In collaboration with Accenture

WORLD ECONOMIC FORUM

Fostering Effective Energy Transition

INSIGHT REPORT

JUNE 2024

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Contents

Foreword

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The speed and trajectory of the global energy transition are now more important than ever. It is critical for both policy-makers and businesses to balance the three energy system priorities of equity, security and sustainability. It is also clear that there is no single universal answer for all countries. The *Fostering Effective Energy Transition* report, now in its 14th edition, benchmarks energy system performance and readiness for the transition through the Energy Transition Index (ETI) and provides insights across nations.

In the past decade, the sustainability dimension of energy system performance has improved with a shift to renewables and the integration of electric vehicles into mainstream use. However, progress has been uneven globally. Aside from increased adoption of wind and solar, it has not kept pace with the trajectory needed to reach net zero by 2050, particularly regarding energy efficiency gains, system electrification and adoption of low-carbon energy sources and fuels. In a significant step forward, recent decisions at the 28th Conference of the Parties (COP28) aim to double energy efficiency and triple renewable energy capacity by 2030, and transition away from fossil fuels in a just and equitable manner.

Equity-focused policies and decisions are gaining prominence. However, investments in developing nations remain insufficient, and challenges persist within and across countries, especially in energy affordability and access. Meanwhile, energy security risks need to be managed effectively amid rising geopolitical tensions. ETI data shows that while countries have managed to address security shocks in recent years, this comes at the expense of equity and sustainability.

Countries are ramping up efforts to enhance transition readiness, including human capital development, where clean jobs represent more than half of all energy-related jobs. Clean energy infrastructure investments have also been increasing, reaching $1.8 trillion in 2023, but almost 90% of the growth since 2021 has been in advanced economies and China,[1] highlighting wide gaps in transition momentum.

Digital innovations, including generative artificial intelligence (AI), present significant opportunities for energy companies, enabling them to generate over $500 billion in savings annually.[2] This can enhance equity and security by enabling additional capital investment or reducing energy supply costs. Nevertheless, as these technologies advance, the electricity needed for their computational demands will increase and must be managed carefully through the adoption of more efficient AI models and clean energy sources.

While ETI scores have reached record highs and shown notable improvements across various dimensions, the pace of progress has slowed, partly due to growing uncertainties in the global landscape. The ETI provides decision-makers with a comprehensive assessment of global energy systems and trends over time. This year's edition maintains consistency with last year's methodology, enabling stakeholders to make comparisons and track developments. The 2024 ETI also introduces "tailored pathways," providing new perspectives on country pathways and global collaboration. These pathways allow decision-makers to consider country-specific dimensions, such as income level, local energy resources and region, to maximize impact and advance the energy transition.

Executive summary

In a dynamic global landscape, most countries are progressing in the energy transition, with the centre of gravity moving towards developing nations.

Growing uncertainties are impeding energy transition momentum despite record Energy Transition Index scores. Global average Energy Transition Index (ETI) scores reached their highest levels, with 107 out of 120 countries making progress over the past decade. However, the global landscape is marked by economic volatility, heightened geopolitical tensions, and technological shifts. This uncertainty is reflected in the ETI, where the rate of improvement over the past three years has decreased.

Energy security continues to be tested, energy equity has gone into reverse and sustainability shows a gradual improvement over the past three years. Geopolitical tensions continue to test energy security, yet there are positive signs that countries are successfully mitigating most risks. Equity has faced a setback in the past three years driven by increased energy prices and fossil fuel subsidies. Sustainability has shown progress, mainly due to improved energy efficiency and increased share of clean energy, despite energy-related emissions growing by 1.1% in 2023.[3] Transition readiness has progressed significantly, driven by regulations and political commitment, education and human capital, and infrastructure. While innovation growth has slowed, countries like China and India are leading in developing new energy solutions and technologies.

Advanced economies, along with China and Brazil continue to be top performers, together with several developing nations that are forging pathways for progress. Sweden, Denmark, Finland and Switzerland lead the rankings, with France entering the top five performers due to its effective energy efficiency policies, resulting in a 12% reduction in energy intensity in 2022 compared to 2021.[4] Six G20 countries also feature among the top 20 performers on this year's ETI; France, Germany, Brazil, China, the United Kingdom and the United States. In 2023, China commissioned as much solar photovoltaic (PV) as the entire world in 2022, while its wind additions also grew by 66% year-on-year.[5] Brazil's long-term plan for hydropower and biofuels, along with institution-building initiatives, have been key in attracting investments. Estonia, Ethiopia and Lebanon have seen the fastest improvements in the past five years, prioritizing off-grid renewable energy to enhance access and sustainability.

International support that is tailored to country-specific requirements, must be reinforced to direct sufficient financing to emerging and developing economies. The widening gap in transition financing between advanced and developing economies necessitates increased international support and new approaches to unlock investments. Tailoring support based on factors like region, income level and local energy resources can underpin customized energy transition pathways. Sub-Saharan Africa shows the strongest growth in ETI scores, driven by improvement in energy access and affordability. Prioritizing these areas with international support can help sustain progress. Moreover, countries with abundant local energy resources are top performers in equity and security while being the worst performers in sustainability, emphasizing the need to balance the transition.

Decision-makers across the globe must act decisively and collaboratively to accelerate the transition towards an equitable, secure and sustainable energy future.

Introduction

Growing uncertainties complicate the energy transition trajectory, underscoring the need for adaptive and decisive action.

$1.8 trillion

invested in the clean energy transition in 2023.

Recent years have witnessed an increase in global uncertainties, driven by economic, political and technological shifts, adding complexity to the environment in which countries operate and their energy transition trajectory (Figure 1).

Geopolitical tensions pose risks to energy security and hinder international cooperation. Ongoing conflicts in the Middle East risk exacerbating volatility in oil markets, potentially resulting in an oil price spike. Despite a moderation in energy prices, regional disparities persist, constraining economic growth, imposing financial burdens on households and businesses, and hindering efforts to enhance electricity access.[6] This situation could have been much worse if not for the mild weather conditions globally. However, there have been instances of accelerated change, notably in Europe, where there has been a rapid reduction in dependence on Russian natural gas and significant improvements in energy efficiency. Global investments in efficiency increased by 45% since 2020, with countries representing three-quarters of global energy demand strengthening energy efficiency policies or implementing new ones in the past year.[7]

The disruptions caused by the COVID-19 pandemic and the Russia-Ukraine war led to a global energy crisis and a surge in inflation and interest rates during 2022 and 2023. This created a cost-of-living crisis in many countries, raising concerns across industries and economies, especially those in developing countries with dollar-denominated debt and imports. Headline inflation has since slowed down due to tighter monetary policy in G7 nations, with the International Monetary Fund (IMF) projecting a rate of 5.8% for 2024 (down from 6.9% and 8.7% in 2023 and 2022, respectively).[8] However, persistently high interest rates and capital costs remain significant obstacles in the energy transition, particularly for emerging and developing economies. This directly impacts the ability of firms and countries to finance the upfront investments to meet energy demand and decarbonize the energy system. Despite lower operational costs, capital-intensive clean energy solutions remain disproportionately affected due to high upfront capital investment requirements.[9]

In 2023, clean energy sources faced challenges, including uncertainties in subsidies and supply chains, coupled with high interest rates and significant cost increases. These factors reduced returns for developers, deterring much-needed investments in projects. The cancellation of major offshore wind projects in the United States (US) resulted in a temporary slowdown in the wind industry.[10] In parallel, global coal demand saw a 1.4% increase in 2023. However, despite these setbacks, global additions to renewable energy capacity surged by 50% compared to 2022.[11] This uptick was partly due to supportive policies such as the revision of the European Commission's Renewable Energy Directive which introduced "fast-tracking" of permitting procedures to accelerate the deployment of renewables and grids. Falling prices for renewables and rising electricity prices from fossil fuels further boosted the financial attractiveness of renewable energy.[12]

Trade patterns in the energy sector have shifted significantly as governments focus on enhancing supply chain resilience and strengthening energy security. This shift has coincided with accelerated momentum towards cleaner energy sources, including the rapid expansion of renewable power capacity and increased adoption of technologies such as electric vehicles (EVs) and heat pumps, driven partly by supportive government policies.[13] Despite these positive trends, growing trade protectionism and costs create headwinds, especially for developing nations. United Nations Conference on Trade and Development (UNCTAD) data indicates a $1 trillion contraction in global trade in 2023, largely due to reduced demand in developed countries and decreased trade within East Asia and Latin America.[14] Geopolitical tensions have continued to impact bilateral trade flows, evidenced by shifts such as the European Union (EU) reducing its trade dependence on Russia and decreasing trade interdependence between China and the US. However, certain industries, such as motor vehicles, saw growth in trade value, driven by growing demand for EVs.[15] This, coupled with an improved global economic outlook, could bolster trade resilience in the coming year. Uncertainties remain regarding geopolitical tensions and potential future disruptions to global supply chains,[16] underscoring the need for adaptive strategies.

Innovation and technology ecosystems experienced significant volatility. A Crunchbase article states that "total global start-up investment in 2023 plummeted to $285 billion, marking a 38% decline year over year from the $462 billion invested in 2022".[17] These challenges prompted cost-cutting measures,

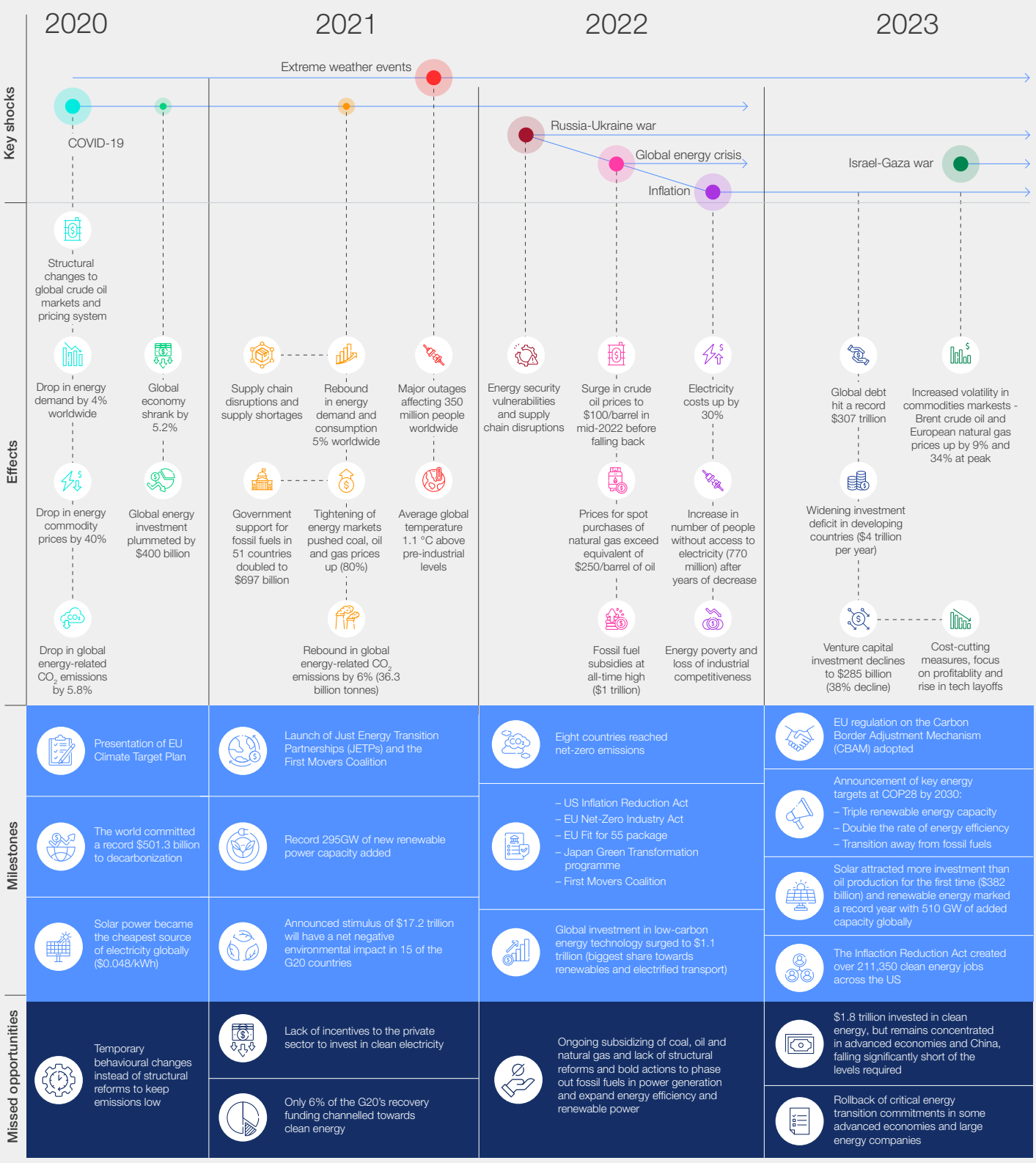
a focus on profitability and a rise in tech layoffs. Investors responded by exercising greater caution, deploying capital more selectively and raising standards for investment at each stage.[18] Despite overall downturns, BloombergNEF found that "global investments in the energy transition hit a record $1.8 trillion in 2023, climbing 17% from a year earlier". Most of this investment was in electrified transport, with China as the largest market, accounting for over one-third of the total investment, followed by Europe and the US.[19] The artificial intelligence (AI) sector was one of the few that saw growth, with global funding to start-ups reaching nearly $50 billion.[20] While AI and generative AI integration require substantial adaptation and investment, it also offers opportunities and value for industry (estimated at $0.3-0.5 trillion annually)[21] and the energy transition. Yet, increased uptake of generative AI may lead to a rapid surge in demand and power consumption from data centres, creating competition for available electric power and requiring additional capacity increases, which must be balanced by gaps in innovation and opportunity.

While global clean energy investment has surged by 40% since 2020, this recent growth has primarily been concentrated in advanced economies and China. In contrast, other emerging and developing economies received less than 15% of the total investment despite accounting for 65% of the world's population and generating about a third of global gross domestic product (GDP).[22] This disparity highlights a concerning trend in financing the energy transition in emerging and developing economies. To align with efforts to limit global warming to 1.5°C, "clean energy investment in these economies outside China must increase more than sixfold, from $270 billion currently to $1.6 trillion by the early 2030s".[23] This investment should prioritize utility-scale solar and wind projects, enhancing electricity networks, and spending on energy-efficient building designs and appliances.[24]

Key energy targets were announced at 28th Conference of the Parties (COP28). These include the "Global Renewables and Energy Efficiency Pledge", which calls for tripling the rate of renewables capacity and doubling the rate of energy efficiency by 2030. Another goal is to transition away from fossil fuels in energy systems in a just, orderly and equitable manner, to achieve net zero by 2050 and limit global warming to 1.5°C.[25] These targets provide additional clarity on the direction of the energy transition journey, despite uncertain implementation pathways. Achieving these targets requires reforms and investments in the energy system. While governments have initiated targeted measures, more decisive action is needed. The importance of tailored policy approaches aligned with local priorities and challenges is increasingly evident. These pathways can accelerate the transition by directing resources to areas with the greatest impact, thereby facilitating a smoother and more effective transition process.

In a landscape marked by complexities and uncertainties, the path forward remains clear: now is the time for all stakeholders across the value chain, spanning supply, demand and distribution, and including both public and private sectors, to take decisive action. This means ramping up efforts to transform their energy systems by implementing innovative solutions, mobilizing investment and driving bold policy reforms. By harnessing the momentum of the energy transition, stakeholders can chart the course towards an equitable, secure and sustainable energy future.

FIGURE 1 | **Volatile period in the energy transition, 2020-2023**



Source: World Economic Forum.

1 Framework

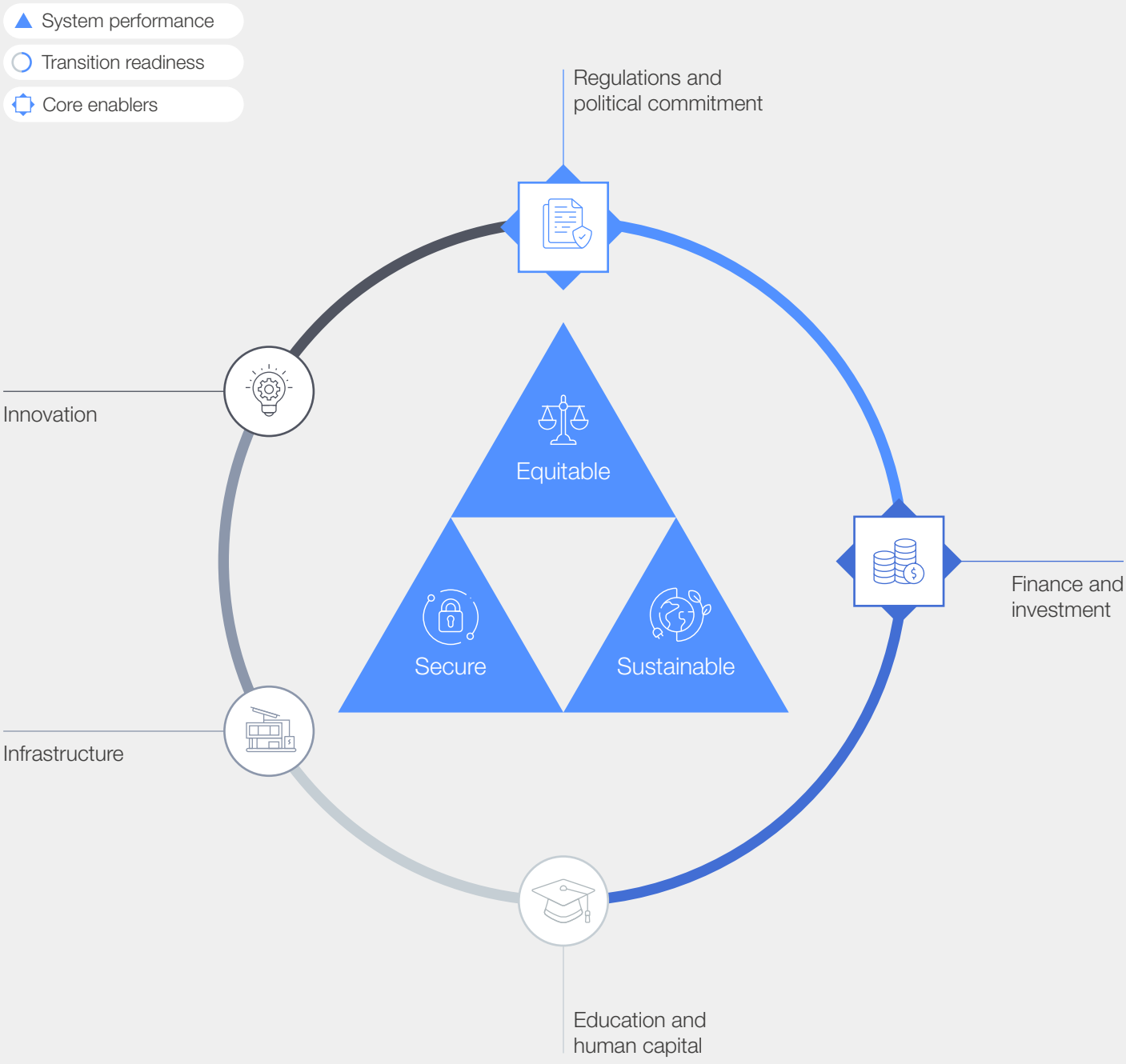
The ETI 2024 framework offers a comprehensive assessment of countries' energy systems with a consistent methodology, allowing decision-makers to compare and track progress.

Decision-makers are confronted with two critical questions in the energy transition: what is needed to accelerate improvements in countries' energy systems, and how can the right conditions be established to capitalize on opportunities arising from the transition? Addressing these questions necessitates a transparent fact base to help decision-makers understand and navigate the complexities inherent in the energy transition.

The Energy Transition Index (ETI), which is an evolution of 14 years of country-level energy system benchmarking, provides a data-driven framework to foster understanding of the performance and readiness of global energy systems for the transition. The ETI covers 120 countries in terms of their current energy system performance on equity, sustainability, and security and readiness of the enabling environment on policies and regulatory framework, infrastructure, innovation, education and human capital, and finance and investment (Figure 2).

A county's final ETI score is a composite of its scores on the two sub-indices of system performance and transition readiness, weighted at 60% and 40%, respectively. System performance is equally weighted across equity, security and sustainability. Transition readiness is split into two groups: core enablers and enabling factors. Core enablers include regulations and political commitment, and finance and investment. Enabling factors include innovation, infrastructure, and education and human capital.

FIGURE 2 **Energy Transition Index framework**



Source: World Economic Forum.

The assessment of a country's energy system performance revolves around three imperatives:

- **Equity:** Ensuring fair distribution, accessibility and affordability of energy for all, along with shared efforts and benefits from sustainability, to foster equitable economic growth and an improved standard of living.

- **Security:** Ensuring supply security through diversification across three levers – in the energy mix, energy trade partners and sources of electricity generation. Resilience, both in gas supplies and the power system, is also instrumental for energy security, in addition to the reliability of the grid, especially as the number and range of power generation and management assets increase as a result of decentralization.

- **Sustainability:** Incorporating demand- and supply-side metrics to reduce carbon dioxide (CO_2) and methane intensity in energy supply, enhancing energy efficiency, promoting responsible consumption through lower energy and emissions footprint per capita, and increasing the share of clean energy in final demand.

A country's progress in energy transition is determined by its transition readiness – i.e. the extent to which a robust enabling environment can be created. The core components are characterized by a strong policy and regulatory framework and the ability to attract and deploy capital on a large scale. An investment climate characterized by a low cost of capital, domestic market liquidity and capital availability, and attractiveness to foreign direct investment is vital for financing the energy transition. Key factors like a skilled workforce, innovation and robust infrastructure are also integral to this framework.

Countries are scored across 46 indicators (Appendix A1) covering the most important aspects across these dimensions of the energy transition. The ETI adopts a minimum-maximum method to normalize indicator scores on a scale from 0 to 100, where a score of 100 signifies the highest global performance on each indicator. Additionally, external factors such as commodity market fluctuations, geopolitics, international climate change action and financial market conditions may impact certain dimensions of a country's score. Therefore, it is important to interpret country rankings within the context of each country's unique circumstances rather than viewing them as a definitive measure of energy transition progress.

2 Overall results

Most countries are making progress in the energy transition, with Northern European nations leading, and China and Brazil showing strong improvement.

Key highlights

1

Global average ETI scores increased by 6% since 2015 but showed slower growth in the past three years.

2

The top 10 countries account for only 1% of energy-related CO_2 emissions, 3% of total energy supply, 3% of energy demand and 2% of the global population.

