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POLICY BRIEF

Recovery Through Reform:

Advancing a hydrogen economy while minimizing fossil fuel subsidies

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This brief is one of three International Institute for Sustainable Development (IISD) policy briefs in its Recovery Through Reform series, which assesses how efforts to achieve a green recovery from COVID-19 in Canada rely on—and can contribute to—fossil fuel subsidy reform.

1.0 Introduction

In December 2020, Canada unveiled a national hydrogen strategy following the announcement of a strengthened climate plan (Natural Resources Canada, 2020b). As the world looks to decarbonize, hydrogen has emerged as the most promising candidate for a “clean molecule” to replace fossil fuels in hard-to-abate industries where electrification is not feasible. Recognizing this opportunity, Canada now joins 18 of the world’s economies comprising more than 75% of global GDP that have released, or are developing, hydrogen strategies (Eurasia Group, 2020), funding for which has increased since the start of the COVID-19 pandemic. Notably, the European Union (EU) recovery package sets aside EUR 550 billion for green projects, including advancing the EU Hydrogen Strategy (Abnett & Green, 2020).

Along with Canada’s national strategy, Quebec, Alberta, Ontario, and British Columbia are all developing strategies for hydrogen (Government of Alberta, 2020b; Government of British Columbia, 2020; Government of Ontario, 2020; Tanguy et al., 2020). Natural Resources Minister Seamus O’Regan has said that “Canada can lead globally on hydrogen” by developing a sector that could employ 350,000 Canadians while reducing Canada’s greenhouse gas (GHG) emissions by 190 million tonnes (Mt) of carbon dioxide equivalent (CO_2e) annually by 2050 (McCarthy, 2020).

Conventional hydrogen is produced with fossil fuels, mostly with steam methane reforming of natural gas. In order to achieve emission reductions, hydrogen production must be done either with steam methane reforming using carbon capture and storage (CCS) (fossil fuel-based hydrogen commonly known as "blue hydrogen") or electrolysis using renewable energy ("green hydrogen"). Canada's hydrogen strategy states that the government intends to support both production pathways, that there is "significant growth potential" for natural gas-based hydrogen, and that additional support for CCS is required (Natural Resources Canada, 2020b). However, more analysis is needed on the merits of blue hydrogen, including for export markets, given the rapidly accelerating international movement on green hydrogen.

Canada's hydrogen strategy notes that from CAD 5 billion to CAD 7 billion in investment in hydrogen will be needed over the next five years (Natural Resources Canada, 2020b). To begin, Canada's updated climate plan promises CAD 1.5 billion for a Low-Carbon and Zero-Emissions Fuels Fund to promote fuels such as hydrogen (Environment and Climate Change Canada, 2020). Clarity is required from the government on how these funds will be spent, as it is not yet clear what portion will go toward blue versus green hydrogen.

Green hydrogen is forecast to out-compete blue hydrogen within the next decade. Fiscal supports for blue hydrogen do not appear to be an efficient use of public funds, in particular given the high costs and uncertainties related to CCS. Using public funds for blue hydrogen could result in stranded assets and create significant opportunity costs as money and time are diverted from other clean energy options, including green hydrogen.

In addition, government must examine whether fiscal measures to support hydrogen align with Canada's international commitment to phase out "inefficient" fossil fuel subsidies by 2025. All potential subsidies to hydrogen should be evaluated against strict social, environmental, and economic criteria, and government should hold blue hydrogen to the same cost and environmental standards as green hydrogen before considering public support.

