

Critical Materials and Renewable Infrastructure: Overcoming Scarcity in Canada's Transition to Net Zero

White paper

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Introduction

Canada's renewable energy sector is undergoing rapid growth, with ambitious goals such as achieving a net-zero electricity grid by 2035. However, two key challenges are slowing progress: material scarcity and infrastructure delays. These interconnected barriers threaten the scalability, efficiency, and cost-effectiveness of renewable energy projects across the country.

Global demand for critical materials like lithium, cobalt, and rare earth elements is at an all-time high, driven by the need for energy storage, wind turbines, and solar panel components. According to the [International Energy Agency \(IEA\)](#), clean energy technologies accounted for over 40% of the global demand for copper, lithium, and cobalt in 2022. This figure is projected to grow exponentially by 2040. Canada is rich in these resources, for example lithium reserves in Quebec and cobalt in Ontario. The problem lies in the country lacking sufficient refining and processing capacity, creating heavy reliance on global supply chains.

In parallel, infrastructure delays, including bottlenecks in grid modernization, energy storage deployment, and permitting, further impede Canada's renewable

energy progress. These challenges are exacerbated by logistical complexities in remote areas and a skills gap in large-scale project implementation. For example, a [CanREA report](#) "Powering Canada's Journey to Net-Zero" highlights that energy storage projects critical for balancing wind and solar variability are often delayed due to regulatory barriers.

This whitepaper examines the causes and impacts of these challenges on Canada's renewable energy transition. It provides actionable insights into building resilient supply chains, scaling domestic manufacturing, and streamlining infrastructure development. Through collaborative efforts and sustainable supply chain management, Canada can address these bottlenecks and secure its position as a leader in the global renewable energy market.



The Current State of Canada's Renewable Energy Supply Chain

Canada's renewable energy ambitions, including achieving a net-zero electricity grid by 2035, rely on robust and efficient supply chains. However, the country's renewable energy supply chain faces

significant challenges, particularly in sourcing critical materials, refining capacity, and infrastructure readiness. These issues threaten the timely and cost-effective deployment of renewable energy projects.

