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Canada's Future in a Net-Zero World: Securing Canada's Position in the Global Green Economy

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A global transition to a net-zero, low-carbon economy is underway, and Canada needs a more coordinated and strategic approach for positioning its industries in the value chains of the 21st century green economy.

This brief is the result of a partnership between the Smart Prosperity Institute, the Pacific Institute for Climate Solutions (PICS), and the Transition Accelerator. The research for this brief was supported by PICS and the Ivey Foundation. The full report is available here.

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INTRODUCTION

A global transition to a net-zero, low-carbon economy is underway, and Canada needs a more coordinated and strategic approach for positioning its industries in the value chains of the 21st century green economy.[1]

The federal government and some provinces have taken significant actions to accelerate Canada's transition to a low carbon economy. However, Canada's major trading partners and competitors are taking a more strategic approach to position their economies in rapidly forming low-carbon value chains. The European Union (EU) has advanced battery and hydrogen strategies.[2] Australia has a technology roadmap that aims to gain market share in many of the same net-zero industries that Canada operates in.[3] The United Kingdom (UK) has deployed industrial strategies for offshore wind, and carbon capture and storage.[4] And history has shown that industrial policy can be a powerful tool for transforming industries and initiating climate action.[5]

Canada is well positioned to act due to previous actions in support of clean growth. But it needs to move quickly and decisively for two key reasons. First, a more coordinated approach is needed to seize emerging economic opportunities for Canadian industry before global value chains form without Canadian firms. Second, direct support for clean growth will help meet climate mitigation objectives. The Pan-Canadian Framework carbon pollution pricing system is essential, but it needs to be complemented by efforts to build green industry.[6] If we simply raise prices on fossil fuels without lowering the costs of alternatives and building up industrial partners that are politically invested in the transition, there is a risk that rising prices will produce a political backlash that undermines support for the carbon price. This could happen not only through consumer discontent, but more importantly, also through insufficient creation of new jobs in companies and sectors providing alternatives to support a just transition.

Existing funds and policies correctly aim to support clean competitiveness, but:

- investments are spread thin across sectors;
- investments are often one-off grants to individual firms.
- priorities are fragmented across departments, federal and provincial governments, and private actors;

In this report, we argue for a strategic approach that:

- focuses on the top economic opportunities;
- creates long-term strategies that integrates policy tools; and
- aligns public and private actions by co-developing roadmaps to develop key sectors.

This brief proposes a methodology for sectoral roadmapping and collaborative action to begin this work. It also identifies seven high priority opportunities, three enabling conditions, and eight further opportunities for clean growth development in Canada.

BACKGROUND

The #1 recommendation of the Expert Panel on Sustainable Finance was to **"Map Canada's long-term path to a low-emission, climate-smart economy, sector by sector,** with an associated capital plan."[7]

Canada has taken some steps towards a strategic approach to secure its future economic prosperity. The federal government has created Economic Strategy Tables and has begun to take a bottom-up approach to sectoral development for clean growth. Some of the other strategic initiatives to support emissions reductions and clean growth across different sectors include the Small Modular Reactor (SMR) Roadmap[8], the Hydrogen Strategy[9], and the Net-Zero Carbon Concrete Roadmap.[10] While these are critical first steps, future growth strategy requires a **more collaborative and active approach** that can identify interlinkages between sectors and drive change along specific timelines.

— To be effective, a clean growth strategy needs a focused portfolio of clean competitiveness opportunities for public and private investment.

Canada has a wealth of funds and financing initiatives that must be aligned. The federal government has a variety of funds and initiatives, spread across Ministries and departments. The Strategic Innovation Fund, the Canadian Infrastructure Bank, the Business Development Bank of Canada, Sustainable Development Technology Canada, the Industrial Research Assistance Program, the Zero Emissions Transit Fund, amongst others, provide the basis of a strong innovation ecosystem.[11] But these funds need to be focused and aligned in a strategic way. And they need to be combined with funds from First Nations and the provinces. Previous investments from these funds have tended to be one-off, divorced from a clear, public strategy that would allow other elements of the cluster and finance to crowd-in.

