Sciences Po
Energy Review

EU-Canada Energy Relations:

Cooperation Opportunities and Shared Challenges

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EUROPEAN CHAIR FOR SUSTAINABLE
DEVELOPMENT AND CLIMATE TRANSITION

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Contents

About 2

Editorial Note 5

Annotated Bibliography 7

Interview with Darius Snickeus 12

Interview with Antonina Scheer 15

Critical Essays

Easy-to-Transport Materials for Hard-to-Decarbonize Sectors: The Case for Canada-EU agreements on Green Iron Production **18**

A SWOT Analysis of EU-Canada Cooperation on Rare Earth Elements **24**

Critical Minerals, Critical Moment: Strengthening Canada-EU Collaboration to Advance Sustainable Mining Standards **30**

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Introduction

About the Board

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Clara is a master's student in International Energy Transitions at Sciences Po. She holds a bachelor's degree in Political Science from the London School of Economics. Currently, she is an analyst intern in the division for energy technology policy at the International Energy Agency, where she works on clean energy technology supply chains and trade. Clara has previous experience in FDI and trade consultancy and energy market research.

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Natalia is an M2 in International Economic Policy at PSIA and a Policy intern at Business at OECD. She is interested in the intersection of technology, energy, and economic policy - a nexus she explores at the OECD and at Sciences Po Energy Review. Prior to starting her Master’s, Natalia worked in International Trade law, interned at the Council on Foreign Relations, and for the U.S. Department of State.

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Madeleine is a dual master’s student in Environmental Policy and International Political Economy at Sciences Po Paris and the London School of Economics. She has recently focused her research on sustainable insurance at the UN Environment Programme Finance Initiative (UNEP FI) and currently works at the Center for Economic Transition Expertise (CETEx), where she works on the integration of insurance into adaptation strategies for the European agrifood system.

Introduction

We gratefully acknowledge the support from the CARE team, without which this issue would not have been possible.

About The Climate Adaptation, Resilience and Empowerment (CARE) Program

The Climate Adaptation, Resilience and Empowerment (CARE) Program is an international collaboration between Sciences Po, the University of Toronto, the University of British Columbia and the University of Guelph. It aims to equip graduate students with the knowledge, skills and networks needed to address the complex challenges of climate change through interdisciplinary education, applied research and international collaboration. CARE brings together students, researchers and practitioners across disciplines and continents to explore the social, political and economic dimensions of climate action. Through joint projects, fellowships, public events and a growing network of partners, the programme builds bridges between academic inquiry and real-world transformation. Beyond fostering exchange among universities, CARE serves as a platform for experimentation and co-creation - encouraging participants to rethink climate governance, justice and sustainability through comparative and transnational perspectives. Its activities span collaborative research on sufficiency and low-carbon transitions, capacity-building initiatives such as the CARE Climate Leadership program, and the development of shared resources for teaching and engagement. At its core, CARE seeks to nurture a community of emerging climate leaders able to navigate complexity, work across sectors and borders, and contribute to systemic change toward a more equitable and sustainable future.

Introduction

About the Sciences Po Energy Review

The Sciences Po Energy Review is a graduate student-led publication to advance dialogue about energy. Motivated by the pressing global need for energy transitions, the journal primarily employs a social scientific approach without being constrained by any single discipline, featuring graduate student writing and expert analyses. By placing contributors in conversation with peers and experts, the publication seeks to strengthen existing debates and research about energy at Sciences Po and beyond, and welcomes submissions from all around the world. The Sciences Po Energy Review is hosted by the European Chair for Sustainable Development and Climate Transition. The Review was founded by Gabriele Romeo and Ernest Lee (Promotion 2024).

About the European Chair for Sustainable Development and Climate Transition

The mission of the Chair is to advance education, innovation and public dialogue for the design and practice of policies for sustainable development and climate transition, within and outside of Europe. Challenges of climate change adaptation, decarbonisation, safeguarding planetary boundaries, green financing, biodiversity depletion and geopolitical environmental risks need to be understood and overcome in order to advance ambitions of the European Green Deal. The Chair's mission is to drive education, innovation, and public discourse in the development of sustainable policies and climate transition, both within Europe and globally. We are dedicated to addressing critical challenges such as decarbonization, climate change adaptation, implementing the energy transition, green finance and minimising environmental risks. Our ultimate goal is to support the European Green Deal's ambitious objectives. Our work centres on facilitating social and environmental transitions. We focus on analysing the content and governance of policies, partnerships, and actions needed to create transformative pathways for regions and cities. Our aim is to strike a balance between economic growth, social progress, and environmental protection. We are committed to establishing a broad network of actors who will contribute to research, education, and discussions on important topics such as regional well-being, just transition, climate mitigation and adaptation, energy transition, and climate-resilient infrastructure. Our approach embraces various perspectives, including economic, sociological and technological, overcoming traditional disciplinary boundaries. Hosted at the Paris School of International Affairs (PSIA) and the School of Public Affairs, the Chair is governed by two committees with the help of a team. The Chair is funded by: Hermès International, HSBC and the European Investment Bank (EIB).

Editor's Note

The harsh geopolitical climate has reminded us that Canada and the EU-27 share many of the same political values and priorities. There is strong impetus for cooperating on energy: The European Union faces energy constraints, whereas Canada holds vast energy resources. The question is therefore not one of intent, but of whether deepened energy cooperation can be realised in practice. While oil remains easy to transport across seas, could other forms of Canadian energy reach the EU?

Building cross-Atlantic infrastructure like subsea interconnectors, LNG terminals and establishing hydrogen corridors have been on the cards for some time now. But politics and timing is as important as technical feasibility. In our interview, Darius Snickeus depicts the political narratives shaping Canada's energy infrastructure projects. We discuss how this, together with changing demand, will affect the cross-Atlantic energy flows (p. 12). Another option is to locate energy-intensive manufacturing steps in Canada – circumventing the need for complicated infrastructure. In their critical essay, Sequiera et al. argue that Canada should focus on exporting green iron rather than green hydrogen, which would allow it to retain value in Canada while allowing Europe to meet its green steel targets (p.18). This could be an attractive trade-off for the EU: By importing green iron from Canada, the EU could involve more states in its quest for building a green steel market, while saving its scarce energy resources for later steps of the steelmaking process.

The EU-Canada energy cooperation has historically focused on energy security. During the 1970s, Canada was seen as a bastion of energy security, as it helped found the IEA and became one of the G7-countries. Later, climate change came to dominate EU policy agendas, pivoting priorities further apart. But today, the energy security notion has once again taken a prominent position in the energy discourse. But today it is not just about oil.

Clean energy technologies like solar PV, wind and EVs need critical minerals to run. As the importance of these technologies grows, the need to secure critical minerals supply chains has become clear. With promises of investment flowing from the EU into the Canadian mining sector, will the EU-Canada critical minerals collaboration become a success story? Aya Darwash & Rosa Lawrence's piece offers a comprehensive analysis of the current state of the Canadian rare earth elements mining through their detailed and example-rich SWOT analysis (p. 24).

The EU has been clear on its commitment to ESG. A 2024 survey found that one in ten Canadian mining companies still operate without a formal ESG strategy. Will the EU's ambitious standards hamper its role as an assertive critical minerals partner? However, having the EU forge ahead as a regulatory ice breaker role could be a strategic benefit for governments who want to tighten up their standards without having political tailwind to do so. Laura Smith's piece offers a hopeful view on the effect of EU environmental regulation on mining practices in Canada (p. 30).

Increased cooperation also offers valuable opportunities for policy learning. Comparing the procedural justice processes for indigenous populations in mining and clean energy project development can offer Canada and the Nordics interesting comparison points and pinpoint weaknesses (see p.10). Another shared challenge rests with fossil fuel employment. My interview with Antonina Scheer casts light on the centrality of solving fossil fuel employment 'addiction' to unlock more climate action (p. 15). Previous fossil fuel phaseouts, like that of coal in Germany, can also offer valuable learnings for Canadian policymakers (p.7).

Together with the editorial board, I hope that this issue will serve to inspire and develop thinking about EU-Canada cooperation. Thank you for your thought-provoking critical essays. Thank you to the editorial team for curating the bibliography, and providing feedback to our authors. Finally, I want to extend a warm thank you to the CARE team, who made this issue possible and were patient and helpful as we put this issue together. ■

Clara Klint - Editor in Chief, Paris, November 2025

PART I

Annotated Bibliography

Annotated Bibliography

Framing the debate.

The following section offers a series of short notes which summarises and reviews literature connected to the issue theme, offering a starting point for the discussion, as well as a complement to the contributions in this issue.

German and Canadian Commissions for Just Transition: How structural issues stifled ambition.

Citation: Gürtler, K., Löw Beer D, and J.A. Herberg. "Scaling Just Transitions: Legitimation Strategies in Coal Phase-out Commissions in Canada and Germany." *Political Geography* 88 (April 28, 2021): 102406. https://doi.org/10.1016/j.polgeo.2021.102406.

Note by Madeleine Tron: In 2018, both Germany and Canada established stakeholder-driven commissions to design a just transition away from coal. Canada's commission had a more limited mandate, focusing on recommendations for local structural changes in communities and among energy workers, in line with the government's 2030 target and subsequent national energy policies. On the other side of the Atlantic, the German government tasked its commission with far broader responsibilities, including developing a national phase-out plan and a comprehensive strategy for transitioning affected regions. Questioning the legitimacy dynamics surrounding such commissions, Gürtler, Löw Beer, and Herberg (2021) show how overly broad mandates and poorly defined democratic processes can result in insufficient climate ambition, at a disproportionate cost to secure local support. Comparing Canada and Germany, the authors provide key insights into the factors that determine the extent to which the recommendations of these temporary advisory bodies are accepted by the public and aligned with scientific expectations. Semi-structured interviews conducted with commission members reveal several dysfunctions inherent to these bodies. Notably, the broad scope of the German commission emerged as a key factor explaining its low level of ambition as the commission ultimately agreed on a 2038 phase-out target, significantly less ambitious than Canada's 2030 goal – or as the authors bluntly summarise the German strategy: 'global climate ambition has been traded in for acceptance at the local level' (p.12). This piece offers a critical perspective for analysing the factors influencing the success of multi-stakeholder commissions, while also highlighting that the outputs of such commissions are strongly shaped by their members, agendas, and internal organisation.

Annotated Bibliography

Parallel paths or partnership? On EU & Canada's evolving energy relationship

Citation: Dolata, Petra, and Petra Dolata. "Canada, the EU and Energy Security: A Historical Perspective." *Canadian Foreign Policy Journal* 28, no. 3 (September 2, 2022): 216–33. https://doi.org/10.1080/11926422.2022.2125411.

