

# Industrial Electrification



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## **Industrial Electrification**

May 2022

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**Citation:** Electrifying Canada. (2022). *Industrial electrification*. International Institute for Sustainable Development. <https://www.iisd.org/system/files/2022-05/industrial-electrification-en.pdf>



## About Electrifying Canada

Electrifying Canada is a business-led task force aiming to accelerate electrification across Canada to reach net-zero by 2050. As business leaders, we are eager to collaborate with government, Indigenous, and civil society leaders to translate electrification ambition into action. The Electrifying Canada task force is affiliated with the Energy Transitions Commission and funded by its founding members. Learn more at [electrifyingcanada.ca](http://electrifyingcanada.ca).

### Members:



I V E Y foundation

Teck



### Advisors:



Energy  
Transitions  
Commission

## About the Research

Research for the Electrifying Canada task force is provided by Dunsky Energy + Climate Advisors. Dunsky's team of nearly 50 specialists across the buildings, transportation, industry, and energy supply sectors is proud to serve as the task force's research arm.

This report is a collective view of the Electrifying Canada task force and may not represent the individual viewpoints of members and/or their respective organizations.



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# 1. Turning Net-Zero Ambition Into Action on Industrial Electrification

Industrial activity is a major contributor to Canada’s greenhouse gas emissions: excluding oil, gas, and refining industries, industrial energy use and processes are the sources of around 15% of Canadian emissions (Langlois-Bertrand et al., 2021). The sector’s immense diversity means there is no one-size-fits-all solution to meet net-zero emissions targets but rather countless opportunities for innovation. In many cases, this means electrification—substitution of fossil fuels for clean Canadian electricity, with opportunities ranging from the implementation of commercially available solutions to experimenting with emerging technologies.

The Electrifying Canada task force is targeting industrial sectors that have high energy consumption and significant potential to electrify existing processes but which have not seen high levels of electrification to date. We have identified the **manufacturing, mining, and construction sectors** as meeting these criteria, in addition to being sectors where Canada possesses unique experience and motivation for decarbonization.

## 1.1 State of Play

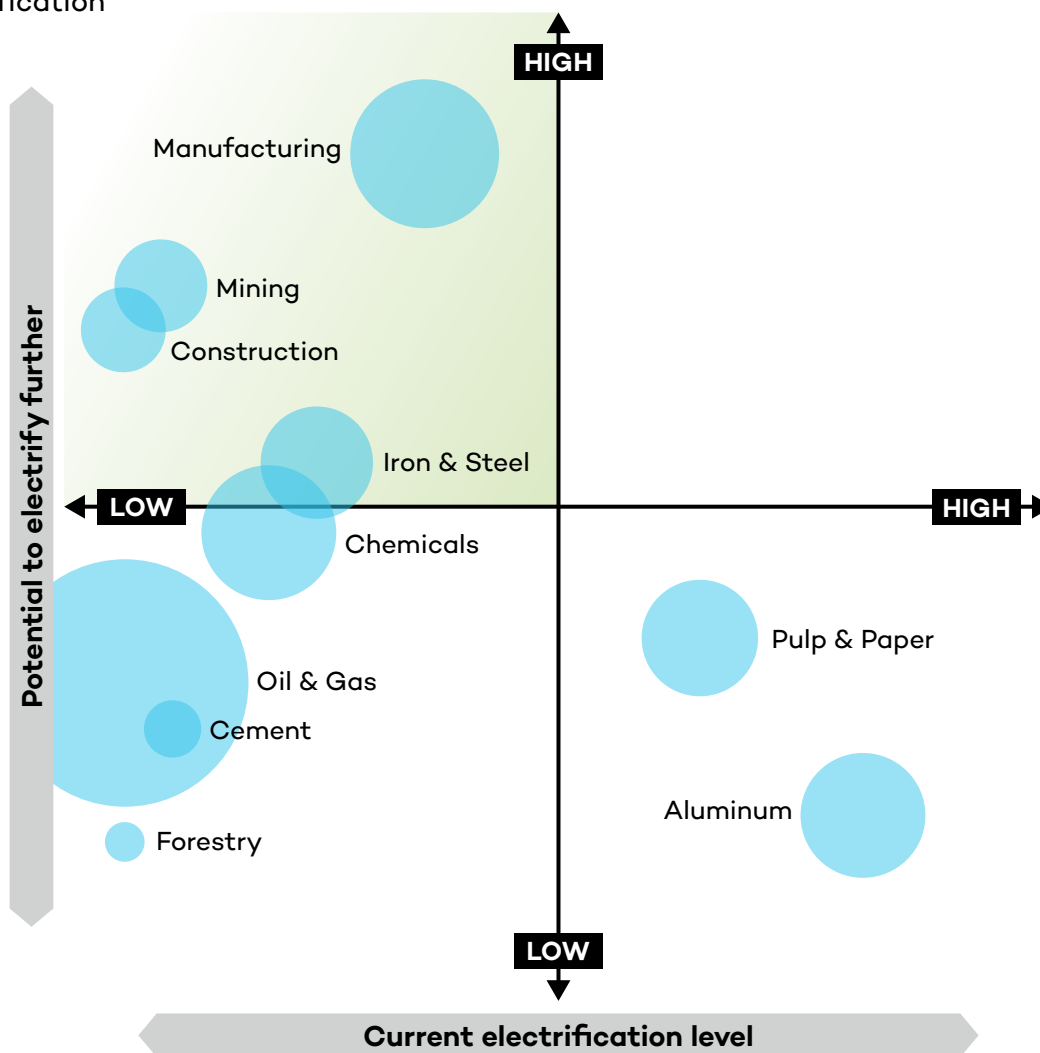
Today, the Canadian industrial sector uses electricity to power more than 25% of its energy needs. In its *Canadian Energy Outlook 2021*, the Institut de l’énergie Trottier forecasts that industry needs to ramp up its electricity use to meet 41% of its energy needs by 2050 while simultaneously reducing the sector’s total energy consumption—in other words electrifying while significantly improving energy productivity in parallel (Langlois-Bertrand et al., 2021).

