

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

White paper

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Introduction

The UK'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. Although the UK has limited domestic reserves of these materials, its dependence on international supply chains makes it highly vulnerable to geopolitical risks and price fluctuations.

Simultaneously, infrastructure challenges such as grid capacity constraints and delays in energy storage deployment further slow

the progress of renewable energy projects. These issues are compounded by logistical inefficiencies and a skills gap in large-scale project execution. For example, the UK's grid connection delays are now a bottleneck for over 600 renewable energy projects, according to [National Grid ESO](#).

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





The Current State of the UK's Renewable Energy Supply Chain

The UK'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, domestic production capacity, and infrastructure readiness. These issues threaten the timely and cost-effective deployment of renewable energy projects.

Critical Materials: Reliance on Imports

The UK lacks substantial domestic reserves of critical materials such as lithium, cobalt, and rare earth elements. These materials are crucial for energy storage

systems, wind turbine magnets, and solar panel components. As a result, the country relies heavily on global markets for these resources. [Over 60% of rare earth element refining occurs in China](#), making UK renewable energy projects highly susceptible to geopolitical risks, price volatility, and supply chain delays.

Key Risks:

- Price volatility driven by fluctuating global demand and geopolitical tensions.
- Logistical delays from overburdened international supply chains.
- Ethical concerns, such as sourcing materials linked to environmental degradation or labour exploitation.

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

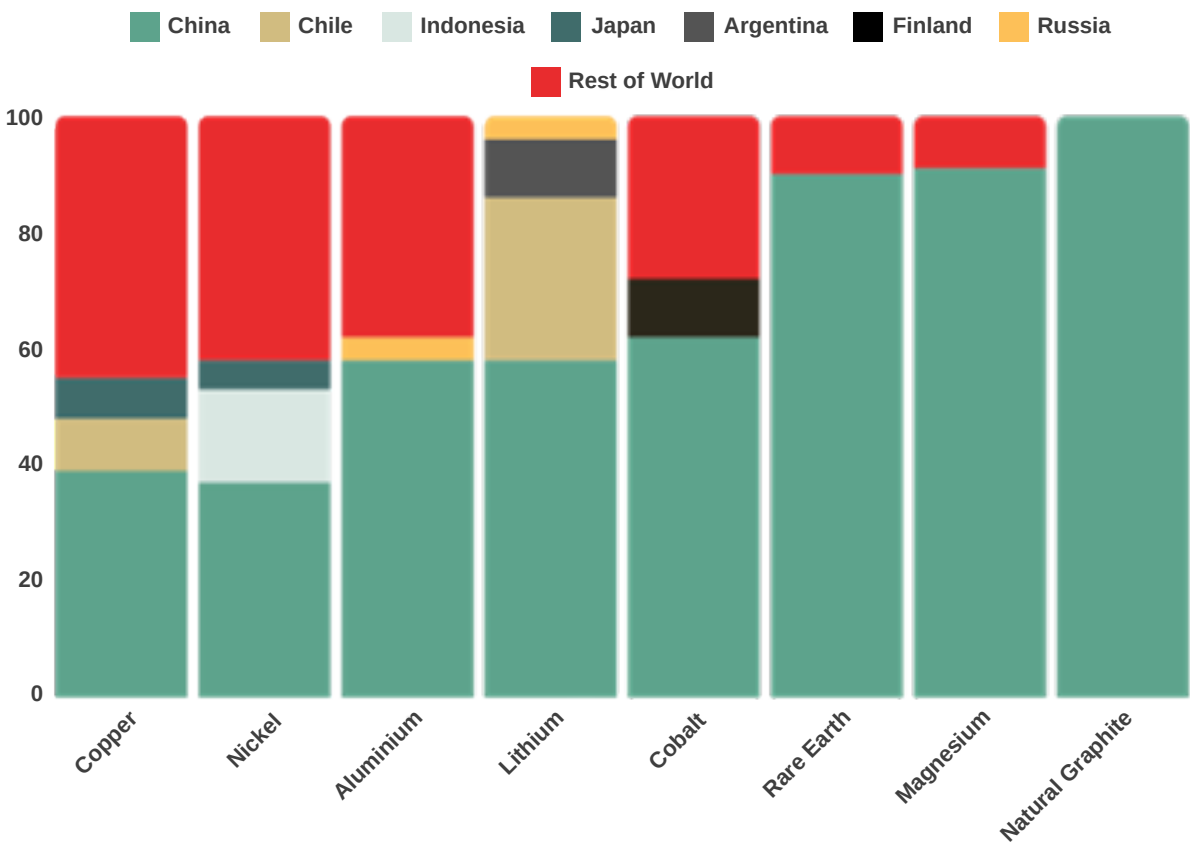


Fig 1: Data source: [International Energy Agency \(IEA\)](#)

Section Two

Infrastructure Bottlenecks:
Aging and Underprepared

The UK’s aging grid infrastructure and limited energy storage capacity are ill-equipped to support the rapid expansion of renewable energy projects. According to [The Royal Society’s report](#) on large-scale electricity storage, electricity demand in the UK is expected to double by 2050. However, current grid modernisation efforts and energy storage capacity remain insufficient to address this growth.

