In collaboration
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Fostering Effective Energy Transition 2025

INSIGHT REPORT

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Foreword

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The 2025 edition of the *Fostering Effective Energy Transition* report arrives amid growing geopolitical, technological and climate-related disruption.

Rather than a single transition, the world is undergoing a broader transformation – redefining how energy is produced, consumed and governed. This is being driven by mounting climate risks, accelerated innovation, fractured global cooperation and rising pressure to deliver reliable, affordable and low-emission energy systems.

The Energy Transition Index (ETI) offers a long-term view of how energy systems evolve across countries, building on 15 years of energy transition benchmarking at the Forum. Early progress, particularly in Europe, was fuelled by climate ambition, falling renewable costs and growing public support. In many emerging and resource-rich economies, energy security and equity were more pressing. Over time, national priorities have expanded, with strategies increasingly shaped by supply chain resilience, industrial policy and competitiveness goals.

The 2025 ETI reflects this evolving reality. Clean energy investment surpassed $2 trillion, and 65% of countries improved their performance. Yet progress remained uneven. Advanced economies and emerging Europe focused on infrastructure and grid upgrades, while emerging Asia advanced through rising investment and innovation, and Sub-Saharan Africa improved most in regulation and policy. Systemic constraints – from limited institutional capacity to financing and infrastructure barriers – continued to hamper progress, especially in low-income economies with fast-growing demand and constrained capital access.

Today's transition is not linear. Energy systems are being restructured in response to diverging national priorities, and decentralization and digitalization are creating new supply and consumption models. Elsewhere, industrial policy, energy sovereignty and mineral security have come to the forefront. These shifts do not displace climate ambition but increasingly embed it within broader goals for resilience, competitiveness and development.

Looking ahead, transformation will require more than innovation. Energy systems must be resilient, flexible and able to scale clean technologies, improve efficiency, secure critical inputs and reduce emissions from legacy infrastructure. Setting targets is no longer enough – capacity for delivery must be actively built amid global uncertainty.

Technologies like artificial intelligence (AI), advanced storage and decentralized infrastructure are accelerating change but also increasing pressure on power systems, supply chains and regulation. As AI, quantum computing and industrial digitalization evolve, countries must harness their potential without overwhelming already-strained systems.

There is no single blueprint. Countries will follow different paths at different speeds. Ensuring a durable and inclusive transformation requires alignment between ambition, finance and delivery – guided by market signals, grounded in local realities and supported by international cooperation.

The 2025 ETI offers a data-driven tool to align ambition with action and build more resilient, equitable and sustainable energy systems. Developed with Accenture and key data partners, it reflects shared insights into global energy challenges and opportunities.

Executive summary

There is growing progress towards a secure, equitable and sustainable energy system, but momentum could stall amid financing and geopolitical challenges.

In 2024, there were underlying vulnerabilities across energy supply chains and markets, combined with record energy demand.

Conflicts disrupted trade flows while surging demand from electrification, including from artificial intelligence (AI)-driven data centres, pushed global energy demand up by 2.2% (the fastest pace in years). Despite continued expansion of renewables and improvement in energy efficiency, energy-related CO_2 emissions reached a record high of **37.8 billion tonnes**. Clean energy investment grew to **over $2 trillion** – double the 2020 levels, but well below the **$5.6 trillion needed annually** through 2030. Moreover, annual growth in investment slowed to 11% – down from 24-29% annually in the previous three years.

The 2025 Energy Transition Index (ETI) recorded a 1.1% year-on-year increase in global scores – over twice the average pace of the past three years.

The ETI is based on three system performance dimensions – **security, equity and sustainability** – and five enabling dimensions of transition readiness. System performance improved (1.2% y-o-y), though this was uneven across its three dimensions. **Equity** saw the strongest rebound, nearing pre-COVID-19 pandemic levels, supported by moderating energy prices and structural subsidy reforms. **Sustainability** maintained a steady upward trend as clean energy use increased. **Security**, however, stagnated, constrained by limited diversification, high import dependence and inflexible power systems in many countries. **Transition readiness**, which considers regulation, infrastructure, education, innovation and investment capacities, slowed to just 0.8% y-o-y, well below its 10-year trend.

Overall, 65% of countries improved their ETI scores in 2025, but only 28% simultaneously advanced across security, equity and sustainability, reflecting uneven progress. **Sweden, Finland and Denmark** retained the top three ranks, reflecting strong infrastructure, diverse low-carbon energy systems and long-term policy stability. **China's** rank reached an all-time high of 12th place, driven by strong innovation capacity and the world's largest clean energy investment volumes. The **US** ranked 17th, due in large part to strong security and improved sustainability. **India** advanced in energy efficiency and investment capacity.

Regional dynamics reinforce the multi-speed nature of the transition.

Emerging Europe and emerging Asia led regional improvements in transition readiness, but through distinct pathways. Emerging Europe advanced most in infrastructure (+8.3%) and education (+5.8%), while emerging Asia saw gains from investment (+18.7%) and regulations (+2.6%). Meanwhile, regions like Sub-Saharan Africa improved through stronger political commitment and financial flows – reinforcing the multi-speed nature of transition readiness.

Global energy systems are under growing pressure from climate, geopolitical and technological disruptions. Geopolitical and economic uncertainties, such as rising trade tariffs, have highlighted vulnerabilities in supply chains. These factors could create investment risks and shift government focus towards more immediate priorities, slowing progress moving forward.

Adaptive, locally tailored solutions will be crucial for scaling clean energy while ensuring resilience and affordability. Accelerating innovation will be essential, including by fully harnessing the performance opportunities enabled through AI, energy efficiency, clean fuels, storage, smart grids and other methods.

Five priorities stand out for building resilience:

① Adopt stable, adaptive policy frameworks to attract long-term capital and cultivate cooperation.

② Modernize energy infrastructure – especially grids, storage and interconnectors.

③ Invest in skilled talent to help boost innovation and execution capacity.

④ Accelerate clean technology commercialization, especially in hard-to-abate sectors.

⑤ Enhance capital investment in developing economies.

While momentum is improving, many systems remain vulnerable – reinforcing the need to align near-term gains with long-term readiness.

Introduction

Amid rising disruption, energy transition progress remains uneven, necessitating adaptive strategies, targeted investment and redefined energy security.

The **Energy Transition Index** (ETI) provides a data-driven framework to assess how 118 countries are positioned to navigate the evolving energy landscape. It measures both **system performance** (security, equity and sustainability outcomes) and **transition readiness** (enablers of progress including infrastructure, policy and capital). This year's results showed a modest recovery, driven by improved access and rising clean energy adoption. Yet, progress on long-term enablers – such as infrastructure, regulation and investment – slowed, exposing persistent vulnerabilities in system resilience and the capacity for future scaling.

Amid rising geopolitical, financial and climate pressures, the energy transition is being influenced by competing priorities. While momentum has slowed in some regions, political commitment remains active in others. In this context, a fact-based assessment is critical to tracking where transition efforts are delivering progress and where momentum could stall.