2.0 Current Context

Hydrogen strategies have recently started to proliferate and have further accelerated in the wake of the pandemic. In 2017 Japan became the first country to release a national hydrogen strategy, followed by South Korea in early 2019. These strategies were crafted with a view to advancing the two countries' automotive industries and, in the case of Japan, strengthening energy security (Matsuda et al., 2019; Ministry of Trade, Industry and Energy, 2018). A reduction in GHG emissions was seen as an additional benefit. Australia released a national hydrogen strategy in 2019, looking to increase its energy exports to Asia (COAG Energy Council, 2019). A major shift in the hydrogen space occurred with the EU's commitment to carbon neutrality by 2050, which spurred the development of the European Green Deal. The EU Hydrogen Strategy, released in July of 2020, describes hydrogen as a key priority to achieve the European Green Deal (European Commission, 2020). While recognizing the potential for Europe to increase its competitiveness in emerging technologies, the EU Hydrogen Strategy's focus is firmly on replacing fossil fuels in industrial processes and other hard-to-decarbonize sectors. The strategy has thus helped reframe hydrogen from one among an array of emerging technologies to a key part of the renewable energy transition.

In the past months, in the wake of the European Green Deal, other countries have also released national hydrogen strategies, including France, Germany, and Spain (de Beaupuy, 2020; Martin, 2020; Ministerio para la Transición Ecológica y el Reto Demográfico, 2020).[1] To help increase buy-in from industry, a number of industry groups have also been included, playing an active role in the development of these strategies. For example, Hydrogen Europe, an industry association, partnered with academics and the European Commission to produce Hydrogen Roadmap Europe, which informed the development of the EU Hydrogen Strategy (Fuel Cells and Hydrogen 2 Joint Undertaking, 2019; Hall, 2020).

Along with policy announcements, governments have announced new funding for hydrogen, much of it tied to COVID-19 recovery packages. For example, Germany has committed EUR 9 billion of its coronavirus recovery package to green hydrogen to achieve its target of 5 gigawatts (GW) of hydrogen capacity by 2030 and 10 GW by 2040, and France has committed EUR 7 billion of its recovery package to reach its target of 6.5 GW of green hydrogen capacity by 2030 (de Beaupuy, 2020; Martin, 2020). As governments ramp up spending to stimulate economies in response to impacts from the pandemic, spending on hydrogen has the potential to significantly impact the direction taken by the world's energy systems.

Common to the European strategies is an emphasis on green hydrogen over blue hydrogen. Both Germany and Spain have signalled that they will be prioritizing green hydrogen, with Germany expected to import a majority of its supply due to land constraints (International Trade Administration, 2020; Martin, 2020). The EU Hydrogen Strategy specifically calls for 40 GW of green domestic hydrogen production capacity by 2030 (European Commission, 2020). Outside of Europe, President Joe Biden has also pledged support for green hydrogen in his clean energy plan (Biden for President, 2020).

3.0 Where We Are Now in Canada: National and provincial hydrogen strategies

In December 2020, Natural Resources Canada published *Hydrogen Strategy for Canada: Seizing the Opportunities for Hydrogen*. It details plans to increase hydrogen production from fossil, renewable, hydro, and nuclear energy (Natural Resources Canada, 2020b). At the provincial level, Alberta and Quebec have put forward competing visions for hydrogen production, with Alberta seeking to expand production at natural gas plants using carbon capture, while Quebec looks to leverage its sizable hydro capacity. The Ontario government, pressed by the Ontario-based Hydrogen Business Council, has announced plans for its own strategy to be released in 2021 (Ontario, 2020). British Columbia is also soon to release a strategy, largely based on a 2019

[1] The United Kingdom is currently drafting a national hydrogen strategy (Edwardes-Evans, 2020).

study that recommended leveraging the province's natural gas reserves and hydroelectric power (Government of British Columbia, 2020; Zen and the Art of Clean Energy Solutions, 2019).

Canada's hydrogen strategy calls for technology-neutral, performance-based policies and regulations. However, it also takes that view that "hydrogen produced at scale can be the long-term answer for Canada's natural gas utilities to stay competitive in a carbon-constrained future" (Natural Resources Canada, 2020b). While public funding has yet to be attached to the strategy (other than the CAD 1.5 billion Low-Carbon and Zero-Emissions Fuels Fund), Natural Resources Minister Seamus O'Regan has suggested new funding could be delivered through the Natural Gas Innovation Fund set up by the Canadian Gas Association (Canadian Gas Association, 2020). Natural Resources Canada has already committed CAD 6 million to this fund through the Petroleum Technology Alliance of Canada and the Canadian Gas Association (Natural Resources Canada, 2020a).

