auction (Ontario, Quebec). Examples of such eligibility thresholds in Canada include 25,000 tonnes in Quebec and Ontario, 50,000 tonnes under the federal pricing benchmark and 100,000 tonnes in Alberta. So, there is nothing special here with OBP. It could follow GHG reporting thresholds already established, unless perhaps if the federal benchmark is applied at 50,000 tonnes.

Given the potential cost savings to emitters with OBP treatment relative to the fully priced emissions under a carbon levy or full auction in cap and trade, it is not surprising that firms not meeting the emissions threshold will seek to **opt-in to the OBP program**. The conditions under which an opt-in could be contemplated include the following:

- Firms competing in the same product markets as those covered under the OBP
- Firms with emissions close to the OBP inclusion threshold, with opting-in reducing the incentive to game emissions for inclusion
- Firms in start-up or expansion mode where emissions will approach the inclusion threshold
- Highly traded sectors that may not be emissions intensive, but for which the full carbon costs could result in significant cost impacts

What emissions are to be covered? Ideally more policy coverage is a good thing, providing a broad incentive to reduce emissions from all sources. Typically, the OBP emission boundary choices include:

- Combustion emissions from process heat
- Industrial-process emissions, including fugitives
- Onsite transport
- Indirect emissions — if energy imports such as heat, hydrogen and electricity are reported for the facility

Across a given population of facilities, different production processes may have very different emission profiles consisting of combustion, process or indirect emissions. When bundling emissions for OBP-setting purposes, care is needed to understand how total covered emissions may change the relative emission intensity(ies) for a firm, between firms and across different product groups. Adding to the challenge is a likely high degree of variability in emissions over time, especially for globally exposed commodity producers such as coal and pulp and paper. Experience suggests that the compliance tonnes can bounce around depending on how compliance tonnes are calculated. Regulators need to understand this dynamic.

What is the product? With a move to OBP, a critical need and likely big data gap will be for production data to be paired with emissions for the OBP product categories. Most greenhouse gas reporting regulations do not require production data, and therefore reporting regulations will likely need be updated so that production data can be paired with covered emissions.

So, what is the product? This simple question is not so straightforward. Many ways exist to specify "the OBP product" both within a facility and across facilities:

- Refineries produce many types of barrels of fuel. Iow are these to be weighted into one uniform product category?
- The production for gas plants is typically measured in many ways, with no uniform reporting. For example, gas plants can report total input gas processed, total output gas produced, output quantities of different gas fractions, or total embodied energy in the product. Input gas can also require very different levels of treatment that impact emissions and may not be differentiated by OBP. How can these various metrics be unified, or should they?
- Pulp and paper mills may have a mix of soft and hardwood pulp with differing production processes. Can these be weighted to represent a uniform product?
- Coal facilities may produce various grades and types of coal (e.g., thermal or metallurgical coal) in differing resource plays with differing energy levels required for extraction. Should similar yet clearly different products have different OBP levels? What if these similar but differentiated products have very different prices and therefore financial impacts from a single OBP rate?

Just settling on "the product" can take some time and will require careful consideration and an understanding of the facilities and their production processes.

A further challenge can be to attribute production to the covered emissions. This is a real issue for multiproduct facilities that require separate product OBPs where emissions and production must be

apportioned to the separate OBA product groupings. It may seem simple to calculate, but really the reporting data at the facility level is rarely organized to sort energy and emissions into discrete production types. In many cases, different products will have shared emissions from different processes that are not easily disentangled. Data gaps and work arounds may therefore be needed with both facility-level data and data used for compliance calculations.

Clearly, the mixing and matching of covered emissions with facility production can get complex, with significant data needs. When there is uncertainty, ongoing stocktaking will be needed to improve data quality, review the OBP rates and understand outcomes relative to policy objectives.

4 SETTING STRINGENCY: THE ABCs OF THE OBP

While setting the OBP rate is important for policy stringency, it is just one element in the stringency calculation.