In 2025, the imperative to accelerate energy transition efforts is not just about meeting long-term climate targets – increasingly, it's about managing a growing set of interconnected risks to national security, economic stability and social resilience.

The past year underscored the scale and complexity of this challenge. Notably, **2024 was the hottest year on record**, testing energy systems under extreme conditions. Conflicts in Europe, the Middle East and Africa disrupted supply chains and heightened global uncertainty. Energy demand grew by **2.2%** (the fastest pace in a decade), driven by climate shocks that increased cooling needs, electrification and the rapid expansion of artificial intelligence (AI). It's projected that data centres alone will account for 10% of global power demand growth by 2030. Yet, global energy efficiency progress stagnated, with primary energy intensity improving by just 1%. Meanwhile, emissions climbed to a new high of 37.8 billion tonnes, according to the International Energy Agency's *Global Energy Review 2025* – underscoring the widening gap between ambition and delivery.

This highlights the urgent need to reduce emissions more aggressively and "bend the curve". While the expansion of renewables is accelerating, increasing global demand ensures that fossil fuels remain deeply entrenched in energy systems. To address this, energy efficiency – offering both immediate economic, energy security and environmental benefits – must be prioritized in transition strategies.

Amid these disruptions, the global energy mix is shifting in new directions. Liquified natural gas (LNG) demand has surged in Asia and Europe, and nuclear power is regaining momentum. This is largely attributable to China's rapid expansion as well as many countries' strong interest in small modular reactors (SMRs). Digital infrastructure and the growing share of intermittent production are placing new pressures on grids. **Clean energy investment surpassed $2 trillion in 2024**, doubling from 2020 levels and supporting over 16 million jobs with technological innovations that are rapidly progressing in areas like energy storage and electromobility. For a growing number of businesses and governments, clean energy is no longer just a climate imperative – it is a driver of industrial opportunity and future competitiveness.

Electricity systems reached a new high of 49% clean energy share, reflecting strong progress in power sector decarbonization. Yet, the average clean energy share in the overall primary energy mix remains just 14.8%, underscoring slower progress in heating, transport and industry. At the same time, annual clean energy investment growth slowed to 11% (down from 24-29% in recent years), raising concerns about future momentum.

Meanwhile, monetary tightening, persistent inflation and a shift towards economic protectionism have increased the cost of capital, particularly in emerging markets. **The World Trade Organization (WTO) expects global merchandise trade to contract by 0.2% in 2025**, reversing earlier growth forecasts and reflecting the broader shift towards economic fragmentation and more localized supply chains. Countries are exerting tightened control over critical energy materials – such as lithium, cobalt and rare earths – in response to geopolitical uncertainty. Reinforcing these pressures, the International Monetary Fund (IMF) downgraded its global growth forecast, citing inflation, fiscal strain and geopolitical fragmentation as key reasons. Financing costs in emerging economies remain up to seven times higher than in advanced markets, exacerbating a **$2.2 trillion annual investment gap** for clean energy.

Amid state-armed conflict, extreme weather events and geoeconomic confrontation – highlighted as top global risks in the World Economic Forum's *Global Risks Report 2025 20th Edition* – energy security and industrial competitiveness have become central national priorities. Countries are increasingly focused on securing and localizing clean energy supply chains, safeguarding critical resources and harnessing energy transition efforts as strategic advantages in the face of growing geopolitical and trade-related challenges. Concurrently, the escalating nexus of extreme weather, geopolitical strategy and transition goals is driving a rethinking of energy security frameworks – not just at the national level, but also within sub-national systems. This shifting landscape is transforming how nations approach resilience, reliability and regional cooperation for future energy systems.

The transition remains **multi-speed and uneven**. **Advanced economies**, led by the Nordics, continued to top the ETI rankings, supported by diversified energy systems and institutional strength – but faced challenges with grid congestion, high prices and delivery bottlenecks. Notably, Nigeria made strong progress, rising from 109th place in 2016 to 61st in 2025 – driven by improvements in financial investments and infrastructure. **Latvia and the United Arab Emirates** posted some of the fastest score gains, demonstrating the power of clean energy adoption and targeted reforms. **China** reached fifth globally in **transition readiness**, largely due to its innovation ecosystem and recent political commitments, including an economy-wide emissions reduction plan. **Japan** combined world-leading energy access and strong innovation with renewed momentum through updated emissions targets. The US led in energy security, while **India** advanced in energy efficiency and investment capacity.

While 77 of 118 countries improved their scores in 2025, the share of countries advancing across all three energy dimensions was only 28%, highlighting that the majority still progressed unevenly. These disparities were mirrored in global capital flows: over **80% of energy demand growth** came from emerging and developing economies, but **more than 90% of clean energy investment since 2021** was seen in advanced economies and China, revealing a misalignment between capital flows and future demand.

As countries prepare for a more fragmented and volatile energy future, three system-level priorities are emerging:

① **Energy security redefined**: Beyond affordability and supply diversity, security now includes grid resilience, critical minerals access, energy efficiency and digital infrastructure vulnerability.

② **Investment where it matters most**: Addressing the capital imbalance is vital. Without stronger financial mechanisms in emerging markets supported by effective policy environments, national and global transition goals will fall out of reach.

③ **Infrastructure as a limiting factor**: Constraints have shifted from technology to delivery. Grid capacity, permitting processes and workforce readiness are now some of the most decisive levers of progress.

Looking ahead, success will depend not just on accelerating ambition but aligning it with delivery capability. The 2025 ETI highlights that momentum is rebuilding – but, to ensure a sustainable transition, plans must translate into tangible projects, and commitments into capital. That will require **stable regulation, credible pipelines and supportive ecosystems** that can scale solutions where they are needed most.

There is no single path forward. Countries have different starting points, capacities and constraints. While global coordination sets direction, **effective execution will depend on adaptive, context-specific approaches**. Aligning national transitions with shared global goals relies on grounded strategies that reflect local realities, because, in an increasingly volatile world, resilience and adaptability will determine success. Cooperation across national borders remains vital to energy security, equity and sustainability.