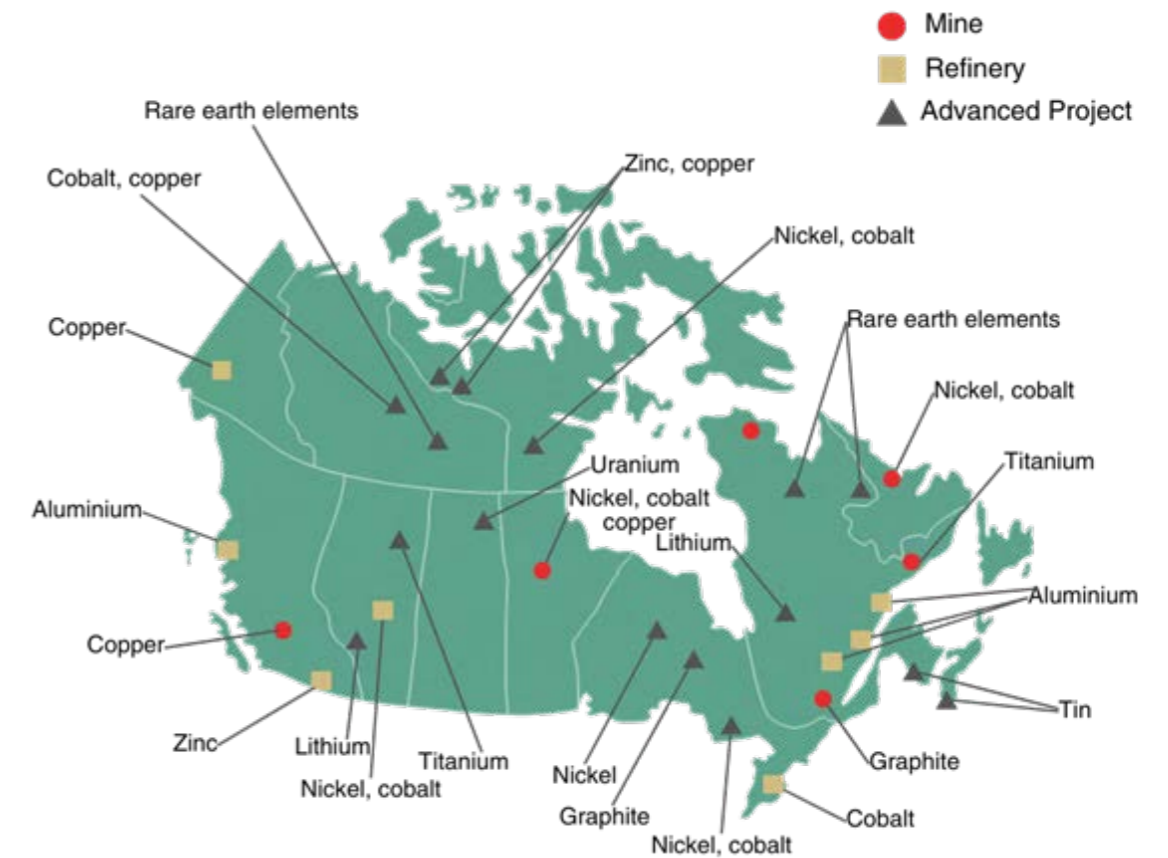


Fig 1: Reference from Government of Canada, Critical Minerals Strategy document

Section Two

Critical Materials: Resources Abundant, Refining Scarce

Canada is home to vast reserves of critical materials essential for renewable energy infrastructure:

- **Lithium:** Key for energy storage systems, with significant deposits in Quebec's James Bay region.
- **Cobalt:** Found in Ontario, this material is crucial for battery manufacturing.

- **Rare Earth Elements:** Essential for wind turbine magnets and solar panels, with deposits in several provinces.

Despite these resources, Canada lacks sufficient domestic refining and manufacturing capacity. According to Natural Resources Canada, 70% of the world's rare earth refining occurs in China, creating a dependency that exposes Canadian renewable energy projects to geopolitical risks, price volatility, and supply chain delays.

Top Countries by Share in Global Processing and Production of Critical Minerals in 2023