3

Only 17% of countries in 2024 balanced the progress in dimensions of the energy triangle.*

4

Only 28% of countries showed strong improvement in the dimension with the lowest score, signalling progress towards a more balanced system.

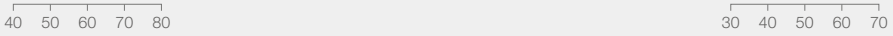
5

Overall, 53 countries have made steady progress in the past decade.

*Balanced is defined as when all three sub-indices scores – equitable, secure and sustainable – are making positive progress simultaneously.

TABLE 1 | **ETI 2024 ranking table**

Rank	Country	ETI score (2015–2024)	2024 ETI score	SP[1] ('24)	TR[2] ('24)
1	Sweden		78.4	79.4	76.8
2	Denmark		75.2	72.0	80.1
3	Finland		74.5	70.7	80.1
4	Switzerland		73.4	76.2	69.1
5	France		71.1	74.7	65.6
6	Norway		69.9	75.2	62.0
7	Iceland		68.0	71.8	62.2
8	Austria		67.9	68.5	67.0
9	Estonia		67.8	73.7	59.0
10	Netherlands		66.7	62.7	72.7
11	Germany		66.5	65.0	68.7
12	Brazil		65.7	69.9	59.4
13	United Kingdom		65.6	66.3	64.6
14	Portugal		65.4	67.0	62.9
15	Latvia		65.2	70.1	58.0
16	Spain		64.3	64.7	63.7
17	China		64.1	66.6	60.3
18	Luxembourg		64.1	64.1	64.1
19	United States		64.0	67.3	59.0
20	Chile		63.9	67.9	58.0
21	Israel		63.8	70.4	54.0
22	Australia		63.7	63.2	64.4
23	Korea, Rep.		63.5	62.4	65.2
24	Lithuania		63.2	64.7	60.9
25	New Zealand		62.8	68.3	54.5
26	Japan		62.4	63.1	61.4
27	Canada		62.4	65.5	57.8
28	Hungary		62.1	68.5	52.4
29	Slovenia		61.9	68.2	52.5
30	Costa Rica		61.3	72.1	45.0
31	Poland		61.3	66.0	54.2
32	Vietnam		61.0	65.6	54.2
33	Uruguay		60.8	69.0	48.5
34	Belgium		60.8	61.6	59.6
35	Colombia		60.7	65.7	53.3
36	Bulgaria		60.6	66.9	51.2
37	Greece		60.5	58.9	63.1
38	Azerbaijan		60.3	68.8	47.6
39	Croatia		60.1	66.4	50.7
40	Malaysia		60.1	69.8	45.6
41	Italy		59.7	62.7	55.2
42	Paraguay		59.6	70.1	43.9
43	Albania		59.4	65.0	51.0
44	Czech Republic		59.2	67.3	47.2
45	Ireland		58.7	60.4	56.2
46	El Salvador		58.4	70.6	40.0
47	Peru		58.3	71.0	39.3
48	Romania		58.3	69.0	42.2
49	Slovak Republic		57.5	64.6	46.9
50	Qatar		57.3	60.1	53.1
51	Panama		57.1	66.4	43.2
52	United Arab Emirates		57.0	62.4	48.8
53	Mauritius		56.8	67.2	41.2
54	Indonesia		56.7	69.9	36.9
55	Cyprus		56.6	61.3	49.6
56	Georgia		56.3	63.7	45.1
57	Mexico		56.3	68.7	37.6
58	Saudi Arabia		55.9	62.8	45.4
59	Turkey		55.8	62.7	45.5
60	Thailand		55.8	63.2	44.6
61	Malta		55.6	64.9	41.8
62	Oman		55.5	58.9	50.3
63	India		55.3	63.6	42.8
64	Singapore		55.0	54.1	56.5
65	Morocco		54.9	60.5	46.5
66	Bolivia		54.8	68.1	34.7
67	Montenegro		54.6	59.9	46.6
68	Namibia		54.5	62.0	43.3
69	Sri Lanka		54.2	64.4	39.0
70	Kenya		53.6	63.8	38.4
71	Tajikistan		53.6	65.2	36.1
72	Lao PDR		53.5	54.0	52.9
73	Jordan		53.5	57.7	47.1
74	Ecuador		53.2	67.5	31.8
75	Egypt, Arab Rep.		53.0	64.3	36.0
76	Ukraine		52.9	62.6	38.3
77	Cambodia		52.9	61.6	39.9
78	Serbia		52.9	61.1	40.5
79	Armenia		52.7	60.9	40.5
80	Kyrgyz Republic		52.7	61.7	39.3
81	Macedonia, FYR		52.6	59.5	42.3
82	Argentina		52.6	64.9	34.3
83	Gabon		52.5	65.1	33.5
84	South Africa		52.4	58.0	44.0
85	Lebanon		52.0	56.9	44.6
86	Angola		52.0	67.6	28.7
87	Ethiopia		51.7	59.5	39.9
88	Bosnia and Herzegovina		51.5	55.3	45.8
89	Tunisia		51.3	57.1	42.6
90	Cote d'Ivoire		51.2	59.2	39.1
91	Algeria		50.9	65.1	29.7
92	Ghana		50.9	62.1	34.1
93	Zambia		50.9	55.6	43.7
94	Guatemala		50.8	63.7	31.4
95	Venezuela		50.4	67.6	24.7
96	Brunei Darussalam		50.3	58.4	38.2
97	Dominican Republic		50.1	56.8	40.2
98	Kazakhstan		50.1	57.3	39.3
99	Trinidad and Tobago		49.7	57.2	38.6
100	Nepal		49.6	57.8	37.3
101	Cameroon		49.2	61.8	30.2
102	Iran, Islamic Rep.		49.0	59.4	33.3
103	Bahrain		48.8	55.4	38.8
104	Kuwait		48.6	54.1	40.3
105	Philippines		48.4	59.1	32.4
106	Honduras		48.3	59.3	31.9
107	Republic of Moldova		48.1	55.3	37.2
108	Nigeria		46.9	59.4	28.2
109	Bangladesh		46.8	60.8	25.6
110	Jamaica		46.6	50.3	41.1
111	Senegal		46.6	53.3	36.5
112	Zimbabwe		46.3	50.7	39.7
113	Pakistan		46.2	55.2	32.5
114	Nicaragua		46.0	57.7	28.6
115	Botswana		45.6	54.3	32.7
116	Mongolia		45.4	55.3	30.5
117	Mozambique		45.3	57.0	27.8
118	Tanzania		44.3	49.7	36.1
119	Yemen, Rep.		43.8	55.1	26.8
120	Congo, Dem. Rep.		42.0	53.7	24.4



- 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 2015 — 2024

---- 2024 global average (56.5)

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

2.1 Transition scores

This year saw the highest global average scores in the history of the ETI, with modest improvements in system performance of about 0.2% and strong progress in transition readiness, with a growth of 2%. The top 10 ranked countries in the ETI are predominantly advanced economies, mainly from Northern Europe. They collectively contribute only 1% of energy-related CO_2 emissions, 3% of total energy supply and represent 2% of the global population. Sweden leads the rankings, followed by Denmark and Finland. Norway, however, has seen a drop in its ETI rank for the first time in many years, due to increasing electricity prices and decline in renewable capacity buildout.

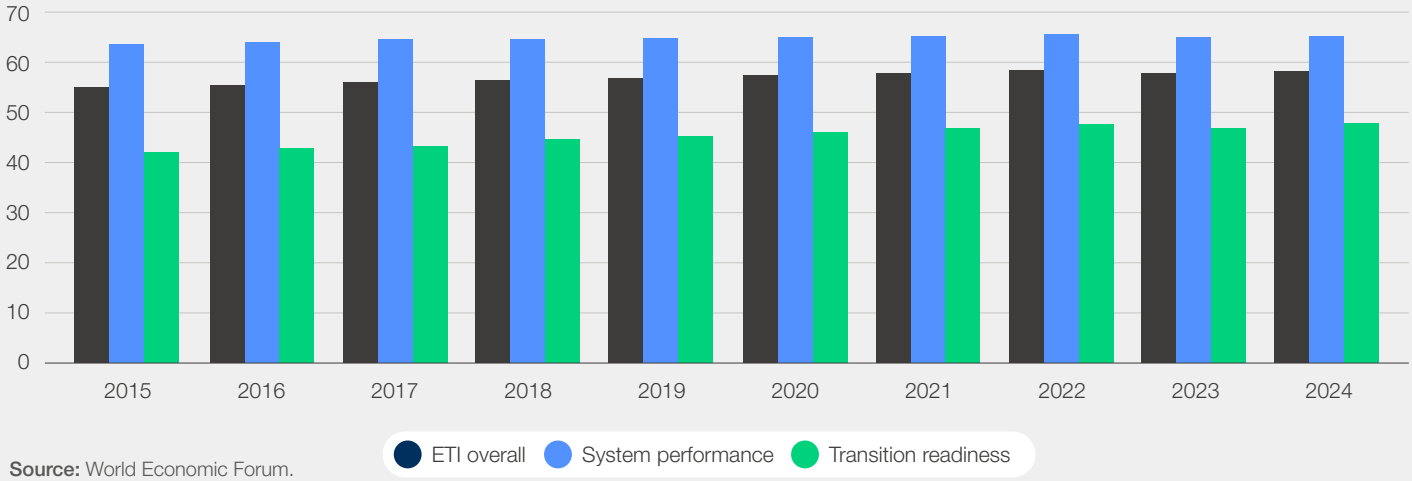
Notably, six G20 economies feature in the ETI top 20, including France, Germany, Brazil, China, the UK and the US. Over the past year, infrastructure and regulatory commitment have experienced the most significant growth, increasing by approximately 4%, while innovation, and finance and investments have declined by 1%.

Over the past decade, the list of top performers in the ETI has remained relatively unchanged; although countries such as China, Brazil and Chile have entered the top 20 performers owing to their energy transition efforts over several years. Despite each country adopting a unique energy transition pathway, they share common characteristics, including:

- Enhanced energy security through diverse energy and electricity mixes, as well as a mix of import partners
- Improved energy and carbon intensity
- Increased share of clean energy in the fuel mix
- A carbon pricing mechanism
- Strong and supportive regulatory environments to drive the energy transition

From 2015 to 2024, the global average scores for the ETI have consistently increased, driven by improvements in both system performance and transition readiness (Figure 3).

FIGURE 3 **Global average Energy Transition Index and sub-index scores, 2015-2024**



Source: World Economic Forum.

> Last year, 17% of countries, including notable examples like France, China, Poland, Belgium and India, showcased improvement across equity, security and sustainability.

Major growing centres of demand, such as China, Brazil and India, have improved their ETI scores.

Out of 120 countries, 107 have shown progress over the past decade, with 30 countries seeing their scores increase by more than 10%. Notably, China and Brazil have progressed in recent years, primarily due to a ramp-up in renewable energy capacity additions and an overall increase in the share of clean energy. Both countries already rely on hydropower for a significant share of energy consumption and have committed to solar and wind capacity ramp-up. Different measures have come together in these countries over the years to create an enabling environment for the energy transition. Brazil's long-term commitment to hydropower and biofuels,[27] combined with recent strides in solar energy, has set the country on the path to becoming a leader. Its focus on planning and policy instruments, as well as strengthening institutions, has built the right ecosystem for energy transition momentum.

Meanwhile, India has made strides in its clean energy infrastructure, with renewable energy and biomass comprising 42% of its power generation capacity,[28] making it the fourth-largest renewables market globally. With annual investments nearing $10 billion, India is driving the adoption of electric vehicles (EVs) and the production of green hydrogen.[29] However, the significant dependence on coal in both China and India continues to be a major factor in their emission intensity.[30]

Last year, 17% of countries, including notable examples like France, China, Poland, Belgium and India, showcased improvement across equity, security and sustainability, highlighting the difficulty in establishing a balanced transition.

In 2024, a notable 28% of nations, including Kuwait, Nigeria, Bangladesh, Mozambique and Tanzania, are actively transitioning towards a more balanced energy system. This evolution is characterized by significant advancements in the lowest-scoring sub-index among equity, security and sustainability. Such progress indicates a strategic shift towards a more equitable, secure and sustainable energy landscape in these countries.

Meanwhile, improvements in ETI scores have slowed in Germany, Japan and the US over the past year.

In recent years, Germany has increased its coal-based energy production by 35% in 2022 compared to 2020,[31] to compensate for reduced reliance on Russian gas, raising its carbon intensity. Germany also phased out nuclear energy in April 2023 with plans to replace it with solar and wind energy. While solar and wind energy adoption has increased, most of the gap has been filled by coal.[32] Japan has been significantly impacted by fluctuations in gas prices, leading to a drop in its equity scores due to challenges with energy affordability. Early success with clean hydrogen shows promising signs. The US has seen robust growth in ETI scores over the past three years, with the Inflation Reduction Act (IRA)[33] playing a key role in providing the economic environment for renewable energy and EV adoption. However, the pace of the transition has decreased in the past year due to a backlog in connecting clean energy projects to the grid,[34] especially with large projects taking longer to connect. Additionally, while solar and wind are generally accepted by the public, local restrictions by homeowners driven by NIMBYism (not-in-my-backyard) pushed energy players to build assets in areas with strong potential for wind and solar while respecting the needs of local communities.[35]

Among the new entrants in the top 20 are Latvia and Chile. Latvia has bolstered its sustainability performance with renewables contributing to approximately three-quarters of its power generation, largely driven by hydropower and biofuels.[36] Additionally, Latvia has made strides in energy security by diversifying its import partners. Chile, on the other hand, has significantly improved its ETI score this year, with increased renewable energy capacity[37] leading to improved sustainability performance and reduced energy imports.

Despite these advancements, the global imperative to balance equity, sustainability and security remains paramount. Only 20 countries improved scores across all three dimensions in the past year. The growing complexity of macroeconomic landscapes and escalating geopolitical tensions have introduced additional challenges, underscoring the need for tailored pathways towards the energy transition to address these evolving dynamics effectively.

FIGURE 4 | **Regional scores and key insights: average scores by peer group – ETI 2024**

64.8
Average score
13% 32%
29%

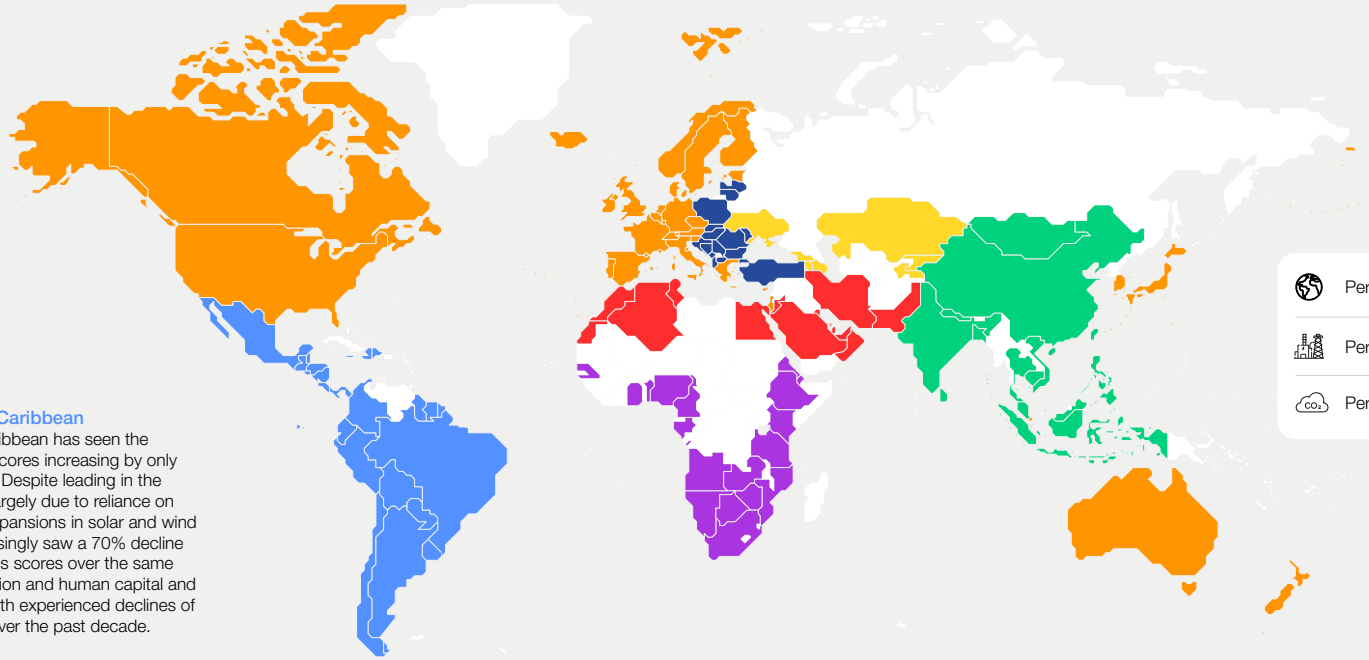
Advanced economies
Over the past decade, advanced economies, led by Nordic countries, have seen a strong 6% improvement in their average ETI scores. While they have achieved universal access to electricity and progress on decarbonization, affordability has become a challenge due to elevated energy prices in recent years. In the last year, progress has been remarkable in education and human capital and infrastructure. However, security and finance and investments saw a decline due to the energy crisis and uncertainty in energy markets.

54.1
Average score
1% 1%
1%

Commonwealth of Independent States
In the past decade, the Commonwealth of Independent States (CIS) has seen a 4% improvement in aggregate ETI scores. Notably, regulation and political commitment scores have increased by 32% in this period, driven by improvements in energy efficiency and renewable energy, in line with COP28 outcomes. However, there has been a recent decline in education and human capital and innovation scores, attributed to decrease in jobs in low-carbon industries and public spending on research and development. In addition, energy affordability challenges remain for consumers, exacerbated by high fuel subsidies, which experienced a 60% increase in the last year.

53.9
Average score
46% 38%
45%

Emerging and developing Asia
Emerging and developing Asia, including populous nations like India and China, has shown an 8% improvement in ETI scores over the past decade, mainly in reducing energy intensity. The region has also bolstered its regulation and policy framework, evident in a 16% increase in the carbon pricing score. However, progress on the sustainable front has stalled, marked by a concerning increase in carbon intensity. Despite renewable energy additions, the region remains heavily reliant on coal.



55.2
Average score
8% 6%
4%

Latin America and the Caribbean
Latin America and the Caribbean has seen the slowest growth, with ETI scores increasing by only 3% over the past decade. Despite leading in the sustainability dimension, largely due to reliance on hydropower and recent expansions in solar and wind capacity, the region surprisingly saw a 70% decline in investment in renewables scores over the same period. In addition, education and human capital and innovation environment both experienced declines of 5% and 9% respectively over the past decade.

49.6
Average score
11% 4%
2%

Sub-Saharan Africa
Sub-Saharan Africa has witnessed remarkable energy transition growth of 10% over the last decade, making it the strongest performer across all groups on the equitable dimension. Notably, the region has experienced the highest gain of 58% in regulation and political commitment scores, alongside advancements in education and human capital. However, the region faces challenges in attracting global investments and fostering public-private partnerships to strengthen infrastructure and diversify its energy mix.

51.8
Average score
8% 7%
7%

Middle East, North Africa and Pakistan
Over the past decade, the Middle East, North Africa and Pakistan region has seen a 7% growth in ETI scores, which have stagnated in the last three years. The region's heavy reliance on oil revenues poses challenges for a sustainable energy transition. While transition readiness has improved by 22% over the decade, the region has seen the most significant decline in finance and investments in the past three years.

57.5
Average score
2% 3%
3%

Emerging and developing Europe
Emerging and developing Europe has demonstrated strong growth, with a 7% increase in ETI scores over the past decade. The group excelled in transition readiness, experiencing a 16% gain in scores, driven by advancements in regulation and political commitment and finance and investments. Over the past three years, significant progress has been made in adding renewable energy capacity and enhancing transport infrastructure, reflected in improved infrastructure scores. However, challenges remain due to high energy imports and consumer affordability concerns.

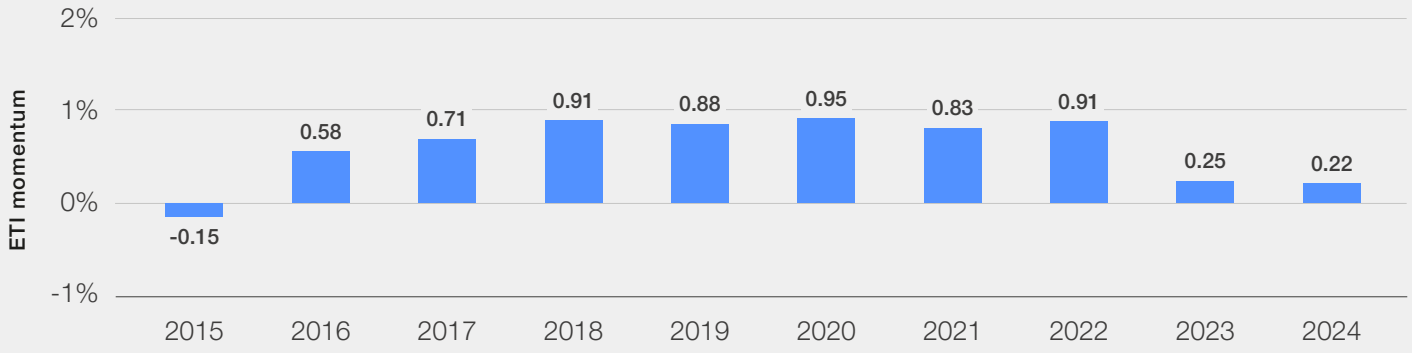
2.2 Transition momentum

ETI scores assess a country's current energy system without accounting for the pace of its transition. The concept of transition momentum highlights the countries that are rapidly transitioning and those that face risks. While there is no globally defined percentage to measure the progress of the energy transition, its pace depends on various factors, including the country and region-specific circumstances, the availability of resources and technology, the degree of political commitment and public support, and the overall urgency of addressing the climate crisis.

Although ETI scores reached their highest in 2024, transition momentum has slowed in the last three years.

ETI scores showed a three-year compound annual growth rate (CAGR) of 0.22% in 2024 compared to 0.83% in 2021.

FIGURE 5 **Energy Transition Index momentum, three-year CAGR percentage, 2015-2024**



Source: World Economic Forum.