While designing its cap-and-trade system, Ontario identified the following "ABC" calculation, which provides a nice conceptual framework for the design choices required to set the OBP compliance obligation and therefore policy stringency:

A = Transitional **Assistance** factor:

- The transitional **Assistance** factor is used to move the quantity of free allocations under the OBP closer to a fully priced system.
- Can range from a rate of 0 where all emissions are priced to 1, which allocates all compliance tonnes at the rate stipulated by the B factor (below).
- Typically, the A factor is used to grant industry time to transition to lower-carbon operations and reflect misaligned carbon prices in home and away markets. In theory, if all countries had a similar carbon price, the A factor should be zero.

B = OBP **Benchmark** for the allocation, which can be the OBP rate (μ_{OBA} *in Equation* 1):

- The OBP Benchmark rate is set to reflect desired compliance tonnes per unit of production, applied to all facilities with similar products, for example, GHGs per tonne of lime.
- Complexities with OBP setting and facility data needs may require an alternative approach to using an OBP, such as one based on input (like the heat rate) or output (such as emissions).
- Using a B factor not based on an OBP could be transitional approach until better data is obtained.

C = **Cap** decline or annual tightening rate:

- The annual tightening rate as a percent, which can be set to zero or aligned with an emission performance objective, such as the rate of change to achieve a GHG target.

The product of these parameters can then be applied against production to determine the quantity of free compliance tonnes for the facility, as in equation 2 (below). More formally,

$$C_{i...n} = a * (\mu_i - \mu_{OBPi}) P_i * c \quad (2)$$

Where,

$C_{i...n}$ = *compliance tonnes for products i to n*

a = transitional assistance factor, which ranges between 0 and 1

μ_i *= emission intensity for firm I, calculated as covered emissions for product i over production for product i*

$\mu_{OBA} =$ *OBP benchmark rate for product i*

P_i *is firm production for product i*

c = cap decline or annual tightening rate

Equation 2

Note that these factors do not necessarily have to be used. If the transitional assistance factor is not to be used, for example, the A factor is effectively set at one and can be ignored (firms get 100% of their OBP rate, or benchmark). Maximum compliance costs are then estimated by multiplying the product of the ABC parameters times a carbon price.

Given that OBP can be differentiated by emission type or product, the ABC parameters can also be differentiated. A notable example is that of industrial-process emissions, which may scale proportionally with production but not have any reasonable potential to abate. There may therefore be a policy case to differentiate the treatment of combustion versus industrial-process emissions for compliance purposes. In this case, the "B" parameter (or OBP rate) could be set to provide enough compliance tonnes to fully cover the facility's process emissions (e.g., for industrial-process emissions, the emission intensity equals the OBP rate), whereas for combustion, the OBP rate would be set as a performance benchmark with an annual tightening rate. Total facility compliance would then be a mix of a tightening compliance obligation on combustion but include enough compliance tonnes to cover industrial-process emissions.

Earlier in this note, we discussed how administrative complexity can arise when emissions covered by the OBP are bundled by facility-emissions type (process, combustion, etc.). Adding to this complexity is the interaction when the A and C factors are used, which can materially change the stringency of the policy. The OBP itself, therefore, is not the only determinant of stringency in the OBP compliance calculation. These interactions — along with the carbon price — will drive tradeoffs between cost, effectiveness and distributional outcomes, which may not be uniform under alternative OBP formulations.

A notable challenge is the limited ability of many LFEs to abate emissions in the short term. Increasing stringency may not necessarily lead to more emission reductions from the regulated entities. To the extent short-term abatement is limited, compliance will be driven into other mechanisms such as offsets or payments to government. If the policy objective is to raise revenue to achieve government priorities like subsidizing technology to accelerate the transition to lower-carbon operations, a more stringent OBP with an annual tightening rate would contribute to this objective. This example has tradeoffs. In the presence of limited abatement opportunities in the short term, adjusting the tightening rate downward (C factor) may make less cash available to invest in abatement opportunities later. At the same time, the increased costs may increase the competitiveness risk, while not necessarily leading to lower emissions.