The potential for electrification is not equal in all industrial sectors. Some plants and processes are making early inroads into electrification—such as aluminum production, which uses electricity to meet over 80% of its energy needs (Natural Resources Canada, 2020). Other industrial activities see much lower electricity use—for example, less than 10% of mining energy needs are met by electricity and virtually no electricity is used in construction (Natural Resources Canada, 2020).

Our task force assessed industrial activity based on the potential to electrify relative to current levels of electrification (Figure 1). Our focus sectors—manufacturing, mining, and construction—can benefit from off-the-shelf or modified existing technologies to begin electrifying more of their operations. However, as explored below, the electrification of these sectors has stalled in the face of a number of barriers.



**Figure 1.** There are major opportunities to meet net-zero targets through industrial electrification



Note: Bubble size reflects current total energy consumption.

Source: Produced by Dunsky Energy + Climate Advisors for Electrifying Canada, 2022.

Data sources: Langlois-Bertrand et al., 2021; Natural Resources Canada, 2020.

Discussing industrial electrification requires addressing the diverse technical solutions, established and emerging, that go far beyond electric boilers. Solutions include highly efficient industrial heat pumps to provide low- to medium-temperature process heating, efficient drying processes using microwaves and infrared heating, indirect electrification through hydrogen (in specific cases), and high-temperature electric arc furnaces in other cases.

Some sectors, like mining, are looking to electrify off-road transportation, benefiting from the learnings of on-road transportation but requiring modifications to vehicles and charging infrastructure based on unique site needs. Each industry and its specific processes have a unique pathway to capitalize on the potential of clean electrification.



## Three big wins for corporate Canada

We see three big wins for industrial electrification:

### 1. Stability of energy pricing

Electricity prices are predictable and relatively stable over the long term compared to fossil fuel commodity prices, which minimizes risks and hedging in operational budgets. Natural gas and oil prices vary based on supplies and global events, as seen with the Russia–Ukraine conflict, which can introduce unpredictable spikes in energy costs.

### 2. Adding “low-carbon value” to Canadian resources and products

Many industrial Canadian products are destined for international markets, and electrified production can add value for buyers who recognize, prioritize, or require lower life-cycle greenhouse gas emissions. Some Canadian industries, such as aluminum, already benefit from Canada’s clean electricity advantage. With electrification, this benefit can be extended to other industrial sectors. In addition, electrification can ensure products remain competitive in markets that are proposing to introduce border carbon tariffs, such as the European Union.

### 3. Exporting our electrification expertise

Canadian industries are developing innovative processes to reduce emissions, supported by a rich industrial research and development environment and strong federal and provincial support. Low-carbon electrification technologies and processes can help overcome challenges that are faced by businesses around the world. Canadian expertise and intellectual property in electrification can be exported, providing Canadian companies with additional value streams from innovation.