To be effective, a clean growth strategy needs a focused portfolio of clean competitiveness opportunities for public and private investment. The identification of these future prospects is part of an economic strategy process that leads also to the development of roadmaps for policies and investment programs. The next section applies a framework for this purpose and identifies sectors in which Canada could develop competitive advantage as the global economy decarbonizes.

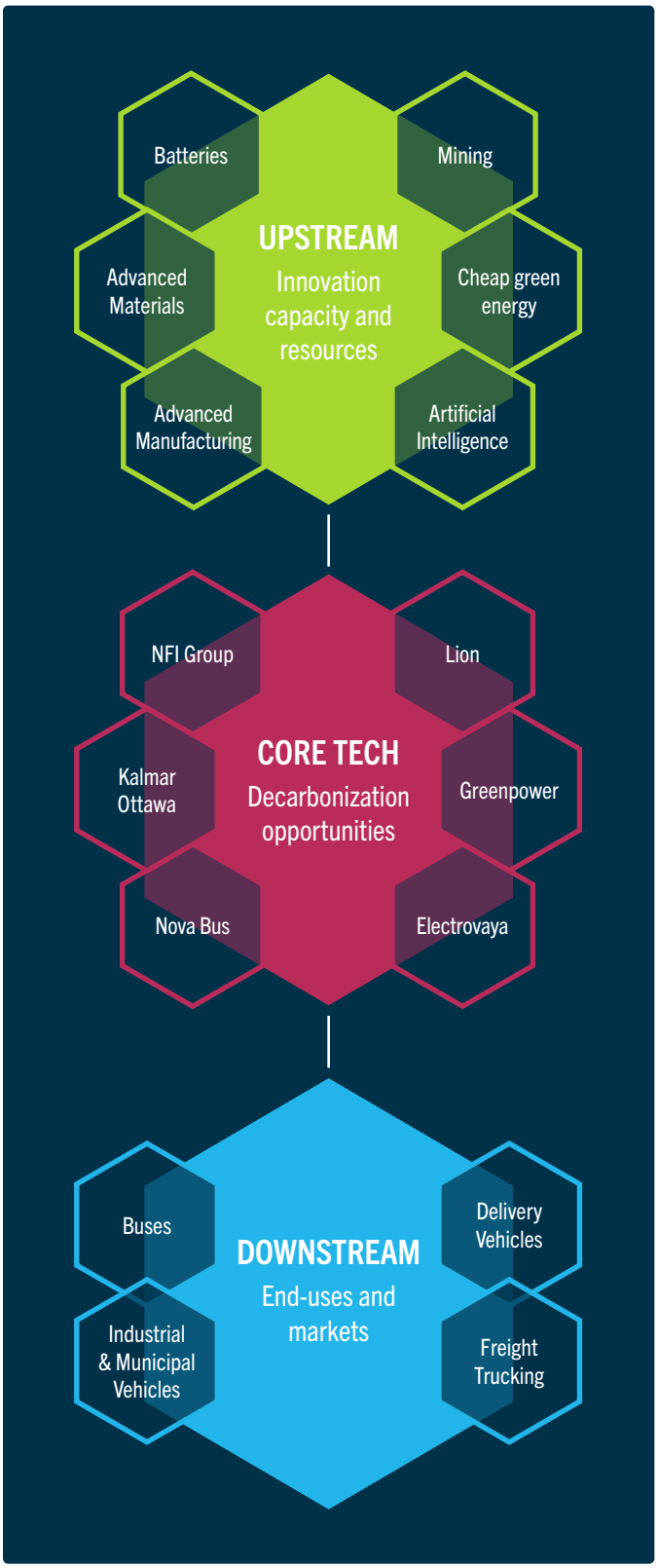
IDENTIFYING STRATEGIC OPPORTUNITIES

Instead of supporting specific firms with one-off grants, Canada should build innovation clusters.

Building innovation clusters is essential to building competitive industries in the global economy. Innovation clusters bring together firms, investors, governments, and universities to learn together over time. Such an approach would build on Canada's supercluster approach, by institutionalizing it and increasing its scale.

> *The goal is not to make all the elements of the value chain "Made in Canada" but to use a whole value chain approach to support and build Canada's most competitive and innovative elements.*

A cluster approach places a core decarbonization technology within a value chain: from upstream research, resource inputs, and supporting technologies to downstream end-uses and markets. We focus our clusters on core technologies because they can be the center of market development strategies that would bring an entire supply chain online. The goal is not to make all the elements of the value chain "Made in Canada" but to use a whole value chain approach to support and build Canada's most competitive and innovative elements.



