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Commitments to the Energy Transition – Leaders and Laggards

Sustainability Research Paper

The Al-Attiyah Foundation

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Between 2014 and 2023, the Earth was already 1.2°C warmer than pre-industrial levels (1850–1900). In 2022, carbon-intensive energy sources (coal (33%), oil (24%), and natural gas (16%)) accounted for 73% of global GHG emissions, which continue to rise. Reversing global warming requires an overhaul of the energy system. The "energy transition" involves shifting from fossil fuels to renewable energy to reduce emissions, lower costs, and address geopolitical concerns, though fossil fuel subsidies distort markets. What countries are leading the energy transition? What differentiates climate action leaders and climate laggards? What can laggards learn from leaders on achieving a just energy transition?

SUSTAINABILITY RESEARCH PAPER

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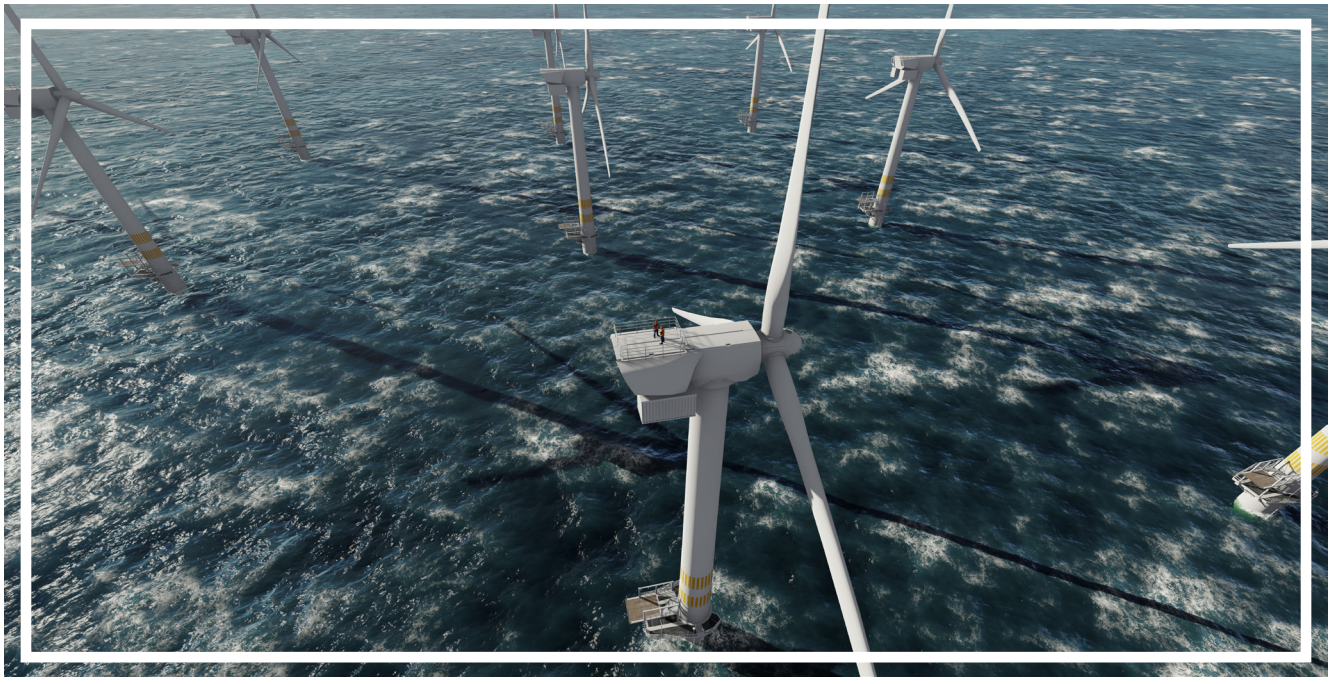


03 EXECUTIVE SUMMARY

- For the last 10-year period (2014-2023) the earth was already 1.2°C warmer than in the pre-industrial years (1850-1900).
- Carbon-intensive energy sources like coal, oil, and natural gas have historically been the largest contributor to global GHG emissions, being responsible for 73% of total global GHG emissions (coal 33%, oil 24%, natural gas 16%) in 2022[1], and emissions continue to rise[2].
- To reverse the effects of global warming the energy system needs to be overhauled. The term "energy transition" refers to the comprehensive shift from traditional fossil-based energy systems to renewable and sustainable energy sources.
- Although Scandinavian countries are currently at the forefront of the energy transition, some countries in the global south have made major strides towards hitting their climate targets. For example, Bhutan is a carbon negative country, capturing and storing more carbon as it emits. The forestry and land use sector serves as carbon sink since 70% of the country's land area under forest cover, and 82% of its energy supply comes from renewables.
- Consistent government policies, support and adoption of technological innovation, and the economic structure and geopolitical stability of a country are major factors affecting the success of the energy transition.
- Globally, the pace of the energy transition is slow, and some countries are struggling to hit their targets. The expansion of renewable energy production lags behind and is unlikely to meet the COP28 target of tripling global renewable energy production. A just transition requires global collaboration, increased investment in clean technologies, and robust policy frameworks to drive equitable and sustainable energy transitions worldwide.

The Intergovernmental Panel on Climate Change (IPCC), in its several reports, has stressed the urgent need to keep the global average mean temperature rise to 1.5°C above pre-industrial levels[3].

The term "energy transition" refers to the global shift from reliance on fossil fuels such as coal, oil, and natural gas to cleaner and renewable energy sources like solar, wind, hydroelectric, and geothermal power. This shift is driven by the urgent need to mitigate climate change, reduce greenhouse gas emissions, and achieve sustainable energy security. The energy transition represents not just a technological revolution but also a socio-economic transformation with profound implications for industries, governments, and societies worldwide.

At its core, the energy transition seeks to decarbonise energy systems while meeting growing global energy demands. Renewable energy sources, coupled with advances in energy storage technologies and digital solutions, have become increasingly cost-competitive. Innovations such as smart grids and energy-efficient systems further enable a smoother transition. Additionally, electrification of sectors like transportation and heating is pivotal in reducing dependence on fossil fuels. However, the energy transition faces significant challenges, including infrastructural adaptation, policy alignment, and equitable access to resources.