Note by Natalia Feinberg: This piece offers an insightful backdrop to contemporary discussions about transatlantic energy cooperation. By situating current policy debates within a longer historical trajectory, it is possible to see how shifting geopolitical priorities, trade patterns, and environmental commitments have both shaped and constrained the potential for deeper Canada–EU energy collaboration. It is a great piece that approaches what many view as a technical problem with a political and historical response, particularly by stressing the harm of the consistent disconnect between political rhetoric and practical alignment. Canada and the EU have long shared common values around market liberalisation, sustainability, and security, yet their energy relationships have evolved in parallel rather than in partnership. The author's historical perspective shows that these gaps stem not only from geography and infrastructure, but also from differing regulatory cultures and strategic identities. This historical framing adds great value to the present conversation on energy transition and security, especially as both sides grapple with the dual imperatives of decarbonization and diversification away from Russian gas. Overall, this analysis provides valuable grounding before diving into policy specifics and reminds all who are less familiar with energy policy that today's challenges are rooted in decades of asymmetrical priorities and missed opportunities.

On the Physical Limits of EU-Canada Cooperation on Gas

Citation: Shendrikova, Diana, Lorenzo Rinaldi, Emanuela Colombo, Diana Shendrikova, Lorenzo Rinaldi, and Emanuela Colombo. "Geopolitical Application of 'Like-Mindedness' Indicator in Choosing and Diversifying EU Energy Partners to Substitute Russian Gas." *SSRN Electronic Journal*, January 1, 2023. https://doi.org/10.2139/ssrn.4604047.

Note by Isha Hiremath: This article provides a framework for understanding how the European Union's pursuit of energy security intersects with its commitment to shared values. Following the Ukraine conflict, the EU has increasingly invoked partnerships with "like-minded" countries as part of its de-risking and diversification strategy. Shendrikova, Rinaldi, and Colombo advance this conversation by developing a measurable Like-Mindedness Indicator (LMI) that quantifies the value alignment between the EU and potential gas suppliers. From the perspective of Canada–EU relations, the article reinforces the notion that Canada stands among the EU's most natural energy partners, both ideologically and institutionally. Yet the authors also highlight the paradox that, despite this strong normative compatibility, Canada's role in Europe's gas supply remains marginal due to infrastructural and export constraints. The paper thus underscores a critical disjuncture between value affinity and material capacity: a theme that has long defined transatlantic energy cooperation. The current state of flux in geopolitics is antithetical to the longer timelines required for energy infrastructure. Under such circumstances, finding a long-term reliable partner is of the utmost importance for any country dependent on imports for energy. I found the authors' approach, by developing a tool to help determine reliability using the LMI extremely timely. But will this stand the test of time? Only time will tell.

Annotated Bibliography

On why Canada won't become a green oil giant

Citation: Cosbey, Aaron. Why Canada Is Unlikely to Sell the Last Barrel of Oil. International Institute for Sustainable Development, December 14, 2022. [Article Link]

Note by Natalia Feinberg: I found this piece both compelling and refreshingly blunt. It tackles four central questions that may unsettle the idealistic energy enthusiast but are essential for anyone seeking a realistic grasp of Canadian energy production. First, it underscores that nearly all of Canada's crude oil is exported to the United States, unpacking how U.S. refinery configurations and domestic policies deeply influence Canadian export prospects. It then asks whether Canada's strong ESG commitments can help it secure new markets. The author draws a critical distinction between investors and customers, highlighting that while investors may prize sustainability, refineries, which are Canada's actual customers, are far less sensitive to how sustainable production is. This makes clear that ESG leadership alone will not restore Canada's lost market share. The third section confronts the economic realities of Canada's relatively high production costs, while the conclusion zooms out to the global level. It considers how weakening OPEC discipline could amplify price volatility, a development with serious implications for Canada's oil sector. Altogether, the article delivers a sobering but necessary assessment of the structural and market forces shaping Canada's energy future.

Understanding the recovery of Canadian oil sands: no longer on the margins?

Citation: Ihejirika, Nnaziri. *The Canadian Oilsands and Strategic Approaches to Profitability*. Oxford Institute for Energy Studies, August 2019. [Article Link]

Note by Gabriele Romeo: How have Canadian oil sands producers weathered past energy market turbulence, and what are their future prospects? This Oxford Institute for Energy Studies (OIES) Insight by Nnaziri Ihejirika touches on a theme that will resonate with any energy enthusiast: technology's power to drive resilience and growth. Challenged by the ascent of US tight oil and the 2014-15 price crash, oil sands producers, long positioned at the upper end of the global supply curve, were compelled to innovate to survive. Ihejirika examines how leading firms turned to automation, predictive maintenance, solvent and input optimisation, modular facility design, and improved bitumen upgrading, all contributing to remarkable reductions in project breakevens. Fast forward to 2025, and several market observers now note that Canadian oil sands operations have become more cost-competitive than many of their U.S. counterparts and other marginal producers. Recent revisions to Alberta's carbon tax framework may further encourage reinvestment in emissions reduction and efficiency gains. The author also points to vertical integration as a lever for future profitability, an approach already pursued, with mixed results, by several oil and gas companies worldwide. Several uncertainties flagged in the 2019 paper have since been resolved, notably expanded offtake capacity and access to new markets through Enbridge's Line 93 and the Trans Mountain pipeline to the Pacific Coast. I recommend this paper to anyone seeking an informed, cautiously optimistic perspective on an industry that remains central to Canada's economic vitality, technological progress, and decarbonisation journey.

Annotated Bibliography

Going back to the start: How the Californian gold rush shaped the mining rulebook

Citation: Dallaire-Fortier, Clara, and Clara Dallaire-Fortier. "Shaped by Boom-and-bust: A History of the Canadian Mining Industry Since 1859." New Political Economy 30, no. 1 (July 7, 2024): 1–18. https://doi.org/10.1080/13563467.2024.2373053.

Note by Clara Klint: The need for critical minerals for clean energy technologies, coupled with the poor human rights and environmental track record of the mining industry represents one of the darkest trade-offs of the transition. Taking a historic deep dive, Clara Dallaire-Fortier's article maps Canadian mining from 1859 to today. Her research shows how factors like finance flows, prices and labour intensity shaped industry dynamics and its role in the economy over time. For example, it is fascinating to read how 160 year old institutional lock-ins still shape the rulebook for mining today: In the mid-1800s a rapid influx of speculators into Canadian mining - who had previously profited from the Californian gold rush – meant Canada needed to establish regulation quickly to support its resource-based economic development model. The strong bargaining power of foreign speculators created strong rights for foreign companies and shareholders that remains with us today. This article is a critical political-economy read for anyone who is interested in how we can build a fairer mining industry.

Indigenous Rights & Mining: Why Sweden should look to Canada

Citation: Lindahl, Karin Beland, Gary N Wilson, Christina Allard, and Greg Poelzer. "To Approve or Not to Approve? A Comparative Analysis of State-Company-Indigenous Community Interactions in Mining in Canada and Sweden." *Environmental Management* 73, no. 5 (March 6, 2024): 946–61. https://doi.org/10.1007/s00267-024-01949-7.

Note by Clara Klint: Recent proposals for new mining and energy projects in the north of Sweden, have cast light on the governance of indigenous rights of the Sami people, whose land - the sparsely populated north - has often been treated as a resource-rich periphery. Beland Lindahl et al's mapping of five active mining projects in Canada and Sweden offer a view on the factors shaping outcomes for Indigenous people. Grounding their study in interactive governance theory, they compare the procedural soundness and acceptance of outcomes among indigenous groups affected by mining projects in both countries. The countries operate differently: Canada safeguards indigenous interests to a much greater extent than Sweden in its approval processes. While Canada has long tried to reconcile with its indigenous communities, with their rights enshrined in law, the Swedish government tends to treat indigenous reindeer herding as one public good to be balanced against others. Canada's protection has allowed indigenous communities to develop a stronger more state-like organisation, enabling negotiations with companies to take place on more equal footing than in Sweden, and fostered broader coalitions with other stakeholders. Bolstering procedural justice can help achieve better outcomes between involved parties. As such, this study provides a critical starting point for discussing governance of Sami rights in mining approval processes and how governance structures affect the range of possible outcomes in mining approval processes.

PART III

Interviews

Darius Snickeus on the State of Canada-EU Energy Cooperation

Darius Snickeus, Business Correspondent | Canadian National Observer

Darius Snieckus, Business Correspondent at Canadian National Observer, was formerly Chief Executive Editor of Aegir Insights, an offshore wind consultancy. Between 2009-2023 he was Technology Editor and later Editor-in-Chief of *Recharge*, a global renewable energy news and intelligence website and magazine, as well as the convenor of its long-running Thought Leader Roundtable series. Snieckus has written on energy for some 25 years, between 1996-2008, serving on editorial staffs at leading oil & gas titles including *Offshore Engineer*, the *Oil & Gas Journal* and the *Petroleum Economist*. He is a regular speaker, moderator and panellist at international wind power and renewable energy conferences, and a commentator on the energy transition and the blue economy.

Isha: ***There is a growing interest in critical minerals and a recent joint declaration between Germany and Canada. A report said the EU was the largest investor from 2014–2019, but after COVID there was a switch to China. Do you think these new agreements will change who the top investor is or is this mainly political talk?***

Darius: China has an absolute stranglehold not just on mining but also on processing. Critical minerals aren't only about digging ores out of the ground: the real value comes from processing them into usable, high-spec products. That's where China has invested for two decades, especially in graphite, rare earths, and lithium refining. By contrast, Canada has the raw materials, but without large-scale processing facilities, those resources are of little use. The International Energy Agency projects a global market for critical minerals of around $780 billion by 2040, which highlights the scale of economic and geopolitical stakes. Europe knows it cannot depend on China and will look for partners with stable governance and shared democratic values.

So yes, I do believe that European money will flow into Canadian critical minerals, especially since the EU needs reliable G7 partners. But it's important to say: current declarations are essentially MOUs. The test will be whether they crystallize into contracts with real investment and infrastructure, or remain "agreements to agree."

Clara: ***Is the EU seen as a reliable partner, or one arriving opportunistically after the squeeze was felt?***

Darius: Canada does not see the EU as opportunistic. There's a long history of trade and cultural ties between the two, so this isn't a new relationship starting from scratch. Canada values these connections and frankly, Canada also needs them.

What's changed is the framing: critical minerals are now tied to defence as well as energy. They are used in guidance systems, protective gear, and other defence applications. Canada's ministers have started to speak of critical minerals in the same breath as national security. So it used to be kind of an energy plus defence narrative but it's increasingly becoming kind of a defence plus energy narrative. This gives the relationship more strategic weight than before.

Isha: ***Let's talk LNG, and exports to Europe. You've argued the EU's demand will decline, making an east-coast LNG terminal unprofitable. If Canada produces abundant cheap LNG, won't buyers still come?***

Darius Snickeus on the State of Canada-EU Energy Cooperation

Darius: This is one of the most complicated issues in Canada's energy debate. On the surface, it seems logical: energy is essential, so cheap LNG should always find a buyer. The promotion is very much around the fact that we have the lowest risk, lowest carbon LNG on the planet in Canada. So, the LNG from Canada is much different from the ones that are sourced from Qatar or the U.S., which come with their own set of political entanglements. Canada is posing to be an honest broker for the EU. However, at present we have no export infrastructure which is directed towards the European markets, and by the time an FID is taken, and an export terminal is constructed, the demand is projected to decline. Forecasts by analyst groups such as Rystad, Bloomberg, and Wood Mackenzie all point towards plateauing demand by 2030. Canada risks entering the market just as it shrinks.

