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# Tariffs, Trade, and Transition: The Impact of Trade Barriers on Sustainable Energy Goals

Sustainability Research Paper

The Al-Attiyah Foundation

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The global clean energy transition stands at a critical juncture, with trade policy set to determine whether renewable capacity targets are achieved or systematically undermined over the next decade. As governments increasingly adopt adversarial trade policy to protect domestic industries, the fundamental assumptions and economics underlying international energy cooperation are being challenged.

Emerging trade fragmentation threatens to permanently reshape clean energy markets, with implications extending far beyond current tariff disputes. How are escalating tariffs and trade policy uncertainty disrupting clean energy supply chains and undermining global renewable capacity targets? What strategic opportunities exist for supply chain diversification and regional clean energy hub development despite rising trade barriers?

## SUSTAINABILITY RESEARCH PAPER

This research paper is part of a 12-month series published by the Al-Attiyah Foundation every year. Each in-depth research paper focuses on a current sustainability topic that is of interest to the Foundation's members and partners. The 12 technical papers are distributed to members, partners, and universities, as well as made available on the Foundation's website.

# 03 EXECUTIVE SUMMARY

- Government tariffs and trade policy uncertainty have emerged as critical threats to global sustainable energy deployment, with US tariffs on solar panels exceeding 250% and battery component duties approaching 100%, fundamentally disrupting cross-border flows essential for the energy transition.
- Clean energy supply chains face unique vulnerabilities to policy volatility, as renewable technologies depend on geographically dispersed manufacturing networks spanning over 50 countries, making single policy changes capable of affecting global deployment rates.
- Trade barriers could delay global renewable capacity targets by three to five years, with clean energy goods facing average tariff rates significantly higher than those for conventional energy equipment, and non-tariff barriers adding compliance costs of 15-25% to project values.
- Economic disruption is accelerating. The World Bank has reduced global growth forecasts to 2.3% in 2025 due to trade tensions, while nearly USD 8 billion in clean energy investments were cancelled in the first quarter of 2025 alone.
- Concentrated supply chains create systemic risks, as China dominates global manufacturing of key clean technologies, while the US remains fully reliant on foreign sources for critical minerals like natural graphite.
- Corporate adaptation strategies are evolving rapidly, including supply chain diversification, nearshoring production and enhanced scenario planning to navigate regulatory uncertainty across multiple jurisdictions.
- Policy uncertainty hinders growth by delaying investments and raising risk premiums, with development banks noting a 20–30% rise in financing costs for cross-border renewable projects.
- Scenario modelling reveals that removing half of the current trade barriers could increase photovoltaic applications by 7% and improve carbon emissions reduction potential by 4-12 gigatons of CO2 equivalent by 2060.
- Regional opportunities exist despite global fragmentation, with Middle East and North Africa (MENA) countries possessing substantial critical mineral reserves and a strategic geographic positioning for the development of clean energy trade hubs.
- International policy coordination is essential, requiring harmonised regulations and joint responses to manage uncertainty and sustain climate progress.

Global trade has emerged as a critical enabler for scaling clean energy technologies and achieving net-zero targets, with cross-border flows of components, materials and expertise underpinning the energy transition. The interconnected nature of clean energy supply chains means that government tariffs and trade policy uncertainty have a disproportionate impact on renewable energy deployment, battery manufacturing, and critical mineral processing across all industries, with implications extending far beyond the energy sector. Recent analysis demonstrates that clean energy technologies require significantly more international coordination than conventional energy systems, with solar photovoltaic panels alone involving supply chains that span over 50 countries for component sourcing, assembly, and distribution[1].

Recently, there has been an unprecedented escalation in trade tensions, reshaping the global clean energy landscape through a series of linked policy developments. US tariffs on clean technology imports have reached levels not seen since the Great Depression era, with solar panel duties exceeding 250% and battery component tariffs approaching 100%, creating immediate cost pressures for further energy project development. At the same time, carbon border adjustment mechanisms have introduced new compliance requirements. The European Union's Carbon Border Adjustment Mechanism (CBAM) implementation, for instance, affects imports of steel, cement, aluminium, and hydrogen. China has imposed export restrictions on critical minerals, including lithium, graphite and rare earth elements. These developments signal a fundamental shift from the multilateral trade framework that has underpinned global energy markets for decades, with policy unpredictability becoming a major driver of economic outlook uncertainty.

Unlike traditional energy commodities, renewable energy technologies rely on complex, geographically dispersed manufacturing networks that are particularly sensitive to trade disruptions, with single policy changes capable of having a profound impact on global deployment rates. Evidence from the World Trade Organization (WTO) indicates that clean energy goods face average tariff rates significantly higher than those for conventional energy equipment.  Additionally, non-tariff barriers, including technical regulations, certification requirements, and local content mandates, add estimated compliance costs of 15-25% of project values. International Energy Agency projections indicate that current trade barriers could delay global renewable energy capacity targets by three to five years. Development banks are reporting 20-30% increases in risk premiums for cross-border renewable energy investments. Academic studies show that trade policy uncertainty leads to 'option value effects,' prompting firms to delay irreversible investments until policies become clearer—even if expected returns are positive. This theoretical framework explains why clean energy deployment responds more severely to trade policy volatility than traditional sectors[3,4].

For MENA, these global trade tensions present both significant risks and strategic opportunities that could reshape the region's role in the worldwide energy transition. However, trade fragmentation poses challenges for African carbon markets, which rely heavily on global verification services, auditors, drone monitoring and data platforms that may become less accessible under restrictive trade regimes.

MENA countries possess substantial reserves of critical minerals essential for clean energy technologies, including lithium deposits in Saudi Arabia, phosphate resources in Jordan and copper reserves across Egypt and Oman. The region's geographic position between Europe, Asia and Africa provides unique advantages for serving as a clean energy trade hub, particularly for hydrogen production and export, with potential to capture significant value from global supply chain diversification trends.

Table 1: Trade Impact on Clean Energy

## Trade Impact on Clean Energy

Tariff-Driven Cost Increases by Segment

| Technology | Region | Tariff impact (%) | Deployment delay (months) |
|---|---|---|---|
| Solar PV | US | 18 | 7 |
| Solar PV | EU | 12 | 5 |
| Wind | US | 14 | 9 |
| Wind | EU | 10 | 6 |
| Batteries | US | 21 | 8 |
| Batteries | EU | 16 | 7 |

*Note: Estimates are based on data from WTO, IEA and BloombergNEF 2025 reports, reflecting average tariff and delay impacts for major markets, with basic regression analysis. Calculations aggregate segment-level impacts and do not include company-specific disclosures.*

### An Increasingly Uncertain Trade and Financing Backdrop

Even prior to the outbreak of escalating trade tensions in April 2025, trade fragmentation had been increasing substantially as a compliance burden for corporates, affecting operational efficiency and investment decision-making processes. Companies now face the challenge of navigating multiple regulatory frameworks simultaneously, with different technical standards, certification requirements and local content mandates across key markets. The complexity goes well beyond traditional tariff calculations.3 This fragmentation has led to increased working capital requirements as companies maintain larger inventories to buffer against supply chain disruptions, while also necessitating more sophisticated risk management systems to track regulatory changes across multiple jurisdictions.

The overall effect has been to slow decision-making processes and increase the time required for project development and implementation across clean energy value chains[5].

Financial institutions also face heightened counterparty risks due to trade policy uncertainty, necessitating enhanced due diligence and more conservative risk management approaches in clean energy project finance. Development banks report increases in risk premiums for cross-border renewable energy investments, while corporate renewable energy procurement has slowed due to uncertainty in supply chain costs. Asset managers have responded by reducing equity risk exposure and maintaining higher allocations to debt-based instruments, reflecting the increased volatility and unpredictability in clean energy markets.