How do we identify Canada's top economic opportunities in the global economy of the 21st century?

We designed an assessment framework with five criteria. This first involves assessing the technology and the role it is likely to play in a **net-zero future.** This includes the **maturity of the technology** and the associated abatement potential. We tried to identify areas where Canada will be relatively protected from intense global competition. Overall, it is much more difficult for small open economies to maintain competitive advantage in technologies and products that are candidates for mass global production unless they have clear national and innovation advantages.

Then we analysed three features of the cluster, looking upstream to resources and inputs and downstream to markets. **National advantage** assesses whether Canada is likely to develop and maintain long-term cost advantages. These may be due to the availability of relevant natural resources (natural capital), upstream inputs, or specialized labour skills (human capital), particularly in a regional and global context. **Innovation capacity** assesses whether Canada has an advantage due to existing firms or research clusters. The third area is **market potential.** This involves looking at what the export potential of a particular technology could be, either within the North American or global market. We focused on opportunites with export potential because Canada will need to develop new export markets as oil and gas receipts decline. We also sought to identify core technologies and services that would have large market potential to provide a pull on upstream elements.

This assessment framework was complemented and informed by an expert consensus survey. Participants were asked to allocate 1000 chips across technological opportunity areas across sectors such as renewable power for export (electric power sector) or medium-and-heavy-duty vehicles (transportation sector). This generated quantitative data which we incorporated into our analysis. The experts were also interviewed about their choices and we recorded this qualitative data and followed up on their suggestions.

— We designed an assessment framework with five criteria:

1. Role in a net-zero future

2. Maturity of the technology

3. National advantage

4. Innovation capacity

5. Market potential

A key aspect of the analysis was also the identification of important **uncertainties** affecting the likely prospects of the various technologies. We sought to identify opportunities where global uncertainties were low.

PRIORITY CLUSTERS FOR CANADIAN CLEAN GROWTH

We identified seven high priority opportunities, three enabling conditions, and eight further opportunities.

7 High Priority Cluster Opportunities for Clean Growth

Manufacturing medium and heavy-duty zero-emission vehicles

Green chemistry for biofuels, plastics, net-zero fertilizer

Carbon capture, utilization, and storage, and direct air capture

Alternative proteins for the agricultural sector

Green and / or blue hydrogen production

Mass structural timber for buildings

Net-zero aluminum refining

Taken together, these seven clusters provide a strong portfolio of opportunities that balance those for 2030 and 2050, include some that are low-risk and some high-risk high-reward, and provide opportunities for all regions of Canada. They also all centre on potential large markets and so can provide the demand-pull necessary to help industries upstream of them achieve competitiveness.

They draw on Canada's strengths in resources, while presenting the possibility of adding value to those legacy industries. They also take advantage of Canada's entrepreneurial advantage and seek to build on its strengths in cleantech.

Enabling opportunities exist in net-zero minerals, carbon accounting and expansion of the clean grid. And important opportunities also exist for net-zero mining operations, production of battery metals, smart energy tech for buildings, manufacture of non-ice marine shipping and fuel cell capacity, biofuels and manufacture of short-haul aircraft, vertical agriculture and low emissions fertilizers. See Table 1 for full details.

Table 1 presents two kinds of findings. First, we conducted an expert survey that asked respondents to allocate 1000 chips across opportunity areas. The table reports the median score across all respondents. Second, we assessed each opportunity according to three criteria outlined above. For National Advantage (resources) a 3 means Canada has high existing capacity, 2 that Canada has potential and an existing model or demonstration, and 1 that there is untapped potential only. For Innovation Capacity, a score of 3 means that Canada has a mature cluster of 5 or more firms in the sector, 2 that Canada has strong research capacity in universities and other institutions plus some promising startups, and 1 that there is research capacity only. Finally, we considered whether the market potential for the product was small or large, both regionally and globally. Top priority opportunities scored well on all three dimensions.