- **Energy Storage Challenges:** The report highlights that long-duration energy storage, particularly hydrogen storage, will play an essential role in balancing intermittent renewable energy sources. Despite this, projects face delays due to complex permitting processes and regulatory barriers.

Logistical and Workforce Challenges

The UK faces logistical hurdles in transporting renewable energy components, particularly to rural or remote project sites. Additionally, the renewable energy sector is experiencing a workforce skills gap, especially in areas such as grid modernisation and large-scale project implementation. Without addressing these workforce shortages, delays in project delivery and increased costs are likely to persist.

Workforce Challenges:

- **Skills Shortage:** The UK energy sector needs to fill approximately [400,000 roles by 2050](#) to achieve net-zero goals, with 260,000 being new roles and 140,000 replacing those leaving the workforce. This demand spans various regions, and according to [a National Grid Report](#)

nearly 100,000 jobs in the North, over 50,000 in the Midlands, and nearly 90,000 in Scotland, Wales, and Northern Ireland.

- **Training Gaps:** There is a pressing need for expanded training and apprenticeship programs to meet the demand for skilled workers, particularly in Scotland, which has significant investments planned in offshore wind and other renewable projects.

Logistical Challenges:

- **Supply Chain Pressures:** The renewable energy sector is experiencing material and component shortages, permitting and regulatory issues, high inflation, and rising costs, leading to supply chain disruptions.
- **Grid Connection Delays:** [Delays in connecting renewable projects](#) to the national electricity grid are causing some developers to defer projects, particularly in Scotland, which accounts for two-thirds of the UK’s offshore wind market.

Regional Insights:

- **Scotland:** Faces acute workforce shortages and grid connection delays, impacting offshore wind projects. Significant investments are planned, necessitating a skilled workforce and efficient logistics.
- **North England:** Requires tens of thousands of skilled workers to meet renewable energy targets, with a focus on transitioning from traditional energy sectors to renewables.
- **Midlands and Devolved Nations:** Also face substantial workforce demands, with over 50,000 jobs needed in the Midlands and nearly 90,000 in Scotland, Wales, and Northern Ireland.