Recent macroeconomic conditions have significantly impacted the equity dimension of the energy transition. Inflation and high interest rates have compounded the challenge making it difficult for lower-income communities and developing nations to invest in sustainable energy solutions. These solutions often come with higher upfront costs, further exacerbated by the increased cost of borrowing. Additionally, energy prices have surged in recent years due to several factors: increased demand post-pandemic recovery, supply chain disruptions, geopolitical tensions affecting oil and gas supply, and underinvestment in traditional energy sectors amid the shift to clean energy sources. These issues have led to tighter energy markets and higher prices, hindering accessibility to affordable clean energy solutions and impeding progress towards an equitable energy transition.[38]

Furthermore, energy supply disruptions have intensified pressure on energy security measures. In response, nations have prioritized immediate energy security concerns, often at the expense of a more equitable and sustainable transition.

Several countries have made notable progress in their energy transition journeys, each with tailored pathways to address their unique challenges and opportunities.

Among the major global economies, the countries with the strongest momentum include Australia, China, Indonesia, Brazil and Canada. Australia's 2022 Climate Change Act enhanced the country's political commitment to sustainable transition and has ramped up its security dimension by further reducing reliance on fuel imports.[39] China continues to be the major player in manufacturing clean energy technologies and has significantly ramped up its domestic renewable energy capacity, adding record-level solar photovoltaics (PV).[40] Indonesia enhanced energy access, especially in rural areas, reaching 98% access in 2023, compared to 93% in 2022. Canada's 2021 Emissions Trading Systems (ETS) permit allowed the commercialization of several emerging technologies in some applications, such as carbon capture, utilization and storage (CCUS) and clean hydrogen.[41]

Lebanon, Ethiopia, Tanzania, Zimbabwe, and South Africa are the top five countries in energy transition momentum. While these countries have shown significant strides, there is still considerable room for improvement. Nevertheless, the success stories of these countries, which are in the lower quartile of the ETI ranking, provide valuable and specific lessons, especially for those nations that have, so far, experienced an unbalanced energy transition.

“ Moving the needle on a meaningful global energy transition requires that countries with lower ETI scores hasten their transition efforts.

Additionally, moving the needle on a meaningful global energy transition requires that countries with lower ETI scores (yet showing considerable potential for progress) hasten their transition efforts. Common themes across the countries with the highest momentum scores include:

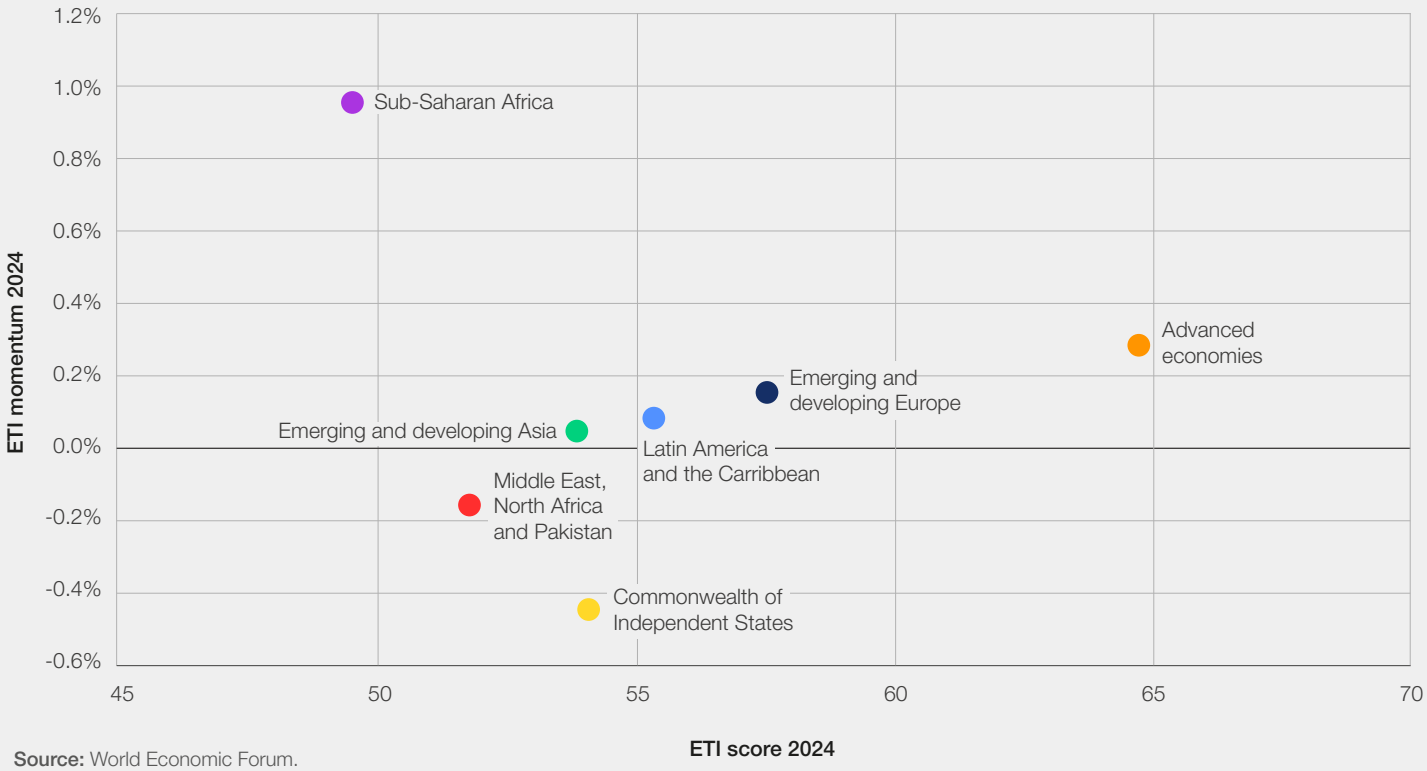
- Reduced fossil fuel subsidies, leading to renewable energy being an economically preferred alternative.
- Proliferation of decentralized renewable energy (DRE) leading to improved energy access, reliability and decarbonization.
- Increase in clean energy jobs.

For example, in Lebanon, a significant reduction in fossil fuel subsidies catalysed a surge in distributed solar energy.[42] Meanwhile, Ethiopia embarked on its National Electrification Program in 2017, charting a course towards universal energy access by 2025, with a specific target of providing off-grid power solutions to 35% of its population.[43] Tanzania has emerged as a front-runner in Sub-Saharan Africa, with a rapid expansion of electricity, achieving a notable 37.7% increase in accessibility across both rural and urban areas from 2011 to 2020.[44] Zimbabwe witnessed a rise in renewable energy generation, primarily through hydropower, leading to improved energy access and substantial job growth in clean energy sectors.[45] Despite strides made in improving energy and carbon intensity, South Africa’s energy sector still has significant room for further enhancement.[46]

On the other hand, several countries have experienced a reversal in energy transition momentum over the past three years, notably, the UK, Italy, Turkey, Angola and Kuwait. The UK has been an early leader in the energy transition and continues to be a top performer; however, the energy crisis hit UK households particularly hard as the country is heavily reliant on natural gas, contributing 39% of its energy mix, had a decline in momentum due to energy affordability declining.[47] The UK increased its liquefied natural gas (LNG) imports from the US. However, a lack of diversity in energy imports also impacts the security dimension.[48] Similarly, Italy is heavily reliant on gas, and Turkey has seen a decline in the equity dimension due to surging electricity and gas prices, accompanied by a drop in transition readiness performance, particularly in regulation and investments. Angola’s momentum has stalled due to a reduction in renewable energy investments. Additionally, Kuwait remains one of the most carbon-intensive economies globally, characterized by heavy reliance on fossil fuels and high energy intensity.[49]

Regional breakdown of ETI momentum reveals a wide divergence in performance, with Sub-Saharan Africa showing the strongest improvement, while the Commonwealth of Independent States experiences the most significant decline.

FIGURE 6 | **ETI momentum vs score by region, 2024**



Source: World Economic Forum.

Sub-Saharan Africa leads with the highest positive momentum, driven primarily by advancements in energy security and regulations. The region has diversified its imports and significantly improved grid reliability. However, there is still substantial room for improvement, especially on the equity and finance fronts to expand access to electricity and clean cooking and unlock more investments in the energy system. Advanced economies follow, with smaller yet positive momentum, mainly due to notable improvements in sustainability, including a decade-long trend of steadily decreasing energy and carbon intensity. Emerging and developing Asian countries have experienced modest positive momentum, driven by enhanced transition readiness across political commitments and infrastructure.

In Latin America and the Caribbean, momentum has levelled off, with improvements in sustainability from increased renewable energy contributions partially offset by declining equity due to gas prices. For emerging and developing Europe, the improvements in energy security and sustainability, through diversification in energy imports and increased renewable energy, have been partially offset by a decline in affordability.

The Middle East, North Africa and Pakistan has shown negative momentum due to sustainability challenges. Despite the region's high potential for solar energy and deployment in a few countries, it has the highest energy intensity and trails other regions in terms of integrating renewable energy into the energy mix. The Commonwealth of Independent States also shows negative momentum, with increasing energy prices and subsidies.

2.3 A lookback on COVID-19 impacts

System shocks will continue to test the resilience of the energy sector. One of the most important shocks in recent years was the COVID-19 pandemic. It is important to analyse the impact of a black swan event such as the COVID-19 pandemic to draw key learnings for future purposes. This examination provides important lessons for bolstering preparedness, resilience and sustainability in anticipation of future shocks. The critical takeaways include:

- Developing renewable energy capacity and local manufacturing for green energy technologies enhances resilience and ensures reliable supply.
- Implementing time-of-use electricity pricing flattens the energy demand curve, which is essential as electricity use increases with more electrification and remote work, particularly in energy-intensive countries.

“ The COVID-19 pandemic also underscored the importance of energy security, emphasizing the need for reliable access to electricity and reducing dependence on imported fossil fuels.

– Aligning immediate economic needs with long-term sustainability goals is achieved through stimulus measures and broad policy tools.

– Advancing digital transformation boosts efficiency, growth, customer experience and reliability.

– Diversifying energy imports and cutting fossil fuel subsidies is accomplished by integrating both centralized and decentralized renewable energy sources.

The COVID-19 pandemic years witnessed substantial disruptions in global energy markets, with over 100 countries implementing lockdown measures by March 2020.[50] China, a major player in global clean energy technology manufacturing, hosting over 80% of the world’s solar PV module manufacturing capacity and accounting for 58% of onshore wind turbine manufacturing,[51] was the first to initiate lockdowns. In recent years, some countries and regions have sought to localize critical parts of the manufacturing processes, as evidenced by the EU’s 2030 objective to produce at least 40% of key products domestically to decrease greenhouse gas emissions.[52] Recent geopolitical events, including the Russia-Ukraine war, Middle East conflicts and others, further solidify the need for local resilience, both in clean and conventional sources.

COVID-19 lockdowns and remote work arrangements shifted residential energy demand and consumption patterns, altering peak demand times and overall energy use. Companies have swiftly adapted to changing energy consumption dynamics, exemplified by the proliferation of residential smart energy management solutions like smart thermostats and energy monitoring systems.[54] Moreover, heightened consumer awareness of electricity pricing throughout the day has spurred the adoption of time-of-use pricing plans from utilities suppliers. Additionally, energy-saving apps have become popular in places like the UK, where electricity prices particularly spiked. These developments enable consumers to adjust their use patterns and flatten the demand curve. As consumers increase the time spent working from home, countries with high energy intensity can adopt time-sensitive electricity pricing to drive down peak demand, which would reduce the total capacity needed.

Some governments were able to tackle immediate economic recovery needs with long-term sustainability ambitions through new policies and stimulus packages. Stimulus packages varied in their support for renewable energy. For example, the NextGenerationEU[55] initiative, a €807 billion recovery plan responding to the economic impact of the COVID-19 pandemic, aimed to spur economic growth while accelerating the transition to a green and digital economy. Similarly, the IRA is the largest climate investment in US history, designed to mobilize private capital to achieve climate goals and strengthen long-term growth.[56]

The COVID-19 pandemic also catalysed innovation in the energy sector, with accelerated adoption of digital technologies, smart grid solutions and energy storage systems. Utilities suppliers globally accelerated the deployment of advanced metering infrastructure and smart grid solutions to remotely monitor and manage energy distribution networks. The focus on resilience and sustainability also spurred innovation in renewable energy technologies, energy efficiency measures and decentralized energy systems. The COVID-19 pandemic also underscored the importance of energy security, emphasizing the need for reliable access to electricity and reducing dependence on imported fossil fuels, aligned with the COP28 outcome of transitioning away from fossil fuels.

While the COVID-19 pandemic presented an opportunity to translate the temporary emissions drop into longer-term progress, compounding impacts such as geopolitical tensions, “higher for longer” interest rates and other uncertainties have complicated the energy transition path. However, some effects are enduring, including the need to build resilient supply chains, enhance energy system flexibility and maintain commitment to decarbonization and energy efficiency.

FIGURE 7 | **Evolution of key indicators, pre-COVID-19 pandemic (2019) vs post-COVID-19 pandemic (2022)**

	2019		2022
Global clean energy investments	$1.1 trillion	↗	$1.4 trillion
Global energy intensity (2017 PPP)	4.44 MJ/$	↘	4.24 MJ/$
Share of renewable energy in the total electricity generation	26.1%	↗	29.5%
Global GHG emissions	52.6 Gt CO_2eq	↗	53.8 Gt CO_2eq
CO_2 intensity: CO_2 per TES	46.27 kg/GJ	↘	45.41 kg/GJ
Average commute time	27.6 minutes	↘	26.4 minutes
Global fossil fuel consumption subsidies	$441 billion	↗	$1 trillion
People without access to electricity	778 million	↘	774 million
Electricity domestic consumption	23,718 TWh	↗	25,530 TWh
Global market share of EVs within passenger car sales	2.6%	↗	14%

Note: MJ = megajoule; PPP = purchasing power parity; GJ = gigajoule; CO_2eq = carbon dioxide equivalent; TWh = terawatt hour; TES = Total Energy Supply

Source: International Energy Agency (IEA); Bloomberg New Energy Finance; Environmental Investigation Agency; Society for Human Resource Management; Enerdata; World Trade Organization; Electronic Data Gathering, Analysis, and Retrieval (EDGAR).

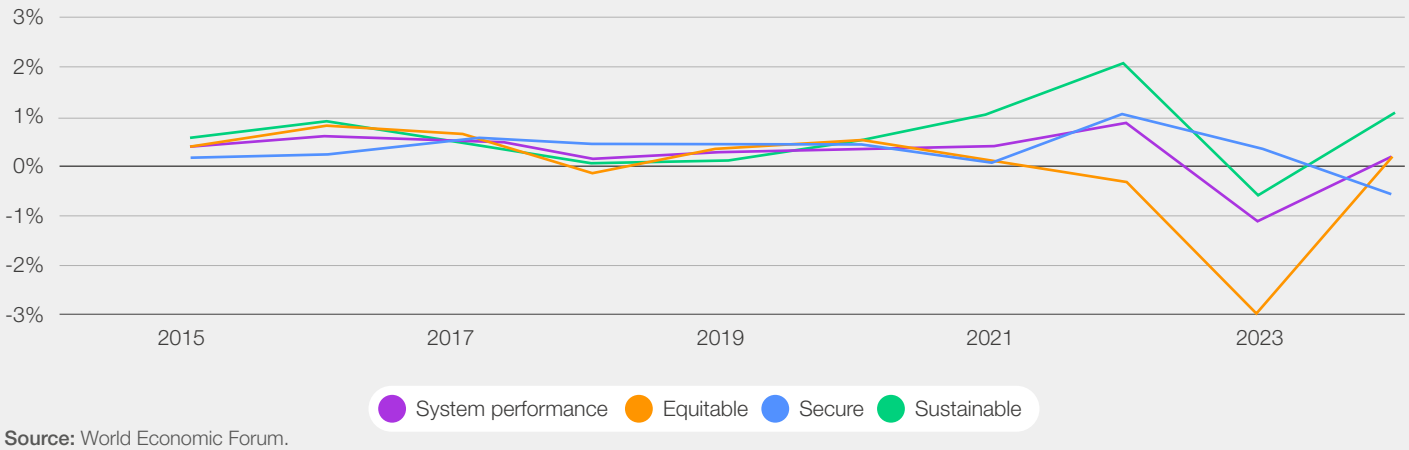
3 Sub-index and dimension trends

Despite energy security challenges, overall improvement is driven by recovery in equity and continued progress in sustainability, alongside strong transition readiness.

3.1 System performance

To achieve an effective energy transition, nations must navigate a delicate balance across the equitable, secure and sustainable dimensions (Figure 8). Over the past decade, 81% of countries tracked by the ETI have witnessed improvements in their energy system performance, indicating strong growth. Global average system performance scores have steadily increased by 3%, with sustainability increasing by 6% and security by 3%. However, improvement trends vary across dimensions due to competing priorities, economic uncertainties and geopolitical complexities.

FIGURE 8 **System performance dimension scores year-on-year change, 2015-2024**



Source: World Economic Forum.

81%

of countries tracked by the ETI have witnessed improvement in energy system performance.

The global average score for energy security declined in 2024, compared to equity and sustainability scores, primarily due to countries switching from net exporters to net importers, as a small number of net exporters gained more market share. Also, flexibility in the electricity system reduced because of limited coal-to-gas switching due to high gas prices, slowing down the decade-long trend of security. Equity scores have improved by 0.2% in 2024, largely due to wholesale gas prices declining by nearly 40% in 2023 compared to 2022 whereas energy subsidies continue to increase steadily, with 2022 levels at three times the level compared to 2020. The sustainability dimension has shown the most advancement, marked by substantial renewable energy capacity additions in 2023. The evolution of countries across these dimensions in the past decade is further explored in the following sections.

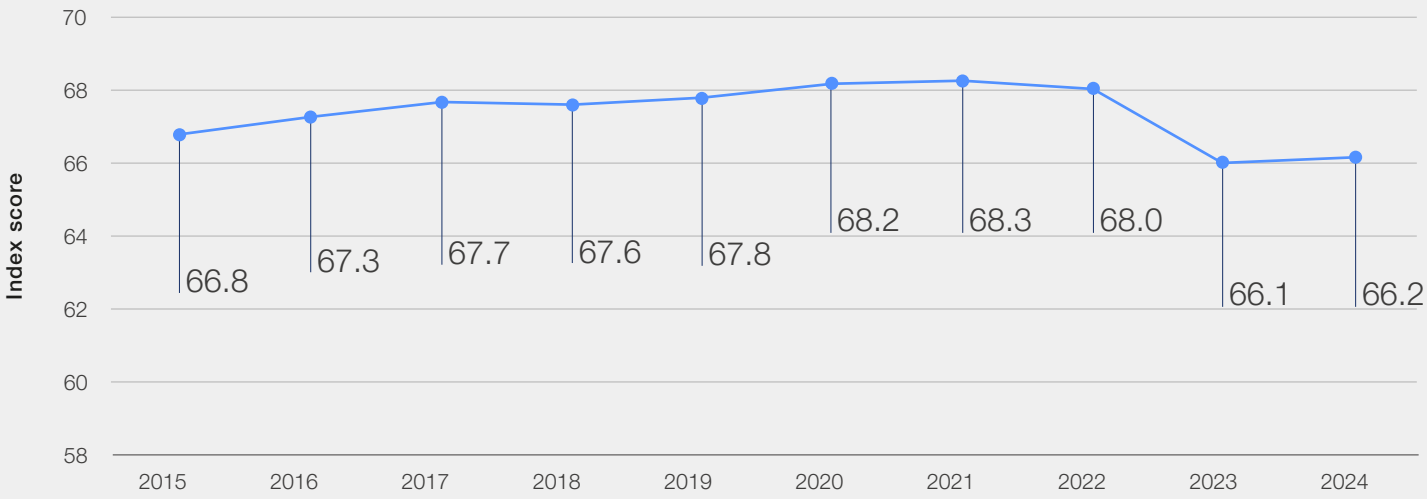
Equity

The imperative for achieving an **equitable** energy transition is rooted in the pivotal role of the energy sector in driving socioeconomic growth. This involves affordable access to modern and clean forms of energy for all, supporting the continuity of economic development[57] and ensuring that the benefits and opportunities of transitioning to a clean energy system are accessible to and shared among all segments of society.[58] Equity efforts aim to prevent historically marginalized communities from bearing a disproportionate burden of negative impacts.

While the energy transition offers the potential to create new jobs and economic opportunities, improve livelihoods and empower individuals, communities and societies, if not managed properly, it also risks exacerbating costs and inequalities, impacting vulnerable populations. Therefore, leaders often face the challenge of implementing policies and infrastructure investments that support economic growth while maximizing social welfare and ensuring access to diverse and affordable energy sources.[59]

The ETI's equitable dimension tracks the access, affordability and economic development of the energy system. Since 2015, the global average score for the equitable dimension has seen a slight 1% decline, with a recent increase of 0.2% from 2023 to 2024 and a 3% decline from 2022 to 2023 following market signals, as shown in Figure 9. Notably, this dimension is the only one showing negative progress over the past decade. Oman, Israel, the US and Qatar are leading in 2024, while countries in Sub-Saharan Africa, including the Democratic Republic of the Congo, Tanzania, Zambia and Zimbabwe rank in the lowest quartile. Although global average scores for energy access have seen gains since 2015, scores for energy affordability and economic development have declined by 8% and 2%, respectively. This can be attributed to the lingering effects of the energy crisis and the significant shock to energy prices experienced in 2022, leading to increased household expenditures, as well as the rapid reintroduction of energy subsidies at higher levels. However, these trends vary by country, depending on their stage of economic development.

FIGURE 9 | **ETI equitable dimension trend, 2015-2024**



Source: World Economic Forum.

Geopolitical conflicts and disruptions in key energy-producing regions, like the Middle East and Ukraine, rattled global energy supply chains, leading to shortages and subsequent price hikes.

ETI trends also show that while the rate of access to electricity in urban and rural areas as well as access to clean cooking fuels has slowed in the past three years, electricity prices remain high across several regions and countries. As economies reopened post-COVID-19-pandemic lockdowns in 2021, global gas and electricity prices began to surge, escalating further in 2022 amid the Russia-Ukraine war, reaching unprecedented levels. Throughout 2022, wholesale gas and electricity prices in Europe and other regions hit record highs, with concerns about potential disruptions to supply, prompting government interventions to ensure affordability for households.[60] While electricity and gas prices have started to stabilize, particularly in Europe, they still remain higher than they were in 2022.[61] These high prices continue to fuel inflationary pressures that deter investments in countries already dealing with high interest rates and greater volatility. They also disproportionately affect low-income households and exacerbate major concerns regarding a fair and equitable energy transition.