1 About the ETI

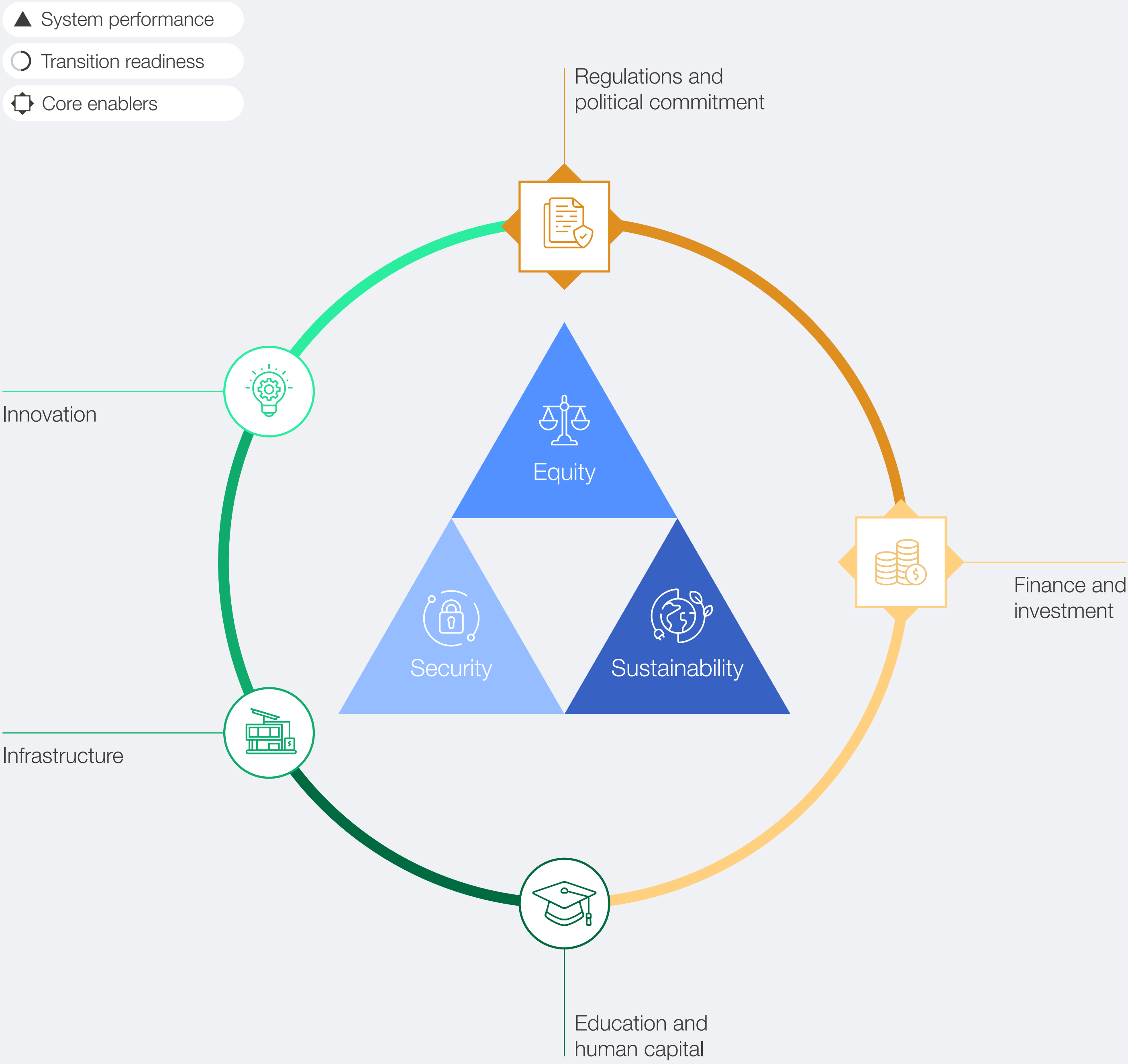
The ETI 2025 offers a comparative framework with which to assess national energy systems and track energy transition progress.

Decision-makers face two key questions in the energy transition: what is needed to accelerate improvements in national energy systems, and how can the right enablers be put in place to support these improvements? Answering these questions requires a clear and transparent fact base to help navigate the complexities of the energy transition effectively.

The ETI builds on 15 years of country-level benchmarking at the World Economic Forum, offering a data-driven framework to assess the performance and readiness of global energy systems in the transition. Covering 118 countries, the ETI evaluates current energy system performance in terms of security, equity and sustainability, as well as five readiness factors (Figure 1).

A country's final ETI score is a weighted composite of two sub-indices: system performance (60%) and transition readiness (40%). System performance is evenly distributed across equity, security and sustainability dimensions, while transition readiness is divided into two categories: core enablers and enabling factors. Core enablers include regulation and political commitment as well as finance and investment, while enabling factors encompass innovation, infrastructure and education and human capital.

FIGURE 1 **ETI framework**



Source: World Economic Forum.

The evaluation of a country's energy system performance is centred on **three key imperatives of the energy triangle**:

- **Security**: ensuring a stable and resilient energy supply through diversification (across the energy mix, trade partners and electricity generation sources), grid and power supply reliability, and robust infrastructure to enhance adaptability to external shocks
- **Equity**: ensuring access to energy for all (consumers and industries), energy affordability and price stability while supporting economic growth and development
- **Sustainability**: advancing the environmental performance of energy systems to support a low-emissions, resource-efficient, clean-energy future by reducing carbon dioxide (CO_2) and methane (CH_4) intensity, improving energy efficiency, lowering per-capita energy and emissions footprints and increasing the share of clean energy in final demand through balanced demand- and supply-side measures

A country's energy transition progress also depends on its transition readiness – the ability to establish a strong enabling environment for the transition. Transition readiness is driven by the following core enablers:

- **Regulations and political commitment**: creating robust policies and regulations that are essential for cultivating a competitive energy transition
- **Infrastructure**: ensuring the physical and digital infrastructure is robust enough to support the transition to a low-carbon economy
- **Education and human capital**: developing a skilled workforce capable of meeting the demands of the emerging clean energy sector
- **Innovation**: developing cutting-edge technologies in energy systems, essential for sustainability and security
- **Finance and investment**: ensuring a sustainable financial ecosystem that can attract investments at scale to support energy transformation

As part of the ETI, countries were assessed using 43 indicators that captured key aspects of the energy transition across the three key imperatives of equity, security and sustainability, as well as the transition readiness dimensions. The data was sourced from many different organizations, with emphasis on ensuring data quality through relevance, coverage, comparability, recency and quality of sources.

ETI scores use a 0-100 scale, with 100 representing the highest global performance for each indicator and index component. Results reflect the latest available data at the time of collection. Combined with index improvements, these changes reduced the comparability of the 2025 ETI with previously published editions. Moreover, while no index can fully mirror all the factors and complex realities impacting energy systems and transitions, the ETI scores aim to reflect both performance and contextual circumstances. Also, external factors – such as commodity market fluctuations, geopolitics, international climate action and financial market conditions – influenced certain dimensions of a country's score. As such, scores should be interpreted as a reflection of both performance outcomes and enabling conditions, and viewed in the context of each country's structural realities rather than as an absolute ranking of transition progress (Box 1).

Further details on the methodology are available in the appendix.

BOX 1 Key terms of the ETI methodology

Score reference	System performance score	Transition readiness score	Global and regional averages
All scores in this report (from individual indicators to the overall index) are based on a 0 to 100 scale, with 100 being the highest possible value. Scores reflect the most recent data and updates available at the time of production.	This score reflects how a country's energy system was performing in terms of security, equity and sustainability, using 23 indicators to give an overall picture.	This score reflects countries' preparedness to support future energy needs, using 20 indicators assessing enabling factors such as regulation, infrastructure, capital and investment environment, human capital and innovation capacity.	References to global, regional or overall scores for the index or its components refer to the simple average of all country scores – not adjusted for size, gross domestic product (GDP) or population unless noted.