No hard-and-fast policy rules exist about the tradeoffs associated with compliance costs, emission reductions and revenue generation. For example, an annual tightening rate greater than zero or a more stringent OBP rate will drive more emission reductions and revenue but at a higher cost and therefore competitiveness risk to industry. Given the possible combinations and interactions of the ABC factors, regulatory agencies should analyze scenarios to explore how these parameters interact to drive compliance for facilities.

The compliance tonnes are just one element of stringency, while carbon price comprises the other. Ideally, any scenario analysis should be tied to an economic analysis that looks at the compliance costs under the scenarios relative to some firm benchmarks such as profits, sales or investment. Understanding total compliance costs in the context of the financial impact on firms' operations is a priority for scenario analysis. We pick this thread up again in the last section of this note.

5 THE BASIS OF THE OBP RATE OR BENCHMARK FACTOR

Given the importance of the OBP rate (or B factor) to overall compliance and the technical expertise required for setting the rate, this section takes a closer look at the alternatives available for setting the OBP rate.

We suggest a simple four step process:

- Step 1: Set sector benchmark.
- Step 2: Look for swings in compliance tonnes and costs.
- Step 3: Look for compliance outliers.
- Step 4: Adjust the parameters to address challenges.

Each step is discussed below.

Step 1: Set Sector Benchmark

The OBP rate will first and foremost need to be formulated identically to the emission intensities for the covered facilities in the OBP product category. Practically, this means that the bundling of emission types and product must be uniform between OBP and emission intensity used for facility compliance.

A few options exist for setting where the benchmark or OBP rate falls:

- Alberta's Climate Leadership panel recommended a mix of OBPs including a "good as best-in-class gas standard" for electricity, a "top quartile production-based" OBP for oil sands (add sector production cumulatively, then select emission intensity of firm sitting at 75% percentile of production) and a "top decile global performance benchmark" for upgrading and refining.
- The Government of Canada's benchmark pricing policy indicates that the output-based standard will be set at a level that represents best-in-class performance (top quartile or better) to drive reduced emissions intensity.

As the starting position, therefore, regulatory agencies should seek to set the OBP rate to reflect top emission performers among peers within the jurisdiction or against facilities elsewhere. If performance is to be benchmarked from a population of facilities from outside the jurisdiction for whatever reason (not enough facilities, bigger data set elsewhere, alignment of stringency globally to smooth costs, etc.) care is needed to ensure the emission quantification methods and OBP formulations (types of emission included) are not significantly different.

One must also consider whether facilities outside the jurisdiction form a reasonable basis for comparison. Do these facilities have markedly different input feedstocks, fuels or processes that are not available or appropriate in Canada? If we use a jurisdiction benchmark, care must also be taken not to punish sectors that have taken significant early action at reducing emissions compared with peers elsewhere.

To identify top-tier emissions performance, the distribution of emission intensities across covered facilities need to be estimated. Ideally, multiple years of data would be available to accurately reflect the cyclical nature of facility production and emissions. If the data is not available, this information can be developed in consultation with industry, extracted from annual reports or imputed based on some other statistical approach such as apportioning production to a metric that can be scaled to the facility like employment, emissions or gross output.

Additional considerations in setting OBP level include:

- **Does abatement opportunity factor in the OBP rate?** Facility abatement opportunities and cost can be very different depending on, for example, plant age, processes in place, input feedstocks and fuels used.
- **Do you allow for differentiated treatment across sectors?** For example, do sectors with a history of poor financial performance (e.g., profit margins) get a lower relative stringency OBP to avoid facility closure risk?
- **Is the playing field level?** Setting an OBP allows a lot of room to adjust for special factors and competing interests. The number-one goal may be to reduce emissions, but the playing field is unlikely to be level for all sectors.

Step 2: Look for Swings in Compliance Tonnes and Costs

With top emissions performance established, scenario analysis should assess the impact on compliance tonnes, including financial impact testing to compare compliance costs against firm metrics such as sales and profits. To assess the impact of the OBP, a good benchmark is to compare it against a scenario that prices all emissions (e.g., a carbon-levy scenario) to see if the OBP is reducing the cost impact on firms.