The financial sector's more cautious approach has created additional barriers to clean energy deployment, as projects face higher financing costs and more stringent approval processes, particularly for cross-border investments that involve multiple regulatory jurisdictions[6].

Addressing these trade barriers requires coordinated international policy efforts to sustain progress towards global sustainable energy goals. Policy unpredictability and rising trade barriers constrain clean energy investment at precisely the moment when accelerated deployment is most critical for meeting climate targets. At the level of corporate decision-making, fragmentation and uncertainty necessitate that companies allocate more resources to developing sophisticated intelligence capabilities to support supply chain management and resilience, including strategic sourcing.

The MENA region's potential to expand panel exports faces constraints, despite substantial domestic manufacturing investments and a strategic geographic positioning. Despite major investments by Gulf Cooperation Council states in renewable energy and related infrastructure, China's dominance in key manufacturing limits the region's ability to gain global market share. Strategic partnerships with key manufacturing nations, particularly in Southeast Asia, can accelerate renewable deployment and domestic capacity, but still face the same trade policy uncertainties affecting global markets.

Figure 1: Role-Specific Insight

# 09 POLICY UNCERTAINTY UNDERMINES GROWTH

Rising global policy uncertainty significantly reduces bilateral trade, with the industrial products and clean energy sectors experiencing disproportionate impacts that threaten the pace of sustainable energy transitions. Academic research indicates that trade freedom significantly hinders clean energy development in more than 100 countries, with policy volatility creating measurable disruptions to the cross-border flows of components, materials and expertise essential for renewable energy deployment. The World Trade Uncertainty Index shows that increases in global uncertainty empirically reduce bilateral trade volumes, with manufacturing and technology-intensive sectors facing the most severe constraints. Clean energy supply chains are uniquely vulnerable to policy volatility, as they depend on manufacturing networks spread across more than 50 countries, making them highly sensitive to single policy change[6,7,8].

Horizontal trade integration between countries at similar stages of the value chain can partially mitigate the impacts of uncertainty. In contrast, deeper global value chain participation tends to amplify exposure to policy shocks across multiple markets simultaneously. Countries engaged in horizontal integration benefit from reduced transaction costs and shared risk exposure, enabling more resilient trading relationships during periods of heightened policy volatility. However, sectors with extensive global value chain participation, including renewable energy manufacturing and critical mineral processing, face compounded risks as policy changes in any single jurisdiction can cascade through entire supply networks. This creates challenges for clean energy deployment, where manufacturing networks often span dozens of countries and require stable, predictable policy environments to maintain cost-competitive production[9].

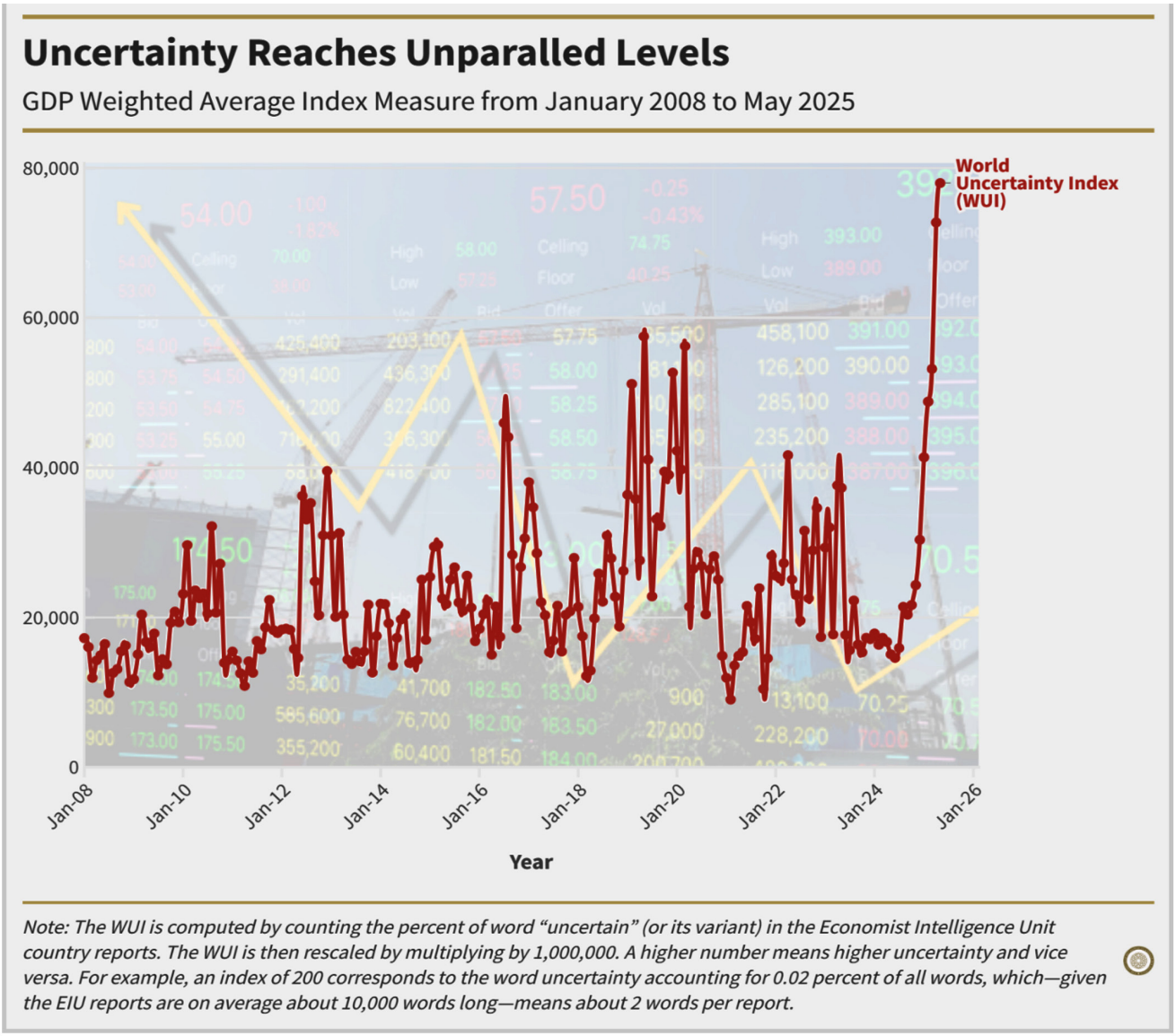
Persistent policy uncertainty complicates value chain integration and strategic planning across all regions, requiring sophisticated scenario-based risk management. Companies operating in clean energy value chains must now develop multiple contingency plans to address potential policy changes, increasing operational complexity and resource requirements. The need for scenario planning has become particularly acute for multinational corporations with exposure to multiple regulatory jurisdictions, where policy changes in any single market can affect global operations. This complexity creates barriers to entry for smaller companies and increases the advantages of scale for larger corporations with sufficient resources to manage regulatory uncertainty across multiple markets[10].

## Supply Chains Under Pressure

Cross-border flows of components and materials form the foundation of clean energy supply chains. The International Energy Agency estimates that China accounts for most of the global manufacturing capacity for each key clean technology and component. Chinese producers earn sizable revenues from the US market, where tariff impacts are now most pronounced. The US imported over 54 gigawatts of solar panels in 2024, with the vast majority sourced from Vietnam, Thailand, Malaysia, and Cambodia. Meanwhile, domestic manufacturers supplied only about 30% of the wind turbine blades installed domestically. This extensive reliance on imports means that sweeping reciprocal tariffs, combined with existing 25% aluminium and steel tariffs, directly increase prices across all clean energy technologies[11].