## 1.2 Key Barriers to Industrial Electrification

Our research and interviews with Canadian and Indigenous corporate leaders identified three main barriers to industrial electrification that will need to be overcome to reach net-zero:

1. **Technical readiness:** Diverse industrial processes require diverse technical solutions for electrification. We have seen major advances in innovative technical solutions in some sectors; however, other industrial processes are challenging to electrify, such as cement, chemical, and steel production. These industries are in the early stages of exploring and piloting electrification technologies that still must achieve both technical and economic feasibility.
2. **Lack of confidence in the availability and reliability of electricity:** Industrial operations need to be confident that electricity will always be available where and when it is needed. Some operations are not able to access electricity at the scale needed to



transform operations or, at remote sites, gain access to the grid. Further, while Canadian grids are generally considered reliable, even a momentary interruption in electricity supply can result in costly production losses. Until now, on-site fossil fuel storage has ensured operational availability and reliability, and operators are seeking guarantees for the same level of service from electricity.

3. **Cheap natural gas creates a challenging business case:** Today, relatively cheap natural gas presents tough competition for electrification. Industries investigating electrification often encounter a lengthy time for return on investment, which is unappealing in sectors where a quick payback is required. This challenge is exacerbated by infrequent opportunities—often measured in decades—to electrify. Fuel-switching to electricity is generally only viable when replacing major equipment at end of life, and if the economics of electrification are not favourable for electrification at that time, fossil fuel-consuming technologies and processes will be selected again, potentially delaying electrification for decades.

Despite these barriers, innovative solutions are being tested and implemented across the country to electrify industry.