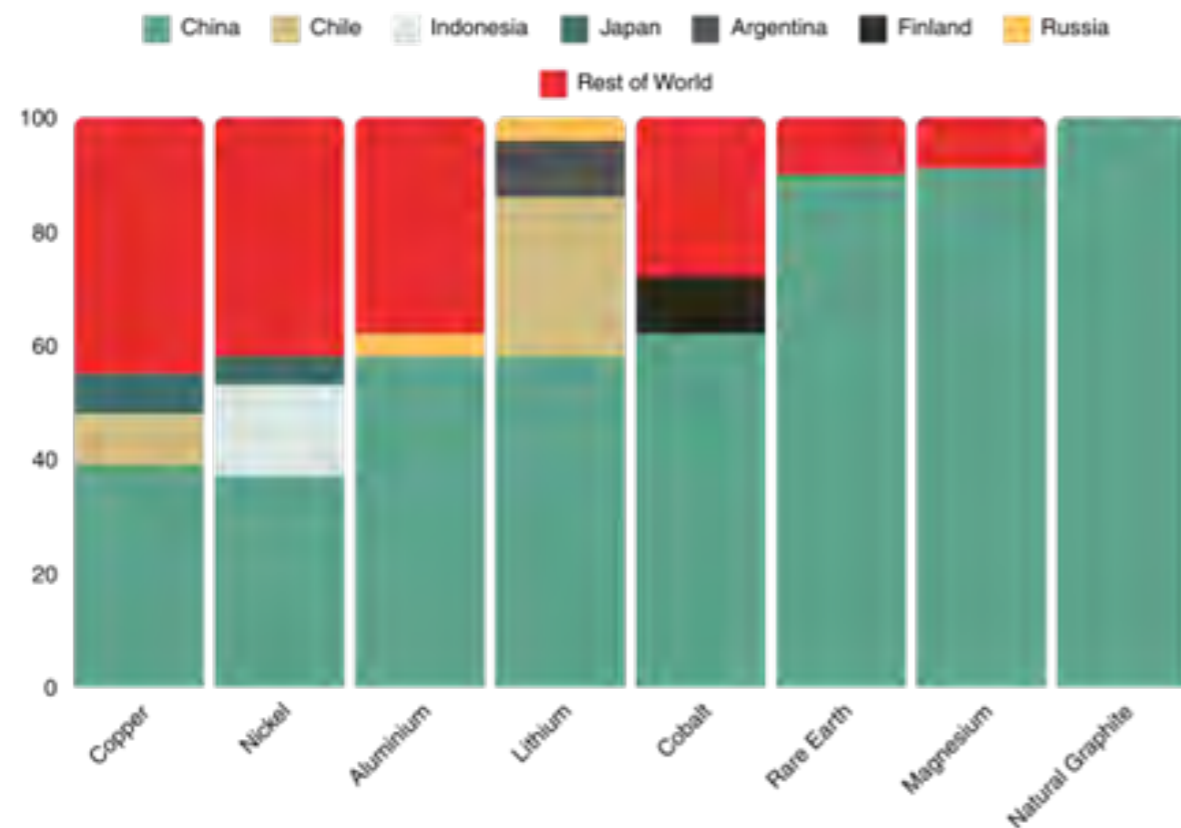


Fig 2: Data source: International Energy Agency (IEA)

Infrastructure Bottlenecks: Aging and Underprepared

Canada's aging grid infrastructure and insufficient energy storage capacity are ill-prepared to handle the rapid growth of wind and solar power. The Canada Energy Regulator (CER) projects electricity demand will double by 2050, but current grid modernization efforts are slow. This creates delays in connecting renewable projects to the grid and limits scalability.

Energy storage, a critical component for balancing intermittent renewable energy sources, is also underdeveloped. The Canadian Renewable Energy Association (CanREA) reports that project approvals for storage facilities are often delayed due to lengthy permitting processes, contributing to Canada falling short of its clean energy targets.

Logistical and Workforce Challenges

Canada's vast geography and low population density pose logistical hurdles in transporting materials to remote project sites. Additionally, a renewable energy workforce skills gap exacerbates delays, particularly in rural regions where expertise in implementing large-scale projects is limited.

These issues create a supply chain that struggles to keep pace with Canada's renewable energy ambitions, highlighting the need for domestic capacity-building and stronger partnerships to address bottlenecks.



Understanding the Demand for Critical Materials

The global transition to renewable energy is driving unprecedented demand for critical materials. Technologies such as energy storage systems, wind turbines, and solar panels depend on materials like lithium, cobalt, and rare earth elements. This surge in demand presents both opportunities and challenges for Canada's renewable energy sector.

Global Demand for Critical Materials

According to the International Energy Agency (IEA), the demand for critical minerals used in clean energy technologies is projected to grow significantly by 2040. For instance:

- **Lithium demand** is expected to increase by over 40 times, driven by energy storage and electric vehicles.
- **Cobalt usage** could grow by 20 times due to its importance in battery technology.
- **Rare earth elements** are indispensable for wind turbines and advanced electronics, with demand expected to double in the same timeframe.



Fig 3: Projected Demand Growth Rates by 2040 (IEA)

Canada's Role in Meeting Demand

Canada holds significant reserves of these materials, with deposits concentrated in key regions:

- **Lithium:** Quebec's James Bay region is home to substantial reserves, positioning Canada as a potential leader in energy storage material supply.
- **Cobalt:** Ontario has a long history of cobalt mining, particularly in the historic Cobalt Mining District.
- **Rare Earth Elements:** The Northwest Territories and parts of Saskatchewan have substantial deposits, though extraction remains limited.

However, Canada's refining and processing capacity lags behind its resource potential. Over 60% of the global rare earth refining market is controlled by China, making Canadian renewable energy projects vulnerable to supply chain disruptions and price volatility.

Implications for Renewable Energy Projects

- **Project Timelines:** Dependency on imported materials can delay project implementation due to logistical and geopolitical challenges.
- **Costs:** Rising global demand for critical materials is driving up prices, increasing the overall cost of renewable energy procurement.
- **Sustainability Risks:** Ethical concerns, such as conflict minerals and environmentally harmful mining practices, remain significant hurdles without proper supply chain transparency.

Addressing these challenges requires Canada to invest in domestic refining and manufacturing infrastructure, diversify supply chain sourcing, and adopt sustainable supply chain management practices. Tools like [Achilles Supply Chain Due Diligence](#) can help developers ensure ESG compliance and mitigate risks associated with critical material procurement.