Tariffs on critical minerals, such as lithium, cobalt and graphite, create immediate disruptions to the battery and electric vehicle value chains; however, strategic exemptions reveal the complex realities of global supply dependencies. Chinese-made lithium-iron-phosphate (LFP) battery cells now face a combined tariff of nearly 65%. At the same time, the US remains entirely dependent on foreign supply for materials like natural graphite and high-purity manganese sulphate. Critical minerals, including lithium, cobalt, manganese, and natural graphite, have been deliberately excluded from current tariff regimes, whilst MENA countries including Saudi Arabia, Jordan, UAE, Oman and Egypt possess substantial reserves that offer strategic opportunities for supply chain localisation and diversification as demand for essential mineral resources rises with clean energy transitions[12,13].

Figure 2: Uncertainty Reaches Unparalleled Levels




Geopolitical risks and supply chain concentration, particularly Chinese dominance and the vulnerability of the US and EU have created strategic dependencies that intensify concerns about the clean energy supply chain. China's export controls on rare earths reveal critical vulnerabilities in global supply chains, as exporters are now required to obtain licenses to sell rare earths outside of China, affecting all markets.

The US battery energy storage system (BESS) market is particularly exposed, with over 90% of deployments sourced from China, while Chinese clean-tech providers in the MSCI ACWI Investable Market Index generate more than half their sales within the domestic market. This concentration creates systemic risks where policy changes in any single jurisdiction can cascade through entire supply networks, requiring sophisticated risk management and scenario planning capabilities[11].


Trade diversion effects have enabled some countries, particularly those in Southeast Asia, to benefit from supply chain reorientation; however, these gains are now facing new challenges from the expansion of tariff regimes. Malaysia, once the world's third-largest solar module producer, faces disproportionate impacts due to its role in polysilicon and module production, with new tariffs in 2025 targeting its solar products. Almost 10% of clean energy exports from Thailand, Cambodia, and South Korea go to the US, representing one of the highest global exposure levels. Meanwhile, tariff hikes have created uncertainty that curbs exports and discourages reinvestment in domestic clean energy sectors. Several ASEAN economies had viewed green growth as a strategic economic pillar. Rising manufacturing project cancellations in the first quarter of 2025 have significantly impacted sentiment.

Shifts in trade policy and supply chain configurations are also influencing LNG demand and supply dynamics, with implications for global energy markets and the pace of clean energy transitions. China placed a 15% tariff on US LNG imports in February 2025, followed by retaliatory 125% tariffs on all US goods, forcing Chinese buyers to turn away numerous US LNG cargos. The US exported 213 billion cubic feet (Bcf) of LNG to China in 2024, representing a 25% increase from 2023 but still below 2021 levels. This is due to Chinese tariffs having a limited immediate impact on US liquefiers, given already reduced trade volumes. However, the potential for additional retaliatory tariffs from other nations creates broader risks for US LNG exports. At the same time, a delayed energy transition could benefit US liquefied natural gas exports and hydrocarbon revenues in the short term[14].

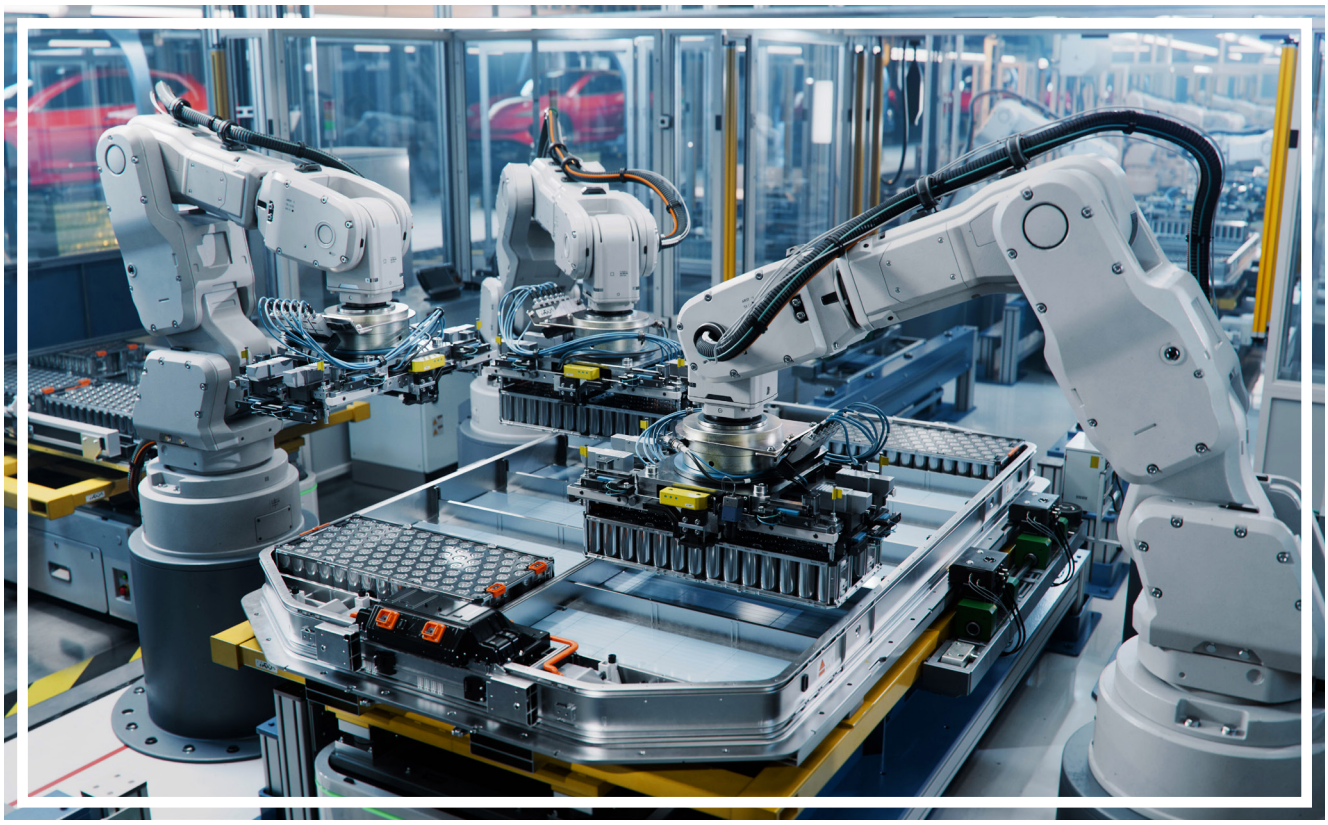
## Economic Disruption Accelerates

The World Bank has reduced its global growth forecast for 2025 by 0.4 percentage points to 2.3%, citing higher tariffs and heightened uncertainty as posing a "significant headwind" for nearly all economies. The cumulative effect has created a raft of import barriers across almost every component of clean energy technology, including solar panels, wind turbine parts and battery systems, which are making clean technologies prohibitively expensive for companies. UNCTAD also warns that global growth is expected to slow below 2.5% in 2025. This is significant because the 2.5% global growth threshold is often associated with a worldwide recession. Trade policy uncertainty, now at historic highs, is eroding business confidence and reshaping global trade patterns, with manufacturers and investors delaying decisions and reassessing supply chain strategies[15,16].