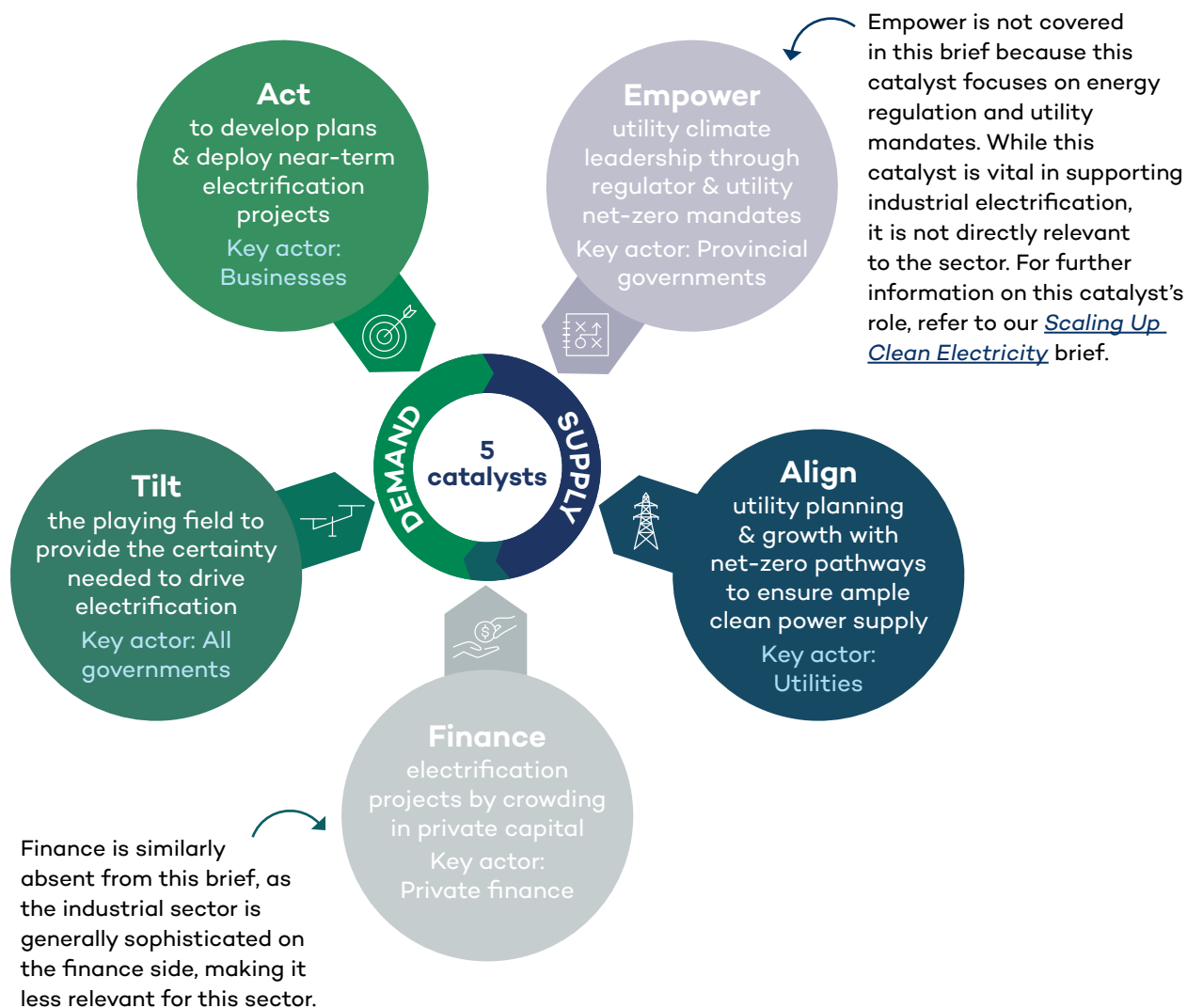




## 2. Seizing the Opportunity: Five catalysts to accelerate electrification

Canada has a transformational opportunity to meet our net-zero target by leveraging the competitive advantage offered by our clean electricity. However, our research finds that while Canada has huge opportunities and significant advantages, we also face a significant risk: complacency. **Without clear direction, proactive planning, and bold decisions, we will not be successful in overcoming the barriers to electrification** identified above. Failure to do so means losing out on our competitive advantage, vastly increasing transition costs and risks, and foregoing significant opportunities.

**Figure 2.** Five catalysts to accelerate electrification





But it is clear that whether we succeed or fail is up to us. Achieving electrification at the pace and scale needed requires the proactive and collaborative efforts of all stakeholders—electricity producers, end users, regulators, and policy-makers—across the electricity value chain. Meeting Canada’s net-zero target is a significant challenge, and clean electrification

is the single most valuable tool to reduce emissions. That is why we, as leaders from the nation’s private sector, have identified five evidence-based catalysts to initiate and enable electrification (Figure 2). This brief translates the catalysts and their implications for industrial electrification.

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Achieving electrification at the pace and scale needed requires the proactive and collaborative efforts of all stakeholders.

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## 2.1 Act to Electrify Industrial Processes via Near-Term Plans and Projects



Take action to support the early deployment of electrified industrial processes, learning by doing, and translating climate action targets into electrification plans and pilots that prove out technologies and approaches to support scaled-up investment.

### Why?

Many corporations have climate action targets, but the action-oriented near-term plans to electrify operations are missing. Smart electrification requires planning and a systems mindset. Industrial plant and process electrification requires a thoughtful long-term vision followed by swift near-term implementation.

### **Call to Action: Businesses must develop near-term company plans, pilots, and projects to electrify operations.**

Industrial operators, ourselves included, must translate long-term corporate climate targets into action: near-term plans and pilots for electrification.

Thoughtful near- and long-term planning is required to chart a path toward decarbonizing industrial processes. Planning for fossil fuel-based equipment replacement and accompanying efficiency and peak demand management measures are key components of gradual and smart electrification.

To succeed, capacity building is needed. Industrial operations staff are focused on ensuring production stays online and efficient, and any changes to current processes must be carried out with meticulous planning. Electrification presents a major operational change and therefore requires clear and early corporate engagement, direction, and support—especially for internal capacity building, which is necessary to ensure a smooth transition.



External expertise can be sought from a growing electrification services sector. Further, each sector can help tackle its unique electrification challenges by developing sector-specific technology roadmaps. These roadmaps can be industry led and promote knowledge sharing and best practices while protecting competitive information.

**Goal:**

This catalyst aims to:

- Accelerate the pace of industrial electrification through planning, pilots, and projects.
- Support measurable near-term progress toward long-term corporate climate targets.
- Build internal and sectoral capacity through project learning and knowledge sharing.
- Develop the emerging Canadian industrial electrification services sector (engineering firms, equipment manufacturers, and maintenance providers) to support scaled-up efforts.

