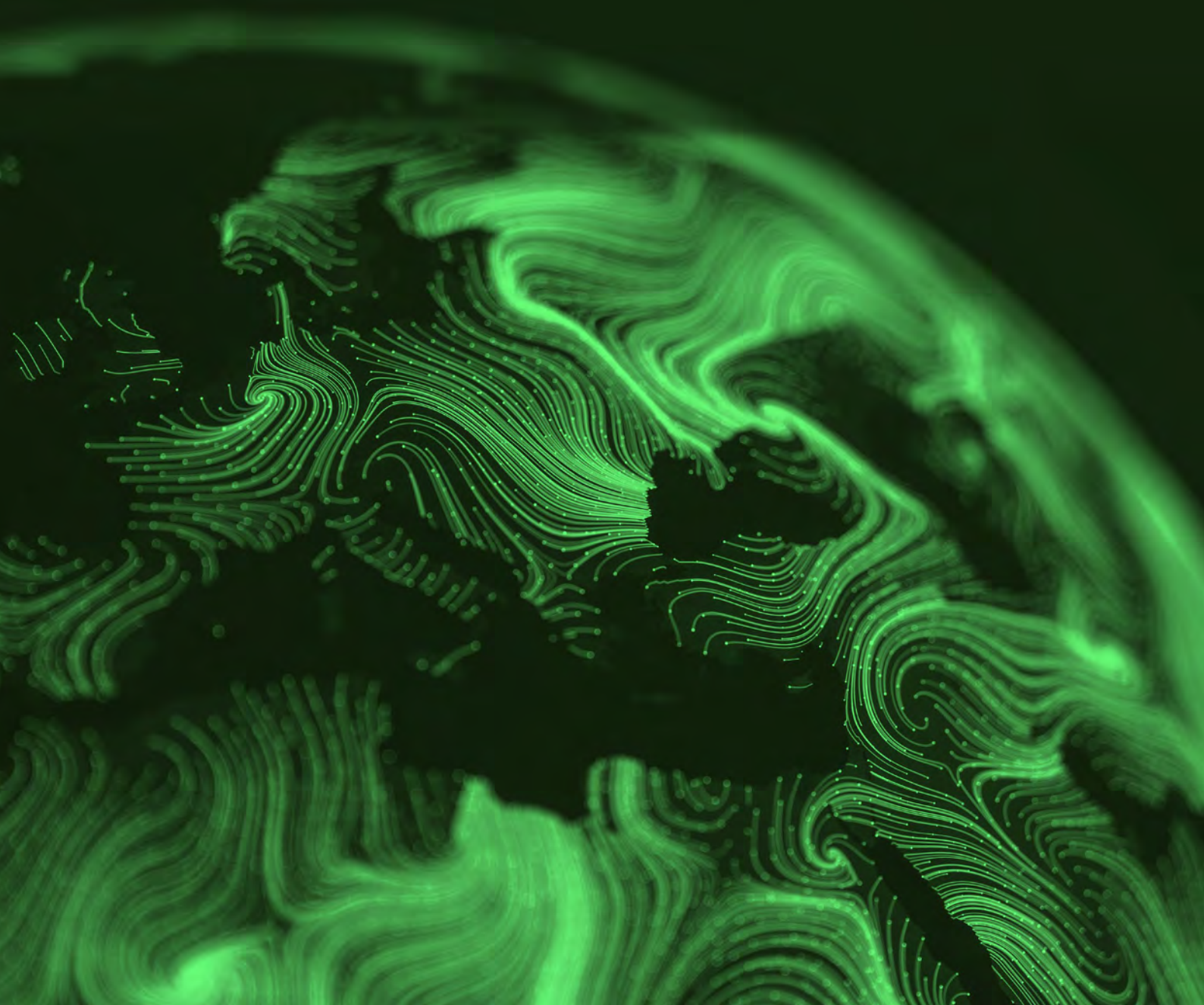
In collaboration with Accenture

WORLD ECONOMIC FORUM

Fostering Effective Energy Transition 2023 Edition

INSIGHT REPORT

JUNE 2023



Images: Getty Images

Contents

Disclaimer
This document is published by the World Economic Forum as a contribution to a project, insight area or interaction. The findings, interpretations and conclusions expressed herein are a result of a collaborative process facilitated and endorsed by the World Economic Forum but whose results do not necessarily represent the views of the World Economic Forum, nor the entirety of its Members, Partners or other stakeholders.

© 2023 World Economic Forum. All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, including photocopying and recording, or by any information storage and retrieval system.

Foreword

Muqsit Ashraf
Global Strategy Lead,
Accenture

Roberto Bocca
Head, Centre for Energy
and Materials; Member of
the Executive Committee,
World Economic Forum

The transformation of the global energy system is well under way. In just over a decade, investments across multiple forms of renewable energy have overtaken investments in fossil fuels. Energy and climate policies now take centre stage in domestic and international affairs. The geopolitical balance of energy has shifted significantly, and new superpowers have emerged in renewable energy component manufacturing, critical minerals and clean technology. The frontiers of energy innovation have been progressively redefined, and thousands of entrepreneurs are working to remake this huge industry. Enabled by mounting scientific evidence, a steady rhythm of extreme weather events and decades of awareness campaigns, climate consciousness is embedded in the public psyche. The Energy Transition Index (ETI) has supported decision-makers through this period, with a robust, consistent and comprehensive framework and a transparent fact base.

Despite the strong momentum, the energy transition has been challenged by near-term exigencies. Following the COVID-19 pandemic, a combination of economic factors and supply chain constraints led to affordability challenges, shortages and blackouts in different parts of the world. The recent energy crisis, a result of the Russia-Ukraine war, is the most severe in decades, leading to the highest levels of inflation in decades, a cost-of-living crisis and macroeconomic instabilities. While investments and policy measures for energy transition have amplified despite the volatile environment, the delicate balance of the energy security architecture, and the adverse effects on vulnerable households and developing countries, demonstrate the importance of balancing the imperatives of security, equity and sustainability for an effective energy transition.

Considering today's context, we have updated the ETI framework to ensure its usefulness for decision-making. The revisions include the improved delineation of inclusiveness and equity, the reprioritization of energy security, the sharpening of the enabling environment scope, and the articulation of transition momentum to complement energy system performance and transition readiness to provide an in-depth view of how fast or slow a country is transitioning, beyond the snapshot values.

The actions taken in the early years of this decade of delivery will be critical in ensuring that strong, long-term ambition is supported by immediate progress. The focus needs to be on enhancing an equitable transition which has been traded off rather than enabled by the focus on security and sustainability. The energy transition must be made resilient to maintain speed under current volatilities and during potential future domestic or international disruptions. Resilience needs to be built into the transition to maintain progress throughout ongoing and future disruptions as COVID-19 and the energy crisis will not be the only international events in the coming decade and beyond.

Through this effort, the World Economic Forum encourages the sharing of best practices and the use of its platform for effective public-private collaboration to facilitate the energy transition process around the world.

Executive summary

Even as the global energy transition is plateauing due to equity challenges, major economies are showing significant progress.

The frontiers of the global energy transition are constantly shifting as countries attempt to emerge out of various health, geopolitical and economic crises. The "polycrisis" has forced countries to reallocate resources and implement measures to address near-term energy security and affordability constraints. It has also provided an opportunity to think about how various aspects of the "energy triangle" have evolved. Equity and inclusiveness evolved from focusing only on access to embracing sustained economic development. Security took a leap from ensuring supplies towards diversifying the energy mix. And sustainability now includes a wider form of clean energy beyond decarbonization, whereas transition readiness demands more focus on regulatory and financial environments. Considering the changing needs of the energy frontier, the Energy Transition Index (ETI) framework has been revised this year to incorporate a wider approach of balancing the three imperatives of the energy triangle – equity, security and sustainability – while harnessing transition enablers effectively.

The ETI benchmarks countries on their current energy system performance and provides a forward-looking measure of transition readiness. Over the past decade, the global ETI scores improved by 10%, supported by an increase of 19% in transition readiness scores, but only a 6% increase in system performance scores. The Nordic countries (**Sweden, Denmark, Norway** and **Finland**) continue to maintain their top rankings, scoring highly on both system performance and transition readiness. A few countries, such as **Kenya** and **Azerbaijan**, jumped significantly in rank this year for making aggressive efforts towards transition readiness by improving their regulatory environment and infrastructure. Importantly, in the last decade, the world's largest energy consumer, **China**, gained 43% – approximately double the global average – in its transition readiness scores, making its way into the top 20 as the only Asian country. This report spotlights certain countries accomplishing noticeable achievements or laying the groundwork for a robust energy transition (see section 6).

This edition of the report refocuses on the need for urgent action towards the transition. Despite making progress on decarbonization and improving on infrastructure, the world still falls short of achieving balanced progress on all aspects of the energy triangle. Thus, "transition momentum" has been incorporated as a measure to determine country progress on the system performance parameters. Only two countries – **India** and **Singapore** – are making advances on all aspects of energy system performance.

The window of opportunity for the energy transition is closing fast. The limited number of countries simultaneously advancing across all aspects of the energy triangle highlights the challenges that countries face in progressing along their energy transition pathways. The following themes emerge from analysing the drivers of past progress that can highlight the path for an accelerated transition:

The current energy transition trajectory puts equity under pressure.

The global average ETI score has increased each consecutive year over the last decade, but the growth has plateaued in the past three years, due to rising challenges to the equity and inclusiveness of the transition. Energy market volatilities resulting from macroeconomic and geopolitical developments over the past three years have led to extreme price shocks, exacerbating energy poverty and stalling energy access. High fuel prices have affected the cost-competitiveness of energy intensive industries, and the rising subsidy burden poses a risk to economic growth. Low-income countries have been disproportionately affected, facing simultaneous challenges from fuel price inflation, food inflation and rising debt burden. While performance on environmental sustainability has grown the fastest and countries are prioritizing energy security after lessons from the energy crisis, inclusiveness and equity considerations need to be addressed for a robust and resilient transition.

The centre of gravity for energy transition is shifting towards emerging and developing economies.

With increasing populations and economic growth in developing countries, particularly China and India, the global demand for energy remains unfazed. Short-term effects from the energy crisis notwithstanding, all emerging economies show consistent improvement on transition readiness, performing better than the global averages over a longer-term horizon. The improvements in the growth of clean jobs, infrastructure development (including the addition of renewables capacity) and political commitments have been significant.

An opportunity also lies in the cost effectiveness of implementing clean solutions in emerging economies, as the average cost of reducing emissions in these economies is estimated to be approximately half of that in advanced economies. All of this, however, must be accompanied by improving the energy intensity of the economy, while reducing the carbon intensity of the energy mix. Further, directing investments towards developing economies can help them boost acceleration.

No one-size-fits-all dimensions exist for all countries.

The countries performing strongly on the equitable dimension have been able to manage affordability concerns due to less reliance on energy imports and cost reflective energy pricing. **Oman, Canada, United States** and **Sweden** are top scorers on this dimension. Chronic energy access challenges are reflected in the low scores of **Democratic Republic of Congo, Zambia, Tanzania** and **Senegal** on this dimension. The top scorers in the secure dimension are mainly advanced economies, such as **United States, Australia** and **Estonia**, followed by **Malaysia**, a developing country. All these countries have a highly diversified energy mix, minimal dependence on fuel imports and minimal interruptions in energy supply. The countries scoring the lowest are **Lebanon, Jamaica** and **Dominican Republic**, mainly because of challenges on the diversity of the energy mix, the need for energy imports and electricity losses. Latin America leads the chart on the sustainable dimension with **Costa Rica, Paraguay** and **Uruguay**, on account of abundant hydroelectric potential. Fossil fuel exporting countries **Bahrain, Kuwait, Oman** and **Qatar** score the lowest on this dimension, attributed to high energy and carbon intensities and a very low share of clean energy in the mix. These results infer that, irrespective of economic development, countries can harness different available resources to successfully transition on various aspects of the energy triangle.

Renewable energy deployment has grown exponentially, though innovation in next-generation energy technologies is necessary.

Despite the fastest growth among the three dimensions of the energy triangle, the global average score on the sustainable dimension lags the scores of the equitable and secure dimensions on an absolute scale throughout the past decade. The silver lining, however, came in 2022 with investments in renewables reaching a record high of $1.3 trillion, a 19% increase from 2021 investment levels and a 70% increase from pre-pandemic levels in 2019. Around the globe, countries have added to their renewable capacities. One reason for this is the wide availability and maturity of renewable technologies. To increase the supply of clean energy and its associated technologies, the innovation landscape of clean energy solutions must be boosted, including alternative fuels, hydrogen, and carbon capture and sequestration.

Policies are paving the way for a progressive transition, and diligence with implementation would shape up the transition trajectory.

With updated country commitments, global greenhouse gas emissions coverage increased from 69% to 77%. A combination of recent policies, such as the US Inflation Reduction Act, Japan's Green Transformation programme, the European Union's Carbon Border Adjustment Mechanism, and evolving mandatory and voluntary carbon markets, are accelerating clean energy supply and technology scalability, and promoting demand efficiency while allowing for transition-oriented economic growth. The transition trajectory hinges on the quality of implementing these policies to stimulate investments in enabling the transition infrastructure, while avoiding unintended consequences on energy equity and global trade. Increasing financing for a low-carbon energy system requires concerted efforts from governments, emphasizing a strong policy and price to ensure green investments offer an attractive risk-adjusted return.

1 Introduction

Recent crises have left countries continually struggling to balance energy security, equity and sustainability.

> The crisis has also shown that, under pressure and led by strong policy measures, faster energy system changes are possible.

The energy transition is at a critical inflection point amid a series of shocks with compounding effects (Figure 1).

Energy supplies and infrastructure have been heavily weaponized during the Russia-Ukraine war, exposing the vulnerabilities of the energy security architecture. Countries with otherwise mature energy infrastructure and sophisticated supply chains were forced to resort to emergency measures to ensure adequate energy supply. Following the disruption of pipeline gas supply from Russia, a combination of strong policy measures, alternative fuel supply agreements, accelerated liquefied natural gas (LNG) infrastructure development, demand management and curtailment, regional collaboration on the use of storage reserves, and a milder than expected winter have helped Europe avoid energy shortages.

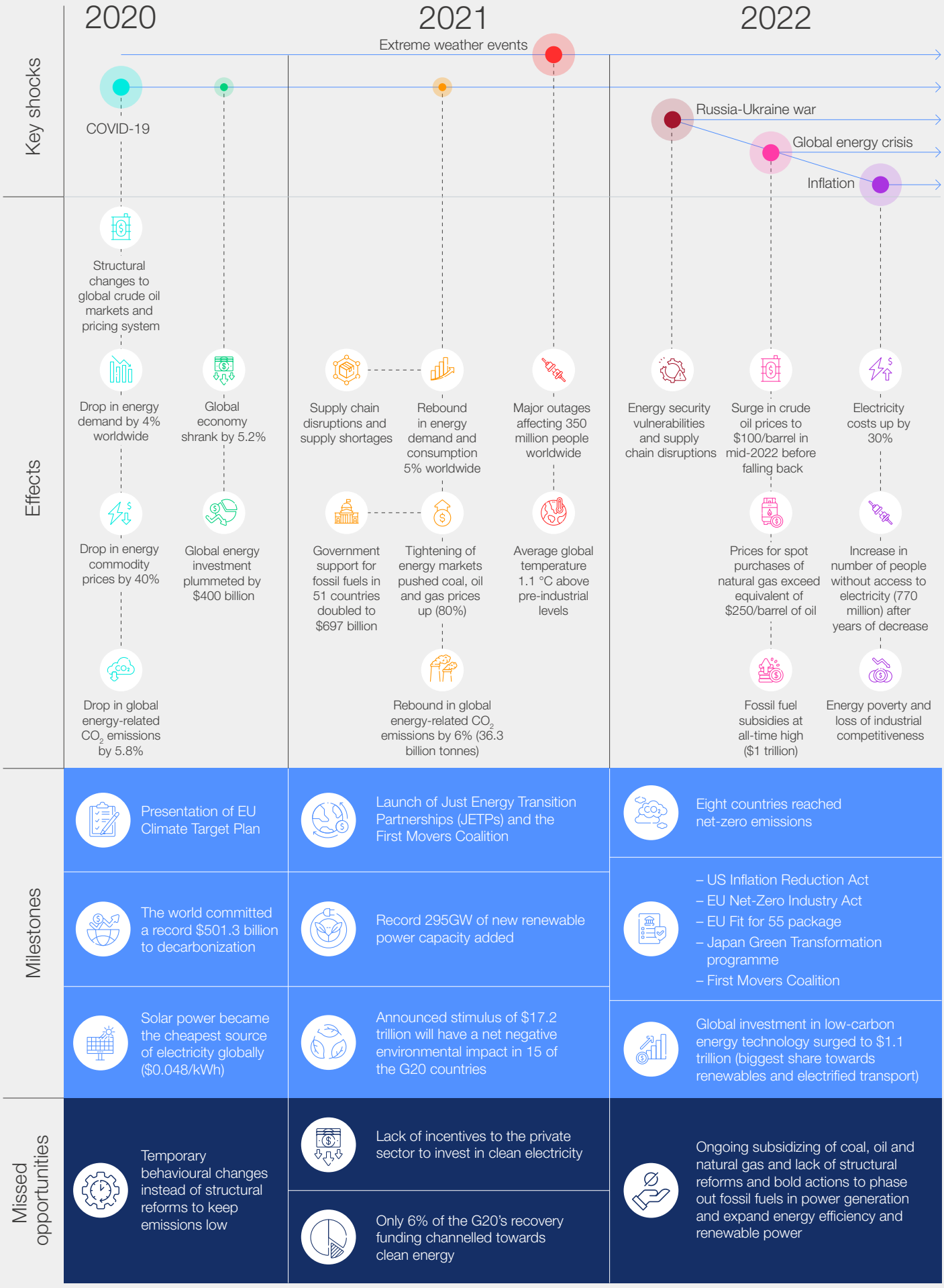
Simultaneously, a concentrated fuel mix, reliance on few trade partners and underinvestment in energy systems emerged as important risk factors. As a result, oil and gas flows may have been permanently redirected, leading to the most significant rebalancing of the energy geopolitical landscape since the 1970s. Gas market volatilities spilled over to electricity markets, prompting considerations for electricity market reforms. Competition for scarce LNG cargoes globally led to some emerging economies being priced out, resulting in blackouts in Pakistan and Bangladesh. The recent energy crisis is the first with a global scope due to interconnected energy supply chains and calls for comprehensive rethinking of energy security strategy in the face of the emerging risks landscape. The crisis has also shown that, under pressure and led by strong policy measures, faster energy system changes are possible, as seen with Europe's diminished dependence on Russian gas.

The global energy crisis also highlighted multiple dimensions of the inclusiveness of the energy transition. The unprecedented surge in energy prices severely affected affordability, with poor households that spend a larger portion of their income on energy affected the most. High energy prices sparked food inflation, leading to a cost-of-living crisis in many countries. Energy market volatilities also affected the competitiveness of energy-intensive industries in some regions. Increasingly, firms are seeking to shift operations to markets with cheaper and more reliable energy, raising concerns over employment in local communities. The fiscal response to mitigate the effects of the energy crisis on consumers and businesses imposed a heavy financial burden on governments, with estimates of fossil fuel subsidies in excess of $1 trillion in 2022.[1] Emerging economies, already dealing with price shocks, are under an increasing debt burden due to monetary policy responses to control inflation. This exacerbates the challenge of attracting low-cost capital on a large scale to finance the energy transition in emerging economies. Just Energy Transition Partnerships (JETPs) have emerged as novel bilateral arrangements to support coal-dependent emerging economies in accelerating the phase-out of fossil fuels while addressing social impacts.

The march of sustainable energy has kept pace through this period of extreme volatility. Last year, for the first time, investments in low-carbon energy technologies surpassed a record $1 trillion.[2] Bilateral finance flows and early-stage financing continued to grow, and global climate tech venture capital funding totalled $82 billion.[3] In response to the energy crisis, landmark legislations were put forward, including the US Inflation Reduction Act, which was passed, and the proposed EU Net-Zero Industry Act to ramp up clean energy, drive innovation and set the scene for accelerated decarbonization. The electric vehicle market saw record growth as unit sales surpassed 10 million in 2022 and 14% of new cars sold were electric.[4] More companies are committing to net zero. As of June 2022, 702 of the world's largest firms had set net-zero targets[5] though credibility gaps remain, leading to increasing scrutiny on the validity of targets and accountability of implementation. Post-pandemic recovery of energy demand and the energy crisis may have led to a rebound in coal, with the slowest rate of coal plant closures in eight years.[6] The latest Intergovernmental Panel on Climate Change report warns that emissions need to be cut by almost half by 2030 to limit warming to 1.5°C.[7]

In light of these developments, it is now more important than ever for countries to further accelerate their energy transition in a way that balances and delivers on the need for an equitable, sustainable and secure energy system, ensuring that it is right for the present and future. Policies will be at the core of shaping a balanced energy transition by encouraging investments in clean energy, promoting innovation, encouraging energy efficiency and ensuring that the transition benefits all segments of society.

FIGURE 1 | **Volatile period in the energy transition, 2020-2022**



Source: World Economic Forum

2 Framework

The ETI 2023 features a revised framework for effective decision-making in the evolving global energy landscape.

“ Energy transition readiness is increasingly shaping countries’ competitiveness strategy, as they incubate nascent industries to support future economic growth.

The ETI provides a data-driven framework to measure and understand the performance of energy systems and readiness for energy transition across countries focusing on the transition. Given the emerging landscape and its potential implications for energy transition decision-making, the ETI framework (Figure 2) has been updated to ensure relevance and usefulness for making decisions. While the energy triangle remains valid – with a balanced approach towards the three priorities of equity, security and sustainability – the updated ETI framework identifies specific components of these dimensions.

The **equitable** dimension of the energy triangle is rooted in several aspects. It aims to ensure affordable access to modern and clean forms of energy for all. It focuses on providing continuity of economic activities through competitive energy prices. It also emphasizes maintaining cost-reflective energy pricing while implementing mechanisms to protect vulnerable consumers and small businesses. In addition, it leverages the green growth momentum to create shared prosperity.

Lessons from the recent energy crisis are reflected in the definition of the **secure** dimension. Supply security through diversification remains important across three levers of diversification – in the energy mix, in their energy trade partners and in the sources of electricity generation. Resilience, both in gas supplies and the power system, is instrumental for energy security. In addition, as the number and range of power generation and management assets increase as a result of decentralization, reliability of grids becomes critical. Future iterations can include other sources of resilience, such as secure supply of critical minerals, different forms of energy storage, grid interconnections and demand response upon availability of robust, timely and consistent data.

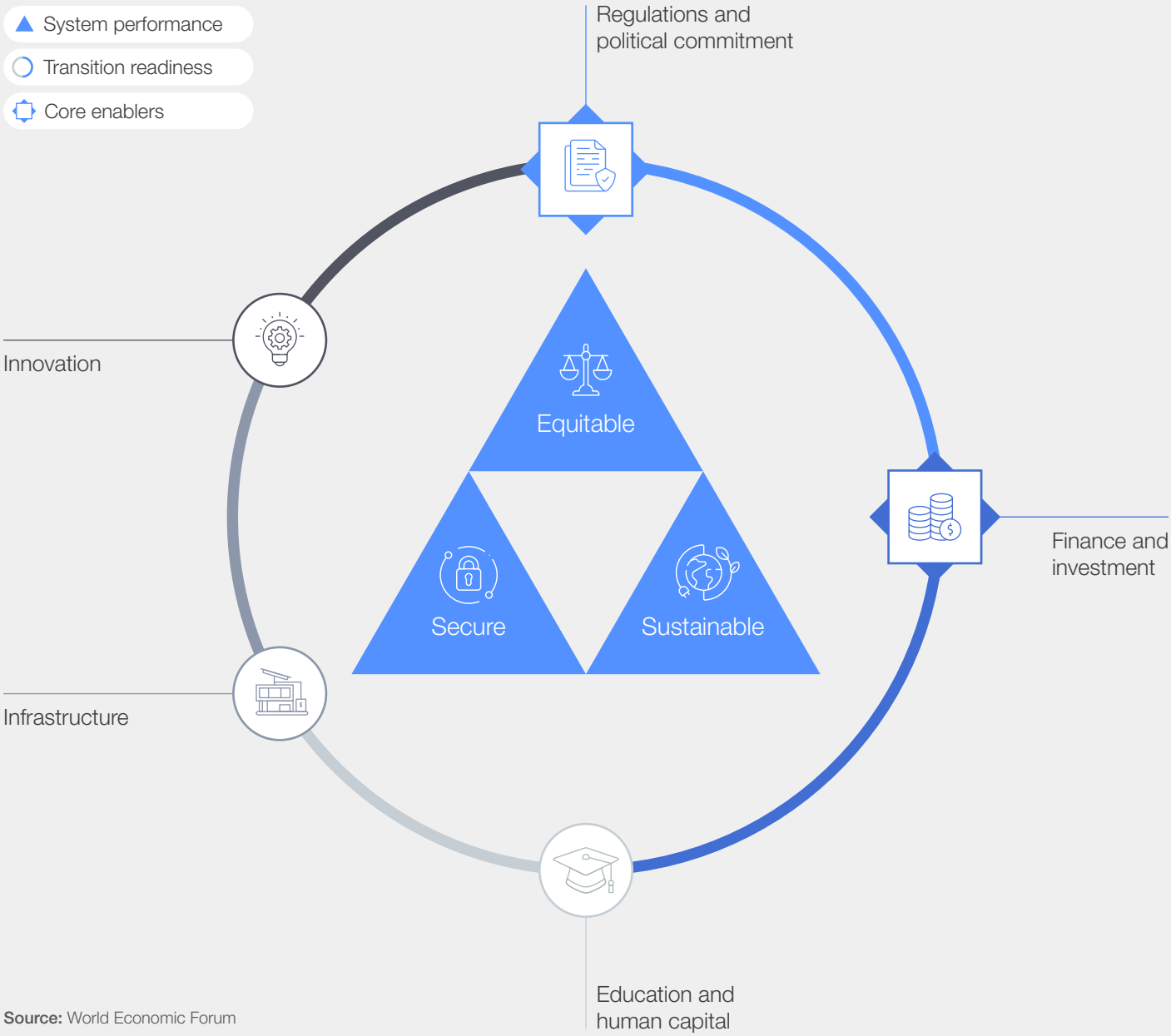
Demand- and supply-side metrics constitute the **sustainable** dimension. Supply-side sustainability requires the reduction of CO_2 and methane intensity of energy supply. In addition to supply-side measures, efforts to reduce the energy intensity of the economy (the quantity of energy required per unit of output or product – a basic measure of energy efficiency), to encourage responsible consumption through lower energy and emissions footprint per capita, and to increase the share of clean energy in final demand, are essential.

The progress on energy transition is determined by the extent to which a robust enabling environment can be created. A robust regulatory framework and ability to attract and deploy capital on a large scale remain the core components of an enabling environment. In addition to a comprehensive policy framework for renewable energy, energy efficiency and energy access, regulatory frameworks need to be aligned with a robust, ambitious and credible roadmap to net zero, supported by efficient pricing of carbon. An investment climate characterized by low cost of capital, liquidity in domestic markets and attractiveness to foreign direct investment is a strong enabler for mobilizing increasing levels of capital for the energy transition. Additionally, advanced economies need to meet the commitment of mobilizing $100 billion of climate finance annually to developing countries. Energy transition readiness is increasingly shaping countries’ competitiveness strategy, as they incubate nascent industries to support future economic growth. Factors such as a skilled workforce, innovation, and physical and digital infrastructure are essential, which are explicitly acknowledged as part of the revised ETI framework.

Momentum

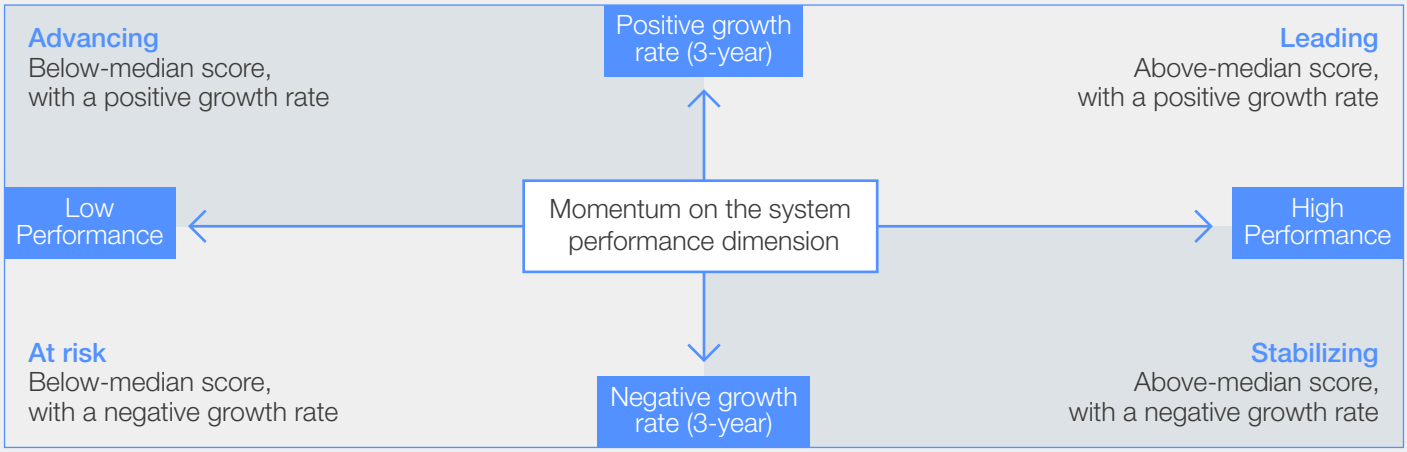
In addition to improving system performance through a balanced energy triangle and creating a robust enabling environment, consistent progress is essential for a timely and effective transition. This report proposes “momentum” as such a measure for energy transition to provide countries with an additional layer of benchmarking with peer economies. The ideation of momentum considers different starting points, country-specific circumstances and energy system structures, and focuses on the short-term historical growth rate of the equitable, secure and sustainable dimensions of the energy system.

FIGURE 2 | **Energy Transition Index update – performance and readiness**



Source: World Economic Forum

FIGURE 3 | **Transition momentum**



Source: World Economic Forum

3 Overall results

A majority of countries show progress, with developing nations taking centre stage in a shifting global landscape.

Key highlights

1

Global average ETI scores increased by 10% since 2014, but showed only marginal growth in the past three years.

2

Only 18% of countries in 2023 have balanced the imperatives of the energy triangle.*

3

Equity was compromised as the transition centred on secure and sustainable.

4

The top 10 countries account for only 2% of global CO_2 emissions from fuel combustion and 4% of total energy supply.

5

Only 41 countries have made steady progress in the past decade.

* Balanced is defined as when the spread between the equitable, secure and sustainable scores is less than 8.5 points.