Case studies highlight a wave of clean energy project cancellations and investment losses. Nearly USD 8 billion in investments and 16 new large-scale factories and other projects were cancelled, closed or downsized in the first three months of 2025 amid escalating market uncertainty. Investments withdrawn since January are more than three times the total investments cancelled over the previous 30 months. Specific cancellations include those of Kore Power's planned USD 1.2 billion lithium battery factory in Arizona, Freyr Battery's USD 2.6 billion battery factory in Georgia, and Bosch's USD 200 million hydrogen fuel cell factory in South Carolina. These cancellations span multiple sectors, including wind, solar and electric vehicle manufacturing, representing another sign of companies' hesitation to push ahead with clean energy projects[17].

Despite global trade tensions, some regional forecasts remain positive, though the broader effect is to distort competition and favour less efficient domestic producers over those with a global competitive advantage. The MENA region is on track for 75 GW of solar by 2030, with total renewable capacity potentially reaching 131 GW if all projects under construction, under development and already announced are successfully realised4. The current installed solar capacity in the MENA region stands at 22.3 GW. However, experience shows that the installation and maintenance of renewable energy projects typically create more domestic jobs than manufacturing, meaning that restrictive trade policies may ultimately hinder job growth rather than protect it.

The distortion of climate finance, technology transfer and innovation ecosystems is limiting progress toward sustainable energy goals and increasing long-term economic risks. The tariffs will make key traditional electricity system components, such as inverters and transformers, more expensive and difficult to obtain, potentially delaying crucial maintenance and expansion of electricity grids at a time when demand is growing fast. The broader economic implications of the tariffs, combined with funding freezes in key Department of Energy and other programmes, will make the US a challenging environment for clean tech innovation[18].



Scenario modelling demonstrates that reducing trade barriers could significantly accelerate global solar technology deployment and enhance progress toward sustainable energy goals, with quantifiable impacts on both capacity expansion and the potential for emissions reduction. Research indicates that removing half of the current trade barriers could increase photovoltaic applications by 7% and improve the cumulative net carbon emissions reduction potential by 4-12 gigatons of CO2 equivalent by 2060. These findings underscore the crucial role of international trade cooperation in achieving the scale and speed of clean energy deployment necessary to meet global climate targets, with trade policy serving as a key enabler or constraint on sustainable energy transitions[19].

National case studies from the US, China, EU and India reveal contrasting impacts of tariffs and trade policy uncertainty on renewable energy markets and climate pledges, highlighting the complex interplay between domestic industrial policy and global climate commitments. The US has imposed Section 201 solar tariffs initially set at 30% with a 5% annual decrease, leading to a 16% increase in solar panel prices compared to pre-tariff levels. India's Production Linked Incentive scheme has channelled billions of dollars to domestic solar, battery, and hydrogen production in the pursuit of developing an industrial base and positioning India as an alternative clean tech producer to China. The EU faces challenges from trade fragmentation, with EU exports expected to decline significantly due to heightened trade uncertainty[20].

Table 2: Trade Barriers and Solar Growth

## Trade Barriers and Solar Growth

Policy Scenarios Shape Deployment and Emissions

| Scenario | Solar PV deployment increase (GW) | Cumulative emissions reduction (GtCO2e) |
|---|---|---|
| Half of trade barriers removed | 750 | 4 |
| Status quo | 0 | 0 |
| Escalated barriers | -160 | -3 |

*Note: Estimates are based on scenario modelling from the IPCC Scenario Database and IEA World Energy Model, as referenced in recent peer-reviewed studies and IEA policy analysis (2023–2025). Segment-level impacts reflect global solar PV deployment and carbon mitigation under different trade policy regimes.*

Global trade outside the EU is expected to expand at a rate well below global economic activity over the forecast horizon, with trade growth remaining constrained despite robust performance in the first quarter of 2025, likely due to advance purchases ahead of tariffs. These frictions can significantly extend project timelines and create financing uncertainties that impact business planning and investment decisions, particularly when compared to fossil fuel components, which are most often zero-rated in trade agreements.

Countries have made progress addressing these hurdles, with Vietnam removing import duties on clean energy components that cannot be produced locally, reducing costs for wind and solar projects. However, the imposition of tariffs on components that can be produced locally may stimulate the deployment of additional productive capacity, particularly for products like wind towers, where minimising transport distances provides a cost advantage[21].

### Corporate Adaptation Accelerates

Corporates and investors are facing increased input costs, supply chain delays and investment uncertainty due to government tariffs and trade policy fragmentation, creating material challenges for business planning and capital allocation. The uncertainty surrounding trade policy has created a challenging environment for renewable energy investments, with developers and financiers exhibiting typical risk-averse behaviours as they await clarity on policy direction[22].

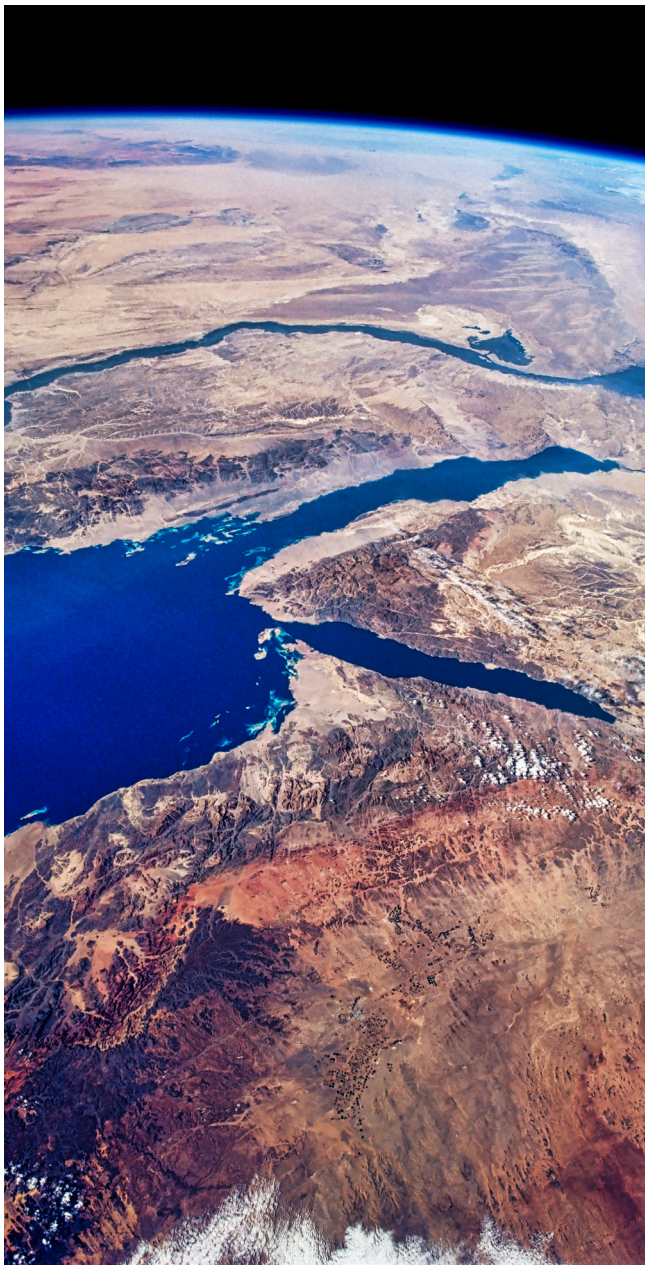
Regulatory and compliance risks are rising as fragmented standards and carbon border measures proliferate, prompting corporates to diversify supply chains, onshore or nearshore production and stockpile key components. The introduction of CBAM is likely to have a significant impact on businesses affected, with some companies facing impacts from CBAM in both their export and import activities.

