SCIENCE FOR POLICY BRIEF

Security implications of the green energy transition

2026

HIGHLIGHTS

- The green energy transition is essential for mitigating climate change risks.
- Yet structural decline in oil revenues, coupled with rising competition for critical minerals needed for the energy transition, creates new uncertainties particularly for oil-dependent states.
- Critical mineral mining is associated with low-intensity conflict, though it is unlikely to produce the same resource curse dynamics as oil or replicate conflict patterns seen with diamonds.
- Higher global warming under weak climate policy scenarios poses more severe security risks than those arising from petroleum revenue losses and critical mineral competition during the energy transition.

Introduction

The global yearly mean temperature is already around 1.5°C above pre-industrial level and on track to reach 2.8°C of warming of by 2100 under current climate policies (1). Every increment of additional global warming further increases risks and impacts from climate change. Avoiding such potentially existential risks requires deep, rapid, and sustained greenhouse gas (GHG) emissions reduction. To this end, the EU has set a legally binding near-term climate target of 55% net reduction in GHG emissions by 2030, compared to 1990 levels, reaching net zero emissions by 2050 (2).

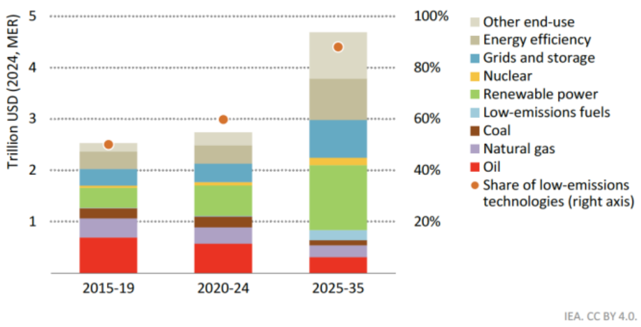
Achieving net zero emissions (NZE) by 2050 will require society-wide shifts towards climate resilient development (1). A key element in this transformation is the replacement of carbon-based energy sources (coal, oil, gas) with renewable alternatives (solar, wind, hydro). This will have clear benefits for sustainability and wellbeing, weaken some drivers of current conflict, and—importantly—avoid or minimize adverse climate change impacts.

However, a green energy transition will introduce material and nonmaterial costs, especially for major exporters of oil and gas (petrostates), involve tradeoffs, and possibly generate impacts that are perceived as unjust or unfairly distributed. Such costs can cause social unrest and motivate violent conflict (mostly at the local level). This policy brief reflects on security implications of two processes: declining demand for petroleum and increasing demand for critical minerals needed for the energy transition.

Implications of the energy transition for oil and critical minerals demand

Renewable energy capacity has expanded rapidly while costs have plummeted in recent years. Under a NZE pathway, installed renewables are projected to increase nearly fourfold by 2035 (3). In contrast, annual average spending on fossil fuels of USD 1 trillion in recent years is projected to shrink by two thirds by 2035 (Figure 1).

Figure 1 – Annual energy investment by sector



Source: International Energy Agency (3).

Oil prices and associated rents for producing countries are projected to fall correspondingly, with prices declining to $33 per barrel by 2035 and $25 per barrel by 2050 (3).

These implications are unevenly distributed. While overall petroleum demand falls dramatically in a NZE future, low-cost producers—primarily OPEC members—are projected to capture an increasing share of a shrinking market, while higher-cost producers face displacement (3).

At the same time, accelerating mitigation efforts will drive significant increases in demand for critical green minerals essential to clean energy technologies (for an overview see Table A1). In NZE scenarios, the combined market value of critical green minerals, such as copper, lithium, nickel and rare earth elements, more than doubles to USD 770 billion in 2035 (4). However, implications for prices are uncertain, since recycling and substitution may offset some demand in the long term (5).

Security risks from declining petroleum demand

The global transition away from fossil fuels will fundamentally reshape oil-producing states, with significant but uncertain security implications.

Current evidence. Research offers robust evidence that petroleum wealth is related to a range of adverse development outcomes, including high fiscal instability and market sensitivity, underdeveloped non-petroleum sectors ("Dutch disease"), low investments in human capital, low bureaucratic capacity relative to income level ("weak state"), corruption, unequal distribution of wealth, and authoritarian governance (*high confidence*) (6).