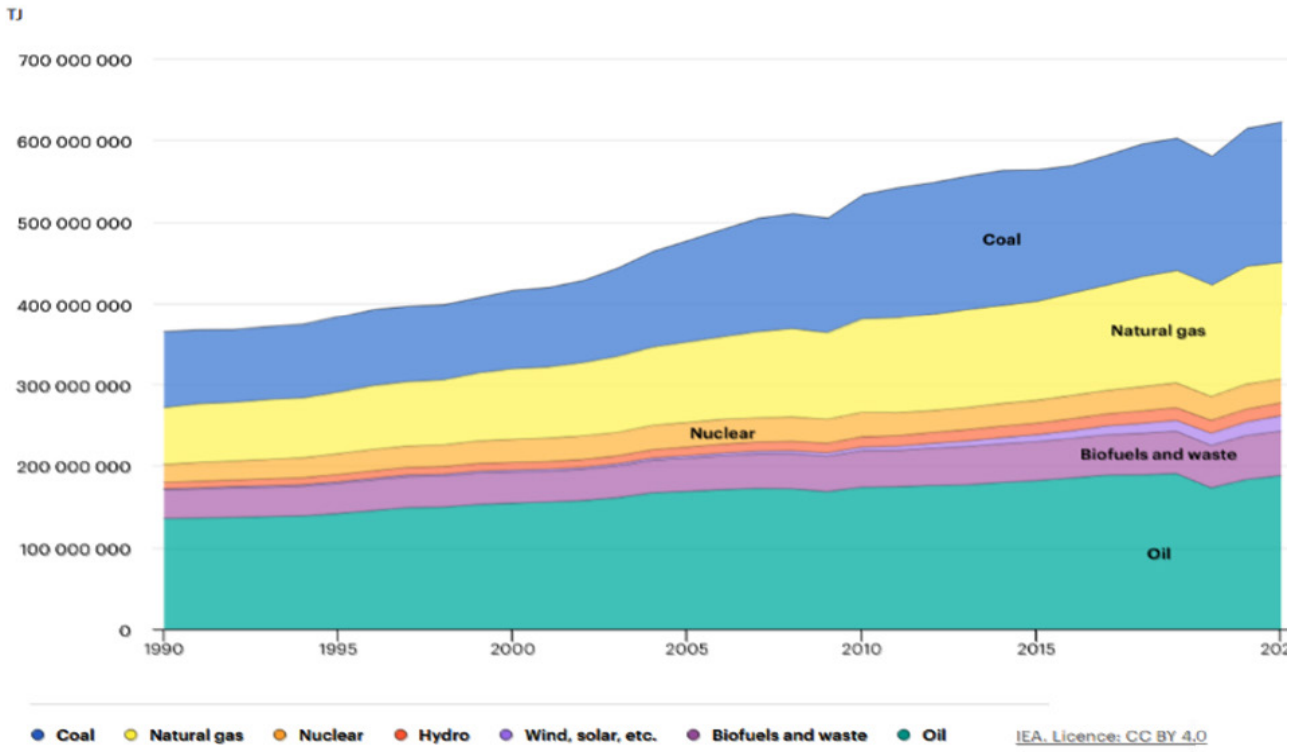
The energy transition is not merely an environmental imperative; it is also an economic and social opportunity.

By fostering innovation, creating green jobs, and promoting energy equity, it paves the way for a resilient, sustainable future.
However, its success depends on global collaboration, strategic investments, and a commitment to overcoming challenges for the benefit of future generations.

Beyond environmental concerns, economic factors are beginning to play an increasingly relevant role for energy transition. Renewable energy sources have become increasingly cost-effective, often outcompeting fossil fuels in terms of price and efficiency. The International Renewable Energy Agency (IRENA) reported that in 2023, approximately 81% (382 gigawatts) of newly commissioned renewable capacity had lower costs than fossil fuel-based electricity, and that in 2022, on average, renewable energy costs were 29% less than those of the cheapest fossil fuel options[4].

Solar photovoltaic (PV) module and lithium-ion battery prices have fallen by 90% since 2010, wind turbine prices by 63%.
Also, carbon pricing mechanisms will continue to increase the costs for fossil fuel-based energy for most regions. BloombergNEF's "Global Carbon Market Outlook 2024"[5] highlights that net-zero targets are pushing regulators to tighten supply and include more sectors, contributing to the upward pressure on carbon prices. In addition, the EU Carbon Border Adjustment Mechanisms (CBAM) impose charges on imported goods based on their carbon content, ensuring that imported products are subject to similar carbon costs as domestic products. This incentivises exporting countries to adopt stricter emission controls, promoting global efforts to reduce greenhouse gas emissions[6].

Figure 1: Global Statistics on Total Energy Supply (TES) for 1990 – 2022[14]