Alberta's hydrogen plan, outlined in its Natural Gas Vision and Strategy, also prioritizes blue hydrogen (Government of Alberta, 2020b). As part of its COVID-19 recovery spending, it has launched the Alberta Petrochemicals Incentive Program in support of the strategy (Alberta Energy, 2020). The program will award grants worth 12% of eligible capital costs to new petrochemical projects, including but not limited to stand-alone blue hydrogen projects. While there is no spending cap, Premier Jason Kenney has estimated the cost at CAD 1 billion (Johnson, 2020).

4.0 The Challenge: Supporting hydrogen without backtracking on fossil subsidy reform or climate commitments

Since Canada first pledged to eliminate inefficient fossil fuel subsidies in 2009, civil society groups have continued to ask the Department of Finance to improve transparency around fossil fuel subsidies (Corkal, Levin et al., 2020). In recent years, Canada has been among the slowest G20 countries in phasing out support for fossil fuels (Geddes et al., 2020). Despite past commitments, federal fossil fuel subsidies have been estimated at roughly CAD 600 million per year (Corkal, Levin et al., 2020), higher after the onset of COVID-19. Moreover, subsidies to natural gas, including for export, have been increasing (Corkal, Levin et al., 2020). Subsidies have also increased at the provincial level. In the 2017/18 fiscal year, fossil fuel subsidies were at least CAD 830 million in BC and CAD 2 billion in Alberta (Corkal & Gass, 2019a; Environmental Defence & IISD, 2019). Royalty adjustments for natural gas deep drilling alone represented CAD 1.1 billion in foregone government revenue to Alberta in 2017/18 (Environmental Defence & IISD, 2019).

As Canada recovers from COVID-19, we need to ensure its spending is fiscally efficient and advances Canada's climate change and fossil fuel subsidy commitments (Corkal, Gass et al., 2020). Recovery measures must include standards and "conditions—"green strings"—that ensure industries receiving public funds are in sync with Canada's climate goals (Corkal, Gass et al., 2020). Money strategically spent on hydrogen could help kickstart Canada's clean energy economy, accelerating the development and deployment of new technologies to further the sustainable energy transition (Task Force for a Resilient Recovery, 2020). With growing excitement for the opportunities that hydrogen presents, there is significant concern that oil and gas producers will secure additional subsidies with the stated goal of advancing Canada's hydrogen strategy (Graney, 2020). **Subsidies to fossil fuel-based hydrogen, including blue hydrogen, are still fossil fuel subsidies under internationally agreed-upon subsidy definitions.** As such, government must demonstrate that there is no other viable option, and that subsidies adhere to strict environmental and social conditions, and be time-limited and periodically reviewed. Subsidies for fossil fuels run counter to Canada's goal of net-zero by 2050.

4.1 Environmental and Cost Challenges of Carbon Capture and Storage

The Canadian hydrogen strategy targets a short-term carbon intensity target for hydrogen of 36.4 grams of CO_2e per megajoule (gCO_2e/MJ) (Natural Resources Canada, 2020b), which could be met with carbon capture that is only roughly 60% effective (Layzell et al., 2020). Though the use of carbon capture can theoretically reduce fossil hydrogen CO_2 emissions by up to 90% (IEA, 2019), the reality is that these figures do not consider upstream emissions such as methane emissions from natural gas production—and recent evidence suggests these emissions are significantly underreported. A 2020 study by Environment Canada found that methane emissions from oil and gas production are twice as high as previously thought (Chan et al., 2020). Nationally, methane leaks from fossil fuel production account for 44% of Canada's methane emissions (Environment and Climate Change Canada, 2018).