Moreover, global energy subsidies surged in 2022, followed by a slight decline thereafter. According to the International Energy Agency (IEA), subsidies for fossil fuel consumption exceeded $1 trillion for the first time as governments moved to shield consumers and businesses from rising energy prices.[62] However, these subsidies pose significant challenges for governments facing tightening fiscal space and competing spending priorities while also reducing incentives for consumers to adapt energy consumption to price levels. Improper management of subsidies can disproportionately impact vulnerable households, fuel social unrest and exacerbate inequality.[63]

> Measuring progress towards an equitable energy transition poses a challenge for decision-makers, necessitating the development of stronger analytical frameworks and metrics.

Equity issues remain largely unsolved and are often less prioritized and understood as compared to energy sustainability and security.

Energy equity encompasses various dimensions within and across nations and stakeholders. The lack of affordable access to modern forms of energy remains a significant concern in many countries, particularly in Sub-Saharan Africa, where significant portions of the population still lack electricity access. At the current rate of progress, the world will reach only 92% of electrification by 2030.[64] Simultaneously, transitioning to cleaner energy systems, whether in advanced or developing nations, necessitates substantial policy changes and infrastructure investments. Despite the strong business and economic case, complications often arise from misinformation or concerns among affected communities, leading to resistance at the grassroots level against externally imposed changes and clean energy infrastructure projects. Additionally, there is a risk of growing disparities in access to clean energy investments and technologies, often accompanied by mistrust and uncertainty regarding the benefits of government policies and business actions. These factors also make it challenging for companies to plan and invest effectively, potentially slowing down the energy transition.[65]

The World Economic Forum's 2024 report, *Building Trust Through an Equitable and Inclusive Energy Transition*, deep dives into equity as a key dimension of the energy system and a concern for stakeholders at various levels: for individuals, communities, businesses and governments. Despite growing awareness, this dimension remains under pressure, especially in a period characterized by crises, turbulence in energy markets and shifting geopolitical priorities, where energy security and sustainability are often prioritized and better understood by decision-makers.

Advancing an equitable energy transition is a key topic in global discourse, prompting policymakers to implement targeted programs to address these issues.

Some countries like Brazil, Canada and India have successfully built the case for an equitable energy transition in their respective contexts. Brazil currently holds the G20 presidency and emphasizes the social dimension of the energy transition, aiming for a fair and inclusive process, as well as allocating resources appropriately and promptly in response to the climate crisis.[66] With its abundant biodiversity, extensive renewable energy potential and significant industrial base, the country has been making strides towards an equitable transition through the Industrial Deep Decarbonization Initiative. This initiative allows Brazil to address challenges in sectors such as cement, steel, aluminium and petrochemicals. It prioritizes social safety nets, community engagement and workforce reskilling, thus ensuring that economic growth aligns with environmental sustainability and social justice.[67]

Similarly, Canada has been emphasizing clean energy projects that prioritize partnerships with Indigenous communities, with a strong focus on promoting asset ownership among these groups. As a result, Indigenous communities now own a significant portion of Canada's power generation capacity, reflecting a commitment to fostering equitable participation and benefit-sharing in the country's clean energy transition. Meanwhile, India has been focusing on leveraging energy for income generation and supporting microenterprises through the productive use of renewable energy sources. This approach is facilitated by policy frameworks that advocate for distributed renewable energy (DRE) solutions aimed at supporting livelihoods. There is also a strong emphasis on ensuring the affordability and economic viability of these solutions, underscoring India's commitment to promoting sustainable energy practices that benefit local communities and drive economic growth.

Effective interventions in achieving energy equity require careful design and targeting. This includes implementing social safety nets and compensatory measures such as cash transfers and temporary basic income initiatives, with a focus on alleviating the burden on low-income households most affected by energy-related costs.

The transition to an equitable energy system involves the collective efforts of multiple stakeholders and requires strengthening and expanding current measurement mechanisms.

Measuring progress towards an equitable energy transition poses a challenge for decision-makers, necessitating the development of stronger analytical frameworks and metrics beyond what the ETI currently captures. Metrics play a key role in operationalizing energy equity and guiding investment and policy decisions that shape the transition. However, given the multifaceted nature of energy equity, establishing metrics and designing policies to measure progress entails first addressing the issue of taxonomy and understanding what constitutes social impact. This process involves laying down a set of foundational principles and developing frameworks and specific indicators to assess impact at various individual, local, national and international levels between nations.

The process of creating analytical frameworks begins with establishing a clear definition of equitable energy transition, tailored to local contexts and accounting for current priorities, historical contexts and specific challenges within each region or country's unique energy transition journey.[68] Then, the main inequities in the energy system need to be identified, which can then serve as guiding principles. A potential framework for measuring energy equity could include a 2x2 matrix considering "light" energy equity and "deep" energy equity.

Light energy equity metrics could focus on measurable quantitative indicators such as:

- **Access to clean energy:** Percentage of households with access to electricity from clean and renewable sources.
- **Affordability:** Energy expenditure as a percentage of income, energy prices relative to income, energy burden (the proportion of income spent on energy bills), vulnerability to utility service disconnections.[69]
- **Asset ownership:** Distribution of ownership of renewable energy infrastructure and resources among different socioeconomic groups.
- **Job creation:** Number of jobs created in the renewable energy sector per capita or as a percentage of total employment.

Deep energy equity metrics may involve more qualitative or nuanced indicators that capture broader socioeconomic considerations, such as:

- **Community engagement:** Level of participation and decision-making power of marginalized and Indigenous communities in energy planning and policy development.
- **Health and well-being:** Measures of community health outcomes, including reductions in respiratory illnesses and other health conditions related to energy use.
- **Social cohesion:** Indicators of social capital, community resilience and trust among diverse stakeholders involved in the energy transition.
- **Equity in decision-making:** Representation of marginalized and Indigenous groups in energy governance structures and decision-making processes.

By incorporating both light and deep energy equity metrics, policy-makers and stakeholders can gain a comprehensive understanding of the equity implications of energy policies and initiatives. This approach enables more intentional design of systems, technology and procedures to ensure a fair and equitable distribution of benefits across the energy system.

GUEST PERSPECTIVE

Towards equitable energy transitions: a people-centred approach

By Brian Motherway, Head of Energy Efficiency and Inclusive Transitions Office, International Energy Agency

While obviously much slower than is necessary, energy systems around the world are starting to change. New clean energy technologies are starting to expand their presence and impact, in some cases very significantly. Last year, almost one in every three new cars sold in Europe was electric, and that number is approaching one in two in China. Heat pump sales saw huge growth after the recent energy crisis and now represent the most-deployed home heating solution, overtaking fossil fuel-based systems in a number of countries. In these ways and many others, people are now beginning to experience clean energy transitions in their communities.

As this transition accelerates – and it will – it is imperative that equity and inclusivity are central considerations for policy-making. Clean energy transitions must prioritize the needs and well-being of people, particularly those who are most in need and most vulnerable to the impacts of climate change and energy poverty. This requires a holistic approach that considers not only environmental objectives but also social and economic dimensions.

All clean energy transition policies are ultimately about enhancing people's lives – reducing their energy bills, increasing their comfort, providing decent jobs or simply avoiding the worst impacts of climate change. The best policies intentionally recognize these benefits and are designed to maximize them while ensuring a fair distribution of these benefits and costs.

As an example, the spectacular growth in EVs has been underpinned in many countries by generous subsidies. Who benefits from these subsidies? In France for example, lower-income applicants receive considerably higher subsidies, making the additional cost of an EV relative to income about the same across society. However, only certain segments of society will ever buy a new car, let alone a new EV. India focuses its subsidies on electric two- and three-wheel vehicles, which are used by a much wider cohort. Many countries also recognize sustainable mobility solutions well beyond cars, investing and supporting accordingly.

Understanding the distributional effects of clean energy policies means measuring them. As the IEA develops its analysis on this issue, it is striking how rare it is for clean energy policies to have well-defined metrics put in place or data being collected regarding who exactly is impacted and how. Metrics and indicators are essential tools for analysing the distributional effects and social impacts of clean energy policies – particularly at the household, community and national levels. Instead of solely relying on aggregate indicators, policies would benefit from more nuanced metrics that assess impacts across income brackets, geographic regions and demographic groups. These metrics can help policy-makers identify knowledge gaps, track progress and make better-informed decisions.

The IEA coined the term "people-centred clean energy transitions" to encompass all dimensions of how people experience and participate in the transformation of the global energy system. This is defined across four key thematic areas: decent jobs and worker protection; social and economic development; equality, social inclusion and fairness; and engaging people as active participants. This last one is no less important than the others, in fact, in many ways, it is the key to achieving them all. By engaging with affected communities and incorporating diverse perspectives, clean energy policies that are responsive to the needs of all segments of society can be designed. Inclusive processes for policy-making can enhance their distributional patterns, and of course can build wider public support for such policies. At this political moment, the risks associated with policies made without a focus on the social dimensions, and on ensuring their acceptance, are very high.

A people-centred approach recognizes the importance of putting people first in planning and policy-making for clean energy transitions. These are not just words. It will require innovative, focused policy design and implementation. Real community involvement takes time and effort, and skill. Good data collection and metrics require significant investment and infrastructure over years. Measuring social outcomes is not the same as measuring kilowatt-hours or tonnes of emissions, but without such a focus, how can clean energy be truly people-centred?

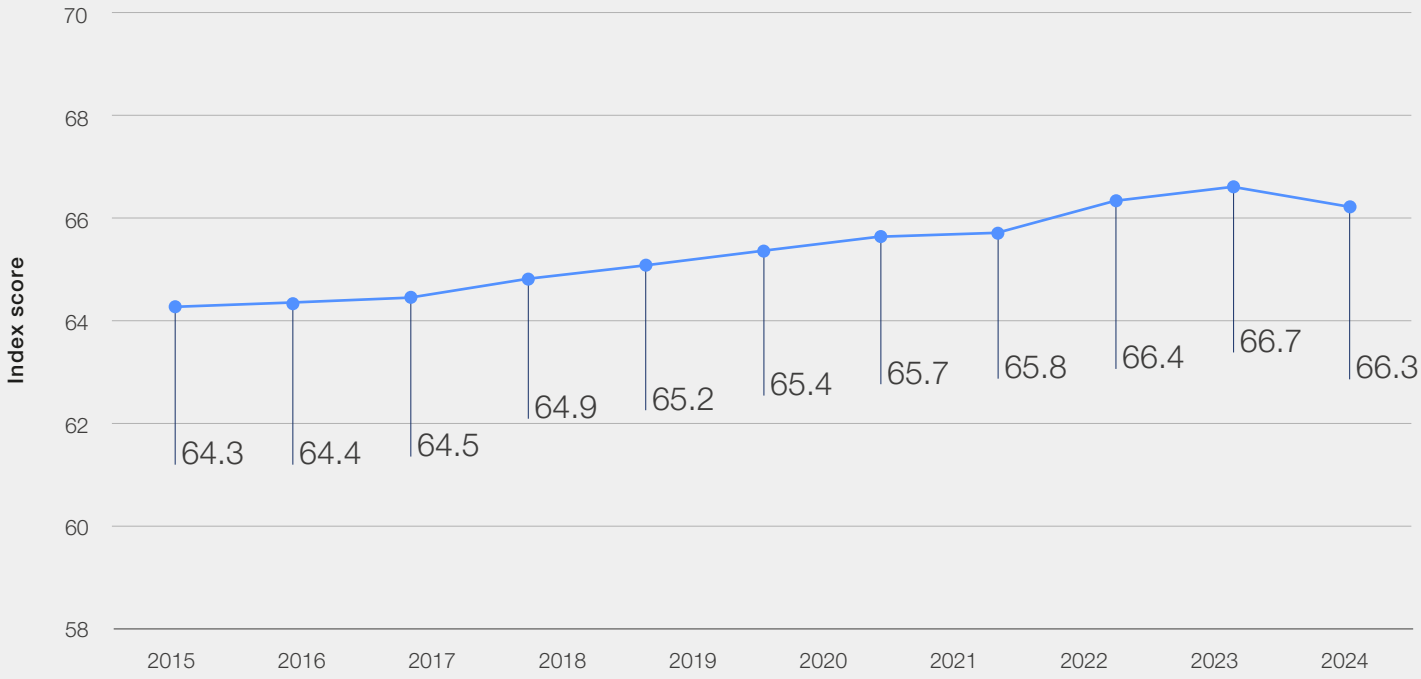
Security

Energy **security**, defined as the continuous availability of energy sources at a reasonable price, has become a prominent topic for countries amid the current energy crisis, driven by market volatilities and disruptions in supply. This period is also characterized by lower investment in traditional energy assets, coupled with an unexpectedly rapid economic recovery after the COVID-19 pandemic, which has strained energy supply chains. This led to concerns about gas availability for winter heating, reduced industrial activity and pressure on government budgets allocated for energy subsidies. Additionally, recent tensions in the Middle East, particularly in the Strait of Hormuz where roughly a quarter of global oil trade flows,[70] have added an additional layer of uncertainty to energy security.

The ETI's secure dimension focuses on energy supply, reliability and resilience. The increase in recent shocks has led to security scores slightly decreasing (-0.6%) in 2024. However, these shocks have been partially offset by countries significantly increasing diversity across import counterparts and energy sources. Thus, this decline has been marginal as most countries have found alternatives. Nevertheless, the focus on security may have come at the expense of energy equity and sustainability, reflected in declining equity scores, and slowing down sustainability momentum. Figure 9 shows the secure dimension score over time.

Advanced economies like the US, Norway, Australia and Estonia score high due to mature energy infrastructure. These countries exhibit strong diversity in energy sources as well as import counterparts. Malaysia also scores highly due to supply diversity, while major fuel exporters like Saudi Arabia, United Arab Emirates and Azerbaijan, score highly due to their gas reserves. For these countries, a key strategic imperative is to maintain energy security while transitioning to decarbonized energy systems.

FIGURE 10 **ETI secure dimension trend, 2015-2024**



Source: World Economic Forum.

Countries have, for the most part, prioritized mitigating energy security risks, partially at the expense of equity and sustainability.

Countries like Colombia, despite being oil producers, have improved energy security in recent years through renewable sources like hydropower and bioenergy.[71] Meanwhile, Egypt's increased domestic energy consumption, coupled with heavy reliance on natural gas for electricity generation, poses energy security risks. Nonetheless, the country's commitment to enhancing the diversity of its energy mix, increased contribution of renewable energy and advancing infrastructure development has effectively mitigated these risks over the past year.[72] Similarly, Poland has risen in the ETI ranking in this dimension by diversifying energy import counterparts away from Russian gas.[73]

Several countries are faced with a dual challenge in ensuring energy security: reducing net energy imports while diversifying energy import counterparts.

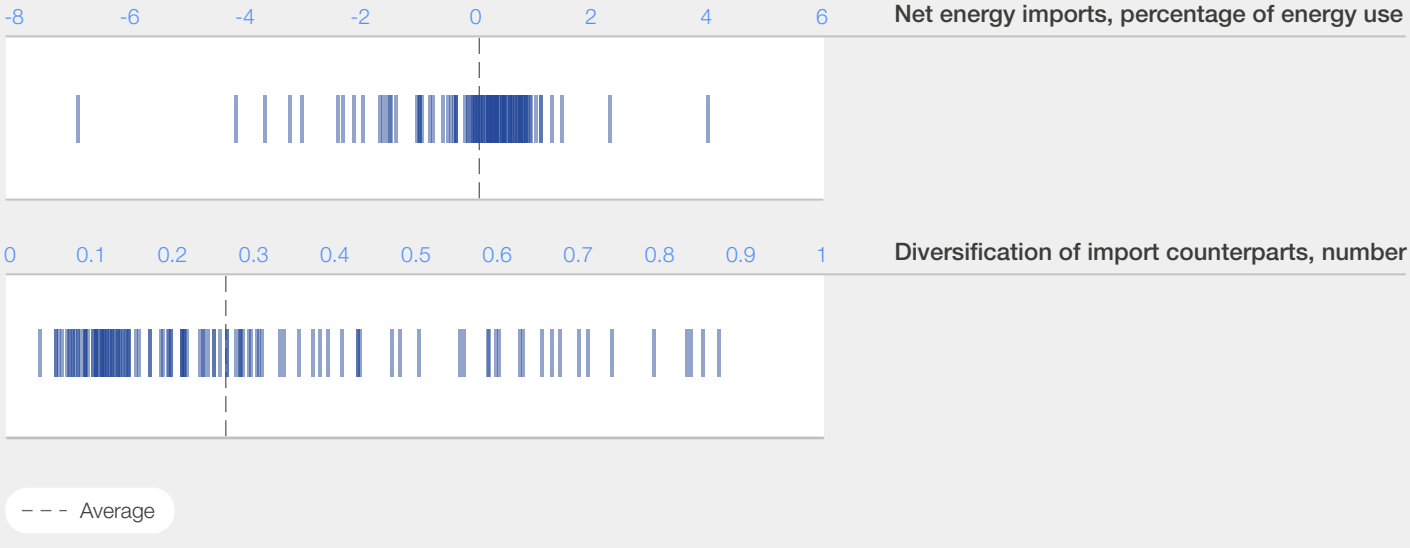
In recent years, a noticeable trend has emerged in the global energy landscape: the slight uptick in net energy imports across most countries. Economic growth and intensified industrial activities have led to increased energy demand, often surpassing domestic production capacities. Consequently, countries must rely more on imports to meet their energy needs, ensuring the stability of their energy supplies. Out of 120 countries analysed in the ETI, 86 are net energy importers in 2024 and only 34 of them are net energy exporters, as shown in Figure 11.

Another notable trend is the improvement in the diversity of energy import counterparts. This evolution stems from an increased awareness of the risks associated with over-reliance on a limited number of energy suppliers, which leaves countries more exposed to risks such as geopolitical instability, supply disruptions and price volatility. To mitigate these risks, nations have diversified their energy import portfolios, sourcing from a wider array of countries and exploring alternative energy sources beyond traditional fossil fuels.

Technological advancements and international cooperation have facilitated this diversification. Renewable energy technologies, such as solar and wind, have become more cost-effective and reliable. Additionally, the development of LNG markets has enabled more flexible and geographically diverse energy trading, reducing dependency on pipeline-bound gas supplies and facilitating importation from distant producers.

Thus, diversification is key. This helps reduce risk and improves resilience but necessitates new approaches to energy storage at grid-scale, regional interconnectors, a range of generation strategies at both small and large scale such as smart grids for distributed smaller scale generation, and changes in energy policy.

FIGURE 11 **Spread of countries on Energy Transition Index security indicators**



Source: World Economic Forum.

Countries need to prioritize six key factors to enhance energy security: supply security, demand management, market and regulatory measures, building global and regional trust, ensuring system stability, and strengthening system security.

The World Economic Forum's 2023 report, *Securing the Energy Transition*, analyses the security dimension. The priority actions remain important as geopolitical tensions continue to rise and strain the energy system:

- System security: Enhance capabilities and focus on risk management in both traditional (physical) and emerging areas (such as cybersecurity) due to increased digitalization and connectivity in energy systems.
- Supply security: Boost the domestic clean energy mix and secure critical mineral supply chains to lessen import reliance and broaden trading networks.
- Demand management: Promote efficient demand management by emphasizing energy efficiency and transitioning materials. Encourage behavioural changes and demand responsiveness through effective policies, tools and communication.
- System stability: Quicken stability improvements to bolster the system's reliability and resilience and invest in transmission and distribution networks.
- Global and regional trust: Work collaboratively to minimize risks and capital costs associated with the transition, drawing on global and regional financial and technological expertise.
- Market and regulatory measures: Pursue strategic investments in clean energy while managing the phasing out and repurposing of existing infrastructure.

GUEST PERSPECTIVE

Transforming energy demand: perspectives from the developing world

By Anish Shah, Group Chief Executive Officer and Managing Director, Mahindra Group

As the global community grapples with the crucial transition towards sustainable energy systems, it is imperative to consider insights from the developing world. Their perspectives on transforming energy demand can offer invaluable lessons as we navigate this global transition.

To limit global warming to 1.5°C, we need to cut emissions by about 7% annually, but they're rising by 1.5% each year, as noted in the World Economic Forum's *Bold Measures to Close the Climate Action Gap* report. Energy-related emissions contribute to over 80% of total global emissions. Although renewable energy production has more than doubled in the last decade, it makes up only slightly over 13% of total energy use (up from 9% in 2011). By 2050, global electricity demand will more than double due to population growth and increased electrification. Despite more renewable energy, it will not be enough to meet our goals. We need to focus on managing demand to make faster progress.

The IEA's plan to reach net-zero emissions by 2050 states that, by then, global energy demand should be about 8% lower than today, despite having a global economy twice as big with 2 billion more people. Transforming how we use energy is crucial for both energy security and cutting emissions. We need to prioritize energy efficiency on par with switching to renewable energy, especially in the next decade.

This is especially true for the developing world as it tries to balance sustainability, affordability and energy security for its development goals. The prevalent notion of a linear correlation between economic growth and energy requirements no longer holds true. India's per capita emissions, at 1.7 tonnes of CO_2, are already 60% lower than the global average of 4.4 tonnes of CO_2 per capita. However, there is still a need to decouple growth from energy demand. This requires significant investment in energy efficiency, particularly during the development of new infrastructure and manufacturing capacity. India has been taking multiple initiatives in this regard. The Indian government's UJALA[74] scheme launched in 2015[75] is the world's largest domestic lighting project to replace energy-inefficient incandescent bulbs and demonstrates how small actions can add up to gigantic outcomes, in this case abating approximately 40 million tonnes of CO_2 annually.

India's Long-Term Low Emission Development Strategy (LT-LEDS), presented at COP26, includes a goal to reduce the carbon intensity of the economy by 45% by 2030 compared to 2005 levels. This is one of the five key goals for the country, along with scaling up renewable energy. It is also a key principle under Mission LiFE (Lifestyle for Environment) launched for public participation. Interactions with the government have emphasized the need for the private sector to do more and act faster.

Boosting energy productivity is not only good for the environment but also financially rewarding. It often pays off quickly, making it a smart investment choice. There is a compelling business case – if measures are taken by 2030, there could be a roughly 30% reduction in energy intensity, and up to $2 trillion in annual savings.[76] Existing technologies and solutions can be deployed. Sectors like industrial manufacturing, transport and the built environment have the potential to drive the most significant impact.

Mahindra Group has embraced energy efficiency as a key decarbonization lever across its entire portfolio of group companies. Our automotive and farm businesses have significantly improved energy productivity, with around 90% increase between the financial year 2023 (FY23) and FY09. This means that we are producing nearly double the output using the same amount of energy, resulting in lower manufacturing costs and financial benefits. This has been made possible through a series of continuous interventions to reduce energy demand per unit of output. Behaviour changes, such as turning equipment off when not in use and the use of energy-efficient equipment are often quick wins. Process innovations (e.g. heat recovery processes) take longer to implement but have a significant impact. Other levers such as efficient building design, the use of certain types of materials for better insulation in the case of the built environment, and electrification and lightweighting in case of the transport sector are also effective.

