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Reconciling Sustainability Transition Priorities with Energy Security ones: a focus on Industrialized Countries

Executive Summary

Implementing policies to foster a sustainable transition while also focusing on promoting energy security has become critical for governments, especially those of industrialized countries which disproportionately contribute to climate change. Balancing these two priorities is turning into a key, strategic challenge in the agenda of advanced economies.

Against this backdrop, in 2023 the G20 countries accounted for 73% of global GHG emissions while climate change is expected to cause an estimated 14.5 million deaths and economic losses for $12.5 trillion by 2050. In response, governments have committed to ambitious targets: by 2050, all G20 countries are projected to achieve at least 80% of their electricity generation from non-fossil sources of energy. Economies are witnessing significant growth in climate finance and are promoting clean technologies' development coupled with energy efficiency policies.

For many countries, advancing the energy transition is also key to reducing energy dependence, as recent geopolitical crises have exposed vulnerabilities in global energy supply chains. Russia's full-scale invasion of Ukraine caused the 2022 wholesale gas price in Europe to be, on average, over 5 times higher than its pre-war level, affecting households and businesses. The development of clean technologies also potentially creates new dependencies, due to the geographic concentration of critical minerals supply chains in a few countries. To address these challenges, countries have adopted a range of measures designed to stabilize and make current energy supplies more affordable, while also boosting domestic production to reduce reliance on imports.

The crisis has underscored the importance of keeping energy prices globally competitive. High energy costs have weakened the industrial competitiveness of some advanced economies, raising concerns about offshoring and the long-term sustainability of energy-intensive industries such as steel and chemicals. Ensuring not only access to energy, but also its affordability, has therefore become a central pillar of energy security strategies.

Finding the right balance between sustainability and energy security is a fundamental driver of competitiveness for industrialized economies. By embracing innovative technologies, fostering international agreements, and implementing tailored policies, these nations can create a more secure and equitable energy landscape for the future.

"Achieving a sustainable future requires advanced economies to harmonize bold climate ambitions with energy security and affordability. As the G20 accounts for over 70% of global emissions, the most industrialized countries are uniquely positioned to lead the way—transforming current challenges into opportunities for resilient, inclusive, and green growth. While recent geopolitical shocks have exposed the vulnerabilities of existing energy systems, they have also opened the door to accelerate innovation and build stronger clean tech value chains. Strategic investments in renewables, energy efficiency, and circular solutions can turn today's disruptions into powerful drivers of long-term environmental and economic progress. A collaborative and synergistic approach between governments and businesses can serve as enabler to unlock this potential, harnessing innovation and key technologies to foster a more equitable and sustainable future."

Andrea Poggi | Head of DCM Public Policy & Stakeholder Relations Centre | DCM Innovation Leader

"Energy transition does not necessarily take its toll on energy security, and the other way around. It is in the very interest of industrialized countries to lead the green transition and ensure a better, more strategic and sustainable growth. However, new policies and financial resources are needed to tackle the short-term impact on companies and households."

Antonio Villafranca | ISPI Vice-President for Research

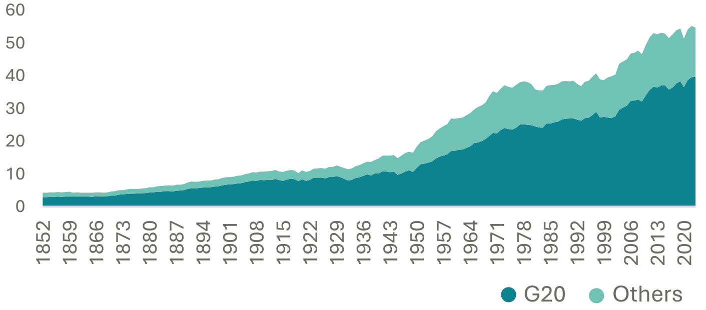
Introduction

Recent geopolitical events have highlighted the need for advanced economies to focus on energy security while promoting the affordability of the energy mix and the development of competitive clean technology value chains as key drivers of the sustainable transition. Balancing these priorities is now a strategic challenge for industrialized countries as they work to meet decarbonization targets while ensuring stable, diverse, and affordable energy sources.