Most businesses will need to adjust to higher prices for goods and services that contribute to greenhouse gas emissions, making carbon price levels in compliance markets, both domestically and abroad, a key consideration for businesses assessing transition risk.

To navigate tariff uncertainty, businesses are adopting multifaceted approaches that integrate supply chain optimisation, legal compliance and financial strategies, including localisation of production to bring operations closer to key markets. Diversifying sourcing across multiple countries helps mitigate risks and provides greater flexibility in shifting operations when needed. Additionally, tariff engineering, which involves modifying product designs or sourcing alternative materials, can lower tariff obligations[23].

Firms in the Global South are investing in local manufacturing and intra-regional energy cooperation as a strategic adaptation, while globally, corporates are advocating for harmonised standards and trade liberalisation to reduce exposure. Developing domestic renewable energy manufacturing is becoming a key policy priority across the Global South, representing an opportunity to reduce import dependency, build local industries by leveraging existing capacities and resources, and create jobs across the entire value chain. Companies are utilising Free Trade Agreements that provide opportunities for reduced or eliminated tariffs, closely tracking changes to agreements such as the United States-Mexico-Canada Agreement and other regional trade deals to optimise tariff benefits. Many businesses are adopting a China Plus One model, maintaining capacity in China to meet local demand while shifting exports to Southeast Asia or Mexico to mitigate geopolitical risks[24].

Complex and cross-cutting carbon border adjustment regimes require a global partnership at all levels to create fair and inclusive standards, ensuring that no one is left behind in the transition to a sustainable, low-carbon future. Businesses ready for the introduction of, or changes to, carbon pricing regimes may gain a competitive advantage. At the same time, compliance markets offer potential opportunities for new products and services for financial institutions and other sectors[25].



Government tariffs and trade policy uncertainty create opportunities for domestic industry development; however, higher consumer prices, slower innovation, and limited technology diffusion across clean energy sectors often offset these gains. While tariffs may offer short-term benefits to specific domestic industries, their long-term effect on sustainability is questionable, as increased costs and market distortions caused by tariffs can hinder the achievement of affordable and clean energy goals. According to US Customs and Border Protection data, the US Department of Commerce imposed countervailing duties on crystalline silicon panels and cells produced in Vietnam, Malaysia, Thailand and Cambodia, with tariffs ranging from 0% to 300%. These findings demonstrate that protectionist measures intended to support domestic manufacturing can paradoxically undermine the broader clean energy transition by making renewable technologies less competitive and accessible[26].

Domestic stimulus measures, such as those implemented in China, can partially offset tariff shocks and help ensure that domestic sales account for a larger share of industrial companies' revenue. However, their effectiveness varies significantly across different market contexts. The implementation of broad tariffs is poised to dramatically hinder efforts to combat climate change and weaken environmental legislation, notably through disruptions to clean energy supply chains.

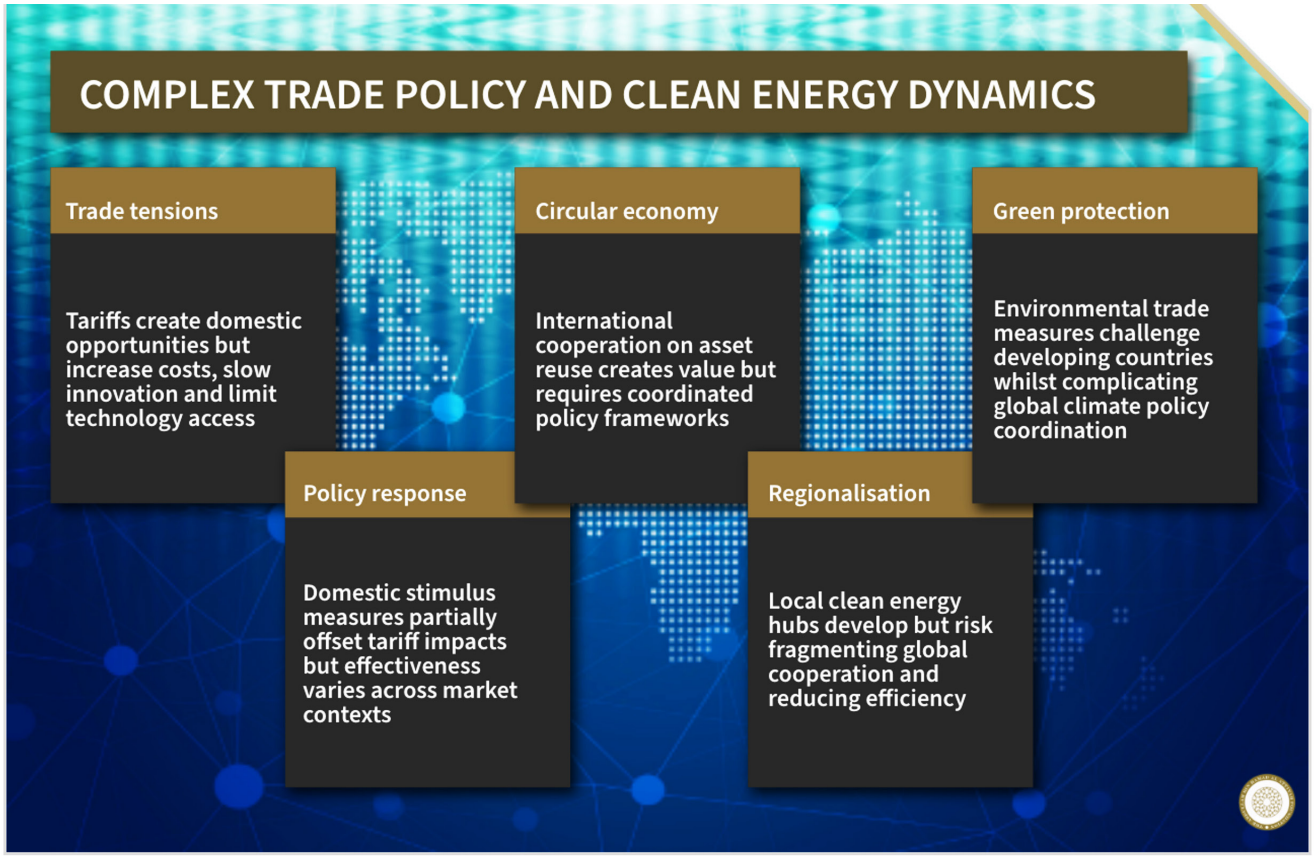
Circular economy approaches and international cooperation on end-of-life and second-life assets and materials present new opportunities for value creation and resource efficiency, though these require coordinated policy frameworks to realise their full potential. India demonstrated leadership by steering the G20 during its Presidency to a common goal of tripling global renewable energy capacity by 2030, while also ramping up subsidies for renewable energy.

Active collaboration between researchers, industrial manufacturers, renewable power plant managers and government bodies is crucial for achieving these circular economy objectives in the clean energy sector[27].

The emergence of regional clean energy hubs illustrates how localised value chains can develop, but also highlights risks of regional fragmentation and protectionism that could undermine global cooperation, including technology transfer and reduce the overall efficiency of global clean energy deployment. Germany, the largest economy in Europe, has been particularly affected by the rise in tariffs, with the commission predicting that the German economy will experience stagnation as exports are expected to decline by 1% in 2025. The impact of regionalisation and market fragmentation is particularly evident in Europe in the current context.