TABLE 1 | **ETI 2023 ranking table**

Rank	Country	ETI score (2014–2023)	2023 ETI score	SP[1] ('23)	TR[2] ('23)
1	Sweden		78.5	81.0	74.8
2	Denmark		76.1	73.7	79.8
3	Norway		73.7	77.3	68.3
4	Finland		72.8	68.9	78.6
5	Switzerland		72.4	75.7	67.4
6	Iceland		70.6	73.9	65.6
7	France		70.6	73.3	66.5
8	Austria		69.3	69.2	69.5
9	Netherlands		68.8	65.7	73.5
10	Estonia		68.2	74.2	59.2
11	Germany		67.5	64.6	71.9
12	United States		66.3	68.4	63.2
13	United Kingdom		66.2	67.7	64.0
14	Brazil		65.9	68.9	61.3
15	Portugal		65.8	66.7	64.5
16	Spain		65.0	65.1	64.7
17	China		64.9	65.0	64.8
18	Hungary		64.3	68.8	57.5
19	Canada		64.2	66.7	60.3
20	Luxembourg		64.2	61.5	68.2
21	Albania		63.7	71.6	51.8
22	New Zealand		63.7	68.2	56.9
23	Uruguay		63.6	71.5	51.8
24	Australia		63.6	63.1	64.3
25	Costa Rica		63.5	74.5	46.9
26	Latvia		63.4	69.0	55.1
27	Japan		63.3	63.7	62.9
28	Israel		62.7	67.3	55.7
29	Slovenia		62.6	68.0	54.4
30	Chile		62.5	63.4	61.3
31	Korea, Rep.		62.3	60.3	65.3
32	Azerbaijan		62.0	69.6	50.7
33	Croatia		62.0	67.0	54.4
34	Paraguay		61.9	72.9	45.3
35	Malaysia		61.7	70.0	49.3
36	Lithuania		61.2	62.0	60.1
37	Greece		60.9	60.3	61.7
38	Italy		60.6	63.9	55.6
39	Colombia		60.5	65.6	53.0
40	Poland		59.7	63.0	54.7
41	Ireland		59.3	61.3	56.3
42	Belgium		59.2	59.6	58.5
43	Viet Nam		58.9	60.3	56.9
44	Slovak Republic		58.8	64.9	49.7
45	Czech Republic		58.6	66.2	47.2
46	Kenya		57.8	65.9	45.6
47	El Salvador		57.3	72.2	35.1
48	Bulgaria		57.2	62.8	48.9
49	Romania		56.8	65.8	43.3
50	Bosnia and Herzegovina		56.7	60.3	51.4
51	Panama		56.4	66.2	41.7
52	Cyprus		56.4	61.7	48.4
53	Peru		56.4	70.7	34.9
54	Thailand		55.9	62.3	46.2
55	Indonesia		55.8	67.3	38.6
56	Morocco		55.6	60.7	48.1
57	Saudi Arabia		55.3	62.0	45.3
58	Namibia		55.1	63.3	42.7
59	Qatar		55.0	58.2	50.2
60	Mauritius		55.0	65.4	39.4
61	Malta		54.9	61.5	45.1
62	Georgia		54.8	64.0	41.0
63	United Arab Emirates		54.6	58.7	48.3
64	Ukraine		54.5	63.2	41.5
65	Turkey		54.3	58.9	47.4
66	Sri Lanka		54.3	63.5	40.6
67	India		54.3	61.4	43.6
68	Mexico		54.1	64.9	37.8
69	Montenegro		54.0	62.4	41.5
70	Singapore		53.7	51.2	57.6
71	Jordan		53.7	58.4	46.7
72	Armenia		53.6	60.0	44.1
73	Tajikistan		53.6	66.4	34.4
74	Bolivia		53.5	66.0	34.7
75	Cote d'Ivoire		53.1	64.0	36.9
76	Kazakhstan		53.0	61.1	40.9
77	Serbia		52.9	61.1	40.5
78	Ecuador		52.8	67.8	30.2
79	Egypt, Arab Rep.		52.4	62.5	37.2
80	Macedonia, FYR		52.3	61.4	38.7
81	Cameroon		52.2	65.4	32.4
82	South Africa		52.2	56.6	45.5
83	Lao PDR		52.1	59.2	41.6
84	Cambodia		52.1	59.9	40.4
85	Argentina		52.0	63.1	35.5
86	Algeria		51.9	64.8	32.6
87	Guatemala		51.9	65.2	32.0
88	Ghana		51.5	63.1	34.1
89	Tunisia		51.4	58.1	41.5
90	Oman		51.3	58.6	40.3
91	Kyrgyz Republic		50.6	61.7	34.1
92	Iran, Islamic Rep.		50.4	61.6	33.6
93	Dominican Republic		50.3	55.4	42.7
94	Philippines		50.2	61.5	33.2
95	Ethiopia		49.8	61.1	32.7
96	Gabon		49.5	64.7	26.8
97	Nepal		49.2	58.2	35.7
98	Trinidad and Tobago		48.3	56.8	35.7
99	Angola		48.1	64.0	24.4
100	Honduras		48.0	59.6	30.5
101	Republic of Moldova		47.8	55.7	36.1
102	Kuwait		47.8	51.3	42.5
103	Venezuela		47.7	64.3	22.7
104	Senegal		47.6	53.8	38.3
105	Brunei Darussalam		47.3	55.0	35.7
106	Botswana		46.9	54.9	34.9
107	Pakistan		46.9	55.2	34.5
108	Nigeria		46.0	58.4	27.5
109	Mozambique		46.0	58.1	27.8
110	Bahrain		45.7	52.0	36.3
111	Mongolia		45.4	56.3	29.0
112	Lebanon		45.2	50.1	37.9
113	Bangladesh		45.0	56.8	27.3
114	Nicaragua		44.9	57.1	26.6
115	Jamaica		44.9	50.4	36.5
116	Zimbabwe		44.7	50.7	35.7
117	Zambia		44.3	56.7	25.8
118	Tanzania		42.9	51.4	30.1
119	Congo, Dem. Rep.		42.3	54.3	24.3
120	Yemen, Rep.		40.0	56.3	15.5

- Emerging and developing Europe
- Middle East, North Africa and Pakistan
- Sub-Saharan Africa
- Latin America and the Caribbean
- Commonwealth of Independent States
- Advanced economies
- Emerging and developing Asia

ETI Score 2014 — 2023

---- 2023 Global Average (56.3%)

1 System performance 2023; **2** Transition readiness 2023 **Note:** The average score for 2023 is 56.3.
Source: World Economic Forum

3.1 Transition scores

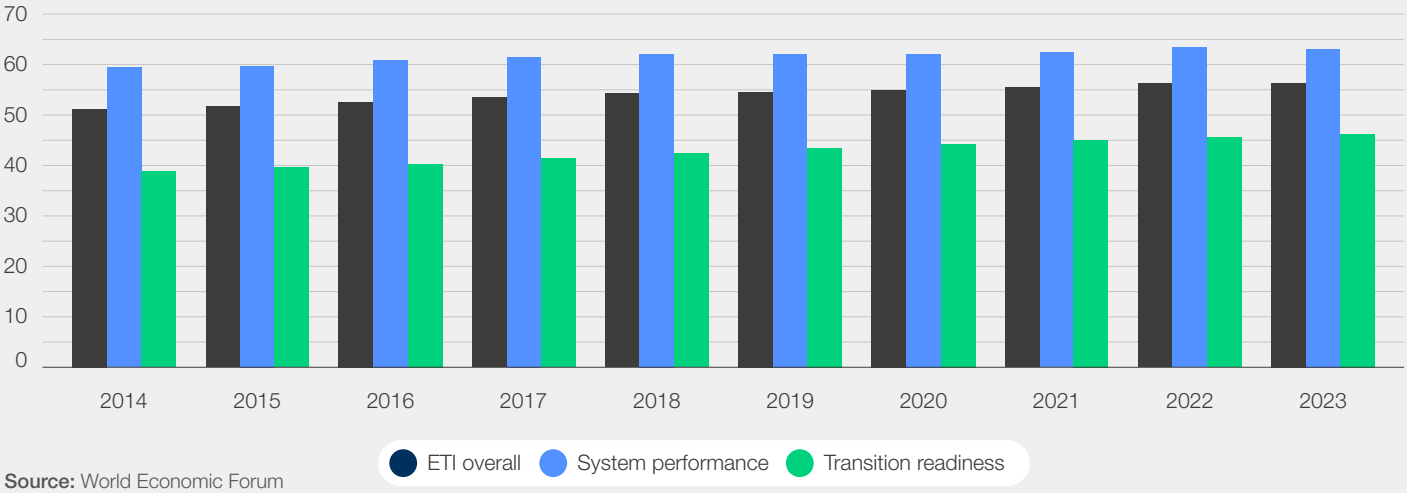
All countries ranked in the top 10 are from Western and Northern Europe, and account for 2% of energy-related CO_2 emissions, 4% of total energy supply and 2% of the global population. **Sweden** leads the global rankings, followed by **Denmark** and **Norway**. Among the world's 10 largest economies, only **France** features in the top 10. The list of top performers in the ETI has remained broadly unchanged over the course of the past decade. Although each country's energy transition pathway is different, they all share common attributes, including:

- Reduced levels of energy subsidies
- Enhanced energy security from a diverse energy and electricity mix, as well as a mix of import partners
- Improved carbon intensity
- Increased share of clean energy in the fuel mix
- A carbon pricing scheme
- A strong and supportive regulatory environment to drive the energy transition

High-ranking countries also show high scores on transition readiness because of their strong institutional and regulatory frameworks, their ability to attract capital and investment on a large scale, their innovative business environment and their high level of political commitment on energy transition. Both China and Brazil feature in the top 20, a result of their performance thus far and readiness to continue to transition.

The global average scores for the ETI have increased successively each year from 2014 to 2023, the result of gains across both system performance and transition readiness (Figure 4).

FIGURE 4 **Global average Energy Transition Index and sub-index scores, 2014-2023**



Source: World Economic Forum

Certain large emerging centres of demand, such as China, India and Indonesia, have improved their scores by more than 10 percentage points.

Of the 120 countries, 113 have made progress over the last decade but only 55 have improved their scores by more than 10 percentage points. Notably, large emerging centres of demand, such as **China, India** and **Indonesia**, have seen these improvements. Only 41 countries have made steady gains over the last decade (defined as consistently above-average performance improvements on the ETI). While this list includes many advanced economies, it also has 14 countries from developing and emerging Europe, developing and emerging Asia, and Latin America and the Caribbean. **Qatar** and **Mexico** narrowly miss falling into the category; they made steady gains until 2023 when their progress fell below the average. These insights demonstrate the difficulty of maintaining progress and the energy transition's inherent complexity.

The top improvers between 2022 and 2023 are **Azerbaijan** and **Kenya**. Kenya has typically progressed behind the global average while Azerbaijan has been ahead of it. Both have shown large improvements across several transition readiness parameters, including financial investment, infrastructure and innovation. Joining them among the top improvers is **Paraguay**, which has made progress every year for a decade, and **Zimbabwe**, whose score grew by 9% but continues to lag the global average. Importantly, as countries advance, they should achieve a balanced energy system, but only 18% of them have achieved this balance, leaving those without it vulnerable to risks related to energy security, inequality and the consequences of climate change.

GUEST PERSPECTIVE

Business is backing the accelerated energy transition

By Ana Botín, Group Executive Chair, Banco Santander;
Chair, World Economic Forum International Business Council

Recent experiences underline how crucial a secure, affordable and sustainable energy system is to economic growth, and an orderly and equitable transition. Look at the impact that rising energy prices have had on stoking inflation, which has hit low-income families and small and medium-sized enterprises (SMEs) the hardest. This underscores the need for the energy transition, which the World Economic Forum supports, to tackle the trilemma: how do we get energy that is low carbon, affordable and reliable, underpinning the growth needed to finance the transition.

The Forum's International Business Council (IBC) has launched a project that can harness its members combined economic impact – 130 companies representing roughly 3% of global energy demand – to accelerate the energy transition. This project is not only a challenge, requiring collaborative action across sectors, industries and borders, but also an opportunity to foster growth and influence the way our economies and societies can provide safer, fairer and more sustainable outcomes.

Much of the focus has, understandably, been on energy supply. However, according to the International Energy Agency's Net Zero by 2050 pathway, to meet the Paris Agreement's emissions goals by 2050, the world will need to consume 8% less energy than it does today. At the same time, the world's economies will need to grow in a sustainable manner to provide for 2 billion more people. This means that energy consumption as a portion of economic output as well as the carbon intensity of the energy individuals consume will have to decline – that is, people will have to be smarter and more efficient in their energy use.

IBC members have decided to focus on the demand side of energy transition. Managing and reducing the energy intensity of demand is an area where our companies, as leaders in their sectors and as stakeholders in their home countries, can foster more efficient use of energy and promote policies and practices that can lead to success. The aim is to do this in a way that complements, rather than duplicates, other similar initiatives, within and outside the Forum's ecosystem.

First, supported by our knowledge partner PwC, the IBC will create a common vision for demand-side energy transition, with an eye towards reducing energy consumption as a portion of GDP and carbon-intensity within that equation. A key part will be how we support emerging and developing countries to do this. We will survey IBC members to help identify best practices, priorities and existing plans and targets, as well as obstacles, which we will use as a baseline for action. Second, we will engage governments and multilaterals to advocate for the policies needed to remove obstacles and promote demand-side energy transition, while also exploring opportunities to contribute to sectoral transition frameworks.

IBC members, who are global leaders in their respective industries and regions, are uniquely placed to help accelerate the energy transition by catalysing company, sector and country-level action. The community has an opportunity to leverage its collective influence and convening power to accelerate a low-carbon, secure and just transition of the global energy system by bringing together the private sector, governments and international organizations.

We know the limits of a one-size-fits all approach but are also convinced we can share solutions and efficiencies that can be adapted to have impact. We will not forget the importance of SMEs and developing countries in this regard. We will not only seek ways to support and incentivize them, but also to unlock equity financing for the transition. All IBC members are affected by the energy transition, and are relevant in influencing it, both as energy consumers and producers.

Banks, too, must play a role. Financing the energy transition is, and will continue to be, one of the major challenges, and opportunities, for financial institutions. This is especially true in Europe, where 70% of business finance comes from banks.

The task is daunting, but the goal is attainable if we work together. Through collaboration within the business community, the public and private sectors and relevant global bodies, we can build an energy system that is low carbon, affordable and reliable.

Key highlights

1

Only 2 out of 120 countries are accelerating across the equitable, secure and sustainable dimensions.

2

20% of the world is manifesting slowing (retracting) progress on energy equity.

3

Countries accounting for over 90% of the world's emissions are prioritizing sustainability.

3.2 Transition momentum

Momentum is not equal across dimensions and countries are prioritizing sustainability for balanced economic growth, social well-being and natural resource preservation.

The ETI scores measure a country's current energy system, but not how fast they are transitioning. Momentum shows who is transitioning the fastest and which countries are at risk. No globally defined percentage exists that defines the progress of the energy transition. The transition's pace will depend on a variety of factors, including the specific context of each country or region, the availability of resources and technology, the level of political will and public support and the urgency of the climate crisis. What is known, however, is that the energy transition needs to accelerate to limit the effects of climate change.

Figures 5A-C show the distribution of countries across four quadrants for each system performance dimension, depending on the current score and the three-year growth rate of the dimension score between 2020 and 2023. As a result, countries' near-term focus areas are visible as positive contributions to momentum. The figures assign each country to one of four quadrants:

- **Leading countries** – with above-median dimension scores and positive growth rates
- **Stabilizing countries** – with above-median dimension scores but negative growth rates
- **Advancing countries** – with below-median dimension scores and positive growth rates
- **At-risk countries** – with below-median dimension scores and negative growth rates

Only 2 out of 120 countries – **India** and **Singapore** – are advancing across the equitable, secure and sustainable dimensions, each with its own unique transition journey. The limited number of countries managing simultaneous advance on all elements of the energy triangle highlights the challenges many countries face with balancing efforts and required, focused investments and policy changes.

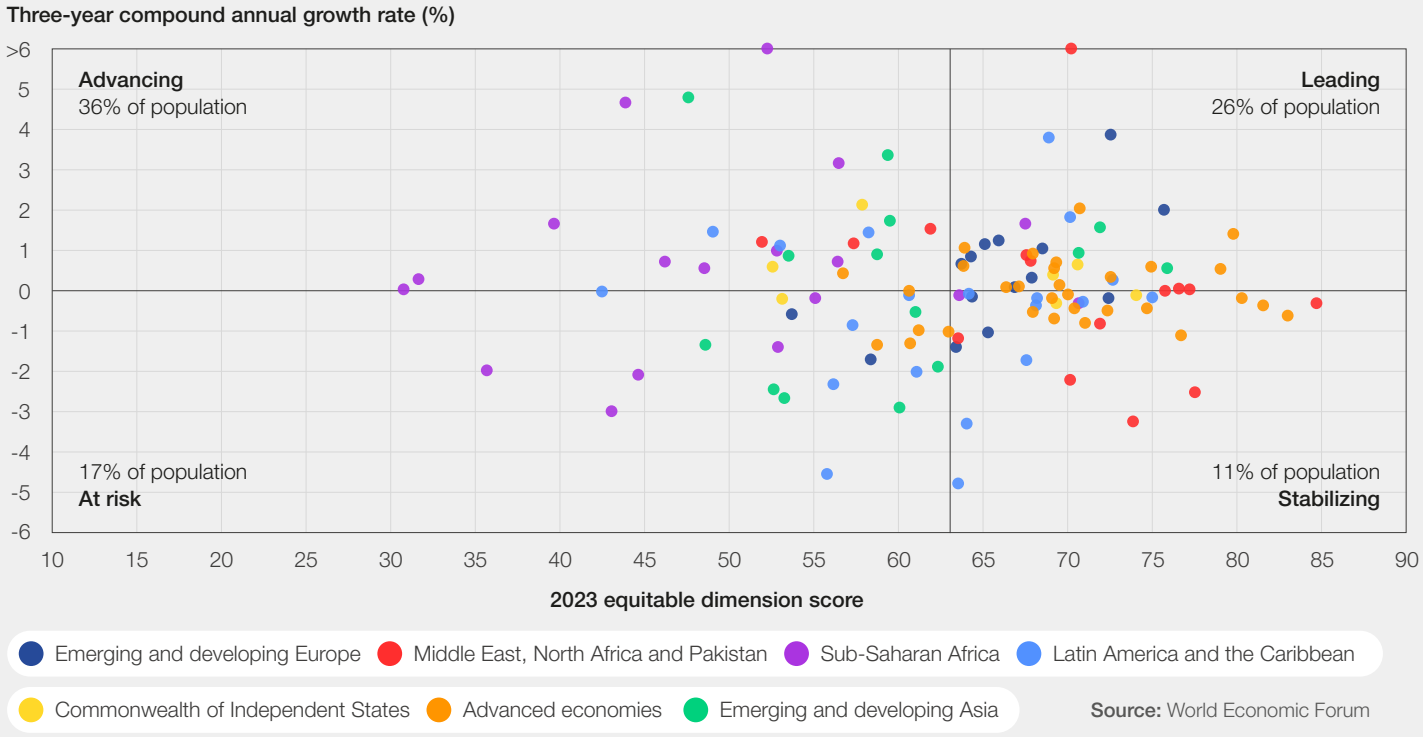
Momentum for the equitable and secure dimensions is more dispersed across the four quadrants due to the dimensions' previously being near-term focus areas for many countries. The results show that 62% of the world's population now reside in a country that is leading or advancing on an equitable energy transition. These countries are promoting energy equity and addressing social inequality as well as addressing energy affordability. **Kenya** and **Tunisia** are demonstrating strong momentum in this dimension. On the other hand, nearly 20% of the world's population lives in countries at risk of not achieving an equitable energy transition. These countries need to quickly identify challenge areas and resolve them by implementing infrastructure upgrades, subsidies or supportive policies.

Countries leading or advancing within the secure dimension have focused on ensuring a diverse energy mix, increasing resilience to price volatilities and strengthening infrastructure, including improved grid stability and flexibility; **Brunei Darussalam, Ghana** and **Albania** all demonstrate strong momentum here. Each country's progress towards a more diversified and secure energy system is at different stages, but they all have fossil fuels in common as their primary energy source. Brunei has focused on diversifying its energy sources, while Ghana and Albania have reduced imports and improved energy reliability. Although some countries have established secure energy systems, others are stabilizing in terms of momentum as they shift their focus to other areas. All countries must ensure that they shift to cleaner, local electricity generation and reduce reliance on fossil fuels (internal and imported). With 11 countries being at risk on both the equitable and secure dimensions, special attention must be given to identify blockers, and other countries should provide technical and financial support to move these countries back on track.

Many countries are prioritizing sustainability, focusing on policies and programmes that promote energy conservation, renewable technologies and innovation in energy storage and grid modernization. **Estonia** and **Luxembourg** have both demonstrated strong momentum. Each has a different profile in terms of sustainability, but they are all signatories to the Paris Agreement. Estonia has prioritized investment in renewables, and Luxembourg in reducing greenhouse gas (GHG) emissions. **Saudi Arabia** is also advancing within sustainability but, considering its starting position, it needs to rapidly step up the growth rate on sustainability.

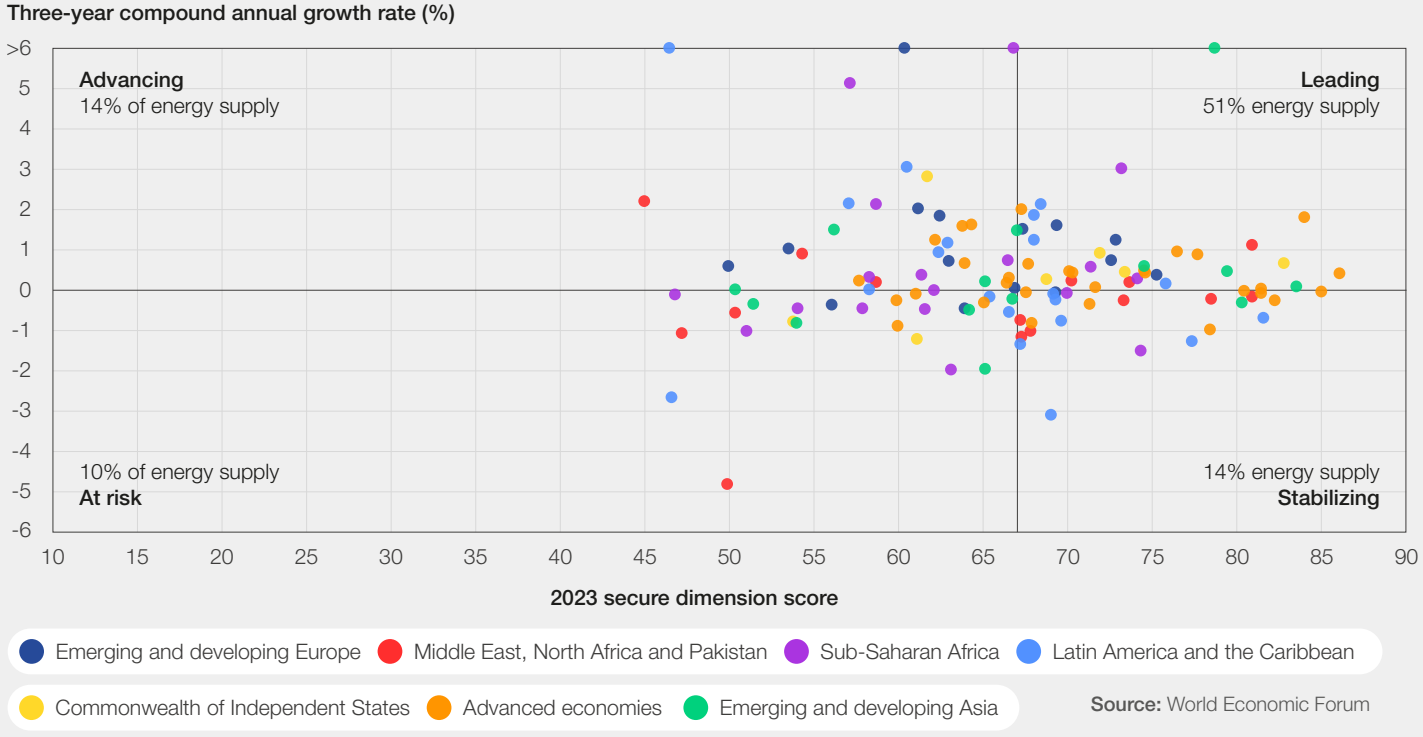
The countries at risk within the sustainable dimension are major fuel exporting nations where transitioning to sustainable energy sources may require significant investment and infrastructure upgrades (which can be difficult to implement in resource-rich economies). The sustainability and security of the energy system are closely intertwined, as an unsustainable energy system can pose a long-term threat to energy security. By prioritizing sustainability, countries are working towards achieving a balance between economic growth, social well-being and the preservation of natural resources.

FIGURE 5A **Momentum across the equitable dimension**



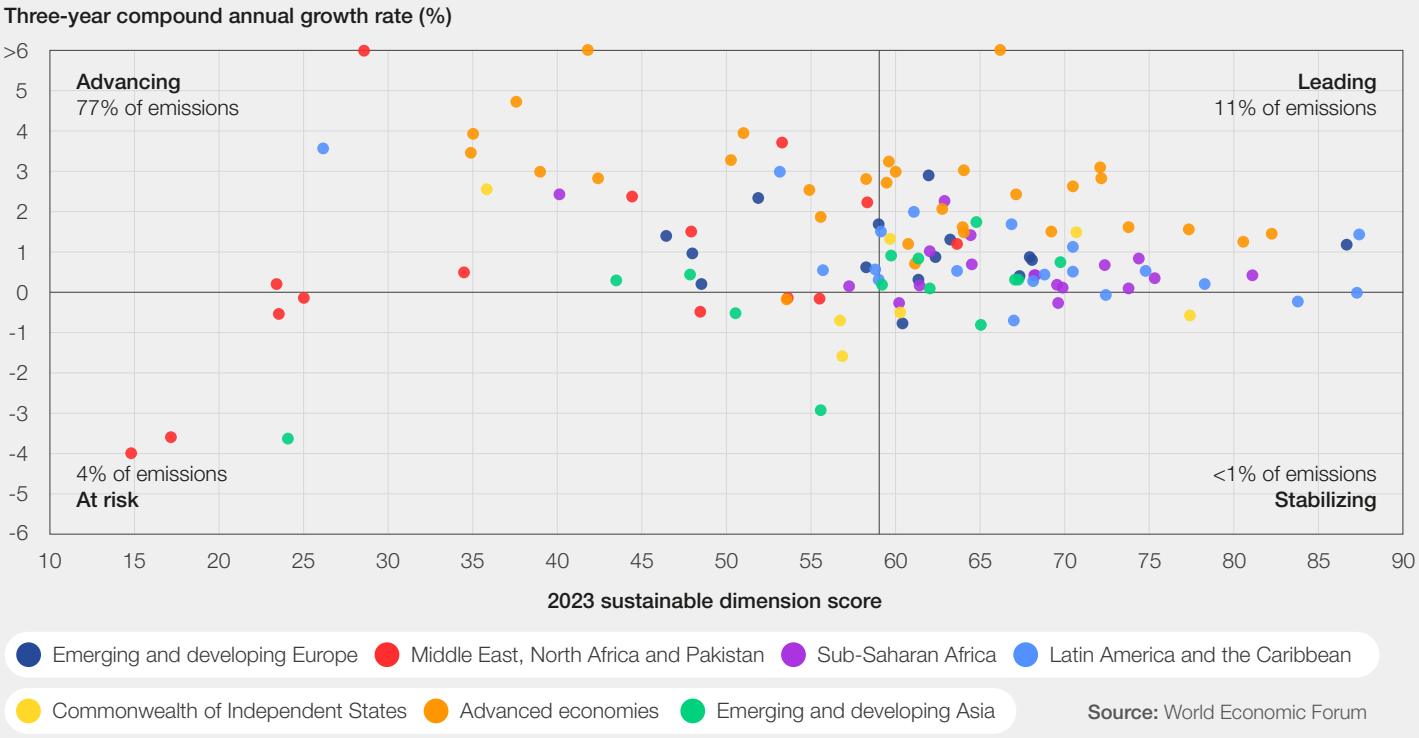
Source: World Economic Forum

FIGURE 5B **Momentum across the secure dimension**



Source: World Economic Forum

FIGURE 5C | **Momentum across the sustainable dimension**



Source: World Economic Forum

65.2
Average score
14% 34%
31%

Advanced economies

Over the past decade, the ETI scores of advanced economies improved steadily by 11%, led by the Nordic region. All advanced economies have been able to achieve 100% access to electricity and develop reliable energy systems, but suffered greatly on affordability because of high energy prices in the past three years. The group made tremendous advances on regulatory policies, infrastructure, human capital and financial investment, but lags on innovation where it could make pioneering developments.

54.6
Average score
3% 7%
7%

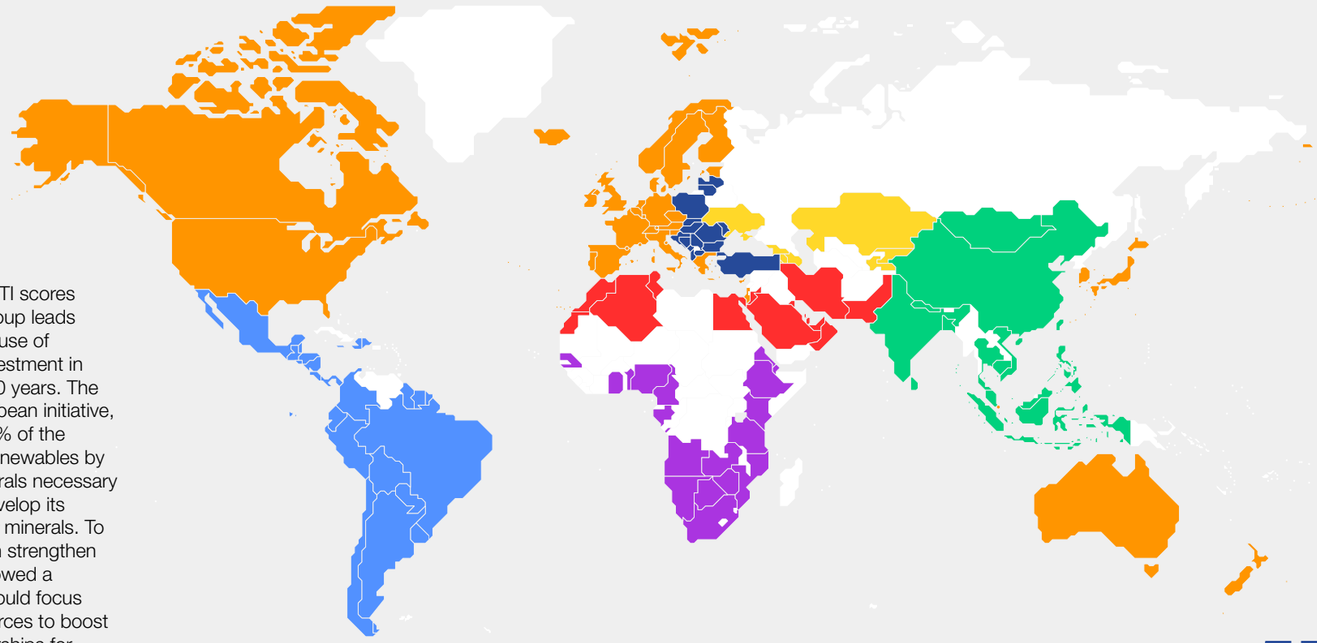
Commonwealth of Independent States

The Commonwealth of Independent States witnessed an improvement in aggregate ETI scores by 11% over the past decade. But its system performance scores declined last year with an increase in subsidies and high gas prices. In the last 10 years, the group witnessed a jump of 22% in transition readiness scores, but that was limited to only 1.5% in the last year. The contribution to the large increase comes from significant improvement within clean energy jobs over the decade, providing hope and employment for a prepared green workforce. In the future, the group should focus on improving energy affordability for its consumers and reducing fuel subsidies, which grew by a huge 17% in the last year.

53.4
Average score
51% 39%
46%

Emerging and developing Asia

Emerging and developing Asia, home to the populous countries of India and China, improved its ETI scores by 12% in the last decade. While this is one of two groups that have made greater than 10% improvement on the equitable dimension in the past decade, it increased fuel subsidies dramatically in the last year. Performance on the sustainable dimension remains flat with worsening carbon intensity. The group should focus on improving both security and sustainability given the energy demand per capita is projected to double by 2050. With a 28% increase in enabling environment scores, the region has strengthened its policy framework and financing environment. Focusing on innovation, adding more renewable capacity and diversifying the energy mix by moving away from fossil fuels can accelerate the transition for this group.



- % of global population
- % of global total enegy supply
- % of global CO_2 emissions

54.8
Average score
9% 6%
4%

Latin America and the Caribbean

This group showed the slowest gain, with ETI scores increasing 5% over the last decade. The group leads on the sustainable dimension due to heavy use of hydroelectric power. But surprisingly, its investment in renewables scores declined by 65% over 10 years. The Renewables in Latin America and the Caribbean initiative, created at the end of 2019, aims to fulfil 70% of the group's electric energy consumption with renewables by 2030. Latin America produces several minerals necessary for clean energy technologies and could develop its firmly set mining sector to diversify into new minerals. To unlock further improvements, the group can strengthen its enabling environment, where again it showed a modest growth of just 8% in 10 years. It should focus on leveraging its advantage in natural resources to boost innovation, promoting public-private partnerships for better credit access, and introducing environmental tax reforms for long-term benefits.

57.7
Average score
3% 3%
3%

Emerging and developing Europe

This group showed the most promising growth, increasing ETI scores by 13% over the past decade. But problems mounted last year as the energy crisis hit the group the hardest, leading to a decline in scores. The wholesale prices of electricity and gas have surged 15-fold since the beginning of 2021, severely affecting households and businesses. The group performed well on transition readiness, with a gain of 22% in its scores. In the past three years, the group significantly improved on adding clean energy jobs and on investments in renewables, which was reflected in its renewable capacity addition scores. In the short term, these countries need to focus on reducing energy demand and increasing affordability for their consumers, while continuing to strengthen their readiness for the future.

49.2
Average score
11% 4%
2%

Sub-Saharan Africa

Sub-Saharan Africa's energy transition growth of 11% has been one of the most promising in the last decade, and it is the strongest performer of all groups on the sustainable dimension. On certain parameters, such as scores for regulatory indicators for sustainable energy (RISE), creation of green jobs, and regulation and political commitment, it was also the best performer. Sub-Saharan Africa showed the maximum gain of 18% on scores on the equitable dimension in the past decade, but recent trends show a slowdown, about which the region should be cautious. It needs to focus on improving its energy mix and harnessing its abundance of natural resources to transition faster to a low-carbon economy. The group can do so by attracting global investments, leveraging public-private partnerships and strengthening its infrastructure.

50.5
Average score
9% 8%
7%

Middle East, North Africa and Pakistan

The scores for the Middle East and North Africa and Pakistan grew by 8% in the last decade and have been flat for the past three years, where the heavy reliance on oil revenues continues to pose challenges on the path to a sustainable energy transition. Even though subsidy scores improved by 200% – the maximum for any group – they plunged 33% in the last year alone. This group needs to catch up on sustainable scores by reducing energy intensity and share of GHG emissions. On transition readiness, it was at par with other groups with a 20% gain over the last 10 years but showed the maximum decline on innovation. Directing its investments towards development of environmental technologies can help on this front.

Source: World Economic Forum

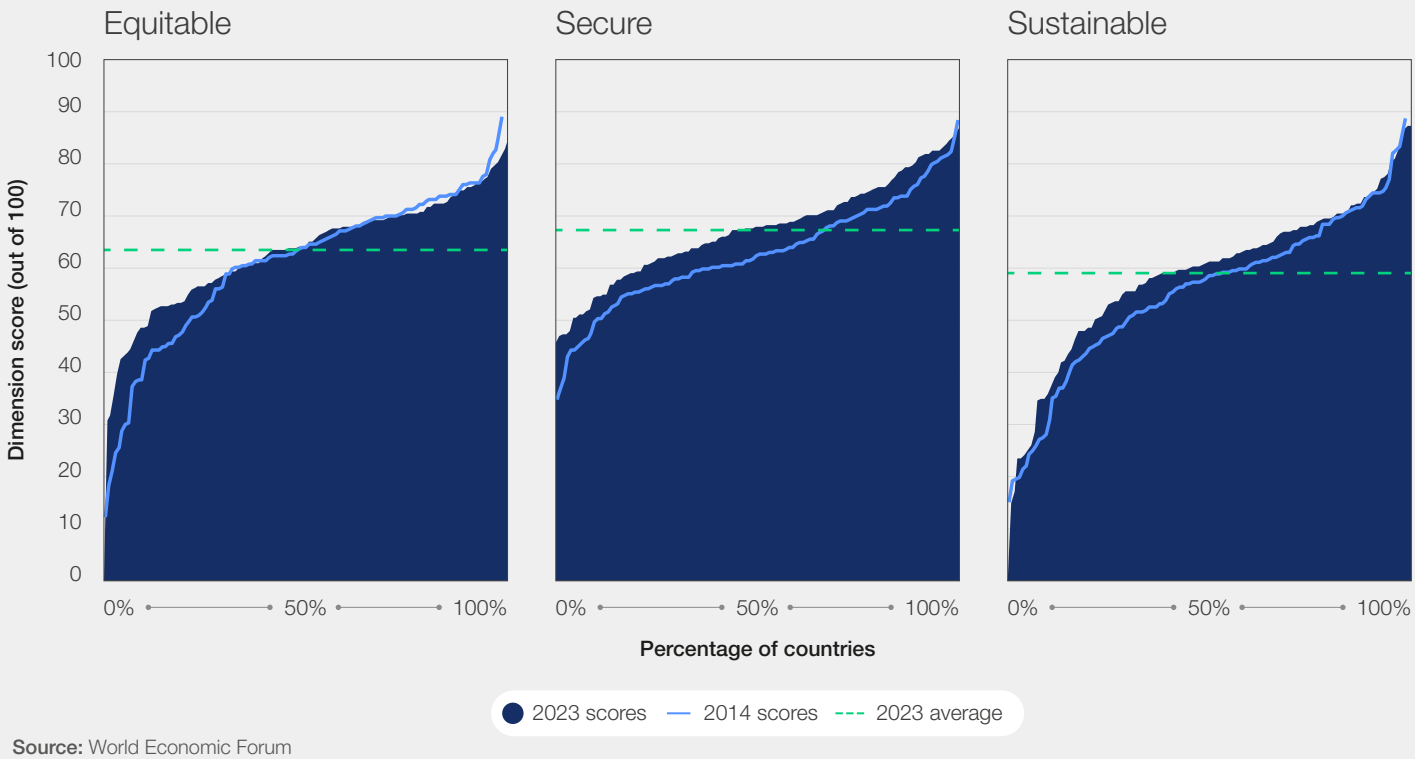
4 Sub-index and dimension trends

The current energy transition trajectory is masking a decline in equity and inclusiveness.

4.1 System performance

To achieve an effective energy transition, countries must balance their energy system across the equitable, secure and sustainable dimensions, and make progress on all (Figure 7). In the last decade, 83% of the countries tracked by the ETI have improved their energy system performance, an indication of their strong energy system growth. Global average system performance scores have steadily increased from 59.5 to 63.0. Improvement patterns differ across dimensions however, as countries face competing priorities, economic uncertainties and geopolitical challenges.