Actions solely within a company's operation are not sufficient, and engaging with value chain partners can help spur investment and action, ultimately magnifying impact. Platforms like the International Business Council have a critical role to play in accumulating best practices, knowledge sharing and implementing clear pathways of transformation across regions and sectors. Industry players can also collaborate to create awareness, e.g. Mahindra Group and Johnson Controls partnered to launch a non-commercial climate advocacy platform for accelerating energy-efficient built environment in India.

The case for investing in energy efficiency solutions is clear. To drive maximum impact, private sector companies need to focus on three key levers:

- **Prioritize it strategically:** Focus on accelerated action, recognizing the significant opportunity cost of further delays in investing in energy efficiency.
- **Create a governance structure:** Implement a strong governance process led by senior leaders with clear ownership, disrupting the status quo of what is often considered business as usual.
- **Develop a collaborative mindset:** Operationalize the value chain through effective collaboration, including awareness building, capability and technology sharing and financing, where feasible. Focus on both mindset shifts and concrete governance practices.

In tandem, governments can also consider creating awareness and policy interventions (e.g. guidelines for energy-efficient built infrastructure, incentives for retrofitting, etc.) to shape an enabling environment for accelerated adoption. India is leading the way in creating outcomes that can be replicated. The developing world has an opportunity to rewrite the rules and show the way to successfully transform energy demand – an example of reverse innovation is frugal, scalable innovation originating in developed countries and then scaled across the world.

In the journey towards transforming energy demand, the golden thread is one of collective effort and the cumulative impact of numerous small initiatives. Now is the moment for collective action, as we unite to pave the way for a greener, cleaner future.

Sustainability

The ETI defines its **sustainability** dimension based on a mix of energy efficiency, decarbonization and advancements towards clean energy systems. Over the past decade, this dimension has seen a 6% growth globally (Figure 12).

In 2023, total energy-related CO_2 emissions increased by 1.1%, reaching a record high of 37.4 gigatonnes (Gt). This increase contrasts with the urgent need to rapidly curb emissions to align with the climate objectives outlined in the Paris Agreement. Despite this surge, emissions increased significantly slower than growth in global GDP, which shows there is positive trend in improved carbon and energy intensity of economic growth. Over the past decade, emissions increased by slightly over 0.5% annually. This trajectory cannot be attributed solely to the COVID-19 pandemic; although emissions experienced a sharp decline in 2020, they rebounded to pre-pandemic levels the following year. Furthermore, GDP growth slowdown does not account for this trend, as it has averaged 3% annually over the last decade, in line with the preceding 50 years.

Adding to concerns, global temperatures exceeded the 1.5°C threshold for the first time in 2024, starting in January, making it the warmest year on record. This was driven by intensified heat from escalating ocean temperatures and the "El Niño" effect, underscoring the urgent need for decisive action to address climate change.

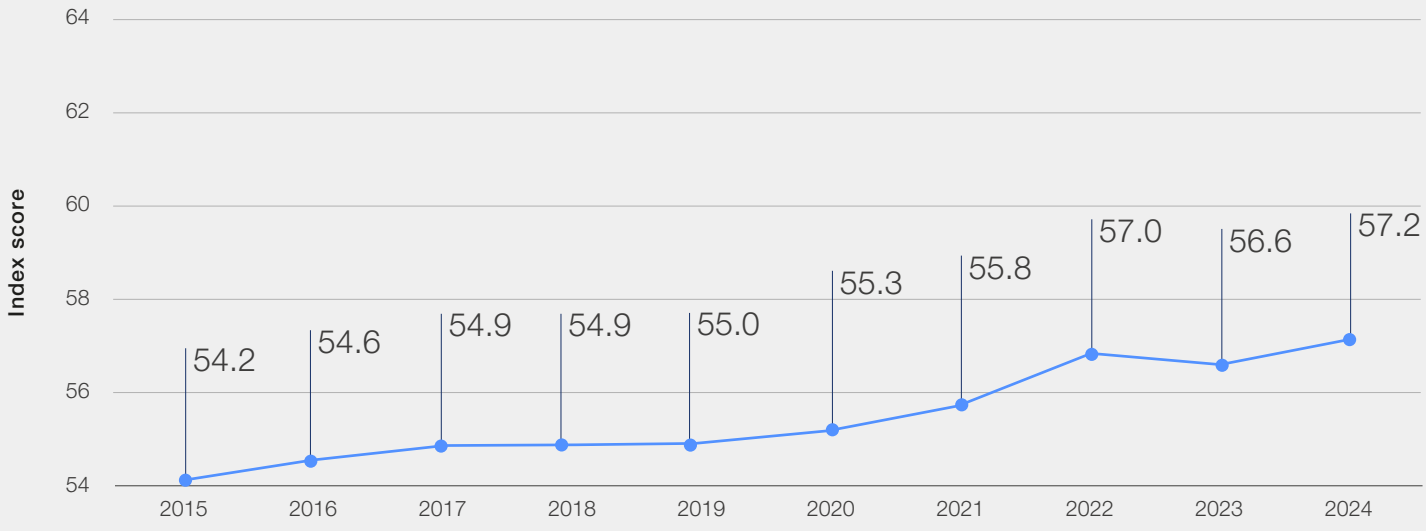
Emissions grew slower than global GDP in 2023, signalling decoupling of emissions from economic growth.

COP28 marked the completion of the first global assessment of efforts to combat climate change under the Paris Agreement. The assessment revealed insufficient progress in various aspects across climate action, including reducing greenhouse gas emissions and enhancing resilience to climate impacts. Consequently, countries collectively agreed upon measures to accelerate the shift away from fossil fuels, with a specific target of tripling renewable energy and doubling energy efficiency by 2030.

Costa Rica, Sweden and Paraguay lead the sustainability dimension charts for 2024. Countries from Sub-Saharan Africa and Latin America and the Caribbean rank in the top quartiles whereas countries from the Middle East, North Africa and Pakistan region rank in the lowest quartiles on the sustainable dimension, despite their above-average performances in the equitable and secure dimensions.

However, coal capacity continues to grow, exhibiting 2% growth in 2023, mainly driven by China and a slowdown in phasing out in the US and Europe. Coal capacity grew for the first time outside of China since 2019.[77]

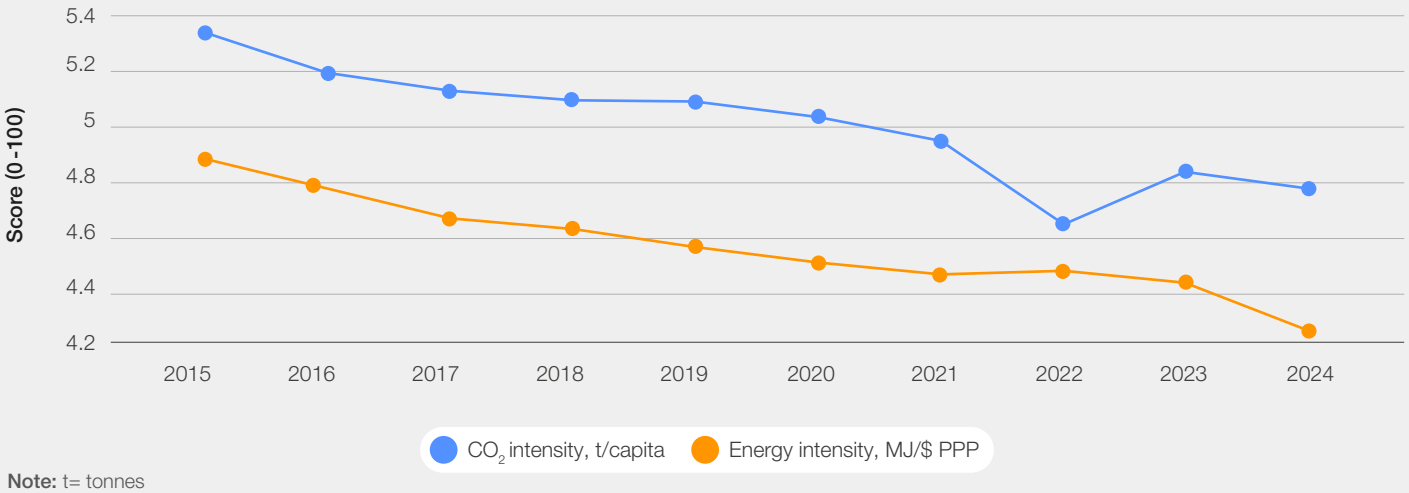
FIGURE 12 **ETI sustainable dimension trend, 2015-2024**



Source: World Economic Forum.

Despite significant strides in renewable energy adoption, global emissions continue to rise. It is essential to distinguish between the growth of renewable energy and the trajectory of emissions. Notably, a modest decline in emissions growth from 1.3% in 2022 to 1.1% growth in 2023 can be attributed to factors such as coal-to-gas switching, weaker industrial production in some countries and milder weather conditions, rather than the expansion of renewable energy sources alone. The global sustainability scores need to improve further to accelerate the transition, as advancements in this dimension directly impact net-zero goals.

FIGURE 13 | **Energy intensity and CO_2 intensity trend, 2015-2024**



Note: t= tonnes
Source: World Economic Forum.

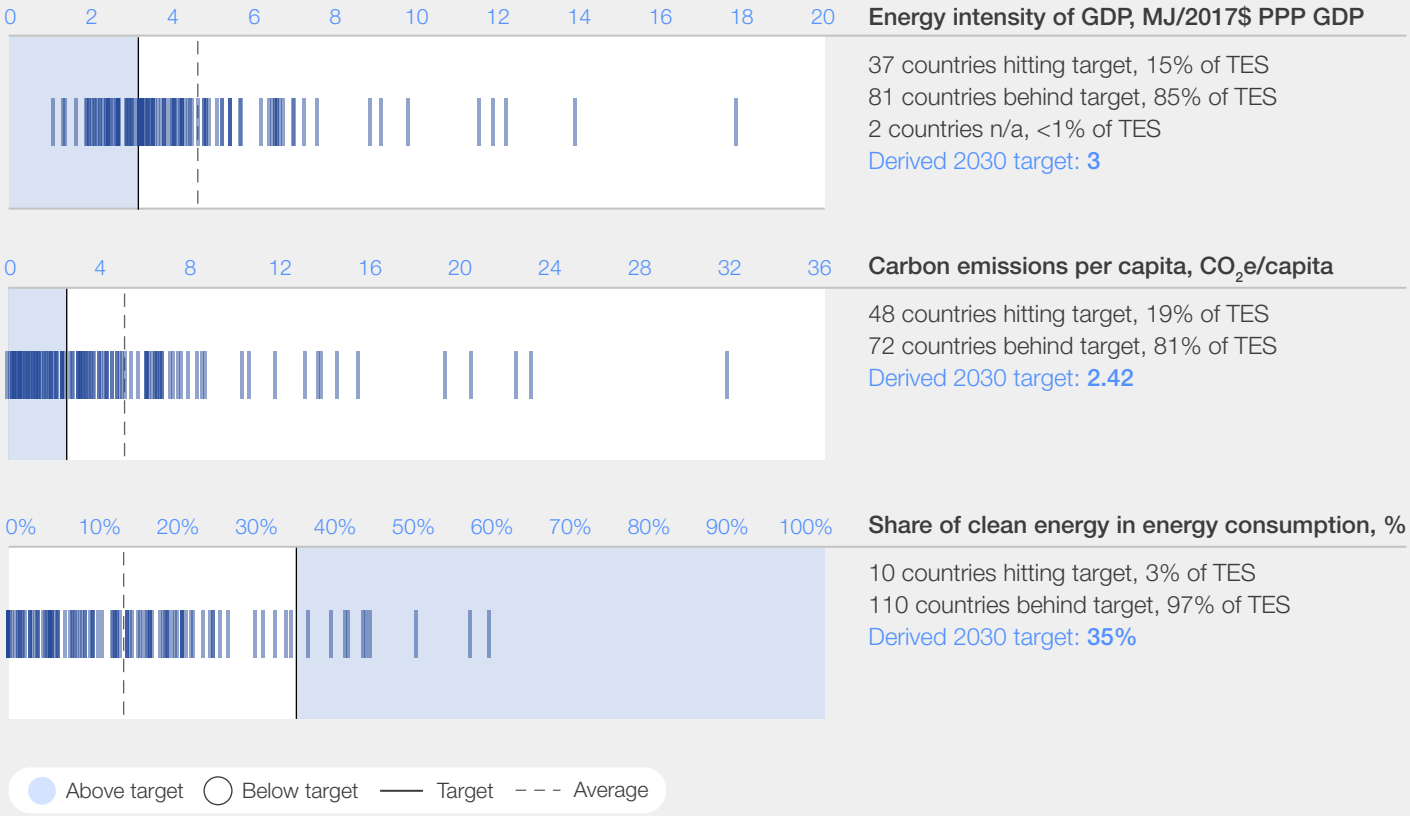
Engaging oil and gas exporting nations to prioritize emissions reduction is crucial for effective climate action. This includes adopting cleaner energy technologies like carbon capture and storage (CCS) and methane detection methods. Leveraging existing infrastructure, oil and gas exporting countries can advance the hydrogen economy by repurposing assets for hydrogen production and investing in hydrogen technologies powered by renewable energy or natural gas with carbon sequestration.

As an example, Canada's province of British Columbia first implemented a carbon tax in 2008. By 2019, as their carbon price went from CAD 10 (Canadian dollars) to CAD 40 per tonne of CO_2, carbon emissions per person decreased by 12%, twice as fast as those in the country overall. This policy recycled revenue in the form of cuts to personal and corporate income taxes, low-income tax credits and a property tax reduction for northern and rural homeowners, making it more equitable while also incentivizing emissions reduction. Encouraged by this success and the public support for British Columbia's carbon pricing, the Canadian federal government followed suit in 2018, instituting a requirement for provinces to either adopt a strong climate policy of their own or accept a "backstop" federal carbon tax, known as the fuel charge. This carbon tax applies to 22 different forms of fossil fuels currently. The price basis was CAD 65 per tonne of CO_2 equivalent (CO_2e) in 2023 and will increase by CAD 15 per tonne each year until 2030 when it hits CAD 170.

In 2023, renewable energy witnessed unprecedented growth, marking a record year with nearly 510 gigawatts (GW) of added capacity globally.

This surge, which is the fastest growth rate in the past two decades, was predominantly driven by solar energy, which accounted for 75% of the added capacity in 2023. The largest growth occurred in China, as it alone commissioned as much solar PV capacity in 2023 as the entire world did in the previous year, while also experiencing a 66% year-on-year increase in wind additions. It is important to note that some countries experienced a slowdown in wind adoption, with some governments reducing subsides. It is critical for these companies to achieve higher levels of efficiencies to offset the reduction in subsidies.[78] However, the transition of energy-intensive industries such as steel, cement, aluminium and chemicals manufacturing to clean energy sources requires additional solutions beyond renewables alone.

FIGURE 14 | **Country density based on 2030 targets derived from IEA Net Zero 2030 scenarios**



Note: Energy intensity of GDP, MJ/2017$ PPP GDP: This indicator is obtained by dividing total primary energy supply over gross domestic product measured in constant 2017 US dollars at purchasing power parity.

Source: International Energy Agency; International Renewable Energy Agency.

Energy efficiency can help save costs, reduce emissions, and improve energy security. A 2024 World Economic Forum report, *Transforming Energy Demand*, shows a $2 trillion annual economic savings potential and 31% energy efficiency gain that can be unlocked by 2030 in industry, transport and buildings through business action, enabling policies and public private partnerships. Further, the pivotal role of electrification cannot be underestimated both to achieve efficiency gains and reduce carbon intensity of energy production. According to the IEA, investments in energy efficiency technologies increased by 16% to $600 billion in 2022, which is a record high.[79] This includes growth in electrification, end-use renewables and efficient buildings.

Recent trends, such as the decline in EV[80] adoption juxtaposed with the rise in heat pump installations in the EU, underscore this point. Electrification, especially in sectors like transport and heating, holds potential to improve energy efficiency and reduce greenhouse gas emissions. Therefore, integrating discussions on electrification alongside energy efficiency efforts is imperative to maximize climate mitigation impact. By recognizing the complementary nature of these strategies, policymakers and stakeholders can develop more holistic approaches to advance sustainable energy transitions and combat climate change effectively. For example, Norway offers incentives such as tax exemptions, toll discounts and free parking for EV owners, leading to a rapid increase in EV adoption and contributing to the country's goal of achieving net-zero emissions by 2030.

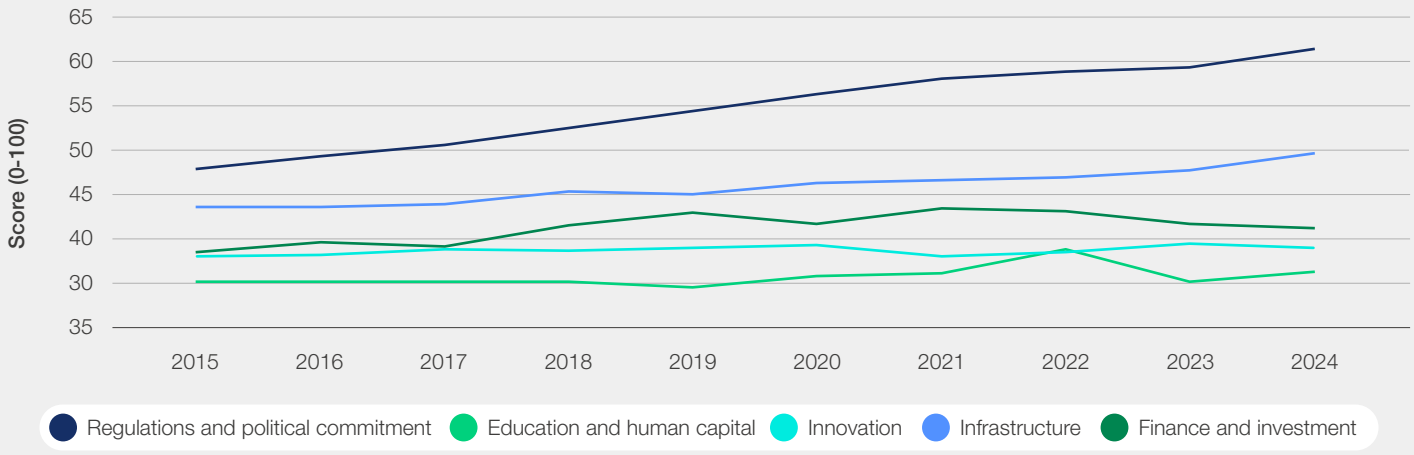
Addressing the challenge of rising emissions necessitates a comprehensive approach that considers the complexities of the entire energy system and seeks to transition towards a sustainable, low-carbon future.

3.2 Transition readiness

The ETI's **transition readiness** sub-index is rooted in various factors, including the stability of the policy environment, the level of political commitment, the investment climate, access to capital, consumer engagement, and the development and adoption of new technologies. These elements collectively shape a country's ability to steer its energy transition effectively. While some factors, such as skills or the quality of transport infrastructure, extend beyond the energy system, they significantly influence the trajectory and success of the energy transition and are explicitly acknowledged as part of the sub-index.[81]

Over the past decade, transition readiness has shown a positive trend, marked by notable advancements and strong year-on-year growth in key enablers such as regulation and political commitment, infrastructure, and education and human capital (Figure 15). In 2024, South Korea, Japan and China emerge, alongside leading advanced European economies, among the top 20 countries exhibiting the most enabling environment for the energy transition, while the Democratic Republic of the Congo, Venezuela, Yemen and Bangladesh rank in the lowest quartile.

FIGURE 15 **ETI transition readiness trend, 2015-2024**



Source: World Economic Forum.

Tangible progress is evident in enhancing transition readiness, particularly in regulation and political commitment, education and human capital, and infrastructure.

Regulation and political commitment, which is one of the direct enablers for the energy transition, has seen a notable increase, with two consecutive years of over 3% year-on-year growth in scores. Driven primarily by carbon pricing mechanisms and country commitments, the growth in this dimension underscores the impact of recent global policy focus on accelerating the energy transition. In 2024, Luxembourg, Denmark and Switzerland emerge as top performers in this regard. Additionally, South Korea and Canada along with a cohort of leading advanced European economies, demonstrate a strong enabling regulatory environment to accelerate the energy transition. Canada is committed to achieving net-zero emissions by implementing measures to cap and reduce emissions from the oil and gas sector by 2030. The Canadian government also introduced five investment tax credits to encourage capital investments supporting the energy transition.[82]

Education and human capital have also experienced rapid growth over the years, particularly as the number of jobs in low-carbon industries surged. Clean energy jobs accounted for around 50% of total jobs in the energy sector in 2023.[83] As the global energy transition gains momentum, significant shifts are expected in the jobs landscape. While most regions saw growth in clean energy jobs over the past three years, the Middle East, North Africa and Pakistan and emerging and developing Asia stand out as exceptions. Furthermore, China, currently housing the largest energy workforce globally, witnessed significant changes between 2019 and 2022. During this period, clean energy jobs in China increased by 2 million, while fossil fuel-related jobs decreased by 600,000. Today, 60% of the country's energy workforce is employed in clean sectors, largely attributed to the significant build-out of clean tech manufacturing, which has been a major driver of employment growth.[84] The US's IRA has sparked an investment and manufacturing boom that is driving long-term economic growth across the country and creating jobs in underserved communities. Companies have committed over $242 billion in new investments to build the clean

energy economy, including EVs, batteries and energy storage, clean energy manufacturing, and clean power generation, among others.[85] As of September 2023, more than 211,350 new clean energy jobs were created,[86] with projections indicating approximately 1.5 million jobs over the coming decade.[87]

Renewable energy infrastructure has also witnessed growth. Globally, countries have added to their renewable capacities, driven by the widespread availability and maturity of renewable technologies. Notably, Brazil and Chile emerge as top performers in 2024, ranking among the top 20 countries in this regard, alongside leading advanced European economies. Brazil, known globally for having one of the cleanest electricity mixes, has seen continuous expansion in its renewable energy industry. Large hydropower plants play a significant role in the country's domestic electricity generation, contributing to its global leadership in renewable energy deployment.[88] Similarly, Chile generates 35% of its energy from solar and wind,[89] evidenced by substantial infrastructure development and the emergence of a thriving renewable energy industry, which enjoys enduring political support and active engagement from established companies invested in its success.[90]

However, there has been a decline in innovation growth, with companies and the public sector struggling to keep pace with the significant advancements required in research and development (R&D). Despite this downturn, emerging economies like China and India have demonstrated their ability to rapidly adopt and even lead in new energy technologies and value chains. China has seen significant growth in areas like batteries, EVs and high-voltage transmission, while India has substantially expanded its renewable energy capacity and made advancements in clean hydrogen. China continues to allocate the largest share of its GDP towards investments in renewables, followed by Finland, Poland, and Bosnia and Herzegovina.