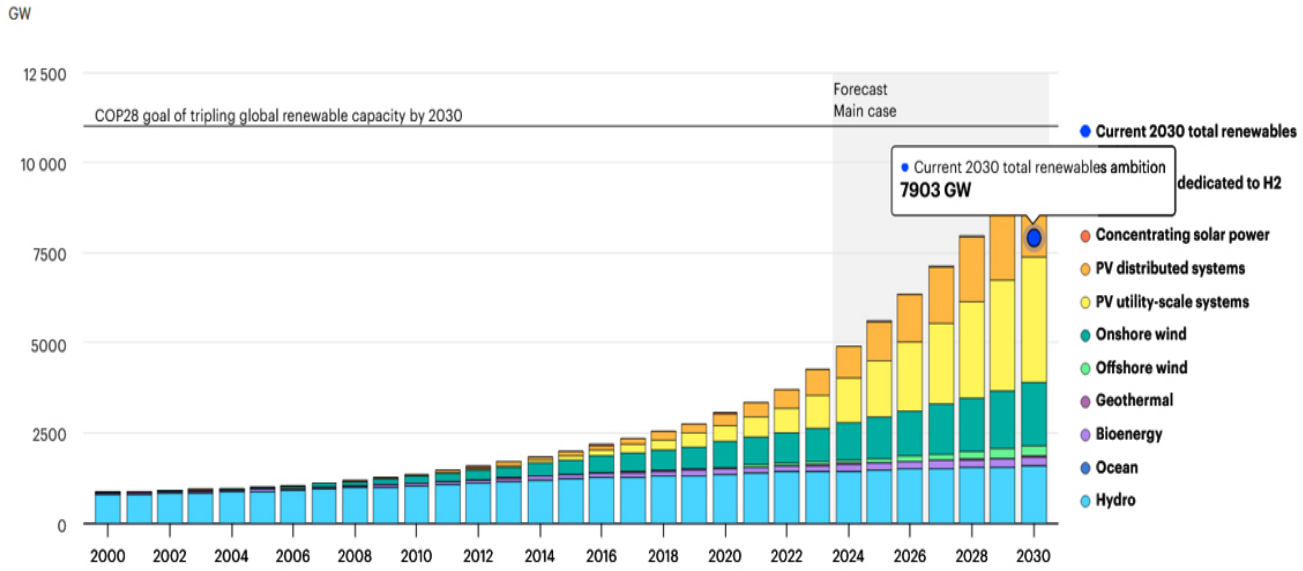
Furthermore, investing in renewable energy infrastructure can reduce energy costs over the long-term, benefiting consumers and governments alike, and opening avenues for job creation in emerging industries. It is estimated that the transition to clean energy has already saved USD 521 billion in fuel costs since 2000, accounting for global GDP growth by 3.1% in 2023 and can create 85 million new jobs annually[7],[8],[9].

The deployment of renewable energy capacity accelerates strongly and comprises 86% of all new power additions globally[10]. However, the renewable energy share in the global energy mix is expanding only slowly due to rising total energy consumption (Figure 1). In 2022, 81% of the global total energy supply were still provided by fossil fuels (oil 30%, coal 33%, natural gas 23%). Figure 2 shows the development of renewable energy production from 2000 to 2023, and the IEA estimates for 2024 to 2030.

The IEA estimates show that the COP28 goal of tripling renewable energy capacity by 2030 will be unmet[14].
Finally, geopolitical reasons motivate the energy transition by the need to enhance energy security, reduce reliance on imported fossil fuels, and mitigate risks associated with volatile global energy markets.

Shifting to renewables allows countries to achieve energy independence by utilising domestic resources like solar, wind, and hydropower. Additionally, the transition reduces geopolitical tensions tied to fossil fuel supply chains and transportation chokepoints. As global decarbonisation accelerates, countries are aiming to secure leadership in clean energy technologies, including green hydrogen and batteries, to gain economic and strategic advantages in a rapidly evolving energy landscape.

Figure 2: Development of renewable energy production from 2000 to 2023, and the IEA estimates for 2024 to 2030[11]



07 TOOLS USED TO TRACK LEADERS AND LAGGARDS IN THE ENERGY TRANSITION

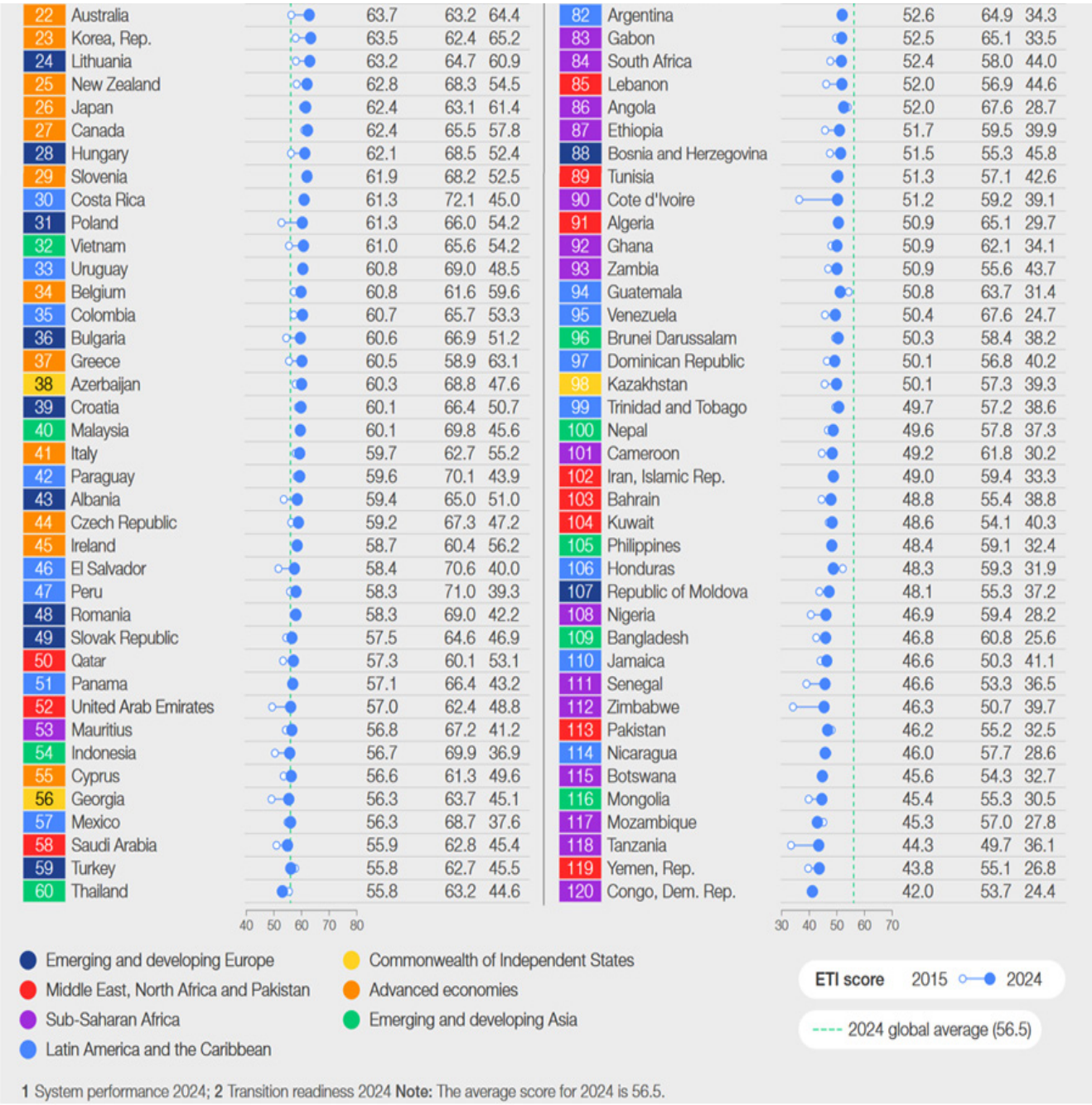
As elaborated in the section above, the energy transition describes a societal shift in the use of energy resources. Therefore, assessing a country's performance in the energy transition requires the consideration of various metrics, each focusing on different aspects of progress. The IEA synthesises various metrics in its Tracking Clean Energy Progress report[12] and provides forecasts in the World Energy Outlook[13] series. The Renewable Global Status Report (GSR)[14] by REN21 tracks global renewable energy developments covering markets, policies, energy systems and infrastructure. While these reports describe the progress in global energy transition and highlight countries' performance on selected individual metrics, they do not compare countries' progress in the energy transition across several dimensions simultaneously.