These resource curse dynamics have been associated with increased risk of civil conflict—both separatist rebellion where oil production occurs in politically marginalized areas (e.g., Angola, Indonesia, Nigeria) and conflict over control of state power (e.g., Sudan, Iraq) (*high confidence*) (7,8). Some research also suggests that oil-rich states may be more prone to initiate international conflicts (so-called petro-aggression), though the evidence on this is limited (9).

The relationship between oil wealth and stability is generally U-shaped: massive oil revenues tend to stabilise wealthy petrostates through co-optation of opposition elites, expansive domestic subsidies (e.g., food, fuel), and harsh repression. In contrast, countries with moderate oil wealth—particularly those that are already fragile—cannot afford such policies and face higher risks of violence (7,10).

Terminology

Green energy transition refers to the global shift from fossil fuels (petroleum, coal) to renewable energy sources (solar, wind, hydro).

Critical green minerals are minerals essential for renewable energy technologies, which may face supply risks due to geographic concentration (Table A1).

Resource curse refers to adverse effects of high income dependence on revenues from resource extraction, including sensitivity to market fluctuations, corruption, and authoritarianism.

Conflict is shorthand for organised, political violence that results in at least 25 battle-related deaths per year (11). This includes interstate conflict, civil conflict, and non-state (inter-communal) conflict.

Social unrest is here used as a generic term for popular resistance (e.g., protests, riots, strikes) with potential to escalate to conflict.

What this could mean for the future. The transition period toward an NZE future carries particular risks to petrostates. Declining revenues are likely to constrain their capacity to maintain consumer subsidies, public services, and patronage networks that underpin political stability (12). Large-scale protests and repression during past oil busts and economic crises, as seen in Iran during January 2026, may serve as a warning of what is to come (*medium confidence*) (13,14).

Longer-term implications are more uncertain but potentially positive if countries manage to adapt to a post-petroleum economy. As oil loses value, incentives to capture the state or control resource deposits through violent means diminish and other resource curse dynamics also weaken. States that currently rely on petroleum rents to fund repression may give in to pressure to liberalize in order to remain in power, though the risk of violent regime change and state collapse also increases (*low confidence*).

Venezuela: Oil bust and eventual intervention

Venezuela illustrates how petrostates with weak institutions resort to repression in bust periods when they cannot afford costly subsidies and co-optation to maintain stability.

Venezuela was already facing economic crisis when the oil price collapse began in 2014. The state implemented social spending cuts by year's end. Protests erupted and Venezuela's security forces killed hundreds of regime opponents and jailed thousands of protesters (12,15). The Maduro regime turned the country in a more authoritarian direction. Yet, despite intensifying domestic and international resistance, it survived the oil bust without regime change or leadership transition (12,15).

While the Maduro government managed to remain in power through widespread and violent repression in the bust period, President Maduro was abducted by US forces in January 2026. One stated reason for the intervention was the exploitation of Venezuelan oil by US firms (16).

Note of caution. Most research reviewed here examines political effects of short-term price shocks rather than long-term structural decline. The scenarios outlined here are plausible, but the evidence base for predicting security consequences of *permanent* drops in demand and revenues remains thin.

Security risks from critical minerals

The energy transition will dramatically increase demand for minerals essential to renewable energy technologies, batteries, and electrification. This raises the question of whether green energy transition minerals might generate the same security risks long associated with oil.

Current evidence. Most minerals differ fundamentally from petroleum in their conflict potential. They typically constitute a small share of national GDP, offer opportunities for recycling and substitution (5,17), and are less amenable to looting by armed groups due to infrastructure requirements and comparably lower rents generated (17,18). For these reasons, the nation-wide resource curse dynamics observed in petrostates tend to be less prominent in mineral-producing countries—with notable exception for countries where minerals are more dominant in the national economy, such as the DRC and Zambia (*medium confidence*) (5).

However, minerals are associated with localized security risks. Mining operations are linked to local violence via several processes, including use of militarized security companies, economic and political corruption, unfair benefits distribution, and repression or even dispossession of affected communities (*high confidence*) (19,20). More than half of the resource base is located in or near indigenous people's land (21). Environmental defenders also face elevated risks in mining areas (22). These dynamics are well-documented for cobalt and other minerals already central to the energy transition (23,24).