Financing the transition, particularly in emerging and developing economies, is a significant focus, with a growing emphasis on exploring innovative methods.

> Despite the higher growth rates and energy supply deficits prevalent in many parts of the emerging and developing nations, investment tends to be heavily concentrated in some advanced economies.

The global energy future increasingly depends on the decisions made in emerging and developing economies. While energy consumption in these regions remains relatively low, without substantial action to transform their energy systems, these economies are likely to contribute to the bulk of emissions growth in the coming decades.[91] Trillions of dollars of investments are needed annually to decarbonize emerging economies.[92] Despite the higher growth rates and energy supply deficits prevalent in many parts of the emerging and developing nations, investment tends to be heavily concentrated in some advanced economies. According to S&P Global, "with $8 of every $10 of current renewable energy investment going to projects in developed economies plus China", this leaves a significant portion of the global population behind.[93]

Private sector investment hinges on attractive risk-adjusted returns and the bankability of projects, which depends on several factors. Among these, the cost of capital is crucial, with variations driven by factors like country and currency risks, as well as the policy environment. In many emerging and developing economies, debt and equity costs can soar up to seven times higher than those in the US or Europe.[94] Additionally, investors face a lack of transparency regarding the actual cost, making it difficult for them to actually price risk and for policy-makers to take effective action.[95] When projects are not commercially viable, concessional finance, government support and guarantees from multilateral development banks (MDBs) can be instrumental in making them bankable. In the Association of Southeast Asian Nations (ASEAN) region, despite substantial growth in energy demand, renewable power development lags due to inadequate policy and investment frameworks. According to the IEA, "regulatory barriers, incumbent interests and inflexible commercial arrangements have perpetrated the prioritization of fossil generation over renewable".[96]

The rising global focus on emissions reduction is driving the market for green bonds,[97] while energy efficiency also emerges as a cost-effective means to reduce energy demand.[98] De-risking initiatives play a significant role in unlocking private capital for sustainable energy projects. For instance, in Sub-Saharan Africa, the African Energy Guarantee Facility offers insurance against political risks for green energy projects aligned with EU guidelines. Similarly, in Nigeria, InfraCredit's guarantees have facilitated access to local currency debt finance from the domestic bond market for energy infrastructure projects valued at $300 million.[99] Standardizing climate assessments at the national level in developing countries can further stimulate domestic private finance for energy transition projects.[100] Additionally, there is an opportunity to leverage philanthropies, development finance institutions and private capital to foster partnerships. Through these measures, stakeholders can enhance the financial viability of the energy transition and accelerate progress towards climate goals. The *Network to Mobilize Investment for Clean Energy in the Global South* is a unique World Economic Forum community of public and private sector stakeholders engaged in promoting knowledge exchange and developing practical solutions to unlock barriers and solutions to scale capital for energy transition in emerging and developing economies.

GUEST PERSPECTIVE

Three opportunities and actions to harness the power of generative AI to enable the energy transition

By Julie Sweet, Chair and Chief Executive Officer, Accenture

The energy transition is one of the most urgent challenges facing this generation. As energy businesses work to reach their sustainability goals, reinvent their enterprises and succeed in the transition, they have a powerful new ally: generative AI.

This revolution in the power of AI has arrived at a time of great need for innovation, including how to reduce the cost premium of lower carbon solutions, scale the technologies required, renew and reskill the workforce, and attract and deploy as much as $4 trillion a year in investment.

Accenture research shows that generative AI holds incredible potential as a catalyst for reinvention – it can improve productivity in nearly half of the activities in the energy industry. We estimate that by 2030 the industry's investment in generative AI is set to more than triple, from approximately $40 billion a year to over $140 billion.

Leading companies are already realizing value across their value chain: exploration, development and production, and reinventing some of the most critical workflows. For example, a national oil company is using generative AI through a large language model (LLM) and a dedicated search engine to allow employees to "chat" in real time with a growing knowledge base of over a quarter of a million documents. In practical terms, this means a recent graduate can immediately access the knowledge of an industry veteran, significantly increasing efficiency, productivity and upskilling, de-risking execution, and putting knowledge where it matters: right at the front line.

We see three key opportunities for generative AI to drive the energy transition:

Speed and cost in the delivery and execution of capital projects: Generative AI enables better forecasting of the project schedule, reduction in delays, cost overruns and other project risks, by proposing effective mitigation actions. It can cut by as much as half the time necessary to perform the upfront concept, engineering and detailed design work, compressing the review and approval processes.

Enhanced asset efficiency and productivity: By leveraging operational data, generative AI can improve the maintenance, operations and efficiency of key assets. For example, AI is able to adjust the angle of solar panels or the pitch of wind turbine blades in real-time to maximize energy capture based on weather conditions and to ensure that power is available to the grid at forecasted times of greatest demand and optimal pricing.

Strengthened supply-demand management and trading: Generative AI can handle vast quantities of structured and unstructured data, enabling new solutions that can predict or automatically suggest or respond to energy demand. Ultimately, this could flatten the energy demand curve, lower the capital expenditure required in physical infrastructure and improve overall use rates.

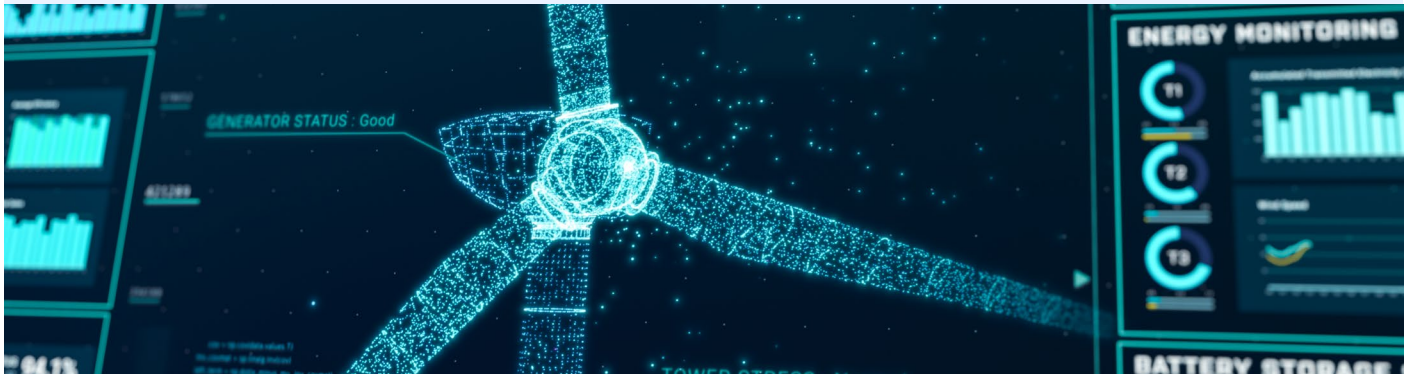
To realize value from generative AI, companies need to take some important actions.

First, most companies still need to access the right data and a strong digital core. This means ensuring a robust and complete data foundation, using energy efficient and powerful cloud data platforms, and modernizing applications to harness their full power.

Second, companies must also ensure that they establish strong responsible AI programmes. This commitment is critical, given the imperatives of energy security and the continued advances in both AI and government policies around its responsible use.

Third, companies must make sustainable choices in the ways in which they work beyond the adoption of technology. For example, the carbon footprint of LLMs can be decreased through strategic selection of algorithms, tailored hardware and energy-efficient cloud data centres. An experiment by Accenture showed that modifying pre-trained models for new tasks, instead of building models from scratch, not only retained the same accuracy level but also used nearly three times less energy.

By responsibly and sustainably adopting next-level technologies, and specifically generative AI, the industry can reinvent its very core while accelerating and de-risking the energy transition.



4 Tailored transition pathways

ETI data highlights the diversity of national contexts, emphasizing the need for nuanced global cooperation in the energy transition beyond uniform strategies.

Achieving a successful energy transition requires global cooperation, as highlighted by shared commitments like those in COP28. However, it is evident that countries differ significantly in their initial conditions, readiness and achievements related to energy transitions. Therefore, while the goal is to advance collectively towards a balanced transition, it does not necessitate a uniform approach across all nations.

A nuanced approach that considers multiple dimensions is essential in understanding the energy transition. The analysis of ETI data has highlighted critical national characteristics, such as region, income level and local energy resources.

- **Region:** Common climatic conditions within a region can dictate the viability of solar, wind and hydro energy. Regions often share similar macroeconomic frameworks and energy demand profiles. Importantly, regional cooperation can catalyse the energy transition through initiatives like integrated grids, co-investments, policies, etc.
- **Income level:** This determines a country's financial capability to invest in new energy technologies and infrastructure, influencing the pace and scale of its energy transition. For example, higher income levels correlate to increased energy consumption.
- **Local energy resources:** The availability of local energy resources significantly influences the three dimensions of the energy triangle. For example, countries that are net energy exporters tend to show stronger security and equity performance.

Within this report, the Whisker-Box plots visually represent group averages, indicated by an "X", while the boxes illustrate each group's 25th and 75th percentiles. The whiskers, extending from each box, highlight the maximum and minimum values within each group.

4.1 Regional insights

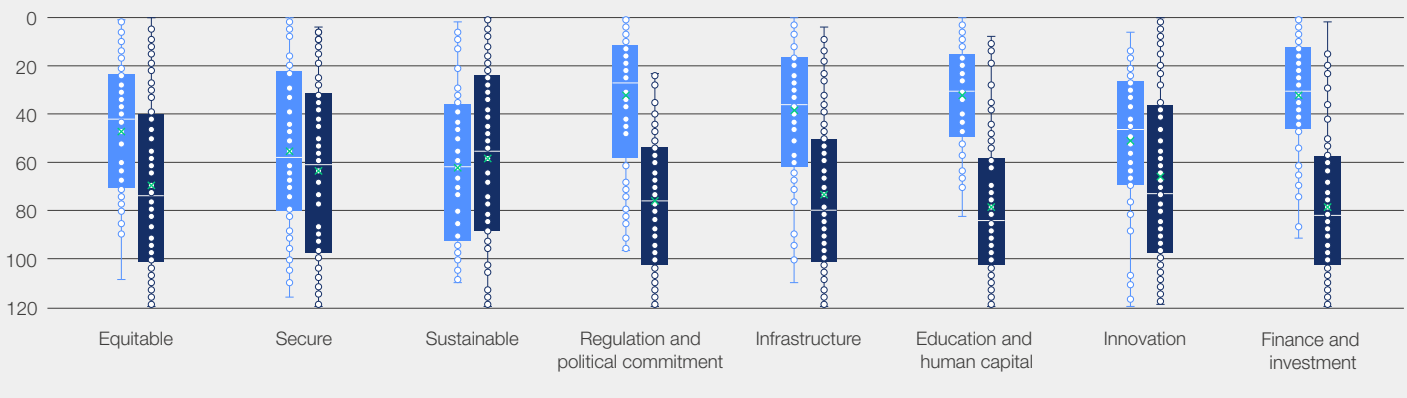
The concept of regional pathways has gained significant traction in international dialogue. While each nation has its unique requirements, there are noticeable similarities within geographical areas. Furthermore, there has been a rise in regional cooperation and agreements, with counties pooling resources, establishing interconnected energy grids, sharing gas facilities, forming trade pacts and engaging in various collaborative efforts. The key insights from this section offer a framework for identifying critical focal points for different regions.

The research is segmented into:

- **Emerging and developing regions/nations:** Commonwealth of Independent States, emerging and developing Asia, Middle East, North Africa and Pakistan, Latin America and the Caribbean, and Sub-Saharan Africa
- **Advanced and developed economies:** North America, Europe, Australia, New Zealand, Singapore, South Korea and Japan

It is crucial to acknowledge that while the advanced economies and emerging and developing nations groupings encompass a diverse range of countries, the analysis is cautiously prudent in identifying general trends. Additionally, the increasing importance of supporting emerging and developing nations is a key driver in conducting this analysis. Therefore, the insights presented are focused on areas where statistical differences are prominent and significant.

FIGURE 16 **Region level Energy Transition Index ranking**



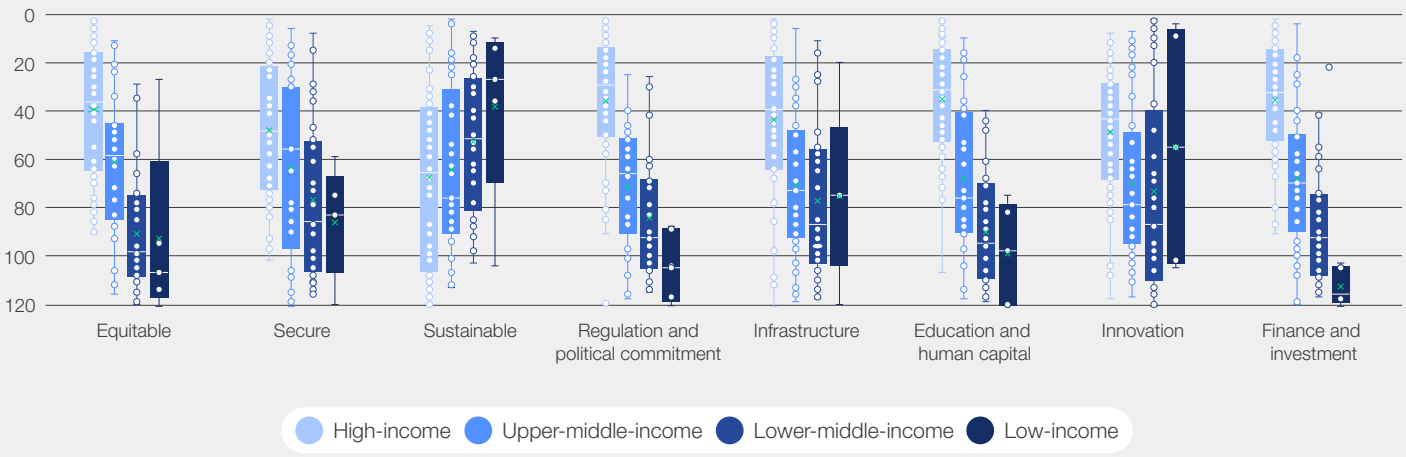
Source: World Economic Forum.

Key takeaways based on region	
Recommendation	**Description**
1 **Bridge the investment gap**	One of the biggest gaps observed between the advanced economies and emerging and developing nations is in investment levels. This underscores the urgent need for financial support from advanced nations to facilitate an equitable energy transition in emerging and developing nations while also unlocking more domestic capital in emerging and developing nations. The key question revolves around determining where to allocate these investments effectively.
2 **Prioritize equity in the energy transition**	Disparities in equity mark the most significant divergence in system performance between advanced economies and emerging and developing nations, often overshadowing sustainability concerns. Ensuring access to affordable energy is important, as these regions are disproportionately affected by price fluctuations.
3 **Avoid over-emphasizing security at the expense of equity and sustainability**	Security represents the smallest gap between all regions in terms of system performance, indicating that countries have prioritized solving for security in recent years. This suggests that countries view security as a foundational first step, followed by equity and sustainability.
4 **Narrow the regulatory disparity**	Regulation exhibits the highest discrepancy between the top performing region (advanced economies) and the second (emerging and developing Europe). This highlights the potential for other regions to adopt fit-for-purpose regulation based on lessons learned from top performers in this domain.
5 **Break the equity-sustainability gridlock**	The negative correlation between sustainability and equity (-0.67) raises important questions about bridging the gap. This underscores the global imperative of balancing equitable transition with decarbonization. Key drivers behind this negative correlation include fossil fuel subsidies, which lead to enhanced affordability and access but often limit the economic competitivity of renewable energy sources. There are several success stories (e.g. Ethiopia and Zimbabwe) where reducing subsidies led to off-grid renewable solutions ramping up and solving equity and sustainability imperatives. In some countries where the renewable levelized cost of electricity (LCOE) is relatively high, adding clean energy sources has led to an increase in electricity prices.
Region-specific critical priorities	
6 **Advanced economies – sustainability**	Despite strides being made in enhancing sustainability scores over the last decade, advanced economies have significant room for further improvement, primarily due to high energy and carbon intensity. Advanced economies may encourage energy efficiency from the top down, gradually reduce reliance on unabated fossil fuels and adopt technologies that can curb the environmental impact of thermal power plants, such as CCUS, cofiring and low-carbon fuels.
7 **Commonwealth of Independent States – security**	Energy security is the primary concern for this group of countries due to reliance on a limited range of import partners, significant energy imports, lack of diversity in total primary energy supply (TPES) and vulnerability in gas supply resilience. The Commonwealth of Independent States should take steps to improve resource availability and policies towards a more integrated nexus approach to achieve carbon neutrality.
8 **Emerging and developing Asia – equity**	Ensuring equitable access to energy is a critical issue in this region, characterized by limited rural electricity access, affordability challenges, extensive energy subsidies and energy prices not returning to pre-pandemic levels. The region needs to prioritize equity in decision-making, ensuring affected communities are fairly compensated for losses and have access to employment rights programmes.
9 **Emerging and developing Europe – security**	Energy security has gained increasing importance, particularly following the Russia-Ukraine war, emphasizing the need to diversify energy imports, bolster gas supply resilience and decrease overall energy imports. An updated energy grid system could help ensure the security of the energy supply and fast-track permitting for wind and solar projects could help deliver EU energy security through climate action.
10 **Latin America – equity**	Equity emerges as a key concern in Latin America, particularly its sensitivity to energy price spikes. Gas prices and electricity prices have remained high in the region in the past 12 months compared to previous years. The region's existing infrastructure is built to support oil and gas production and consumption, so it needs to expand supportive infrastructure and build more interconnected grids to facilitate the development, storage, distribution and transmission of renewables.
11 **Middle East – sustainability**	The Middle East lags notably in sustainability efforts, necessitating a faster pace towards decarbonization due to heavy reliance on fossil fuels and lack of energy efficiency. The Middle East has some of the highest solar energy potential in the world and solar PV has become the cheapest source of electricity generation for new projects in the region.
12 **Sub-Saharan Africa – equity**	Sub-Saharan Africa faces significant equity challenges, requiring urgent improvements in energy access, affordability and ensuring a fair energy transition. Despite low energy intensity, improving equity takes precedence over sustainability. Decentralized renewable energy solutions, such as mini grids, can help eradicate energy poverty in Sub-Saharan Africa by increasing energy access and establishing an electricity market. These solutions can also improve supply reliability and reduce local pollution from diesel use.

4.2 Income-level insights

Analysing the correlation between a country's income level and its ETI performance yields an alternate perspective. Generally, there is a positive association across most dimensions, indicating that countries with higher income levels tend to have better ETI performance. This suggests that economic prosperity plays a significant role in facilitating a country's energy transition efforts and vice versa. However, sustainability and innovation present exceptions to this trend.

FIGURE 17 **Income level Energy Transition Index ranking**



Source: World Economic Forum.

TABLE 3 **Income-level actions**

Key takeaways based on income	
Recommendation	**Description**
1 **High-income countries need to accelerate decarbonization due to high energy intensity**	While a positive correlation between income level and ETI performance exists across most dimensions, sustainability is an exception. Higher-income countries often exhibit higher energy intensity and carbon intensity compared to their lower-income counterparts. While lower-income counterparts also need to decarbonize, high-income countries contribute a far larger proportion of emissions.
2 **Foster the regulation-financing nexus**	The regulation and financing dimensions demonstrate the strongest correlation among any two dimensions. This suggests that an enabling regulatory framework fosters a robust financing landscape for energy transition initiatives. High-income countries particularly excel in these areas.
3 **Diversify innovation portfolio – not only in technologies but also countries**	Despite high-income countries allocating substantial resources to R&D, there is no clear correlation between income level and innovation performance. This underscores the importance of global investment in innovation across different regions and technologies. Innovation requires a diversified portfolio approach, both in terms of the types of technologies and regional location.

4.3 Local energy resources insights

The third perspective in customizing energy transition pathways involves assessing a country's status as either a net importer or exporter of energy. Notably, net-importing countries often demonstrate a higher level of readiness for transition. Among affluent net-importing nations, there is a concerted effort to enhance the efficiency of the energy system, possibly driven by the need to mitigate the vulnerabilities associated with energy importation, such as supply disruptions and price volatility.

TABLE 4 | **Local energy resources actions**

Key takeaways based on local energy resources	
Recommendation	**Description**
1 **High-income exporters could balance performance**	High-income net exporters – such as the Gulf Cooperation Council (GCC), Canada, Australia, etc. – demonstrate the strongest performance in security and equity compared to other groups but lag in the sustainability dimension. This presents a significant opportunity for these countries to redirect available resources towards boosting sustainability in the energy sector.
2 **Low-income exporters need to re-invest in the energy sector**	Low-income exporters rank lowest on the financing dimension, indicating that these countries tend to invest the proceeds from energy exports in other sectors (e.g. education and healthcare). This presents an opportunity for higher-income countries to support financing the energy transition in these countries. Consequently, the performance of low-income importers closely mirrors that of high-income exporters, emphasizing the need for targeted assistance to bridge the gap in energy investment.
3 **Transfer solutions from high-income importers and their success stories on transition readiness**	High-income importing countries have established a conducive environment, particularly in terms of regulation, financing and infrastructure. This is to optimize their energy systems given the lack of local energy resources. Low-income countries, both in terms of exports and importers, can derive key lessons that would help optimize the global energy system.
4 **Low-income importers could focus on equity and energy security**	Low-income net importers show the most robust sustainability performance compared to other groups. However, they fall behind in equity and security aspects, indicating a chance for these nations to reallocate their resources towards enhancing these dimensions.

5 Looking ahead: top 10 actions

“ Actions should be taken to regain momentum across security, equity and sustainability while advancing transition readiness.

Despite the notable progress in the energy transition, concerted efforts are needed to ensure momentum picks up. Actions should be taken to regain momentum across security, equity and sustainability while advancing transition readiness. The top 10 actions that emerge from the ETI 2024 are:

1. **Implement regulations to advance decarbonization**. Strong political commitment is needed to ensure progress and continuity in decarbonization policies. While countries must adapt to their specific circumstances, this can include enabling policies for renewable energy expansion, carbon pricing, green stimulus packages and reducing fossil fuel subsidies. These measures can help to integrate centralized and decentralized renewable energy sources while enhancing energy security and equity.