In addition, green protectionism risks undermining global cooperation and climate ambition, with unintended consequences for innovation, investment flows and the effectiveness of climate policy across multiple dimensions. The Carbon Border Adjustment Mechanism introduces new criteria into the global trading system, where environmental standards become as important as price and quality. For developing countries, the rise of green protectionism presents a complex challenge, as many of these nations heavily rely on traditional industries and lack the necessary financial and technological resources to transition rapidly to greener practices. Countries such as China and India view the CBAM as a protectionist trade measure. At the same time, businesses and governments worry that its implementation will be imprecise due to the complexity of verifying the emissions embedded in imports.

Figure 3: Complex Trade Policy and Clean Energy Dynamics




## Policy Coordination Imperatives

International initiatives led by the International Energy Agency (IEA), the World Trade Organization (WTO), the United Nations Framework Convention on Climate Change (UNFCCC) and technical bodies are increasingly focused on harmonising trade and climate policy to address the risks posed by government tariffs and trade policy uncertainty. The WTO plays a critical role in supporting the global energy transition and decarbonisation through legal reforms, enhanced transparency obligations and strengthened monitoring of implementation. The WTO recognises that divergent regulatory tools across different members adversely affect supply chains and traders.

Multilateral agreements, that the UNFCCC framework provides, are needed to affirm and clarify the application of the Paris Agreement and the principles of common but differentiated responsibilities to the design and implementation of unilateral climate-based trade measures. These international frameworks emphasise that interoperability of standards, equivalence of climate policies and mutual recognition of regulatory schemes must be prioritised to reduce trade fragmentation and support clean energy deployment[28].

There is a growing call for coordinated global rules on carbon border measures and circular economy standards, with recommendations to address gaps in current frameworks and enhance policy effectiveness across multiple dimensions.

Table 3: Policy Response Effectiveness

## Policy Response Effectiveness

Harmonisation and Reform Drive Resilience

| Region | Harmonisation adopted (%) | Tariff reform impact (index) | Circular economy standards adopted (%) | Carbon border policy impact (index) |
|---|---|---|---|---|
| EU | 85 | 70 | 68 | 80 |
| North America | 72 | 65 | 60 | 75 |
| Asia-Pacific | 68 | 80 | 54 | 70 |
| MENA | 75 | 60 | 50 | 65 |
| Africa | 60 | 55 | 48 | 50 |
| Latin America | 62 | 58 | 52 | 55 |

*Note: Estimates are based on broad review of IEA Policy Tracker, UNFCCC Policy Database, OECD Policy Instruments and peer-reviewed policy effectiveness studies (2023–2025). Regional values reflect relative adoption and impact of policy responses to*

Without coordination, carbon border measures risk creating new trade barriers that slow rather than accelerate the clean energy transition, requiring global norms for their design and implementation to ensure that efforts to reduce greenhouse gas emissions do not inadvertently obstruct the global transition to sustainable energy solutions.

The development of global principles for effective border adjustments should be achieved through inclusive global engagement among trade and environment ministers at the WTO and UNFCCC levels, with compliance with WTO rules and fundamental principles of the UNFCCC and the Paris Agreement being essential. Fostering international cooperation on circular economy policies for renewable technologies can create sustainable supply chains that reduce costs while protecting natural resources.

However, businesses eager to deploy cross-border circular solutions currently face significant hurdles. Creating a truly circular economy for clean energy requires multilateral cooperation to align standards and regulations, as well as the harmonisation of laws across jurisdictions to enable the smoother flow of secondary materials.

The GCC is prioritising harmonised regulatory frameworks to support regional clean energy markets and mitigate the risks of policy fragmentation. GCC countries have implemented a set of measures favourable to free trade, including reducing trade barriers, harmonising regulations, and increasing transparency, in line with their WTO obligations.

GCC member states have harmonised their applied tariffs to create a unified external customs tariff, with almost all countries using a general import tariff rate of 5% on all agricultural and industrial products. The ultimate objective of the GCC Common Law is to achieve economic integration among member states and support the industrial process, including harmonisation of legislation on customs, contingency trade remedies and technical barriers to trade.

Recent academic research demonstrates that trade policy uncertainty creates what scholars term "epistemic uncertainty", stemming from deficiencies in knowledge, information or skills rather than pure randomness. This distinction is critical for policy design, as scholars argue that epistemic uncertainty necessitates information-seeking and coordination strategies, whereas aleatory uncertainty (pure randomness) is better addressed through diversification approaches. The failure to distinguish between these uncertainty types can lead to suboptimal policy and corporate responses[29].

Table 4: Trade Scenarios: Estimated Sector Impacts

## Trade Scenarios: Estimated Sector Impacts

Escalating trade risks to hinder energy transition

| Scenario | Global growth projection (%) | Solar PV deployment impact (GW) | EV price increase (%) |
|---|---|---|---|
| Baseline (current tariffs) | 2.80 | 0 | 0 |
| Limited trade conflict | 2.30 | -200 | 7 |
| Full-blown trade war | 1.80 | -370 | 15 |

*Estimates are based on IMF World Economic Outlook (2025), IEA scenario analysis, and synthesis of academic and international agency sources cited in the scenario analysis section. Segment-level impacts reflect plausible outcomes for global growth, solar PV deployment, EV prices and clean energy investment under each scenario based on linear regression analysis.*

Historical precedents, such as the 2018–2019 US-China trade war, provide key lessons on tariff escalation, currency effects and corporate adaptation in the context of global supply chains. During the previous US-China trade war period, the Chinese yuan depreciated significantly against the US dollar. At the time, analysts estimated that a 60% tariff on China would require a 10%-12% depreciation of the yuan to offset the negative impact. Corporate responses during this previous period of trade instability included supply chain diversification, with companies seeking alternative sourcing arrangements and establishing production facilities outside China while maintaining some presence there. The clean energy sector demonstrated resilience in terms of global corporate power purchase agreements, showing that momentum in clean energy transitions can persist despite trade tensions[30].

The IMF's baseline scenario, outlined in its April World Economic Outlook 2025 projections, anticipates global growth slowing, with moderate but persistent impacts on sustainable energy markets and investment. According to the IMF, global growth is expected to slow from 3.3% in 2024 to 2.8% in 2025, reflecting a weak carryover from late 2024 and the impact of renewed trade tensions. The IMF estimates that global growth would have been projected at 3.2% in 2025 had trade tensions not escalated. This revised projection reflects both the direct effects of trade policy changes and the broader adverse impact of policy uncertainty. For sustainable energy markets, this baseline scenario creates ongoing challenges for project financing and deployment, as demonstrated by immediate supply chain disruptions[31].

A limited trade conflict scenario would further dampen global growth, increase input costs, and delay the deployment of clean energy, particularly in regions that rely on imported components. Economic uncertainty caused by trade wars can deter investment in research and development of new sustainable technologies, as companies become more risk-averse during periods of trade conflict. In this scenario, tariffs on green technologies could make it more expensive for developing countries to access these technologies, potentially delaying their sustainable development pathways[31].

A full-blown trade war scenario could trigger severe supply chain disruptions, currency volatility and a significant decline in sustainable energy investment, undermining progress toward climate and energy goals.

The IMF estimates that global growth could fall below 2.0% in 2025 with considerable probability should downside risks materialise, with further escalation of protectionist trade policies leading to reduced investment, lower productivity and more persistent inflationary pressures. In this scenario, the global clean energy transition would face a slower pace, as trade wars inject uncertainty into investment decisions and disrupt innovation[31].

Scenario analysis highlights the importance of robust risk management, financial planning, and adaptive strategies to mitigate downside risks and capitalise on opportunities in a highly uncertain policy environment. Despite trade tensions, the momentum of the transition to clean energy technology appears to be intact, with demand continuing to be underpinned by the cost competitiveness of new build solar generation, government support and corporate purchases of renewable energy.