2

Overall results

The ETI signals a modest but broad-based recovery in energy transition progress – yet major questions remain about this trend's durability.

2.1 Transition scores

BOX 2 Transition scores – key takeaways

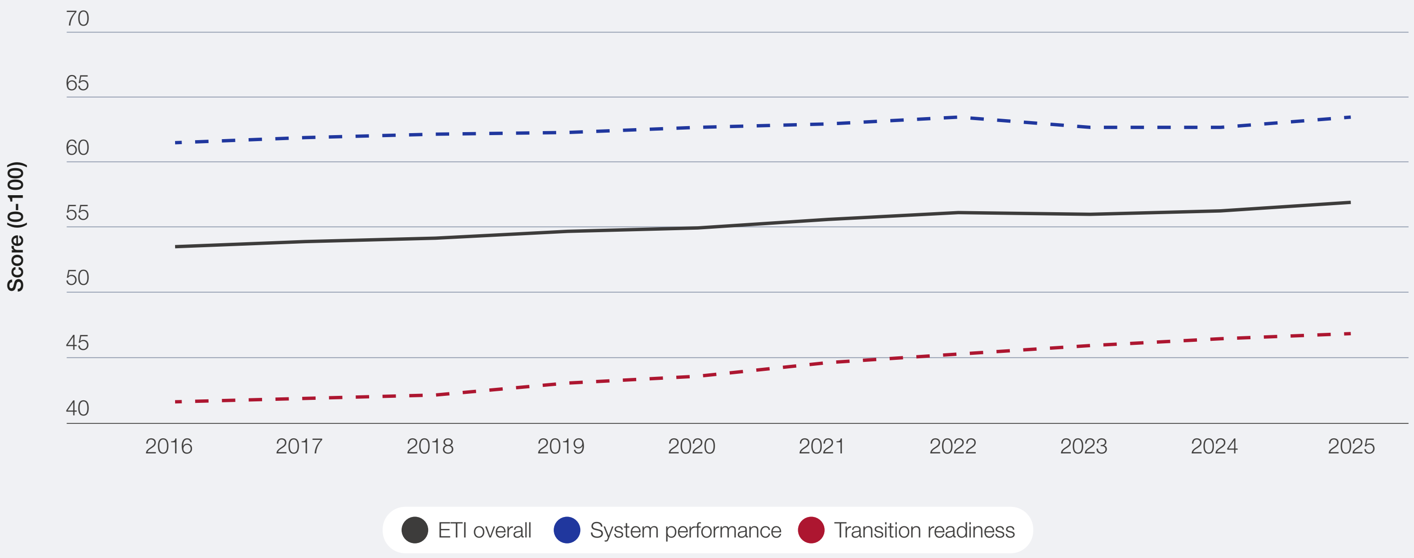
After several years of slow momentum, overall ETI scores in 2025 improved – +1.1% year-on-year (y-o-y) – by more than double the average rate of the past three years (+0.4%), reflecting the accelerating recovery in energy transition progress.

Energy system performance improved. After recent declines, average system performance rose by 1.2% y-o-y in 2025 – returning to 2022 level.

There was slower improvement in the enablers for the transition. In 2025, transition readiness rose by just 0.8% y-o-y – less than its 10-year average of 1.2% and notably slower than system performance, which outpaced readiness growth for the first time in recent years.

Momentum is real – but its resilience remains uncertain. The 2025 rebound is encouraging, but fallout from recent geopolitical and economic shocks may still lie ahead, raising questions about the durability of recent gains and the strength of global energy systems.

FIGURE 2 Global average ETI and sub-index scores, 2016-2025

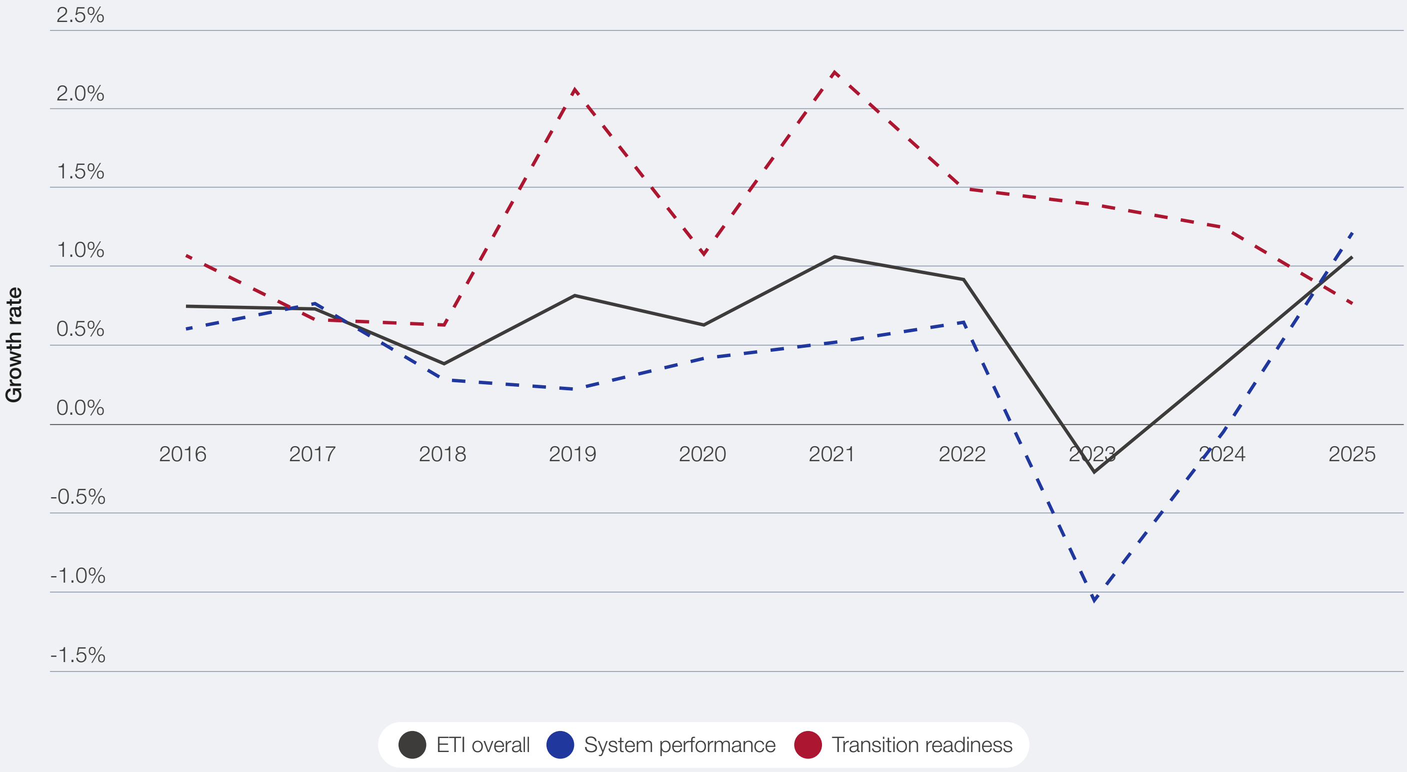


Source: World Economic Forum.