The most prominent composite indicator for measuring level of energy transition is the Energy Transition Index (ETI)[15] by the World Economic Forum (WEF). The ETI measures current energy system performance and readiness of their enabling environment for the energy transition for 120 countries. The ETI ranking table for the 120 countries in 2024 is shown in Figure 3. The numbers in the red boxes are MENA countries, Qatar coming in at number 50. All MENA countries either show an advancement in the energy transition between 2015 and 2024 or no movement.

There are other alternative composite indicators, such as, the Climate Change Performance Index (CCPI)[16] by Germanwatch, the Green Growth Index (GGI) by the Green Growth Institute[17] and the Global Green Economy Index (GGEI) by Dual Citizen LLC[18]. These indicators include energy components that focus on the transition to low-carbon energy, with the GGI and GGEI including, metrics that also focus on the land use sector and environmental protection.

Figure 3: 2024 Country Ranking on Their Energy Transition Advancement Between 2015 and 2024 as per the ETI Created by the WEF[18].

Rank	Country	ETI score (2015–2024)	2024 ETI score	SP[1] ('24)	TR[2] ('24)
1	Sweden		78.4	79.4	76.8
2	Denmark		75.2	72.0	80.1
3	Finland		74.5	70.7	80.1
4	Switzerland		73.4	76.2	69.1
5	France		71.1	74.7	65.6
6	Norway		69.9	75.2	62.0
7	Iceland		68.0	71.8	62.2
8	Austria		67.9	68.5	67.0
9	Estonia		67.8	73.7	59.0
10	Netherlands		66.7	62.7	72.7
11	Germany		66.5	65.0	68.7
12	Brazil		65.7	69.9	59.4
13	United Kingdom		65.6	66.3	64.6
14	Portugal		65.4	67.0	62.9
15	Latvia		65.2	70.1	58.0
16	Spain		64.3	64.7	63.7
17	China		64.1	66.6	60.3
18	Luxembourg		64.1	64.1	64.1
19	United States		64.0	67.3	59.0
20	Chile		63.9	67.9	58.0
21	Israel		63.8	70.4	54.0
61	Malta		55.6	64.9	41.8
62	Oman		55.5	58.9	50.3
63	India		55.3	63.6	42.8
64	Singapore		55.0	54.1	56.5
65	Morocco		54.9	60.5	46.5
66	Bolivia		54.8	68.1	34.7
67	Montenegro		54.6	59.9	46.6
68	Namibia		54.5	62.0	43.3
69	Sri Lanka		54.2	64.4	39.0
70	Kenya		53.6	63.8	38.4
71	Tajikistan		53.6	65.2	36.1
72	Lao PDR		53.5	54.0	52.9
73	Jordan		53.5	57.7	47.1
74	Ecuador		53.2	67.5	31.8
75	Egypt, Arab Rep.		53.0	64.3	36.0
76	Ukraine		52.9	62.6	38.3
77	Cambodia		52.9	61.6	39.9
78	Serbia		52.9	61.1	40.5
79	Armenia		52.7	60.9	40.5
80	Kyrgyz Republic		52.7	61.7	39.3
81	Macedonia, FYR		52.6	59.5	42.3