Ultimately, the short-term carbon intensity set in Canada's strategy is significantly below ideal carbon capture rates of at least 80%–90% for blue hydrogen. Overall emission intensity is also significantly higher than hydrogen from renewable energy, thanks in large part to methane emissions. In short, **blue hydrogen will never be as low-carbon as green hydrogen.**

Carbon capture is unproven at a commercial scale and continues to be extremely expensive. As an unproven technology, the full costs are not entirely known and could be exponential. It also lacks a robust regulatory framework. Deployment of CCS technology internationally has relied heavily on government intervention (DNV GL, 2019). A 2020 study found that carbon capture and subsurface storage for natural gas plants cost USD 80 to USD 90 per ton of CO_2 (Schmelz et al., 2020). Despite significant momentum for CCS before 2010, the reality is that implementation has slowed in recent years due to costs and policy barriers (Organisation for Economic Co-operation and Development [OECD] & International Energy Agency [IEA], 2016). Globally, the deployment of CCS is falling well below targets for the IEA's 2°C scenario (OECD & IEA, 2016). A report on hydrogen by the International Renewable Energy Agency (IRENA) finds that CCS technology is far below its potential (IRENA, 2019). Some forecasts estimate that CCS could not be at scale until the 2040s unless significant policy progress is made, including a carbon price higher than the cost of capture and storage (DNV GL, 2019).

Funding for carbon capture projects already represents a significant source of fossil fuel subsidies in Canadian jurisdictions. For example, Alberta spent CAD 272 million on its Carbon Capture and Sequestration Initiative in 2018/19, and carbon capture will be a significant spending area for the Technology Innovation and Emissions Reduction (TIER) fund, which is being emptied to provide COVID-19 stimulus in the province (Government of Alberta, 2020a; Emissions Reduction Alberta, 2020; Environmental Defence & IISD, 2019). Should these trends continue and be amplified by subsidies for fossil fuel-based hydrogen, it could contribute to an expansion of fossil fuel production that is at odds with what is required to achieve the <1.5°C temperature rise referenced in the Paris Agreement (Stockholm Environment Institute [SEI] et al., 2019).

4.2 Green Hydrogen on the Rise

Along with environmental arguments against subsidizing blue hydrogen, the literature suggests that green hydrogen will likely be the hydrogen of choice for cost reasons within less than 10 years. For example, Bloomberg New Energy Finance (BloombergNEF) forecasts that green hydrogen will be competitive with blue hydrogen by 2030 ("Hydrogen economy," 2020). The costs of both electrolyzers and renewable energy, especially solar photovoltaic (PV), continue to decline steeply, whereas steam methane reforming is a mature technology whose cost is projected to remain stable. Additional government support for green hydrogen worldwide may accelerate this trend. In the time since BloombergNEF made its price forecasts, Joe Biden won the American presidential election with a clean energy plan that includes a commitment to "ensure that the market can access green hydrogen at the same cost as conventional hydrogen within a decade" (Biden for President, 2020). Since it may be years before CCS technology is fully deployable, blue hydrogen may not be an economically feasible solution. If green hydrogen prices fall below blue hydrogen as forecasted by BloombergNEF ("Hydrogen economy," 2020), **there is a risk that new blue hydrogen projects may, by 2030, be at a competitive disadvantage at least from that point forward.**

Canada has indicated that it intends to pursue exports for hydrogen, including blue hydrogen (Natural Resources Canada, 2020b). However, the potential for export for blue hydrogen may be called into question since some export markets are already choosing to focus on green hydrogen in their recently announced strategies (e.g., Germany).

4.3 Avoiding Market Distortions

Public funds granted to oil and gas for carbon capture and methane emissions reduction projects, such as the Canadian Emissions Reduction Innovation Network (CERIN) initiative (Environment and Climate Change Canada, 2020), still represent fossil fuel subsidies. These types of subsidies allow producers to reallocate spending that may normally have gone to emission reductions to production, thus lowering the cost of producing fossil fuels and creating an uneven playing field when we need to be rapidly transitioning to renewables to meet our climate goals (Moerenhout & Irschlinger, 2020; SEI et al., 2019).