The urgency of a sustainable transition

Greenhouse gas emissions have steadily increased over recent decades, reaching 55 billion tons of CO2 equivalents in 2023. This trend has been largely driven by G20 countries, which accounted for 73% of global emissions in 2023[1].

Figure 1 | Global GHG emissions (billion tons of CO_2 equivalents), G20 countries and non-G20 countries, 1852-2023



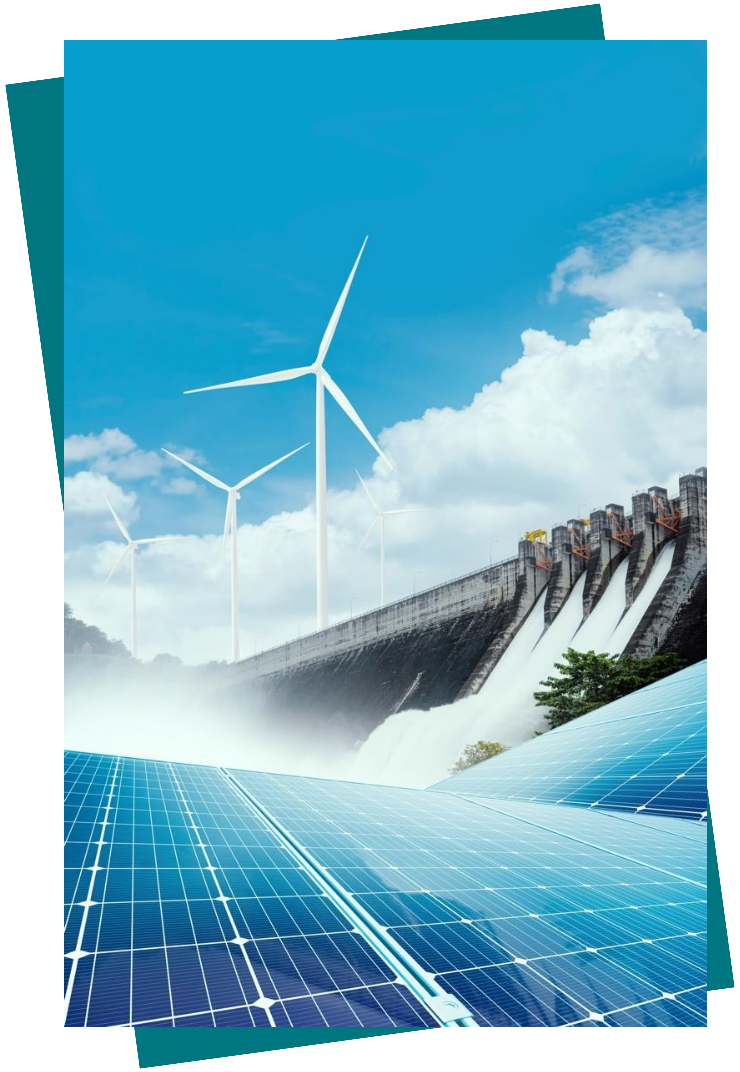
Source: Elaboration by Deloitte on Jones et al. primary data, 2024 Link

Despite the Paris Agreement's commitment to keeping global temperature rise well below 2°C by the end of the century, eleven G20 members are currently off track to meet their commitments. Moreover, collective G20 targets fall significantly short of the emissions reductions needed to align with 2°C and 1.5°C mitigating scenarios[2].

Failing to reduce emissions has profound consequences for ecosystems worldwide, imposing high costs on human health, biodiversity, and water security. These impacts are particularly severe for low-income countries[3] and Small Island Developing States (SIDS)[4] , the latter of which contribute less than 1% of global emissions while bearing a disproportionate share of the worst consequences of climate change[5].

By 2050, climate change is expected to provoke an estimated 14.5 million deaths, economic losses totaling $12.5 trillion, and up to $1.1 trillion in extra healthcare expenditures[6]. Moreover, estimates suggest that every 1°C increase in global temperature could result in a 12% reduction in global GDP[7].

Approximately $44 trillion in economic value generation — over half of the world's total GDP—is moderately or highly dependent on nature and its ecosystems[8], which are being severely threatened by climate change, the overexploitation of natural resources and excessive land consumption. Forests for instance, which harbor 80% of terrestrial biodiversity and absorb approximately 2.6 billion tons of carbon dioxide each year[9], have been reduced by nearly 420 million hectares globally—an area equivalent to the size of the European Union - between 1990 and 2020[10].