Energy system performance improved. After recent declines, average system performance scores rose by 1.2% y-o-y in 2025 – its fastest recovery in a decade – returning to 2022 levels. Much of this recovery was a result of greater equity dimension scores (+2.2% y-o-y), reflecting easing energy prices and structural subsidy reforms in many countries. Average sustainability scores also improved (+1.2% y-o-y), highlighting lower energy and emissions intensities and clean energy's increased share of energy consumption. Nevertheless, global energy prices remained elevated. Meanwhile, system security average scores remained below recent levels, marginally improving in 2025 (+0.4% y-o-y), indicating persistent vulnerabilities in energy supply flexibility and diversity.

Progress on transition readiness slowed. In 2025, transition readiness rose by just 0.8% y-o-y, falling below its 10-year average of 1.2% and marking the first time since 2017 that system performance (+1.2%) outpaced preparedness. While past gains in regulation, infrastructure, innovation, education and investment have underpinned long-term progress, recent momentum has weakened. Regulatory frameworks, innovation ecosystems and investment capacity showed signs of stagnation, and, in some regions, a diminished rule of law further undermined policy effectiveness. This is relevant as improvements in readiness typically precede gains in performance. If readiness continues to lag, future progress in energy security, equity and sustainability could be at risk.

FIGURE 3 | Global average ETI and sub-index growth rates, 2016-2025



Source: World Economic Forum.

Momentum is real – but exposed to disruption. While 2025 marked a strong rebound in ETI scores, underlying vulnerabilities persisted. The full economic and geopolitical impact of 2024 has yet to materialize – and may trigger second-order effects that stall or reverse progress. Rising tariffs, volatile capital markets and mounting fiscal pressures are already delaying infrastructure investment and increasing the cost of long-term financing. Public funds may be redirected to near-term economic stabilization, defence or social priorities – potentially crowding out investment in clean energy, innovation and grid resilience. These shifts risk widening transition gaps and weakening the durability of current gains.

This uncertainty is underscored by the developments that have shaped the energy landscape (Box 3).

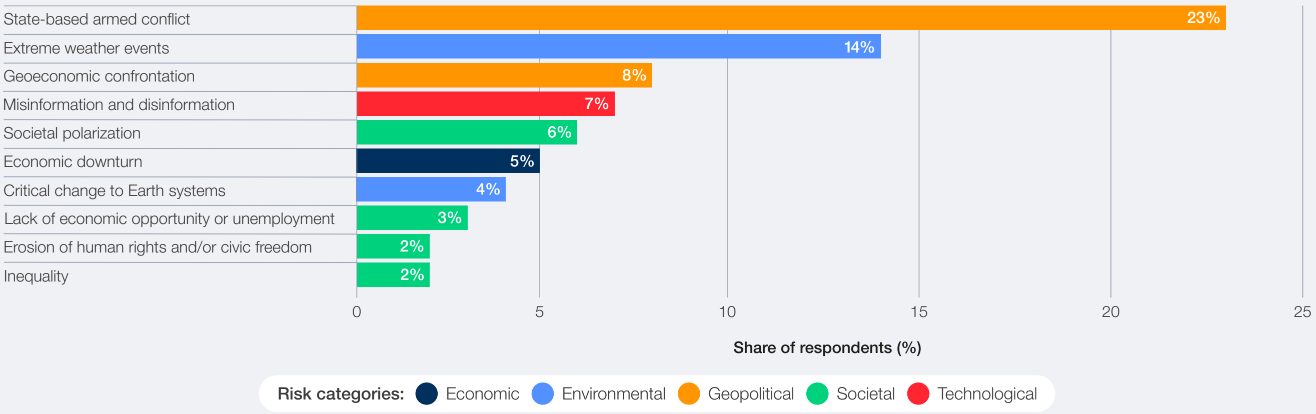
BOX 3 | The global energy landscape, 2024-2025

The events of 2024 set the tone for a turbulent energy landscape in 2025. A confluence of geopolitical, economic and technological disruptions exposed key vulnerabilities in global systems – heightening the urgency of securing more resilient, adaptive energy strategies:

- **Geopolitical tensions intensified**: Conflicts in key regions – including Europe, the Middle East and Africa – reinforced a global sense of fragility. State-based conflict was ranked as the top global risk in the World Economic Forum's *Global Risks Report 2025*, reflecting a sharp rise in concerns around geopolitical fragmentation, proxy wars and terrorism.[1]
- **Conflicts over trade increased**: Closely linked was the growing threat of geoeconomic confrontation, including the use of sanctions, tariffs and investment screening – now ranked as the third most pressing global risk, directly after extreme weather events.[2]
- **Supply chain disruption continued**: These tensions deepened supply chain disruptions – driven by trade restrictions, resource nationalism and economic decoupling – exposing vulnerabilities in energy markets and limiting access to critical materials for renewables, batteries and grids.

According to the World Economic Forum's *Global Risks Report 2025*, the following factors are likely to present a material risk on a global scale in the year 2025 (see graph below).

World Economic Forum's global risks factors



Source: World Economic Forum. (2025). *The Global Risks Report 2025 20th Edition.*

- **Global energy demand surged**: Global energy demand surged by 2.2%, well above the decade's average, driven by record electricity use caused by heatwaves, electrification[3] and data centre growth. Most new demand was met by renewables and natural gas, deepening energy security risks for importers and boosting revenues for exporters.
- **CO_2 emissions hit an all-time high**: The emissions impact in 2024 – the hottest year on record[4] – was also notable. Global energy-related CO_2 emissions rose by 0.8% to 37.8 billion tonnes.[5] While emissions continued to grow, the rate of increase slowed relative to previous years – even as the global economy expanded by 3%,[6] and energy demand reached record levels (up 2.2%).
- **Energy prices eased but remain volatile**: Prices declined from 2023 highs. This was largely driven by falling global energy commodity prices, although regional market factors led to diverging trends. However, in most regions, prices remained well above pre-COVID-19 pandemic levels, and underlying volatility persisted due to ongoing demand pressures and supply-side uncertainties.
- **Monetary dynamics constrained investments**: While short-term rates fell, long-term capital remained expensive due to inflation and sovereign debt stress, especially in emerging markets.
- **Digital expansion reshaped energy consumption**: The AI market size surged in 2024 (+35% y-o-y),[7] and it's projected that data centres will account for 10% of global power demand growth by 2030.[8] While their aggregate impact is still moderate, energy demand from AI and data infrastructure is expected to be highly concentrated in certain countries – such as Ireland and parts of the US[9] – underscoring the urgency of localized grid upgrades and clean energy expansion.