Clara: ***How important is oil & gas to Canada's economy?***

Darius: The reality is very different from the perception. If you ask Canadians what their biggest export is, most will say oil and gas. Alberta in particular has shaped the narrative that the nation depends on hydrocarbons. But in truth, oil & gas only contributes around 3% of GDP and 0.7% of jobs.

This mismatch creates political distortion. Because the sector is so loud, policymakers act as if it's Canada's economic backbone. Meanwhile, opportunities in clean industries are undervalued. For instance, the IEA projects much lower global oil & gas demand by 2050 than Canada's own regulator does while Canada's forecast is about six times higher! That gap isn't just "optimism bias"; it's delusional, and risks leaving Canada behind while other countries industrialize around renewables. There's also an employment angle. Clean industries like renewables, storage, and efficiency can create far more jobs than oil & gas currently sustain. By sticking with outdated projections, Canada risks missing this industrial shift.

Isha: ***There are other transatlantic interconnection projects on the table. What should we make of the NATO L, an HVDC power link connecting Canada with the EU?***

This is a fascinating project. Cost estimates put it around $30 billion, which sounds huge, but compare it with Canada's Trans Mountain pipeline (TMX) expansion, which cost $34 billion for a much smaller infrastructure project. So financially, NATO L is not unrealistic. Technologically, there's nothing unproven here. China has already built long HVDC trunk lines, and similar projects have been attempted elsewhere. NATO L would transmit clean Canadian electricity directly to Europe, helping stabilize grids as more renewables come online.

"Canada risks entering the [LNG] market just as it shrinks."

The problem isn't cost or technology — it's politics and priorities. Canada's government is currently investing political and financial capital in LNG terminals and CCS projects, not in nation-scale clean power transmission. We're not seeing NATO L or Wind West being discussed. Prime Minister Carney came in on a promise of accelerating the energy transition and climate ambition. However, early indicators are the opposite. Even though NATO L could be transformative, it's absent from the current "nation-building" project list. That reflects how political decisions, rather than technical or financial barriers, are slowing the shift. If built, NATO L could make Canada a battery for Europe by exporting clean power across the Atlantic. But for now, it remains an idea waiting for political momentum.

Darius Snickeus on the State of Canada-EU Energy Cooperation

Clara: ***Could deeper EU–Canada energy integration force the EU's to relax some of its regulatory standards?***

The energy transition is an industrial transformation. Too often it's framed narrowly as an energy issue, when in reality it's about reindustrializing economies around new technologies. The EU understands this. Its Green Deal links climate policy directly to industrial competitiveness. That's why EU policies, despite occasional slowdowns, drive systemic industrial change. By contrast, Canada is still stuck in a binary narrative: old vs new energy, hydrocarbons vs renewables. This makes it harder to design industrial policy for the transition. There are ways to bridge this gap. For example, geothermal development could repurpose oil & gas drilling skills, making the transition less politically polarizing. But it requires political will and investment.

"Ultimately, provinces can resist federal leadership, but they cannot resist global capital trends."

So, EU–Canada cooperation could absolutely strengthen the EU's stance by broadening supply chains and industrial collaboration. But Canada needs to stop treating the transition as just an energy story: it is about the entire economic transformation.

Clara: ***How do provincial politics shape the transition in Canada?***

Darius: Canada's federal structure makes the energy transition uniquely challenging. Provinces control resources; the federal government controls infrastructure. That alone sets up friction. Canada lacks interconnections between provinces. A national grid could balance power across regions, improving resilience and lowering costs. Such a project has been costed at $34 billion, the same cost as the TMX pipeline. It is not a question of technological and financial feasibility but rather, of political feasibility.

Take Alberta: It is currently in the process of finalising its destructured energy market plan. According to some analysts, 11 GW of renewables projects exited Alberta's queue because investors saw regulatory uncertainty. That's an enormous lost opportunity, and lost investments. The key principle here is that climate risk is capital risk. Provinces that resist clean investment risk losing capital flows entirely. Markets will punish delay. Ultimately, provinces can resist federal leadership, but they cannot resist global capital trends.

Isha: ***Anything we've missed?***

Darius: Yes! We can't complete a conversation without talking about Green hydrogen. This is a cautionary example. Two years ago, it was hyped as the future, with Canada and Germany signing three MOUs. Analysts predicted green hydrogen would quickly outpace blue or grey. But reality has been different: demand is not there, and those MOUs have gone quiet.

This shows the dangers of overpromising on unready technologies. Meanwhile, CCS potential is overstated with studies suggesting only about 10% of the claimed global storage capacity is realistic. Yet policymakers talk as if CCS could absorb unlimited emissions. That's not science, it's messaging. The energy transition is less than 20 years old. It's messy, contested, and uneven, much like the early industrial revolution. There will be hype cycles, false starts, and political battles. But the underlying transformation is unstoppable. The real risk is that Canada delays while others move ahead, missing out on jobs, industrial growth, and strategic influence. ■

The Dynamics of Fossil Fuel Employment with Antonina Scheer

Antonina Scheer, Senior Policy Fellow | LSE

Antonina is a Senior Policy Fellow at the London School of Economics and serves as the Deputy Director of the TPI Global Climate Transition Centre (TPI Centre) at the London School of Economics (LSE). The Centre is an investor-backed initiative guiding investors who want to invest for the climate. There, she supervises the ASCOR (Assessing Sovereign Climate-Related Opportunities and Risks) project, which benchmarks climate mitigation strategies across more than 80 countries. She also oversees cross-cutting research on themes such as the just transition. Prior to her current role, Antonina was an Analyst at LSE's Grantham Research Institute on Climate Change, contributing to corporate climate assessments and sectoral decarbonisation pathways. Her earlier experience includes roles at the Climate Bonds Initiative and IRENA. She holds an MSc in Environmental Change and Management from the University of Oxford. She earned her BSc in Environment, Geology, and Economics from McGill University.

Alberta produces some of the world's most expensive and carbon-intensive oil from its vast oil sands. In their study, Antonina Scheer and colleagues investigate the potential labour market repercussions of a declining oil industry. By studying economic performance across all sectors during a prolonged slump, they show how negative impacts extend well beyond sectors directly involved in extraction. In my interview with Antonina, we discuss the dynamics of unconventional oil employment, and how solving the fossil fuel employment question could be a lever for unlocking further climate action.

Clara: *Why research fossil fuel employment in Alberta?*

Antonina: The Paris Agreement has this idea of common but differentiated responsibilities, the idea that wealthy countries should be doing more, they should be moving faster, they should hit net zero sooner, they should spend more on R&D and allow the spillovers to benefit other countries. Coming from Canada, it's a wealthy, very high-emitting country, and also a settler state with a colonial history. There's a very clear reason for Canada to be among the first and most ambitious leaders in mitigation and reducing emissions.

At the same time, we're a major fossil fuel producer, and that drives a lot of the politics around climate change in Canada. If we could try to get the just transition right in Canada, that there's a way to protect the workers, jobs, and prosperity of people who now rely on oil and gas, then that would remove a big blocker for Canada to be doing more on climate action.

" If we could get the just transition right that would remove a blocker for Canada to do more on climate action."

But it's extremely challenging, and just transition needs to be more than a narrative and a promise. It needs to be matched with real support - it runs very deep: The identity and the type of prosperity that you get from extracting a fossil fuel is hard to match.

The Dynamics of Fossil Fuel Employment with Antonina Scheer

Clara: ***What do you think we get wrong when we talk about fossil fuel employment in the current debate or even in the academic discourse?***

Antonina: Talking to people in the industry I learned there are things beyond the economics, such as identity. A lot of people working in the oil sands, they feel a justified pride in having been part of a prosperous industry. While recognising the local environmental harms and the global climate harms, there is something to respect in community pride and pride in doing hard work. That is much stickier than just the jobs.

" There's pride in doing hard work. That is much stickier than just jobs"

But at the same time, a lot of workers really just want to be able to feed their families. There is a lot of openness and willingness to transition. So those are two truths that slightly contradict each other, but we live in a world of contradictions. So managing that, starting with that respect, recognising that identity, and then building dialogue from there - that's the wider politics of the question.

Clara: ***Should we expect fossil fuel workers to participate in the green economy?***

Antonina: It won't be a one for one – but it doesn't have to be. One piece of just transition of protecting everyone impacted by a transition is early retirements - you can subsidise early retirement so that certain people don't need to be retrained - they're just supported a bit sooner than they would otherwise. The rest of the people you would hope would get retrained, but not necessarily all in low-carbon activities.

In our paper, we found that a lot of construction jobs were affected by oil price. Construction can be constructing the roads to go to the extraction site. You can be constructing roads to go anywhere. It could be a solar plant or a theme park. It doesn't really matter. So certain things would just be into the general economic activity.

If a country or jurisdiction wants to get ahead of the transition and they rely a lot on fossil fuels now, they should be thinking about other sectors, and not just green ones, but other sectors that that can offer growing employment.

Clara: ***Geothermal is sometimes cited as a potential transition technology that can make use of the same skills as fossil fuel extraction. Do you think it could be a help in transitioning workers?***

Antonina: In general, part of the challenge is location. So where you have great fossil fuel reserves, you may not have great geothermal potential. And then the challenge becomes about worker mobility and can the people who were employed in one, can they reasonably be moved or expected to move to a different place where this other opportunity is there. So that's another dimension of just transition: new jobs, are they in the right place? And that's true for renewables as well. ■

Read the paper here:

Using a mix-methods approach, Scheer et al investigate the effect of global oil prices swings on the fossil fuel dependent Albertan economy, finding far-reaching effects into many sectors. The paper teases out often missed tenets of fossil fuel work precarity beyond losing ones job.

Scheer, Antonina, Moritz Schwarz, Debbie Hopkins, and Ben Caldecott. "Whose Jobs Face Transition Risk in Alberta? Understanding Sectoral Employment Precarity in an Oil-rich Canadian Province." Climate Policy 22, no. 8 (July 13, 2022): 1016–32. https://doi.org/10.1080/14693062.2022.2086843.

PART II

Critical Essays

Easy-to-Transport Materials for Hard-to-Decarbonize Sectors:

The Case for Canada-EU agreements on Green Iron Production

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Introduction

In this paper, we propose that the production and export of DRI using green hydrogen as a reductant can be a cost and energy efficient alternative to the direct export of green hydrogen. The introduction of the Carbon Border Adjustment Mechanism (CBAM) and the gradual phase-out of free allocations under the EU Emissions Trading System (ETS) can incentivize the development of this link in the Canada-EU green steel supply chain. Building on existing policies, this proposal suggests leveraging the naturally complementary relationship between energy-abundant Canada and a rapidly decarbonizing but energy-scarce Europe.