Sources:: [1] Computed by Deloitte on Jones et al. primary data, 2024 Link | [2] European Commission, 2025 Link | [3] The World Bank Group assigns the world's economies to four income groups: low (primarily Sub-Saharan Africa), lower-middle (primarily Northern, Western and Southern Africa, and South Asia), upper-middle (primarily China, South-East Asia, Central and South America), and high (primarily Europe, Middle East, and North America). The classifications are updated each year on July 1, based on the GNI per capita of the previous calendar year (World Bank, 2024-2025 Link) | [4] Small Island Developing States are a group of 39 island nations home to approximately 65 million people who live across more than 1,000 islands (UNDP, 2024 Link) | [5] UN, 2024 Link | [6] WEF, 2024 Link | [7] National Bureau of Economic Research, 2024 Link | [8] World Bank, 2024 Link | [9] WHO, 2025 Link | [10] FAO, Link

Steps towards a greener future

Facing climate related issues, governments (in particular those of industrialized economies) are allocating more resources to reduce pollution, curb resource consumption and develop innovative clean technologies.

In 2023, energy-related CO_2 emissions reached a record high of 37.7 gigatons (Gt), marking a 1.3% increase from the previous year, with the energy sector accounting for approximately 85% of total global CO_2 emissions[11]. The electric power sector emerged as the largest contributor, responsible for 36% of these emissions. Among other major sectors, industry produced nearly 10 Gt CO_2, making up around 26.5% of global energy-related emissions, followed by transport at over 8 Gt CO_2 (21.2%), and the buildings sector which contributed for approximately 3 Gt CO_2 (7.9%)[12].

Renewable energy and clean tech

During COP 28, G20 countries committed to tripling their renewable power generation capacity by 2030. As of 2022 G20 countries produced 28.9% of their electricity from renewable sources, while the G7 members generated 28.5% of renewable electricity, both less than the global 29.1%[13].

According to the Nationally Determined Contributions (NDCs) of G20 countries, under a 1.5°C scenario no G20 nation is expected to have a share of non-fossil electricity generation below 50% by 2035. Furthermore, by 2050, all G20 countries are projected to achieve at least 80% of their electricity generation from non-fossil sources[14].

The year 2024 witnessed a historic acceleration in the global renewable capacity addition, with an increase in renewables of 585 GW showing a record rate of 15.1% annual growth, and surpassing 2023's growth rate of 14.3%. Around 452 GW of solar PV was added in 2024, growing by 32.2% and reaching a total capacity of 1865 GW worldwide. Solar and wind are the two main drivers to the renewables' growth, jointly accounting for almost 97% of the expansion[15].

Clean energy development and deployment have also profound economic impacts: in 2023 the clean tech sector has contributed approximately $320 billion to the global economy - 10% of global GDP growth[16]. This surge was fueled by the rapid expansion of key clean energy technologies—solar PV, wind, EVs, batteries, electrolysers, and heat pumps—whose market value quadrupled between 2015 and 2023, surpassing $700 billion[17]. Supporting this momentum, global investment in clean technology manufacturing rose by 50% in 2023, reaching $235 billion, nearly 10% of total global investment growth. Specifically, 80% of these investments were directed toward solar PV and battery manufacturing, with electric vehicle (EV) plants accounting for another 15%[18]. The expansion of global manufacturing capacity, coupled with a steep learning curve, has accelerated the decline of PV and battery prices and thus their affordability and cost-competitiveness.

Carbon Capture, Utilization and Storage (CCUS) technologies are also gaining momentum as a necessary complement to renewable energy generation in achieving net-zero targets, especially in emission-intensive sectors[19]. Between 2019 and 2023, global investment in CCUS systems in the power sector more than tripled, rising from $210 million to $682 million with a CAGR of 26.5%[20]. Although there are only 45 facilities currently operational worldwide, with a capture capacity of approximately 50 Mt CO_2 per year, announced projects could increase capture capacity to 435 Mt CO_2 and storage capacity to 615 Mt CO_2 annually by 2030[21].