In 2025, investor confidence faces renewed pressures amid mounting global volatility. As of 21 May 2025 the US continues to enforce a 10% universal tariff[10] alongside elevated "reciprocal" tariffs on 57 countries.[11] Combined with an evolving global trade landscape and broader fragmentation, these measures are amplifying market uncertainty, reshaping supply chains and raising capital risk premiums. Capital markets remain highly sensitive to inflation, fiscal stress and geopolitical tensions – potentially slowing corporate capital expenditure (CapEx), delaying clean technology deployment and increasing the cost of capital for long-horizon energy investments. Higher input prices, increased investments in defence and trade disruptions are also forcing fiscal trade-offs, which may impact public investment in clean infrastructure, digital transformation and innovation. Reflecting this turbulence, in April 2025, the IMF revised its global growth forecast for 2025 from 3.3% down to 2.8%, with similarly muted expectations for the Eurozone (0.8%), underlining the weakening macroeconomic backdrop for energy transition investment.

This evolving landscape raises urgent questions about the resilience of energy systems – particularly energy security and the adaptability of policy frameworks. The following analysis of sub-index trends and country-level performance explore this in detail.

Source: World Economic Forum.

2.2 Country trends and regional insights

BOX 4

Country trends and regional insights – key takeaways

The global energy transition is regaining momentum, but progress remains uneven. In 2025, 65% of countries improved their ETI scores, but only 28% advanced across all three dimensions – security, equity and sustainability – reinforcing the need to strengthen all sides of the energy triangle.

Top performers remain stable, but new frontrunners are emerging. European countries dominated the top 10, but momentum is building elsewhere. China and the US improved their scores, while Latvia, Nigeria and the United Arab Emirates showed how targeted reforms can drive rapid progress.

Readiness is key to lasting transition leadership. High performers outscored major economies by over seven points (with the largest gaps in human capital, infrastructure and regulation).

The transition is multi-speed and shaped by local realities. Emerging Europe led in pace, emerging Asia in investment and Middle East, North Africa and Pakistan in equity – showing there's no single path to progress.

Source: World Economic Forum.

Table 1 shows the overall rankings of countries in the 2025 ETI.[12] While average global scores recovered from recent stagnation, the rankings highlight diverging country trajectories in both system performance and transition readiness.

Some countries continue to consolidate their leadership through consistent policy commitment, renewable energy investment and other measures, while others face setbacks due to either structural gaps or external shocks.

TABLE 1 ETI ranking table 2025

Rank	Country	ETI score (2016-2025)	2025 ETI score	SP[1] ('25)	TR[2] ('25)
1	Sweden		77.5	77.0	78.1
2	Finland		71.8	72.7	70.5
3	Denmark		71.6	70.3	73.7
4	Norway		71.5	75.6	65.3
5	Switzerland		71.0	71.4	70.3
6	Austria		70.6	70.2	71.1
7	Latvia		69.4	70.6	67.6
8	Netherlands		69.2	65.6	74.7
9	Germany		68.8	66.7	71.9
10	Portugal		68.6	70.1	66.4
11	Estonia		68.0	71.8	62.3
12	China		67.5	65.1	71.3
13	Iceland		67.3	70.4	62.6
14	France		67.1	70.3	62.4
15	Brazil		67.0	69.9	62.6
16	UK		66.8	68.4	64.5
17	US		66.8	65.8	68.2
18	Spain		66.6	68.6	63.6
19	Lithuania		66.6	65.9	67.6
20	Israel		66.1	72.2	56.9
21	Chile		65.7	72.0	56.2
22	Slovenia		65.4	69.7	59.0
23	Hungary		65.4	70.0	58.5
24	New Zealand		64.9	70.9	55.9
25	Japan		64.9	66.8	62.0
26	Croatia		64.6	69.6	57.3
27	Greece		64.6	62.6	67.8
28	Belgium		64.0	63.8	64.3
29	Bulgaria		63.7	65.6	60.9
30	Romania		63.7	69.8	54.6
31	Luxembourg		63.3	60.6	67.3
32	Australia		63.0	61.7	64.9
33	Canada		62.8	63.9	61.0
34	Republic of Korea		62.8	63.5	61.7
35	Uruguay		62.5	71.1	49.6
36	Italy		62.4	66.2	56.6
37	Albania		61.5	70.3	48.3
38	Colombia		61.3	67.5	52.0
39	Ireland		61.1	63.5	57.5
40	Czechia		61.1	66.4	53.1
41	Georgia		60.9	66.4	52.6
42	Azerbaijan		60.1	69.1	46.8
43	Poland		59.9	63.4	54.7
44	Costa Rica		59.9	69.5	45.6
45	Slovak Republic		59.8	66.3	50.0
46	Malta		58.8	68.9	43.6
47	Malaysia		58.7	67.5	45.4
48	United Arab Emirates		58.4	62.0	53.1
49	Viet Nam		58.1	66.6	45.2
50	Türkiye		57.9	63.5	49.5
51	Thailand		57.3	65.6	44.9
52	Singapore		57.0	55.9	58.6
53	Peru		56.9	68.3	39.6
54	Panama		56.2	66.8	40.4
55	Mexico		56.0	67.3	39.0
56	Ukraine		55.9	67.9	38.0
57	Argentina		55.6	68.3	36.6
58	Indonesia		55.5	66.8	38.7
59	Cyprus		55.1	58.8	49.5
60	Saudi Arabia		55.0	60.1	47.2
61	Nigeria		54.8	62.5	43.2
62	Tunisia		54.6	59.7	46.9
63	Jordan		54.5	58.9	47.9
64	Namibia		54.4	59.2	47.3
65	Armenia		54.3	63.2	40.8
66	North Macedonia		54.2	62.1	42.4
67	Sri Lanka		54.0	63.5	39.7
68	El Salvador		54.0	69.8	30.3
69	Mauritius		53.9	63.8	38.9
70	Morocco		53.7	58.6	46.4
71	India		53.3	60.4	42.7
72	Bosnia and Herzegovina		53.1	58.9	44.4
73	Cambodia		53.1	61.0	41.2
74	Egypt		53.1	65.9	33.8
75	Qatar		53.0	59.4	43.3
76	Philippines		53.0	62.1	39.3
77	Lebanon		52.9	60.5	41.5
78	Kyrgyz Republic		52.7	58.6	44.0
79	South Africa		52.6	55.2	48.9
80	Paraguay		52.6	66.8	31.4
81	Serbia		52.5	60.2	40.9
82	Oman		52.2	57.0	45.2
83	Montenegro		52.2	58.1	43.2
84	Republic of Moldova		52.1	62.1	37.0
85	Bolivia		51.9	67.4	28.8
86	Bangladesh		51.8	66.0	30.6
87	Ecuador		51.7	65.5	31.0
88	Kenya		50.7	60.9	35.5
89	Algeria		50.7	65.0	29.3
90	Cote d'Ivoire		50.5	62.3	32.7
91	Dominican Republic		50.4	57.6	39.6
92	Angola		50.4	65.7	27.4
93	Cameroon		50.4	63.4	30.8
94	Kazakhstan		50.3	58.8	37.5
95	Tajikistan		50.2	61.3	33.5
96	Gabon		49.8	62.5	30.8
97	Ghana		49.8	62.8	30.3
98	Lao PDR		49.6	54.0	43.0
99	Guatemala		48.7	61.4	29.7
100	Kuwait		48.6	57.7	35.1
101	Pakistan		48.5	55.5	38.1
102	Iran, Islamic Rep.		47.6	58.8	30.8
103	Brunei Darussalam		47.6	57.9	32.1
104	Nepal		47.5	55.1	36.2
105	Bahrain		47.2	54.3	36.6
106	Mozambique		47.1	56.1	33.6
107	Nicaragua		46.8	56.1	32.9
108	Honduras		46.5	57.5	30.0
109	Zambia		46.3	51.8	38.1
110	Senegal		46.1	56.3	30.7
111	Tanzania		46.0	57.3	29.1
112	Ethiopia		45.9	58.3	27.2
113	Zimbabwe		44.8	53.3	32.2
114	Jamaica		44.5	50.8	35.0
115	Mongolia		44.2	53.7	29.9
116	Trinidad and Tobago		44.0	55.2	27.0
117	Botswana		42.8	49.4	32.8
118	Congo, Dem. Rep.		42.4	50.3	30.4