Embedding renewable energy "up" the supply chain in intermediate steel products can benefit both Canada and the EU by minimizing physical and financial loss through more efficient transport. Eastern Canadian provinces that already have a low-carbon residual energy mix, like Ontario and Quebec, can harness their competitive advantage through a low-carbon commodity export industry, while EU steelmakers can benefit from lower-cost, low-carbon intermediate feedstocks as well as the expansion of EU standards into markets beyond the Union itself.

Plans for export terminals for liquified natural gas - allowing Canadian gas to enter the EU - have been on the cards since 2022, but have yet to materialise.[1] Existing hydrogen transportation methods are characterized by high compression costs before transport, low densities for gaseous hydrogen, or high boil-off-losses for liquid hydrogen. This renders transatlantic hydrogen transport inefficient, particularly since maritime transport is the only reasonable possibility. Pipelines are significantly more efficient for transportation but require large infrastructure investment; connecting Canada and Europe via a hydrogen pipeline is not realistic in the short to medium term. Large-scale transatlantic transport is therefore a significant challenge.

By recognizing the financial, material and environmental costs of inefficient transport and storage, policy should shift focus to produce easier to transport products from green hydrogen. DRI is an ideal candidate for such a product. This is why we call for integrated, robust, and decarbonized EU-Canada steel supply chains. The development of EU-Canada trade in green intermediate steel products has distinct advantages over plans for EU-Canada green hydrogen corridors.

Limits to Steel Decarbonisation in the EU

Steelmaking is one of the noted "hard to abate" sectors which currently accounts for approximately 7-9% of annual human-made carbon emissions.[2] Steel is most commonly produced through two routes: the blast furnace - basic oxygen furnace (BF-BOF) route and the electric arc furnace (EAF) route. In the BF-BOF pathway, iron ore is reduced in a coking coal-fired BF to produce molten iron, also known as hot metal. This hot metal is then refined through oxidation in the BOF. This process causes high emissions of greenhouse gases, releasing an average of 1.8 tonnes of CO2e per tonne of crude cast steel produced in the EU accounting for a

[1] Tim Hodgson, "Canada Has the LNG Europe Wants. Why Can't It Deliver?" Politico, April 23, 2024, https://www.politico.eu/article/canada-lng-europe-tim-hodgson/

[2] World Steel Association, "Climate Change and the Production of Iron and Steel," World Steel Association, accessed August 8, 2025, https://worldsteel.org/climate-action/climate-change-and-the-production-of-iron-and-steel/.

significant part of the emissions of steel production[3]. EAFs traditionally run on cold scrap feedstock but benefit from the addition of direct-reduced iron or DRI, melted by electric arcs from graphite electrodes[4].

DRI is a crucial part of the mix as most grades of scrap – and the grades whose supply is growing fastest, already in surplus in the EU – contain significant amounts of tramp elements like copper, nickel, tin, molybdenum, and chromium[5]. Carbon is also added, but in small amounts to be injected into the molten steel bath. As such, EAFs have drastically lower Scope 1 CO2e emissions than BF-BOFs; in the EU, they emit less than 0.05 tonnes of CO2e per tonne of steel produced on average.[6] Continued dependence on natural gas in EAF steelmaking raises the CO2e emissions, including Scope 2, to an average just above 0.2 tonnes of CO2e per tonne of steel produced.[7] Scope 2 emissions represent the primary source of emissions in EAF steelmaking *given* either a very high-grade scrap or DRI feedstock. Low-carbon energy sources such as renewable electricity can be utilized to greatly reduce the emissions intensity of this process; the EU's significant and growing renewable capacity should be sufficient to lower the Scope 2 emissions of the process. The difficult step will be to lower the Scope 3 emissions, which account for the emissions of the feedstock.

Given the importance of transitioning from BF-BOFs to EAFs, replacements for and supplements to high-quality, low-alloy scrap will become increasingly necessary. Within the EU, several steelmakers including ArcelorMittal, Salzgitter, Thyssenkrupp, SSAB, and POSCO have incorporated DRI into their EAF steelmaking[8]. The use of DRI as an additional feedstock is imperative to produce high-quality steel with strict residuals requirements, as well as to increase the utilization rate of non-high-grade scrap.[9] To ensure that this DRI is sustainably produced, it will need to utilize green hydrogen rather than natural gas as a reductant; however, this is not cost-effective at EU production costs[10]. This is the locus of intervention we propose in this article.

Uphill Battle: Policy incentives for EU green steel

The European transition to green steel has nominally been underway for years now. While there are many different mechanisms in place, they can be divided into two broad categories: *incentives* and *penalties*. On the *incentive* side, Germany has taken early initiative in this process, evidenced by its significant grants to steelmakers like ThyssenKrupp,[11] including the tkH2Steel project which aims to produce 2.5 million tonnes of DRI starting in 2026.[12] In total, Germany approved EUR 6.9 billion in subsidies for ThyssenKrupp, Salzgitter, and Stahl-Holding-Saar.[13] However, the

[3] D. Koolen and D. Vidovic, *Greenhouse Gas Intensities of the EU Steel Industry and Its Trading Partners*, EUR 31112 EN (Luxembourg: Publications Office of the European Union, 2022), ISBN 978-92-76-53417-4 (online), doi:10.2760/170198 (online), JRC129297, 15.
[4] Satyendra Kumar Sarna, "Use of Direct Reduced Iron in Electric Arc Furnace," Ispatguru, 2013, accessed August 8, 2025, https://www.ispatguru.com/use-of-direct-reduced-iron-in-electric-arc-furnace/.
[5] Sebastian Dworak, Helmut Rechberger, and Johann Fellner, "How Will Tramp Elements Affect Future Steel Recycling in Europe? — A Dynamic Material Flow Model for Steel in the EU-28 for the Period 1910 to 2050," *Resources, Conservation and Recycling* 179 (April 2022), https://www.sciencedirect.com/science/article/pii/S0921344921006807.
[6] Koolen and Vidovic, *Greenhouse Gas Intensities of the EU Steel Industry and Its Trading Partners*, 16.
[7] Ibid.
[8] Woon Kim and In Won Sohn, "Critical Challenges Facing Low Carbon Steelmaking Technology Using Direct Reduced Iron," *Joule* 6, no. 10 (2022): 2228–2232.
[9] Stephen Hornby and Geoff Brooks, "Impact of Hydrogen DRI on EAF Steelmaking," Midrex, accessed August 8, 2025, https://www.midrex.com/tech-article/impact-of-hydrogen-dri-on-eaf-steelmaking/.
[10] Karen Benavides et al., "Mitigating Emissions in the Global Steel Industry: Representing CCS and Hydrogen Technologies in Integrated Assessment Modeling," *International Journal of Greenhouse Gas Control* 131 (2024), https://doi.org/10.1016/j.ijggc.2023.103963.
[11] European Commission, "State Aid: Commission Approves German €550 Million Direct Grant and Conditional Payment Mechanism of up to €1.45 Billion to Support ThyssenKrupp Steel Europe in Decarbonising Its Steel Production and Accelerating Renewable Hydrogen Uptake," press release, July 20, 2023.
[12] "German Economic Ministry Plans 2 Billion Euro Funding for Thyssenkrupp," Reuters, June 5, 2023, https://www.reuters.com/markets/europe/german-econ-ministry-plans-2-bln-euro-funding-thyssenkrupp-2023-06-05/
[13] "ArcelorMittal Drops Plans for Green Steel in Germany Due to High Energy Costs," Reuters, June 19, 2025, https://www.reuters.com/sustainability/climate-energy/arcelormittal-drops-plans-green-steel-germany-due-high-energy-costs-2025-06-19/.

cost of green hydrogen has so far proved to be prohibitively expensive. ArcelorMittal has already pulled out of the aforementioned German state-backed project.[14] The Swedish steelmaker Stegra, which received more than EUR 6.5 billion in funding for a green hydrogen-fed steel plant in 2024, recently announced that it requires more funding in order to complete its green steel plant in Boden due to high energy and green hydrogen costs.[15]

On the *penalty* side, European steelmakers have ostensibly been obligated under the flagship Emissions Trading System (ETS) since its introduction in Directive 2003/87/EC. This obligation has largely been a bookkeeping exercise so far, as EU steelmakers have received "free allocations" of emissions allowances (EUAs) to maintain their global competitiveness. With the introduction of the Carbon Border Adjustment Mechanism (CBAM), the free allocation mechanism no longer has an economic justification. However, high energy costs currently make this transition prohibitively expensive. In particular, DRI steelmakers will face a significant increase in their production costs when they must pay for all their emissions; even with a carbon border adjustment mechanism, persistently high energy costs may keep them at a disadvantage.

Commission Implementing Regulation (EU) 2021/447 provides the revised benchmark values for free allocations that were in effect until last year. DRI falls under the category of hot metal, which was allotted a benchmark value of 1.288 EUAs per tonne of metal produced – at the average 2024 EUA secondary market price, these free allocations save the producer approximately EUR 84 per tonne of product.[16] Hot metal production has historically been emissions-intensive due to its reliance on either coal, coke, or natural gas as a reducing agent and is therefore an important use-case for green hydrogen. Consulting the Implementing Regulation (EU) 2021/447, we note that electric arc furnace (EAF) carbon steel received only 0.215 EUAs per tonne of product, while EAF high alloy steel received 0.268 EUAs per tonne. EAF steelmakers are therefore considerably better prepared for industrial decarbonization than DRI and other hot metal producers.

Without DRI, however, ramping up EAF production will quickly run into supply bottlenecks as demand for high-grade scrap increases[17]. Securing cost-effective supply will be crucial as the steel market is highly competitive. Fastmarkets assessed the differential for green long steel, with Scope 1, 2, and 3 emissions less than or equal to 0.5 tonnes of CO2e per tonne of steel produced. This has varied between €15-35 per tonne over domestic rebar since its introduction in April 2025[18]. It is worth noting that this price premium is significantly less than the current market value per tonne of product of the free allocation provided to hot metal producers under the EU ETS. With the removal of these subsidies, cost-effective DRI and low-alloy scrap supply is necessary to ensure EU steelmakers' competitiveness in their domestic market, let alone abroad.

[14] Ibid.
[15] "Sweden's Stegra Seeks More Funds for Green Steel Project, Business Daily DI Reports," Reuters, September 4, 2025, https://www.reuters.com/sustainability/climate-energy/swedens-stegra-seeks-more-funds-green-steel-project-business-daily-di-reports-2025-09-04/.
[16] European Commission, Commission Implementing Regulation (EU) 2021/447 of 12 March 2021 determining revised benchmark values for free allocation of emission allowances for the period from 2021 to 2025 pursuant to Article 10a(2) of Directive 2003/87/EC of the European Parliament and of the Council, *Official Journal of the European Union*, L 87, March 15, 2021, 29–34, https://eur-lex.europa.eu/eli/reg_impl/2021/447/oj.
[17] Roland Berger, "The Growing Battle for Scrap Steel in Green Steel Production," Roland Berger, accessed September 9, 2025, https://www.rolandberger.com/en/Insights/Publications/The-growing-battle-for-scrap-steel-in-green-steel-production.html.
[18] Vladislava Novokreshchenova, "Launch of Two European Domestic Green Long Steel Price Assessments: Pricing Notice," Fastmarkets, April 9, 2025, https://www.fastmarkets.com/insights/launch-of-two-european-domestic-green-long-steel-price-assessments-pricing-notice/.