2. **Deliver energy equity for vulnerable households**, such as social safety nets and compensatory measures, including cash transfers and temporary basic income initiatives to alleviate energy-related costs. This is key to ensuring fair access to energy across different socioeconomic groups and preventing energy poverty. These initiatives can be ramped up or down in an agile manner based on macroeconomic conditions.

3. **Increase investments in clean energy infrastructure**. Clean energy investments reached $1.8 trillion in 2023 but remain well below the $4.5 trillion needed annually by 2030.[101] Additionally, investment has been concentrated in advanced economies and China. Emerging and developing countries need high-income countries to ramp up support while also ensuring a conducive environment for investments in key areas like clean fuels, electricity and energy storage.

4. **Invest in energy efficiency solutions**. To meet COP28 target of doubling energy efficiency by 2030, private companies need to focus on accelerated action, investing in energy efficiency, implementing a strong governance process with clear top-level ownership and operationalizing the value chain through effective collaboration. This includes awareness building, mindset shifts, and capability and technology sharing and financing. Governments also need to prioritize policy interventions in this space to enable private sector investments and incentivize people to save energy.

5. **Upgrade grid capabilities for more efficient distribution of energy**. With increasing electrification and proliferation of decentralized energy, the role of transmission and distribution is gaining prominence and requires a ramp-up in investments. Grids need to maintain reliability while connecting variable loads from renewable sources.

6. **Enhance collaboration between sectors and nations**. Implement initiatives to attract capital for clean energy projects and enhance the effectiveness of these investments. Foster strong partnerships with philanthropies, development finance institutions and private investors to drive growth in the clean energy sector. As interest rates continue to weigh in on the cost of capital, public and private entities need to offer favourable terms to accelerate clean energy infrastructure buildout.

7. **Lower emission intensity of fossil fuels**. Fossil fuels are likely to continue contributing significantly to the overall energy mix in the coming years. However, coal-to-gas switching, focusing on lighter oil products and minimizing oil and gas extraction emissions could help reduce fossil fuel emissions intensity.

8. **Drive R&D and adoption of new technologies**, including new battery technologies, offshore wind, and green ammonia-based hydrogen for shipping and steel production. Despite the availability of many of these viable solutions, they lack broader accessibility. Investing in digital adoption is important to build data management capabilities, which are essential for accurate product-level emission reporting and green standards. Scaling AI and GenAI use cases can drive efficiency and productivity in the energy system.

9. **Accelerate the decarbonization of hard-to-abate sectors**. Progress has stalled in hard-to-abate sectors across industry, production and transport. Technology, market and regulatory environments need to deliver cost reduction of green technologies, define clear standards and solidify green premium mechanisms.

10. **Prioritize the development of a skilled workforce for the energy sector**. This includes reskilling workers affected by the energy transition and providing new skills and capacity building to those who will benefit from newly created jobs. As jobs in carbon-intensive energy sectors are expected to decrease in the coming decades, companies and policy-makers need to help reskill employees to transition to clean energy jobs.

The message from this year’s ETI is clear: there is no time to waste. Decision-makers across the globe must act decisively and collaboratively to accelerate the transition towards an equitable, secure and sustainable energy future.

Appendices

A1 Methodology and indicators

FIGURE 18 **Methodology and indicators**

Note: USc15/kwh = 15 US cents per kilowatt-hour; PPP = purchasing power parity; MMBTU = metric million British thermal unit; TPES = total primary energy supply; T&D = transmission and distribution; kT = kilotonnes.

Emerging and developing economies

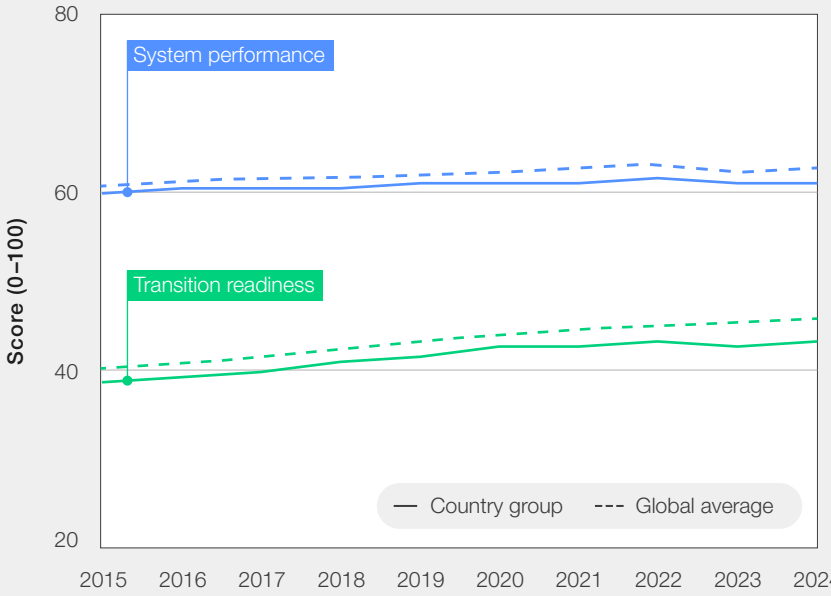
Average ETI score	Average rank	Average momentum
52.6	79/120	0.24%

Key macroeconomic and ETI data

Average population (millions)	84.25	Average share of clean energy (%)	12%
Average GDP ($ trillions)	0.51	Average energy intensity (MJ/$2017 PPP GDP)	4.5
Average net energy imports (% of energy use)	1.0%	Average CO_2 intensity (CO_2/TES)	45.25

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply

Country group[1] system performance and transition readiness, 2015-2024



Diverse energy landscape: Emerging and developing nations encompass a wide range of energy contexts, from regions heavily reliant on fossil fuels to those making significant strides in clean energy adoption, reflecting a varied pace and approach to energy transition.

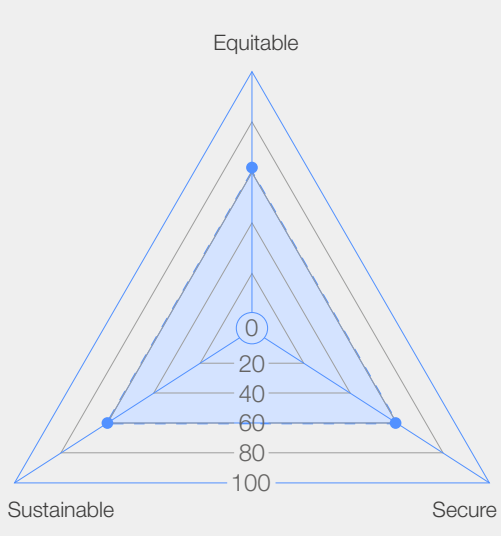
Financial constraints: Many countries in the emerging and developing nations face financial limitations that hinder their ability to invest in cleaner energy technologies and infrastructure, making international support and investment critical for facilitating their energy transition.

Energy access and equity challenges: A significant portion of emerging and developing nations struggles with ensuring universal energy access and equity, where transitioning to sustainable energy sources must also address energy poverty and affordability issues.

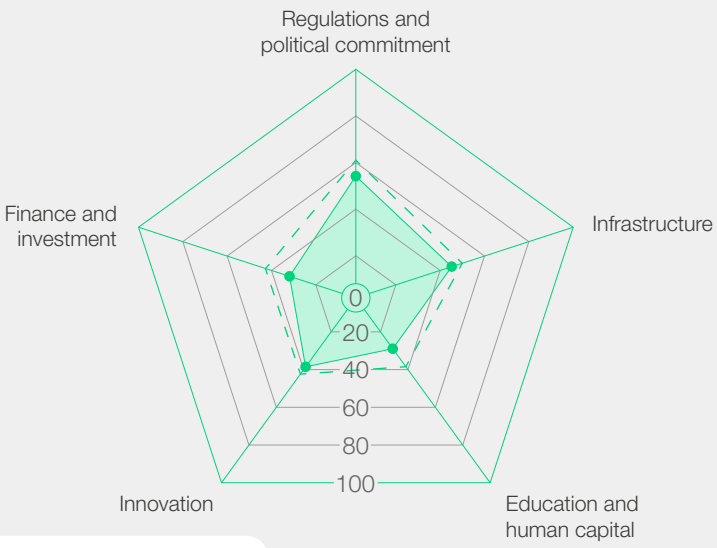
Opportunity for leapfrogging: Emerging and developing nations hold the potential to "leapfrog" directly to modern, clean energy systems, bypassing some of the traditional energy infrastructure.

Note: 1. Emerging and developing economies include Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Cambodia, Cameroon, China, Colombia, Congo, Dem. Rep., Costa Rica, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Ethiopia, Gabon, Georgia, Ghana, Guatemala, Honduras, India, Indonesia, Iran, Islamic Rep., Jamaica, Jordan, Kazakhstan, Kenya, Kyrgyz Republic, Lao PDR, Lebanon, Macedonia, FYR, Malaysia, Mexico, Mongolia, Montenegro, Morocco, Mozambique, Namibia, Nepal, Nicaragua, Nigeria, Pakistan, Paraguay, Peru, Philippines, Republic of Moldova, Senegal, Serbia, South Africa, Sri Lanka, Tajikistan, Tanzania, Thailand, Tunisia, Turkey, Ukraine, Venezuela, Vietnam, Yemen, Rep., Zambia and Zimbabwe.
Source: World Economic Forum.

System performance



Transition readiness



Source: World Economic Forum.

G7 nations

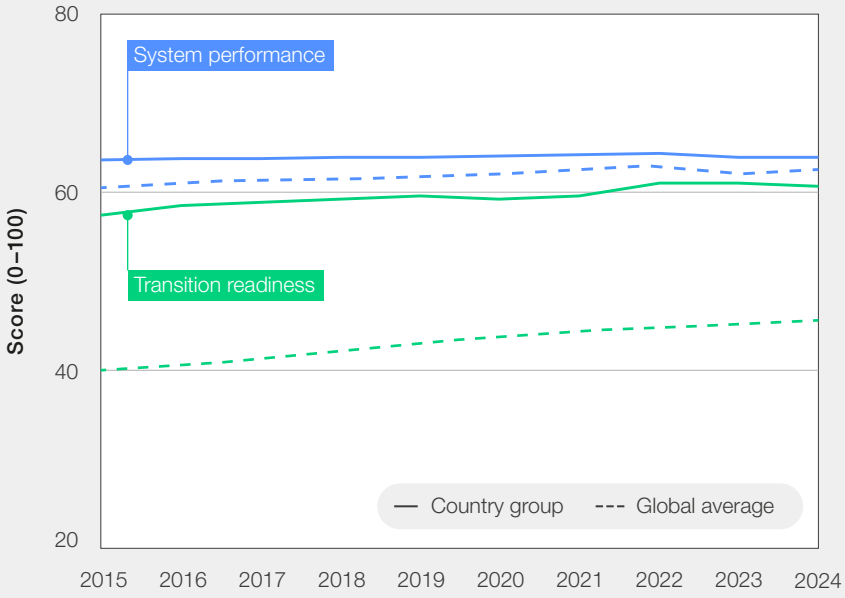
Average ETI score	Average rank	Average momentum
64.5	20/120	0.01%

Key macroeconomic and ETI data

Average population (millions)	110.74	Average share of clean energy (%)	18.2%
Average GDP ($ trillions)	6.26	Average energy intensity (MJ/$2017 PPP GDP)	3.35
Average net energy imports (% of energy use)	35%	Average CO_2 intensity (CO_2/TES)	47.84

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply

Country group[1] system performance and transition readiness, 2015-2024



Sustainability lagging:
These economies are leaders in energy security and equity but lag the global average in sustainability, mainly driven by higher energy intensity.

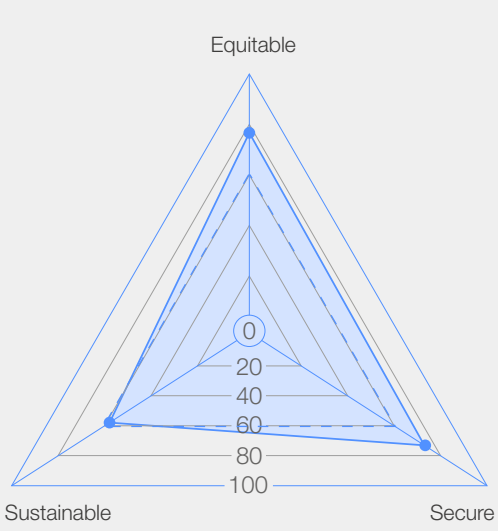
Energy intensity:
G7 economies have higher energy consumption per capita due to higher standards of living and industrialization. Thus, these economies contribute significantly to global carbon emissions.

Leading regulations and investments:
These countries typically set the standard for decarbonization regulations and significantly outpace other countries in terms of clean energy infrastructure spending.

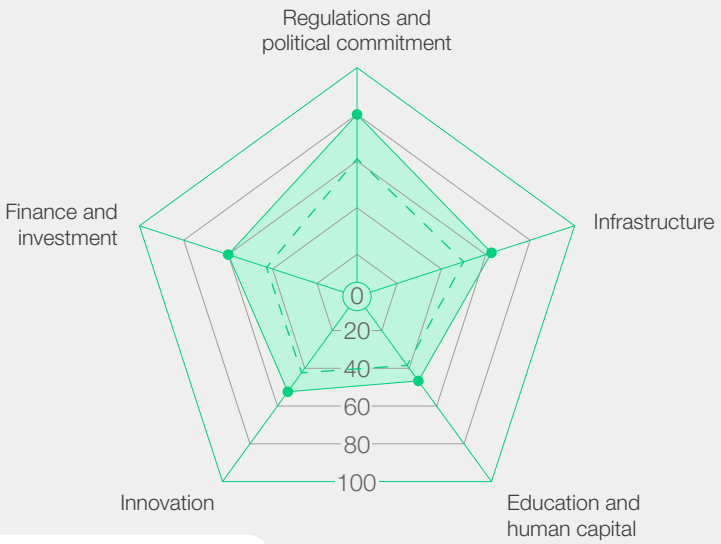
Coal phase down:
A key driver of declining emissions growth in these countries is coal-to-gas and coal-to-renewables in recent decades.

Note: 1. G7 nations include Canada, France, Germany, Italy, Japan, the United Kingdom and the United States
Source: World Economic Forum.

System performance



Transition readiness



Country group Global average

Source: World Economic Forum.

G20 nations

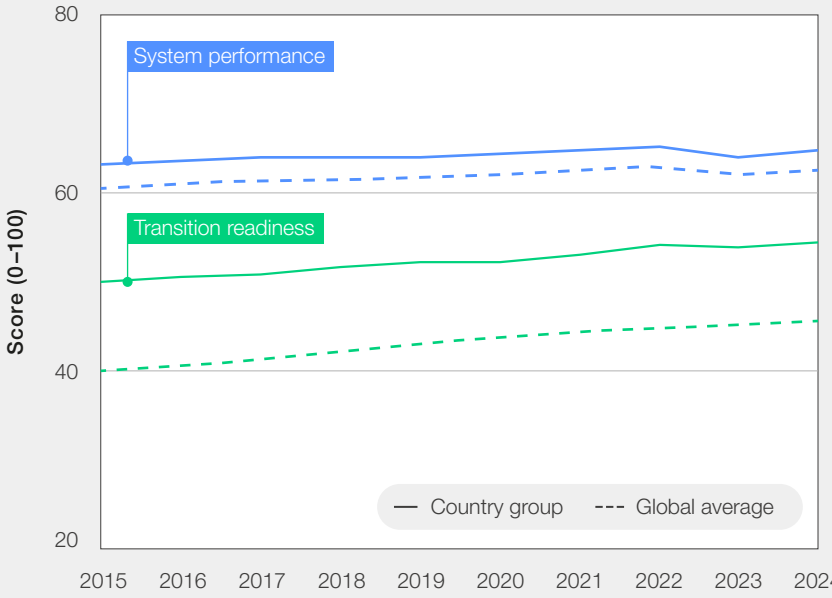
Average ETI score	Average rank	Average momentum
62.0	32/120	0.44%

Key macroeconomic and ETI data

Average population (millions)	161.34	Average share of clean energy (%)	14.3%
Average GDP ($ trillions)	2.79	Average energy intensity (MJ/$2017 PPP GDP)	3.4
Average net energy imports (% of energy use)	36%	Average CO_2 intensity (CO_2/TES)	49.30

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply

Country group[1] system performance and transition readiness, 2015-2024



Narrowing system performance gap:
The gap between G20 and the rest of the world has narrowed in system performance. Price spikes, especially in Europe, led to a setback in equity.

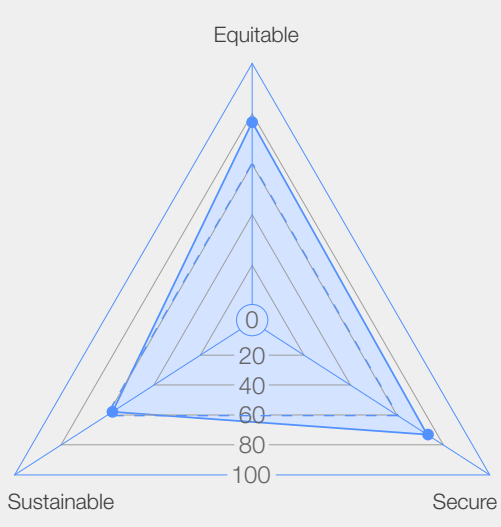
Ramping up transition readiness:
G20 countries have ramped up transition readiness by enhanced political commitments, increased clean energy investments, development of human capital.

Sustainability showing a positive trend:
G20 countries have shown significant improvements in sustainability performance. Sustainability leaders in Europe have gained momentum (e.g. France). Additionally, countries such as China and Brazil have strong momentum.

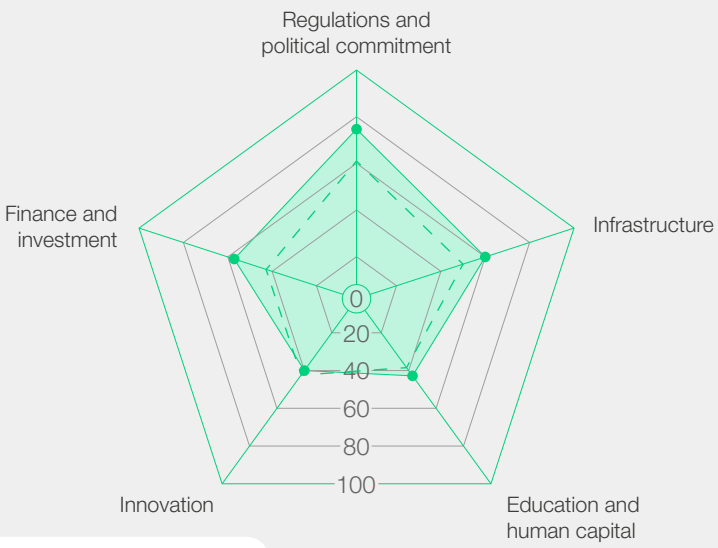
Equitable transition:
The topic of equitable transition has gained prominence in G20 countries to ensure the costs and benefits of the transition are distributed in an even manner.

Note: 1. G20 nations include Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Korea, Rep., Latvia, Lithuania, Luxembourg, Malta, Mexico, Netherlands, Poland, Portugal, Romania, Saudi Arabia, Slovenia, South Africa, Spain, Sweden, Turkey, the United Kingdom and the United States.
Source: World Economic Forum.

System performance



Transition readiness



Source: World Economic Forum.

OPEC+ nations

(Organization of the Petroleum Exporting Countries+)

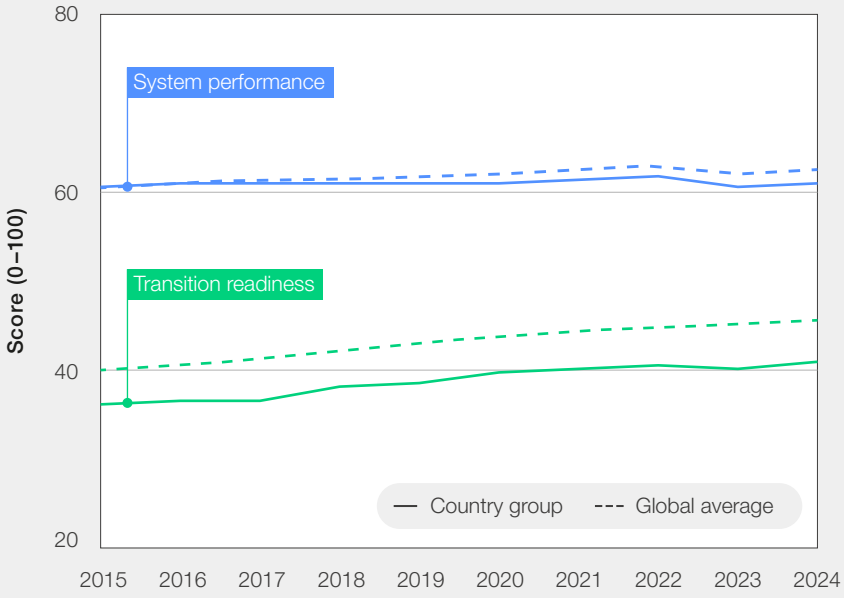
Average ETI score	Average rank	Average momentum
53.6	75/120	0.01%

Key macroeconomic and ETI data

Average population (millions)	52.86	Average share of clean energy (%)	4.3%
Average GDP ($ trillions)	0.48	Average energy intensity (MJ/$2017 PPP GDP)	5.86
Average net energy imports (% of energy use)	-125%	Average CO_2 intensity (CO_2/TES)	47.85

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply

Country group[1] system performance and transition readiness, 2015-2024



Reducing fossil fuel emission intensity:
The group will play a critical role in reducing the emission intensity of fossil fuels. This can be done by reducing emissions during oil and gas extraction and refining, focusing on lighter products, improving quality, etc.

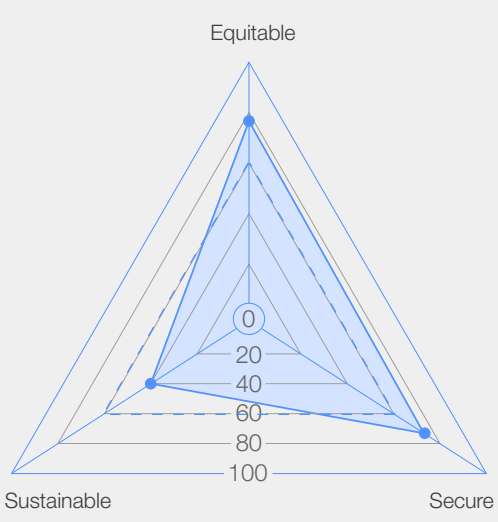
Methane crackdown:
The group reaffirmed ambitions to reduce methane emissions and flaring during COP28.