Renewable Energy Workforce and Grid Challenges by Region

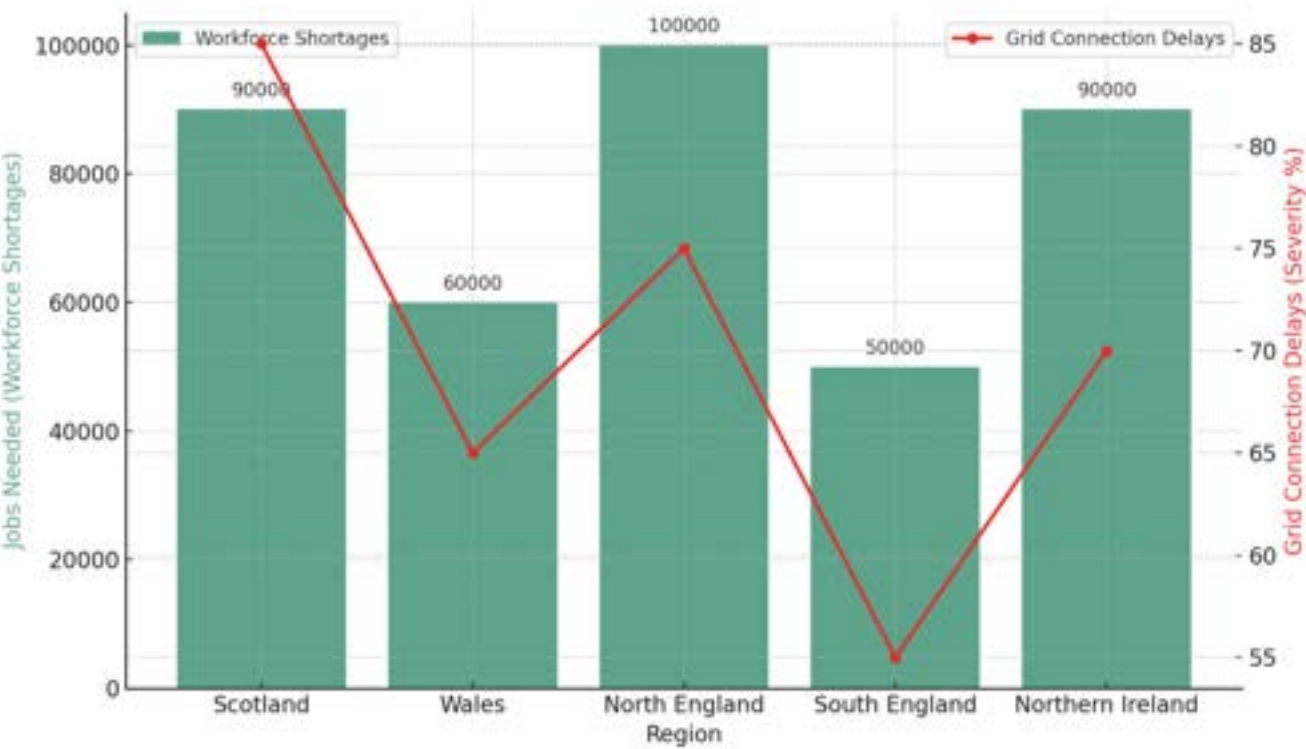


Fig 2: Data taken from various sources: [Maersk](#), [National Grid](#), [Electrical Review](#), [Financial Times](#)

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 the UK'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.



400%
Lithium



200%
Cobalt



100%
Rare Earth Elements

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

The UK's Role in Meeting Demand

The UK's reliance on imports for critical materials introduces several risks. Over 60% of rare earth element refining is controlled by China, highlighting the vulnerability to geopolitical tensions and supply chain disruptions. For example, delays in procuring essential materials have impacted timelines for offshore wind projects, such as the [Dogger Bank Wind Farm](#), which depends on rare earth magnets for turbine construction.

Despite lacking substantial domestic reserves, the UK can bolster its position in the global supply chain:

- **Investing in Recycling Initiatives:** Establishing facilities to recover critical materials from end-of-life products like lithium-ion batteries, such as through the government-supported [ReLiB project at the University of Birmingham](#).
- **Advancing Alternative Technologies:** Developing next-generation solutions, including solid-state batteries, which could significantly reduce reliance on cobalt and lithium.
- **Strengthening International Partnerships:** Collaborating with resource-rich countries such as Canada and Australia to diversify supply sources and reduce dependency on single markets.
- **Adopt Sustainable Practices:** Tools like [Achilles Supply Chain Due Diligence](#) can help developers ensure ESG compliance and mitigate risks associated with critical material procurement.

By starting to implement measures like these, the UK can strengthen its renewable energy supply chain, mitigate risks, and position itself as a leader in the global clean energy transition.





Infrastructure Delays: A Growing Concern

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

Grid Modernisation: Outdated Systems Slowing Progress

The UK’s electricity grid, originally designed for traditional energy sources, struggles to accommodate intermittent renewables

like wind and solar. Electricity demand is expected to double by 2050, but investments in grid upgrades have not kept pace with this demand. These delays impact renewable energy capacity integration, with significant bottlenecks observed in areas like Scotland and Northern England.

- **Challenge:** Limited transmission capacity restricts the connection of renewable projects, creating delays in revenue generation and cost increases for developers.
- **Example:** The Hornsea Wind Farm faced connection challenges, highlighting the urgent need for grid modernisation.

Energy Storage: Critical for Balancing Renewables

Energy storage systems are vital to addressing the variability of wind and solar power, ensuring consistent energy supply during periods of low generation. However, the UK’s energy storage capacity is insufficient to meet growing demands.

- **Challenge:** Permitting delays and regulatory uncertainty hinder the development of large-scale storage projects.
- **Impact:** Without adequate storage, renewable energy efficiency and reliability are compromised, limiting their contribution to clean energy goals.
- **Example:** [The Royal Society](#) highlights that tens of terawatt-hours of storage are needed to stabilise the grid, yet current investments fall short.

Permitting and Policy Misalignment

Inconsistent regulatory processes across the UK create uncertainty for developers. For example, delays in permitting for renewable energy projects in Scotland and Wales have deterred investors, slowing the pace of deployment.

- **Challenge:** Variability in approval timelines discourages investment and delays critical infrastructure projects. Recent analyses indicate that [approximately 63% of renewable energy project applications between 2018 and 2023](#) failed to progress beyond the planning stage. Only about 20% of projects are currently moving forward.