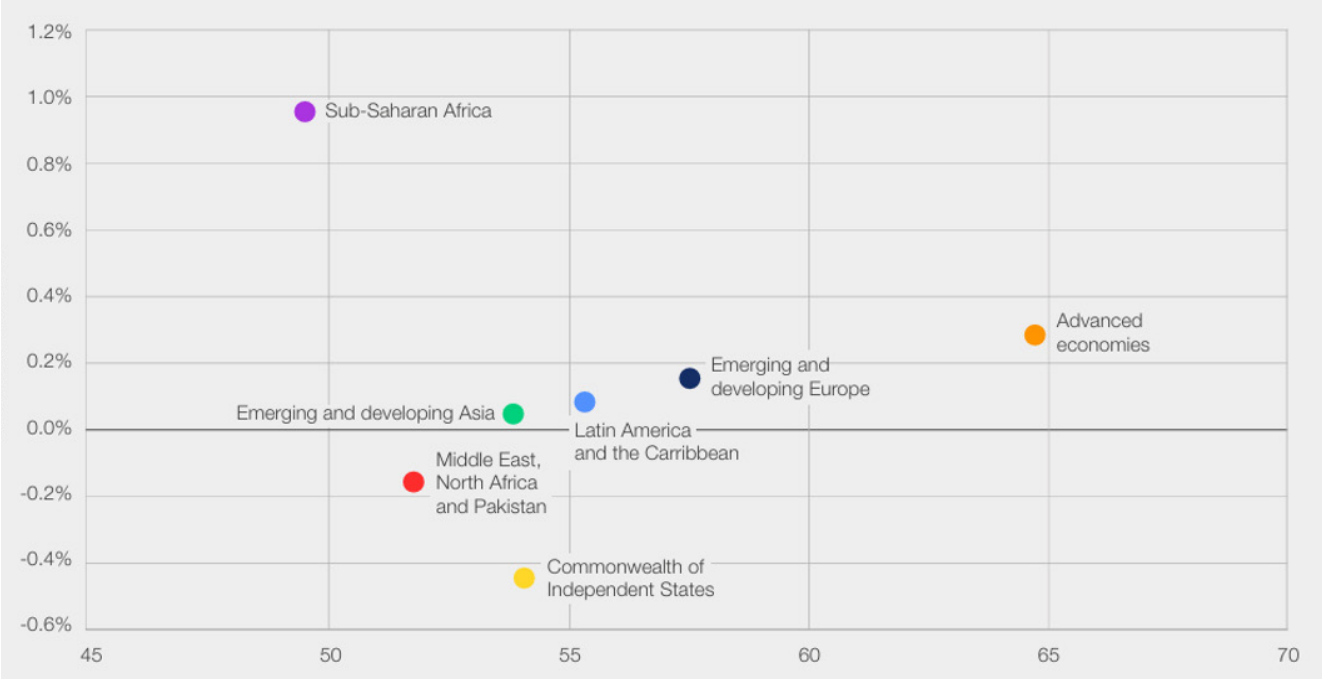


1 System performance 2024; **2** Transition readiness 2024 **Note:** The average score for 2024 is 56.5.

In the ETI 2024 country ranking, only European countries occupy the top ten positions, while the bottom ten countries, with the exception of Mongolia, Pakistan, Yemen, and Nicaragua, are located in Sub-Saharan Africa (see Figure 3). This indicates a strong correlation between economic resources and the performance of countries in energy transition. Figure 4 plots the ETI score against the ETI momentum that measures the pace of transition. While on average, Sub-Sahara Africa is demonstrating efforts by catching up with better energy security and regulations, the MENA region has not shown advancement over the last ten years, having on average the highest energy intensity, dependency on fossil fuels and slow progress on switching to renewable energy.

The Commonwealth of Independent States (CIS) is taking steps backwards, related to increasing energy prices. In this section, we will discuss leaders and laggards from various regions and economic groups, not only focusing on the current ranking but also on the trend.

Figure 4: ETI Score 2024 (WEF, 2024)[18]



Denmark

Ambitious policies and technological innovation make Denmark a frontrunner in realising a low carbon energy transition. Energy related emissions have been reduced by 47% since 2000, and electricity consumption per capita and total energy intensity of the economy went down by 9% and 43%, respectively from 2020-2023[19].

The 2020 climate-neutrality law plans the phase-out of the domestic oil and gas sector. While oil is mainly used in the transport sector (72%), gas is used by industry (48%) and residential heating and cooking (35%). In electricity production, oil and gas contribute only 3.8%, while over 80% is produced by renewables. The share of renewables increased by 424% since 2000.

Wind turbines supplied 57.6% of Denmark's electricity, the largest share of wind among IEA countries22.

Denmark is one of the first countries to establish a national fund for negative CO_2 emission (NECCS fund)[20], and this year they already contracted three companies for future biogenic carbon removal and storage (BECCS). In 2023, Biofuels and waste accounted for 34.7% of the total domestic energy supply. Biomass fuels over 60% of district heating and plays a key role in decarbonising Denmark's heating sector[22].

However, challenges remain, including ensuring grid stability as intermittent renewable sources like wind and solar dominate the energy mix. Denmark continues to invest in energy storage and smart grid technologies to address these issues.

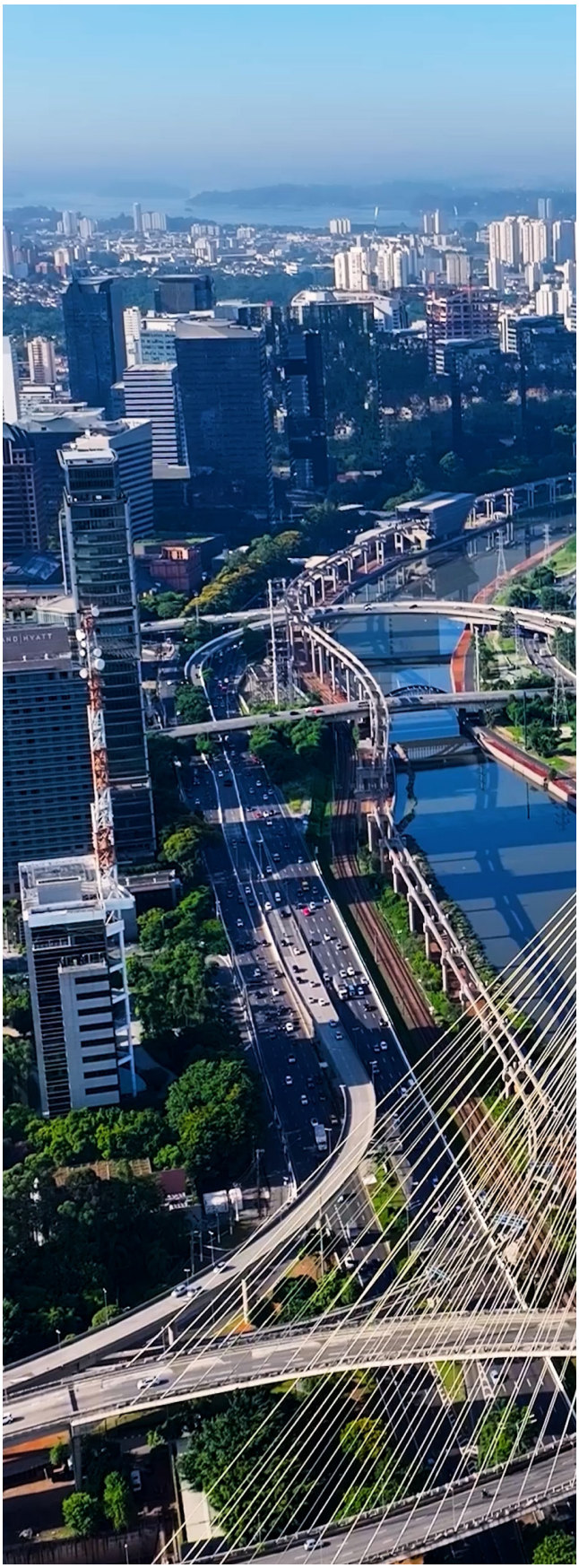
Its innovative policies and renewable energy achievements make Denmark a model for energy transition worldwide.