Imbalanced transition:
OPEC+ leads in security and equity performance, but lags in sustainability. The group of countries have an opportunity to reinvest proceeds from oil exports in decarbonizing the domestic energy sector.

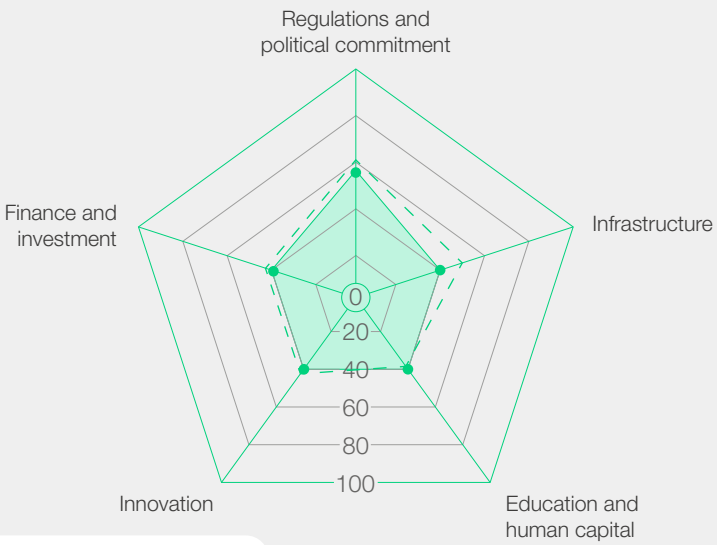
Human capital opportunity:
With reskilling, these countries can produce the workforce of the future for clean energy sectors.

Note: 1. OPEC+ nations include Algeria, Azerbaijan, Bahrain, Brazil, Brunei Darussalam, Gabon, Iran, Islamic Rep., Kazakhstan, Kuwait, Malaysia, Mexico, Nigeria, Oman, Saudi Arabia, United Arab Emirates and Venezuela.
Source: World Economic Forum.

System performance



Transition readiness



Country group --- Global average

Source: World Economic Forum.

BRICS+ nations

(Brazil, Russia, India, China and South Africa)

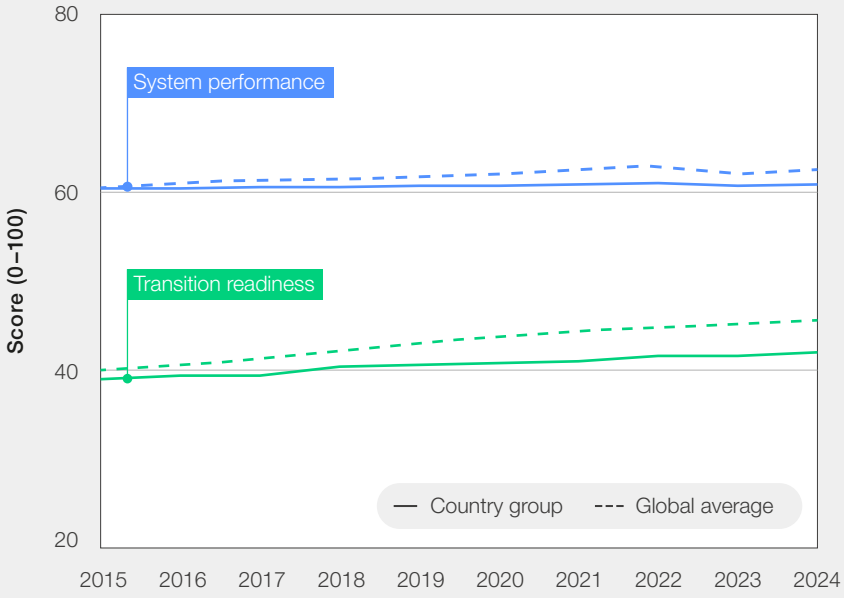
Average ETI score	Average rank	Average momentum
56.0	61/120	0.75%

Key macroeconomic and ETI data

Average population (millions)	385.93	Average share of clean energy (%)	7.2%
Average GDP ($ trillions)	2.93	Average energy intensity (MJ/$2017 PPP GDP)	5.5
Average net energy imports (% of energy use)	-31%	Average CO_2 intensity (CO_2/TES)	49.45

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply

Country group[1] system performance and transition readiness, 2015-2024



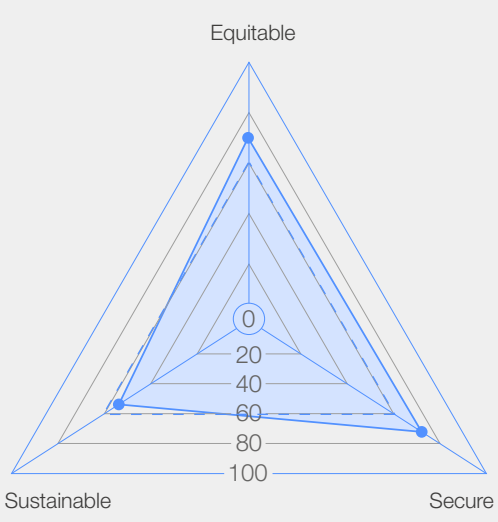
The role of China and India:
With roughly a third of the global population, these two countries will play a critical role. Both have experienced progress in renewable energy buildout, energy access improvements and energy security. However, the phase down trajectory of coal will be a major driver of emissions. Additionally, these countries are in a strong position for green tech manufacturing.

Centres of growth:
Many economies are on a trajectory for strong economic growth (e.g. India, Saudi Arabia and Brazil) and need to decouple emissions and GDP growth. This requires improving energy intensity and decarbonizing the energy sector.

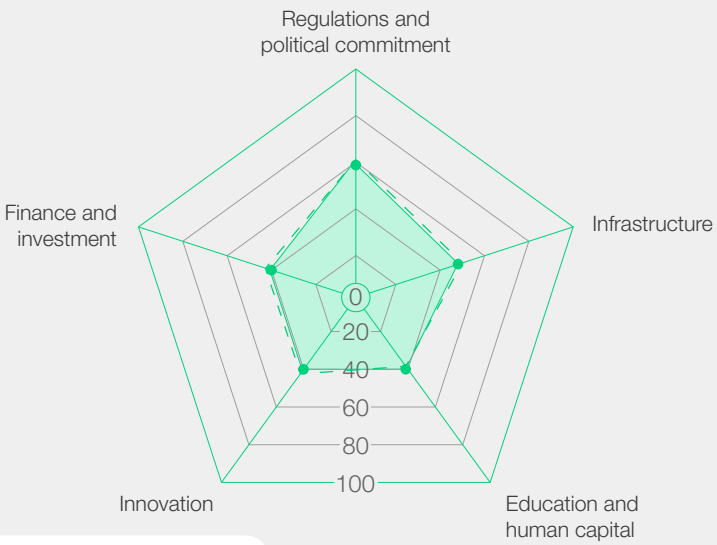
Regulatory commitment:
The regulatory framework of these countries is mixed. Carbon pricing, in particular, lags other countries, which is a key enabler of decarbonization.

Note: 1. BRICS+ nations include Brazil, China, Egypt, Arab Rep., Ethiopia, India, Iran, Islamic Rep., Saudi Arabia, South Africa and the United Arab Emirates.
Source: World Economic Forum.

System performance



Transition readiness



Source: World Economic Forum.

Equity leaders: top five

Average ETI score 60.6

Average rank 36/120

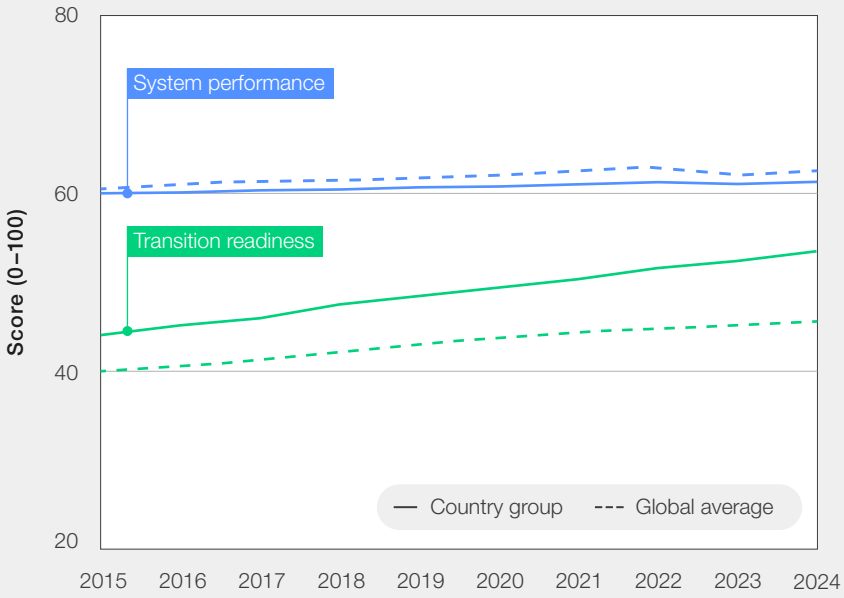
Average momentum 0.7%

Key macroeconomic and ETI data

Average population (millions)	77.81	Average share of clean energy (%)	7.3%
Average GDP ($ trillions)	5.70	Average energy intensity (MJ/$2017 PPP GDP)	5.34
Average net energy imports (% of energy use)	-135%	Average CO_2 intensity (CO_2/TES)	52.26

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply

Country group[1] system performance and transition readiness, 2015-2024



Balancing price and subsidies: Equity leaders are frontrunners in delivering affordable energy. However, this often comes through fossil fuel subsidies, which can reduce a country's budget and prevent the economic competitiveness of renewable energy.

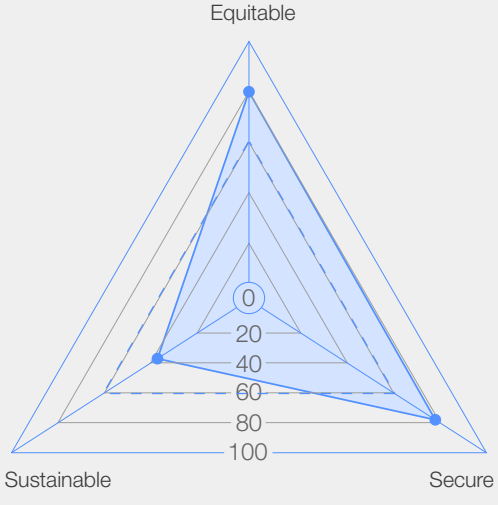
Local energy resources: Equity leaders have ample access to local energy resources. They also typically have a diverse energy mix, integrating fossil fuels with clean energy resources to drive down and optimize energy prices.

Sustainability being compromised: Equity leaders, through fossil fuel subsidies, have hindered clean energy development.

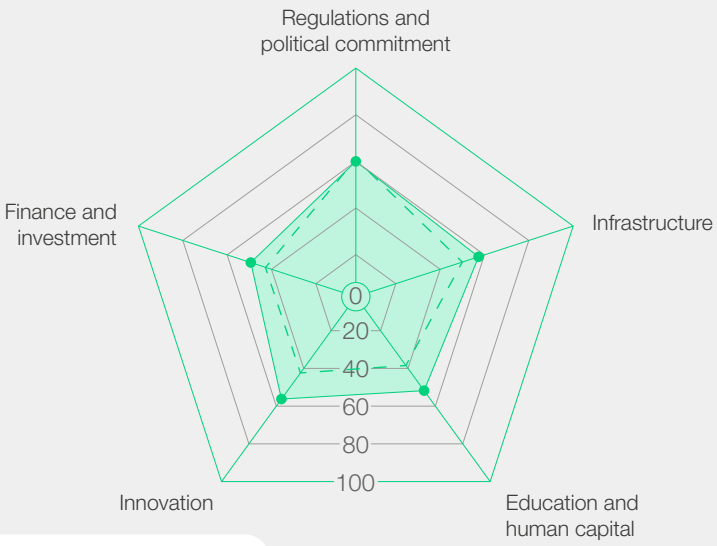
Incentive systems: The US's IRA and Canada's Environment and Climate Change (ECCC) are success stories in delivering green transformation through tax incentives and other financial instruments.

Note: 1. Equity leaders: top five include Canada, Israel, Oman, Qatar and the United States.
Source: World Economic Forum.

System performance



Transition readiness



Country group --- Global average

Source: World Economic Forum.

Security leaders: top five

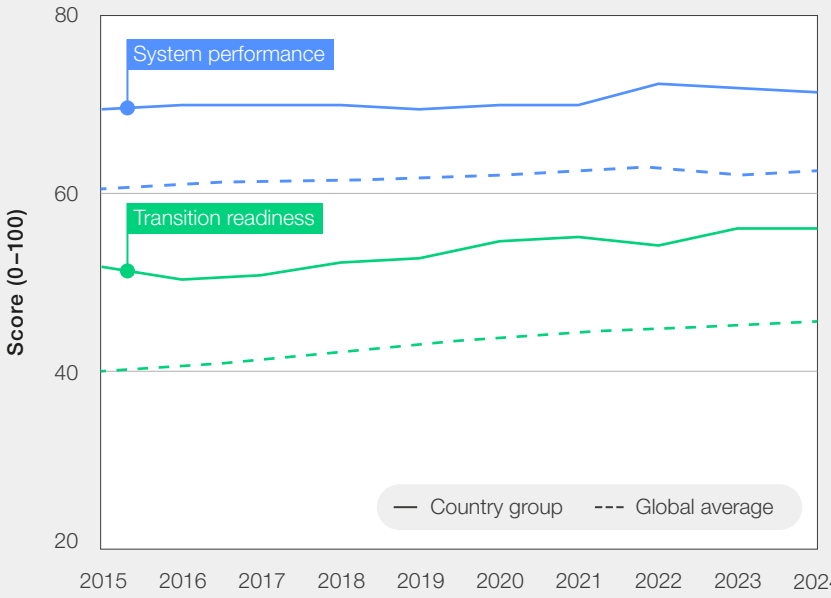
Average ETI score	Average rank	Average momentum
65.1	19/120	0.01%

Key macroeconomic and ETI data

Average population (millions)	80.00	Average share of clean energy (%)	17.7%
Average GDP ($ trillions)	5.63	Average energy intensity (MJ/$2017 PPP GDP)	4.0
Average net energy imports (% of energy use)	-180%	Average CO_2 intensity (CO_2/TES)	49.2

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply

Country group[1] system performance and transition readiness, 2015-2024



Diverse energy mix at the core: Security leaders have a diverse energy mix, integrating natural gas, oil, solar, wind, nuclear, coal and hydropower in the overall mix. This makes these countries resilient in the event of shocks.

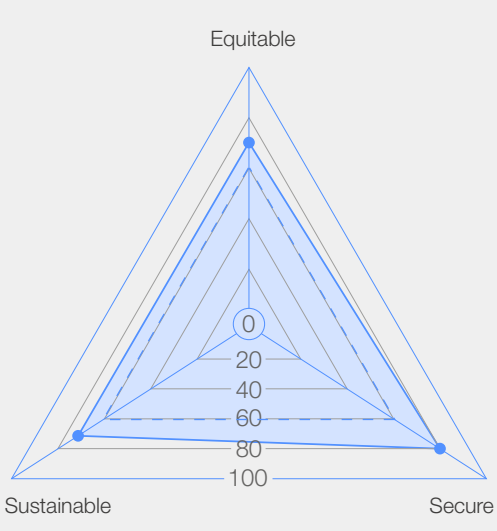
Diversity in import counterparts: While most of these countries are net exporters of energy, they have been able to build a diverse base of countries to import from.

Grid reliability: These countries have also invested in grid reliability and are performing strongly in minimizing transmission and distribution losses and customer interruptions (SAIDI, SAIFI).

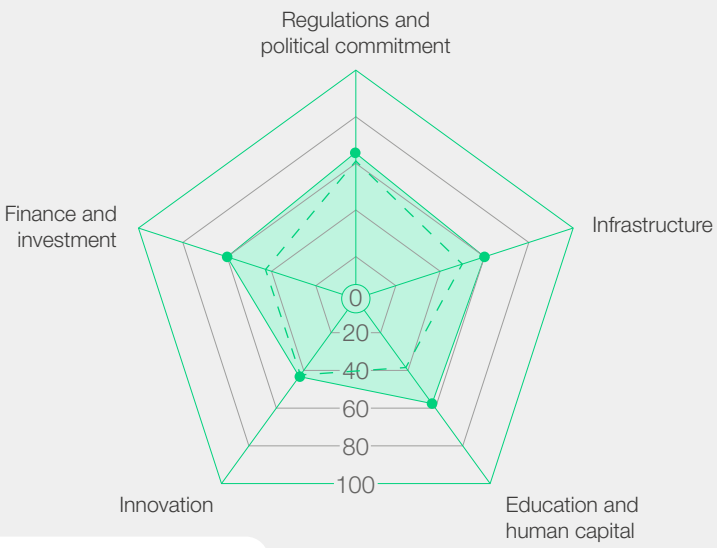
Risk of over-indexing: Countries must be wary of over-indexing on security at the expense of equity and especially sustainability.

Note: 1. Security leaders: top five include Australia, Estonia, Malaysia, Norway and the United States.
Source: World Economic Forum.

System performance



Transition readiness



Source: World Economic Forum.

Sustainability leaders: top five

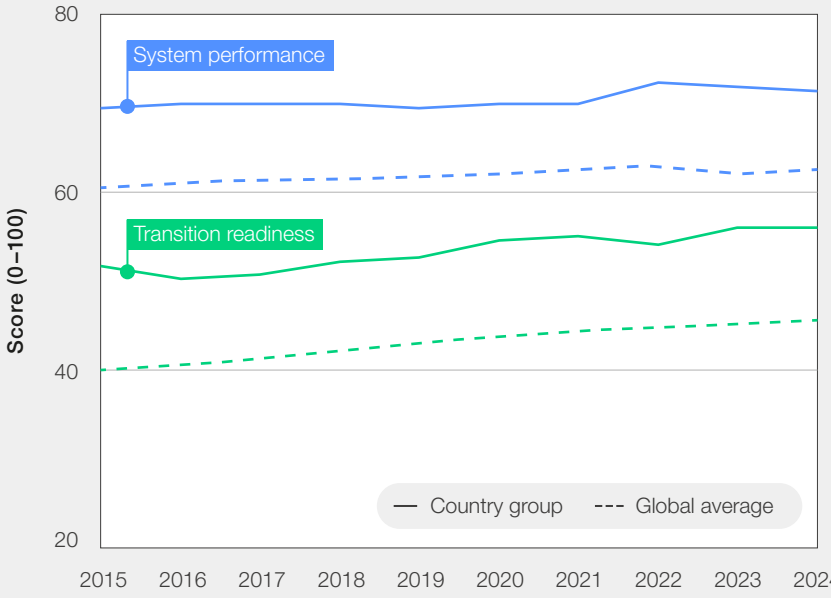
Average ETI score	Average rank	Average momentum
66.4	24/120	0.7%

Key macroeconomic and ETI data

Average population (millions)	6.79	Average share of clean energy (%)	39%
Average GDP ($ trillions)	0.31	Average energy intensity (MJ/$2017 PPP GDP)	2.4
Average net energy imports (% of energy use)	35%	Average CO_2 intensity (CO_2/TES)	30.3

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply

Country group[1] system performance and transition readiness, 2015-2024



Energy intensity reduction: These countries have placed regulation and financial incentives to drive down energy consumption, allowing them to meet the majority of energy demand through clean energy sources.

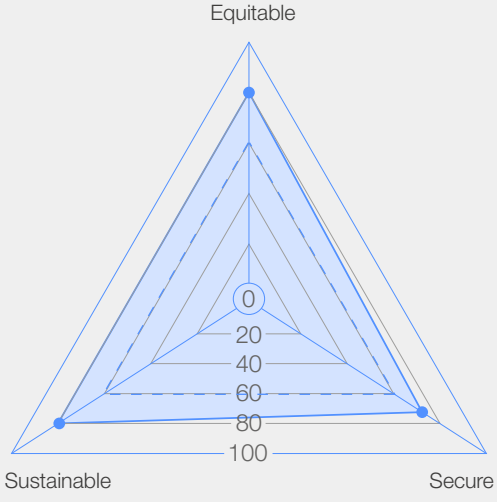
Strong presence of renewable potential: These countries also benefit from having access to hydropower, solar and wind energy. Furthermore, by reducing fossil fuel subsidies, countries have been able to maximize the potential from renewables.

Carbon pricing: These countries also have carbon pricing frameworks in place that increase the economic competitiveness of renewables.

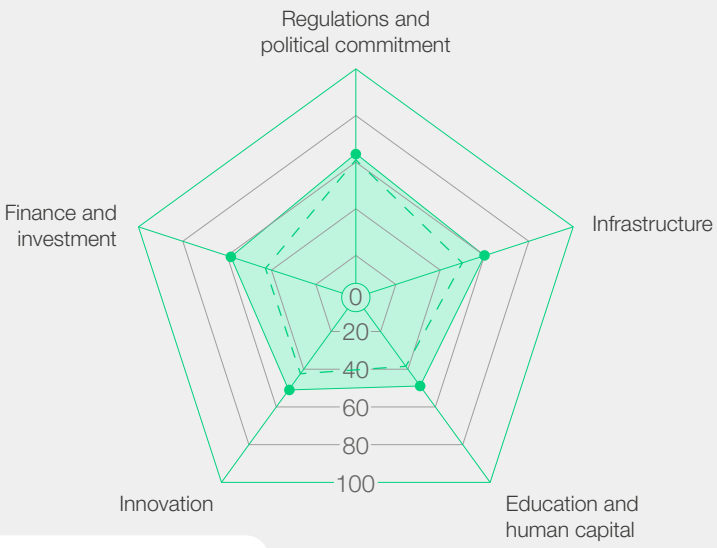
Strong investment environment: Through regulatory reforms and political stability, these countries attract investments from local players and from abroad. This is evident in increasing investments in clean energy infrastructure.

Note: 1. Sustainability leaders: top five include Albania, Costa Rica, Paraguay, Sweden and Switzerland.
Source: World Economic Forum.

System performance



Transition readiness



Source: World Economic Forum.

Contributors

Data sources

The World Economic Forum acknowledges and thanks all data contributors.

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.

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The World Economic Forum acknowledges and thanks the individuals and experts without whose support the *Fostering Effective Energy Transition 2024* report would not have been possible:

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Endnotes

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