What this could mean for the future. As demand grows, localized risks may intensify and spread to new extraction sites. The primary concern is not national-level instability but an increase in local-level conflict, community displacement, and human rights abuses in mining regions as exemplified by cobalt mining in the DRC (24–26). At the international level, mineral concentration may enable supply coercion—as seen with China repeatedly using rare earth export restrictions most recently in 2025 (27). While there is little evidence linking mineral wealth to military aggression, negotiations on Ukraine's critical mineral reserves and US interest in Greenland's resources suggest that competition over critical minerals may increasingly shape geopolitical dynamics and heighten interstate conflict risks amid erosion of the rules-based international order *(low confidence).*

Emerging and long-term risks and opportunities. The transition towards renewable energy offers potential long-term benefits for peace—both by mitigating dangerous climate change and by restructuring the energy system. The resources required for the green transition are renewable or recyclable, geographically diversified, and unlikely to generate resource curse dynamics at scale (5).

However, the transition period may carry distinct risks. Unlike temporary price busts, structural decline in fossil fuel demand could progressively exhaust petrostate coping mechanisms as familiar adaptation strategies reach their limits. For critical minerals, national-level instability appears unlikely, but localized risks—conflict around mining sites, community grievances, human rights abuses—may intensify as extraction expands. There is little research distinguishing the transitional phase from a post-transition world (26), making these projections uncertain. Figure 2 offers a visual representation of the connections discussed here.

Insights for policy

Strengthen multilateralism: A rules-based international order is essential to minimize conflict risk. The EU should support multilateral frameworks for managing the green transition, including just transition financing for vulnerable petrostates.

Strengthen R & D efforts: Focus on energy efficiency, mineral recovery and recycling that lowers mineral demand and need for new exploitation (28). Recycling rates are currently low and for some materials expensive, but have long-term impacts on supply and will get cheaper as recycled volumes increase (25,29).

Strengthen transparency and due diligence: Traceability initiatives substantially reduce mining-related conflict (30,31).

Adopt conflict-sensitive approaches and strengthen rule of law in mining governance: Integrating conflict sensitivity into extraction planning, strengthening local rule-of-law frameworks, and ensuring meaningful community participation and fair compensation can help prevent mining operations from fuelling grievances or local violence (20,24,30).

Comparing the options: Even though this brief considers pathways from a green energy transition to conflict, these security risks likely are much less severe than those that would emerge in a counterfactual low-mitigation future, due to the possibility of catastrophic climate impacts with cascading risks across sectors and regions (32,33).

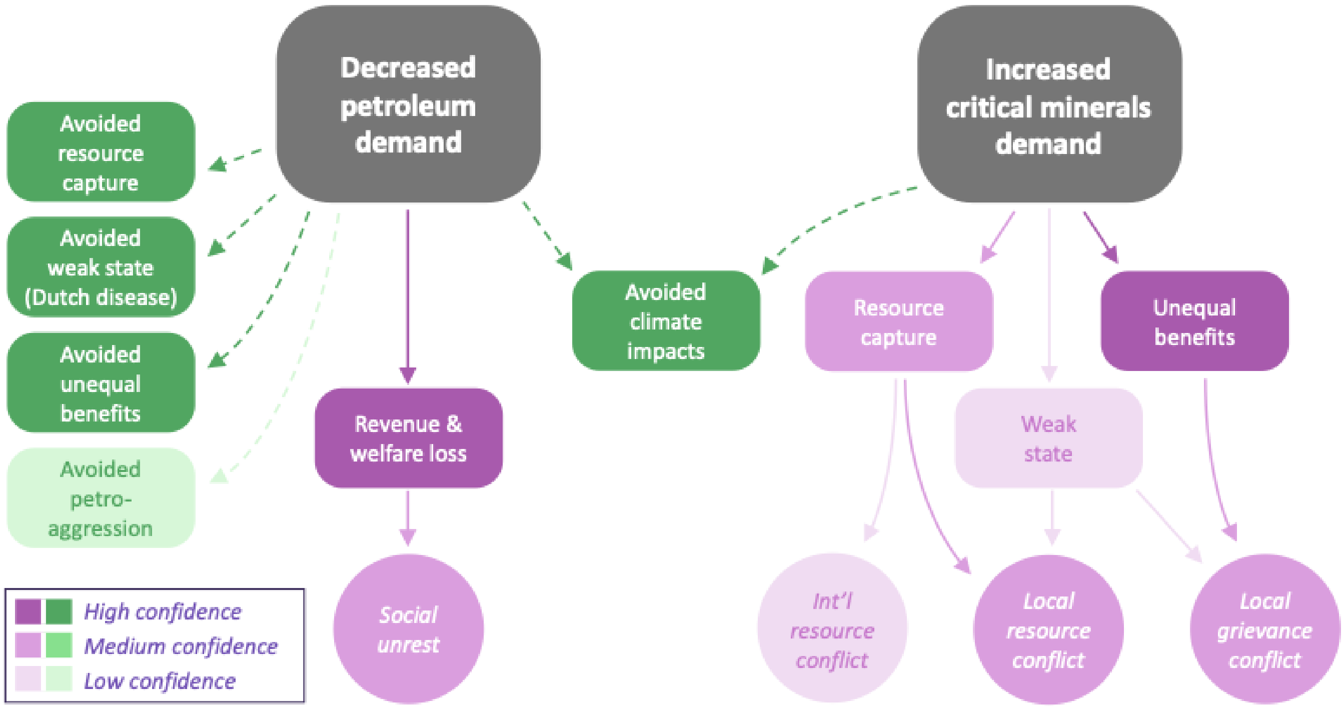
Ukraine: critical minerals and Russian invasion