Average UK Renewable Project Approval Time (Through Planning, Submission and Approval) in Years

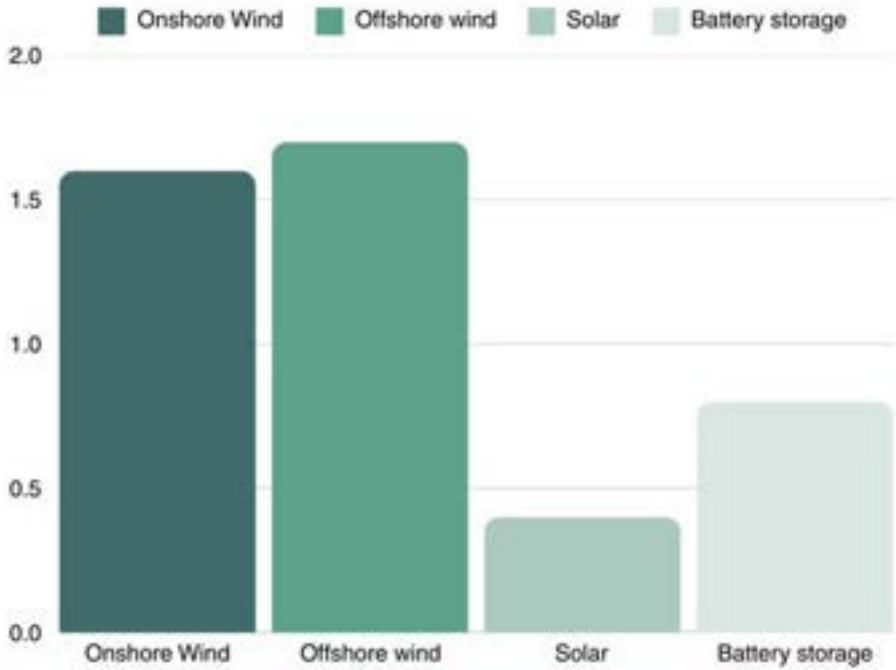


Fig 4: Source: [Knight Frank, Planning for a Renewable Future](#)

Solutions to Overcome Material and Infrastructure Scarcity

To address the complex challenges of material shortages and infrastructure delays, the UK'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. The UK should 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 aligned with Environmental, Social, and Governance (ESG) standards, reduce risks tied to conflict minerals and unethical practices.

- **Adopting Digital Supply Chain Tools:** Technologies that provide real time 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 predictive analytics, prequalified supplier network, risk evaluation and reporting confidence enables continuous supply chain improvement.





Scaling Domestic Refining and Manufacturing

The UK’s lack of domestic processing and manufacturing capacity for critical materials presents a significant bottleneck. Addressing this gap involves:

- **Investing in Processing Facilities:** Establishing plants capable of refining materials like lithium and rare earth elements would reduce reliance on imports and shorten project timelines. For example, developing a lithium refining facility could position the UK as a global leader in energy storage material production. Tools like Achilles help assess risks associated with potential suppliers, including financial stability and compliance with health, safety, and geopolitical standards.
- **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 strengthens the UK’s renewable energy infrastructure while driving economic growth and job creation.

Streamlining Infrastructure Development

Infrastructure delays remain a significant barrier to achieving the UK’s renewable energy goals. Addressing these challenges requires:

- **Modernising the Grid:** Investments in smart grid technologies and upgrades to transmission networks are important 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.

- **Standardising Permitting Processes:** Reducing variability in permitting requirements across regions would streamline approval timelines and provide predictability for developers. For example, Scotland’s six-month pause on new renewable energy projects in 2023, aimed at assessing environmental impacts and planning policies, created short-term uncertainty for developers. While intended to address long-term concerns, this temporary pause delayed project approvals and highlighted the risks of inconsistent permitting 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, the UK can unlock the full potential of its renewable energy projects and meet growing electricity demands.

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 minimising 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 the UK's Renewable Energy Future

The UK is at an important moment in its renewable energy transition. With increasing investment in clean energy infrastructure and a growing focus on sustainability, the country has the potential to lead the global renewable energy supply chain. However, challenges such as material shortages, limited refining capacity, and infrastructure delays risk slowing progress toward its net-zero goals.

Overcoming these barriers requires a proactive and collaborative approach. Strengthening supply chain resilience through ethical sourcing, investing in domestic processing and manufacturing, addressing the skills gap, and modernising infrastructure are critical steps. By embracing technological innovation, streamlining permitting processes, and ensuring policy consistency across regions, the UK can overcome bottlenecks and accelerate the deployment of renewable energy projects.

The path forward is clear: aligning 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 the UK as a leader in the global transition to clean energy.

How Achilles Supports the Transition

Achilles plays a key role in enabling this transformation. With expertise in sustainable supply chain management and supplier pre-qualification, Achilles provides the tools and insights needed to address these challenges. By leveraging Achilles' solutions, businesses can:

- Mitigate risks associated with global supply chains.
- Ensure compliance with ESG standards.
- Build resilient, transparent, and efficient supply chains.

By supporting these efforts, Achilles helps the UK's renewable energy sector unlock its full potential and achieve its net-zero ambitions.

[Learn more.](#)





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 **Achilles**
Supply Chain Sustainability