● Emerging Europe
● Middle East, North Africa and Pakistan
● Sub-Saharan Africa
● Latin America and the Caribbean
● Advanced economies
● Emerging Asia

ETI score 2016 ○—● 2025

---- 2025 global average (56.9)

1. System performance 2025; **2.** Transition readiness 2025;
Note: Refer to the Appendices section for details on updates and modifications to the methodology.
Source: World Economic Forum.

> In emerging Europe, Latvia (the region's leader) posted strong gains, while Bosnia and Herzegovina showed impressive momentum, helping the region achieve the highest score increase.

In 2025, 77 out of 118 countries (65%) recorded an increase in their overall ETI scores, with an average gain of 1.1% – signalling a broad, though uneven, recovery in transition momentum. In total, 38%[13] of countries recorded their strongest improvement in the dimension where they had previously scored lowest, potentially reflecting targeted efforts to close structural gaps. Meanwhile, only 28% of countries achieved gains across all three dimensions of the energy trilemma – underscoring how the transition is increasingly multi-speed and multidimensional, shaped by varying national priorities, capabilities and starting points.

Advanced economies continued to lead the rankings, accounting for 16 of the top 20 performers. The Nordics – Sweden, Finland, Denmark and Norway – retained the top positions, reflecting high performance across energy diversification, clean energy adoption, strong policy frameworks and reliable infrastructure. Sweden remained the top performer, with consistently strong scores across all three system dimensions – equitability, security and sustainability. Switzerland maintained its place in the top five while Norway re-entered the **top five** tier, highlighting renewed momentum in its energy transition efforts. Nevertheless, the highest-ranked countries showed room for improvement, as progress slowed in some cases.

Major economies showed selective gains with potential to lead. China led emerging Asia, with a 2.2% y-o-y ETI score gain and the fifth-highest transition readiness score globally – driven by strong innovation ecosystems and financial capacity. The US grew its score by 0.6% y-o-y and topped the security dimension, supported by supply diversity and robust infrastructure. India advanced in energy intensity, CH_4 emissions and regulations and financial investments. Brazil led Latin America with steady progress in clean energy adoption and improved equity. Saudi Arabia, the second-best scorer in the Middle East, North Africa and Pakistan region, improved in security and was the country that improved the fastest in renewable capacity build-out.

Tailored reforms are accelerating progress across emerging Europe and emerging Asia. In emerging Europe, Latvia (the region's leader) posted strong gains, while Bosnia and Herzegovina showed impressive momentum, helping the region achieve the highest score increase in 2025 (+2.8% y-o-y) – particularly in infrastructure (+8.3%) and equity (+5.6%). In emerging Asia, China led the region's performance, backed by regulatory improvements and clean energy investment, while the Kyrgyz Republic demonstrated notable acceleration (+16.2%).

Latvia and the United Arab Emirates illustrate how focused policies can accelerate progress. Latvia entered the ETI top 10 for the first time, driven by a 7.9% y-o-y score increase supported by gains in equity, clean energy capital flows and renewable energy capacity buildout. Meanwhile the United Arab Emirates recorded the highest improvement in the Middle East (+7.9% y-o-y). This was enabled by targeted subsidy reforms,[14] rising clean energy shares, falling energy intensity and continued expansion of the Barakah Nuclear Power Plant – now supplying nearly 25% of the country's electricity.[15] Nigeria also stood out, with one of the fastest improvements in transition readiness (+36.8% y-o-y), driven by major advances in investment capacity, infrastructure and regulation.

These cases highlight how diverse countries can drive rapid gains through targeted, context-specific efforts.

Top performers

The highest-ranking countries on the ETI continue to demonstrate what effective and resilient energy transition pathways can look like. In 2025, the top 10 performers continued to consist predominantly of advanced economies, most notably from Northern and Western Europe.

While they represent a small share of global energy demand and emissions, collectively accounting for only 3% of energy-related CO_2 emissions, 4% of total energy supply, 2% of the global population and 9% of the global GDP, they provide valuable insights into long-term transition strategies (Table 2).

Despite their differences in geography and economic structure, they share five core enablers:

- **Clear and stable policy signals**: Governments provide long-term certainty through legally binding climate targets, national climate laws and regulatory frameworks that span sectors. Meanwhile, long-term roadmaps guide investment across sectors and tools like carbon pricing send strong market signals.

- **Highly diversified clean energy mix and efficiency as a strategic priority**: Countries rely more on renewables and nuclear, and less on fossil fuels, embedding energy efficiency in design and planning (e.g. district heating systems, low-energy buildings, smart metering).

- **Modern infrastructure for secure and flexible energy systems**: Governments strengthen energy resilience by modernizing grid infrastructure and integrating digital technologies – combining clean energy expansion with investments in flexibility, interconnection and storage.

- **Strong industrial strategy and high investment in clean technology**: Governments align climate ambition with economic strategy – combining green industrial policies with high public and private investment in innovation and commercialization of technologies like hydrogen, energy storage and smart grids.

- **Social trust and just transition architecture**: Environmental taxes are paired with strong welfare systems and fair access to clean technologies, ensuring sustained public support.