**Spotlight: Electrifying Teck's mining fleets and Diageo's distillery**

In 2020, Teck committed to a long-term target to reach net-zero emissions across its mining operations by 2050 and translated this goal into near-term targets and actions (Teck Resources Limited, 2022b). By 2025, Teck aims to achieve net-zero purchased electricity emissions and to displace 1,000 internal combustion engine vehicles with zero-emission vehicles by 2025. By 2030, Teck aims to reduce the carbon intensity of its operations by 33% (Teck Resources Limited, 2021).

These near-term targets have created urgency for action. Electricity was identified as a key abatement opportunity for emissions associated with its transportation and stationary combustion and process needs. Teck has purchased electric pit buses for one site (Teck Resources Limited, 2021) and is testing the world's first electric on-highway transport truck to haul copper concentrate (Teck Resources Limited, 2022c). These pilot projects are happening in concert with scoping, feasibility studies, and trials for further electric vehicle use, including an agreement to pilot and deploy 30 Caterpillar electric large-haul trucks starting in 2027 (Teck Resources Limited, 2022a).

As Teck acts to decarbonize its operations, the available and forecasted supply of clean electricity is becoming an increasing barrier to the further electrification of its operations.

Another multinational company is also turning to electricity to achieve its climate goals. Diageo is a multinational alcoholic beverage company that has set medium-term climate targets to have net-zero operations (in its scope 1 and 2 emissions) and a 50% reduction in its supply chain (scope 3) emissions (Diageo, n.d.).

This effort has led to near-term efforts to decarbonize operations through clean electrification. Diageo has committed to making its Salaberry-de-Valleyfield, QC distillery carbon neutral by 2025. This ambitious goal will be achieved by replacing natural gas and



fuel oil with electrification. The manufacturing process, reliant on hot water and steam, will use specialized equipment, including a mechanical vapour recompression evaporator, steam dryers, and an electric boiler. In addition, the distillery will reduce overall consumption through efficiency measures, including during Hydro-Québec's peak demand hours, to reduce pressure on the grid. The facility, which produces Crown Royal among other products, will become the first to electrify fossil fuel-based operations in North America. The total investment of CAD 94 million includes CAD 46 million from the federal and provincial governments and Hydro-Québec (Diageo, 2021).

## 2.2 Align Utility Planning and Growth With Net-Zero Pathways to Ensure Ample Clean Power Supply for Industrial Electrification



Align and optimize utility planning with net-zero to ensure industries have enough clean power where and when it is needed to electrify plants and processes.

### Why?

Net-zero planning requires proactive outreach by utilities, system planners, and system operators to industrial operators not only to understand the scale and pace of electricity demand coming from industrial processes but also to encourage and “sell” electrification.

Industrial operations have unique energy requirements that can vary greatly between sectors. Reliability must be 100% for some processes, while other plants can handle lower levels of reliability or have flexible loads, which can help manage peak demand. Further, electrification may require major capacity increases that require long-term transmission and distribution planning to deliver the electricity where it is needed by when it is needed (i.e., aligning with end-of-life equipment replacement cycles). Understanding and planning for these future needs are critical to ensuring that electrification is a viable and effective option for industry.

### **Call to Action: Governing bodies of utilities and planning authorities must proactively align plans and investments with achieving industrial net-zero emissions.**

The governing bodies of utilities and planning authorities must focus planning and action on scenarios aligned with Canada's climate commitments. This shift allows utilities to expand their focus to decarbonize economy-wide energy use, including through industrial electrification.

Utility resource planning should expand beyond the traditional capacity planning to proactively assess and plan for electricity supply to be available to supply over 40% of industrial end use by



2050 under net-zero pathways (Langlois-Bertrand et al., 2021) while reaping the benefits of cost-effective energy-efficiency improvements and mitigating peak demand challenges.

### Goal:

This catalyst aims to:

- Ensure Canadian businesses have enough clean power to electrify their industrial operations.
- Encourage utilities to become proactive champions of electrification and to bridge the gap between industrial electrification needs and utility planning.
- Improve awareness of utilities regarding their central role in accelerating industrial electrification to reach economy-wide net-zero targets.

### Spotlight: Electrifying B.C.'s industrial operations

BC Hydro is actively looking to fund major projects that fuel the switch from fossil fuels to its low-carbon electricity grid. Industrial customers can submit projects where the fuel-switching load is at least 5 MW, with an interconnection cost of CAD 5 million. BC Hydro will fund 50% of an electrification project through the CleanBC Facilities Electrification Fund, up to CAD 15 million (BC Hydro, 2022a). This fund was developed by the Government of British Columbia using CAD 84.4 million in federal funding (Government of British Columbia, 2021). However, this program remains limited to grid-connected industries and available grid capacity.