FIGURE 7 **System performance dimension scores, 2014 and 2023**



Source: World Economic Forum

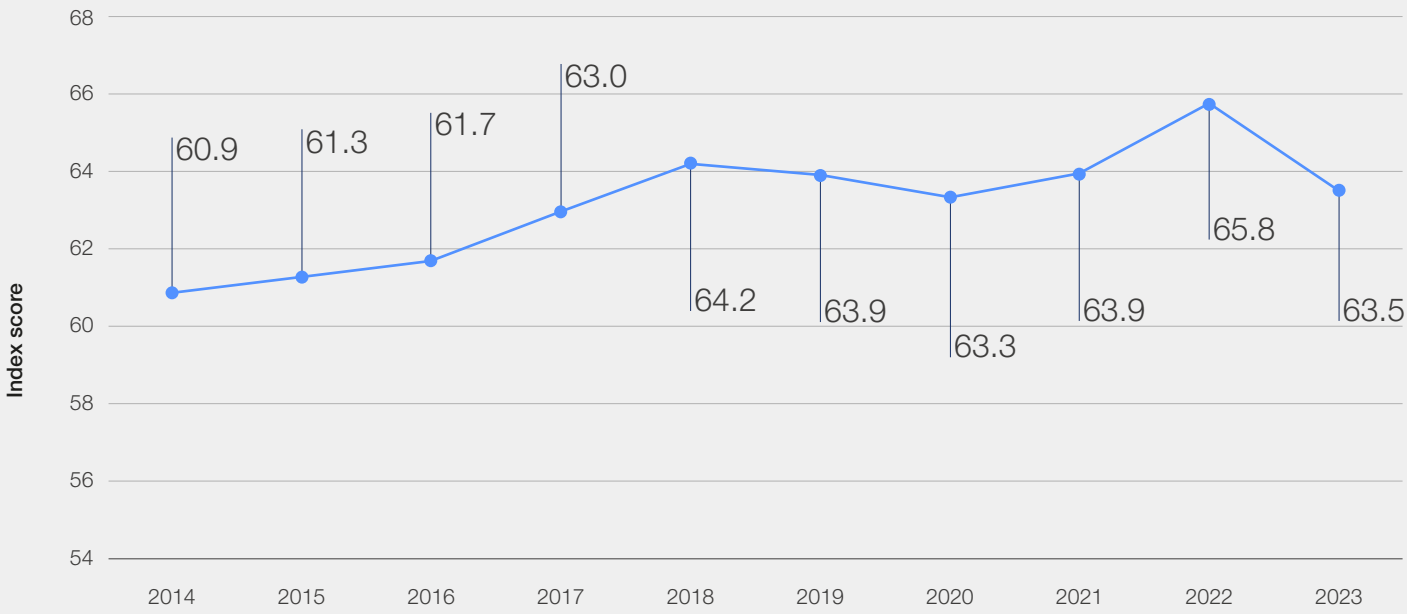
The global average score for sustainable in 2023 remains the lowest among the three dimensions. Secure has progressed the most, narrowly outperforming sustainable, and to the detriment of the equitable dimension, which has slowed overall. Urgent and accelerated measures are needed to continue the noticeable effect on the sustainable dimension to ensure a balanced energy system. Progress within sustainable is noticeably lacking within the fossil fuel-exporting nations. Countries' evolution on these dimensions over the past decade is further explored below.

Equitable

The imperative of the **equitable** energy transition stems from the critical role played by the energy sector in driving socio-economic growth. While the energy transition has the potential to create economic opportunities, it could bring high costs and inequalities if not managed properly, particularly for the world's most vulnerable populations. This requires leaders to make difficult choices, particularly in emerging and developing economies, to support economic growth that maximizes social welfare while ensuring access to abundant and diverse forms of energy at affordable prices.

The ETI's equitable dimension tracks the access, affordability and economic development of the energy sector. Globally since 2014, the score for the equitable dimension has seen a 4% increase, with a recent 3% increase from 2021 to 2022 and a 4% decline from 2022-2023 following market signals, as shown in Figure 8. Oman, Canada, the United States and Sweden are leading in 2023, while countries in Sub-Saharan Africa, including the Democratic Republic of Congo, Zambia, Tanzania and Senegal, rank in the lowest quartile. While global average scores on energy access and economic development have seen gains since 2014, those for energy affordability have substantially declined (5%), owing to the ongoing energy crisis and unprecedented shock to energy prices and household expenditures. These trends, however, vary by country depending on the stage of economic development.

FIGURE 8 **ETI equitable dimension trend, 2014-2023**



Source: World Economic Forum

Global demand and prices for electricity and oil surpassed pre-pandemic levels in 2021 because of the strong correlation between economic growth and energy consumption. Natural gas prices also climbed to their highest in a decade in Europe, the United States and major Asian markets, owing to a combination of demand- and supply-side factors. These imbalances carried over to 2022 with energy prices sustaining record-high levels due to the Russia-Ukraine war. As the global energy crisis persists, the surge in energy prices continues to fuel inflationary pressures that deter investments in countries already dealing with high interest rates and greater volatility. As a result, energy access investments dwindle while affordability of energy services also becomes severely constrained, adding to concerns of the equity and justice of the energy transition.

Estimates suggest that around 75 million people who gained access to electricity recently will likely lose the ability to pay for it, and 100 million people may go back to using traditional biomass for cooking.[8] ETI trends show that while the rate of access to electricity in rural areas as well as access to clean cooking fuels has slowed in the past three years, electricity prices remain high across several regions, including advanced economies, emerging and developing Europe, and the Middle East, North Africa and Pakistan. This implies a different set of affordability challenges, however, than those in Sub-Saharan Africa. To alleviate the effects of high electricity prices, many countries introduced legislation and measures such as the regulation of wholesale and retail prices; revenue caps on renewables, nuclear and coal plants; reductions in

> There is risk of a harmful subsidy race where advanced economies with greater fiscal power might emerge as winners, and emerging and developing economies with scarcer fiscal resources would find it difficult to compete.

energy taxes; and energy subsidies. While these market interventions can help mitigate the effects of the energy crisis, minimizing uncertainty in the investment landscape is required to ensure that these measures do not deter much-needed investment.

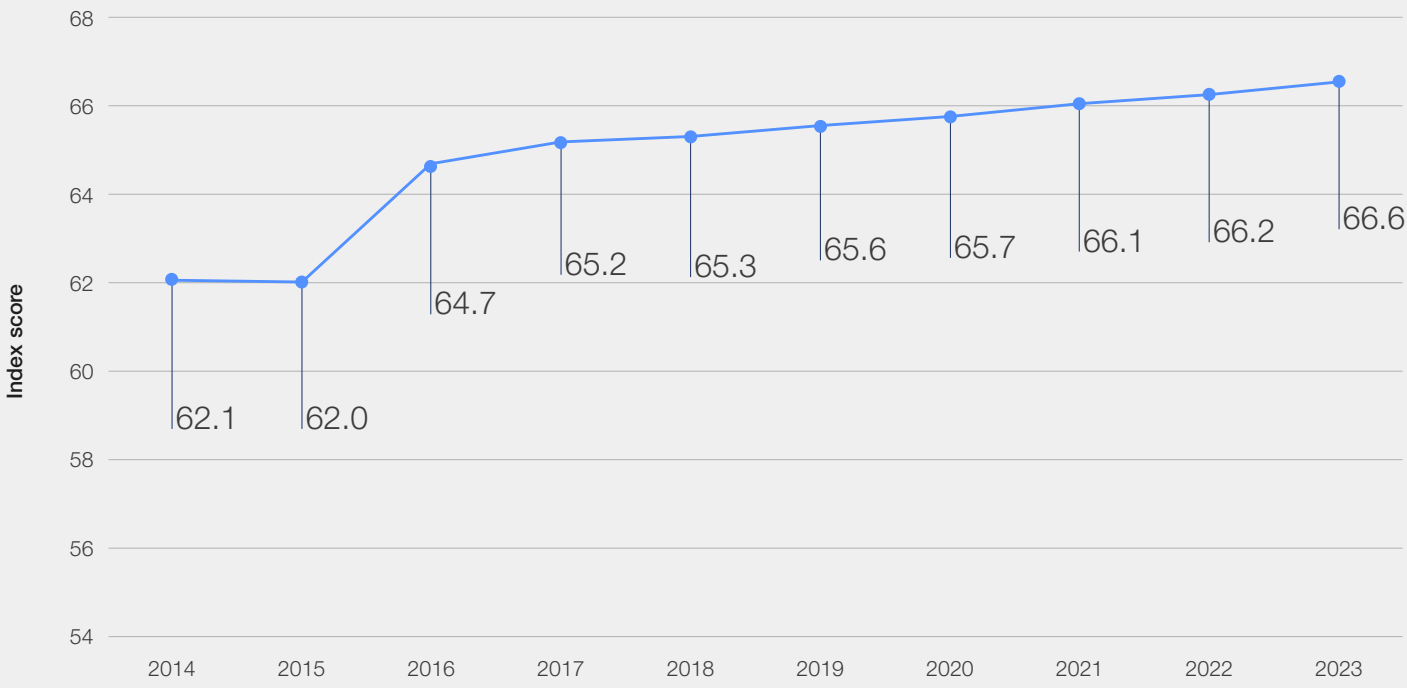
ETI trends further show that following an initial decline in the last few years, energy subsidies have been reintroduced rapidly and at much higher levels. Fossil fuel consumption subsidies worldwide soared in 2022; oil subsidies increased by approximately 85%, and natural gas and electricity consumption subsidies more than doubled.[9] Even though these subsidies are meant to protect consumers from volatile energy prices, they create an additional burden on governments amid tightening fiscal space and spending pressures on other priorities and reduce incentives for consumers to adapt energy consumption to price levels. In the face of persisting price pressures and crisis conditions, these measures require significant cumulative resources, which poses serious risks for the energy sector particularly in emerging and developing economies.

The risk now is a harmful subsidy race where advanced economies with greater fiscal power might emerge as winners, and emerging and developing economies with scarcer fiscal resources would find it difficult to compete with them for investments. This could also hinder the transfer of technology to these nations, ultimately raising the cost of the energy transition.[10] For countries that are unable to make those commitments, this raises the question of how to make the energy transition inclusive. If the goal is to protect consumers from price shock and to correct market failures, a coordinated approach is required, allowing subsidies to be targeted to meet the needs of the poorest and most vulnerable nations and households, and to ensure a level playing field.

Secure

Energy security is "a primary concern for governments and economic players across the globe, and a dimension whose impacts multiply across supply chains, countries and international systems. People, companies and nations depend on secure and uninterrupted access to energy at affordable prices".[11] The ETI's **secure** dimension tracks energy supply, reliability and resilience. On a global scale, the secure dimension scores have shown the most progress over the past decade, although they still lag the equitable and sustainable dimensions. Figure 9 shows the dimension score over time. Advanced economies, such as United States, Australia and Estonia, score highly due to mature energy infrastructure, and many are able to withstand potential disruptions to gas supply chains. Malaysia scores highly due to supply diversity and reliability. Major fuel exporters, such as Saudi Arabia, UAE and Azerbaijan, also score highly due to their gas reserves.

FIGURE 9 **ETI secure dimension trend, 2014-2023**



Source: World Economic Forum

Diversification is critical for a secure and economic energy system as it reduces dependency, enhances resilience, manages economic risks, fosters innovation and competitiveness, and supports sustainability goals. Countries with energy security challenges have typically failed to diversify either their domestic energy mix or their energy import partners, or both; some of the results have been seen in recent months in Europe. The ETI shows that out of 29 advanced economies, eight have fuel import dependency on just three trade partners for over 70% of their net energy imports. Seven of these eight countries are in Europe.

Three levels are needed for impactful diversification: in the energy mix, electricity supply and consumption. Their importance is recognized by several of the United Nation's Sustainable Development Goals directly or indirectly relating to electricity and energy diversification and consumption. Trends from the ETI show that energy diversification is more advanced than electricity diversification, with progress being uneven; while the electricity mix is progressing, the energy mix remains stable. Some countries that have successfully diversified their energy and electricity mixes may now focus on improving quality and reliability and reducing energy costs. Many countries in the Sub-Saharan Africa and the Middle East, North Africa and Pakistan regions, however, may need to first address energy access challenges before tackling grid infrastructure improvements and subsequent diversification efforts. Policies also have an important role in driving innovation and expansion and in shaping energy systems to accommodate new technologies. The 2022 energy crisis incentivized renewable energy over gas in the medium term. More incentives may be needed to shift energy demand permanently towards clean energy and to accelerate electrification.

Energy systems need to "withstand operational disturbances, such as grid outages, planned maintenance, extreme weather events or financial shocks (e.g. price volatility). Stability enhancements which strengthen the reliability and resilience of the system have never been more important or more challenging".[12] Force majeure events, including cold snaps in New York,[13] heatwaves in Japan,[14] and earthquakes in Turkey[15] and Syria, have shown countries that grid operations need to be able to recover quickly in the event of tail-risk scenarios. As energy systems become more interconnected and reliant on advanced technologies, such as smart grids, supervisory control and data acquisition systems, and other digital infrastructure, they can become vulnerable to cyberthreats. Thus, cybersecurity measures and robust defences need to be prioritized to mitigate these risks as grids advance. The growing share of electricity in final demand due to electrification, coupled with the rising unpredictability and frequency of extreme weather events, compounds the risks and vulnerabilities of energy grids in the ongoing energy transition.

Maintaining global trust will be important in the future for ensuring stable energy supply and demand at national and international levels. Countries must have confidence in each other's ability to honour their energy commitments, as any disruption in the global market could have severe consequences for economic and social stability. Interconnectors, both within countries and across international borders, play a vital role in facilitating this trust by enabling the efficient transmission and sharing of electricity, diversifying energy sources and promoting cooperation in the face of geopolitical risks. The increasing activism of geopolitics, including the complex relationships between the Organization of the Petroleum Exporting Countries, China, the United States and Europe, further emphasizes the importance of interconnectors and ongoing cooperation in ensuring a sustainable energy future.

Electrification's rise in final demand and extreme weather events increase risks for energy grids in the ongoing energy transition.

GUEST PERSPECTIVE

Europe needs more wind now. And we need it fast.

By Jochen Eickholt, Chief Executive Officer,
Siemens Gamesa Renewable Energy

After decades of small steps, the EU and other parts of the world – most notably the US – now seem to be serious about transforming energy systems. This is especially clear in the case of wind energy, where over the past year policy-makers introduced several new ambitious targets.

Recently, the EU proposed the Net-Zero Industry Act, which includes increasing wind-turbine manufacturing capacity to 36 GW annually by 2030. To put that into perspective: In 2022, Europe installed wind turbines totalling 16 GW. That's half of what we need – a huge gap to fill within a short period.

The onshore market in Germany, for example, shrank significantly in 2018[16] – and the number of offshore wind projects barely increased. This has forced suppliers to close businesses, thousands of people to lose their jobs, and many skilled professionals to move into different sectors, making it even more challenging to achieve the EU's ambition of reaching 440 GW of wind energy capacity by 2030.

We need massive investments and better access to funding.

Wind turbine manufacturers are able and ready to contribute to the ambitious installation targets in Europe and around the world. However, appropriate policy frameworks are necessary.

Massive investments need to be mobilized in key infrastructure such as roads, ports and grids to meet the growing demand for renewable energy and to expand production capacities. Given the slow expansion in recent years, the major challenge – especially for offshore wind – will be to sustainably increase manufacturing capacities. Existing policy frameworks have hindered wind turbine manufacturers in establishing a sustainable business model. Future frameworks need to facilitate the expansion of production capacities and the EU, and its member states, must put more substantial and flexible public funding mechanisms in place if we want to achieve government expansion targets.

This summer, the EU is expected to propose a Sovereignty Fund. It remains to be seen whether it will provide an approach as pragmatic and clear as that of the US Inflation Reduction Act, which mobilizes investment with a preference for domestic green technologies. The EU Innovation Fund, however, which is limited to the funding of technological breakthroughs and will be in place until the Sovereignty Fund is established, is not suitable in its current form to support accelerated investment in manufacturing capacity.

We need to cut through the red tape.

Slow permitting processes have been a thorn in the European wind industry's side. In Europe, an overall capacity of 80 GW is currently trapped in various stages of permitting. This is a big number given today's overall capacity of a little over 204 GW. Had those 80 GW been installed by 2022, they could have eased the energy crisis in Europe. To speed up the process, it is crucial that every permitting authority act quickly and unbureaucratically.

Further needs are to diversify the supply chain, ensure inflation compensation and reassess auction design.

Wind turbine manufacturers have not been spared from the significant disruptions in global supply chains.

While the European wind industry needs to do its part by implementing diversification strategies, the EU must do its part as well. The energy transition will need a secure, abundant and affordable supply of critical minerals. While the recently passed Critical Raw Materials Act, which aims to secure and diversify a domestic supply chain of raw materials, is a step in the right direction, we are still waiting on details regarding implementation. Raw materials must be available for wind turbine manufacturers at fair prices. Otherwise, there is no level playing field.

Furthermore, given the critical role played by the private sector in the EU's energy transition, building sustainable business models is key. Cost escalations between auctions and project construction expose developers and manufacturers to rising costs that can dramatically exceed projected revenues and reduce margins. This is due in part to broader macroeconomic and geopolitical factors. Mechanisms to compensate for inflation-induced cost escalations are crucial to create a risk profile conducive to long-term investments at scale.

Finally, policy-makers need to introduce and emphasize qualitative auction criteria, such as sustainability, cybersecurity and "made in Europe" elements. As it stands, the predominant weighting of the price criterion also increases electricity prices for end consumers, which contradicts the goal of affordable energy.

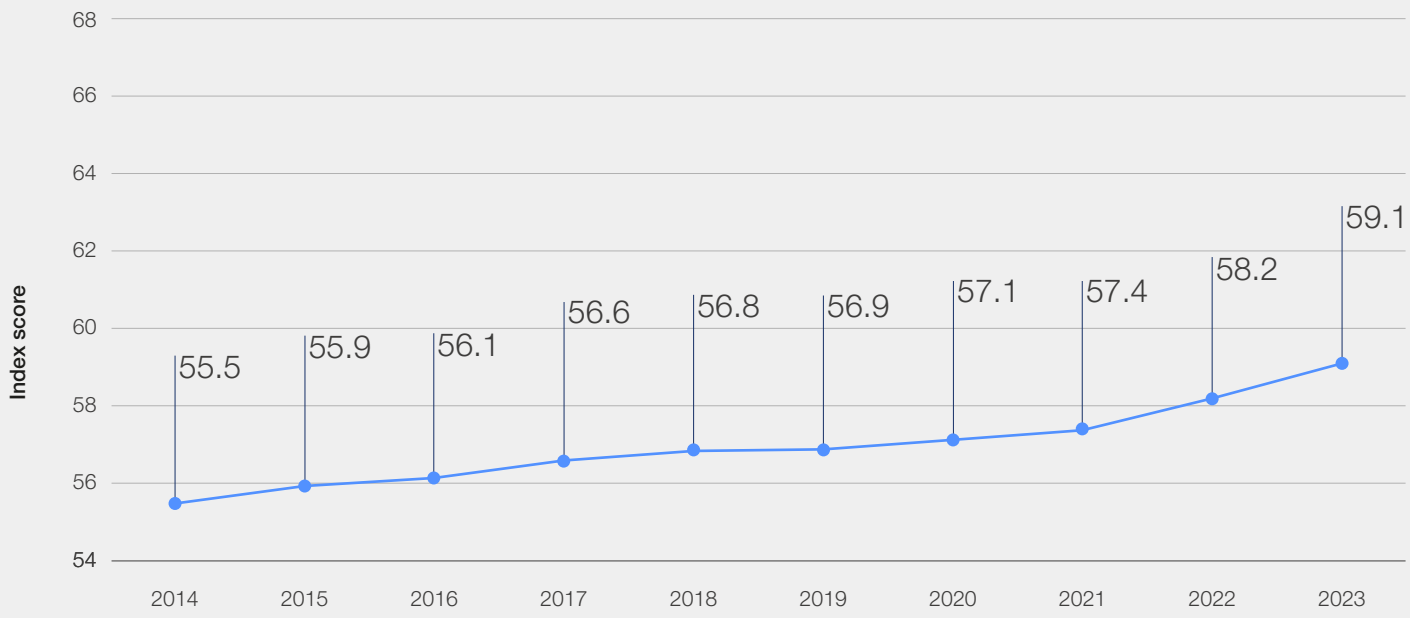
The goal is clear, and so is the path – now we have to show we really want it.

If we really want energy independence in Europe, we need to make sure we have a healthy and resilient wind industry. There is no question that the wind industry is of enormous strategic importance. But we need to act fast. We need more wind now.

Sustainable

The ETI bases the **sustainable** dimension on a combination of energy efficiency, decarbonization and progress towards clean energy systems. In the past decade, this dimension has seen a 7% growth (Figure 10) in the global scores, with Costa Rica, Paraguay and Albania leading the charts for 2023. Paraguay's use of hydropower in its energy mix has enabled it to maintain low-carbon intensity in its economy and effectively manage air pollution, providing it with one of the cleanest energy mixes in South America. The countries from the Middle East, North Africa and Pakistan region rank in the lowest quartiles on the sustainable dimension, despite their above-average performances on the equitable and secure dimensions. They can embrace sustainability by switching to low-carbon sources of energy, eliminating water scarcity and improving household waste management. This can happen with the public and private sectors collaborating to make the switch to a more sustainable way of life. The global sustainable scores, however, need to improve further to accelerate the transition, since improvement on this dimension has a direct effect on net-zero goals.

FIGURE 10 **ETI sustainable dimension trend, 2014-2023**



Source: World Economic Forum

Transitioning towards sustainable energy systems is a complex process requiring careful policy planning and implementation. A central theme is that no one-size-fits-all policy package exists for sustainable energy transitions, as each country's objectives and constraints will shape its policy approach. Yet around the world, many countries are undergoing or planning transitions towards sustainable energy systems through a combination of policy measures, technological advances and changes in consumer behaviour.

A few examples:

- **Energy efficiency:** According to the International Energy Agency (IEA), "Since 2020, governments worldwide have helped mobilise around USD 1 trillion for energy efficiency-related actions such as building retrofits, public transport and infrastructure projects, and electric vehicle support. This amounts to approximately USD 250 billion a year being deployed from 2020 to 2023, equivalent to two-thirds of total clean energy recovery spending."[17] For example, also according to the IEA, "under its recovery and resilience plan, Spain intends to invest EUR 3.4 billion in half a million energy renovation actions through tax incentives and the creation of 'one-stop' renovation offices".[18]

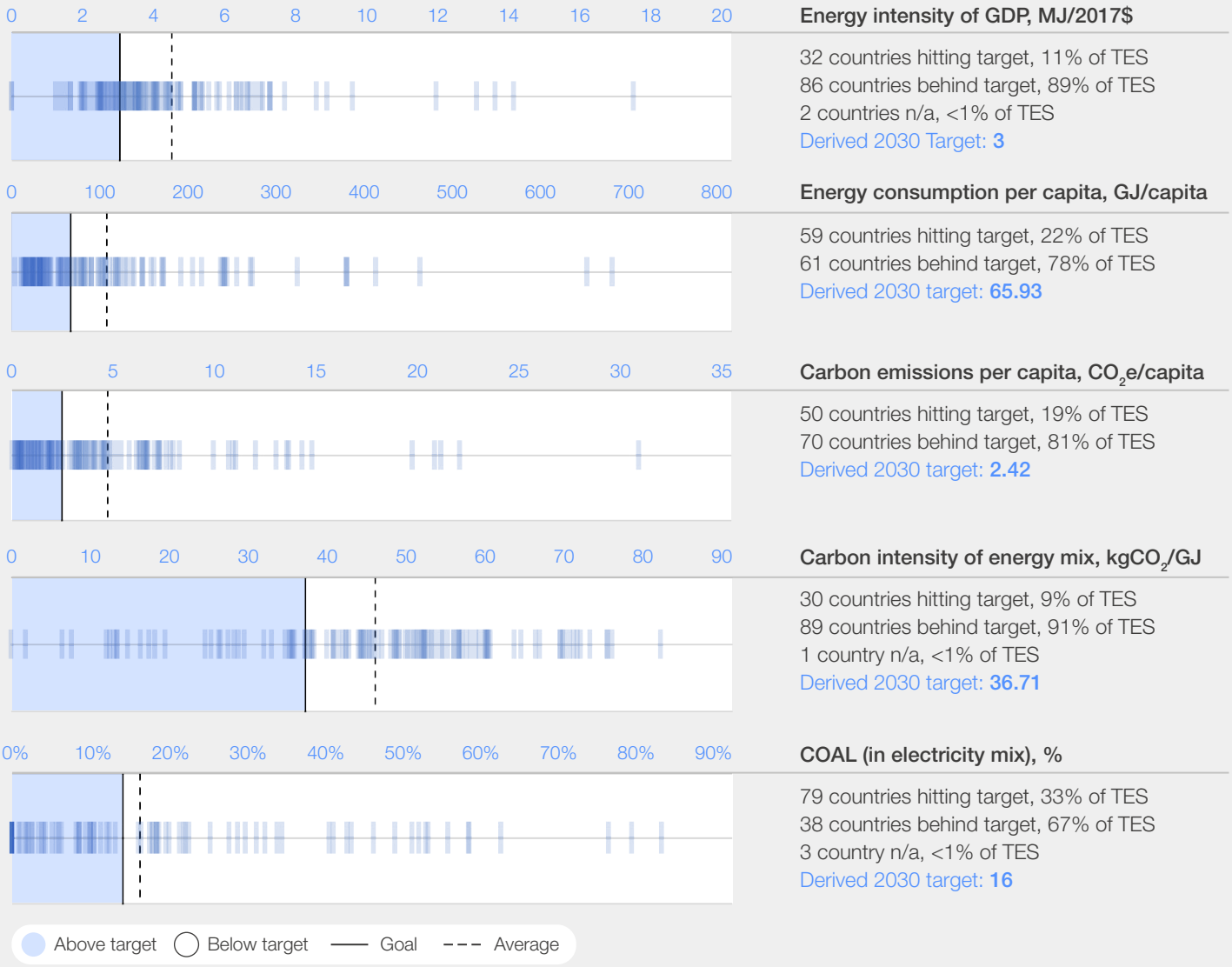
- **Technological advances:** Achieving net-zero emissions requires the immediate and widespread deployment of clean and efficient energy technologies. Major economies are integrating their climate, energy security and industrial policies into broader strategies. Examples include the US Inflation Reduction Act, the Fit for 55 package and REPowerEU plan in the EU, Japan's Green Transformation programme, India's Production Linked Incentive schemes and China's latest Five-Year Plan.

– **Behavioural changes:** Such changes, or the daily alterations that diminish wasteful or excessive energy consumption, are important to reach net-zero emissions by 2050. At the 26th Conference of the Parties (COP26), Indian Prime Minister Narendra Modi unveiled Mission LiFE (Lifestyle for Environment), a programme that aims to prioritize individual behaviour in the global climate action discourse by shifting away from the current "use-and-dispose" economic model towards a circular economy characterized by conscious and deliberate utilization.[19] This move should be welcome for a highly populous country such as India, where behavioural changes can have a substantial effect.

Despite some of the progressive initiatives, the sustainable energy system remains vulnerable at large. In 2022, the Russia-Ukraine war led to a global energy crisis with skyrocketing prices and supply disruptions. As a result, countries resorted to coal to fulfil energy demands. The world's coal consumption reached a new high, surpassing 8 billion tonnes in a single year for the first time and eclipsed the previous record set in 2013. The bright side is that governments, banks, investors and mining firms continue to show a reluctance to invest in coal, particularly thermal coal. No clear indications exist of a reversal in investment trends outside of China and India, where domestic production has been raised to decrease external dependence.[20] In addition, the policy responses overall in many regions to the global energy crisis, such as those taken in major economies (e.g. EU, United States and Japan), are likely to accelerate clean energy developments further.

While global commitments and actions to advance the sustainable energy transition have increased recently, they still fail to attain the required level to limit the rise in global temperatures to 1.5°C and avoid the more severe consequences of climate change. Several sustainable indicators have been analysed to evaluate how far countries are from the ideal targets (Figure 11).

FIGURE 11 **Country density based on the 2030 targets derived from the IEA Net Zero by 2050 scenarios**



Notes: MJ = megajoule; GJ = gigajoule; TES = total energy supply

Source: IEA, "World Energy Outlook 2022 Free Dataset", January 2023, https://www.iea.org/data-and-statistics/data-product/world-energy-outlook-2022-free-dataset (accessed 17 May 2023).

To curtail global warming further to 1.5°C, global GHG emissions must be cut by 45% within eight years and continue to decline rapidly after 2030 to avoid exceeding the remaining atmospheric carbon budget. The triple planetary crisis of climate change, pollution and biodiversity loss requires widespread implementation of renewable energy technologies, electric vehicles and energy-efficient retrofits for buildings. Cross-cutting systemic transformations of food systems and the financial system are also necessary to reduce emissions beyond current mitigation pledges.

The need now is to continue accelerating the overhaul of global energy systems and to set milestones for various sectors and technologies. Solutions include:

- **Renewable energy:** Solar photovoltaics and wind power should account for nearly 70% of global electricity generation in 2050.
- **Energy efficiency:** Increasing energy-efficient solutions for buildings, vehicles, appliances and industry can create jobs while reducing emissions.
- **Electrification:** Electrification in final demand can drive the rapid reduction of emissions through electric vehicles in transportation, heat pumps in buildings and electric furnaces in industry.
- **Bioenergy:** Low-emission fuels and biomethane can replace natural gas for heating and transportation.
- **Carbon capture, usage and storage:** This can help tackle emissions from existing assets like cement and enable low-emission hydrogen production.
- **Hydrogen-based fuels:** Hydrogen can be used in heavy industries, such as steel and chemicals, and in transportation for ships and planes.

TABLE 2 | **A closer look at the progress of sustainable dimension indicators over the past three years**

Progress on the sustainable dimension varies depending on the indicator considered. This chart outlines five indicators using a three-year compound annual growth rate. It helps to identify individual leaders as well as country focus areas and gaps. The order is consistent with the 2023 ranks.

Country	Energy intensity	CO_2 intensity	CO_2 per capita	Share of electricity	Renewable capacity
Sweden	🟡	🟡	🟢	⚪	🟡
Denmark	🟡	🟢	🟢	🟢	🟡
Norway	🟡	🔴	🟢	🟡	⚪
Finland	🟡	🟢	🟢	⚪	🟢
Switzerland	⚪	🟢	🟢	🟡	🔴
Iceland	🔴	🟢	🟢	⚪	⚪
France	🟡	🟡	🟢	🟡	🟡
Austria	⚪	🟡	🟢	🟡	⚪
Netherlands	🟡	🟢	🟢	🟢	🟢
Estonia	🟢	🟢	🟢	⚪	🟢
Germany	🟡	🟢	🟢	🔴	🟡
United States	🟡	🟡	🟢	🟡	🟢
United Kingdom	🟡	🟡	🟢	🟡	🟡
Brazil	⚪	🟢	🟢	🟡	⚪
Portugal	🟡	🟢	🟢	🟡	⚪
Spain	🟡	🟢	🟢	⚪	🟡
China	⚪	🟡	🔴	🟢	🟡
Hungary	🟡	🟢	🟢	🟡	🟢
Canada	🟡	🟡	🟢	🟢	⚪
Luxembourg	🟡	🟡	🟢	🟡	🔴
Albania	🟡	🟢	🟢	🟢	⚪
New Zealand	🟡	🟡	🟢	🟡	🟡
Uruguay	🔴	🔴	🔴	🟡	⚪
Australia	⚪	🟢	🟡	🟡	🟢
Costa Rica	⚪	🟢	🟢	🟢	⚪
Latvia	🟡	🟡	🟡	🟡	⚪
Japan	🟡	⚪	🟢	🟡	🔴
Israel	🟡	🟢	🟢	🟢	🟢
Slovenia	🟡	🟡	🟢	🟢	🔴
Chile	🔴	⚪	🟡	🟢	🟢
Korea, Rep.	🟡	🟢	🟢	🟡	🟢
Azerbaijan	🔴	🔴	🔴	🔴	🟡
Croatia	⚪	🟡	🟡	⚪	🟢
Paraguay	⚪	🟡	🟡	🟢	⚪
Malaysia	🔴	⚪	🔴	🔴	🟡
Lithuania	🟡	🔴	🔴	🟡	🔴
Greece	🟡	🟢	🟢	🔴	🟢
Italy	⚪	🟡	🟢	🟡	🔴
Colombia	🔴	🔴	⚪	🟢	⚪
Poland	🟡	🟢	🟢	⚪	🟢
Ireland	🟢	🟢	🟢	🟢	🟡
Belgium	🟡	🔴	🟢	🟡	🟡
Viet Nam	🔴	🔴	🔴	⚪	🟢
Slovak Republic	🟡	🟢	🟢	🔴	🔴
Czech Republic	🟡	🟢	🟢	🟡	🔴
Kenya	🟡	🟢	🟢	⚪	🟡
El Salvador	🔴	🔴	⚪	🔴	🟡
Bulgaria	🟡	🟢	🟢	🔴	🔴
Romania	🟡	🟡	🟡	🔴	🟡
Bosnia and Herzegovina	🔴	🟢	🟡	🔴	🔴
Panama	🔴	🔴	🟡	🟢	🔴
Cyprus	🟡	🟡	🟢	⚪	🟢
Peru	⚪	🟢	🟢	⚪	⚪
Thailand	⚪	🔴	🟡	🟡	🔴
Indonesia	⚪	🔴	🔴	🟢	🟡
Morocco	🔴	🔴	🔴	🟡	🔴
Saudi Arabia	⚪	🟡	🟢	🟡	🟢
Namibia	🔴	🟡	🟢	🔴	🟡
Qatar	🔴	🔴	🟡	🟢	🔴
Mauritius	⚪	⚪	🟢	🔴	🟡

Country	Energy intensity	CO_2 intensity	CO_2 per capita	Share of electricity	Renewable capacity
Malta	⚪	🔴	🟡	🟡	🟢
Georgia	⚪	🔴	🔴	🟡	🔴
United Arab Emirates	🔴	🟢	🟡	🟡	🟢
Ukraine	🟡	🟡	🟡	⚪	🟢
Turkey	🟡	🟡	🟡	🟡	⚪
Sri Lanka	🔴	🟢	🟡	🟢	⚪
India	⚪	🟡	🟡	🟡	🟡
Mexico	🔴	🟢	🟢	🟢	🟢
Montenegro	🔴	🔴	🔴	🟡	⚪
Singapore	🟡	🔴	🟡	🟡	🟢
Jordan	🟡	🟢	🟢	🟢	🟢
Armenia	🔴	🔴	🔴	🔴	⚪
Tajikistan	🔴	🔴	🔴	🔴	🔴
Bolivia	🟡	⚪	🟢	🟡	🔴
Cote d'Ivoire	🟡	○	🟡	🟢	⚪
Kazakhstan	🟡	⚪	🟡	🔴	🟢
Serbia	🟡	🟡	🟡	🔴	🔴
Ecuador	⚪	🟡	🟢	🟢	🔴
Egypt, Arab Rep.	🟢	🟢	🟢	🟢	🟢
Macedonia, FYR	🟡	🟡	🟡	🟡	🟢
Cameroon	⚪	🔴	🔴	🟡	🟡
South Africa	⚪	🟡	🟢	🔴	🔴
Lao PDR	🟢	🔴	🟡	🟢	🟢
Cambodia	🔴	🔴	🔴	🟢	🔴
Argentina	🔴	🟡	🟢	🟢	🟡
Algeria	🔴	⚪	🟡	🔴	🔴
Guatemala	⚪	🟡	🟡	⚪	🔴
Ghana	🔴	🔴	🔴	🟢	🔴
Tunisia	⚪	🔴	🟡	🟢	🟡
Oman	🔴	🔴	🟡	🔴	🟢
Kyrgyz Republic	⚪	🟡	🟢	🟢	🔴
Iran, Islamic Rep.	🔴	🔴	🟡	🟢	🔴
Dominican Republic	🟡	🔴	🟡	🟢	🟢
Philippines	⚪	🔴	🟡	🟢	🔴
Ethiopia	🟡	🔴	🔴	🟢	⚪
Gabon	🟡	🔴	🟡	🟡	🔴
Nepal	⚪	🔴	🔴	🟢	⚪
Trinidad and Tobago	🟡	🟡	🟢	🟢	🟢
Angola	🔴	🟢	🟢	🟢	🔴
Honduras	🔴	🟢	🟡	🟡	⚪
Republic of Moldova	🔴	🔴	🔴	🟢	🟢
Kuwait	🔴	🟢	🟡	🟢	🟢
Venezuela	○	⚪	🟢	🟢	⚪
Senegal	⚪	🟡	🟡	🔴	🟢
Brunei Darussalam	🔴	🔴	🔴	🟢	🟢
Botswana	🟡	🟢	🟢	🔴	🟢
Pakistan	🟡	🟢	🟢	🟡	🔴
Nigeria	🔴	🟡	🟡	⚪	🟡
Mozambique	⚪	🟢	🟢	🟡	🔴
Bahrain	🔴	🟡	🔴	🟡	🟢
Mongolia	🔴	🟢	🔴	⚪	🟡
Lebanon	🔴	⚪	🟢	🟡	🟡
Bangladesh	🟡	🟢	🟡	⚪	🟡
Nicaragua	🔴	🟢	🟢	🟡	🔴
Jamaica	🟡	🟢	🟢	🔴	🟡
Zimbabwe	🔴	🟢	🟢	🔴	⚪
Zambia	🔴	🔴	🔴	🔴	⚪
Tanzania	⚪	🔴	🔴	🟢	🟡
Congo, Dem. Rep.	🟡	🔴	🟡	🟢	🔴
Yemen, Rep.	○	🟢	🟡	🔴	⚪

🟢 Progress > 67th percentile 🟡 Progress 67th-33rd percentile ⚪ Progress 33rd-0 percentile 🔴 Negative progress ○ Data not available

Source: World Economic Forum

GUEST PERSPECTIVE

How Morocco stays the course on a just transition towards sustainable development

By Leila Benali, Minister of Energy Transition and Sustainable Development of Morocco; President, United Nations Environment Assembly

A nation loses critical energy supplies and looks for alternatives, balancing its near-term needs against longer-term sustainability goals. While most think this refers to a European country following the Russia-Ukraine war of 2022, it also describes the Kingdom of Morocco, which managed to meet its development needs without derailing the sustainability agenda, while increasing energy security.