Easy-to-Transport Materials for Hard-to-Decarbonize Sectors:

The Case for Canada-EU agreements on Green Iron Production

Harnessing Canada's renewable energy assets for more value added.

The power network will be the backbone of the net-zero economy envisioned in Canada and Europe's decarbonization goals.[19] This net-zero power grid will be driven by non-emitting generation, including variable sources like photovoltaic solar and wind. However, the ability to decarbonize will be constrained by limits on the uptake of variable renewable energy given that the power grid must always be balanced.[20] Quebec, with a large installation of hydroelectric power can generate 100% of its domestic demand direct emissions-free,[21] while Ontario has significant hydroelectric and nuclear energy capacity affording these provinces good opportunities for balancing an increasing share of variable renewables.[22]

Such benefits are compounded by the energy price differential between Canada and the EU. In 2024, European wholesale electricity prices averaged EUR 74/MWh[23] compared to the Ontario average of CAD 32.19/MWh (approximately EUR 20/MWh).[24] Since 2022, the wholesale electricity price in Europe has been trending downwards from an uneconomically high level but continues to be characterized by high volatility. In contrast, costs in Ontario are expected to decline as the province recently overhauled its electricity markets to a structure more closely emulating that of most European markets[25] which is expected to further lower costs by CAD 700 million in the first 10 years of implementation.[26] Ontario and Quebec enjoy clean energy abundance, a large skilled worker base, and a well-developed steel and hot metal production chain.[27] Increasing the uptake of renewable energy in these provinces could therefore be directed "up" the supply chain, embedding low-emissions renewable energy in semi-finished and intermediate goods like DRI. This would allow these Canadian provinces to maintain and revitalize their iron and steel industry while providing EU steelmakers with much-needed DRI feedstocks as they decarbonize their production processes.

Standard-setting: the first steps towards an integrated green steel supply chain

The immediate challenge to enabling trade in green iron is one of synchronizing regulations and definitions. The EU's methodology for calculating embedded emissions is well-tested, having been used in monitoring, reporting and verification since the implementation of the EU ETS. However, its definition for green hydrogen production in the RED III and the Delegated Regulation on Additionality only establishes that the production of green hydrogen must be supported through power purchasing agreements with renewable energy plants (or plants owned by the hydrogen producer). The regulation also states that electricity taken from the grid may count as renewable if it meets geographic and temporal correlation requirements for renewable energy penetration. A more precise, quantitative metric is needed to

[19] Natural Resources Canada, "Canada's Steel Industry Aiming for Net-Zero CO2 by 2050," Natural Resources Canada, accessed August 8, 2025, https://natural-resources.canada.ca/stories/cipec-news/canada-s-steel-industry-aiming-net-zero-co2-2050.

[20] Canada Energy Regulator, Government of Canada, "CER – Towards Net-Zero: Electricity Scenarios," accessed July 2024, https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2021/towards-net-zero.html.

[21] Hydro-Québec, "Données ouvertes / Open Data," Hydro-Québec, accessed August 2025, https://donnees.hydroquebec.com/explore/?sort=modified.

[22] Independent Electricity System Operator (IESO), "Data Directory," IESO, accessed August 2025, https://www.ieso.ca/Power-Data/Data-Directory.

[23] Directorate-General for Energy, European Commission, "Quarterly Reports Confirm Continued Electricity and Gas Market Resilience," European Commission, March 31, 2025, https://energy.ec.europa.eu/news/quarterly-reports-confirm-continued-electricity-and-gas-market-resilience-2025-03-31_en

[24] Independent Electricity System Operator (IESO), "Market Data," IESO, accessed August 2025, https://www.ieso.ca/market-data.

[25] Reform introducing a single day-ahead market and locational marginal pricing for balancing markets

[26] Independent Electricity System Operator (IESO), "Overview of Market Renewal," IESO, accessed August 2025, https://www.ieso.ca/Market-Renewal/Background/Overview-of-Market-Renewal.

[27] Jonas Algers and Chris Bataille, *Strategic Decarbonisation of the Canadian Iron and Steel Industry: A Worker-Centered Path to Cut Emissions, Increase Value Added and Strengthen Global Supply Chains* (Lund University, 2025), accessed September 9, 2025, https://lucris.lub.lu.se/ws/portalfiles/portal/218312088/Algers_Bataille_2025_Strategic_decarbonisation_ENG_CLEAN.pdf.

adequately calculate embedded Scope 3 emissions throughout the supply chain. In this case, the Canadian definitions appear better-suited to the task at hand. In its credit-based system, Canada currently defines "low-carbon hydrogen" as hydrogen that has a *life cycle* carbon of less than 4kg CO2 per kg of hydrogen produced.[28] To further incentivize decreased carbon intensities, Canada offers a tiered subsidy to producers providing a base subsidy for hydrogen produced with an intensity of between 2-4 kg CO2/kg hydrogen, and higher subsidies for producers in operating in the 0.75-2kg intensity range with the highest incentives for production with an intensity of less than 0.75kg CO2/kg hydrogen.[29] A first step forward would be to incorporate these quantitative, production-based definitions into the EU's standards for Scope 3 emissions, despite the difference in techniques of incentivization adopted by the two states.

To successfully build an integrated EU-Canada green hydrogen-based steel supply chain, it is also important to ensure that prior commitments to standardization are implemented in a logical order. Common standards and approaches to certification were outlined as a priority at the EU-Canada Summit in November 2023. To claim exemptions from the CBAM, Canadian exporters will need to familiarize themselves with EU monitoring, reporting and verification processes. The joint standardization of a definition of green hydrogen proposed above is a first step in this direction. After that, green hydrogen certification standards should be extended to include products which use green hydrogen as an input, including direct-reduction iron and green steel. This would involve agreement by all parties on a suitable methodology, which could be based on the EU ETS as proposed above.

For a market-based transition to be effective, mandatory and binding standards must be agreed upon by all stakeholders. This will provide a solid legislative basis for the emergence of price differentials in the green steel market and allow market participants to have the certainty needed for long-term decarbonization strategy. The Low Emission Steel Standard (LESS) has been introduced in the EU with the goal of developing precisely such a set of standards; it presently aims to include various metrics including the percentage of scrap steel and global warming potential according to the Environmental Product Declaration. LESS was initiated by stakeholders across the German steel value chain and backed by both German and European authorities. The Canadian government, as well as the provincial governments of Ontario and Quebec, should work towards joining this standardization process to facilitate the development of their DRI export industry.

Initiatives to connect Canadian and European businesses have already been advanced in green hydrogen and could be built on to encourage green steel cooperation. Public consultation for the EUR 400 billion bilateral green hydrogen auction via H2Global is now underway in Germany.[30] Under this scheme, 10-year offtake offers from Canadian green hydrogen producers will be matched with German buyers. The difference between the highest bid and the ask will be borne by Canadian and German taxpayers. As such, the cost has been taken from industry and placed on to the public. It is therefore crucial to ensure that any green hydrogen supply chain developed between Canada and the EU delivers value for taxpayers, not just for shareholders. We propose extending this collaboration to include products with net-zero or low embedded emissions like DRI produced

[28] Canada Revenue Agency, "Calculating the Credit - Clean Hydrogen Investment Tax Credit (ITC)," Government of Canada, accessed August 2025, https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/corporations/business-tax-credits/clean-economy-itc/clean-hydrogen-itc/claiming-credit-ch-itc/calculate.html.
[29] Ibid.
[30] Hannah Bassett, "Germany and Canada Launch €400 Million Renewable Hydrogen Auction Consultation," Independent Commodity Intelligence Services, July 30, 2025, https://www.icis.com/explore/resources/news/2025/07/30/11123809/germany-and-canada-launch-400-million-renewable-hydrogen-auction-consultation/.

with green hydrogen. Using Canada's renewable energy to decarbonise the steel supply chain will help minimizing material losses and boost economic efficiency. Some initial steps are already clear and in progress, including discussions on harmonizing standards. Canadian steelmakers should participate as stakeholders in the LESS and should familiarize themselves with the CBAM to best capitalize on the opportunity.

Finally, European policymakers have been gradually fleshing out the EU Steel and Metals Action Plan. While Member State governments will undoubtedly work to protect their domestic industry from competition, an accommodative policy may only prolong the use of inefficient technology in the European steel sector and thereby delay the inevitable. Pulling back from longstanding policy commitments like the phase-out of free allocations or implementing protectionist measures would undermine this hard-won reputation. The rapid increase in Chinese renewable energy production coupled with China's well-developed steel production infrastructure presents a formidable threat to Europe's steelmakers in the absence of abundant low-carbon energy, low-alloy scrap, and DRI supply. Avoiding the turmoil and arbitrariness of US-style protectionism would maintain Europe's position as a key proponent of free trade as well as a predictable and responsible centre of global commerce. Protectionism would delay the EU's decarbonization plan and jeopardize decades of concentrated policymaking and business development.

Maintaining the phase-out while strictly enforcing the CBAM can define the contours of the green steel market as the surcharge for emissions-intensive steel can translate into a price premium for emissions-efficient steel. The present crisis is therefore also an opportunity for both Canada and the EU: what is needed is the policymaking and commercial will to capitalize on it. ■

A SWOT Analysis of EU-Canada Cooperation on Rare Earth Elements

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Introduction

Critical minerals have become essential for countries to achieve their strategic and environmental aims. In 2022, the International Energy Agency (IEA) reported that 60% and 85% of Rare Earth Elements (REEs) are mined and processed in China, followed by the United States and Australia.[31] The European Union (EU) has a greater than 90% dependence on China for the category of REEs that are necessary to achieve their energy transition goals. Despite having an estimated 15.2 million tonne (mt) of REE reserves and an educated workforce, Canada has not tapped into this potential because it has not leveraged its partnerships.[32, 33] The focus of this paper will be on the technological cooperation between Canada and the EU on diversification and capacity building of the REE supply chain. The 17 REEs consist of the 15 lanthanides, as well as yttrium and scandium.[34]

This paper conducts a SWOT analysis to assess the strengths and weaknesses of the current EU-Canada relationship on critical minerals, then discuss the opportunities and threats to building upstream capacities and encouraging investments into processing. The analysis finds that Canada has an abundance of REEs, strong Environmental, Social and Governance (ESG) standards, and EU partnerships that positions it as a trusted partner for building REE supply chains. However, limited processing capacity, financing challenges and regulatory delays slow progress. Innovation in recycling and coal/steel byproduct extraction offers a unique opportunity for Canada to become competitive, but market volatility and China's dominance remains a key threat.