Infrastructure Delays: A Growing Concern

While material shortages pose significant challenges, delays in renewable energy infrastructure further threaten Canada's transition to a net-zero grid. Grid modernization, energy storage deployment, and regulatory processes are essential to scaling renewable energy projects, yet they continue to face significant bottlenecks.

Grid Modernization: Outdated Systems Slowing Progress

Canada's electricity grid was designed for traditional energy sources and struggles to accommodate intermittent renewables like

wind and solar. According to [the Canada Energy Regulator \(CER\)](#), electricity demand is projected to double by 2050. However, investments in grid upgrades have not kept pace with this demand, causing delays in integrating new renewable energy capacity.

- **Challenge:** Limited transmission capacity is creating significant bottlenecks, particularly in provinces like Alberta and Ontario, where renewable energy growth is accelerating.
- **Impact:** Developers are unable to connect completed wind and solar projects to the grid, delaying revenue generation and increasing costs.

Energy Storage: Critical for Balancing Renewables

Energy storage systems are essential for addressing the variability of wind and solar power, ensuring consistent energy supply during periods of low generation. However, Canada's energy storage capacity remains insufficient.

The Canadian Renewable Energy Association highlight that energy storage projects often face lengthy approval processes, slowing deployment. These delays not only impact grid stability but also deter investment in renewable energy projects reliant on storage systems.

- **Challenge:** Permitting delays and regulatory uncertainty hinder the development of large-scale energy storage systems.
- **Impact:** Without adequate storage, the efficiency and reliability of renewable energy projects are compromised, limiting their contribution to Canada's clean energy goals.

Permitting and Policy Misalignment

Regulatory processes in Canada vary significantly between provinces, creating uncertainty for developers. For example, Alberta recently implemented a six-month pause on new renewable energy projects to assess their impact on the grid. While this pause aims to address long-term concerns, it has created short-term disruptions in renewable energy procurement and project deployment.

- **Challenge:** Inconsistent policies across provinces result in unpredictable approval timelines.
- **Impact:** Developers face increased risks and delays, discouraging investment in renewable energy infrastructure.

Logistical and Workforce Challenges

Canada's vast geography and low population density add complexity to infrastructure deployment. Transporting materials and components to remote project sites increases costs and timelines. Additionally, a skills gap in renewable energy infrastructure development exacerbates delays, particularly in rural regions where specialized expertise is limited.

Solutions to Overcome Material and Infrastructure Scarcity

To address the complex challenges of material shortages and infrastructure delays, Canada's renewable energy sector must adopt strategic solutions that enhance resilience, sustainability, and efficiency across the supply chain. These solutions involve diversifying supply sources, investing in domestic capacity, streamlining infrastructure development, and leveraging collaboration and technology.

Building Resilient Supply Chains

Reducing reliance on global markets is key when aiming to mitigate risks associated with geopolitical tensions and price volatility. Canada must focus on:

- **Partnering with Ethical Suppliers:** Leveraging tools like [Achilles Supply](#)

[Chain Due Diligence](#) ensures that materials such as lithium and cobalt are sourced responsibly, reducing the risk of conflict minerals entering the supply chain. Verified suppliers align with Environmental, Social, and Governance (ESG) standards, reducing risks tied to conflict minerals and unethical practices.

- **Adopting Digital Supply Chain Tools:** Technologies that provide monitoring and predictive analytics can identify bottlenecks and reduce disruptions, enabling more efficient sourcing and logistics management. [MyAchilles](#) provides a window to your supply chain performance and reporting. Using a combination of our prequalified supplier network, risk evaluation and reporting confidence enables continuous supply chain improvement.

Scaling Domestic Refining and Manufacturing

Canada's vast reserves of critical materials remain underutilized due to limited domestic processing and manufacturing capacity. Closing this gap involves:

- **Investing in Processing Facilities:** Building plants capable of refining materials like lithium and rare earth elements would reduce reliance on imports and shorten project timelines. For example, a lithium refining facility in Quebec could position the region as a global leader in energy storage material production. Achilles offers insights into potential risks associated with suppliers, including financial stability, health and safety practices, and geopolitical factors. This information supports in making informed decisions when selecting partners for processing facility projects.
- **Promoting Public-Private Partnerships:** Collaborative efforts between governments and private investors can accelerate the establishment of domestic manufacturing hubs for wind turbine components, solar panels, and energy storage systems.