In addition, BC Hydro offers a discounted electricity rate to new or existing industrial operators looking to electrify projects with a load of at least 20 GWh. The Fuel Switching Rate provides a 20% discount on the energy and demand charge for the first 5 years, then 13% and 7% in years six and seven, respectively (BC Hydro, 2022b). These rates can tackle a major barrier to industrial electrification: a poor near-term business case due to low-cost natural gas.

## 2.3 Tilt the Playing Field Toward Decarbonization by Improving Carbon Pricing Certainty



Facilitate greater investment certainty by guaranteeing a rising price on carbon pollution to drive down emissions from industries over time. Policy commitments should be backstopped by financial guarantees that can mitigate the risk that federal carbon pricing does not reach planned levels.

### Why?

Changes to industrial operations have long-term implications, and the business case is built on today's economics and tomorrow's predicted market. There is uncertainty as to whether the



federal price on carbon pollution will increase as scheduled to 2030 and whether the pollution pricing system itself can withstand future changes in government. This presents a decision challenge for industries that are making operational decisions that could lock in fossil fuel use for decades. Mitigating the risk of a scenario in which carbon price increases do not materialize can help support a clear business case today for low-carbon electrification investments.

**Call to Action: The federal government must reinforce the carbon pollution pricing signal by providing assurances about future price increases.**

The federal government must reinforce the carbon pollution pricing signal by helping to develop or deliver a mechanism to provide assurances on future price increases, effectively shifting the risk of lower carbon prices away from industry. The recent Federal Emission Reductions Plan commits to exploring “investment approaches, like carbon contracts for differences, which enshrine future price levels in contracts between the Government and low-carbon project investors, thereby de-risking private sector low-carbon investments” (Environment and Climate Change Canada, 2022). This commitment must be followed by near-term action. A similar concept had been previously proposed by the C.D. Howe Institute, in which the Canada Infrastructure Bank would offer contracts to mitigate uncertainty regarding future carbon pricing policy (Beugin & Shaffer, 2021).

**Goal:**

This catalyst aims to provide industrial operations with long-term vision and investment certainty on the decarbonization scale and timeline.

**Spotlight: Decarbonizing German industry with carbon contracts for difference**

In April 2021, the German environment ministry proposed a pilot to offer carbon contracts for difference to industries looking to decarbonize (Federal Ministry of Finance, 2021b). These 10-year contracts, available through auction, offer a guarantee from the German government pertaining to the differential costs between actual project-related emission mitigation costs and the EU Emissions Trading System prices, based on a fixed reference price of carbon. If the EU Emissions Trading System price is lower than the contract reference price, the government pays the difference—and vice versa in the higher carbon price scenario (Hillemann & Ehls, 2022). This contract reduces uncertainty regarding the future market price of carbon, improving the decarbonization business case and access to financing (Wacket & Eckert, 2021). In June, the German government announced that there would be additional funds for the program for 2022 (Federal Ministry of Finance, 2021a).



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# Annex 1. Electrifying Canada

## Members

- Richard Florizone – President and CEO, IISD (co-chair)
- Susan McGeachie – Head, BMO Climate Institute (co-chair)
- Chris Adachi – Director, Climate Change, Teck Resources
- James Brewer – Vice President of Corporate Strategy and Business Development, OPG
- Philippe Dunsky – President, Dunsky Energy + Climate Advisors
- Niilo Edwards – Executive Director, First Nations Major Projects Coalition
- Colleen Giroux-Schmidt – Vice President, Corporate Relations, Innergex Renewable Energy Inc.
- Grant Isaac – Chief Financial Officer, Cameco
- Bruce Lourie – President, Ivey Foundation
- Michael Torrance – Vice President, Chief Sustainability Officer, BMO Financial Group

## Secretariat

- Jane McDonald – Project Director
- Stephanie Cairns – Project Coordinator
- Philippe Dunsky – Research Lead
- Dan Woynillowicz – Communications Lead
- Mathieu Lévesque – Research Coordinator
- Richard Bridle – Research Support
- Vanessa Farquharson – Communications
- Bill Hamlin – Stakeholder relations

## Advisors to the Electrifying Canada task force

- Ita Kettleborough, Energy Transitions Commission
- Philip Lake, Energy Transitions Commission



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