Differing formulations of the OBP can induce big swings in compliance tonnes and costs given the choices and interactions of the types of covered emissions, the attribution of production to emissions, the interaction with the A and C factors (when applicable) and the most certainly the OBP rate (B factor). During testing, the analysis should reveal how compliance might change under alternative formulations and assumptions. The OBP is explicitly creating winners and losers, with large swings in compliance tonnes possible, including a move between crediting and owing.
The presence of instability in compliance tonnes could signal the need to move away from the top-tier or top-performing OBP rate. But the weakening of the OBP away from top-tier performance may lead to

unanticipated outcomes such as more crediting for those facilities above the OBP rate. It will certainty weaken the stringency of the policy. Both outcomes need careful consideration within the overall policy objectives and political preferences.

Step 3: Look for Compliance Outliers

Establishing the benchmark on some sort of top-tier performance will inevitably lead to a distribution of impacts between facilities. In sectors with a big spread in emission intensity, the OBP rate may lead to high crediting for facilities outperforming the OBP or significant compliance costs for facilities that are far away from the OBP.

It is therefore advisable to identify the spread in OBP outcomes across facilities, looking for deviation between facilities. An easy data test for outliers — or a given range of OBAs — is to estimate a minimum, maximum and standard deviation for each OBA by facility. This then enables spreads between facilities to be rapidly identified.

With resilient outliers that are hard to address through the ABC calculation, collaring may be considered, where a maximum compliance obligation is set to limit the cost exposure on the outlier facility. Essentially the firm's emission intensity is not used for compliance but rather the firm's emission intensity is set to some maximum limit, for example at one standard deviation from the mean of the population.

Step 4: Adjust the Parameters to Address Challenges

Options to reduce policy stringency when top-tier performance may not be desirable include:

- Reducing the tightening rate if an option (C factor)
- Accepting lower than top-tier performance, say at 80% of the top-tier value
- Tuning the OBP to achieve a certain compliance cost outcome, such as similar costs across facilities
- Ramping up stringency gradually to achieve top-tier performance to allow firms even more time to transition
- Reconsidering the reformulation of compliance-covered emissi

6 SUMMARY OBSERVATIONS

Perhaps the greatest risk associated with OBP is that of political economy, where individual sectors and facilities can make a financial hardship case for why their OBP rates may need to be reduced in stringency. Therefore, the principles of good governance must apply to OBP rate setting. These include the need for sound data and information, analytics and a transparent process.

The challenges for politicians are two-fold. First, they require a clear picture of the tradeoffs between emission reductions and financial impacts for different OBP rates. Next, they need to identify the OBP rate where enough emissions are priced to drive continuous improvement in emissions performance while ensuring the viability of export-oriented industries.

OBP theory is well established, with clear economic and likely political-economy cases to design and implement OBP. But really, we're just starting to gain experience with OBP and how it can be operationalized in Canada. Below are some summary observations based on experience so far:

- **OBAs work well for addressing competitiveness.** While this paper identified several challenges associated with developing an OBP compliance regime, it bears repeating that there are significant competitiveness benefits associated with the administrative burden. Analytics have shown that the use of OBP can significantly reduce the average cost of the policy for highly trade-exposed and emission-intensive facilities, which then flows through to macroeconomic indicators such as GDP. The tradeoff with OBP is a small loss in emission reductions given that emissions are not fully priced. Similarly, governments can also expect that carbon proceeds will be lower given that not all emissions are priced under OBP. Efforts in Alberta, Ontario and Quebec to implement differing forms of OBP will continue to provide learning opportunities to both help design the federal backstop and figure out how OBP can be implemented in other Canadian jurisdictions.
- **OBP is one approach to provide free allocations to industry.** OBP is one decision point in a larger set of decisions to design and implement carbon pricing. OBP is not a stand-alone policy, but rather one approach to reduce carbon costs for globally exposed and highly emission-intensive industries. OBP sits within a larger policy framework that typically has an emission-trading component with multiple channels of compliance flexibility. That said, OBP can live within a carbon-tax system, informing how emission rebates could be calculated to reduce competitiveness risks.
- **The administrative burden should not be underestimated**. We note that there is a tradeoff for regulatory agencies in pursuing an OBP approach to shelter industry from global competition. Expect lots of work; experience suggests that a disproportionate amount of work is required to design this element of a broader carbon-pricing agenda. All industries consider their sector special and will ask for exemptions.
- **Information asymmetry is a real problem, increasing the risk that the OBP rate will miss the mark**. The regulator will be challenged to match both emissions and production data across facilities within the OBP product group. This challenge increases with complex sectors that are