# 25 CONCLUSION

The analysis reveals that government tariffs and trade policy uncertainty pose a significant threat to the global deployment of sustainable energy, with empirical evidence demonstrating that current trade barriers could delay renewable capacity targets and substantially reduce the potential for mitigating carbon emissions. The interconnected nature of clean energy supply chains, spanning the globe for technologies such as solar photovoltaics, creates unique vulnerabilities where single policy changes can cascade through entire networks, fundamentally altering project economics and investment decisions.

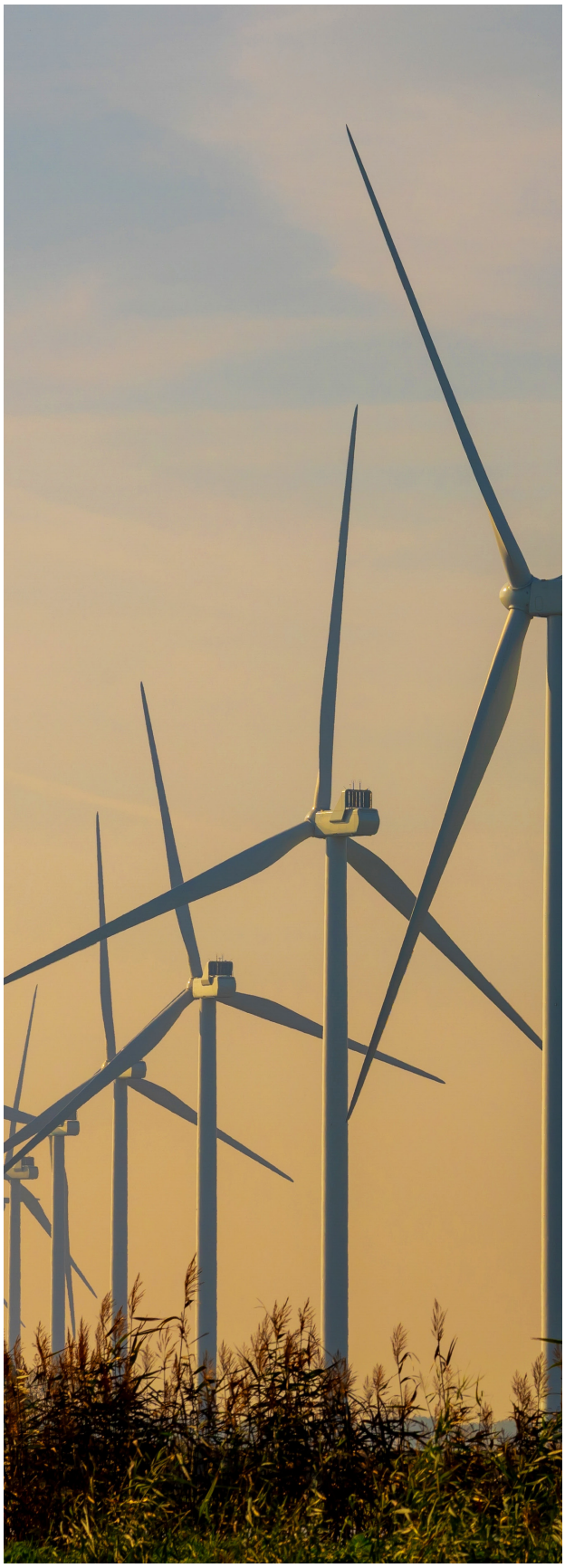
Economic disruption is accelerating, with nearly USD 8 billion in clean energy investments cancelled in the first quarter of 2025 alone, while development banks report prohibitive increases in risk premiums for cross-border renewable projects. The concentration of manufacturing capacity, particularly China's dominance across key technologies, has created systemic dependencies that amplify the impact of trade restrictions. Simultaneously, corporate adaptation strategies are evolving rapidly, including supply chain diversification, nearshoring and enhanced scenario planning, though these measures increase operational complexity and resource requirements.

The material risks for business leaders include prolonged investment uncertainty, supply chain fragmentation and elevated compliance costs from divergent regulatory frameworks. However, strategic opportunities exist through regional clean energy hub development, circular economy initiatives and technology innovation that reduces dependence on critical mineral imports.

The MENA region's substantial mineral reserves and strategic geographic positioning exemplify how localised value chains can emerge despite global fragmentation.

Evidence-based policy coordination is crucial for addressing epistemic uncertainty and preventing further market fragmentation. International frameworks, such as those through the IEA, WTO, and UNFCCC, must prioritise the interoperability of standards, equivalence of climate policies, and mutual recognition of regulatory schemes. Scenario analysis confirms that cooperative approaches, rather than protectionist barriers, are essential for achieving both economic recovery and climate objectives.

Key preparations for business include developing sophisticated risk management frameworks, investing in supply chain intelligence capabilities and advocating for harmonised international standards. Successful approaches require balancing cost optimisation with supply chain resilience while maintaining the scale and coordination necessary to achieve global sustainable energy objectives. The urgency of climate action demands that trade policy serve as an enabler, not an impediment, to the energy transition.



1. IEA. (2024). Energy Technology Perspectives 2024. https://www.iea.org/reports/energy-technology-perspectives-2024 [accessed 15 June 2025]

2. Zuo Q, Majeed MT. Does trade policy uncertainty hurt renewable energy-related sustainable development goals in China? Heliyon. 2024 Jul 25;10(15):e35215. doi: 10.1016/j.heliyon.2024.e35215. PMID: 39166068; PMCID: PMC11333896. [accessed 15 June 2025]

3. Linus Mattauch, Cameron Hepburn, Fiona Spuler, Nicholas Stern, The economics of climate change with endogenous preferences, Resource and Energy Economics, Volume 69, 2022, 101312, ISSN 0928-7655, https://doi.org/10.1016/j.reseneeco.2022.101312. [accessed 15 June 2025]

4. Ibrahim Nana, Rasmane Ouedraogo, and Sampawende Jules Tapsoba. IMF Working Paper. The Heterogeneous Effects of Uncertainty on Trade. WP/24/139. July 2024. https://www.imf.org/-/media/Files/Publications/WP/2024/English/wpiea2024139-print-pdf.ashx [accessed 15 June 2025]

5. Wu Yan. How does trade freedom affect the development of clean energy? based on the moderating effect of carbon emissions. Frontiers in Environmental Science. Volume 13. 2025. DOI: 10.3389/fenvs.2025.1552231. ISSN=2296-665X. [accessed 15 June 2025]

6. IEA. (2023). World Energy Investment 2023. https://www.iea.org/reports/world-energy-investment-2023 [accessed 15 June 2025]

7. World Uncertainty Index (WUI). https://www.policyuncertainty.com/wui_quarterly.html [accessed 15 June 2025]

8. Panos Kouvelis, Xiao Tan, Sammi Y. Tang (2025) Flexibility Value of Reshoring Capacity Under Policy Uncertainty and Domestic Competition. Manufacturing & Service Operations Management. https://doi.org/10.1287/msom.2023.0387 [accessed 15 June 2025]

9. UNCTAD. (2025). Global trade in 2025: Resilience under pressure. https://unctad.org/news/global-trade-2025-resilience-under-pressure [accessed 15 June 2025]

10. WTO. (2025). WTO warns global trade could fall in 2025 amid rising tensions. https://www.weforum.org/stories/2025/04/global-trade-decline-2025-international-trade-stories-this-month/ [accessed 15 June 2025]