Strengths

As global demand for REEs grow and countries seek to diversify away from Chinese supply chains, assessing Canada's competitiveness and potential profitability in the REE industry becomes critical. Canada possesses an abundance of critical minerals and is a leading producer of nickel, potash, aluminium, cobalt and uranium. These minerals are commonly used in batteries, fertilisers,

[31] Inga Carry, "Critical Raw Materials Partner Canada: An (Almost) Perfect Match: The European-Canadian Raw Materials Partnership in Times of Friendshoring," *SWP Comment*, Stiftung Wissenschaft und Politik (SWP), German Institute for International and Security Affairs, 2024, 29/2024, https://doi.org/10.18449/2024C29.

[32] Eurostat, "International Trade in Critical Raw Materials," accessed August 7, 2025, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International_trade_in_critical_raw_materials.

[33] Natural Resources Canada, "Rare Earth Elements Facts," January 23, 2018, https://natural-resources.canada.ca/minerals-mining/mining-data-statistics-analysis/minerals-metals-facts/rare-earth-elements-facts.

[34] Brendan A. Bishop et al., "Insights into the Rare Earth Element Potential of Coal Combustion By-Products from Western Canada," *Environmental Science: Advances* 2, no. 3 (2023): 529–42, https://doi.org/10.1039/D2VA00310D.

transportation materials and nuclear energy.[35] The Centre for Strategic and International Studies (CSIS) assess Canada's 'proximity to feedstock' that being proximity to ores including REEs, as a major strategic advantage.[36] The commercial viability of an REE supply chain depends on the transportation costs because they can constitute more than 50% of the total delivered cost.[37]

The delivery and production costs are further mitigated by infrastructure, which Canada has committed to building with a $1.5bn (CAD) fund for infrastructure development of critical mineral supply chains.[38] REE production demands a substantial water resource which advantages Canada as it has the world's largest fresh water supply. Moreover, Canada is committed to ESG standards which ensures that businesses and facilities are built with the intention of being sustainable and resilient. As evidence, Canada's only REE refinery in Saskatoon recycles and reuses all the water within their plant. [39]

The country's commitment to ESG provides an intangible advantage against other critical mineral producing countries that do not adhere to the same standards as the EU seeks to secure supply chains that are carbon competitive, sustainable and just. Canada has also signed a total of 12 bilateral agreements on critical minerals that aim to secure financial cooperation and mobilize research and development in recycling, processing and mining, underscoring its international reputation as a trusted partner and supplier.

Many of these agreements have been with the EU, priming Canada to be the EU's biggest partner in critical minerals. The most relevant is the Canada-EU Strategic Partnership on Raw Materials that focuses on the integration of Canada-EU material value chains and innovation collaboration. This policy is motivated by the EU Critical Raw Minerals Act (CRMA) which sets a benchmark that by 2030 they want "no more than 65% of the EU's annual consumption from a single third country."[40] Another initiative launched this year was the Canada-EU High-Level Energy Dialogue and Industrial Policy Dialogue which provides a new platform for collaboration as it relates to energy and industrial supply chains.[41] Lastly, Canada's inclusion into the Horizon Europe programme, the EU's and world's largest research and innovation programme, will catalyse knowledge exchange between the two countries by fostering institutional collaboration and expanding access to research grants.[42] All these policy commitments lay down the building blocks of an integrated materials supply chain.

Weaknesses

Despite Canada's potential, there is only one operating REE mine.[43] This is because production of raw REEs has technical challenges that make it difficult to guarantee the economic viability of mines and other REE related projects. These costs can be mitigated by mineral processing hubs. However, the weakest link in Canada's raw material supply chains remains processing.

Although Canada lays out an ambitious plan to develop both upstream and midstream levels of the

[35] Service Canada, "The Canadian Critical Minerals Strategy," campaigns, December 9, 2022, https://www.canada.ca/en/campaign/critical-minerals-in-canada/canadian-critical-minerals-strategy.html.
[36] Gracelin Baskaran and Meredith Schwartz, *Developing Rare Earth Processing Hubs: An Analytical Approach*, July 28, 2025, https://www.csis.org/analysis/developing-rare-earth-processing-hubs-analytical-approach.
[37] Baskaran and Schwartz, *Developing Rare Earth Processing Hubs*.
[38] Canada, "The Canadian Critical Minerals Strategy."
[39] Gracelin Baskaran and Meredith Schwartz, *Developing Rare Earth Processing Hubs: An Analytical Approach*, July 28, 2025, https://www.csis.org/analysis/developing-rare-earth-processing-hubs-analytical-approach.
[40] EU Commission, "Critical Raw Materials Act - European Commission," accessed August 7, 2025, https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials/critical-raw-materials-act_en.
[41]" EU Commission, "EU-Canada High-Level Energy Dialogue - European Commission," accessed August 7, 2025, https://energy.ec.europa.eu/news/eu-canada-high-level-energy-dialogue-2025-03-11_en. Critical Raw Minerals Act (CRMA).
[42] EU Commission, "International Cooperation with Canada in Research and Innovation," April 11, 2025, https://research-and-innovation.ec.europa.eu/strategy/strategy-research-and-innovation/europe-world/international-cooperation/association-horizon-europe/canada_en.
[43]"SRC Rare Earth Processing Facility First to Produce Rare Earth Metals in North America | Saskatchewan Research Council," Saskatchewan Research Council, September 16, 2024, https://www.src.sk.ca/news/src-rare-earth-processing-facility-first-produce-rare-earth-metals-north-america.

value chain, projects continue to move slowly, and others have halted completely during construction.[44] For example, the Kipawa Rare Earths Mineral project based in Quebec was terminated in 2022 because Quebec Precious Metals never submitted an Environmental Assessment within the timeframe provided, because the company ran out of funds for the exploration of the project.[45]

Lack of financing is one of the primary reasons for this slow project pipeline. For two decades, Chinese investors and companies were the ones willing to invest in the Canadian mining sector, but because of the geo-politicization of raw material supply chains, the Canadian government now screens and blocks Chinese investment into these projects on national security grounds.[46] This has halted the construction of the only other REE processing facility in Saskatoon.[47] Current international agreements with the EU do not mandate any fiscal commitments to building supply chain capacity.[48] Moreover, European companies hesitate when it comes to investing in raw material projects because there is almost no mining industry left, and companies act as end-users.[49] The other reason that these projects have been slow to progress is because of the permitting and regulations.[50] Varying provincial critical mineral strategies and approval processes cause lengthy delays, deterring international cooperation and investors expecting faster returns who do not want to be tied up to a project that takes years to provide a return on profit.[51] Projects include, ClayHowells,[52] Lackner Lake,[53] and Elliot Lake in Ontario, [54] all of which were terminated or suspended in the project exploration stage due to the steep cost of production.

Opportunities

Although current market conditions suggest that REEs are well-supplied on a global basis until 2035, if supply from China is disrupted for any reason, the remaining global supplies would only cover 35-40% of the need.[55] Recently, the Chinese government announced export controls on seven medium and heavy rare earth-related items.[56] With the expectation that global demand for magnet REEs will double by 2050 and China's export controls will remain in place for the foreseeable future, a supply gap will open which Canada is well-positioned to fill. Figure 1 shows the one fully operational REE supply chain which starts at the Nechalacho Mine in the Yukon, then the minerals are processed at the Saskatchewan Research Council (SRC) refinery in Saskatoon, then they are shipped to Europe via a Norwegian company from the east coast.[57] This supply chain was only made possible with the fiscal support of the federal government and partnerships with Europe.[58] Given the success of this first supply chain, Strange Lake, Alces Lake and Ashram Project are being funded in the same way including a new processing plant at Sept-îles. Figure 2 illustrates the aftermath of creating a REE supply chain, with exports more than doubling in 2024.

[44] Carry, "Critical Raw Materials Partner Canada."
[45] Canada, Impact Assessment Agency of. "Kipawa Rare Earths Project." February 11, 2013. https://iaac-aeic.gc.ca/050/evaluations/proj/80029.
[46] Carry, "Critical Raw Materials Partner Canada."
[47] Jacob Lorinc, "Canada Blocks Chinese Rare Earths Deal in Trudeau-Led Crackdown," *Bloomberg.Com*, June 17, 2024, https://www.bloomberg.com/news/articles/2024-06-17/canada-blocks-chinese-rare-earths-deal-in-trudeau-led-crackdown.
[48] Carry, "Critical Raw Materials Partner Canada."
[49] Charalampides et al., "Rare Earth Elements: Industrial Applications and Economic Dependency of Europe", 2.
[50] Raphael Deberdt and Angeline Letourneau, "Establishing a Critical Minerals Industry: Review of Canada's Administrative and Legal Efforts at the National and Sub-National Levels," *Resources Policy* 107 (August 2025): 105660, https://doi.org/10.1016/j.resourpol.2025.105660.
[51] Deberdt and Letourneau, "Establishing a Critical Minerals Industry", 4.
[52] "Clay-Howells." *Argyle Resources*, n.d. Accessed September 11, 2025. https://argyleresourcescorp.com/projects/ree/clay-howells/.
[53] International Explorers & Prospectors. "Lackner Lake Carbonitite Complex." International Explorers & Prospectors Inc., 2018. https://internationalexplorersandprospectors.com/lackner-lake.
[54] Appia. "March 2025 Investor Presentation." *Investor Information*, March 2025. https://appiareu.com/investors/.
[55] IEA, "Overview of Outlook for Key Minerals – Global Critical Minerals Outlook 2025 – Analysis.," IEA, 2025, https://www.iea.org/reports/global-critical-minerals-outlook-2025/overview-of-outlook-for-key-minerals.." According to IEA N-1 Assessment Scenario excluding the top supplier and demander.
[56] IEA, "Overview of Outlook for Key Minerals – Global Critical Minerals Outlook 2025 – Analysis.,"
[57] Carry, "Critical Raw Materials Partner Canada."
[58] SRC, "SRC Rare Earth Processing Facility First to Produce Rare Earth Metals in North America | Saskatchewan Research Council."

A SWOT Analysis of EU-Canada Cooperation on Rare Earth Elements

Despite the impressive jump in exports, the facility is still not processing minerals at capacity.[59] For Canada and the EU to grow this supply chain, they still need to improve upstream REE capacities.

Figure 1. Current REE supply chain in Canada, created by the authors.

While the owners of the Nechalacho mine plan to expand operations, that may take years before it is fully realized.[60] Although the traditional REE extraction works for other REE mining countries, strict environmental regulations prevent the same projects in Canada to move at the same speed despite federal and provincial fiscal support. This paper argues that the Canadian policy environment uniquely incentivizes innovation in critical mineral production.

One example of this is the Geomega Rare Earths Recycling facility that is still under construction in Saint-Bruno-de-Montaville but is expected to be completed by the end of 2025. It is supported by the National Research Council of Canada and is based around its patented "Separation of Rare Earths" technology.[61] The idea is that the plant will be able to recycle the REEs from end-of-life products like NdFeB magnets, bauxite residue and sulphide tailings.[62] Given Europe's focus on recycling within the CRMA, this could open fiscal avenues for jointly funded strategic projects. The success of this plant could serve as a stepping stone to building the recycled REEs supply chain.