2022 will be remembered as the year when consumers and policy-makers favoured short-term security over sustainability. However, security concerns are neither temporary nor superfluous. Energy transition takes time and could require investments of $250 trillion over 30 years. In Africa alone, nearly 600 million people remain without access to modern forms of energy. After lockdowns, wars and market dislocations, 2022 offered us a clear conviction: this is the wrong time to lose credibility and trust after years of advocacy on climate, nature and biodiversity protection.

In 2021, a 10 billion cubic metre natural gas pipeline between Africa and Europe shut down, cutting Morocco off. The country could have gone down an irreversible path of retooling the energy system with fossil fuels. Instead, it joined the world at COP26 in resolutions to move beyond coal. Though Morocco was still recovering from the economic shockwaves of COVID-19, it turned this challenge into an opportunity by putting in place a roadmap for energy security, including fast-tracking sustainable access to the international LNG market to "power past coal," decarbonizing industries and addressing the intermittency of renewables.

The integration with international LNG markets by reversing the flow of a transcontinental pipeline was a critical move to restore the trust of people, investors and allies, with a just and informed energy, economic and social transition. Against a backdrop of uncertainty, Morocco decoupled supply from infrastructure and increased the system's security, sustainability and flexibility by enabling more renewables, pushing for more efficiency and increasing integration with global markets – three pillars of its energy strategy.

In Europe, commodity and utility bills soared to record levels. Countries scrambled to acquire supplies or curtail consumption. For some, 2022 resembled the 1970s oil price shocks. This time, countries have barely emerged from a global pandemic, with soaring inflation and tightening monetary policies. Energy poverty, supply insecurity and environmental degradation have become the norm in many countries, alongside food and water crises.

A difficult global environment makes informed sustainable economics and renewed multilateralism even more critical. This is key to tackle the triple crisis of this century: climate change, pollution and biodiversity loss. Three telling examples:

- Carbon prices reached €100 per ton the first time in February 2023 in the EU emissions trading system, pushing the value of traded global markets for CO_2 close to €1 trillion – a clear signal of informed economics.
- As we consider the theme of the sixth session of the United Nations Environment Assembly, to end plastic pollution and promote nature-based solutions for supporting sustainable development, the call to reinvigorate multilateralism to overcome the multiple crises that put the viability of life on earth at risk is pressing and needs to be supported with informed decisions.
- The July 2022 Inflation Reduction Act's Hydrogen Shot incentives target $1 per kg by 2031, which is a positive economic signal. However, while some are lifting fracking bans, re-firing coal, and arbitrarily pricing in and out externalities, policy-makers must ensure that taxpayers' money is not used to incentivize new bubbles that generate negative returns to society, stranded assets or bankruptcies.

If financial institutions and the private sector say that, with the right economies of scale and incentives, properly structured investments, and the right balance between adaptation and mitigation, we can move together towards a just, informed, affordable and bankable transition, why not do just that? To restore and nurture trust.

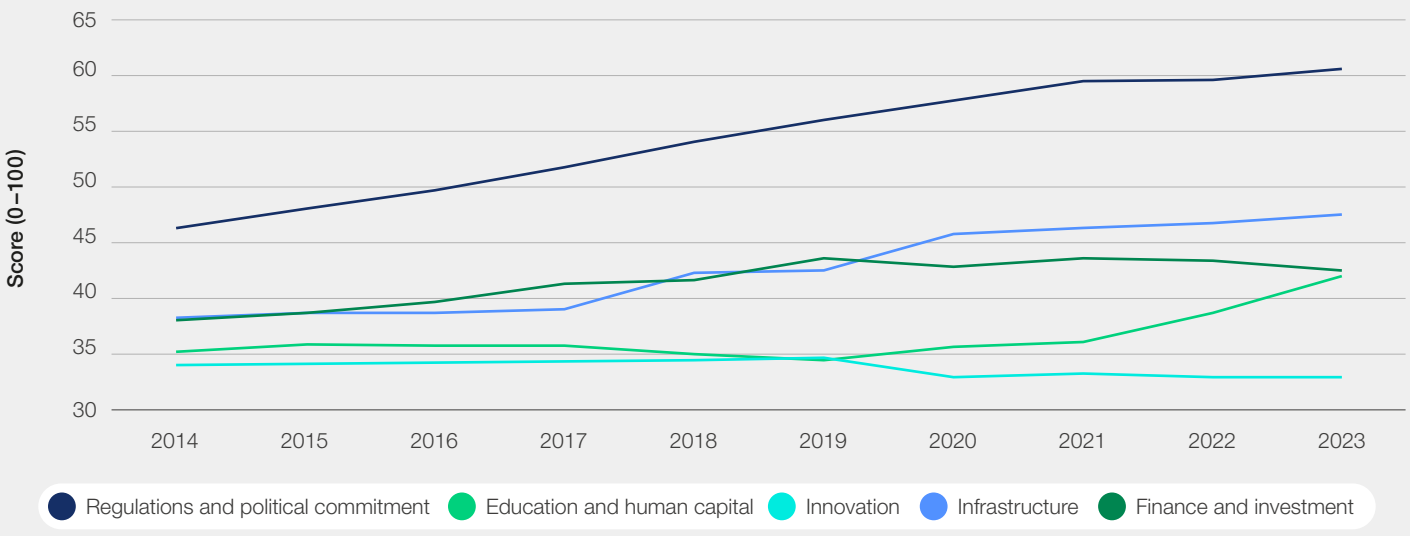
4.2 Transition readiness

Only six countries managed to direct more than 1% of their GDP in 2022 towards investments in renewables.

As mentioned in *Fostering Effective Energy Transition 2020 Edition,* "the energy system's ability to deliver on the imperatives … depends on the presence of an enabling environment for the energy transition, measured in the ETI framework by the transition readiness sub-index. Energy transition readiness is captured by the stability of the policy environment and the level of political commitment, the investment climate and access to capital, the level of consumer engagement, the development and adoption of new technologies, etc. Some of these factors are beyond the scope of the energy system", such as skills or quality of transport infrastructure, "but nevertheless determine the effectiveness and future trajectory of energy transition in a country."[21]

Similar to the progress achieved on global system performance imperatives, transition readiness enablers sustained a growing global average performance over the past 10 years (Figure 12). The direct enablers have been fuelling countries' transition readiness and showcase the effect of recent global focus on the policy and investment transition choke points. On the other hand, human capital and innovation transition enablers did not make substantial progress over the same period, underscoring the importance of paying more attention to these blind spots to unlock further transition momentum. In addition to a set of leading advanced European economies, South Korea, China and Japan are among the leading 20 countries regarding the enabling transition environment in 2023.

FIGURE 12 **ETI transition readiness trend, 2014-2023**



Source: World Economic Forum

Financial investment in clean energy continues to be a key enabler for transitioning economies. It nurtures other enablers of transition, such as technology development and deployment, while actively facilitating the scale-up of renewables capacity and associated infrastructure. Despite the progress achieved, investments in clean energy supply remain a challenge. Only six countries managed to direct more than 1% of their GDP in 2022 towards investments in renewables. China had the largest share of GDP investments, investing more than 1.5% of GDP in renewables, followed by Viet Nam, Azerbaijan, and Bosnia and Herzegovina.

Country commitments to their transition targets that were set as part of the Paris Agreement have been translating into transition strategies. The level of granularity and maturity of these strategies varies significantly. As of 2023, only 17 out of 120 countries have managed to reflect their net-zero targets into their respective laws, in a manner that targets all GHG emissions and delivers in 2050 or earlier.

An effective country policy for energy transition provides the necessary framework to accelerate the transition to a cleaner energy system and address the associated challenges of equity and security. While most countries have a strong enabling policy environment regarding energy access, that environment is not as strong for policies that enable scaling of renewable capacity or inducing energy efficiency. Aside from a set of leading advanced European economies, South Korea, India, Mexico and Hungary have recently exhibited a strong enabling regulatory environment to accelerate a balanced transition.

4.3 A closer look at innovation

Speed and scale: Advanced energy solutions

Advanced solutions – including hydrogen, sustainable aviation fuels, advanced nuclear, storage, carbon and demand management – harness, manage and use clean energy across the energy system. As key enablers of the energy transition, they help address the intermittency of renewable energy, enable electrification of transport and industry, improve system efficiency, decarbonize hard-to-abate sectors and eliminate CO_2 from the atmosphere.

The IEA estimates that around $2.8 trillion will be invested in energy in 2023. More than $1.7 trillion is going to clean energy, including renewable power, nuclear, grids, storage, low-emission fuels, efficiency improvements and end-use renewables and electrification. For every $1 spent on fossil fuels, $1.7 is now spent on clean energy. Five years ago this ratio was 1:1.

FIGURE 13 **The price of solar modules declined by 99.6% since 1976**

Price per Watt of solar photovoltaics (PV) modules (logarithmic axis)
The prices are adjusted for inflation and presented in 2019 US$.

Source: Roser, Max, "Why did renewables become so cheap so fast?", Our World in Data, 1 December 2020, https://ourworldindata.org/cheap-renewables-growth (accessed 17 May 2023).

Like wind and solar, the giga scale and industrialization of advanced solutions have the potential to drive down costs – thus, there is a need to exponentially accelerate the speed and scale of their deployment. For example, to be on the path to net zero by 2050, the energy system needs to see battery storage capacity grow 15 times[22] and carbon capture, usage and storage 40 times[23] by 2030. Similarly, the clean hydrogen market is expected to grow from $0.5 billion to $120 billion[24] and advanced biofuels from $3 billion to $180 billion.[25]

Deployment at this scale needs to be backed by significant capital. The IEA notes that $0.9 trillion needs to be invested by 2030 to modernize electricity networks and build public electric vehicle charging stations, hydrogen refuelling stations, direct air capture and CO_2 pipelines, storage facilities, and import and export terminals. Further, $1.7 trillion needs to be invested annually in low-carbon technologies in end-use sectors.[26] Most of this investment will need to come from the private sector, supported by public policies that create incentives and set appropriate regulatory frameworks.

A growing number of investors from both specialized and larger infrastructure funds are actively seeking opportunities in the sector. Moreover, governments provide strong support through policies aiming to multiply clean energy investments. Innovative capital market instruments, such as green bonds, open additional avenues to increase funding. The green bonds market experienced spectacular growth from $36 billion worth of issuances to $270 billion in 2020.[27] Subsequently, an increasing number of projects are being announced and deployed. The IEA has observed that, "announced [electric vehicle] battery production capacity for 2030 is only 15% lower than the level of battery demand underpinning the IEA's Net Zero Emissions Scenario" and "cumulative output of electrolyser manufacturing capacity could reach 380 GW by 2030, which is still little more than half of 2030 needs" in that scenario.[28]

However, it is often difficult for investors to find opportunities that match their profile in terms of scale and maturity. The risk appetite of financial institutions is not always tailored to support advanced solutions. This is a challenge in emerging markets and developing economies, causing them to receive a small fraction of investments. In addition, sovereign and currency risks, the lack of standards and regulations, and slow permitting processes remain significant barriers to clean energy investments in these economies.

Achieving the needed pace and scale of growth and investments requires innovators, large energy producers and users, and investors to form partnerships and play their part. To aid in this process, the World Economic Forum is producing the "Handbook for Exponential Deployment of Advanced Energy", which will include a set of strategic recommendations for these key stakeholders to expand and accelerate the deployment of advanced energy solutions. This initiative, led by the Forum's Advanced Energy Solutions community, engages leaders in frontier, fast-growing segments of the energy system and seeks to help eradicate the green premium and maximize co-benefits.

5 Conclusion

Several environmental, macroeconomic and geopolitical events over the past decade have affected the energy system in myriad ways and highlighted the complexities of the energy transition. Over the past decade, the world has made significant strides towards transitioning to low-carbon energy systems, although not at the pace required to achieve net-zero emissions by 2050. **The lack of consistent and balanced progress for many countries highlights the challenge of navigating the energy transition.**

By elevating energy security to be a cornerstone of the framework, advances in the secure dimension can be seen as countries aim for a stable and secure supply of energy to maintain economic growth, national security and the well-being of their populations. **Very few countries, however, are advancing momentum across the equitable, secure and sustainable dimensions, and improvements in security are being delivered at the expense of the others.** The strong competition for secured access to gas suppliers and stocks replenishment, along with concerns about security of supply, pose significant challenges for the upcoming winter. Additionally, some areas will come under future scrutiny, such as the importance of critical raw materials, upcoming regulatory obligations for reporting on sustainable investments, and the vulnerability of energy systems to extreme weather events.

While a decarbonized future energy system can provide energy security dividends from abundant and localized low-carbon energy sources, ensuring energy security and affordability through the transition will require fossil fuels in the medium term.[29] **Countries will need to adjust demand and improve economics of supply to minimize emissions. Cleaner energy sources and technologies will be required in the next two to three years to meet 2030 targets and limit the effects of climate change.** Most of these have existed for decades but will need greater and more targeted investment or incentives. To ensure an equitable transition, greater investment will also be required in skills training, research, innovation and incentives to build sustainable supply chains that protect ecosystems and cultures.[30] Policies have emerged but require implementation.

The focus of the energy transition needs to shift to more populous and developing nations in Asia, Latin America, Africa and the Middle East, as they account for a significant portion of the world's population as well as global carbon emissions. While several countries are committing to the energy transition and have vast renewable energy resources, they lack the finances and technical know-how to develop them fully. By collaborating and providing support, a more secure, sustainable and equitable future can be found for many. Bolstering the enabling environment will put these countries on the leading edge.

As for the upcoming COP28 summit, which will include the conclusion of the first Global Stocktake, an assessment of the world's progress towards achieving its climate goals. The stocktake will capture what countries and stakeholders are doing or failing to do to fulfil the Paris Agreement. What is clear from this year's ETI, however, is that **countries must move at a faster pace than they are now to transform their energy systems; moreover, the window for such effort is closing.** The actions taken in the early years of this decade of delivery will be critical in ensuring that strong, long-term ambition is supported by immediate progress.[31] The focus must be on enhancing an equitable transition, which has been traded off rather than enabled by the focus on the secure and sustainable dimensions. The energy transition must be made resilient to maintain speed under current volatilities and during potential future domestic or international disruptions.

6 Country performance profiles

These countries stand out for laying the groundwork for a robust energy transition.

Germany

ETI Score
67.5

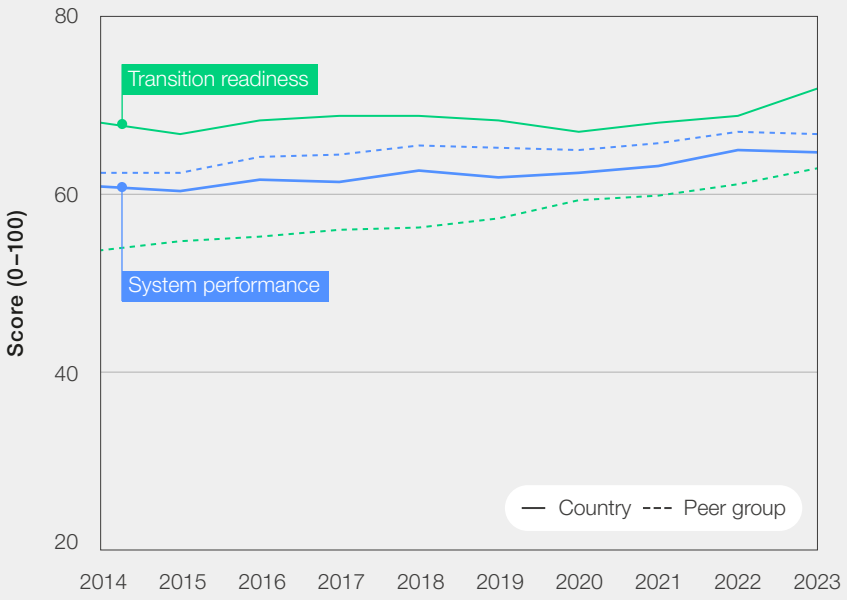
Rank
11/120

Key macroeconomic and ETI data

Population (millions)	83.2	Energy consumption per capita (GJ/capita)	140.1
GDP ($ trillions)	4.26	Energy intensity (MJ/$2017 PPP GDP)	2.70
Net energy imports (% of energy use)	65.0	CO_2 intensity (CO_2/TPES)	50.62

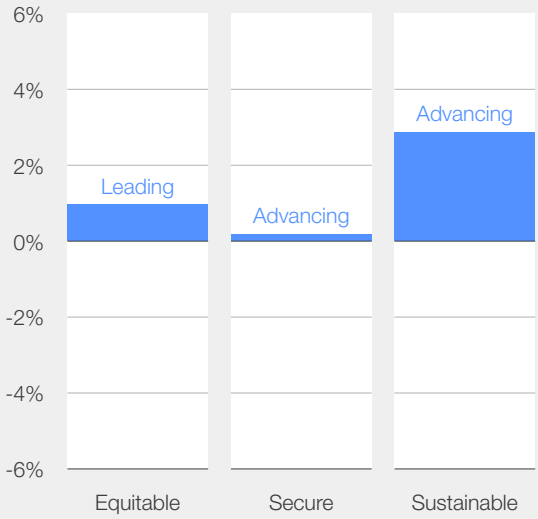
Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023



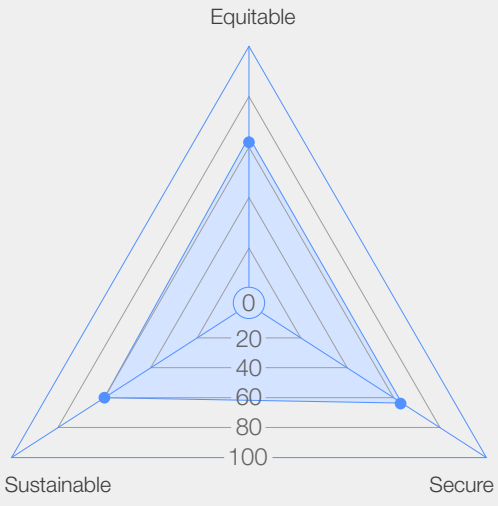
Energy transition current assessment

Momentum

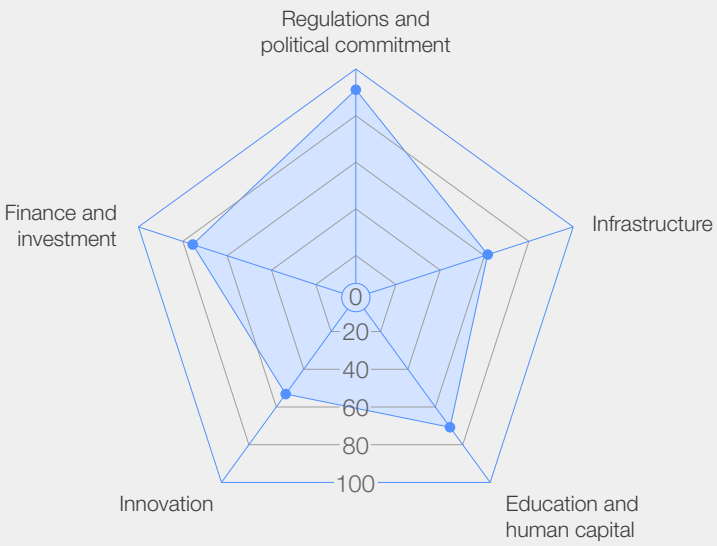


Note: [a] Relevant World Economic Forum peer group: Advanced economies
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Reduce GHG emissions by at least 55% by 2030 compared to 1990
- Achieve net-zero emissions by 2045

Energy policy priorities

- Cover at least 80% of gross electricity consumption by renewable sources by 2030
- Have at least 15 million electric cars in 2030
- Install 1 million public charging points with non-discriminatory access by 2030
- Phase out coal-fired power generation by 2038
- Reduce primary energy consumption by 50% by 2050

Country analysis

Key progress on ETI

Germany is the fourth-largest economy in the world and ranks 11 out of 120 countries on the ETI 2023. Since 2014, Germany's score on the ETI has increased by 6%, which shows both the robustness of its energy transition efforts and the challenges large economies face in improving quickly. Within system performance, Germany's scores on the secure and sustainable dimensions have improved, driven largely by supply security, an increase in share of renewable energy in the electricity mix and strong reductions in the energy intensity of the economy. Even though the carbon intensity of the overall energy mix has declined over the years by 9%, it remains relatively high, owing to persistent challenges in decarbonizing hard-to-abate sectors, such as heating, transport and heavy industry. Germany ranks fifth globally on transition readiness, which provides an assessment of the enabling environment for energy transition, as it is one of the top three countries on regulation and political commitment.

Key imperatives and policies in place

The core elements of Germany's energy transition are improving energy efficiency and expanding renewables as quickly as possible. The government has invested in the development of energy-efficient technologies and infrastructure, such as smart grids and electric vehicle charging stations. This has resulted in Germany now producing over 40% of its electricity from renewables,[32] having set a goal of reaching 80% by 2030.[33] The country has introduced several policies aimed at increasing the share of renewables in the energy mix, phasing out nuclear power (with the last plant closing in April 2023) and reducing GHG emissions, resulting in the country becoming a leader in the energy transition. The *Energiewende* (energy transition) was instituted nearly a decade ago as a plan for transforming the energy system, making it more efficient and supplied mainly by renewable energy.

The German Renewable Energy Sources Act has played a significant role in the transition by providing a legal framework and financial incentives for the expansion of renewable energy sources. This, together with the Energy Industry Act, forms the legal basis of the German energy industry and provides "a framework policy to enhance competition, security of supply and sustainable energy production … Furthermore, this Act stipulates supplementary provisions for the access of electricity from renewable sources to the grid as well as the construction of intelligent grids including electricity storage. In 2012 the law was amended to speed up the expansion of offshore wind farms. The major focus is on a system change towards a consistent and efficient offshore grid expansion by introducing a binding offshore grid development plan".[34] The government also passed a law in 2020 that required phasing out all coal-fired electricity generation no later than 2038; the timeline was recently brought forward to 2030. The net result of these policies is reflected in the country's high ETI scores on regulation and political commitment, as well as decarbonized and clean energy.

What's next?

Energy transition remains a process as Germany's diversification of its energy mix is not purely focused on sustainability and efficiency gains but also on security. Over-reliance on imported gas from Russia and high energy prices were the main challenges faced by Germany during the energy crisis. The Russia-Ukraine war prompted the government to institute emergency measures, such as building LNG regasification capacity and delaying coal plant closures, which slowed down the transition momentum and locked in more emissions in the system. To ensure reduced dependence on Russian gas and accelerate the longer-term transition in Germany, the government has instituted numerous amendments to existing laws and funding programmes that primarily focus on enhancing the nation's renewable energy capabilities, particularly in onshore wind; increasing the volume of renewable power auctions; and speeding up grid planning and the growth of offshore wind connections to carry electricity generated from wind power in northern Germany to large industrial complexes in the south. Additional actions, such as "creating the legal and financial frameworks for carbon contracts for difference, an instrument that supports industry in transitioning to climate-neutral production processes",[35] promoting research and development in green hydrogen to create modern future-oriented climate protection technologies, and forming strategic partnerships, could help ensure an orderly energy transition in Germany and provide lessons for other countries.

United States

ETI Score
66.3

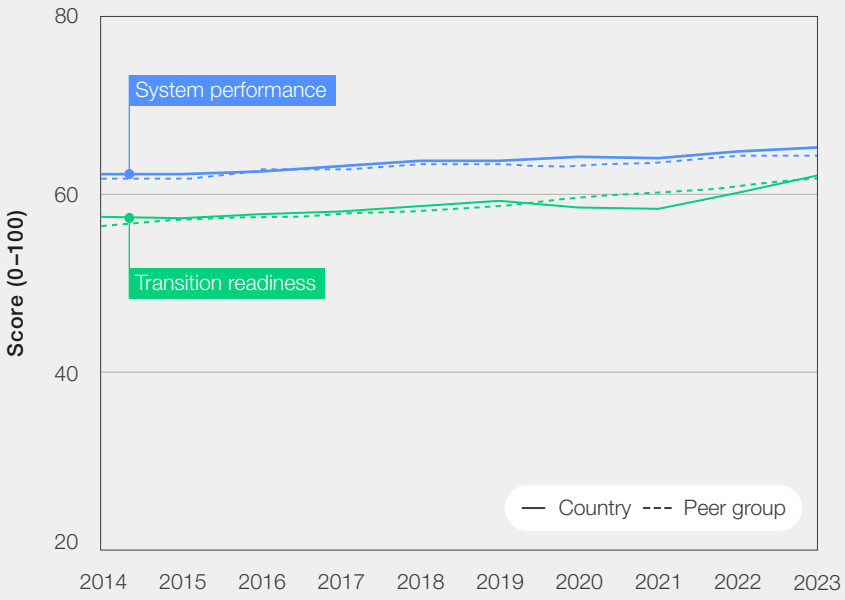
Rank
12/120

Key macroeconomic and ETI data

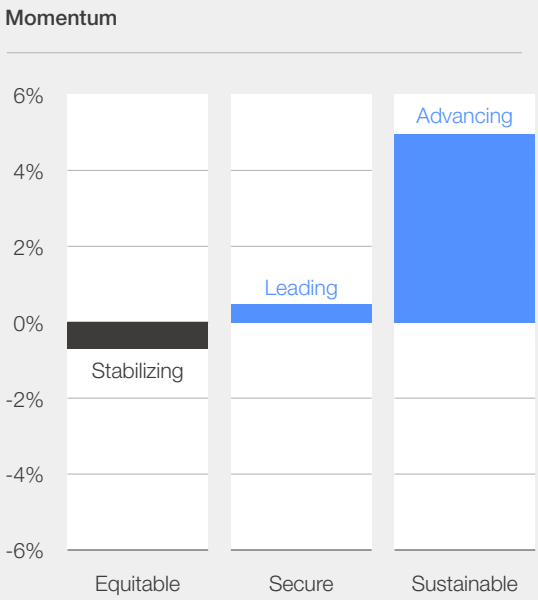
Population (millions)	331.9	Energy consumption per capita (GJ/capita)	257.4
GDP ($ trillions)	23.32	Energy intensity (MJ/$2017 PPP GDP)	4.27
Net energy imports (% of energy use)	-4.0	CO_2 intensity (CO_2/TPES)	49.90

Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023

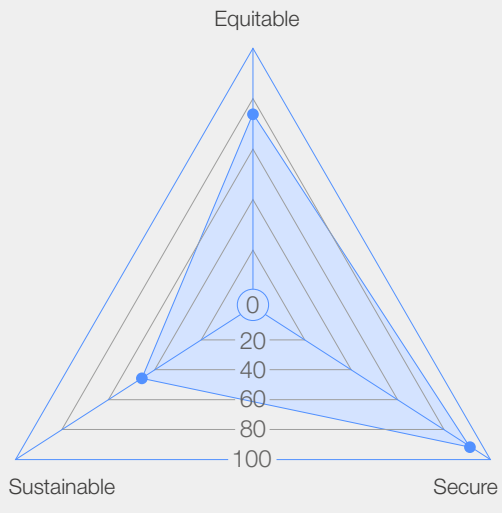


Energy transition current assessment

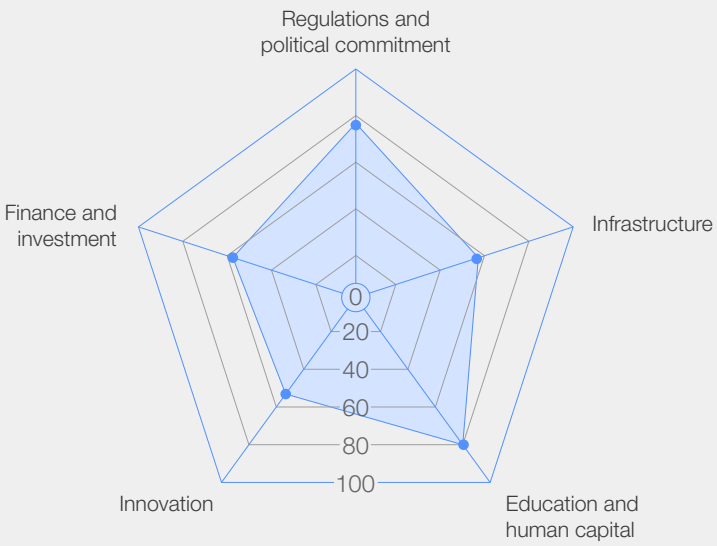


Note: [a] Relevant World Economic Forum peer group: Advanced economies
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Achieve an economy-wide target of reducing net GHG emissions by 50-52% below 2005 levels in 2030
- Achieve net-zero emissions by 2050
- Reach 100% carbon pollution-free electricity by 2035

Energy policy priorities

- Reduce energy waste
- Electrify and drive efficiency in vehicles, buildings and parts of industry
- Scale up new energy sources and carriers, such as carbon-free hydrogen

Country analysis

Key progress on ETI

The United States (US) ranks 12 out of 120 countries on the ETI 2023. The overall ETI score for the US has seen a 10% gain over the past 10 years, driven by improvements in system performance, particularly in the secure and sustainable dimensions. Within the sustainable dimension, energy intensity and CO_2 emissions per capita saw marked gains since 2014, falling by 20% and 22%, respectively. The focus on sustainability is further highlighted by the country's momentum in this dimension. Within transition readiness, further improvements can be found in areas such as renewable capacity buildout; development of low-carbon jobs; public research, development and demonstration; and sustaining a stable regulatory framework and political commitments.

Key imperatives and policies in place

The country's ageing energy infrastructure poses significant challenges for the energy transition, which requires massive deployment of energy efficiency and renewable energy, a nationwide modernization and expansion of the electricity grid, and broadening accessibility and affordability of clean energy technologies. Achieving this in an equitable way requires directing energy infrastructure and resilience investments to communities and industries that, until now, have struggled to transition. In recent years, several policies have been implemented in the US to accelerate the energy transition. The federal government set ambitious targets for reducing GHG emissions, encouraged the deployment of renewable energy technologies through tax credits and grants, and established mandatory renewable energy standards at the state level. Furthermore, the private sector has made substantial investments in clean energy research and development, and in the deployment of renewable energy projects. The net result of these efforts is reflected in the country's high ETI scores on regulation and political commitment and decarbonized energy, showing that the US is now well positioned as a leader in the global transition towards a low-carbon, sustainable energy future.

Two notable policies that appear to be working well for the US are the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA). "The BIL includes significant funding for transmission and grid improvements ($75 billion), increasing resilience of the nation's natural and physical infrastructure ($50 billion), investing in a national electric vehicle charging infrastructure ($7.5 billion), and reducing methane emissions from orphaned oil and gas wells ($4.7 billion)."[36,37] One of the BIL's most significant features is the creation of the Office of Clean Energy Demonstrations (OCED), dedicated to supporting "demonstration projects in clean hydrogen, carbon capture, grid-scale energy storage, small modular reactors, and beyond. With over $20 billion in initial funding, the OCED will fund research and development and proof-of-concept projects that seek to galvanize follow-on private sector investment to deploy clean technologies".[38] The IRA provides positive incentives to support the energy transition in "the form of clean energy tax credits along with programs and pools of finance for commercial and emerging clean technologies, infrastructure, and products", and local content requirements. "It commits roughly $369 billion in funding for climate and clean energy provisions", and it is estimated it will "reduce US net emissions by 32% to 42% below 2005 levels by 2030, compared to 24% to 35% without it, and scale clean generation to supply up to 81% of all electricity".[39]

What's next?

Projections from these policies suggest a huge potential for the US energy transition and provide many clean energy companies with the certainty they require. The relationship between incentives provided, capital invested and the effect of emissions, however, is not always straightforward. Additional lessons for the US were identified to enable a more orderly transition.[40] These include "designing and deploying a capital-efficient and affordable system; strengthening supply chains to provide stable access to raw materials, components, and skilled labour; securing access to adequate land with high load factors for the deployment of renewables while taking into account the needs of local communities; reforming transmission development to include proactive planning, fast-track permitting, and systematic consideration of transmission alternatives; creating market mechanisms for expanding firm capacity to ensure reliable and adequate clean energy supply; and accelerating technological innovation to ensure timely deployment of new clean technologies".[41] Without these additional elements, many of the clean energy benefits on offer may be lost.