Brazil

Brazil has made significant strides in its energy sector, becoming a leader in renewable energy production, and the G20 country with the largest share in renewable energy supply in 2022. 49% of total energy supply and 89% of electricity production come from renewable resources. While biofuels and waste contribute with 33% to total energy supply, mainly helping to decarbonise the transport sector, 60% of Brazil's electricity production comes from hydropower. However, solar and wind energy production accelerated in the last ten years, yielding 95k GWh wind energy and 51k GWh solar PV in 2023 [21].

Being an emerging economy, Brazil increased CO_2 emissions per capita by 15% and emissions from fuel combustion by 40% from 2000-2022. Thus, even by heavily expanding biofuel production, the transport sector remains the largest emission source (51%), followed by the industry sector (21.6%)[23]. While energy supply per unit GDP remained about constant from 2000-2021, emission intensity in transportation and manufacturing sector rose by 49% and 31%, respectively[22]. The extensive use of liquid biofuels from food and feed crops has sustainability drawbacks. The cultivation of biofuel crops causes emissions from land use, and direct and indirect land-use change, and can have adverse effects on ecosystems and biodiversity.

In August 2024, President Luiz Inácio Lula da Silva launched the National Energy Transition Policy, aiming to attract BRL 2 trillion in investments to further enhance the country's renewable energy infrastructure[24].



Despite these advancements, challenges remain, including the need to diversify energy sources beyond hydropower to mitigate risks associated with climate variability. Ongoing efforts to integrate more solar and wind energy, alongside policy reforms and technological innovations, are essential for Brazil to maintain its leadership in the global energy transition.

Bhutan

Bhutan is a carbon negative country, capturing and storing more carbon than it emits[25]. The forestry and land use sector serves as carbon sink since 70% of the country's land area is under forest cover, and 82% of its energy supply comes from renewables[26]. Though the country's rugged terrain and dispersed population made the development of modern energy infrastructure challenging, 99% of the population are grid-connected[27].

Bhutan's energy supply is provided by traditional biomass used for cooking and heating (47%), hydropower (34%), coal (10%), and oil (8%). In 1986 India supported Bhutan in the construction of the first large-scale hydropower project. In the following years, Bhutan further strengthens the hydropower sector and increased hydropower exports to India, which currently accounts for one-third of the country's export and foreign exchange earnings and constitutes 26% of its GDP[30]. However, longer and hotter dry seasons, extreme rainfall, as well as the continuing loss in glaciers, adds variability in the river flows and hydropower production. Bhutan's economy is currently over-reliant on hydropower, introducing economic volatility due to hydro resource fluctuations and dependence on a single export market. To diversify energy production, other renewables, such as wind, biogas and solar, are being developed, but potential for wind and solar is low compared to the global average[30].

Bhutan is facing a major challenge of rapidly rising CO_2 emissions in the industry and transportation sectors. However, the country is aiming at the electrification of these sectors, and seriously exploring the viability of green hydrogen production[29].

Kenya

Kenya is seen as a leader in renewable energy development in Africa. Electricity and electrification are cornerstones for its energy transition. The country has set an ambitious target of achieving 100% renewable energy by 2030 and is making progress towards reaching it[28]. Kenya boasts a wealth of renewable energy resources, and currently supplies 87.7% renewable electricity, including geothermal (47.5%), hydropower (21%), wind (16%), and solar (3.9%)[29].

The first hydropower projects started in the mid-20th century, but frequent droughts demonstrated risks of heavy reliance on this technology. With passing the Geothermal Resources Act in 1982, Kenya lay the foundation to become one of the leading nations in geothermal energy production[30]. The Lake Turkana Wind Power project is currently Africa's largest wind farm with an installed capacity of 310 MW[31]. Decentralised solar home systems gain increasing attention in off-grid rural areas[32].

Kenya has undertaken regulatory and institutional changes to enhance energy access and promote investment in renewable energy, as demonstrated by the enactment of the Energy Act of 2019[32]. Electricity access increased from 37% in 2013 to well above 70%, but occasional power cuts remain a challenge[33],[34]. The Kenya Energy Transition Investment Plan launched last year highlights future energy transition efforts that could lead to benefits such as minimised energy costs and job creation opportunities[35].

Challenges remain in high energy costs and the decarbonisation of the transport sector. Skewed contracts with independent power producers requiring foreign currency payments even if their power is not used have led to increasing monthly bills. Increased competition in the energy market is needed to achieve lower consumer prices. The transport sector was the largest source of emissions (62,2%) in 2021 and while Kenya's energy intensity decreased by 21% from 2000-2023, CO_2 emissions per capita increased by 26%[32].

Algeria

Algeria is a global major producer and exporter of oil and gas. The economy is highly dependent on hydrocarbon revenues as the sector contributes to 14% of GDP and 86% of exports. While the geographic conditions provide good potential for wind and solar energy[36], these technologies only account for 0.1% of total energy supply[37] and 0.7% in power generation. From 2000-2022 electricity consumption per capita went up by 158%, energy intensity by 35%, leading to an increase in energy-related CO_2 emissions of 146%. Domestic energy prices are low and heavily subsidised[38].

The dependency on hydrocarbons and the lack of economic diversification are threats for sustainable long-term development of the economy. To address this, the government has set ambitious targets to produce 27% of its electricity from renewable sources by 2035, primarily through solar power.

In 2021, Algeria initiated strategic partnerships with nations such as China, Germany, and the United States to develop renewable energy projects and technologies[39].