Biofuels are also emerging as a potential solution to decarbonize hard-to-abate sectors such as aviation and maritime transport[22]. Their compatibility with existing energy infrastructure and reliance on widely available feedstocks—such as agricultural and forestry residues—make them especially attractive. Bioenergy's share in the total energy supply is set to grow from 6% today to 13% by 2030 and 18% by 2050 in the Net Zero Emissions (NZE) Scenario, all from sustainable sources that minimize environmental impacts[23].

Sources: [11] IEA, 2024 Link | [12] IEA, 2024 Link | [13] IRENA, 2024 Link | [14] European Commission, 2025 Link | [15] IRENA, 2025 Link | [16] IEA, 2024 Link | [17] IEA, 2024 Link | [18] IEA, 2024 Link | [19] IEA, 2023 Link | [20] Global Energy, 2024 Link | [21] IEA, 2024 Link | [22] IEA, 2024 Link | [23] IEA, 2023 Link

Nuclear energy

Investments in new energy sources have been recently accompanied by a renewed interest in nuclear as a dispatchable low-emission source capable of addressing reliability and intermittency pitfalls of wind and solar (especially if not backed by battery energy storage systems, BESS). Several industrialized countries, such as the US and European ones, announced plans to extend current reactors' lifetime[24]. Moreover, Small Modular Reactors (SMRs) received particular attention in developed countries, due to their reduced upfront costs, shorter development times and lower construction risk compared to conventional nuclear plants. The 'France 2030 Investment Plan', for instance, provided €1 billion in funding for innovative reactors including SMRs, while in the US the 'Advanced Reactor Demonstration Program' provided $3 billion for similar purposes[25].

Energy efficiency

During COP 28, G20 countries also committed to doubling the global average annual rate of energy efficiency improvements by 2030. Accelerating such improvements could account for over one-third of all CO_2 emission reductions needed between now and 2030[26].

Public and private investments in energy efficiency are increasingly focused on end-use sectors, such as buildings, transportation, and industry. In 2024, these investments are expected to grow by approximately 4%, reaching around $660 billion, equaling the record-high levels of 2022[27].

Climate finance

Advanced economies[28] have experienced significant growth in climate finance[29], reaching $589 billion in 2022. This expansion has been largely fueled by rising investments in buildings and infrastructure (35%), followed by energy systems (29%) and transport (26%). Investments in buildings and infrastructure reached $207 billion, while energy systems rebounded to $171 billion, led by the expansion of renewable energy. Funding for transport rose from $37 billion to $153 billion, driven primarily by battery electric vehicles[30].

Circularity

The G20 is responsible for ~75% of global waste and the majority of the global consumption of natural resources. A roadmap on waste management and circular economy has been approved, prioritizing the prevention and the reduction, reuse and recycling of waste, while building partnerships that effectively support developing nations in this endeavor[31].

Green regulation and potential pitfalls

Industrialized countries, particularly in Europe, have been at the forefront in drafting regulation aimed at supporting a sustainable transition. The introduction of the European Green Deal[32] in 2019 marked a significant step forward for the European Union, coupled with the EU Taxonomy[33] aimed at driving investments towards sustainable ends. However, these policies also raised potential risks of "carbon leakage" and relocation of production in jurisdiction imposing less stringent requirements, as a consequence of regulatory burdens for firms producing within the EU[34]. In this respect, other environmentally friendly initiatives, such as the Deforestation Regulation (EUDR), have been partially scaled back in their scope and administrative stringency to meet the requests of affected businesses.

Sources: [24] IEA, 2025 Link | [25] IEA, 2025 Link | [26] IEA, 2024 Link | [27] IEA, 2024 Link | [28] As of October 2024, 37 countries were classified as advanced economies by the IMF, link | [29] *"Climate finance refers to local, national or transnational financing—drawn from public, private and alternative sources of financing—that seeks to support mitigation and adaptation actions that will address climate change"* (UNFCCC, 2024 Link) | [30] G20, 2024 Link and Climate Policy Initiative, 2024 Link | [31] G20, 2024 Link | [32] European Commission, 2025 Link | [33] European Commission, 2025 Link | [34] IMF, 2023 Link

Threats to energy security

The transition towards a green economy and "away" from fossil fuels is instrumental to mitigating the effects of climate change and, for some countries, to reducing their energy dependence.