United Kingdom

ETI Score
66.2

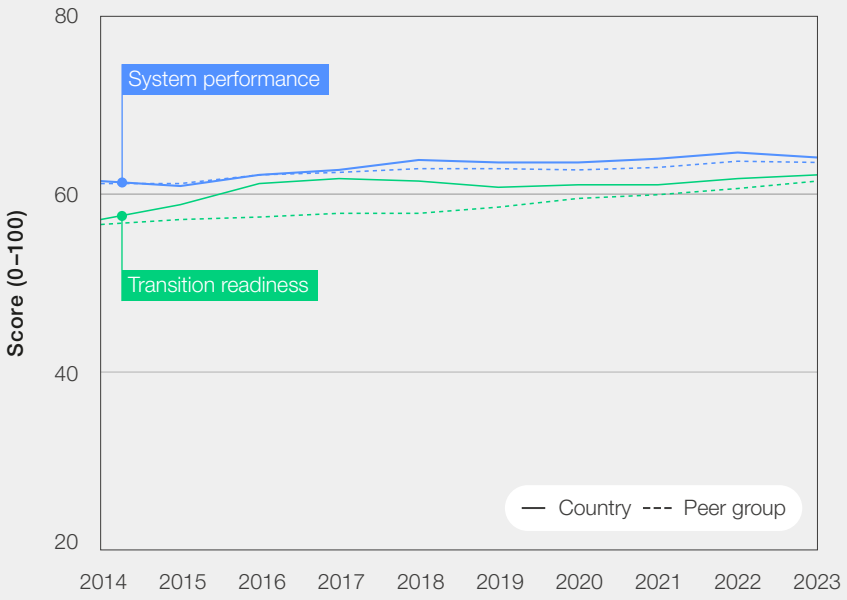
Rank
13/120

Key macroeconomic and ETI data

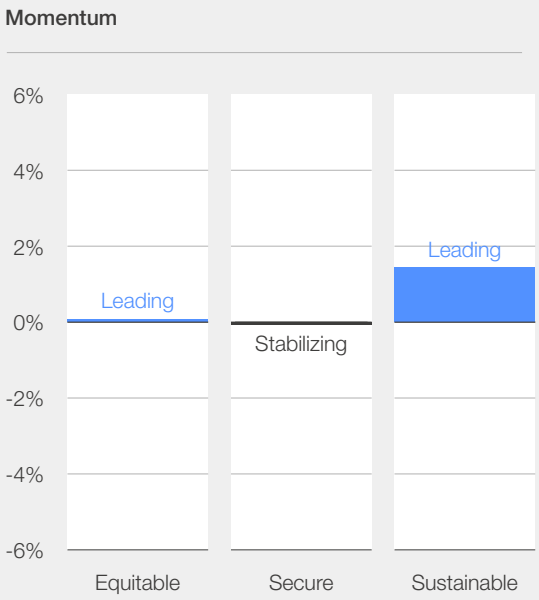
Population (millions)	67.3	Energy consumption per capita (GJ/capita)	96.07
GDP ($ trillions)	3.13	Energy intensity (MJ/$2017 PPP GDP)	2.29
Net energy imports (% of energy use)	28.1	CO_2 intensity (CO_2/TPES)	46.96

Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023

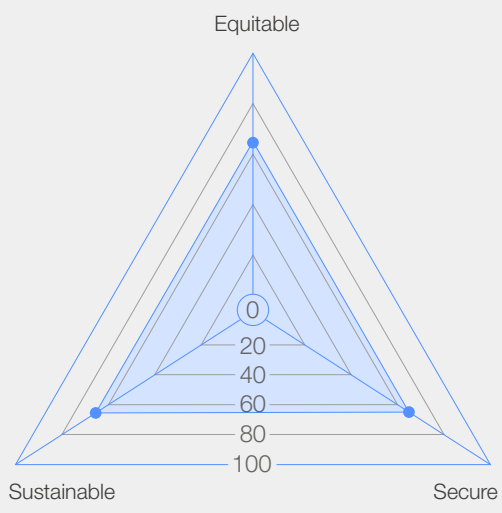


Energy transition current assessment

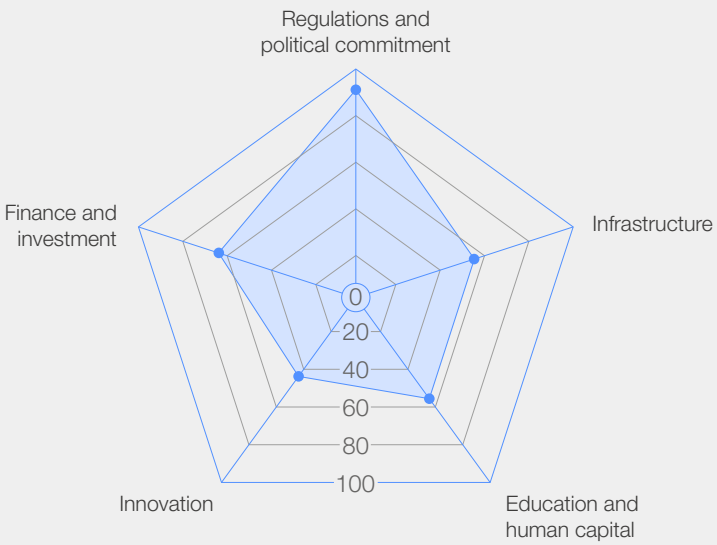


Note: [a] Relevant World Economic Forum peer group: Advanced economies
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Reduce emissions by at least 68% by 2030 compared to 1990
- Achieve net-zero emissions by 2050

Energy policy priorities

- Achieve 50 GW of power annually from offshore wind by 2030, 70 GW of power annually from solar by 2035, and build new nuclear power stations to generate 24 GW of power annually by 2050
- Achieve 5 GW of low-carbon hydrogen production capacity by 2030ns to generate 24 GW of power annually by 2050
- Accelerate the shift to zero-emission vehicles
- Invest in carbon capture, usage and storage – four sites by 2030, capturing up to 10 metric tonnes of CO_2 emissions per year

Country analysis

Key progress on ETI

The United Kingdom (UK), ranking 13 out of 120 countries on the ETI 2023, has seen an 11% improvement in its ETI score over the last 10 years. It has been a consistent performer, demonstrating a strong enabling environment for energy transition, particularly on dimensions such as education and human capital, infrastructure, and regulation and political commitment. The UK's momentum has stabilized in the secure dimension but continues to lead in equitable and sustainable. As reported by Thanet District Council, "in 2019, the UK became the first major economy in the world to legislate a binding target to reach net zero emissions by 2050".[42] Coal has been phased out of power generation ahead of schedule, and the share of renewables in the energy mix has increased.

Key imperatives and policies in place

The UK's legal framework, including the 2008 Climate Change Act, has provided stability and consistency for investors and businesses, contributing to the success of renewable energy deployment and emissions reduction. The energy policy, however, has undergone several changes in recent years, creating uncertainty in the market, and recent reports have highlighted the need to provide long-term policy commitments and regulations.[43] Even so, the country has made significant investments in offshore wind, with one of the largest installed capacities globally, and is considered a leader in this space. The development of a large domestic supply chain for offshore wind energy has also created jobs and economic growth, which is reflected in the high ETI scores for human capital.

Nuclear power is seen as a key part of the UK's low-carbon energy mix, with recent investments to replace ageing infrastructure and introduce new facilities. The government's ambition to increase solar energy generation capacity by up to 70 gigawatt (GW) by 2035 demonstrates its commitment to diversifying its energy mix further.[44] To reduce emissions from hard-to-abate sectors, the UK is investing £20 billion over the next two decades to scale up its carbon capture sector.[45] With its 2023 International Climate Finance (ICF) Strategy, the UK aims to double ICF to £11.6 billion between 2021-2022 and 2025-2026. It seeks to further accelerate the transition in both energy-producing and energy-consuming sectors by rapidly expanding the portfolio of renewable investments; working through coalitions and partnerships under the Breakthrough Agenda; increasing investments in research and development of low-carbon technologies; strengthening governance, policy and regulatory frameworks and strategic energy systems planning; and deploying clean energy projects in energy intensive industries.[46]

Dependence on oil and gas has left the UK exposed to the global fossil fuel price shock. Annual "gas and electricity price increases to April 2022 were the largest ever recorded in a series going back to 1970, and have continued to rise as Russia has restricted the supply of gas to continental Europe", increasing concerns about energy affordability and security.[47] To overcome these challenges, the government has been actively transitioning its energy sector to meet its 2050 net-zero target, focusing on the production, distribution and consumption of energy in more sustainable ways. A British Energy Security Strategy was published, aiming to decarbonize the electricity system and "set strong and stretching targets for the roll-out of low-carbon electricity generation" in the coming decade, though much of the strategy focuses on "electricity generation and oil and gas supply".[48]

What's next?

The UK faces challenges with its grid, so any lessons learned in this space could be applied to others as well. To deliver genuine energy security, the country is prioritizing improving energy efficiency and reducing energy demand by implementing policies to improve energy efficiency in buildings, transport and industry. The Heat and Buildings Strategy includes a phase-out of gas boilers by 2035 and the installation of 600,000 heat pumps per year by 2028.[49] The Future Homes Standard also sets new standards and regulations to reduce carbon emissions in new homes from 2025, acting as an incentive for solar installations in housing developments.[50] The UK has brought forward its target date for discontinuing the sale of new petrol and diesel cars in favour of electric vehicles from 2040 to 2030.[51] Backed by a £1.6 billion investment from the Electric Vehicle Infrastructure Strategy, the UK plans to expand its charging network to have 300,000 public chargers by 2030.[52]

Brazil

ETI Score
65.9

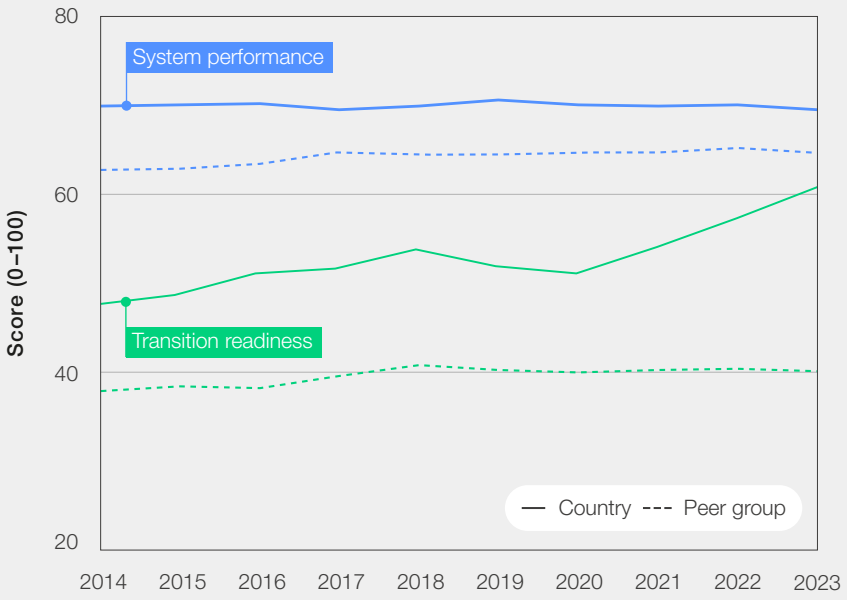
Rank
14/120

Key macroeconomic and ETI data

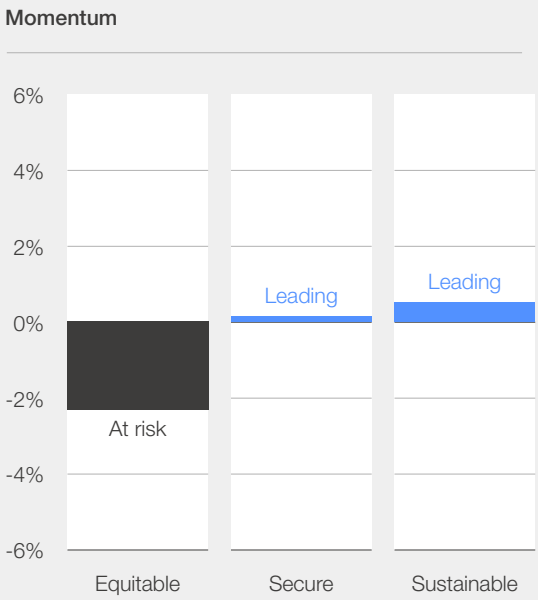
Population (millions)	214.3	Energy consumption per capita (GJ/capita)	56.21
GDP ($ trillions)	1.61	Energy intensity (MJ/$2017 PPP GDP)	4.00
Net energy imports (% of energy use)	-11.1	CO_2 intensity (CO_2/TPES)	32.44

Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023

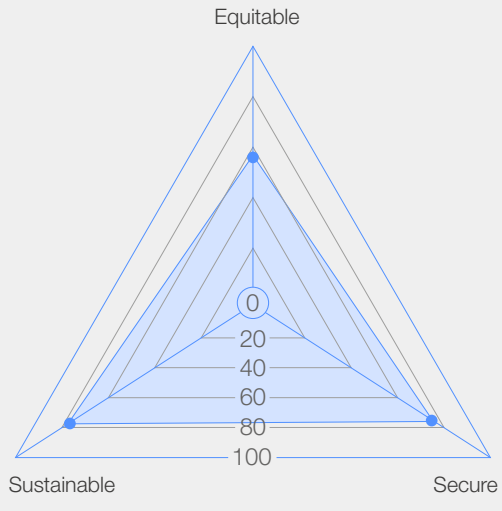


Energy transition current assessment

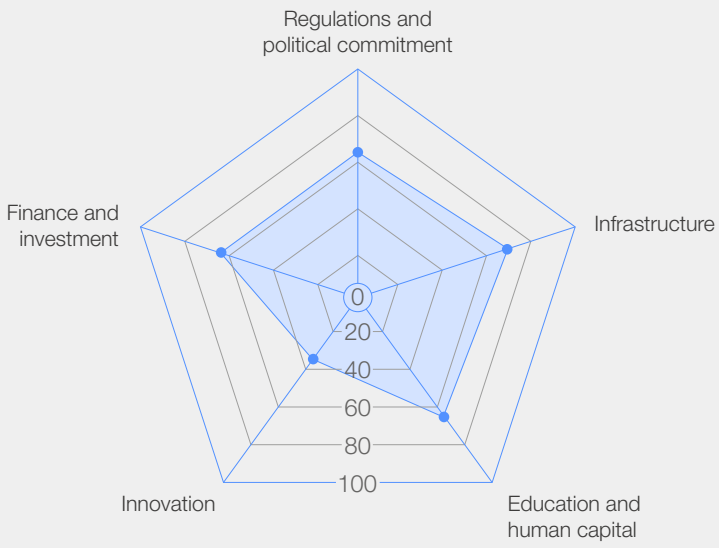


Note: [a] Relevant World Economic Forum peer group: Latin America and the Caribbean
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Achieve climate neutrality by 2050
- Reduce GHG emissions from 2005 levels by 37% by 2025, and by 50% by 2030
- Achieve a 45% share of renewables in the energy mix by 2030
- Achieve an 18% share of sustainable biofuels in the energy mix by 2030

Energy policy priorities

- Expand biofuel consumption, increase ethanol supply and raise the share of advanced biofuels and biodiesel in the mix
- Increase the share of renewables beyond hydropower to generate electricity to between 28% and 33% by 2030
- Achieve 10% efficiency gains in the power supply by 2030

Country analysis

Key progress on ETI

Brazil is the ninth-largest economy in the world[53] and ranks 14 out of 120 countries on the ETI 2023. The overall ETI score for Brazil has seen an 8% improvement since 2014, having slipped slightly in 2020 and then increasing again. Brazil's scores on transition readiness have seen a significant improvement over the years. Today, Brazil ranks among the top 14 countries on sustainability of the energy system, owing to its high share of renewables in the energy mix, with 80% of its electricity coming from large hydropower plants.[54] Investments in wind and solar generation have also increased significantly in recent years, making Brazil's electricity sector one of the least carbon-intensive in the world. Recent droughts, however, have caused the country to rely on more expensive thermal power plants and imports to meet its electricity demand, resulting in some challenges across the equitable, secure and sustainable dimensions within system performance.

Key imperatives and policies in place

While Brazil has made progress in creating a robust enabling environment for energy transition – in terms of building a stable regulatory environment to attract capital and investment and building infrastructure to facilitate energy transition – more effort is needed to provide a stable policy environment backed by ambitious targets to accelerate the transition. The government's main goal is to structure the public policies needed to place the country as a world leader in clean energy while also leveraging its significant oil and gas resources. Brazil has already implemented several policies to transition towards a more sustainable and low-carbon energy system. The Auctions for Renewable Energy Support programme was launched in 2004 to encourage the installation of new renewable energy projects through a competitive bidding process. These auctions have not only helped reduce the cost of renewable energy in Brazil, making it more competitive with traditional energy sources, but have also been successful in attracting significant investment in the sector. With the A-3 and A-4 auctions in July 2021, the government allocated 420 MW of wind and 270 MW of solar, as well as biomass and hydro.[55] In addition, the Brazilian Development Bank recently approved $650 million in financing for wind and solar energy projects.[56] The net results of these policies are reflected in the high ETI scores on regulation and political commitment, infrastructure, and financial investment.

Brazil has become the largest producer of wind energy in Latin America[57] and ranks among the top 10 largest producers in the world.[58] The Programme of Incentives for Alternative Electricity Sources paved the way to create local manufacturing capacity for wind turbines and the components industry.[59] The country has also implemented net metering and the Energy Compensation System for Micro and Mini-Generation to promote distributed solar generation, which currently makes up 70% of its installed capacity.[60] Brazil's national biofuels policy, RenovaBio, came into effect in 2020 and set transportation emission targets, using decarbonization credits to encourage biofuel production and consumption. RenovaBio also promotes the development of advanced biofuels with even lower emissions and has succeeded in making Brazil the second-largest biofuel producer globally.[61]

What's next?

Brazil, with a large and complex grid system that has not fully kept up with the demands of the energy transition, loses about 16% of the power it generates. Historically, Brazil has lacked investment in new grid infrastructure, particularly in remote areas where the potential for renewable energy development exists. A recent World Economic Forum report[62] highlights opportunities for the country to unlock clean energy investments through innovative solutions and collaborative actions, focusing on three areas for acceleration: distributed generation, hydropower modernization and clean energy access for isolated systems. These lessons can also be applied to other countries at similar levels of clean energy development. The proposed solutions include the creation of a distributed generation financing toolbox to support developers and financiers; suggestions of regulatory changes to remove barriers to the commercialization of hydropower plant services; climate risk and resilience mapping for hydropower generation assets; raising awareness of the Climate Bond Standard Hydropower Criteria among potential investors; and creating a platform for existing independent power producers to find developers as well as technical, marketing and financial support to integrate renewables and create hybrid generation models in isolated systems.

China

ETI Score
64.9

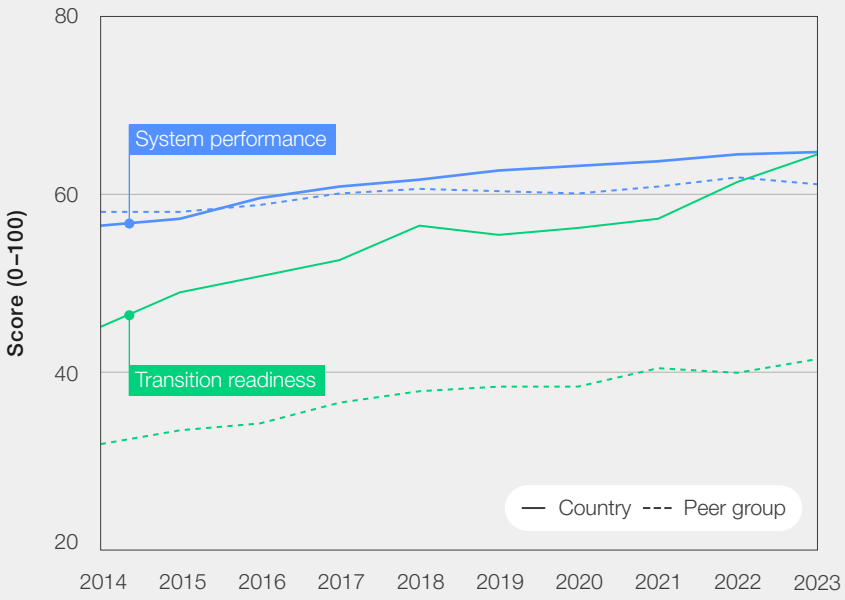
Rank
17/120

Key macroeconomic and ETI data

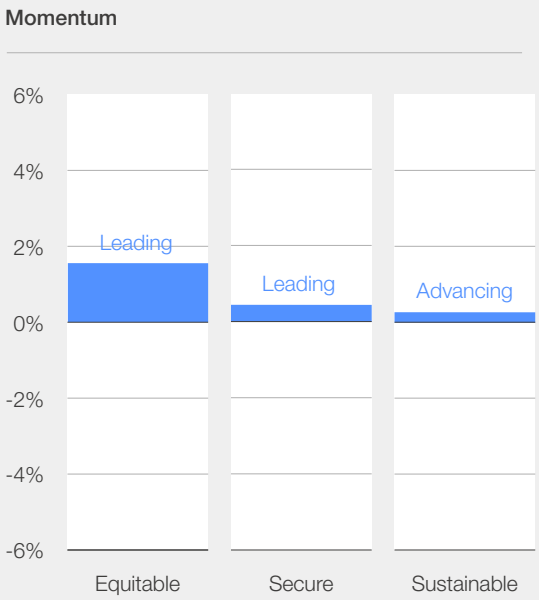
Population (millions)	1412.4	Energy consumption per capita (GJ/capita)	103.8
GDP ($ trillions)	17.73	Energy intensity (MJ/$2017 PPP GDP)	6.37
Net energy imports (% of energy use)	23.0	CO_2 intensity (CO_2/TPES)	68.81

Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023

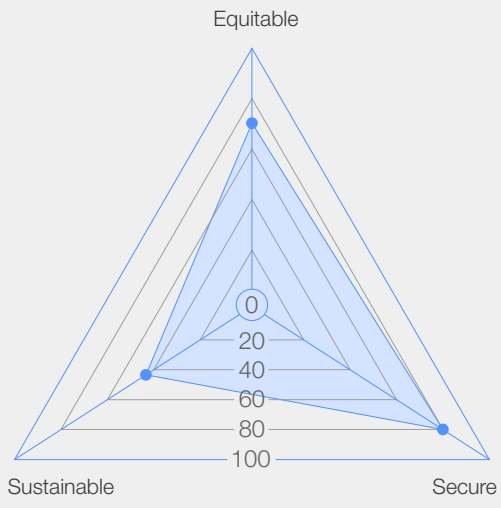


Energy transition current assessment

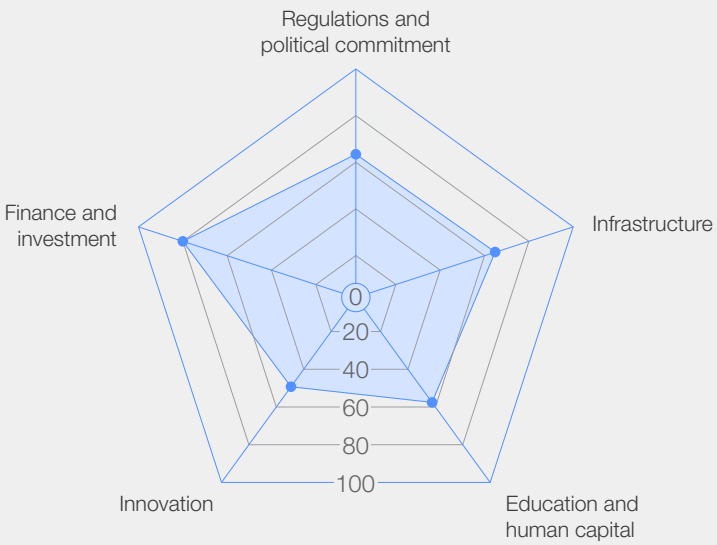


Note: [a] Relevant World Economic Forum peer group: Emerging and developing Asia
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Have CO_2 emissions peak before 2030 and achieve carbon neutrality before 2060
- Lower CO_2 emissions per unit of GDP by over 65% from the 2005 level

Energy policy priorities

- Achieve 3,300 terawatt-hours of annual renewable energy generation by 2025
- Have renewables account for 33% of energy consumption by 2025
- Achieve over 1.2 terawatts of wind and solar power capacity by 2030
- Strictly control coal-fired power projects during the 14th Five-Year Plan (FYP), and phase them down in the 15th FYP

Country analysis

Key progress on ETI

China ranks 17 out of 120 countries on the ETI 2023 and is a new entrant in the top 20 countries. It is among the biggest producers and consumers of energy in the world while also being one of its biggest GHG emitters, currently accounting for one-third of the total global GHG emissions. China has maintained a consistent upward trajectory on the ETI over the past 10 years, improving strongly on system performance and transition readiness. Scores on the secure dimension within system performance have improved, mainly through better quality of electricity supply diversification and associated grid improvements. Sustainable scores, however, remain low on an absolute scale as coal is still the main fuel for generation, accounting for 60% of total power output[63] despite large amounts of renewable energy capacity financed and installed over the years.

Key imperatives and policies in place

China's attempts to improve the enabling environment for energy transition are steps in the right direction, evidenced by President Xi Jinping's September 2020 commitment at the UN General Assembly to reach peak carbon emissions before 2030 and achieve carbon neutrality by 2060.[64] China is emerging as a world leader in innovation: public spending on research and development has risen by 35% since 2014.[65] In pursuing carbon neutrality, however, China faces the challenge of ensuring continued energy security while shifting away from fossil fuels. Nonetheless, in recent years, the theme of China's energy industry has been green development, with several policies and measures designed to accelerate the energy transition, the net results of which are reflected in its high ETI score on regulation and political commitment.

In June 2022, China released its 14th FYP on Renewable Energy Development (2021-2025). As reported by the Energy Foundation, it is "a comprehensive blueprint for further accelerating [its] renewable energy (RE) expansion. The plan targets a 50 percent increase in renewable energy generation (from 2.2 trillion kWh in 2020 to 3.3 trillion kWh in 2025), establishes a 2025 renewable electricity consumption share of 33 percent (up from 28.8 percent in 2020), and directs that 50 percent of China's incremental electricity and energy consumption shall come from renewables over the period 2021-2025. … The RE plan is the second major energy-related 14th FYP released [in 2022]. … [It] establishes detailed targets for primary energy mix, power generation rate, electrification rate, and more. …These two FYPs together reaffirm China's commitment to honouring its carbon pledges through accelerated RE growth".[66]

China has done a great deal to use green finance to increase renewables, investing over $380 billion in 2021, and being one of the first countries to issue a green bond project catalogue, to develop its own Green Bond Principles and to work with the EU to develop the Common Ground Taxonomy.[67] One of the most significant efforts in this surge was powering industrial clusters with green and renewable electricity. China's environmental ministry also proposed to support exploration of near zero-carbon emissions and carbon neutrality pilot demonstrations. Simultaneously, the country is promoting construction of large-scale renewable energy bases, distributed development of wind and photovoltaic in the central and south-east regions, integrated development of water and solar bases in the south-west region, and centralized development of offshore wind in eastern coastal areas.

What's next?

The energy transition in China requires a huge shift in resources, innovation and new technologies to enhance energy efficiency and resource productivity. A recent World Bank report estimates that China will need between $14 trillion and $17 trillion in additional investments up to 2060 for green infrastructure and technology in the power and transport sectors alone[68] and highlights important lessons, including the need for public and private sectors to work together, "a more predictable regulatory environment as well as better access to markets and finance that would allow the private sector to play a central role in delivering market solutions, improving productivity, reducing costs, stimulating technological innovation, and filling the financial gap. … [In addition], training and reskilling workers from the fossil fuel sector and providing targeted assistance to the most affected local communities"[69] could ensure an equitable energy transition.

Canada

ETI Score
64.2

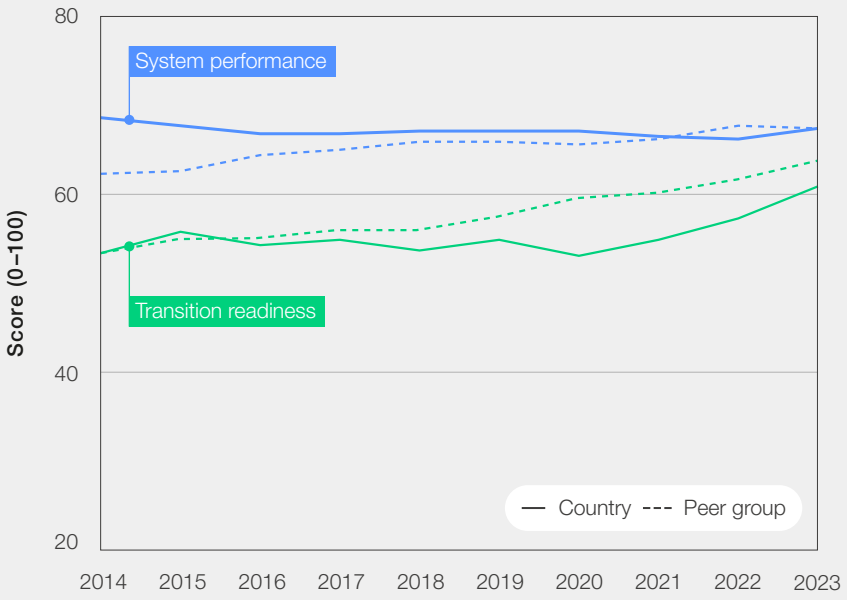
Rank
19/120

Key macroeconomic and ETI data

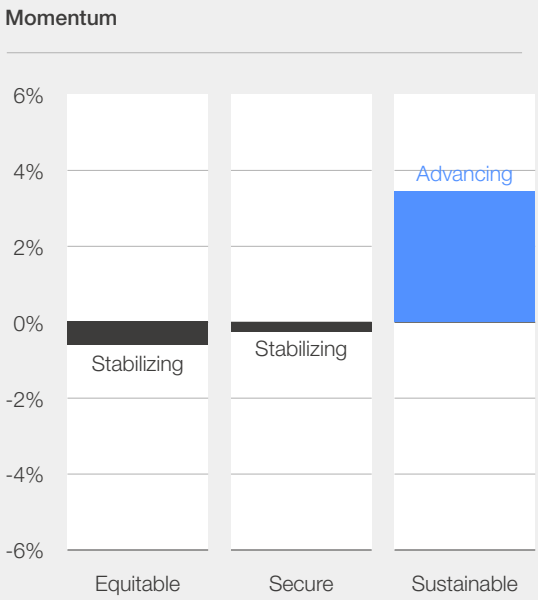
Population (millions)	38.25	Energy consumption per capita (GJ/capita)	312.2
GDP ($ trillions)	1.99	Energy intensity (MJ/$2017 PPP GDP)	6.77
Net energy imports (% of energy use)	-80.6	CO_2 intensity (CO_2/TPES)	42.78

Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023

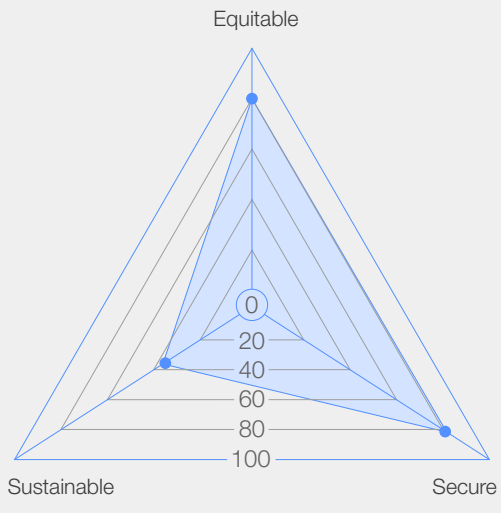


Energy transition current assessment

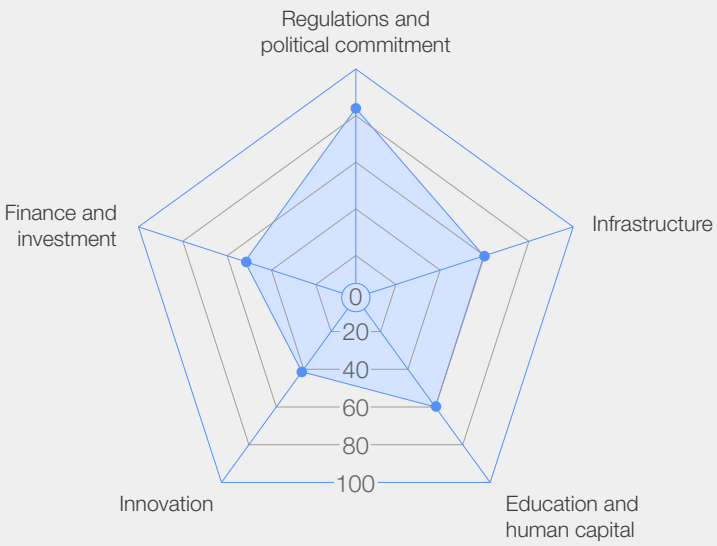


Note: [a] Relevant World Economic Forum peer group: Advanced economies
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Reduce emissions by 40-45% below 2005 levels by 2030
- Achieve net-zero emissions by 2050

Energy policy priorities

- Cut building energy waste through energy efficiency and fuel switching
- Rapidly scale up existing and new strategic clean technologies and the market for clean fuels
- Price carbon pollution, increasing the benchmark price by $15/ton/year, starting in 2023, rising to $170/ton in 2030
- Phase out coal-fired power plants by 2030

Country analysis

Key progress on ETI

Canada is the second-largest country in the world by land area[70] and ranks 19 out of 120 countries on the ETI 2023. With an overall ETI score that has remained fairly stable over the past decade, Canada has consistently ranked among the top 25, with strong results on system performance. Specifically, Canada is a global leader on the equitable and secure aspects of energy transition, as it is a major producer and exporter of oil, gas, hydroelectricity and uranium, and has a growing renewables sector. In recent years, however, Canada has fallen behind its peer group and challenges need to be addressed to accelerate the sustainability of its energy system. The country faces high energy intensity of its economy, high levels of energy consumption per capita and higher-than-average carbon intensity. Within transition readiness, Canada has shown increasing improvement on regulation and political commitment. In fact, the country is leading with bold measures which are critical for an effective energy transition, resulting in strong scores within country commitments.

Key imperatives and policies in place

Canada's vast geography poses challenges for transitioning to renewable energy, as many of the country's remote and northern communities rely on diesel generators for electricity, which are expensive to operate and emit high levels of GHGs. Building renewable energy infrastructure in these areas can be costly and logistically challenging. To better understand energy usage and engage with these communities, the federal government launched the Remote Communities Energy Database in 2018.[71] By providing valuable insights into energy consumption patterns and opportunities for renewable energy development, the database helps to shape the development of effective energy policies and programmes as well as support the transition to a low-carbon, sustainable energy system.

Energy production and use in Canada currently accounts for over 80% of its GHGs.[72] Production from oil sands is highly emissions-intensive, requiring large amounts of energy and water for extraction and processing. To reduce emissions, the federal government implemented a carbon pricing scheme in 2019, targeting a range of emissions including fuel combustion, industrial processes and waste disposal. The carbon price in May 2022 stood at CAD 50 per tonne of CO_2 emitted and is set to increase to CAD 170 per tonne by 2030.[73] Industry itself is also taking steps to reduce emissions, with oil and gas companies investing in carbon capture and storage technology. Furthermore, the federal government's launching of funds, such as the Low Carbon Economy Fund (in which the government is investing another CAD 2.2 billion for seven years, beginning in 2022-2023)[74] and the Canada Infrastructure Bank's strategy to invest CAD 35 billion,[75] provides support for renewable energy projects, energy efficiency measures, and research and development.

Indigenous communities play a substantial role in Canada's energy transition. To foster collaboration and partnership between those communities and the energy sector, the government has established various programmes and initiatives, including the Indigenous Off-Diesel Initiative, which was launched in 2018[76] and aims to transition remote indigenous communities from diesel-powered electricity to cleaner energy sources. It also seeks to enhance the capacity of indigenous communities through training, technical support and other resources required to develop and operate their energy projects.

What's next?