The production of green hydrogen for European energy markets may foster the expansion of renewable energy capacities in the future. However, the pace in development of renewable projects is slow4[40].

In the meantime, there is increased attractiveness for foreign direct investments in the hydrocarbon sector, to further exploit the country's significant gas and oil reserves[41]. In 2020 the government implemented a hydrocarbon law that partially lifts restrictions on foreign ownership and provides improved fiscal terms for foreign investors[42,43]. This law attracted major international players in the oil and gas industry. In 2024, an initiative was launched to unlock new oil and gas potential in six key sites.

Iran

Iran has one of the largest oil and gas reserves of the world. Domestic energy is supplied by gas (71.8%) and oil (26.2%), renewables are below 1%. In the last two decades, energy-related CO_2 emission increased by 123%, energy intensity by 26%, electricity consumption per capita by 139%, and natural gas production by 352%[44].

Despite having extensive green energy potential[45], such as solar, hydro, and geothermal energy, Iran's progress in renewable energy development has been limited. As of 2023, the country built less than 75 MW of renewable power, resulting in an operating capacity of only 879 MW, which constitutes less than one percent of the nation's total electricity[46]. However, Iran has set ambitious targets to enhance its renewable energy capacity, aiming to reach 20 GW of total renewable capacity by 2027 and add 10 GW of solar capacity by 2030. By 2031, policymakers have set the goal of 50 GW of renewable energy capacity[47].

Achieving these goals requires overcoming significant financial and infrastructural hurdles, as well as navigating the complexities of geopolitical tensions. Sanctions are significantly hindering the development of renewable energy projects, and in its Paris Agreement pledge the Iranian Government underlined that meeting the mitigation targets is conditional on a relief of international economic sanctions[48].

Russia

As a major global energy producer, Russia faces significant challenges in transitioning to a sustainable energy system. The country's economy is heavily reliant on fossil fuels, with oil, natural gas, and coal constituting most of its energy production and exports. As of 2022, renewable energy sources accounted for a mere 3.6% of Russia's primary energy supply, and 7.9% of electricity production. Hydropower is the largest contributor. In contrast to Iran and Algeria, energy-related CO_2 emissions only increased by 10% over the last two decades

and energy intensity of the economy decreased by 31%. At the same time crude oil production, natural gas production and coal production rose by 69%, 20% and 90%, respectively. The increase in production mainly served export markets[49].

Despite its vast potential for renewable energy, particularly in wind and solar power, Russia has been slow to develop these resources. Also, Russia has no targets for renewable energy development and the government's energy strategy up to 2035 will concentrate and support the fossil fuel sector5[50]. Russia's progress in the energy transition is strongly impeded by the country's abundant fossil fuel reserves and the essential income derived from their export[51],[52].

Argentina

In Argentina, natural gas dominates the energy mix, accounting for 50% of primary energy supply and electricity generation[53]. Energy-related CO_2 emissions rose by 36% from 2000-2022. While renewables in power generation, dominated by hydropower (20.2%) and wind (9.7%), reached an impressive total share in power supply of 33.2%[56], government subsidies continues to impede on the competitiveness of renewables by keeping fossil energy artificially cheap. However, to reduce the government deficit, overall energy subsidies have been cut by $2.7 billion in the first seven months of 2024[54].

The energy strategy of the current administration focuses on the exploitation of fossil resources to generate revenues[55]. Economic instability, including high inflation, currency devaluation, and recurring financial crises, limit Argentina's ability to attract and sustain investments in energy infrastructure[56],[57].

Although the country has launched initiatives like the RenovAr program to promote renewables, delays in implementation and financing have hindered progress.

Indonesia

Indonesia's performance in the energy transition reflects both challenges and slow progress, with a heavy reliance on fossil fuels and limited development of renewable energy. As of 2022, coal remained the dominant energy source, accounting for 36.4% of the energy mix, followed by crude oil (28.1%) and natural gas (12.7%). Per capita CO_2 emissions doubled over the last two decades[57].

Renewable energy accounts for 13% of Indonesia's energy supply and increased only by 4 percentage points over the last 20 years. Biofuels, hydropower, and geothermal energy lead the renewable sector, but solar and wind development remain significantly underutilised due to high costs, regulatory barriers, and inadequate infrastructure. Grid capacity issues and limited access to financing further hinder renewable integration[58].

Together with international partners, the Government of Indonesia developed the JETP Comprehensive Investment and Policy Plan in 2023, drafting a just energy transition for the country. The JETP covers an energy transition pathway for the power sector, financing needs and requirements, and policy reform recommendations. However, critics argue that the energy transition pathway could still lead to more than twice the level of CO_2 emissions as required to achieve the Paris Agreement's 1.5C° limit, due to off-grid coal plants[59]. Further, financing needs are estimated at $96 billion until 2030 and $580 billion up to 2050[63].

Government Policies

Government policies play a pivotal role in driving the energy transition by setting targets, creating enabling environments, and incentivising investments. Regulatory frameworks, such as emissions reduction mandates, carbon pricing, and renewable energy quotas, provide clear guidelines for reducing reliance on fossil fuels. Incentives like tax breaks, subsidies, and feed-in tariffs make renewable energy projects financially attractive, encouraging private sector participation. For example, countries like Germany have excelled in deploying solar and wind power through robust policy frameworks and competitive incentive schemes.

Technological Innovation

Technological innovation is central to the energy transition, enabling cost reductions, efficiency gains, and new applications of renewable energy. Advances in wind and solar technologies have dramatically reduced their costs, making them cheaper than fossil fuels. Similarly, battery storage innovation supports grid stability by storing energy from intermittent sources like wind and solar, addressing variability issues. Technologies such as solid-state batteries promise greater efficiency and capacity, further bolstering the feasibility of renewables.

Electric mobility, driven by improvements in electric vehicle (EV) battery ranges and charging infrastructure, is transforming the transport sector. The development of hydrogen technologies is also critical for decarbonising hard-to-electrify industries like steel and cement. However, innovation requires substantial investment in research and development, which varies widely across countries, influencing the pace of the energy transition globally.