Scaling local capacity not only strengthens Canada's renewable energy infrastructure but also creates jobs and drives economic growth.

Streamlining Infrastructure Development

Infrastructure delays remain a significant barrier to achieving Canada's renewable energy goals. Addressing these challenges requires:

- **Modernizing the Grid:** Investments in smart grid technologies and upgrades to transmission networks are critical for accommodating intermittent energy sources like wind and solar. Improved grid flexibility ensures renewable energy projects can deliver consistent power. Using [Achilles Pre Qualified Supplier Network](#) allows collaboration with verified suppliers for infrastructure components, like smart grid technologies or storage systems ensuring reliability and compatibility.
- **Standardizing Permitting Processes:** Reducing variability in permitting requirements across provinces would streamline approval timelines and make projects more predictable for developers. Alberta's recent pause on renewable energy projects demonstrates the risks of inconsistent policies.
- **Accelerating Energy Storage Deployment:** Faster approval processes for large-scale battery projects would enhance grid stability, supporting the integration of renewable energy sources.

By streamlining infrastructure development, Canada can unlock the full potential of its renewable energy projects and meet growing electricity demands.



Collaboration with Indigenous Communities

Achilles understands the critical importance of engaging Indigenous communities in renewable energy projects. Many of Canada’s critical material reserves and infrastructure projects are located on or near Indigenous lands, making collaboration essential for equitable, sustainable development.

Achilles supports developers in building these partnerships by offering tools and services that enhance supplier validation, global supply chain management, and ethical sourcing practices. With operations in 18 locations worldwide, Achilles is uniquely equipped to navigate complex supplier dynamics across different regions and ensure alignment with cultural, environmental, and social standards.

- **Global Platform for Supply Chain Management:** Achilles allows developers to manage their entire global supply chain within a single platform, ensuring consistency and transparency in supplier engagements. This enables better collaboration with Indigenous-owned businesses by streamlining procurement processes and creating opportunities for local partnerships.
- **Supplier Validation and Auditing:** Achilles conducts meticulous validation of supplier information and can conduct [physical audits](#) to ensure compliance with ESG and cultural requirements.

This is particularly valuable in projects that require alignment with Indigenous knowledge and sustainability goals.

- **Fostering Trust Through Data Transparency:** By providing detailed supplier profiles, Achilles helps developers foster trust with Indigenous communities. Transparent data ensures that Indigenous stakeholders are informed about project impacts and benefits, facilitating long-term partnerships.

Collaborative efforts not only build trust but also strengthen Canada’s commitment to social and environmental responsibility.

Leveraging Technological Innovation

Innovation is essential for overcoming material shortages and improving infrastructure efficiency. Focus areas include:

- **Recycling Critical Materials:** Establishing recycling facilities for lithium-ion batteries can reclaim valuable materials like lithium and cobalt, reducing dependence on new mining operations and minimizing waste.
- **Developing Alternative Technologies:** Research into solid-state batteries and other next-generation energy storage solutions could diversify supply chains and lessen reliance on scarce materials.