11: MSCI. (2025). Tariffs Expose a Rift in the Clean-Tech Supply Chain. https://www.msci.com/research-and-insights/quick-take/tariffs-expose-a-rift-in-the-clean-tech-supply-chain [accessed 15 June 2025]

12. WTO. (2024). Tariffs on critical minerals and their role in the electric vehicle value chain. https://www.wto.org/english/blogs_e/data_blog_e/blog_dta_01aug24_e.htm [accessed 15 June 2025]

13. Kilinc-Ata N, Alshami M, Munir K. How do strategic mineral resources affect clean energy transition? Cross-sectional autoregressive distributed lag (CS-ARDL) approach. Miner Econ. 2023 Mar 16:1–12. doi: 10.1007/s13563-023-00373-3. PMCID: PMC10018629. [accessed 15 June 2025]

14. IEA. (2025). Gas Market Report, Q2-2025. https://iea.blob.core.windows.net/assets/91739d87-1613-4840-927a-79448067f067/GasMarketReport,Q2-2025.pdf [accessed 15 June 2025]

15. World Bank. (2025). June 2025 Global Economic Prospects. https://www.worldbank.org/en/publication/global-economic-prospects [accessed 15 June 2025]

16. UNCTAD. (2025). Trade tensions and rising uncertainty drag global economy towards recession. https://unctad.org/news/trade-tensions-and-rising-uncertainty-drag-global-economy-towards-recession [accessed 15 June 2025]

17. Informa. Manufacturing Dive. Clean energy manufacturers cancel projects as Trump-era policies take hold. https://www.utilitydive.com/news/inflation-reduction-act-canceled-projects-q1-2025-kore-freyr/746737 / [accessed 15 June 2025]

18. Centre for Strategic and International Studies. (2025). The Impacts of Tariffs on Clean Energy Technologies. https://www.csis.org/analysis/impacts-tariffs-clean-energy-technologies [accessed 15 June 2025]

19. Wang M, Mao X, Xing Y, Lu J, Song P, Liu Z, Guo Z, Tu K, Zusman E. Breaking down barriers on PV trade will facilitate global carbon mitigation. Nat Commun. 2021 Nov 24;12(1):6820. doi: 10.1038/

s41467-021-26547-7. PMID: 34819496; PMCID: PMC8613243 [accessed 15 June 2025]

20. European Commission. (2025). Spring 2025 Economic Forecast: Moderate growth amid global economic uncertainty. https://economy-finance.ec.europa.eu/economic-forecast-and-surveys/economic-forecasts/spring-2025-economic-forecast-moderate-growth-amid-global-economic-uncertainty_en [accessed 15 June 2025]

21. International Institute for Sustainable Development. (2025). How Can Trade Policy Maximize Benefits From Clean Energy Investment? https://www.iisd.org/publications/trade-clean-energy-investment [accessed 15 June 2025]

22. Qamruzzaman, M. (2024). Clarifying the nexus between Trade Policy Uncertainty, Economic Policy Uncertainty, FDI and Renewable Energy Demand. International Journal of Energy Economics and Policy, 14(2), 367–382. https://doi.org/10.32479/ijeep.15470 [accessed 15 June 2025]

23. Supply chain management review. (2025). The shifting landscape of tariffs: Strategies for supply chain resilience. https://www.scmr.com/article/the-shifting-landscape-of-tariffs-strategies-for-supply-chain-resilience [accessed 15 June 2025]

24. Ernst & Young. (2025). How tax and trade leaders can prepare for global tariff disruption. https://www.ey.com/en_be/insights/tax/how-tax-and-trade-leaders-can-prepare-for-global-tariff-disruption [accessed 15 June 2025]

25. Climate Governance Initiative. (2024). Compliance Carbon Market Risks and Opportunities https://hub.climate-governance.org/Resource/carbon-pricing-navigator/compliance-carbon-market-risks-and-opportunities [accessed 15 June 2025]

26. US Department of Energy. (2024). Quarterly Solar Industry Update. https://www.energy.gov/eere/solar/quarterly-solar-industry-update [accessed 15 June 2025]

27. International Institute for Sustainable Development. (2023). Mapping India's Energy Policy: A decade in action. https://www.iisd.org/story/mapping-india-energy-policy-2023/ [accessed 15 June 2025]

28. Sunayana Sasmal, New Approaches and Challenges Regarding Trade, Climate Action, and the WTO. New York: Columbia Center on Sustainable Investment (CCSI), December 2024. https://ccsi.columbia.edu/sites/ccsi.columbia.edu/files/content/docs/publications/New-Approaches-and-Challenges-Regarding-Trade-Climate-Action-and-the-WTO.pdf [accessed 15 June 2025]

29. Daniel J. Walters, Gülden Ülkümen, David Tannenbaum, Carsten Erner, Craig R. Fox (2023) Investor Behavior Under Epistemic vs. Aleatory Uncertainty. Management Science 69(5):2761-2777. https://doi.org/10.1287/mnsc.2022.4489 [accessed 15 June 2025]

30. Columbia University. (2019). Center on Global Energy Policy. High Anxiety: The Trade War and China's Oil and Gas Supply Security. https://www.energypolicy.columbia.edu/publications/high-anxiety-trade-war-and-china-s-oil-and-gas-supply-security/ [accessed 15 June 2025]

31. IMF. (2025). World Economic Outlook April 2025. A critical juncture amid policy shifts. https://www.imf.org/en/Publications/WEO/Issues/2025/04/22/world-economic-outlook-april-2025 [accessed 15 June 2025]

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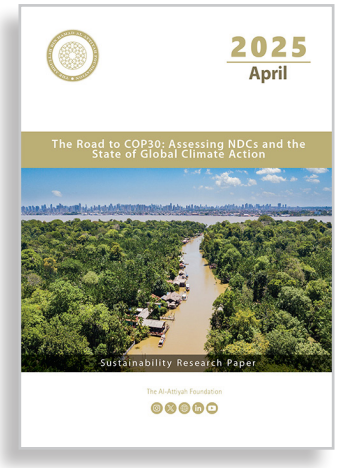


April – 2025

### The Long-Term Target for International Public Climate Finance – The Landscape After COP29 Decision

Nationally Determined Contributions (NDCs) are the primary mechanism through which the Paris Agreement translates global climate ambition into national action.

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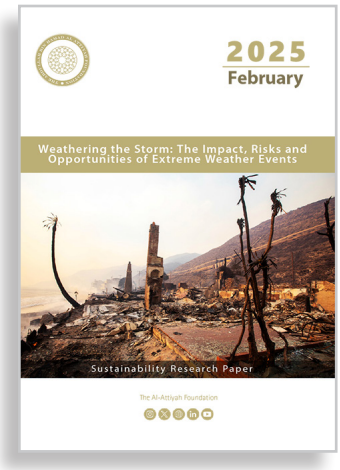


February – 2025

### Weathering the Storm: The Impact, Risks and Opportunities of Extreme Weather Events

Extreme weather events are becoming increasingly frequent, severe, and unpredictable, causing widespread economic, social, and environmental disruptions. Rising global temperatures are driving more intense storms, wildfires, and floods, while chronic climate risks, such as prolonged droughts and shifting precipitation patterns, continue to reshape ecosystems and economies.

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December – 2024

### The Long-Term Target for International Public Climate Finance – The Landscape After the Decision at COP29

The 29th Conference of the Parties (COP29) to the United Nations Framework Convention on Climate Change (UNFCCC), dubbed the 'Finance COP', carried the weighty responsibility of defining a new climate finance goal— the New Collective Quantified Goal (NCQG) to respond to the urgency and scale of the climate crisis while aligning with the broader objectives of the Paris Agreement.

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