Economic Structures

As demonstrated with the leaders and laggards presented above, a country's economic structure heavily influences its performance in the energy transition. Economies reliant on fossil fuels face challenges in shifting to renewables due to financial dependencies on coal, oil, or gas exports. Transitioning away from these resources often entails significant economic restructuring, job reallocation, and the development of alternative industries. Achieving energy transition success in fossil fuel-dependent economies requires just transition strategies.

A just energy transition (JET) refers to the process of shifting from fossil fuels to sustainable energy sources while ensuring fairness, equity, and inclusivity for all stakeholders, particularly workers, communities, and industries dependent on fossil fuel economies. The JET approach integrates environmental goals with social justice to create a sustainable and equitable energy future. It comprises four main pillars: (i) energy security and reliability, (ii) affordability and access to energy, (iii) economic diversification and job creation, and (iv) worker (social) protection and retraining[60],[61],[62],[63].

Geopolitical Stability

Geopolitical stability significantly impacts the energy transition. Regional conflicts can disrupt energy supply chains, delay infrastructure projects, and shift government focus away from renewables to immediate energy security concerns. For instance, the Russia-Ukraine war has highlighted Europe's dependency on Russian natural gas, leading to accelerated renewable energy adoption and diversification efforts. Global trade dynamics also affect the availability and cost of critical materials like lithium, cobalt, and rare earths, essential for batteries and renewable technologies. Countries with stable governance and international cooperation are better positioned to attract investments and develop supply chains for renewable energy. Conversely, nations in politically unstable regions often struggle to prioritise long-term energy transition goals.

Some nations like the UAE and Morocco are implementing ambitious frameworks to attract investments in renewables. Morocco's plan to generate 52% of its electricity from renewables by 2030 is a leading example. Some countries like Qatar and Saudi Arabia are pivoting towards renewable energy as part of broader economic diversification plans, in line with set Vision 2030.

Technological innovation has accelerated renewable energy projects, especially in solar power, with landmark projects like Morocco's Noor Ouarzazate complex and Dubai's Mohammed bin Rashid Solar Park. However, the region lags in battery storage and grid integration technologies, limiting the scalability of renewables.

Green hydrogen development is gaining momentum. Green hydrogen plays a pivotal role in the energy transition by serving as a versatile energy carrier that can decarbonise sectors where direct electrification is challenging. As a zero-carbon fuel when produced via renewable-powered electrolysis, green hydrogen offers a pathway to significantly reduce emissions in hard-to-abate industries, such as steel, cement, and chemicals, where battery electrification is impractical due to weight and range constraints.

Fossil fuel dependency remains a significant challenge for many MENA nations, which derive much of their government revenue from hydrocarbons. Oil-rich countries are investing in renewables to reduce domestic fossil fuel use, freeing up resources for export.

21 CONCLUSION

The global energy transition has achieved notable successes, including rapid growth in renewable energy capacity, significant cost reductions for solar and wind power, and advancements in energy storage technologies. Countries like Brazil, Denmark and Kenya have demonstrated leadership through ambitious policies and widespread renewable integration.

However, significant challenges remain. Many countries, especially those reliant on hydrocarbons, still face an uphill struggle in the diversification of their economies. Emerging markets face financial and infrastructural hurdles, while developed nations grapple with grid integration and intermittency issues for renewables.

Additionally, geopolitical tensions and supply chain dependencies on critical minerals for technologies like batteries hinder progress. Climate policies in some regions remain inconsistent or insufficiently ambitious to meet net-zero targets.

Addressing these shortcomings requires global collaboration, increased investment in clean technologies, and robust policy frameworks to drive equitable and sustainable energy transitions worldwide.

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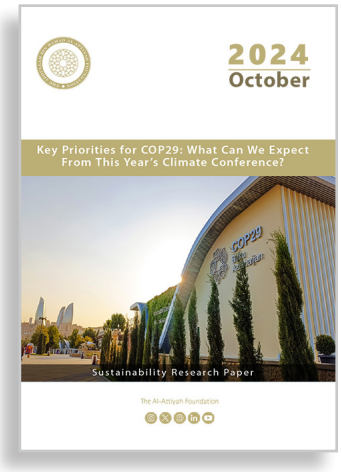
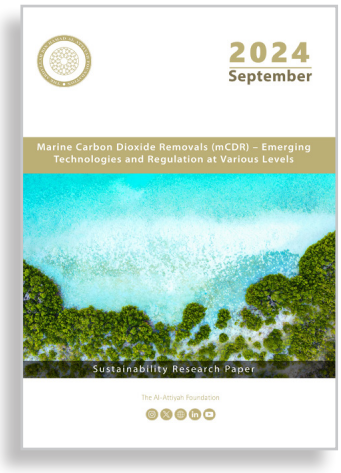


October – 2024

Key Priorities for COP29: What Can We Expect From This Year's Climate Conference?

Summer 2024 recorded the hottest temperatures ever, making it increasingly likely that this year will again break global temperature records. Such developments underscore the urgent need for decisive global action.

(QRCO.DE)



September – 2024

Marine Carbon Dioxide Removals (mCDR) – Emerging Technologies and Regulation at Various Levels

Alongside substantial and rapid emissions reductions, Carbon Dioxide Removal (CDR) is necessary to keep global warming to well below the 2°C temperature goal set by the Paris Agreement.

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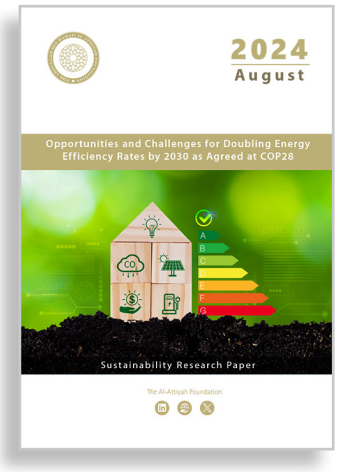

August – 2024

Opportunities and Challenges for Doubling Energy Efficiency Rates by 2030 as Agreed at COP28

Energy efficiency relates to the level of energy consumed for a given output. On macro-economic level, energy intensity is used as a proxy for energy efficiency, which is related to the overall economic output, such as the GDP.

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