Like other major oil- and gas-exporting nations, Canada's energy infrastructure was designed to primarily support fossil fuel production and distribution, making it challenging to integrate renewable energy into the grid. One aspect of Canada's energy transition is its reliance on hydroelectricity, which also means its electricity is 83% non-emitting and among the cleanest in the world.[77] Many of the hydroelectric facilities, however, are located on or near Indigenous lands, which could affect the expansion of hydropower in these areas. Through careful planning, investment and community engagement, Canada could accelerate its transition towards a clean energy future and meet its GHG emissions goals. Other countries at similar levels of clean energy development could learn from Canada's trajectory.

Japan

ETI Score
63.3

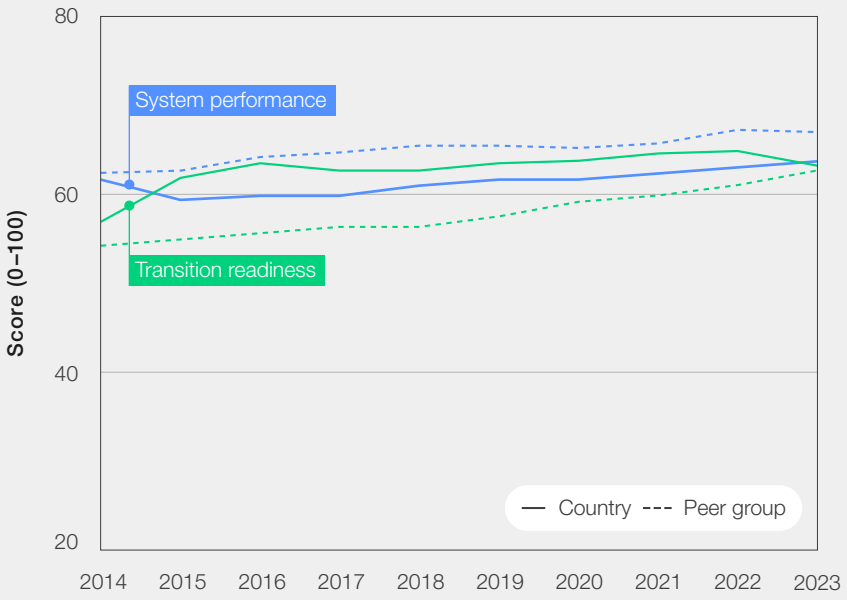
Rank
27/120

Key macroeconomic and ETI data

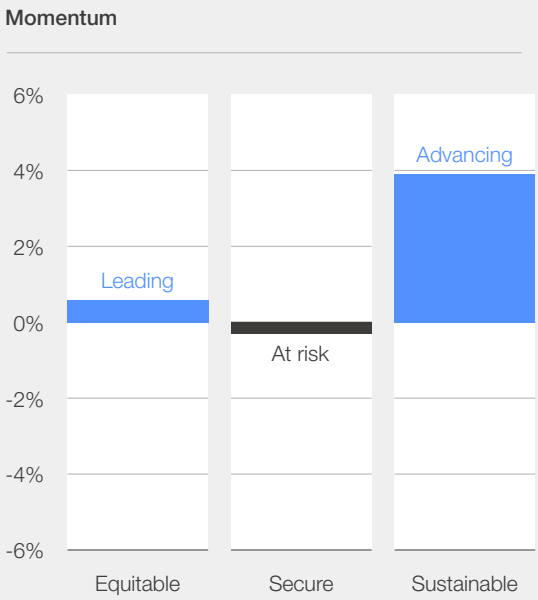
Population (millions)	125.7	Energy consumption per capita (GJ/capita)	127.6
GDP ($ trillions)	4.94	Energy intensity (MJ/$2017 PPP GDP)	3.19
Net energy imports (% of energy use)	89.7	CO_2 intensity (CO_2/TPES)	61.43

Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023

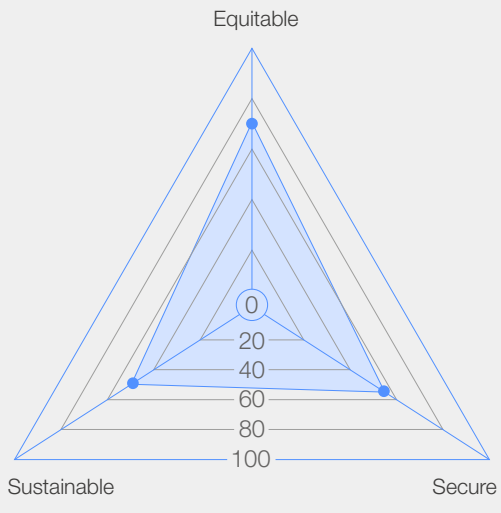


Energy transition current assessment

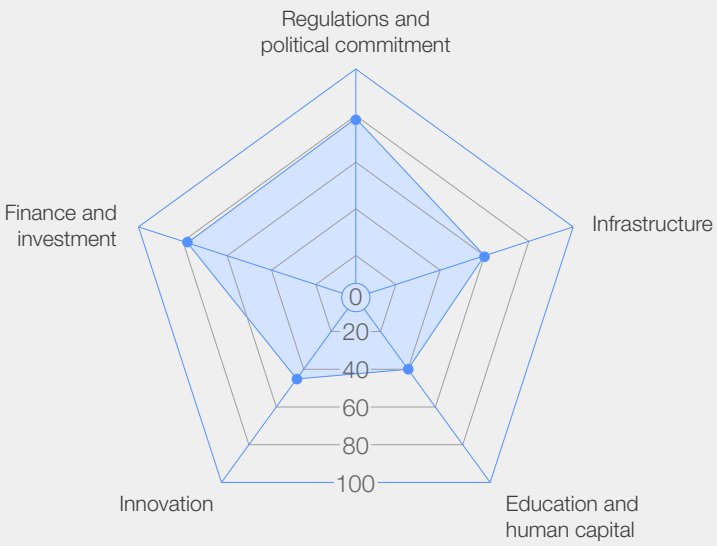


Note: [a] Relevant World Economic Forum peer group: Advanced economies
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Reduce GHG emissions by 46% by 2030 compared to 2013
- Achieve carbon neutrality by 2050

Energy policy priorities

- Achieve 36-38% energy generation from renewables by 2030
- Decrease nuclear energy dependence to 20% and fossil fuel energy generation to 56% by 2030
- Impose energy-saving measures to improve the actual energy efficiency by 35%
- Promote hydrogen/energy storage and decentralized energy systems

Country analysis

Key progress on ETI

Japan ranks 27 out of 120 countries on the ETI 2023, with relatively stable overall ETI, system performance and transition readiness scores over the past 10 years. At a natural disadvantage due to its high dependence on energy imports, Japan maintains high scores on the secure dimension within system performance through the diversification of energy sources as well as import counterparts. The country has notably accelerated within the sustainable dimension, primarily by reducing the energy intensity of its economy, a result of sustained efforts to enhance energy efficiency and productivity across different demand sectors. The enabling environment for energy transition in Japan has steadily improved, evidenced by strong regulation and political commitment, infrastructure, and investments in human capital and education. The recent announcement of net-zero targets provides further momentum to the energy transition but will require sector-specific roadmaps, including for hard-to-abate sectors, with interim milestones to ensure timely progress.

Key imperatives and policies in place

Following the 2011 Fukushima disaster and the country's heavy reliance on imported fossil fuels at a huge cost, several policies were introduced to increase Japan's use of renewable energy sources, while also promoting energy efficiency and conservation to secure its energy transition. This is reflected in the country's high ETI scores on regulation and political commitment. The Sixth Strategic Energy Plan, released in October 2021, set a target for renewables to account for 36-38% of Japan's energy mix by 2030.[78] This decision accelerated the deployment of solar, wind, and hydropower.[79] To meet the target, the total installed capacity would need to increase by 94 GW, with the majority coming from solar photovoltaic. Japan is a densely populated country, however, with limited available land for large-scale renewable projects. To overcome these challenges, Japan established itself as a leader in floating solar power, utilizing its inland lakes and reservoirs for this purpose.[80] In December 2022, the country announced its plan to restart nuclear power plants to help address its shortage of energy and pursue low-carbon development.

Feed-in tariffs were introduced in 2012 to promote the development of solar, wind and biomass. The tariffs for solar started at more than JPY 40/kilowatt-hour (kWh) in 2013 and were reduced steadily to JPY21/kWh for 2020-2021 to encourage greater cost competitiveness while also reducing the financial burden on consumers.[81] In addition, an auction system for renewable energy projects was introduced to further promote cost efficiency and competitiveness. Japan's grid infrastructure, which was traditionally designed for centralized power generation from large power plants, requires significant upgrades (transmission and distribution losses have increased 16% since 2014).[82] As a result, the government is focused on developing a more distributed and diverse energy system, which includes microgrids, energy storage systems and demand response technologies, while also providing subsidies and other incentives to support the development of energy storage projects.

To encourage energy efficiency and conservation, the Top Runner Programme was implemented to set energy efficiency standards and encourage manufacturers to develop more efficient products, reducing Japan's reliance on imports and improving its energy security. To further limit its emissions, Japan also imposes a carbon tax on fossil fuels used by power companies and industrial facilities, and a carbon emissions trading system for large emitters, with a commitment to increase the carbon tax rate over time and expand the emissions trading system to cover more industries and facilities.

What's next?

Japan's energy transition differs from other countries due to its lack of natural resources and space for renewables as well as its historical reliance on nuclear power. While the country has become a global pioneer in hydrogen and has made important progress towards developing an efficient, resilient and sustainable energy system, a report by the IEA[83] examines Japan's energy issues and recommends solutions to help the country attain a secure, affordable and sustainable energy future. The solutions cover accelerating the use of low-carbon technologies, removing regulatory barriers to encourage investments in zero-emissions electricity and improve power system flexibility, and increasing competition in its energy markets.

Indonesia

ETI Score
55.8

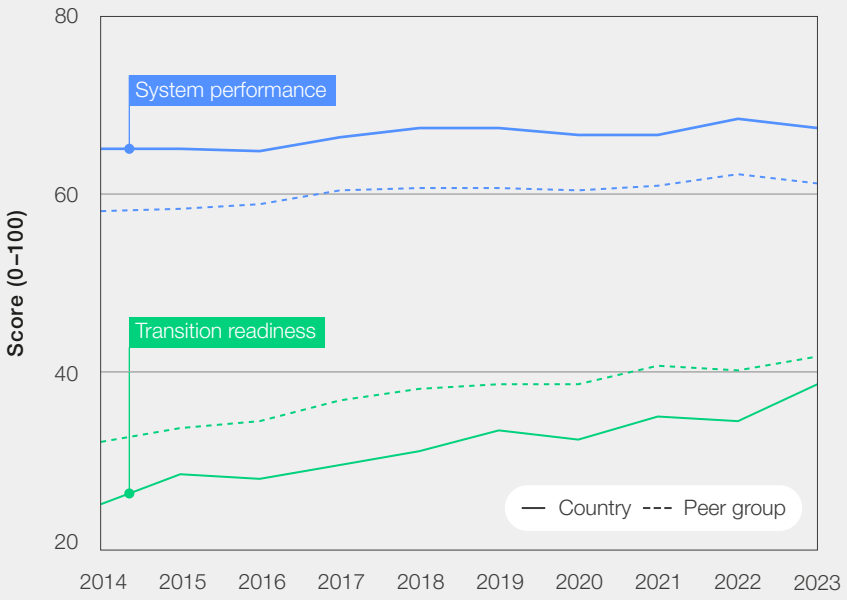
Rank
55/120

Key macroeconomic and ETI data

Population (millions)	273.8	Energy consumption per capita (GJ/capita)	35.94
GDP ($ trillions)	1.19	Energy intensity (MJ/$2017 PPP GDP)	3.12
Net energy imports (% of energy use)	-86.0	CO_2 intensity (CO_2/TPES)	54.47

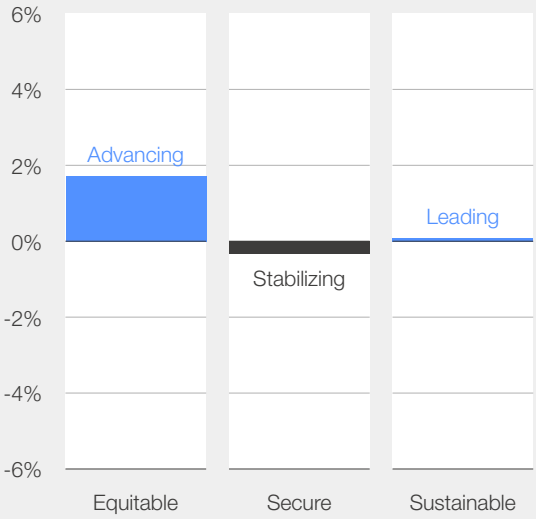
Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023



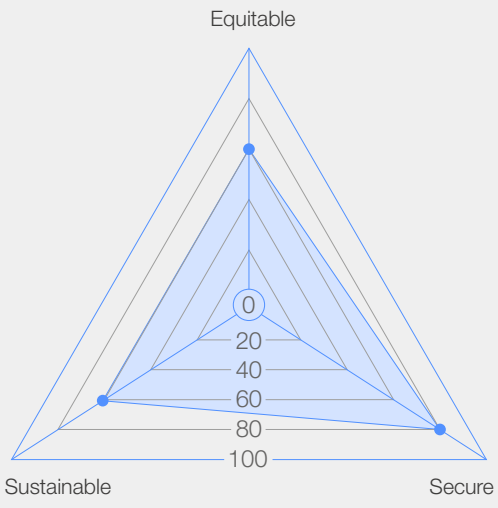
Energy transition current assessment

Momentum

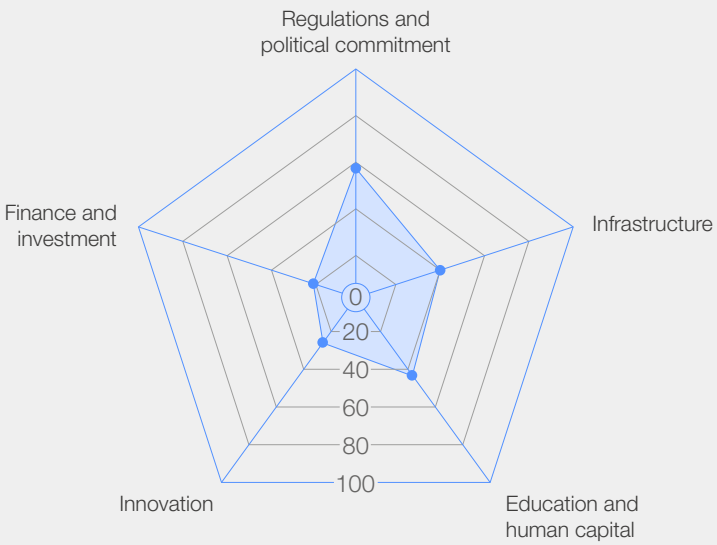


Note: [a] Relevant World Economic Forum peer group: Emerging and developing Asia
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Reduce emissions by 31.9% (unconditional) and 43.2% (conditional) by 2030 compared to business as usual
- Achieve net-zero emissions by 2060 or sooner

Energy policy priorities

- Peak emissions at 290 metric tonnes CO_2 and renewable energy share of power generation at 34% by 2030
- Deploy energy efficiency measures and electrification tools, technologies and reforms
- Retire coal-fired power plants early and restrict the development of captive coal-fired plants
- Develop local industry in renewable energy and energy efficiency

Country analysis

Key progress on ETI

Indonesia, as the largest energy consumer in South-East Asia[84] and a source of rising energy demand, holds the key to effective energy transition in the region and ranks 55 out of 120 countries on the ETI 2023. The country has improved its ETI score by almost 14% since 2014, with the biggest improvement in transition readiness (55%), supported by infrastructure and regulation and political commitment, which remain critical enablers of the energy transition. Within system performance, Indonesia's scores on the equitable dimension have shown the most improvement, with the biggest push coming from access to electricity. Though Indonesia is still one of the largest producers of coal and the fifth-largest GHG emitter,[85] the country has been shifting actively towards scaling up renewable energy in recent years and, with continued momentum, is well positioned to set priorities to limit global warming to 1.5°C.

Key imperatives and policies in place

Sustainable energy transition was one of the main themes of Indonesia's G-20 presidency in 2022, including the recognition that without energy access it would be impossible to achieve an economy-wide energy transition. Indonesia championed a new target for a modern energy minimum that aims to better capture the link between energy consumption and economic growth. The new threshold raises the bar for minimal energy to 1,000 kilowatt/hour (kWh) per person per year, with at least 300 kWh at home and 700 kWh consumed in the wider economy, ensuring that international efforts to end energy poverty ultimately result in meaningful development outcomes.[86] In addition, a JETP for Indonesia was launched to mobilize $20 billion in public- and private-sector financing over a three- to five-year period to facilitate the country's transition from coal to renewable energy, reduce power-sector emissions and achieve net zero by 2050. It lays out a strategy for the country based on the expansion of renewables in the energy mix (34% by 2030), the reduction of on- and off-grid coal-fired electricity generation, and additional commitments to regulatory reforms and energy efficiency while implementing tangible actions to attain an equitable energy transition for workers and communities.[87]

Quickening the deployment of renewable energy capacity will be an important step for Indonesia to boost its energy security and reduce its reliance on fossil fuel imports. Presidential decree no.112/2022 of September 2022 highlights measures to promote renewable energy, including establishing a competent pricing regime for renewable energy sources, tax incentives for renewable energy projects and changing the negotiation process to reach a pricing agreement.[88] Based on the success of its G-20 presidency and as chair of the Association of Southeast Asian Nations (ASEAN) in 2023, Indonesia aims to implement several energy sector measures, including strengthening the ASEAN power grid to support the energy transition and ensure energy security in the region; developing an ASEAN energy security roadmap; stimulating sustainable energy financing; building regional ecosystems for electric vehicles; exploring the potential of emerging clean energy innovations to improve energy access in islands and remote grids, as well as emissions trading schemes and carbon offset platforms; assessing bioenergy potential; and promoting smart and integrated digital energy management in industrial, commercial and building sectors.[89]

What's next?

Though Indonesia has taken significant steps internationally and regionally to accelerate the energy transition, achieving its raised ambitions will not be easy. In the absence of direct subsidies, the current tariff mechanism does not allow renewable energy projects to compete fairly with fossil fuel-based infrastructure, limiting their financial viability. Furthermore, discrepancies in planning and policy considerations and a lack of transparency, add a layer of complexity for investors. The World Economic Forum policy paper, "Policy Opportunities to Advance Clean Energy Investment in Indonesia", outlines recommendations that could help unlock Indonesia's clean energy future. These include creating a renewable energy tariff regime; removing regulatory barriers and implementing stable frameworks to facilitate the uptake of corporate renewable electricity sourcing; working with utilities or electricity suppliers to accelerate the growth of renewable energy infrastructure; implementing legislative and incentive mechanisms; and enhancing the transparency, sustainability and additionality of renewable energy certificates to finance new renewable energy capacity.[90]

Saudi Arabia

ETI Score
55.3

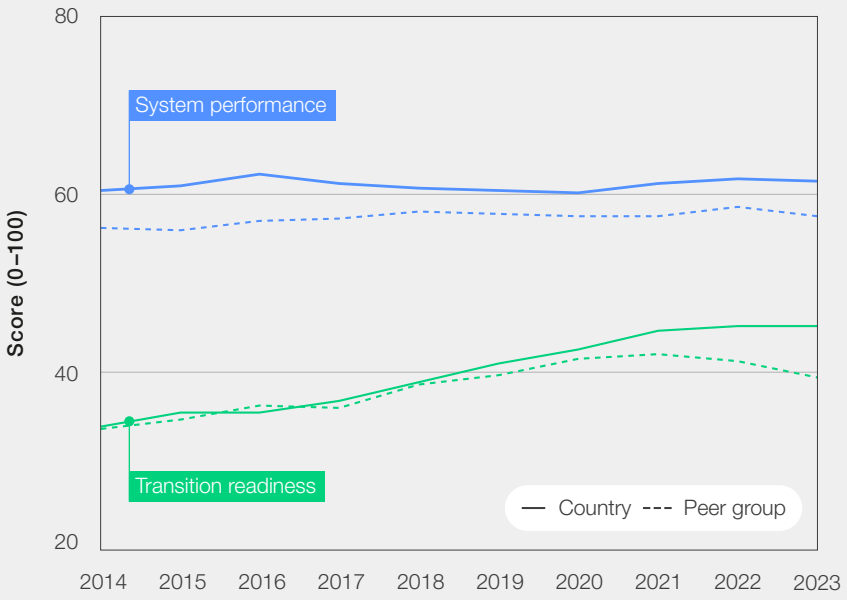
Rank
57/120

Key macroeconomic and ETI data

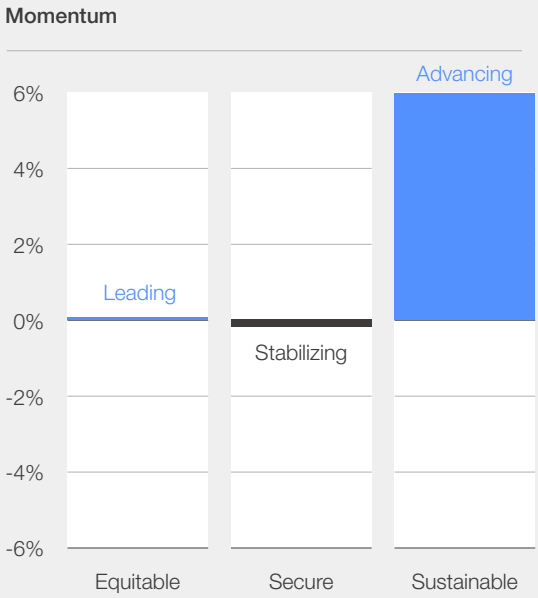
Population (millions)	35.95	Energy consumption per capita (GJ/capita)	267.4
GDP ($ trillions)	0.83	Energy intensity (MJ/$2017 PPP GDP)	6.23
Net energy imports (% of energy use)	-164.0	CO_2 intensity (CO_2/TPES)	50.25

Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023

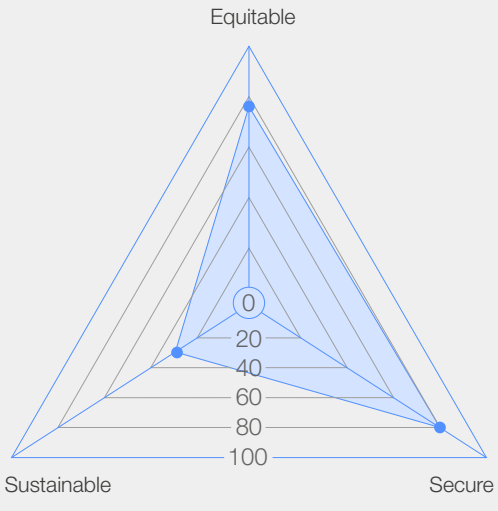


Energy transition current assessment

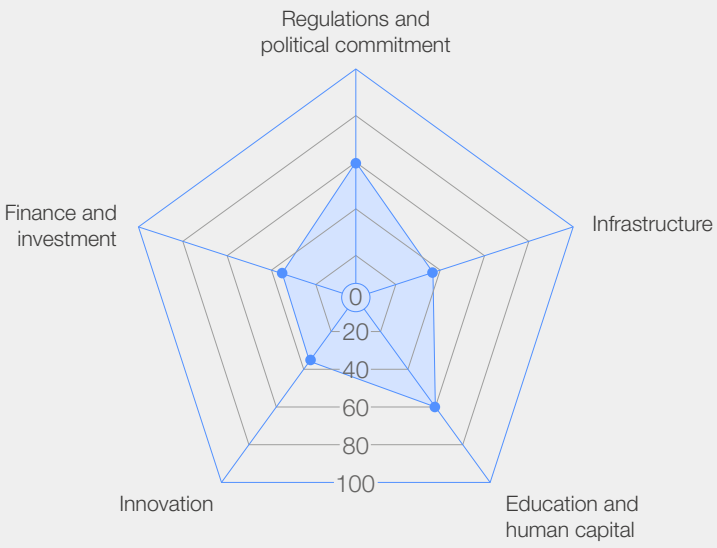


Note: [a] Relevant World Economic Forum peer group: Middle East, North Africa and Pakistan
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Reduce and avoid GHG emissions by 278 million tonnes of CO_2e annually by 2030
- Achieve net-zero emissions by 2060

Energy policy priorities

- Achieve 50% renewable energy in the energy mix by 2030
- Transform Jubail and Yanbu into global hubs for carbon capture, usage and storage
- Achieve 50% electricity generation from natural gas by 2030
- Improve and raise the efficiency of energy consumption in targeted sectors (Super Efficient Equipment Programme by 2025)
- Reduce global methane emissions by 30% by 2030 relative to 2020 levels

Country analysis

Key progress on ETI

Saudi Arabia ranks 57 out of 120 countries on the ETI 2023. The country has long been a dominant player in the oil market, and in recent years has undergone a significant energy transition, recognizing the need to shift towards renewable energy and reduce its carbon footprint. Over the past 10 years, Saudi Arabia has shown an 11% improvement in its overall ETI score, including both system performance and transition readiness. It leads the Middle East, North Africa and Pakistan peer group and ranks highly in both the secure and equitable dimensions. Although its sustainable ranking is making progress, there is still room for improvement, particularly in reducing energy and carbon intensity. To achieve this, measures such as expanding renewable resources and using carbon capture technologies could be implemented. Within transition readiness, significant progress has been made on regulation and political commitment.

Key imperatives and policies in place

Saudi Arabia's Vision 2030 was launched in 2016 and aims to diversify the country's economic resources and help it become more sustainable. Through the Vision, the Kingdom seeks to diversify non-oil exports and increase its share of non-oil GDP from 16% to 50% by 2030.[91] The King Abdullah Petroleum Studies and Research Center maintains that "non-oil exports are an important component of Saudi Arabia's economic diversification, as they can play crucial roles in sustainable economic development and job creation".[92] According to one analysis, "hydrogen production would allow Saudi Arabia to become less reliant on domestic oil as a key source of income"[93] and would use its existing oil and gas infrastructure and supply chain networks. Saudi Arabia's National Hydrogen Strategy, targeting 4 million tonnes per year of clean hydrogen,[94] aims to make the country a leader in its production and export. The Public Investment Fund (PIF) has invested in several hydrogen-related projects, including a joint venture with Air Products to build a $5 billion green hydrogen plant in the country.[95] In October 2022, PIF also successfully auctioned 1.4 million tons of carbon credits, making it the first voluntary carbon market in the region.[96] The country's shift towards renewables, with 11.4 GW capacity under development,[97] represents a significant departure from the traditional economic model and may have geopolitical implications.

Despite the objective of reducing fossil fuel subsidies under Vision 2030, Saudi Arabia still had the world's third-largest subsidies in 2019 at nearly $30 billion, primarily directed towards oil, fossil-fuel electricity production and natural gas.[98] Cheap, available fossil fuels reduce incentives for investments in renewable energy technologies, as companies and investors may view them as less financially viable. Launched in 2021, the Saudi Green Initiative (SGI) describes itself as "steering the implementation of a sustainable long-term climate action plan. Three overarching targets guide SGI's work – emissions reduction, afforestation, and land and sea protection."[99] By 2030, the Kingdom has promised that 50% of its energy will come from renewable sources, and SGI is leading several ambitious efforts that will lower emissions and change the domestic power mix, including creating a programme for carbon capture and storage (Carbon Circular Economy), increasing energy efficiency (Saudi Arabia Energy Efficiency Programme) and investing in new energy sources.

What's next?

The Kingdom has been investing in research and development to support new solar and wind technologies and improve the efficiency and cost-effectiveness of existing technologies. The renewable power sector encounters various challenges, however, including a shortage of skilled human resources. In addition, oil exports remain central to the Kingdom's economic development and export portfolio; Saudi Arabia aims to expand its oil production capacity to 13 million barrels per day by 2027.[100] While this may maintain the country's position as a reliable and versatile global supplier in a volatile market,[101] the additional production and related revenues also provide an opportunity to invest in and develop technologies that can capture generated emissions to ensure the Kingdom meets its emission reduction targets. In addition, Saudi Arabia can become an even stronger leader of the energy transition in the region by developing joint investments, research programmes, training and education, as well as incentives that help accelerate the move to electrification, energy efficiency and use of hydrogen.

United Arab Emirates

ETI Score
54.6

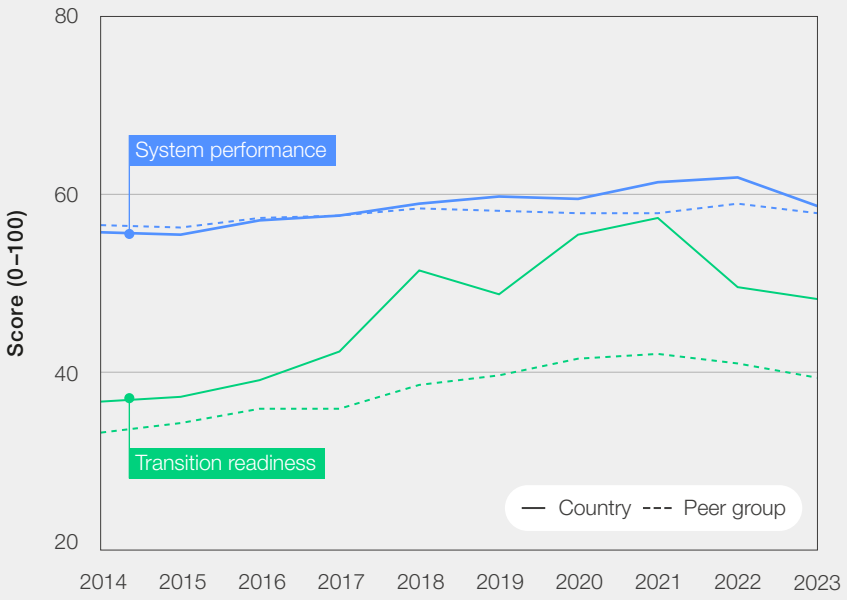
Rank
63/120

Key macroeconomic and ETI data

Population (millions)	9.36	Energy consumption per capita (GJ/capita)	370.9
GDP ($ trillions)	0.42	Energy intensity (MJ/$2017 PPP GDP)	5.48
Net energy imports (% of energy use)	-148.0	CO_2 intensity (CO_2/TPES)	52.48

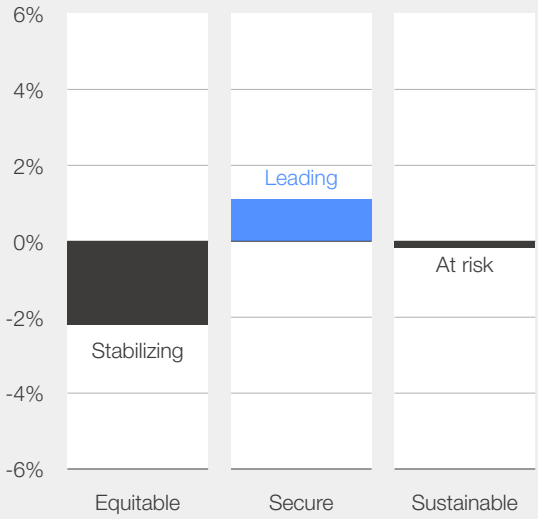
Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023



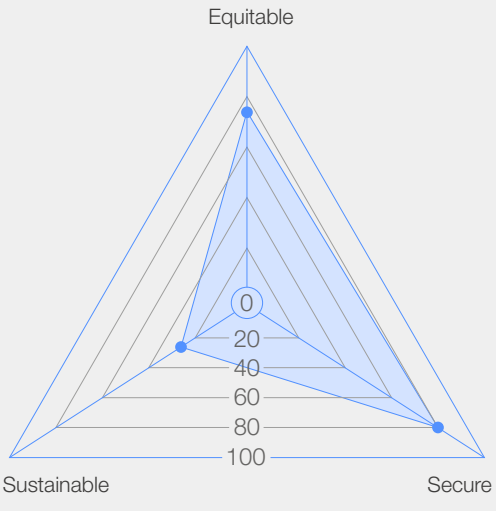
Energy transition current assessment

Momentum

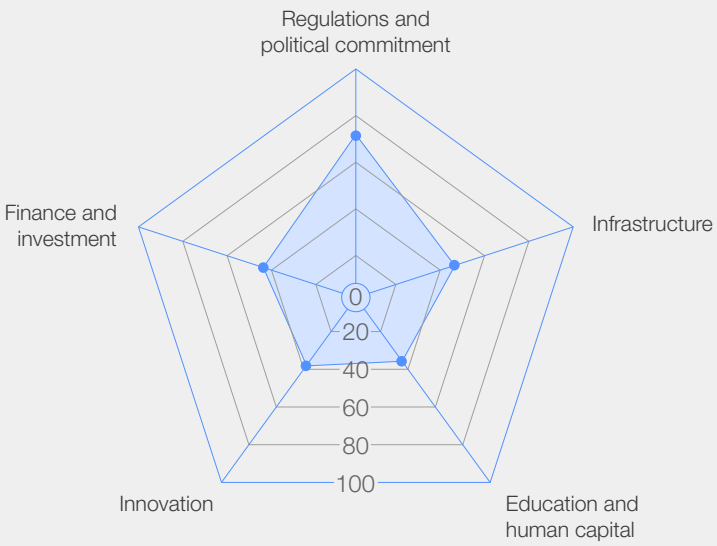


Note: [a] Relevant World Economic Forum peer group: Middle East, North Africa and Pakistan
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Reduce emissions by 31% by 2030 compared to business as usual
- Achieve net-zero emissions by 2050

Energy policy priorities

- Achieve 50% share of clean energy (renewables and nuclear) in the installed power capacity mix by 2050
- Reduce energy demand in the transport, building and industrial sectors by 40% by 2050
- Create a conducive environment for industries of the future, including hydrogen

Country analysis

Key progress on ETI

The United Arab Emirates (UAE), a major oil and gas producer and exporter, ranks 63 out of 120 countries on the ETI 2023. Over the last 10 years, the UAE's ETI score has fluctuated, mainly due to the transition readiness dimension, but the overall trend suggests a gradual strengthening of the enabling environment for the energy transition. The UAE performs strongly on regulation and political commitment, which remains a critical enabler of the energy transition. In addition, progress on system performance remains strong, although progress within the sustainable dimension is slowing. Further improvements can be unlocked by targeting a reduction in energy intensity as well as carbon intensity of the energy mix.