At the same time, geopolitical crises were responsible for increasing vulnerability in global energy markets. The COVID-19 pandemic, Russia's invasion of Ukraine, and conflicts in the Middle East[35] have led to spikes in commodity prices and uncertainties along supply chains and commercial routes.

Russia's invasion of Ukraine in February 2022 had a profound impact on natural gas markets. The wholesale price in 2022 in Europe was, on average, more than 300€/MWh, over 5 times higher than its pre-crisis level[36]. Between the 23rd of February and the 31st of July 2022, the European electricity wholesale price increased by 237%[37]. At the same time, through the successful implementation of the REPowerEU Regulation, the share of Russia's pipeline gas in EU imports dropped from over 40% in 2021 to about 11% in 2024[38]. Meanwhile, the bulk of EU imports to fill the gap from Russian pipelines, in order to cover internal demand, originated from the US through LNG (more than 41% of total TWh equivalent imports in 2023) with an increase in terminals investments across the continent, followed by established North-Sea pipelines and new North-African interconnections[39].

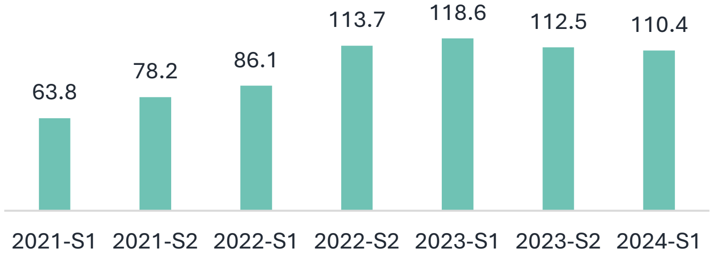
While energy security has been pursued through diversification of supplies, the sudden increase in gas prices was predominantly felt in European markets, while impacts in other parts of the world were somehow more muted. Energy price gaps were already evident between the EU and US before the conflict, but the war led to a further persistent rise in price gaps for both natural gas and electricity[40]. In May 2021 for instance, European gas prices measured in US$/ mmbtu were similar to those in Japan and approximately 3 times those in the US. In August 2022, prices in the EU averaged more than 3 times those in Japan and almost 8 times those in the US[41].

The significant widening of price gaps led to reduced competitiveness in global markets for European manufacturing companies, that faced the harshest impacts on their input costs[42], while also being challenged to re-route clean tech investments in countries with lower energy bills and incentives schemes such as the US Inflation Reduction Act (IRA).

Oil prices also rose due to the conflicts, which increased market volatility. However, the impact gradually weakened as a global oil surplus emerged, driven by stagnant demand in China and strong production by non-OPEC+ countries like the U.S.

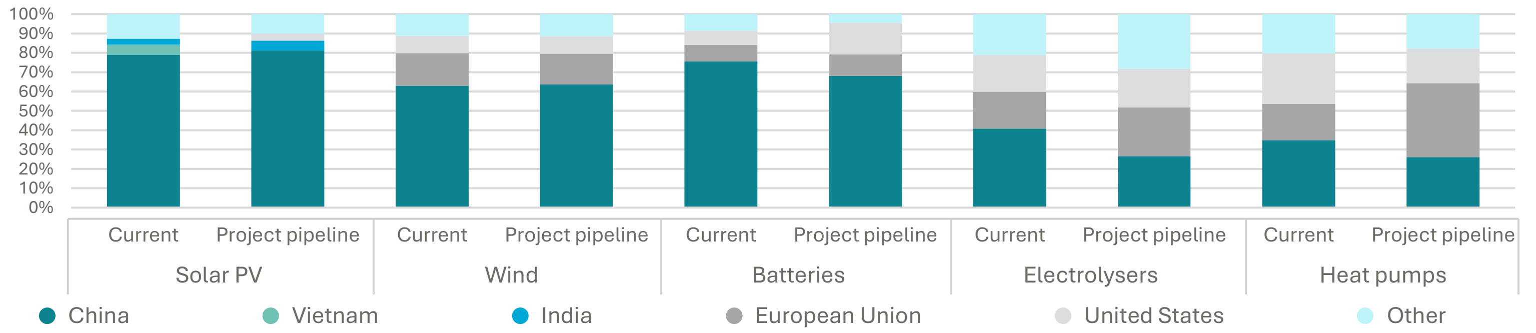
While deploying renewable energy enhances security by reducing the reliance of electricity grids on fossil fuel generation and imports, its supply chains face several challenges, such as high geographic concentration of critical minerals, which are essential to manufacture clean technologies. The Democratic Republic of Congo supplies 70% of cobalt, China 60% of rare earth elements (REEs),