Not all subsidies are inherently bad. However, **given Canada's commitment to phasing out inefficient fossil fuel subsidies and reach net-zero by 2050, a high bar must be set to justify subsidies for blue hydrogen.** It is not an efficient use of public funds to invest in technology that will not necessarily be competitive in 10 years, that does not have clear export markets, and has significantly lower climate contributions than competing technologies. Only under very strict conditions should subsidies for blue hydrogen be considered, and blue and green hydrogen should be held to the same standards for both costs and environmental performance, including emissions intensity. In addition, government should not invest in blue hydrogen if it is not clear that the CCS technology to be used is proven and effective.

If strict criteria are not applied, subsidies to blue hydrogen could delay and stunt the development in Canada of a viable and thriving green hydrogen industry, an industry that market analysts believe has longer-term potential (McDonald, 2020). Using funds to develop innovative technology that lowers the costs of producing blue hydrogen can artificially lower the relative price of blue hydrogen compared to green hydrogen. **Any subsidies for blue hydrogen come with a risk of creating market distortions that could lead to an inefficient allocation of resources and disadvantage green hydrogen and other renewable energy sources.**

4.4 The Need for Transparency and Accountability

To continue its commitment to fossil fuel subsidy reform, the Canadian government must carry out a thorough analysis of subsidies and public finance to fossil fuel-based hydrogen to evaluate whether these funds are truly the most efficient way to achieve policy objectives compared to other options to advance Canada's climate goals. This review should consider social, environmental, and economic costs and benefits (Corkal & Gass, 2019a). Any subsidies to fossil fuel-based hydrogen should also be included in fossil fuel subsidy inventories as part of overall transparency on Canadian fossil fuel subsidies.

5.0 Policy Opportunities

The coming months will be decisive both for COVID-19 recovery and scaling up climate action. Canada's ability to achieve these policy goals will be significantly affected by how governments approach hydrogen strategies and where government dollars are spent. To that end, Canada should:

- Ensure that any subsidies for hydrogen are in line with the government's commitments to phase out inefficient fossil fuel subsidies by 2025, achieve net-zero emissions by 2050 and accomplish its Nationally Determined Contribution under the Paris Agreement. Subsidies and public finance for fossil fuels put these goals in jeopardy.
- Thoroughly evaluate the potential efficiency of subsidies for hydrogen against robust social, environmental, and economic criteria. Based on IISD's analysis:
    - Subsidies for hydrogen based on natural gas without significant levels of CCS should *not* be eligible for government assistance.

    - Subsidies for blue hydrogen should *only* occur if blue hydrogen can meet the same level of environmental performance (including emission intensity) *and* is at or below the cost of green hydrogen. Subsidies for blue hydrogen should not occur if government is not certain that the CCS technology to be used is proven and effective.

- Improve transparency by publicly reporting on direct spending and tax expenditures for hydrogen production. Public money put toward fossil fuel-based hydrogen, including blue hydrogen, should be included in fossil fuel subsidy reporting.
- Follow international best practices being set by Canada's peers. For example, Germany and Spain have laid out hydrogen strategies prioritizing green hydrogen.
- Firmly focus any funding for high-carbon sectors, including fossil fuel-based hydrogen, on maintaining jobs and economic stability. Canada must adhere to "green strings" principles to ensure economic recovery is aligned with climate objectives (Corkal, Gass et al., 2020a).

6.0 Conclusion

The new national hydrogen strategy shows that Canada recognizes hydrogen's potential to help it reach net-zero emissions, particularly in the hardest-to-abate sectors of Canada's economy. Major hydrogen markets internationally are already signalling that they will prioritize green hydrogen, made by electrolysis using renewable energy, which could become cheaper than blue hydrogen by 2030. Canada must make sure it aligns its hydrogen vision with both market projections and the rapid need to decarbonize as it begins implementing its hydrogen strategy. It is at best questionable that investments in blue hydrogen can bring the industry to the same potential as green hydrogen. Blue hydrogen is unlikely to be as cost effective or have as strong an environmental performance as green hydrogen in the medium to long term and therefore is unlikely to be competitive. As a result, Canada must be careful not to provide inefficient fiscal support to blue hydrogen. The federal government should also apply robust value-for-money criteria to determine which policies and incentives most efficiently achieve Canada's long-term climate goals.

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