Russia's invasion of Ukraine in 2022 reflects a convergence of geo-political, historical, and economic drivers (34,35). Yet, Ukraine also holds approximately 5% of the world's critical minerals. Russia's territorial gains have concentrated on resource-rich areas: occupied territories now encompass an estimated 50% of Ukraine's mineral resources (36).

Russia's 2024 Minerals Development Strategy explicitly calls for integrating the occupied territories' mineral complexes into the Russian economy (36).

Any peace settlement must account for this mineral dimension. Territorial concessions would transfer substantial critical mineral wealth to Russia, negatively affecting both Ukraine's post-war recovery and Europe's supply diversification ambitions (37).

Figure 2 – Select pathways for security implications of the green energy transition



Source: Original illustration. The figure visualizes pathways from declining petroleum demand (left) and increasing critical minerals demand (right) to various forms of conflict and instability. Scientific confidence in the prevalence and importance of the immediate effects (pink boxes) and their security implications (pink circles) is indicated by color shade, see legend for details. Green boxes represent outcomes that reduce conflict risk, compared to a counterfactual scenario with no change in petroleum and cricital minerals demand. In line with the scope of this policy brief, security implications of other aspects of the green energy transition—notably expansion of renewable energy production (solar, wind, hydro)—are not illustrated.

A note on confidence

High confidence generally means robust empirical evidence and high scientific agreement.

Medium confidence generally means medium evidence and medium agreement.

Low confidence means limited evidence and/or low agreement.

Judgments follow the IPCC guidance on uncertainty language (38).

Appendix

Table A1 – Critical minerals for low-carbon energy technologies

Element	Application(s)	Main Producing Countries	EU Critical	EU Strategic
Cobalt (Co)	Lithium-ion batteries	DRC (76%), Indonesia, Russia	Yes	Yes
Copper (Cu)*	Electrification	Chile, Peru, DRC, China (diversified)	Yes	Yes
Dysprosium (Dy)	Motors, generators	China (69%), Myanmar	Yes	Yes
Gallium (Ga)	Solar PV, LED	China (99%), Russia, Ukraine	Yes	Yes
Indium (In)	Solar PV, LED	China (70%), S. Korea, Japan	No	No
Lithium (Li)	Lithium-ion batteries	Australia (37%), Chile, China	Yes	Yes
Neodymium (Nd)	Motors, generators	China (69%), Myanmar, Australia	Yes	Yes
Nickel (Ni)*	Lithium-ion batteries	Indonesia (59%), Philippines, Russia	Yes	Yes
Platinum (Pt)	Fuel cells	South Africa (71%), Russia, Zimbabwe	Yes	Yes
Manganese (Mn)	Lithium-ion batteries	South Africa (37%), Gabon, Australia	Yes	Yes
Selenium (Se)	Solar PV	China, Germany, Japan (diversified)	No	No
Silver (Ag)	Solar PV, solar thermal	Mexico, China, Peru (diversified)	No	No
Tellurium (Te)	Solar PV	China (77%), Japan, Russia	No	No
Silicon (Si)	Solar PV	China (79%), Russia, Brazil	Yes	Yes
Vanadium (V)	Redox flow batteries	China (70%), Russia, S. Africa	Yes	No

Note: Critical minerals combine raw materials of high importance to the EU economy and of high risk associated with their supply (39). Strategic raw materials are a subset specifically identified as essential for the green and digital transitions and for defense/aerospace (40). Percentages indicate share of global production (41). Original application data from Månberger and Johannson (5).

* Copper and nickel do not meet standard CRM thresholds but are included as strategic raw materials due to their importance for electrification. Production is relatively diversified.

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