TOP OPPORTUNITIES	VALUE PROPOSITION	EXPERT SCORE (Chips Study)	NATIONAL ADVANTAGE (Resources)	INNOVATION CAPACITY (Research Clusters & Existing Firms)	MARKET POTENTIAL	OVERALL RATING (Priority, Probable, Possible)
Medium and Heavy-Duty Zero-Emission Vehicles	Manufacturing vehicles in niche markets such as school buses, garbage trucks, and forklifts. Creates market pull for mining, battery metals, and hydrogen.	69	**3** – Clean grid reduces manufacturing emissions footprint	**3** – Leading firms in Medium-duty and leading researchers in battery metals	**North Am:** Large **Global:** Unknown	**Priority**
Alternative Proteins	Process, package, and market plant based proteins. Develop IP in emerging tech for cell culture and fermentation. Creates market pull and focus for agriculture.	21.6	**3** – Builds on strengths in primary agricultural production	**2** – Large ag-science R&D research infrastructure; domestic processing industry to build on	**North Am / Global:** Large, fast growing global market	**Priority**
Aluminum	Aluminum refining to utilize intermittent renewables is advanced sufficiently (likely 20 years) to enable refining near the source of bauxite extraction.	Green Steel, Aluminum, & Cement – 58.4	**3** – Significant aluminum refining footprint	**2** – Existing efforts by firms to develop new IP	**North Am:** Large **Global:** Limited	**Priority**
Mass Timber	Structural timber for building, including development of underlying technology.	15.4	**3** – Extensive forest resources	**3** – World-class wood science research capacity, several commercial firms	**North Am / Global:** Large	**Priority**
Green Chemistry	Build upstream innovation capacity in biofuels, plastics, net-zero fertilizer, and battery processing.	Biofuels – 42.5; Plastics & Chemicals – 31.2	**3** – Sizable biomass production	**3** – Comparative advantage in green chemistry IP & commercialization	**North Am / Global:** Large	**Priority**
Carbon Capture, Utilization, and Storage	Integrated services for CCUS project planning and development. Develop innovative negative emissions technologies, such as Direct Air Capture (DAC).	30.5	**3** – Single point sources for carbon capture; downstream advantages in storage and blue hydrogen production	**2** – Existing R&D clusters; fossil fuel industry support	**North Am:** Small US has expertise **Global:** Large	**Priority**
Hydrogen	Green and/or blue hydrogen producing capacity. Development of downstream technologies such as hydrogen fuel cells.	80.6	**3** – Sizeable hydro-electric capacity, gas resources, and CO2 storage	**3** – leading fuel cell research cluster **1** – electrolyzers	**North Am:** Large **Global:** Small Long-run favours local production	**Priority**
ENABLING OPPORTUNITIES						
Net-Zero Minerals	Mining and processing of critical minerals for net-zero supply chains.	50.7	**3** – Key deposits	**3** – Existing firms	Large	**Probable**
Strong Carbon Accounting	Necessary for the operation of effective carbon markets.	33.1	**1** – Expertise must be redeployed	**1** – Expertise must be redeployed	Small	**Possible**
Clean Grid	Expand existing clean grid.	32.5	**3** – Clean power	**3** – Mature grid intertie	Small	**Probable**
IMPORTANT OPPORTUNITIES						
Net-zero mining operations	Environmental mining equipment to a growing minerals sector.	42.1	**3** – Mining sector can provide demand-pull	**3** – Existing cleantech mining firms	**North Am/Global:** Large	**Probable**
Battery Metals	Develop upstream capacity in the production of battery metals.	36	**1** – Mining resources could be developed	**3** – IP advantage in upstream components	**North Am/Global:** Large	**Probable**
Energy Management Tech for Buildings	Manufacture smart thermostats and other tech for buildings.	35.1	**1** – No significant national advantages	**3** – Existing cluster of companies	**North Am/Global:** Small	**Possible**
Marine Shipping	Manufacture net-zero vessels and components.	25	**2** – Leading fuel cell capacity upstream	**2** – Existing Ocean supercluster	**North Am:** Large **Global:** Small	**Possible**
Aviation	Manufacture short-haul aircraft and develop sustainable aviation fuel.	23.7	**2** – Existing industrial capacity	**2** – Research capacity and existing firms	**North Am:** Small **Global:** Small	**Possible**
Vertical Agriculture	Niche market for vertical agricultural systems.	21.9	**1** – Large ag science focused on outdoor	**2** – Several domestic firms in space	**North Am / Global:** Small	**Possible**
Low Emissions Fertilizers	Low or zero emissions fertilizers from sustainable inputs.	22	**2** – Feedstocks and industrial capacity	**1** – No advanced projects	**North Am / Global:** Large	**Probable**

SEIZING OPPORTUNITIES: FROM DESTINATION TO ROADMAPS

Federal, provincial, and First Nations governments can work with experts and the private sector to pursue these opportunities by co-developing clean competitiveness roadmaps.