typically not uniform. Examples include chemical plants or multiproduct facilities where emissions must be apportioned to product groupings.

- **The OBP can discriminate across sectors.** Economic theory indicates that carbon pricing is a fair and equitable way to achieve cost-effective emission reductions. For many reasons, regulatory agencies may choose to not uniformly set top-tier emissions performance as the benchmark across OBP product groups. The ad hoc nature of setting the OBP rate across different product groups may lead to a patchwork of outcomes. While the OBP sits in a carbon-pricing framework, it does not necessarily lead to cost-effective reductions across product groups.

  The OBP is likely sitting within a hybrid system where there is a carbon price on all (or at least most) emissions in the rest of the economy. Understanding the relative impact on facilities with similar products but differently priced emissions via the OBP treatment can provide a useful reference point.

- **Non-OBP approaches to reduce the financial impact may be needed.** There are clear cases when using OBP may not be the best choice for a product group. Examples of this include product groups with a limited number of facilities or multiproduct facilities where the attribution of emissions to product groupings can be a challenge. Regulatory agencies should therefore be prepared to develop workarounds that could include a staged OBP process where facility emission baselines are initially used until better OBP product information becomes available. The bottom line is that a slavish devotion to OBP may pose more risks than benefits and alternative allocation methods may be necessary.

- **When OBP is linked to production, it is are well suited to update with sectors that have variable emissions.** Because compliance tonnes are linked to production, when production goes up or down, the compliance obligation is updated. This can work well in sectors with known variability in demand, such as globally traded commodities like oil, coal and pulp and paper. However, many facilities also have variable emission intensities, where emission intensity is optimized at maximum output and may have a significantly higher emission rate when the facility is run at lower production.

Given these risks, some best practices should be employed.

- **Conduct scenario testing.** From the outset, regulators should be prepared to analyze scenarios for different specifications of the OBP including the covered emission, the product group and other tightening rates. As discussed above, the bundling of types of emissions with facility production can materially change the compliance obligation. When other factors such as transitional assistance or annual tightening rates are added, compliance tonnes can shift significantly.

- **Conduct financial impact testing.** Linking the compliance obligation to the financial performance and health of the regulated entities can help understand the impact of alternative OBP formulations. It can also be used to address political fears of significant impact, while verifying industry claims of financial hardship. With carbon pricing so embedded within Canada now, the financial analysis will need to consider not only the impact of the OBP but also indirect cost impacts through indirect emissions (i.e., transport, electricity) and the supply chain (intermediate inputs).

- **Think about policy measures to address outliers.** Some financial impact outliers may need to be addressed. Ideally, the OBP rate would not be backed away from top-tier performance, but this may become necessary for political acceptability. When this is the case, clear justifications will be needed for why specific accommodations are to be made. Ad hoc decisions for specific facilities should be avoided.
- **Set it, test it and take stock.** With the risks identified above, regulators may initially want to err on the side of caution when setting the OBP rate, especially if there are concerns over information availability or quality. Aligning with an information collection program will therefore be needed from the outset. Then in future periods, the OBP can be updated as new information on outcomes and impacts becomes available. Building in routine stock-taking to assess ongoing policy performance helps reveal OBP impacts and enables ongoing adjustments as needed.

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