Key imperatives and policies in place

The UAE has invested $40 billion in clean energy in the past 15 years,[102] which translates into significant strides to promote renewable sources of energy. More than $160 billion is expected to be invested to achieve net zero by 2050,[103] which will see the UAE continue to shift its energy mix towards renewables, reduce GHG emissions and improve energy efficiency across sectors. The national Renewable Energy Strategy 2050 was launched in 2017 to increase the share of renewables in the total energy mix to 50% by 2050.[104] The country has made significant progress towards achieving this target by investing heavily in renewable energy projects and is home to one of the world's largest single-site solar power plants, the Mohammed bin Rashid Al Maktoum Solar Park, covering 76 km^2. The solar park currently generates 1.63 GW and offsets roughly 1.4 million tonnes of CO_2 emissions every year, and its capacity will expand to 5 GW by 2030.[105,106] The Abu Dhabi National Oil Company also announced a $3.1 billion investment to explore and implement carbon capture and storage technology in its operations, seeking to capture 5 million tonnes of CO_2 annually by 2030.[107] While the net results of these efforts are reflected in UAE's high ETI scores on regulation and political commitment and decarbonized energy, much more remains to be done to reduce the UAE's high emissions per capita globally.[108]

The UAE launched the National Water and Energy Demand Management Programme in 2022 "to improve the energy efficiency of the three most energy-intensive sectors in the country, namely transport, industry and construction, by 40% in 2050. It will launch several initiatives to cut energy demand by 40%, to raise the share of renewables in the energy mix to 50% and to boost water reuse by 95%".[109] Newly implemented building codes and regulations require certain energy standards to be met, such as the use of energy-efficient appliances and equipment. The Emirates Energy Efficiency Strategy will retrofit 30,000 existing buildings in Dubai by 2030, abating 1 million tonnes of CO_2.[110] The UAE is also promoting public transport, alternative fuels and electric vehicles, with the intention of having 42,000 electric vehicles by 2030.[111] A carbon trading exchange and carbon clearing house was announced in Abu Dhabi in 2022 to attract investment in carbon emissions reduction by allowing companies to trade and finance carbon credits. The revenue generated from the carbon pricing system will be used to support renewable energy and energy efficiency projects. The UAE has also invested $2 billion in new desalination plants;[112] these are highly energy intensive, however, and contribute to GHG emissions, which in turn drives the need for more clean energy.

What's next?

The energy sector has been an important enabler of economic development and growth in the UAE, accounting for approximately a third of its GDP. Like other major exporting nations, the UAE has traditionally relied on its oil and gas resources to fuel its economy, but as the world transitions towards cleaner energy sources, demand for fossil fuels will decline over time. The cost of UAE's renewables has been decreasing rapidly in recent years, making them increasingly competitive with fossil fuels. This provides an opportunity for the UAE to diversify its energy exports to include cheap renewable energy, clean technology and services to ensure it maintains its position as a leading energy exporter while also supporting its own energy transition goals. The UAE's natural resource endowment, legacy energy infrastructure and availability of skilled labour, due to investment in education and training programmes (up 30% over the decade), position it favourably in the new energy landscape and provide a reference point for countries at similar levels of clean energy development.

India

ETI Score
54.3

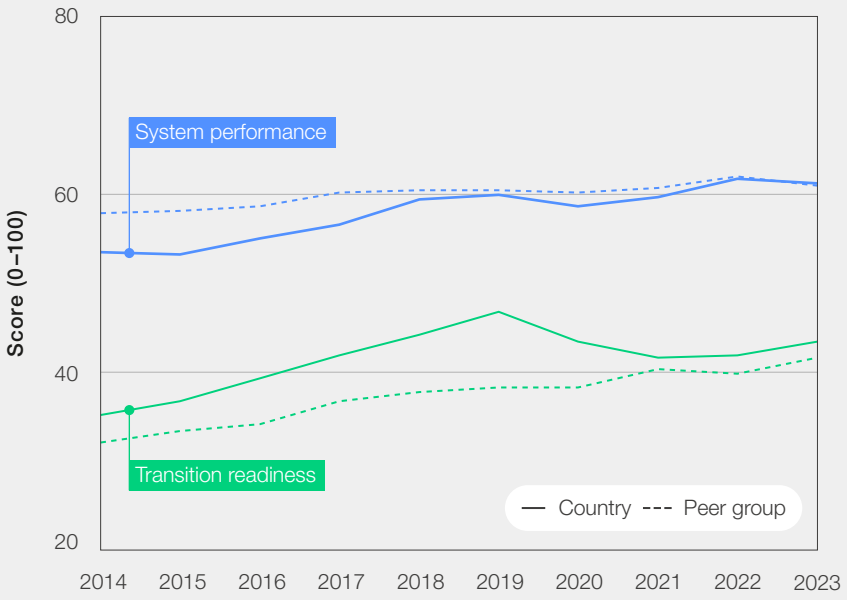
Rank
67/120

Key macroeconomic and ETI data

Population (millions)	1407	Energy consumption per capita (GJ/capita)	26.15
GDP ($ trillions)	3.18	Energy intensity (MJ/$2017 PPP GDP)	4.27
Net energy imports (% of energy use)	37.4	CO_2 intensity (CO_2/TPES)	56.82

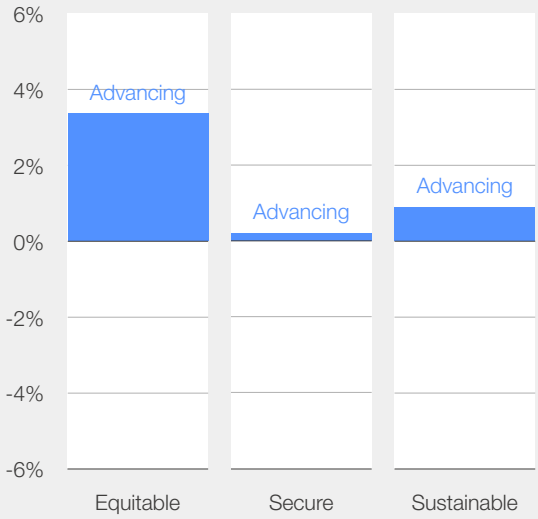
Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023



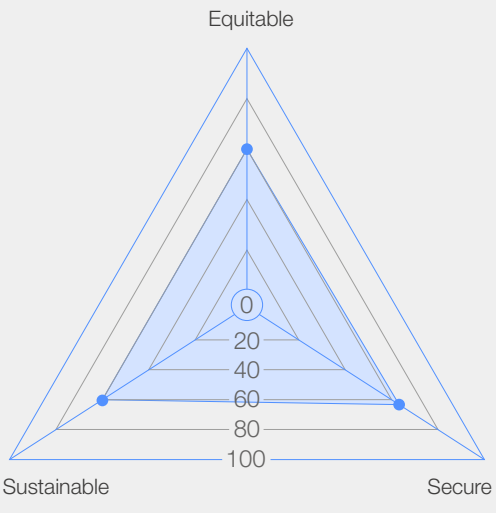
Energy transition current assessment

Momentum

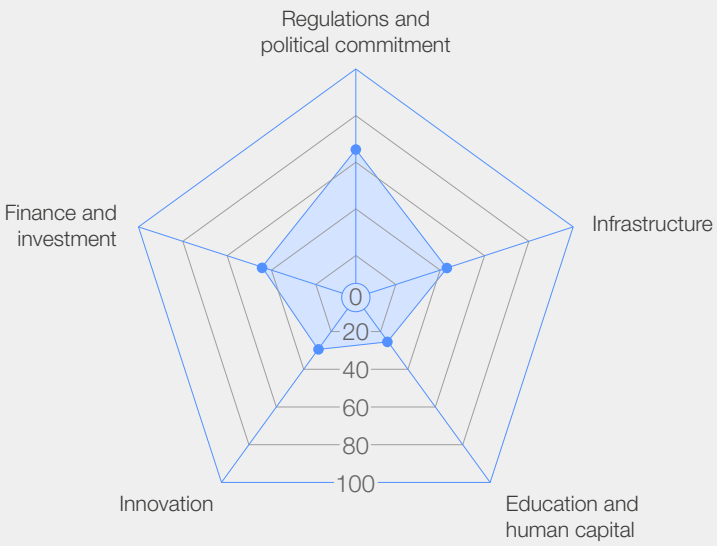


Note: [a] Relevant World Economic Forum peer group: Emerging and developing Asia
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Reduce emission intensity of GDP by 45% by 2030 from the 2005 level
- Achieve net-zero emissions by 2070
- Achieve 50% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030

Energy policy priorities

- Develop low-carbon electricity systems
- Develop an integrated, efficient and inclusive low-carbon transport system
- Promote adaptation in urban design, energy and material efficiency in buildings, and sustainable urbanization
- Decouple growth from emissions economy-wide
- Employ CO_2 removal and related engineering solutions

Country analysis

Key progress on ETI

India ranks 67 out of 120 countries on the ETI 2023, steadily improving across the three dimensions of the energy triangle over the past decade. Achieving universal access to electricity, replacing solid fuels with clean cooking options (primarily liquefied petroleum gas) and increasing renewable energy deployment have been primary contributors to the improvement of India's ETI performance. India also emerged relatively less affected from the recent energy crisis, largely due to the low share of natural gas in power generation and increased use of existing generation capacities. With rising energy demand, India's energy imports have increased in tandem. Although the country maintains a well-diversified mix of energy trade partners, rising import dependence represents a risk amid global energy market volatilities. The energy sector's sustainability profile has improved, due to the reduced energy intensity and the increasing share of renewable energy. The energy mix, however, remains predominantly carbon intensive, with a low share of clean energy in final demand. Improvements in the enabling environment have been driven by political commitment, an ambitious reform agenda, infrastructure investments and a competitive renewable energy landscape.

Key imperatives and policies in place

Since 2000, India's energy consumption has more than doubled. As the fastest-growing major economy, this trend is expected to continue. At COP26, India committed to achieving net-zero emissions by 2070 and raised its ambition in its revised nationally determined contribution to reduce emission intensity by 45% from 2005 levels and attain 50% of cumulative non-fossil fuel power generation capacity by 2030.[113] Decarbonization of power generation and electrification of final demand are key levers of India's energy transition.

The share of renewable energy in power generation has steadily increased to more than 30%, with solar and onshore wind accounting for 92% of incremental capacity in 2022.[114] India's commitment to install 500 GW of non-fossil fuel power generation capacity by 2030,[115] however, will require a substantial increase in investments and the modernization of the grid infrastructure. The financial sustainability and operational efficiency of the distribution sector is key to unlocking faster growth. India is implementing the world's largest smart metering programme, with the target to replace 250 million conventional meters with smart meters. Strengthening financial performance and improving competitiveness of distribution companies is the focus of the proposed Electricity (Amendment) Bill 2022.[116] Interregional transmission capacity, which increased recently to 112 GW,[117] will enable better use of the unevenly distributed renewable energy potential. Grid losses amount to more than 15% of generated electricity, which can be a barrier for growth of renewable energy.

Beyond supply, India has initiated programmes for energy efficiency and the decarbonization of key demand sectors. The Energy Conservation (Amendment) Bill 2022 introduces renewable energy mandates for large energy-intensive consumers and proposes a carbon credits trading scheme. Through the National Green Hydrogen Mission, India aims to facilitate demand, production and distribution of green hydrogen, and establish a competitive Green Hydrogen ecosystem. Furthermore, India has also announced the Lifestyle for Environment (LiFE) initiative to nudge individual and collective action towards sustainable consumption.

What's next?

India is the only major economy with energy transition momentum accelerating across the ETI's equitable, secure and sustainable dimensions. The pace of thermal power plant expansion has considerably slowed, though strategies for early retirement or repurposing of the existing fleet will be crucial. Continued progress will be challenged by two key macro trends: strong economic growth, and the urgency to create quality jobs for a growing working-age population. Manufacturing exports are playing an increasing role in the economy, although the share of low-carbon products in domestic manufacturing and exports remains low. Developing globally competitive manufacturing expertise in emerging low-carbon niche technologies could be a strong vehicle of future growth. A skilled workforce, public-private collaboration in innovation, and investment in research and development in low-carbon technologies are necessary to enable India's energy transition.

South Africa

ETI Score
52.2

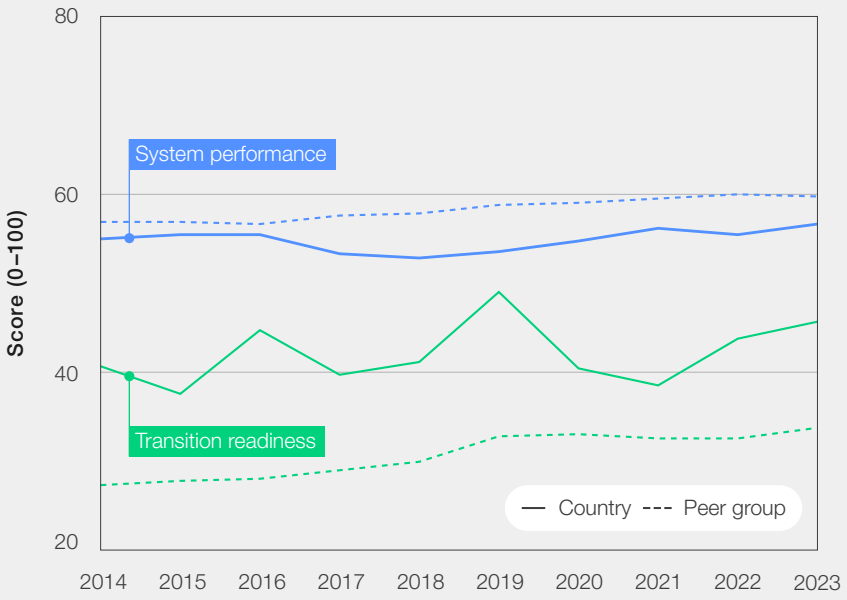
Rank
82/120

Key macroeconomic and ETI data

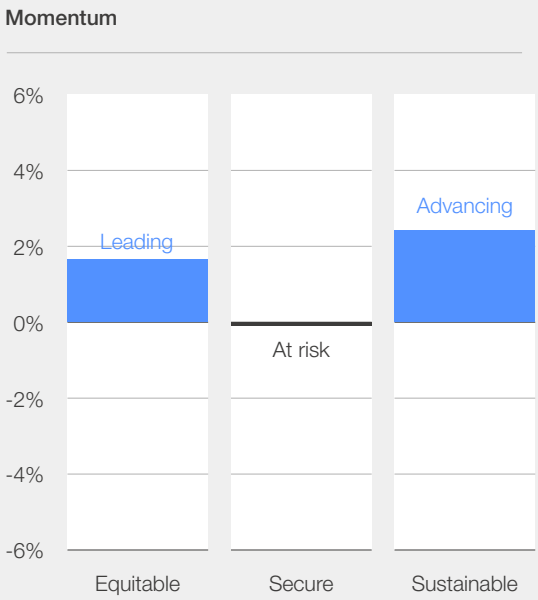
Population (millions)	59.39	Energy consumption per capita (GJ/capita)	88.75
GDP ($ trillions)	0.42	Energy intensity (MJ/$2017 PPP GDP)	6.92
Net energy imports (% of energy use)	-18.8	CO_2 intensity (CO_2/TPES)	74.37

Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023

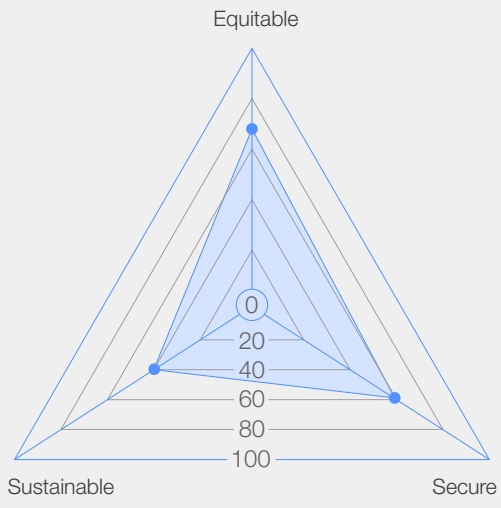


Energy transition current assessment

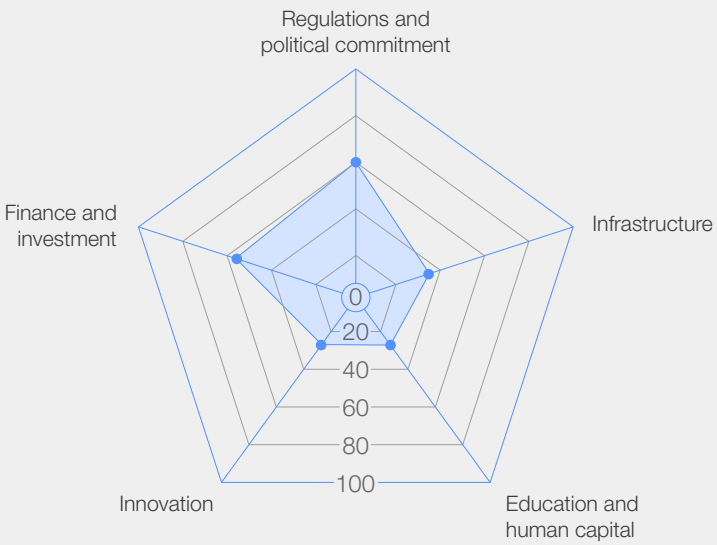


Note: [a] Relevant World Economic Forum peer group: Sub-Saharan Africa
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Reduce GHG emissions to 398-510 metric tonnes CO_2e by 2025, and to 350-420 metric tonnes CO2e by 2030
- Achieve net-zero emissions by 2050

Energy policy priorities

- Decommission the retiring coal generation fleet, in line with a revised Integrated Resource Plan and in tandem with the development of renewable energy generation at scale
- Strengthen transmission grid infrastructure to accommodate the shift to renewable energy
- Build new-energy vehicle supply chain localization and set the base for new-energy vehicle manufacturing
- Become a world-leading exporter of green hydrogen

Country analysis

Key progress on ETI

South Africa, the second-largest economy in Africa, has a large energy sector and ranks 82 out of 120 countries on the ETI 2023. The country has improved its overall ETI score by 6% since 2014. South Africa's system performance scores have improved, supported by better performance in energy access, electricity and clean cooking fuels. While scores in the sustainable dimension are accelerating due to the reduced energy intensity, significant challenges remain. The energy transition in South Africa has historically been an uphill battle, even though the share of renewable energy has increased over the past 10 years. The country still derives about 70% of its electricity from coal, the carbon intensity of the energy mix remains high, and clean energy sources only constitute around 13% of the total energy mix.[118]

Key imperatives and policies in place

Recent announcements for net-zero emissions by 2050 constitute steps in the right direction and indicate the increase in political commitment and strengthening regulatory environment. Several policy developments and measures have been put in place to help the country accelerate its clean energy transition. As reported by Global Compliance News: "At COP 27 in November 2022, South Africa launched its new Just Energy Transition Investment Plan (JET IP) and announced a five-year investment plan for the $8.5 billion financing package, which was announced as part of the country's Just Energy Transition Partnership with France, Germany, the United Kingdom, the United States and the European Union at COP26. The JET IP is aligned with the Cabinet-approved National Just Transition Framework and outlines the investments required to achieve the country's decarbonization commitments, while promoting sustainable development, and ensuring a just transition for affected workers and communities. … The JET IP covers electricity, new energy vehicles (NEVs) and green hydrogen, and identifies $98 billion in financial requirements over the next five years, to come from both the public and private sectors."[119]

South Africa's National Development Plan, draft Integrated Energy Plan and Renewable Energy White Paper all outline the country's policy foundation for energy transition, "an increased focus on a diversified energy mix that includes renewable energy, distributed generation and battery storage"[120] and a move away from carbon-fuelled energy. The Renewable Energy Independent Power Producer Procurement Programme, introduced in 2011, was a competitive tender process designed to facilitate private-sector investment into grid-connected renewable energy generation. The programme's sixth round got under way in 2022, in line with the 2019 Integrated Resources Plan, aiming to procure 2.6 GW of solar and wind power.[121] To encourage the self-generation of renewable energy, the government scrapped the 100 MW licence-exemption threshold for distributed generators and proposed a feed-in tariff for self-generating households and businesses.[122] Moreover, the South Africa Hydrogen Society Roadmap, published in February 2022 and focusing on national ambitions, sector prioritization, the overarching policy framework and the macroeconomic effect of the hydrogen economy throughout South Africa, is an important milestone for the country as it navigates its energy transition.[123]

What's next?

Debt and mismanagement have rendered Eskom, a public electricity utility, vulnerable and caused capacity gaps resulting in load-shedding, frequent electricity blackouts and a lack of affordable and secure power. In the immediate term, the government has put amendments in place to address the electricity supply deficit. South Africa's energy transition nevertheless faces challenges in the medium to long term, including key players influencing policy formulation and having an incentive to support coal, as well as economic and social fallout from the loss of jobs and livelihoods in the coal industry. Room exists to speed up actions to decarbonize the energy mix through energy efficiency measures, the development of renewables, electrification, and the use of carbon capture technologies. Still, given the importance of extractive industries in South Africa, additional opportunities exist to ensure an equitable transition by creating a high-level centralized body to manage the process, engaging all stakeholders early and often, promoting transparency and accessibility in the policy process and forming a supportive legislative framework.

Nigeria

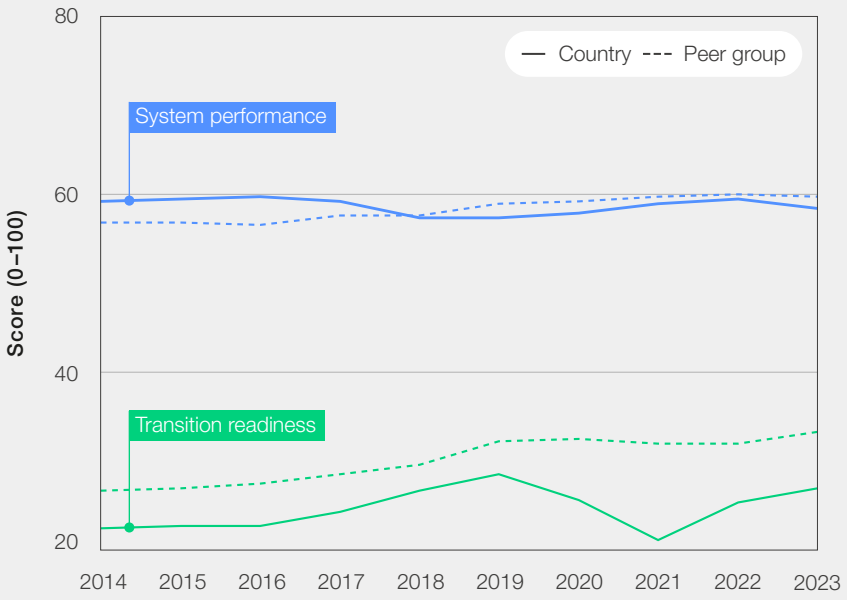
ETI Score	Rank
46.0	108/120

Key macroeconomic and ETI data

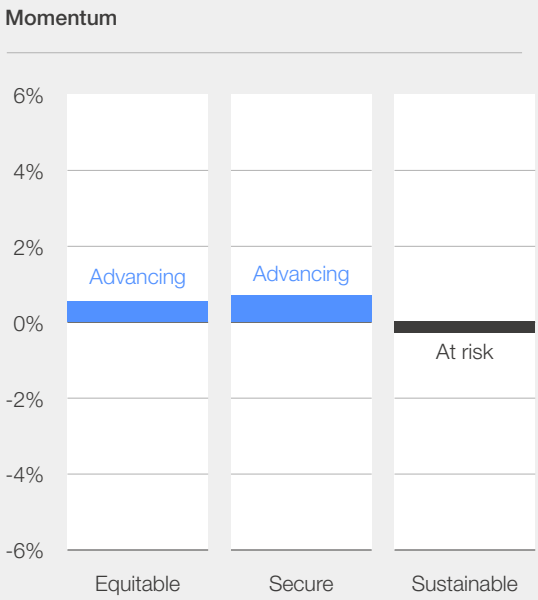
Population (millions)	213.4	Energy consumption per capita (GJ/capita)	31.90
GDP ($ trillions)	0.44	Energy intensity (MJ/$2017 PPP GDP)	6.55
Net energy imports (% of energy use)	-48.0	CO_2 intensity (CO_2/TPES)	13.26

Note: GJ = gigajoule; MJ = megajoule; PPP = purchasing power parity; TPES = total primary energy supply

Country and peer group[a] system performance and transition readiness, 2014-2023

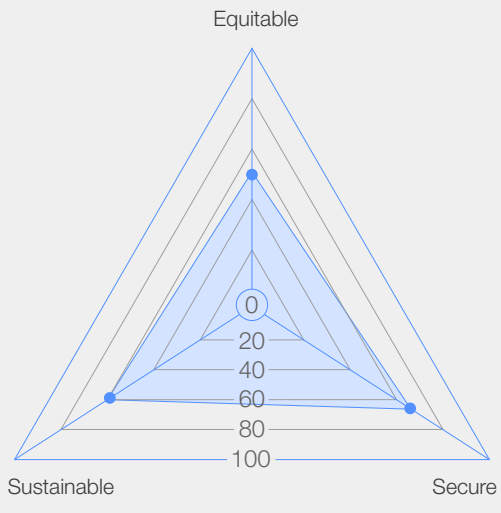


Energy transition current assessment

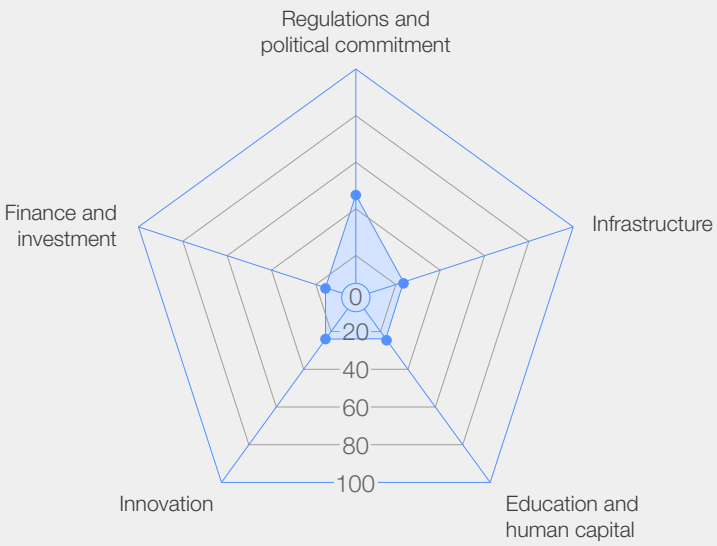


Note: [a] Relevant World Economic Forum peer group: Sub-Saharan Africa
Source: World Economic Forum

System performance



Transition readiness



Source: World Economic Forum

Stated energy transition goals

- Reduce GHG emissions by 20% (unconditional) and 47% (conditional) by 2030 compared to business as usual
- Reduce emissions by 50% from current levels by 2050 and achieve net-zero emissions between 2050 and 2070

Energy policy priorities

- Ensure 48% of the population use liquefied petroleum gas and 13% use improved cookstoves by 2030
- Achieve 2.5% annual reduction in energy intensity in all sectors
- Achieve 30% on-grid electricity from renewables, 13 GW off-grid renewable energy, and reduction of grid transmission and distribution losses to 8% of final energy consumption by 2030
- Achieve zero gas flaring by 2030

Country analysis

Key progress on ETI

Nigeria ranks 108 out of 120 countries on the ETI 2023 and is the largest economy and richest oil resource centre of the African continent, as well as the largest gas consumer and producer of West Africa.[124] Over the last 10 years, Nigeria's overall ETI score has improved (3%), while its system performance scores have fallen slightly (1%). The country's growing population and array of socio-economic issues mean it needs sustainable energy sources to meet the increasing needs for all sectors of the economy. High scores on regulation and political commitment, relative to other enabling dimensions, are evidenced by the country's notable power-sector reforms and plans to accelerate its clean energy transition and meet key development goals, including achieving net zero by 2060.

Key imperatives and policies in place

Nigeria's Climate Change Act, which was signed into law in November 2021, "provides the legal framework and a bold institutional arrangement for action on climate change. The Act established a National Council on Climate Change, chaired by the President, to lead work under the Act and help mainstream climate change action into the country's development agenda. … The vital next step is for the Council to publish Nigeria's first carbon budget as requested by law and put in place efforts to monitor implementation and compliance", according to global think tank ODI[125] In addition, the launch of the country's Energy Transition Plan in August 2021 sets out a timeline and framework for achieving reduction in emissions across five key sectors: power, cooking, oil and gas, transport, and industry. These two important steps and a revised nationally determined contribution are reliable signs of Nigeria's future. Nevertheless, challenges remain to turn these commitments into action.

As ODI points out, a "major obstacle to Nigeria's transition away from fossil fuels is the high levels of government subsidies for their production and consumption. Progress on reforming fossil fuel subsidies has been challenging, as consumers expect accessible energy and affordable pricing from the government as a benefit of being a major oil producer".[126] Nigeria currently has one of the highest rates of energy poverty in the world. The electricity access rate stands at 25% for rural populations for whom biomass and waste are the primary source of energy for cooking. Conversely, Nigeria has one of the highest costs of electricity in the world at an average of $0.52/kWh.[127] "Development finance institutions and other donors, wealthier, high-emitting countries, and international NGOs are well-placed to support this agenda through financing and research, and by encouraging constructive engagement on subsidy reform and justice and social responsibility in energy transition more broadly."[128]

Nigeria's energy transition creates significant investment opportunities, including establishing and expanding industries for solar, hydrogen and electric vehicles, and using its vast natural gas resources for economic development. A Renewable Energy Roadmap was produced with the International Renewable Energy Agency and the Energy Commission of Nigeria in January 2023 that "encompasses all key sectors of the Nigerian energy system to provide additional context for energy policy discussions on how increased ambition in terms of renewable energy – beyond current government policy and targets – can be realised".[129]

What's next?

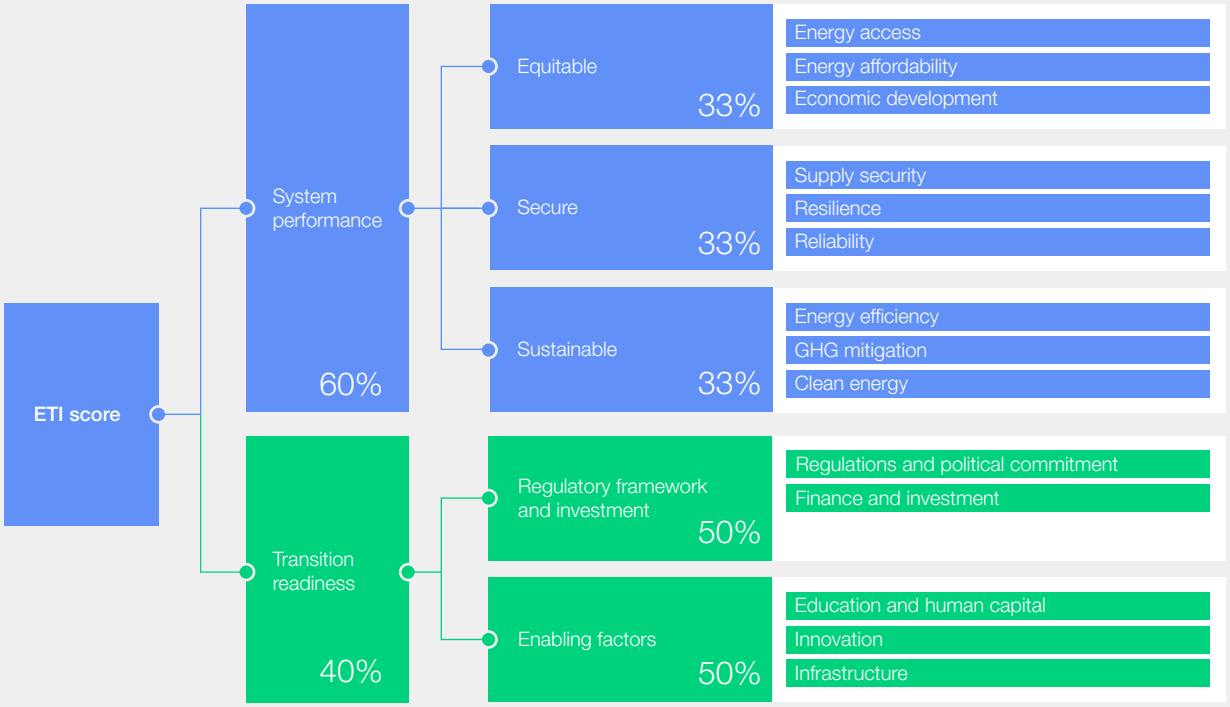
Overall, the energy transition in Nigeria still requires significant investment from the government and support from its citizens. Prioritizing economic development, along with proper planning and strengthening institutional and fiscal frameworks, can help Nigeria accelerate its transition. Based on lessons learned from other countries, the government could identify (and support) low-carbon energy solutions, especially in the rural and peri-urban areas of Nigeria; place greater emphasis on innovation in new energy infrastructure development; improve energy efficiency in small and medium-sized enterprises; explore the effective use of domestic funding; and harmonize different energy policy frameworks. Together with the Renewable Energy and Energy Efficiency Associations-Alliance, the World Economic Forum is engaging key public- and private-sector stakeholders to further understand Nigeria's energy transition policy plans, associated investment barriers to accelerate the clean energy transition, and practical solutions to address those barriers.

Appendices

A1 Methodology

FIGURE 14 **Methodology**

The ETI framework analyses countries' current energy system performance and enabling environment for energy transition in five equally weighted components: equity and inclusion, security, sustainability, regulatory framework and investment, and enabling factors.



Source: World Economic Forum

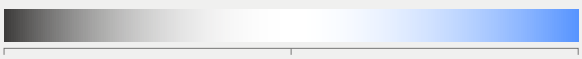
A2 Country ETI score evolution, 2014-2023

TABLE 3 **Change in ETI scores over the last decade**

Country	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2014-2023 score change
Albania										↑ 9.28
Algeria										↑ 2.79
Angola										↑ 0.44
Argentina										↑ 2.49
Armenia										↑ 3.84
Australia										↑ 6.12
Austria										↑ 6.82
Azerbaijan										↑ 10.27
Bahrain										↑ 0.09
Bangladesh										↑ 4.63
Belgium										↑ 4.04
Bolivia										↑ 3.83
Bosnia and Herzegovina										↑ 9.09
Botswana										↓ -1.15
Brazil										↑ 4.61
Brunei Darussalam										↓ -0.37
Bulgaria										↑ 3.33
Cambodia										↑ 7.79
Cameroon										↑ 6.13
Canada										↑ 2.07
Chile										↑ 5.26
China										↑ 12.78
Colombia										↑ 4.4
Congo, Dem. Rep.										↑ 1.27
Costa Rica										↑ 2.94
Cote d'Ivoire										↑ 16.68
Croatia										↑ 7.08
Cyprus										↑ 8.06
Czech Republic										↑ 5.79
Denmark										↑ 3.68
Dominican Republic										↑ 8.68
Ecuador										↑ 3.43
Egypt, Arab Rep.										↑ 1.01
El Salvador										↓ -1.27
Estonia										↑ 10.58
Ethiopia										↑ 1.93
Finland										↑ 9.7
France										↑ 6.34
Gabon										↑ 0.14
Georgia										↑ 4.45
Germany										↑ 3.86
Ghana										↑ 3.8
Greece										↑ 7.51
Guatemala										↑ 4.56
Honduras										↑ 0.62
Hungary										↑ 12.1
Iceland										↑ 7.18
India										↑ 7.97
Indonesia										↑ 6.87
Iran, Islamic Rep.										↑ 1.19
Ireland										↑ 5.44
Israel										↑ 7.58
Italy										↑ 6.31
Jamaica										↑ 2.31
Japan										↑ 3.71
Jordan										↑ 10.49
Kazakhstan										↑ 7.94
Kenya										↑ 10.56
Korea, Rep.										↑ 8.88
Kuwait										↑ 3.62

Year-on-year decline — No change — Year-on-year improvement

Country	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2014-2023 score change
Kyrgyz Republic										↑ 3.74
Lao PDR										↑ 2.47
Latvia										↑ 8.22
Lebanon										↑ 2.44
Lithuania										↑ 10.88
Luxembourg										↑ 7.66
Macedonia, FYR										↑ 4.15
Malaysia										↑ 5.11
Malta										↑ 9.93
Mauritius										↑ 0.65
Mexico										↑ 1.99
Mongolia										↑ 6.9
Montenegro										↑ 1.53
Morocco										↑ 5.64
Mozambique										↑ 3.22
Namibia										↑ 5.4
Nepal										↑ 4.02
Netherlands										↑ 9.4
New Zealand										↑ 2.6
Nicaragua										↓ -0.16
Nigeria										↑ 1.3
Norway										↑ 2.99
Oman										↑ 4.79
Pakistan										↑ 5.13
Panama										↑ 1.33
Paraguay										↑ 5.63
Peru										↓ -1.72
Philippines										↑ 2.13
Poland										↑ 10.52
Portugal										↑ 8.01
Qatar										↑ 2.58
Republic of Moldova										↑ 8.55
Romania										↑ 1.65
Saudi Arabia										↑ 5.33
Senegal										↑ 12.18
Serbia										↑ 4.71
Singapore										↑ 3.24
Slovak Republic										↑ 7.82
Slovenia										↑ 6.57
South Africa										↑ 3.01
Spain										↑ 8.96
Sri Lanka										↑ 2.41
Sweden										↑ 6.47
Switzerland										↑ 6.21
Tajikistan										↓ -1.99
Tanzania										↑ 10.15
Thailand										↑ 5.75
Trinidad and Tobago										↓ -1.3
Tunisia										↑ 3.79
Turkey										↑ 3
Ukraine										↑ 8.06
United Arab Emirates										↑ 6.4
United Kingdom										↑ 6.68
United States										↑ 6.3
Uruguay										↑ 3.58
Venezuela										↑ 1.56
Viet Nam										↑ 6.5
Yemen, Rep.										↑ 1.86
Zambia										↑ 1.29
Zimbabwe										↑ 12.28



Source: World Economic Forum

Contributors

Data sources

BloombergNEF, Climate Policy Initiative, ClimateWatch, Ember, Enerdata, Fitch ratings, Heritage Foundation, INSEAD, International Energy Agency, International Gas Union, International Institute for Sustainable Development, International Monetary Fund, International Renewable Energy Agency, Moody's ratings, Organisation for Economic Co-operation and Development (OECD) Statistics, Portulans Institute, S&P ratings, UN Environment Programme (UNEP), United Nations Conference on Trade and Development (UNCTAD) Stats, Wood Mackenzie Limited, World Bank Group, World Economic Forum, World Health Organization, World Trade Organization.