Figure 2 | Gas prices for household consumers in EU 27 (€ per MWh), Jan 2021 – June 2024 (bi-annual data)



Source: Natural gas price statistics, 2025 (Eurostat)

Figure 3 | Share of top three manufacturing regions for key clean energy technologies in 2023 and 2030 based on announced projects



Source: Overcoming the Energy Trilemma: Secure and Inclusive Transitions (IEA)

Sources: [35] IEFA, 2024 Link | [36] European Commission, 2023 Link | [37] Ferriani & Gazzani, 2023 Link | [38] European Council, 2025 Link | [39] Joint Research Centre, 2025 Link | [40] IMF, 2025 Link | [41] World Bank, 2024 Link | [42] IMF, 2025 Link and Indonesia 40% of nickel. Australia accounts for 55% of lithium mining and Chile for 25%. Processing of these minerals is also highly concentrated, with China being responsible for the refining of 90% of REEs and 60-70% of lithium and cobalt. China is the leading global supplier of clean energy technologies, holding at least 60% of the world's manufacturing capacity for most mass-manufactured technologies (e.g., solar PV, wind systems, and batteries) and 40% of electrolyser manufacturing[43].

These critical dependencies in global value chains have become a central issue in achieving clean energy targets as they pose significant risks to supply security, cost stability, and the pace of the energy transition. Indeed, the risk of overdependency on single suppliers in multiple stages – being mining, refining and downstream activities – could be exacerbated in a context of geopolitical tensions, offsetting declining costs and thus the economic incentive for clean technologies adoption[44].

Energy security policies

Industrialized countries have responded to recent energy security challenges by implementing a range of policies focused on ensuring a stable supply of energy sources, increasing domestic production while diversifying suppliers, and enhancing their affordability.

In 2022, G20 members invested $1.4 trillion in fossil fuels[45], over twice the amount for 2019. Key initiatives included increasing extraction permits and substantial investments to expand long-term production capacity and improve oil and gas transportation infrastructure. At the same time, a major expansion of the liquefied natural gas (LNG) infrastructure, both for export and import, was undertaken. To reduce dependence on specific suppliers and lower prices, (energy import dependency in the EU was valued at around 60% in 2022[46]), several countries invested in the construction of new LNG terminals and the expansion of import facilities, leading to a rise in LNG import capacity by 22% between 2021 and 2023[47]. Source diversification has become a strategic priority, especially for the EU and its member states, which in the first year of the Russia-Ukraine war signed almost 100 energy cooperation agreements[48]. Moreover, in February 2023, EU countries agreed on a Market Correction Mechanism aimed at limiting prices in EU gas markets and preventing disruptions to both energy and financial markets[49]. A similar measure has been introduced in Japan, where a mechanism has been put in place to cap electricity and gas prices[50].

G20 and G7 countries implemented various actions to ensure that the development of clean and renewable technologies goes along with energy security efforts. Countries are also striving to increase domestic production of key green technologies (e.g., solar panels, wind, hydroelectric, geothermal, and nuclear energy) to reduce excessive dependence on foreign suppliers[51]. Finally, investments are increasing in green hydrogen, seen as the main alternative for decarbonizing hard-to-abate sectors[52], and in carbon capture, utilization, and storage [53].

Sources: [43] IEA, 2023 Link | [44] IEA, 2025 Link | [45] Energy Policy Tracker, 2023 Link | [46] European Commission, 2024 Link | [47] IEEFA, 2025 Link | [48] European Council on Foreign Relations, 2023 Link | [49] EU, 2023 Link | [50] Prime Minister's Office of Japan, 2022 Link | [51] World Bank, 2024, Link | [52] IEA, 2024 Link | [53] IEA, 2024 Link