Broad Risk Evaluation



Reporting Confidence



Reduce the Burden



Cost Effective



Robust Supply Chain Due Diligence

Securing Canada's Renewable Energy Future

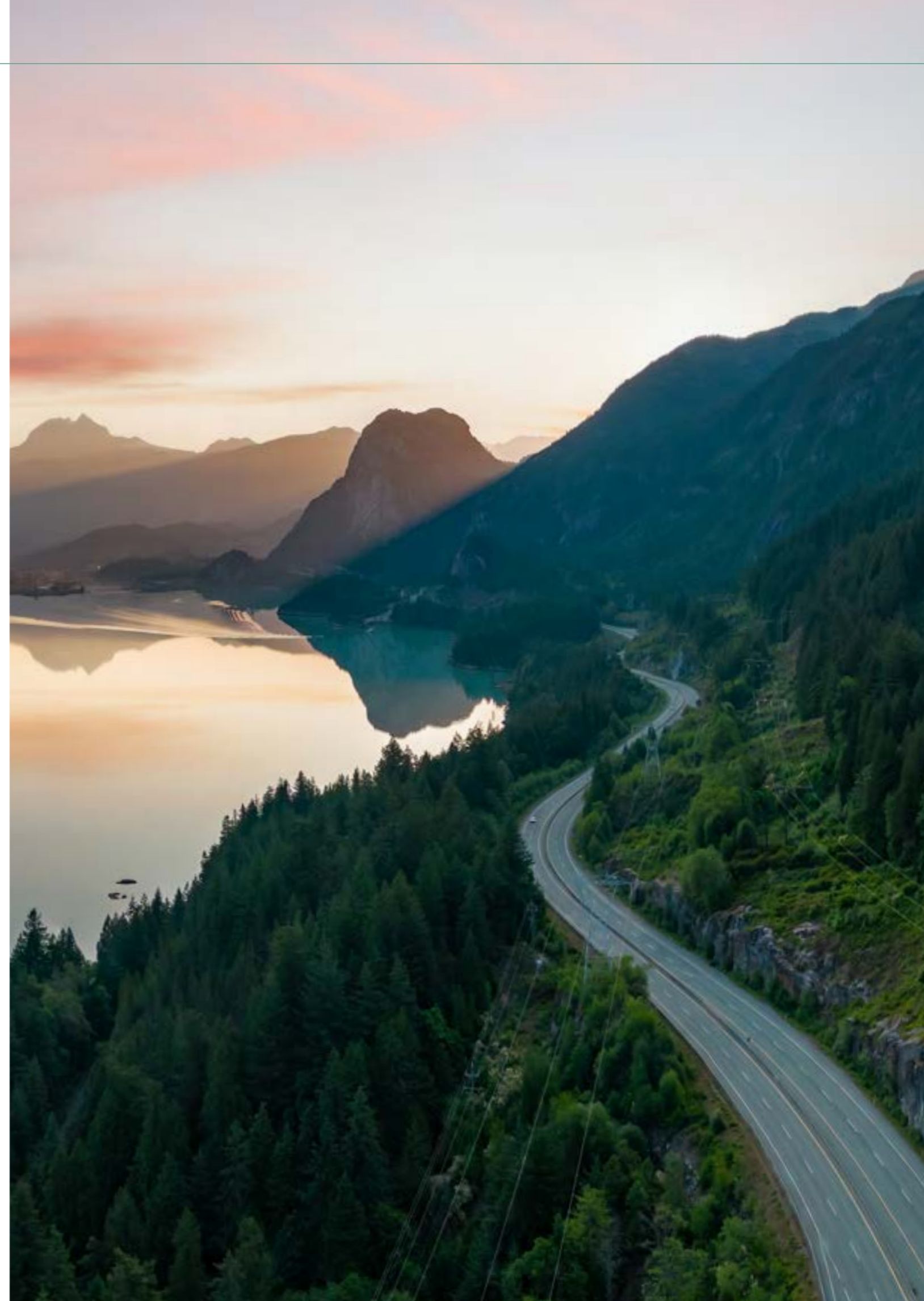
Canada is at an important moment in its renewable energy transition. With abundant reserves of critical materials and a growing focus on clean energy infrastructure, the country has the potential to become a global leader in the renewable energy supply chain. However, significant challenges such as material shortages, refining gaps, and infrastructure delays threaten to derail progress toward its net-zero goals.

Addressing these barriers requires a proactive and collaborative approach. Strengthening supply chain resilience through ethical sourcing, investing in domestic processing and manufacturing, and modernizing infrastructure are essential steps. By fostering partnerships with Indigenous communities, embracing technological innovation, and streamlining

permitting processes, Canada can overcome bottlenecks and accelerate the deployment of renewable energy projects.

The path forward is clear: Canada must align its resources, policies, and technologies to create a sustainable, transparent, and efficient renewable energy supply chain. These efforts will not only drive economic growth but also position Canada as a leader in the global transition to clean energy.

Achilles is here to help. With expertise in sustainable supply chain management and supplier pre-qualification, Achilles provides tools and insights to address these challenges. By leveraging Achilles' solutions, businesses can mitigate risks, ensure ESG compliance, and build resilient supply chains that support Canada's renewable energy future.





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