A clean competitiveness roadmap is a strategic collaboration between experts, industry, finance and governments at various levels. It can serve as the basis of an effective industrial strategy. A roadmap lays out targets, priority actions, policies, investments, and social innovations needed to bring an industry to scale and generate long-term economic value for the cluster and the country. Their power lies in the connections, commitments, and coordination that emerge from true collaboration across all parts of society.

Roadmapping processes in these priority clusters would build on the federal government's economic strategy tables, a variety of provincial initiatives, as well as industry roadmapping exercises. The ongoing experiments in roadmapping and pathway development are exciting, but there is a need to bring these efforts together, align them, and facilitate learning across sectors.

What are the key elements of a strong roadmap?

Look to 2050. The first step is a global analysis that positions the cluster in the 2050 energy system. What technologies will the world need to reach net-zero? Which net-zero technologies will have large global markets? What features of the industry will help make it competitive? This analysis needs to respect the profound uncertainties inherent in such an exercise and lay out multiple possibilities. With a clear picture of the 2050 landscapes, strategic action can begin.

Co-design pathways to 2050. Build a shared roadmap that advances the upstream, midstream, and downstream elements of the cluster to 2050. Outlining a set of priority actions and sequences is crucial to ensure that all the elements of the cluster move in step.

Advance to 2050. Finally, the partners need to co-design and co-deploy the policy and investment interventions that can deliver the 2050 vision. But even well-laid plans will be undone by events, so the industry must experiment, learn, and adjust over time.

How do we successfully create and implement roadmaps?

The success of the roadmaps will depend on fostering strong collaborations between the public and the private sector. When organizations on both sides can learn together, roadmapping processes can be co-developed and co-deployed with purpose and skill.

The key to this is establishing **good information flows** between the public and the private sectors. This is the foundation of good industrial policy. Governments need good quality information from the private sector to make smart investments in the energy transition. At the same time, the government must be careful not to become captured by special interests. If the private sector is the only source of information and analysis, governments risk making investments that do not serve the long-term interests of society as a whole. So, independent expertise is needed.

The Economic Strategy tables, the Superclusters and ongoing roadmapping initiatives are valuable precisely because they work to create the kinds of information flows needed to support strategic action. But Canada needs a set of nimble, yet permanent institutions that will facilitate good information flows and provide a place for strategy, independent expertise, and learning. Moreover, rather than convening large groups of incumbent firms, our roadmap approach is premised upon bringing together willing coalitions of actors invested in the transition from across the whole supply chain.

Different countries use different kinds of institutions to serve these functions. **An excellent model for Canada can be found in the European Commission's hydrogen strategy and battery alliance.** The European context is a good analogue for Canada's federal structure. Canada and Europe share multi-level governance challenges and the need to coordinate many agencies with overlapping jurisdictions.

To develop clean growth strategies, the European Commission and its member states work closely with a public-private partnership called InnoEnergy. InnoEnergy has the deep domain expertise necessary to create strategies in complex technical areas. It has the business know-how to guide and support firms big and small. The European Commission leadership works with InnoEnergy to establish a shared vision and secure funding for projects.

As a public-private partnership, InnoEnergy has the agility and independence to work across jurisdictions and issue areas to coordinate action on clean growth. It demonstrates that a public-private partnership can be an indispensable piece of a clean growth industrial strategy.

What is the role of Governments in this process?

Identify priorities and set clear targets. Given scarce resources and small global scale, governments of small open economies must provide the strategic focus society needs. This means identifying priority areas on the basis of their potential contribution to the long-term welfare of society as a whole.