Another innovative approach is extracting REEs from coal combustion byproducts (CCBs). Although in proof-of-concept phase, a 2023 study successfully extracted REEs from CCBs supplied by utility companies from coal plants in Alberta and Saskatchewan. The highest concentration of REEs were found in samples from the Poplar River Plant in Saskatchewan, of which almost 100% were extracted effectively with acid leaching. Although in development, the proximity of the Poplar River Power Station to the SRC facility could create another potential supply chain for REEs in Canada to Europe (figure 1).

[59] SRC, "SRC Rare Earth Processing Facility First to Produce Rare Earth Metals in North America | Saskatchewan Research Council," When fully operational, the facility can process up to 400 tonnes of REEs per year.
[60] Ollie Williams, "New Study Sets out What Nechalacho Mine Could Deliver," July 28, 2025, https://cabinradio.ca/250819/news/yellowknife/new-study-sets-out-what-nechalacho-mine-could-deliver/.
[61] Geomega Resources. "The Project Process - REE Recycling." Accessed September 11, 2025. https://geomega.ca/ree-recycling/.
[62] GéoMégA, Ressources. "Geomega Provides Update on Rare Earth Magnet Recycling Demonstration Plant." GlobeNewswire News Room, June 4, 2025. https://www.globenewswire.com/news-release/2025/06/04/3093461/0/en/Geomega-provides-update-on-rare-earth-magnet-recycling-demonstration-plant.html.

Keeping in mind, the Canadian coal energy mix was only 2.9% in 2023, REEs may also be extracted from metallurgical coal byproducts from steel production, of which Canada is the 4th largest producer.[63] [64] A study of steel plant waste in India found that blast furnace slag was rich in Ce, La and Nd, elements commonly used in batteries and large-scale magnets in wind turbine generators.[65] Building on this, another study successfully extracted REEs from Indian blast furnace slag via sulfuric acid leaching under optimal conditions, with yields of over 80% for Ce and Nd and over 90% for La.[66] Although no specific research exploring the presence of REEs in steel plant slag has been published in Canada, it is well documented that Canadian coal contains REEs therefore it is plausible that steel byproducts can be a source. Not to mention, Canada could provide the expertise to build coal extraction facilities in coal-producing European countries.

Coal waste and steel slag provide sustainable REE alternatives that reduce environmental damage and impacts on Indigenous sovereignty. Rare earths are traditionally extracted through surface mining or in-situ leaching, then crushed, separated and chemically processed, requiring multiple cycles to achieve purity. The process is slow, wasteful and energy-intensive, posing significant environmental and health concerns. Ores often contain heavy metals and radioactive materials such as uranium and thorium, requiring specialised waste disposal and potentially contaminating local groundwater.[67] Producing one tonne of REEs can generate 2,000 tonnes of toxic waste.[68] Additionally, mining and processing heavy and medium rare earth ores was found to have the highest greenhouse gas emissions

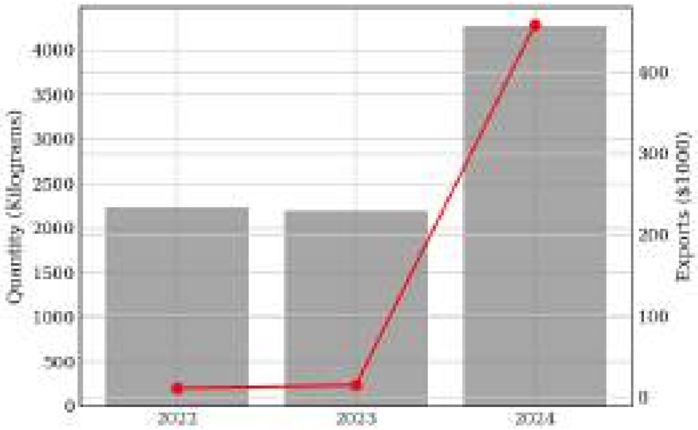

Figure 2. Value and Quantity of Canadian REE Exports, 2022-2024, Created by the author using data from the World Integrated Trade Solution. [69]

and energy consumption per kg compared to other metals.[70] Indigenous communities near REE mines may be disproportionately affected due to dependence on local resources that could become contaminated.[71] Moreover, most of these deposits exist on Indigenous reserves, which raises social and human rights concerns.

Ultimately, this policy angle provides space for international collaboration. These kinds of projects qualify for the European Research Council grants and, under Horizon Europe, can bring into the fold European researchers to collaborate and scale-up the REE recycling and extraction process from coal byproducts. Moreover, Canada's Critical Mineral Exploration Tax Credit could incentivize both

[63] IEA. 'Canada - Countries & Regions'. Accessed 7 August 2025. https://www.iea.org/countries/canada.

[64] 'Mineral Trade - Natural Resources Canada'. Accessed 7 August 2025. https://natural-resources.canada.ca/maps-tools-publications/publications/mineral-trade.

[65] Abhilash, Pratima Meshram, Ajay Gupta, and Subhadra Sen. 'Steel Plant Wastes as a Resource of Rare Earth Elements and Rare Metals–Characterisation, Resource Estimation, and Economic Assessment'. *Transactions of the Indian Institute of Metals* 76, no. 5 (2023): 1321–30. https://doi.org/10.1007/s12666-022-02794-0.

[66] Abhilash, P. Meshram, S. Sarkar, and T. Venugopalan. 'Exploring Blast Furnace Slag as a Secondary Resource for Extraction of Rare Earth Elements'. *Minerals & Metallurgical Processing* 34, no. 4 (2017): 178–82. https://doi.org/10.19150/mmp.7857.

[67] 'Rare Earth Elements - Recovery from Coal-Based Materials, ICSC/334'. *ICSC*, 28 November 2024. https://www.sustainable-carbon.org/report/rare-earth-elements-recovery-from-coal-based-materials/.

[68] Kaiman, Jonathan. 'Rare Earth Mining in China: The Bleak Social and Environmental Costs'. Guardian Sustainable Business. *The Guardian*, 20 March 2014. https://www.theguardian.com/sustainable-business/rare-earth-mining-china-social-environmental-costs.

[69] World Bank, *World Integrated Trade Solution (WITS): Canada Rare Earths Trade Data (HS 280530), 2022–2024, UN COMTRADE*, accessed June 8, 2025, https://wits.worldbank.org/.

[70] Zaimes, George G., Berlyn J. Hubler, Shuo Wang, and Vikas Khanna. 'Environmental Life Cycle Perspective on Rare Earth Oxide Production'. *ACS Sustainable Chemistry & Engineering* 3, no. 2 (2015): 237–44. https://doi.org/10.1021/sc500573b.

[71] 'The Potential Environmental Risks Associated with the Development of Rare Earth Element Production in Canada'. Accessed 7 August 2025. https://cdnsciencepub.com/doi/10.1139/er-2020-0115.

European investors and Canadian businesses to capitalize on the opportunities once it reaches commercial scalability. A platform for these collaborations would be the Policy Dialogue previously mentioned. Since there are currently coal fired power plants operating in four Canadian provinces and a strong steel industry there is an opportunity for rapid growth depending on the supporting infrastructure needed[72]. With a stronger upstream industry, it will necessitate the development of midstream industries and building on the budding processing hub in Saskatchewan.

Threats

Critical mineral markets are volatile, and this is due to the lack of transparency in the market and geopolitics. The REE market is particularly vulnerable because China monopolistically sets the prices and supply of REEs globally.[73] The volatility of the market then threatens international industry collaboration, as European stakeholders may not be willing to provide capital for projects in Canada with the risk of low return. Moreover, there is competition for funding and collaboration with other emerging REE producing countries like Australia. Proactive policies provide no guarantee that Canadian produced REEs will be more cost-effective than Chinese-produced REEs, and so they might not be substitutable. This paper highlights various potential sources of upstream production, however the cost-benefit of these innovative extraction and recycling methods have yet to be weighed against traditional REE mining. This is underscored by the fact that coal ash composition varies widely between sites, requiring site-specific processing and planning. Lastly, the long-term outlook for the supply of coal byproducts is uncertain due the federal government's commitment to electrification of industry and grid decarbonization.

Conclusion

Canada's abundance of REE reserves, good infrastructure, reliable ESG standards and supporting natural resources make it a favourable partner to establish a strong secure supply chain. Europe acts as an important end-user and downstream market for Canada as well as a source of financing and technical expertise. There exists a strong international architecture that incentivizes cooperation on innovation and building REE value chains. However, the technical and economic challenges of building an REE supply chain, namely in establishing a processing hub and mining, complicates ambitions and dissuade meaningful collaboration. These challenges can be overcome by building on the existing REE supply chain and improving upstream capacities by developing and scaling innovative extraction and recycling methods to create incentives to develop the midstream. Given the unique policy supports in place, focusing on creating these new streams, rather than traditional streams is attractive for both Canada and the EU. ■

[72] Government of Canada, Canada Energy Regulator. 'CER – Market Snapshot: Canada's Retiring Coal-Fired Power Plants Will Be Replaced by Renewable and Low-Carbon Energy Sources'. 28 November 2023. https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2020/market-snapshot-canadas-retiring-coal-fired-power-plants-will-be-replaced-renewable-low-carbon-energy-sources.html.

[73] IEA, "Broader View on Energy-Related Strategic Minerals: What Risks to Anticipate? – Global Critical Minerals Outlook 2025 – Analysis," IEA, accessed August 7, 2025, https://www.iea.org/reports/global-critical-minerals-outlook-2025/broader-view-on-energy-related-strategic-minerals-what-risks-to-anticipate.

Critical Minerals, Critical Moment: Strengthening Canada-EU Collaboration to Advance Sustainable Mining Standards

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Introduction

Intensifying global demand for critical minerals has created an economic opportunity and a sustainability imperative for strengthened cooperation between Canada and the European Union. As the EU looks to expand and diversify its critical minerals supply, European Commission President Ursula von der Leyen hailed Canada as a "perfect match" for increasing trade as the EU relies on imports to access these building blocks of the green and digital transitions.[74] Beyond its abundant critical mineral resources, Canada stands out as an attractive partner with shared geopolitical interests amid increased global tensions surrounding critical minerals supply chains.[75] Furthermore, strategic partnerships can help the EU diffuse regulatory developments outside its borders, fostering a broader uptake of environmental standards. For Canada, embracing EU standards goes beyond market access. The mining industry has major climate impacts and ESG issues, from ecosystem degradation to Indigenous rights violations.[76] While critical minerals currently represent just 13.5% of the Canadian mining industry, their ongoing expansion offers a chance to lock in sustainability from the outset.[77] If leveraged strategically, increased trade with the EU could elevate Canada's sustainability practices and position it as a global leader. As such, this essay explores how Europe, Canada, and the planet stand to gain from enhanced collaboration on critical minerals.