Chief expert advisers

The World Economic Forum acknowledges and thanks the individuals and experts without whose support the *Fostering Effective Energy Transition 2023 Edition* would not have been possible:

Morgan Bazilian
Professor of Public Policy, and Director of Payne Institute, Colorado School of Mines

Lin Boqiang
Dean, China Institute for Studies in Energy Policy, Xiamen University

Michaela Campanelli
Head, Climate Strategy, Risk Mitigation, and Disclosure, Eni

Lucy Craig
Director, Innovation and Digitalization, DNV

Rabia Ferroukhi
Director, Knowledge, Policy and Finance Centre, International Renewable Energy Agency (IRENA)

Bertrand Magne
Senior Economist, European Investment Bank (EIB)

Davide Puglielli
Head, Scenario Planning and Group Strategic Positioning, Enel

John Scott
Head, Sustainability Risk, Zurich Insurance Group

Fridtjof Unander
Chief Economist, Aker Horizons

David Victor
Professor of Innovation and Public Policy, University of California, San Diego (UCSD)

Rigoberto Ariel Yepez-Garcia
Manager, Infrastructure and Energy Sector, Inter-American Development Bank (IDB)

Project team

Accenture

Muqsit Ashraf
Global Strategy Lead

David Rabley
Managing Director and Global Energy Transition Lead, Energy

Samiksha Srivastava
Consultant, Strategy and Consulting, Energy

Francesca Tate
Manager, Strategy and Consulting, Energy

World Economic Forum

Mohammed Algeer
Project Fellow, Centre for Energy and Materials

Roberto Bocca
Head, Centre for Energy and Materials; Member of the Executive Committee

Espen Mehlum
Head, Energy Transition Intelligence and Regional Acceleration, Centre for Energy and Materials

Sarah Moin
Programme Analyst, Centre for Energy and Materials

Harsh Vijay Singh
Manager, Energy and Industry Transition Intelligence, Centre for Energy and Materials

Production

Laurence Denmark
Creative Director, Studio Miko

Sophie Ebbage
Designer, Studio Miko

George Messer
Designer, Studio Miko

Fabienne Stassen
Editor, EditOr Proof

Oliver Turner
Designer, Studio Miko

Endnotes

1. International Energy Agency (IEA), *Fossil Fuels Consumption Subsidies 2022*, February 2023, https://www.iea.org/reports/fossil-fuels-consumption-subsidies-2022 (accessed 17 May 2023).
2. BloombergNEF, "Global Low-Carbon Energy Technology Investment Surges Past $1 Trillion for the First Time", 26 January 2023, https://about.bnef.com/blog/global-low-carbon-energy-technology-investment-surges-past-1-trillion-for-the-first-time (accessed 19 May 2023).
3. Net Zero Insights, "The State of Climate Tech '22", 18 January 2023, https://netzeroinsights.com/state-of-climate-tech-2022 (accessed 17 May 2023).
4. IEA, *Global EV Outlook 2023: Catching up with climate ambitions*, 2023, https://iea.blob.core.windows.net/assets/dacf14d2-eabc-498a-8263-9f97fd5dc327/GEVO2023.pdf (accessed 17 May 2023).
5. NewClimate Institute, *Net Zero Stocktake 2022: Assessing the status and trends of net zero target setting*, June 2022, https://ca1-nzt.edcdn.com/Net-Zero-Tracker/Net-Zero-Stocktake-Report-2022.pdf?v=1655074300 (accessed 23 May 2023).
6. Fleck, Anna, "Fewer coal power plants closed in 2022 than in recent years", World Economic Forum, 17 April 2023, https://www.weforum.org/agenda/2023/04/fewer-coal-power-plants-close-in-2022-than-in-recent-years (accessed 19 May 2023).
7. Intergovernmental Panel on Climate Change (IPCC), "Urgent climate action can secure a liveable future for all", Press Release, 20 March 2023, https://www.ipcc.ch/2023/03/20/press-release-ar6-synthesis-report/#:~:text=Meanwhile%2C%20keeping%20warming%20to%201.5,limited%20to%201.5%C2%B0C (accessed 17 May 2023).
8. IEA, "Energy access: Achieving modern energy for all by 2030 seems unlikely", 2022, https://www.iea.org/topics/energy-access (accessed 17 May 2023).
9. Muta, Toru, and Musa Erdogan, "The global energy crisis pushed fossil fuel consumption subsidies to an all-time high in 2022", IEA, 16 February 2023, https://www.iea.org/commentaries/the-global-energy-crisis-pushed-fossil-fuel-consumption-subsidies-to-an-all-time-high-in-2022 (accessed 17 May 2023).
10. Kammer, Alfred, "Europe, And the World, Should Use Green Subsidies Cooperatively", IMF Blog, 11 May 2023, https://www.imf.org/en/Blogs/Articles/2023/05/11/europe-and-the-world-should-use-green-subsidies-cooperatively (accessed 22 May 2023).
11. World Economic Forum, "Securing the Energy Transition", White Paper, January 2023, https://www3.weforum.org/docs/WEF_Securing_the_Energy_Transition_2023.pdf (accessed 17 May 2023).
12. Ibid.
13. CBS News, "Winter storm causes power outages, hits Americans with snow and freezing temperatures before Christmas", 25 December 2022 update, https://www.cbsnews.com/news/winter-storm-power-outages-snow-us-christmas (accessed 17 May 2023).
14. Liang, Annabelle, "Japan urges 37 million people to switch off lights", BBC News, 27 June 2022, https://www.bbc.com/news/business-61947315 (accessed 22 May 2023).
15. Novinite.com, "Turkey's Energy Infrastructure after the Earthquakes: Huge Fire, Stopped Gas and Oil Pipelines", 7 February 2023, https://www.novinite.com/articles/218748/Tu rkey%27s+Energy+Infrastructure+after+the+Earthquakes%3A+Huge+Fire%2C+Stopped+Gas+and+Oil+Pipelineshttps://www.novinite.com/articles/218748/Turkey%27s+Energy+Infrastructure+after+the+Earthquakes%3A+Huge+Fire%2C+Stopped+Gas+and+Oil+Pipelines (accessed 22 May 2023).
16. Bundesverband WindEnergie, "Numbers and facts", https://www.wind-energie.de/english/statistics/statistics-germany (accessed 22 May 2023).
17. IEA, "Energy Efficiency 2022 Executive summary: Energy efficiency spending tops USD 1 trillion, equal to two-thirds of all clean energy recovery packages", 2022, https://www.iea.org/reports/energy-efficiency-2022/executive-summary (accessed 17 May 2023).
18. Motherway, Brian, and Kristina Klimovich, Vida Rozite and Edith Bayer, "Accelerating energy efficiency: What governments can do now to deliver energy savings", IEA, 17 March 2022, https://www.iea.org/commentaries/accelerating-energy-efficiency-what-governments-can-do-now-to-deliver-energy-savings (accessed 17 May 2023).
19. NITI Aayog, "Lifestyle for Environment", https://www.niti.gov.in/life (accessed 22 May 2023).
20. IEA, *Coal 2022: Analysis and forecast to 2025*, "Global coal demand is set to rise in 2022 amid the upheaval of the energy crisis", Executive Summary, December 2022, https://www.iea.org/reports/coal-2022/executive-summary (accessed 23 May 2023).
21. World Economic Forum, *Fostering Effective Energy Transition 2020 Edition*, Insight Report, May 2020, https://www3.weforum.org/docs/WEF_Fostering_Effective_Energy_Transition_2020_Edition.pdf (accessed 17 May 2023).
22. BloombergNEF, "Global Energy Storage Market to Grow 15-Fold by 2030", 12 October 2022, https://about.bnef.com/blog/global-energy-storage-market-to-grow-15-fold-by-2030 (accessed 25 May 2023).

23. IEA, *Net Zero by 2050: A Roadmap for the Global Energy Sector,* October 2021, https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf (accessed 25 May 2023).
24. Global Market Insights, *Green Hydrogen Market Size – By Technology (Alkaline, PEM, Solid Oxide), By Source (Solar, Wind), By Application (Power Generation, Transportation, Industry Energy, Industry Feedstock, Building Heat & Power) & Forecast, 2022-2030*, September 2022, https://www.gminsights.com/industry-analysis/green-hydrogen-market?gclid=CjwKCAiAuaKfBhBtEiwAht6H7-zUFDds4uXiKDQ19EYWBA6NmBTy4Wa--bOo2HbRVHhrFQvBvlv8MhoC7ksQAvD_BwE (accessed 25 May 2023).
25. Net Zero by 2050, op. cit. Calculated for $80/bbl.
26. Ibid.
27. Climate Bonds Initiative, "Record $269.5bn green issuance for 2020: Late surge sees pandemic year pip 2019 total by $3bn", 24 January 2021, https://www.climatebonds.net/2021/01/record-2695bn-green-issuance-2020-late-surge-sees-pandemic-year-pip-2019-total-3bn (accessed 29 May 2023).
28. IEA, *World Energy Outlook 2022*, 2022, https://iea.blob.core.windows.net/assets/c282400e-00b0-4edf-9a8e-6f2ca6536ec8/WorldEnergyOutlook2022.pdf (accessed 17 May 2023).
29. World Economic Forum in collaboration with Accenture, "Securing the Energy Transition", White Paper, January 2023, https://www3.weforum.org/docs/WEF_Securing_the_Energy_Transition_2023.pdf (accessed 17 May 2023).
30. Ibid.
31. World Economic Forum, *Fostering Effective Energy Transition 2021 Edition, Insight Report*, April 2021, https://www3.weforum.org/docs/WEF_Fostering_Effective_Energy_Transition_2021.pdf (accessed 17 May 2023).
32. Alkousaa, Riham, "Germany's 2022 renewable power production rises but still behind 2030 target", Reuters, 12 December 2022, https://www.reuters.com/business/energy/germanys-2022-renewable-power-production-rises-still-behind-2030-target-2022-12-11 (accessed 23 May 2023).
33. Enerdata, "Germany unveils new measures to reach 80% renewables energy mix by 2030", 12 January 2022, https://www.enerdata.net/publications/daily-energy-news/germany-unveils-new-measures-reach-80-renewables-energy-mix-2030.html (accessed 23 May 2023).
34. IEA, "Energy Industry Act (Energiewirtschaftsgesetz)", IEA/IRENA Renewables Policies Database, 21 June 2022 update, https://www.iea.org/policies/4367-energy-industry-act-energiewirtschaftsgesetz?sector=Power+generation&technology=Industry+sector-specific+processes+and+technologies (accessed 17 May 2023).
35. Appunn, Kerstine, "Germany to launch emergency programme for 'huge, gigantic' 2030 emissions target task", Clean Energy Wire, 12 January 2022, https://www.cleanenergywire.org/news/germany-launch-emergency-programme-huge-gigantic-2030-emissions-target-task (accessed 17 May 2023).
36. Ewing, Jackson, et al., *Pathways to Net-Zero for the US Energy Transition*, Nicholas Institute for Energy, Environment & Sustainability, Duke University, 2022, https://www.energy-transitions.org/wp-content/uploads/2022/11/pathways-net-zero-US-energy-transition.pdf (accessed 17 May 2023).
37. The White House, "Fact Sheet: The Bipartisan Infrastructure Deal", 6 November 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/11/06/fact-sheet-the-bipartisan-infrastructure-deal (accessed 23 May 2023).
38. Energy.gov, "DOE Establishes New Office of Clean Energy Demonstrations Under the Bipartisan Infrastructure Law", U.S. Department of Energy, 21 December 2021, https://www.energy.gov/articles/doe-establishes-new-office-clean-energy-demonstrations-under-bipartisan-infrastructure-law (accessed 17 May 2023).
39. Ewing, Jackson, et al., op. cit.
40. Brown, Gracie, et al., "Toward a more orderly US energy transition: Six key action areas", McKinsey Sustainability, 12 January 2023, https://www.mckinsey.com/capabilities/sustainability/our-insights/toward-a-more-orderly-us-energy-transition-six-key-action-areas (accessed 23 May 2023).
41. Siddiqui, Tariq, "Toward a more orderly US energy transition: Six key action areas", Energy Collective Group, 8 March 2023, https://energycentral.com/c/ec/toward-more-orderly-us-energy-transition-six-key-action-areas (accessed 18 May 2023).
42. Thanet District Council, "Public Document Pack: Agenda Document for Cabinet, 22/09/2022", http://democracy.thanet.gov.uk/documents/g6175/Public%20reports%20pack%2022nd-Sep-2022%2019.00%20Cabinet.pdf?T=10 (accessed 18 May 2023).
43. Skidmore, Chris, *Mission Zero: Independent Review of Net Zero*, 2022, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1128689/mission-zero-independent-review.pdf (accessed 24 May 2023).
44. UK Government, *British Energy Security Strategy: Secure, clean and affordable British energy for the long term*, April 2022, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1069969/british-energy-security-strategy-web-accessible.pdf (accessed 24 May 2023).
45. Gillespie, Todd, "UK Makes £20 Billion Bet on Carbon Capture in Race Against US", Bloomberg, 15 March 2023, https://www.bloomberg.com/news/articles/2023-03-15/uk-makes-20-billion-bet-on-carbon-capture-in-race-against-us?leadSource=uverify%20wall (accessed 24 May 2023).

46. UK Government, *Together for People and Planet: UK International Climate Finance Strategy*, March 2023, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1147360/uk-international-climate-finance-strategy-2023.pdf (accessed 24 May 2023).
47. UK Parliament, House of Commons Environmental Audit Committee, "Accelerating the transition from fossil fuels and securing energy supplies", Fourth Report of Session 2022-23, 5 January 2023, https://publications.parliament.uk/pa/cm5803/cmselect/cmenvaud/109/report.html (accessed 18 May 2023).
48. Ibid.
49. UK Government, *Mobilising Green Investment: 2023 Green Finance Strategy*, March 2023, https://www.macfarlanes.com/media/xtfpsage/mobilising-green-investment-2023-green-finance-strategy.pdf (accessed 18 May 2023).
50. UK Government, "The Future Homes Standard: changes to Part L and Part F of the Building Regulations for new dwellings", 1 October 2019, https://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings (accessed 24 May 2023).
51. Edwards, Holly, et al., *Electric vehicles and infrastructure*, Commons Library Research Briefing, House of Commons Library, 21 February 2023, https://researchbriefings.files.parliament.uk/documents/CBP-7480/CBP-7480.pdf (accessed 24 May 2023).
52. UK Government, "Tenfold expansion in chargepoints by 2030 as government drives EV revolution", 25 March 2022, https://www.gov.uk/government/news/tenfold-expansion-in-chargepoints-by-2030-as-government-drives-ev-revolution (accessed 18 May 2023).
53. World Population Review, "GDP Ranked by Country 2023", 2023, https://worldpopulationreview.com/countries/by-gdp (accessed 18 May 2023).
54. IEA, "Countries and regions: Brazil", https://www.iea.org/countries/brazil (accessed 24 May 2023).
55. Sánchez Molina, Pilar, "Brazil allocates 269.3 MW of solar across two energy auctions", pv magazine, 12 July 2021, https://www.pv-magazine.com/2021/07/12/brazil-allocates-269-3-mw-of-solar-across-two-energy-auctions (accessed 24 May 2023).
56. BNamericas, "Brazil's BNDES authorizes US$650mn loans for 3 renewable energy projects", 5 January 2023, https://www.bnamericas.com/en/news/brazils-bndes-authorizes-us650mn-loans-for-3-renewable-energy-projects (accessed 25 May 2023).
57. Government of Brazil, "Brazil is the biggest wind energy producer in Latin America", 8 February 2022, https://www.gov.br/en/government-of-brazil/latest-news/2022/brazil-is-the-biggest-wind-energy-producer-in-latin-america#:~:text=in%20the%20country.-,Brazil%20is%20the%20biggest%20wind%20energy%20producer%20in%20Latin%20America,by%203%2C100%20megawatts%20(MW) (accessed 24 May 2023).
58. World Population Review, "Wind Power by Country 2023", https://worldpopulationreview.com/country-rankings/wind-power-by-country (accessed 24 May 2023).
59. ABEEólica, "The Sector: Wind power development in Brazil", https://abeeolica.org.br/en/wind-energy/the-sector (accessed 17 May 2023).
60. Absolar, "Panorama of solar photovoltaic in Brazil and in the world", 2023, https://www.absolar.org.br/market/infographic (accessed 24 May 2023).
61. IEA, "Biofuel production by country/region and fuel type, 2016-2022", 26 October 2022, https://www.iea.org/data-and-statistics/charts/biofuel-production-by-country-region-and-fuel-type-2016-2022 (accessed 24 May 2023).
62. World Economic Forum, *Mobilizing Investment for Clean Energy in Brazil Country Deep Dive, Summary 2021-2022*, July 2022, https://www3.weforum.org/docs/WEF_Mobilizing_Investment_for_Clean_Energy_in_Brazil_2022.pdf (accessed 24 May 2023).
63. Bloomberg, "China May Boost Coal Power Plant Building Amid Energy Crunch", 9 September 2022, https://www.bloomberg.com/news/articles/2022-09-08/china-to-add-more-coal-plants-than-thought-to-ease-energy-crunch?leadSource=uverify%20wall (accessed 24 May 2023).
64. World Bank, "China's Transition to a Low-Carbon Economy and Climate Resilience Needs Shifts in Resources and Technologies", Press Release, 12 October 2022, https://www.worldbank.org/en/news/press-release/2022/10/12/china-s-transition-to-a-low-carbon-economy-and-climate-resilience-needs-shifts-in-resources-and-technologies (accessed 18 May 2023).
65. Data derived from ETI indicator analyses.
66. Energy Foundation, "China's 14th Five-Year Plans on Renewable Energy Development and Modern Energy System", 5 September 2022, https://www.efchina.org/Blog-en/blog-20220905-en (accessed 18 May 2023).
67. Zhu, Shouqing, et al., "Transition finance will accelerate decarbonization in China. Here's how", World Economic Forum Agenda, 25 November 2022, https://www.weforum.org/agenda/2022/11/transition-finance-will-accelerate-decarbonization-in-china-here-s-how (accessed 24 May 2023).
68. World Bank Group, *China Country Climate and Development Report*, CCDR Series, 2022, http://hdl.handle.net/10986/38136 (accessed 18 May 2023).
69. World Bank, "China's Transition to a Low-Carbon Economy and Climate Resilience Needs Shifts in Resources and Technologies", op. cit.

70. World Population Review, “Largest Countries in the World 2023”, 2023, https://worldpopulationreview.com/country-rankings/largest-countries-in-the-world (accessed 18 May 2023).

71. Government of Canada, Natural Resources Canada, “Remote Communities Energy Database”, https://open.canada.ca/data/en/dataset/0e76433c-7aeb-46dc-a019-11db10ee28dd (accessed 24 May 2023).

72. IEA, *Canada: Energy Policy Review 2022*, 2022, https://iea.blob.core.windows.net/assets/7ec2467c-78b4-4c0c-a966-a42b8861ec5a/Canada2022.pdf (accessed 25 May 2023).

73. Williams, Nia, “Canada, industry in talks to cement future carbon price hikes”, Reuters, 12 May 2022, https://www.reuters.com/business/sustainable-business/canada-industry-talks-cement-future-carbon-price-hikes-2022-05-12/#:~:text=Canada%27s%20carbon%20price%20is%20set%20to%20rise%20to,levels%20by%202030%20and%20reach%20net-zero%20by%202050 (accessed 25 May 2023).

74. Government of Canada, “What Is the Low Carbon Economy Fund?”, 17 October 2022, https://www.canada.ca/en/environment-climate-change/services/climate-change/low-carbon-economy-fund/what-is-lcef.html (accessed 25 May 2023).

75. Canada Infrastructure Bank (CIB), “About the CIB”, https://cib-bic.ca/en/about-us/our-purpose (accessed 25 May 2023).

76. Government of Canada, Impact Canada, “Natural Resources Canada: Indigenous Off-diesel Initiative”, https://impact.canada.ca/en/challenges/off-diesel (accessed 25 May 2023).

77. IEA, *Canada: Energy Policy Review 2022*, op. cit.

78. Obayashi, Yuka, “Japan aims for 36-38% of energy to come from renewables by 2030”, Reuters, 22 October 2021, https://www.reuters.com/business/energy/japan-aims-36-38-energy-come-renewables-by-2030-2021-10-22 (accessed 25 May 2023).

79. Ritchie, Hannah, Max Roser and Pablo Rosado, “Japan: Energy Country Profile”, Our World in Data, 2022, https://ourworldindata.org/energy/country/japan#citation (accessed 25 May 2023).

80. Broom, Douglas, “How Japan became the world leader in floating solar power”, World Economic Forum Agenda, 22 March 2019, https://www.weforum.org/agenda/2019/03/japan-is-the-world-leader-in-floating-solar-power (accessed 25 May 2023).

81. Enerdata, “Japan sets solar PV feed-in tariffs for the 2020-2021 year”, 7 February 2020, https://www.enerdata.net/publications/daily-energy-news/japan-sets-solar-pv-feed-tariffs-2020-2021-year.html#:~:text=The%20Japanese%20Ministry%20of%20Economy%2C%20Trade%20and%20Industry,below%2010%20kW%20is%20set%20at%20JPY21%2FkWh%20%28US%2419c%2FkWh%29 (accessed 25 May 2023).

82. Data derived from ETI indicator analyses.

83. IEA, “Japan 2021: Energy Policy Review”, 2021, https://iea.blob.core.windows.net/assets/3470b395-cfdd-44a9-9184-0537cf069c3d/Japan2021_EnergyPolicyReview.pdf (accessed 18 May 2023).

84. International Renewable Energy Agency (IRENA), *Indonesia Energy Transition Outlook*, 2022, https://www.irena.org/publications/2022/Oct/Indonesia-Energy-Transition-Outlook (accessed 18 May 2023).

85. Brent, Zoe, and Alhafiz Atsari, *The Future of Indonesia’s Energy Sector: Climate Commitments or Committed to Coal?*, Transnational Institute, 5 January 2023, https://www.tni.org/en/publication/the-future-of-indonesias-energy-sector (accessed 25 May 2023).

86. Energy for Growth Hub, “Modern Energy Minimum”, https://www.energyforgrowth.org/projects/modern-energy-minimum (accessed 25 May 2023).

87. Latief, Yusuf, “G20 Summit mobilises $20bn for Indonesia’s just energy transition”, Enlit, 18 November 2022, https://www.enlit.world/finance-investment/g20-summit-mobilises-20bn-for-indonesias-just-energy-transition (accessed 18 May 2023).

88. World Economic Forum, “Policy Opportunities to Advance Clean Energy Investment in Indonesia”, Policy Paper, November 2022, https://www3.weforum.org/docs/WEF_Policy_Opportunities_to_Advance_Clean_Energy_Investment_2022.pdf (accessed 18 May 2023).

89. Batih, Hakimul, “Indonesia’s Energy Transition: Opportunities for ASEAN’s 2023 Chair”, The National Bureau of Asian Research, 2 March 2023, https://www.nbr.org/publication/indonesias-energy-transition-leadership-opportunities-for-aseans-2023-chair (accessed 25 May 2023).

90. World Economic Forum, “Policy Opportunities to Advance Clean Energy Investment in Indonesia”, Policy Paper, November 2022 https://www3.weforum.org/docs/WEF_Policy_Opportunities_to_Advance_Clean_Energy_Investment_2022.pdf (accessed 25 May 2023).

91. KAPSARC, “KAPSARC Investigates Ways to Diversify Non-oil Exports to Achieve Saudi Vision 2030”, 12 October 2021, https://www.kapsarc.org/news/kapsarc-investigates-ways-to-diversify-non-oil-exports-to-achieve-saudi-vision-2030 (accessed 18 May 2023).

92. Ibid.

93. Nakano, Jane, “Saudi Arabia’s Hydrogen Industrial Strategy”, Center for Strategic & International Studies, 7 January 2022, https://www.csis.org/analysis/saudi-arabias-hydrogen-industrial-strategy?amp (accessed 18 May 2023).

94. Saudi Green Initiative, “SGI Initiatives”, https://www.greeninitiatives.gov.sa/sgi-initiatives (accessed 18 May 2023).

95. Nereim, Vivian, "Saudi Arabia to Start Building Green Hydrogen Plant in Neom", Bloomberg, 17 March 2022, https://www.bloomberg.com/news/articles/2022-03-17/saudi-arabia-to-start-building-green-hydrogen-plant-in-neom?leadSource=uverify%20wall (accessed 25 May 2023).

96. Saudi Press Agency, "1.4 Million Tons of Carbon Credits Successfully Auctioned at Voluntary Carbon Market Initiative during Future Investment Initiative Conference", 26 October 2022, https://www.spa.gov.sa/viewfullstory.php?lang=en&newsid=2395702 (accessed 25 May 2023).

97. Saudi & Middle East Green Initiatives, "SGI target: reduce carbon emissions by 278 mtpa by 2030", https://www.greeninitiatives.gov.sa/about-sgi/sgi-targets/reducing-emissions/reduce-carbon-emissions (accessed 25 May 2023).

98. IEA, "Value of fossil-fuel subsidies by fuel in the top 25 countries, 2019", 26 October 2022, https://www.iea.org/data-and-statistics/charts/value-of-fossil-fuel-subsidies-by-fuel-in-the-top-25-countries-2019 (accessed 25 May 2023).

99. Saudi & Middle East Green Initiatives, "SGI: steering Saudi Arabia towards a green future", https://www.greeninitiatives.gov.sa/about-sgi (accessed 18 May 2023).

100. Bakr, Amena, and Yousra Samaha, "Saudi Arabia's Energy Transition Ramps Up", Energy Intelligence, 21 September 2022, https://www.energyintel.com/00000183-45f9-dcbb-a1b7-4dfbc9ad0000 (accessed 18 May 2023).

101. Oxford Business Group, "How Saudi Arabia is positioning itself as a leader in green energy", 2022, https://oxfordbusinessgroup.com/reports/saudi-arabia/2022-report/energy-utilities/powering-forward-solidifying-the-kingdoms-position-in-the-global-energy-market-through-a-combination-of-oil-natural-gas-and-green-initiatives (accessed 18 May 2023).

102. Gulf News, "The UAE has invested over $40 billion in clean energy over the last 15 years", 27 May 2022, https://gulfnews.com/business/corporate-news/the-uae-has-invested-over-40-billion-in-clean-energy-over-the-last-15-years-1.1653561468563 (accessed 18 May 2023).

103. Trade Arabia, "UAE to invest $160bn in clean, renewable energy sources in next 30 years", 26 May 2022, http://www.tradearabia.com/news/OGN_396814.html#:~:text=DAVOS%2C%20May%2026%2C%202022%20The%20UAE%20has%20invested,at%20the%20World%20Economic%20Forum%20in%20Davos%2C%20Switzerland (accessed 25 May 2023).

104. United Arab Emirates, Government portal, "UAE Energy Strategy 2050", 24 November 2022, https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/strategies-plans-and-visions/environment-and-energy/uae-energy-strategy-2050 (accessed 18 May 2023).

105. Dubai Electricity and Water Authority, Innovation Centre, "Mohammed bin Rashid Al Maktoum Solar Park", 17 April 2023, https://mbrsic.ae/en/about/mohammed-bin-rashid-al-maktoum-solar-park (accessed 25 May 2023).

106. MASDAR, "Mohammed bin Rashid Al Maktoum Solar Park (MBR) Solar Park", 2023, https://masdar.ae/Masdar-Clean-Energy/Projects/Mohammed-bin-Rashid-Al-Maktoum-Solar-Park-Phase-3 (accessed 25 May 2023).

107. Abu Dhabi National Oil Company (ADNOC), "ADNOC to Build on its Position as one of the Least Carbon-Intensive Oil and Gas Producers in the World", Press Release, 25 February 2020, https://www.adnoc.ae/en/news-and-media/press-releases/2020/adnoc-to-build-on-its-position-as-one-of-the-least-carbon-intensive-oil-and-gas-producers#:~:text=ADNOC%20plans%20to%20expand%20the%20capacity%20of%20this,forest%20over%20twice%20the%20size%20of%20the%20UAE (accessed 18 May 2023).

108. Our World in Data, "Per capita CO_2 emissions, 2021", https://ourworldindata.org/grapher/co-emissions-per-capita (accessed 25 May 2023).

109. Enerdata, "The UAE launches its National Water and Energy Demand Management Programme", 10 August 2021, https://www.enerdata.net/publications/daily-energy-news/uae-launches-its-national-water-and-energy-demand-management-programme.html (accessed 18 May 2023).

110. Zawya, "Dubai to retrofit 30,000 buildings over next seven years", 1 February 2023, https://www.zawya.com/en/business/energy/dubai-to-retrofit-30-000-buildings-over-next-seven-years-ksknuvr5 (accessed 25 May 2023).

111. Arthur D. Little, *Global Electric Mobility Readiness Index – GEMRIX 2022*, August 2022, https://www.adlittle.com/sites/default/files/reports/ADL_Global_EM_readiness_index_2022.pdf (accessed 25 May 2023).

112. Smart Water Magazine, "Al Mazrouei: UAE to invest $2.08 billion in new desalination plants", 11 May 2022, https://smartwatermagazine.com/news/smart-water-magazine/al-mazrouei-uae-invest-208-billion-new-desalination-plants#:~:text=The%20minister%20of%20energy%20in%20the%20United%20Arab,of%20the%20UAE%E2%80%99s%20leadership%20to%20achieve%20water%20security (accessed 25 May 2023).

113. Government of India, Press Information Bureau, "India's Stand at COP-26", Press Release, 3 February 2022, https://pib.gov.in/PressReleasePage.aspx?PRID=1795071 (accessed 18 May 2023).

114. Lee, Uni, "Solar and wind dominate India's capacity additions in 2022", Ember, 17 March 2023, https://ember-climate.org/insights/research/india-data-story-2023 (accessed 28 May 2023).

115. Government of India, Press Information Bureau, "India takes another big step towards achieving 500 GW of non-fossil fuel based electricity installed capacity by 2030", Press Release, 7 December 2022, https://pib.gov.in/PressReleasePage.aspx?PRID=1881484#:~:text=India%20has%20huge%20ambitions%20in,installed%20capacity%20mix%20by%202030 (accessed 18 May 2023).

116. Lok Sabha Secretariat, New Delhi, “The Electricity (Amendment) Bill, 2022”, Legislative Note, August 2022, https://loksabhadocs.nic.in/Refinput/New_Reference_Notes/English/08082022_123415_1021205203.pdf (accessed 25 May 2023).

117. Government of India, Ministry of Power, “Transmission”, 22 May 2023, https://powermin.gov.in/en/content/overview-0 (accessed 25 May 2023).

118. Ziady, Hanna, “South Africa’s energy crisis deepens as blackouts hit 12 hours a day”, CNN, 18 January 2023, https://edition.cnn.com/2023/01/18/energy/ramaphosa-davos-south-africa-blackouts/index.html (accessed 25 May 2023).

119. Whyte, Kieran, “South Africa: The latest developments in Just Energy Transition”, Global Compliance News, 22 November 2022, https://www.globalcompliancenews.com/2022/11/22/https-insightplus-bakermckenzie-com-bm-energy-mining-infrastructure_1-south-africa-the-latest-developments-in-just-energy-transition_11102022 (accessed 18 May 2023).

120. Ibid.

121. Ibid.

122. Creamer, Terence, “Ramaphosa doubles next renewables round, scraps 100 MW cap on distributed plant and moots feed-in tariff as he unveils load-shedding crisis response”, Engineering News, 25 July 2022, https://www.engineeringnews.co.za/article/ramaphosa-doubles-next-renewables-round-to-5-200-mw-scraps-100-mw-cap-on-distributed-plant-and-moots-feed-in-tariff-as-he-unveils-load-shedding-crisis-response-2022-07-25 (accessed 18 May 2023).

123. Whyte, Kieran, and Zahra Omar, “South Africa: Hydrogen Roadmap – A crucial step in the energy transition journey”, Global Compliance News, 20 June 2022, https://www.globalcompliancenews.com/2022/06/20/south-africa-hydrogen-roadmap-a-crucial-step-in-the-energy-transition-journey080622 (accessed 18 May 2023).

124. IEA, “Nigeria”, 2020, https://www.iea.org/countries/nigeria (accessed 18 May 2023).

125. Okereke, Chukwumerije, et al., “Five opportunities for Nigeria to lead a clean and just energy transition at COP27 and beyond”, ODI, 2 November 2022, https://odi.org/en/insights/five-opportunities-for-nigeria-to-lead-a-clean-and-just-energy-transition-at-cop27-and-beyond (accessed 18 May 2023).

126. Ibid.

127. Ashurst, “Oil and Gas Update: Nigeria’s Energy Transition”, 2 March 2022, https://www.ashurst.com/en/news-and-insights/legal-updates/nigerias-energy-transition (accessed 26 May 2023).

128. Okereke, Chukwumerije, et al., op. cit.

129. Izuora, Chika, “Accelerating Energy Transition With Best Technology”, Leadership Media Group, February 2023, https://leadership.ng/accelerating-energy-transition-with-best-technology (accessed 18 May 2023).

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

The World Economic Forum, committed to improving the state of the world, is the International Organization for Public-Private Cooperation.

The Forum engages the foremost political, business and other leaders of society to shape global, regional and industry agendas.

World Economic Forum
91–93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744
contact@weforum.org
www.weforum.org