Use public finance to facilitate experimentation and learning. Governments are needed to solve market failures in environmental sectors and provide the incentive to act early. But many are concerned that this amounts to "picking winners." But clean growth strategies are not about picking winners; they are about building a cluster's capacity for innovation and action over time. A publicly-funded strategy for research, development, deployment, and demand-pull allows public and private actors to learn collectively.

Engage and coordinate up and down the verticals. The government must help ensure that all the elements of the cluster or vertical move together. The supply chain is developed at the same time as end-use markets are brought online. The government has an important coordination role to play here. It can effectively delegate the role to an independent organization like InnoEnergy in the EU, but it needs to stay involved.

RECOMMENDATIONS

In conclusion, our analysis of Canadian opportunities and international case studies suggest that governments, First Nations, firms, and civil society organizations should:

1. Focus strategic efforts in high priority areas

- We identified seven high priority clusters: **medium- and heavy-duty zero emissions vehicles, alternative proteins, mass timber, green aluminum, green chemistry, hydrogen, and carbon, capture, utilization, and storage.**
- We do not claim to have provided the final word, but government should seek to identify priority areas by considering Canada's position as a small open economy in a rapidly changing global economy and **developing a rigorous framework to assess global competitiveness.** It can then use this to create strategic focus.

2. Engage in collaborative roadmap exercises

Governments, firms, and civil society organizations should support and participate in externally-driven roadmapping exercises.

- **Governments** need to set clear goals and targets, provide public finance, and use its capacity to catalyze action up and down the clusters.
- The **federal government** should seek to align these efforts by convening a high-level cross-departmental clean growth strategy table.
- **Firms** should work in small, committed groups to create technologically, politically, and socially specific roadmaps that chart a clear path to 2030 and 2050 goals.
- **Civil society** should provide its expertise to these exercises, and serve as a locus of learning and experimentation.

Settler organizations and governments should look to First Nations for leadership. They must find ways to support the full sovereignty of the Nations, consistent with the UN Declaration on the Rights of Indigenous Peoples, as they transition to clean energy and improve the livelihoods of their peoples.

3. Take a cluster approach, focusing on the highest value-added areas

Roadmapping exercises should align and drive all the elements of decarbonization technology clusters, looking **upstream** to resources and innovation capacity, and **downstream** to end-uses and markets. Roadmaps must align supply-push and demand-pull policies as well as outline finance and policy needs.

But as a small open economy, Canada should not try to replicate all parts of the value-chain. Rather, it should seek to **build competitive niches** (in, for example, battery metals processing) where Canada can build world-class sub-clusters in high value-added areas. Other areas of the value chain can be imported or subsidized to provide the demand-pull needed to bring high value-add niches online.

cont.

4. Use roadmaps to focus existing funding streams and inspire new strategic investments

We have pointed out the tendency of governments to fund one-off projects that benefit single firms. Roadmaps have the potential to identify strategic investments that bolster the development of true innovation clusters.

The Strategic Innovation Fund, the Canadian Infrastructure Bank, and other funds and agencies should collaborate with roadmapping exercises to develop high-quality projects that meet public sector criteria while increasing the scope and ambition of transition investments.

5. Build intermediary organizations that can support green industrial strategy

Canada needs to build public-private partnerships like InnoEnergy to serve as effective intermediaries. Partnerships or other third-party entities can facilitate good information flows between governments and businesses, provide independent expertise, and serve as a site for learning and experimentation.

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The Pacific Institute for Climate Solutions (PICS) develops impactful, evidence-based climate change solutions through collaborative partnerships which connect private and public sector solution seekers with experts from BC's four leading research universities. PICS is hosted and led by the University of Victoria, in collaboration with the University of British Columbia, Simon Fraser University, and the University of Northern British Columbia.

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The Transition Accelerator exists to support Canada's transition to a net zero future while solving societal challenges. The Transition Accelerator works with innovative groups to create visions of what a socially and economically desirable net zero future will look like and build out transition pathways that will enable Canada to get there. The Transition Accelerator's role is that of an enabler, facilitator, and force multiplier that forms coalitions to take steps down these pathways and get change moving on the ground.

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Smart Prosperity Institute

Smart Prosperity Institute is a national research network and policy think tank based at the University of Ottawa. We deliver world-class research and work with public and private partners – all to advance practical policies and market solutions for a stronger, cleaner economy.

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