Powering climate commitments and protecting biodiversity

Critical minerals are vital to facilitating the global energy transition and upholding climate commitments. Decarbonising energy, transport, and industry depends upon a stable supply of critical minerals. Technologies like electric vehicles,

[74] Carry, I. (2024), *Critical Raw Materials Partner Canada: An (almost) Perfect Match*, German Institute for International and Security Affairs.

[75] IEA (2025), *Growing geopolitical tensions underscore the need for stronger action on critical minerals security*, https://www.iea.org/commentaries/growing-geopolitical-tensions-underscore-the-need-for-stronger-action-on-critical-minerals-security.

[76] Wildlands League (2023), *Mining Claims in Ring of Fire Jump by 30% Since 2022*, https://wildlandsleague.org/news/mining-claims-in-the-ring-of-fire-jump-by-30-since-2022/.

[77] Author's calculations based on Natural Resources Canada (2025), *Annual Statistics of Mineral Production, 2024*, Government of Canada, https://mmsd.nrcan-rncan.gc.ca/prod-prod/ann-ann-eng.aspx.

batteries, and renewable energy infrastructure rely on lithium, cobalt, nickel, graphite, and rare earth elements. Thus, scaling up and ensuring the resilience of critical mineral supply chains is an essential part of meeting international climate goals. For example, the EU's Nationally Determined Contribution (NDC) pledges to reduce emissions by at least 55% from 1990 levels by 2030, with a legally binding net-zero target by 2050 under the European Climate Law.[78] However, in 2024, 95% of the EU's supply of rare earth elements came from China, Russia, and Malaysia – highlighting a significant vulnerability that could be mitigated through diversification including Canadian sources.[79]

Canada's climate and biodiversity commitments are also at stake. Forests, wetlands, and peatlands store vast amounts of carbon and underpin Canada's climate targets, yet they face growing threats from new mining developments in intact ecosystems. Both Canada and the EU are committed to the Kunming–Montreal Global Biodiversity Framework, which aims to halt and reverse global biodiversity loss by 2030, including protecting 30% of land and water[80]. However, the expansion of critical mineral extraction poses a challenge to this goal, as many deposits are located in ecologically sensitive areas such as tundra, boreal forests, and wetlands. These ecosystems not only support biodiversity but also provide natural defences against intensifying climate-related hazards like wildfires and floods. Thus, while expanding critical mineral production is essential for decarbonization, the approach taken will significantly influence Canada's ability to fulfil its climate and biodiversity commitments while preserving its natural resilience.

Economic incentives for expanding extraction

The green transition is not the only motivation for increasing critical minerals extraction. A recent report from the Canadian Climate Institute estimates that Canada risks losing out on CAD 12 billion per year by 2040 if it does not ramp up critical minerals production[81]. Meanwhile, the European Commission estimates that Europe's demand for rare earth elements and lithium are expected to increase seven- and twenty-one-fold, respectively, by 2050[82]. Given these dynamics, Canada's critical mineral reserves will not go untapped.

Environmental risks at stake

Critical mineral extraction not only risks intensifying climate change and its impacts, but threatens ecosystems and may cause pollution. Following in the footsteps of the broader Canadian mining industry would be insufficient as irresponsible mining practices have already caused significant environmental harm. For instance, the 2014 Mount Polley tailings disaster in British Columbia released 22 million litres of mining waste into one of the world's most important salmon spawning grounds.[83] Similarly, the Canadian government is deploying a CAD 3.2 billion project to keep 237,000 tonnes of arsenic left behind by an abandoned mine frozen within thawing Arctic permafrost.[84] These cases underscore the urgent need for increased due diligence and

[78] European Commission (2023), *Update of the NDC of the European Union and its Member States*.
[79] Eurostat (2025), *International trade in critical raw materials*, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International_trade_in_critical_raw_materials.
[80] Convention on Biological Diversity (2024), *Kunming-Montreal Global Biodiversity Framework*, UNEP, https://www.cbd.int/gbf.
[81] Canadian Climate Institute (2025), *Critical Path: Securing Canada's place in the global critical minerals race*.
[82] European Commission. n.d. *Critical Raw Materials Act.* Internal Market, Industry, Entrepreneurship and SMEs. https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials/critical-raw-materials-act_en#overview-of-the-critical-raw-materials-act.
[83] Pollon, C. and E. Al-Aini (2025), *Managing environmental risks of mining critical minerals in Canada*, Canadian Climate Institute.
[84] Monga, V. (2025), *Deep in an Abandoned Gold Mine, a Toxic Legacy Lurks*, Wall Street Journal, https://www.wsj.com/world/canada-gold-mine-arsenic-6be1a2eb.

environmental safeguards as the critical minerals sector expands, to avoid repeating the mistakes of Canada's broader mining industry.

These examples highlight the environmental risks currently at stake amid rising enthusiasm for increasing critical minerals extraction. In Northern Ontario, over 31,000 prospective mining claims cover the James Bay Lowlands, now dubbed the "Ring of Fire". Developments have been approved with little regard to the cumulative environmental impact of so much increased activity in one of the world's largest intact peatlands[10]. Alarmingly, experts have warned that mining just 3% of the Ring of Fire area could erase nearly all of Canada's emissions reductions between 2005 and 2021, jeopardizing the achievement of climate targets.

A narrow window to demonstrate leadership in the critical minerals race

As critical mineral extraction expands, Canadian companies and the mining industry must be incentivized and regulated to reduce environmental risks. This is where an EU-Canada partnership could be leveraged. The EU's evolving regulatory frameworks, combined with significant market power, are well-positioned to export higher norms to Canada's critical minerals sector. Canada has a limited window to set itself apart by embracing the EU's regulatory values, positioning itself as an international leader while reducing the risk of missing its climate and biodiversity targets. Moreover, aligning with Canada's second-largest trading partner provides a strategic advantage. EU standards often cascade globally so early uptake of sustainability and transparency requirements can provide companies a competitive edge.[85]

EU standards as a catalyst for cleaner mining

Increasingly stringent EU standards are setting benchmarks that Canadian companies should begin aligning with. For example, the EU Battery Regulation required imports of EV batteries to declare full lifecycle carbon footprints from February 2025, meaning that Canadian firms seeking to export to Europe must now measure Scope 1-3 emissions.[86] From 2027, the Regulation will also introduce battery passports, which provide lifecycle information including details on material sourcing, carbon footprint, and recyclability – data that companies can begin collecting now.[87] Similarly, the EU Taxonomy for Sustainable Finance sets uniform criteria that measure whether activities are environmentally sustainable across six domains including climate mitigation, adaptation, biodiversity and circular economy. The mining sector is set to be included under the Taxonomy imminently with draft criteria for its addition released in January 2025.[88] Some European companies already reporting under the Taxonomy have pre-emptively taken steps to align their mining operations with the anticipated sustainability criteria. For example, Swedish mining company Boliden has committed to reducing Scope 1 and 2 emissions by 42% by 2030, using 2021 as the baseline year.[89] Meanwhile, the Carbon Border Adjustment Mechanism (CBAM) already covers some Canadian mineral exports like iron ore and steel, which are currently subject to emissions reporting, with certificates required from January 2026. While critical minerals are not yet in scope, they could be added to the CBAM

[85] Trevizan, A. (2024), "The Brussels Effect as a Mechanism for Promoting Global Sustainability: Analysis from a Governance Perspective", *Global Journal of Human-Social Science* 4.
[86] European Union (2023), *EU Battery Regulation*, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R1542.
[87] Rizos, V. and P. Urban (2024), *Implementing the EU Digital Battery Passport: Opportunities and Challenges for Battery Circularity*, Centre d'Etude et de Prospective Stratégique.
[88] EU Platform on Sustainable Finance. 2025. *Advancing Sustainable Finance: Technical Criteria for New Activities & First Review of the Climate Delegated Act.*
[89] Boliden Mineral AB. 2025. *Life Cycle Assessment of Boliden Products, 2024.*

alongside all EU ETS-covered sectors by 2030, either directly through extraction or indirectly via downstream sectors like automotive and battery manufacturing. These evolving policies create both carrots and sticks for Canadian mining companies to align with to increase their sustainability credentials and ensure continued access to increasingly stringent EU markets.

Strengthening human rights protections

Alongside improving environmental performance, closer alignment with EU standards could improve the human rights impacts of Canadian critical minerals operations. The EU's forthcoming Corporate Sustainability Due Diligence Directive (CSDDD) will require businesses to prevent ESG-related harms throughout their supply chains[90]. This means that European firms will need full transparency of Canadian critical mineral operations, including proof of Free, Prior, and Informed Consent (FPIC) from Indigenous communities in areas such as the Ring of Fire. Escalating in summer 2025, flawed and uneven dialogues led to protests, litigation, and encampments in the same area, as the Premier of Ontario moved to designate the area a special economic zone, bypassing local regulations for consultation.[91]

Any discussion on the sustainability of Canadian mining would be incomplete without addressing its global footprint. Canada's mining industry has a long-documented record of ESG violations in Latin America and Africa. In February 2025, the International Rights of Nature Tribunal held in Toronto found Canadian companies guilty of human and Indigenous rights violations, with a final judgement to be presented at COP30 in Belém, Brazil, in November 2025[92]. Therefore, EU due diligence obligations including the CSDDD could increase accountability by barring Canadian companies associated with ESG violations from European contracts.

Towards sustainable extraction and leadership

The global race for critical minerals is underway, offering major benefits for clean energy and climate action, but also posing serious risks to climate goals, ecosystems, and people. The Canada-European Union (EU) Strategic Partnership on Raw Materials reflects a shared desire to "advance world-class ESG criteria and standards."[93] However, this vision can only be put into practice through increased trade and deeper collaboration, alongside expanded extraction in Canada.

The path to be taken by this expansion is yet to be determined. If increased partnership is leveraged strategically, Canadian companies responding to EU market signals could set a global model for responsible critical mineral development. However, this window of opportunity is narrow. While the economic and strategic incentives to scale up extraction are compelling, ensuring this growth aligns with net-zero objectives requires immediate and deliberate action. Therefore, the EU and Canada should use this pivotal moment to deepen their collaboration, ensuring that the critical mineral boom not only fuels the green transition but also upholds environmental integrity and social responsibility. ■

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[90] European Commission (2025), *Corporate sustainability due diligence*, https://commission.europa.eu/business-economy-euro/doing-business-eu/sustainability-due-diligence-responsible-business/corporate-sustainability-due-diligence_en.

[91] Casey, Liam. 2025. *Two First Nations setting up encampment near proposed bridge to Ring of Fire.* The Canadian Press. https://globalnews.ca/news/11262265/first-nations-ring-fire-encampment-journey.

[92] International Rights of Nature Tribunal. 2025. *Rights of Nature Tribunal finds Canadian Mining companies guilty for the violation of Rights of Nature across South America and Serbia.* https://www.rightsofnaturetribunal.org/canadian-mining.

[93] Government of Canada. 2025. *Our critical minerals strategic partnerships.* https://www.canada.ca/en/campaign/critical-minerals-in-canada/our-critical-minerals-strategic-partnerships.html.