TABLE 2 **Top 10 performers in the ETI 2025**

Country	2025 ETI score	Structural strengths	Progress highlights 2025
Sweden	77.5	Clean energy mix (biofuels, nuclear, waste), strong regulation, market-based policies[16] and top-tier innovation ecosystem[17]	Continued to lead the ETI, driven by rising low-carbon technology advantages, effective carbon pricing through net carbon rates, low methane emissions, clean job growth, robust R&D investment and a top-ranked credit rating
Finland	71.8	Legally binding 2035 carbon neutrality target, sector-specific decarbonization plans[18] and strong nuclear/renewables energy mix[19]	Advanced with reduced fuel imports and led in grid reliability, with low transmission losses and minimal power interruptions
Denmark	71.6	Net zero by 2045,[20] backed by a comprehensive policy framework, diversified energy mix,[21] offshore wind leadership and hydrogen infrastructure expansion	Led in economic freedom, supported by open markets, transparent regulation and strong institutional frameworks
Norway	71.5	Clean power mix (hydro, wind),[22] robust, interconnected grid, high transport electrification and capital access via sovereign wealth fund[23]	Strengthened position with soaring renewable energy investment and world's lowest net energy imports, reflecting strong export capacity
Switzerland	71.0	Advanced regulatory architecture (CO_2 Act),[24] clean, balanced energy mix, and innovation hubs	Maintained performance with rising renewables and clean job growth, underpinned by world-leading carbon pricing
Austria	70.6	Strong public support for early climate neutrality (2040) and accelerating renewable deployment through integrated national energy and climate planning [26]	Climbed rankings with more clean energy jobs and led infrastructure with robust renewable capacity buildout
Latvia	69.4	Expanding renewable share,[27] modernization of grid infrastructure and synchronization of grids with Continental European Network[28]	Top improver with soaring clean investment (+973% y-o-y), lower fuel imports and leading low-carbon job share
Netherlands	69.2	Strong transmission infrastructure and substantial investments in (smart) grid modernization and hydrogen-ready networks[29]	Strengthened performance with a rise in renewable energy investments and declining reliance on gas imports
Germany	68.8	Sectoral net-zero targets, strong industrial policy and frameworks for hard-to-abate sectors,[30] and dedicated hydrogen infrastructure[31]	Maintained energy transition progress through expanded renewable capacity, ongoing coal phase-down and growing renewable energy investment
Portugal	68.6	Expanding renewable share (wind)[32] and major investments in grid,[33] hydrogen[34] and offshore wind development[35]	Improved performance with a cut in net fuel imports and greater affordability for industry

Source: World Economic Forum.

Large economies: influencing the pace and priorities of transition

The true test of the global energy transition lies with the world's five largest economies. While the ETI top 10 continue to offer strong examples of long-term leadership, it is the top five largest economies – China, the US, the EU, Japan and India – that will ultimately determine the pace and direction of the global energy transition due to their sheer size. Together, they account for around half of global GDP – measured in 2015 constant PPP (purchasing power parity) terms – population and total energy supply (TES), but nearly two-thirds of global emissions, giving them outsized influence through their consumption patterns, investment flows and policy choices.

Over the past decade, all five of these economies made progress in the energy transition (including above-average gains in sustainability). In particular, the US, EU and Japan made consistent gains in areas such as energy efficiency and emission intensity, and benefit from more mature regulatory regimes. Yet, the emerging markets of China and India experienced the greatest overall improvement, especially in increasing access to energy and strengthening transition readiness. While all of these economies will play a critical role in the future of the energy transition, they each have differing strengths and challenges (Table 3) that require varied approaches.

TABLE 3 **Top five largest economies in the ETI 2025**

Economy	2025 ETI score	Structural strengths	Structural challenges	2025 progress highlights
China	67.5	China showed high levels of readiness for the energy transition, backed by leading clean energy and industrial infrastructure, human capital, innovation and investment. The economy accounted for nearly 40% of the world's clean energy investment in 2024.	Despite the rapid expansion of renewable energy and clean energy technology diffusion, energy and emission intensity remained relatively high. Meanwhile, energy supply flexibility and diversity could be further strengthened to augment energy security.	China showed strong progress due to expanding renewable capacity and clean-energy technology production and diffusion. For the first time, the country's CO_2 emissions declined 1.6% y-o-y in the first quarter of 2025,[36] despite increasing energy demand.
US	66.8	The US is a world leader in energy security and equity thanks to an affordable, abundant and diverse energy supply, and relatively reliable grid infrastructure. The US' transition is also supported by favourable conditions for innovation, a skilled labour force, and deep and robust financial markets.	While the country has made significant progress, expanding clean energy use and reducing energy and emission intensity over the past decade, its energy efficiency and emission levels lag behind other major advanced economies.	The US showed continued gains in energy efficiency and an increasing share of clean energy, backed by expanding renewable energy capacity and low-carbon employment.
EU	65.5	Over 40% of member states scored in the top 20 of the 2025 ETI. The EU's lead in energy sustainability expanded over the past decade, with member states on average having lower energy intensity and CH_4 production, and greater clean energy shares than other major economies. The region's energy transition is supported by strong regulatory architecture, infrastructure, human and technological capital and financial markets.	Differences in economic development and transition readiness can lead to uneven transition progress among member countries. Moreover, despite recently easing prices and import diversity, energy affordability and import dependence remain critical equity and security challenges.	Easing energy prices improved affordability, while energy sustainability was supported by increased renewables capacity and the diffusion of renewable energy technology.
Japan	64.9	Favourable regulatory, innovation and financial ecosystems bolster readiness and clean energy technology diffusion and production, while energy security and equity are backed by reliable grid infrastructure and diverse electricity supply.	Over the past decade, Japan has experienced increased electricity and gas prices, and reduced energy supply flexibility. The country needs to continue to improve energy sustainability and expand the use of clean energy. It will be crucial to take action to reinvigorate the deployment and development of related technologies.	Recent declines in electricity and gas prices have eased affordability challenges, while increased use of clean energy and regulatory improvements have coincided with declining energy and emissions intensity.
India	55.3	Over the past decade, India made significant strides in increasing equity through greater access to energy and clean fuels, while also improving energy regulations and investment in renewable and other clean-energy technologies.	Continued improvement in grid reliability, energy access for rural areas and further reducing dependence on imported energy may enable further progress in energy security and equity. Further investment in infrastructure, renewables, labour force development and financing conditions could help boost the country's energy transition.	India made progress in lowering energy intensity and CH_4 emissions, creating more favourable energy regulations and increasing clean energy investments.

Note: EU score is based on the simple average of its 27 member states.
Country selection is based on GDP in purchasing power parity (PPP).

Source: World Economic Forum.

Regional trends

Average ETI scores varied significantly across regions, reflecting differences in energy demand profiles, institutional capacity and economic structure.

FIGURE 4 Regional performance snapshot

Advanced economies

65.8
Average ETI score

🌐 13%
🏭 31%
☁ 28%

Security	72.9
Equity	71.8
Sustainability	57.6

Continue to lead the global energy transition with strong innovation ecosystems, regulatory maturity and investment capacity. However, emerging political fragmentation and permitting delays are challenging execution speed.

Emerging Europe

59.4
Average ETI score

🌐 3%
🏭 3%
☁ 3%

Security	68.2
Equity	69.8
Sustainability	58.2

Fastest-growing region, with progress driven by price-related equity improvements, infrastructure upgrades and enhanced education systems.

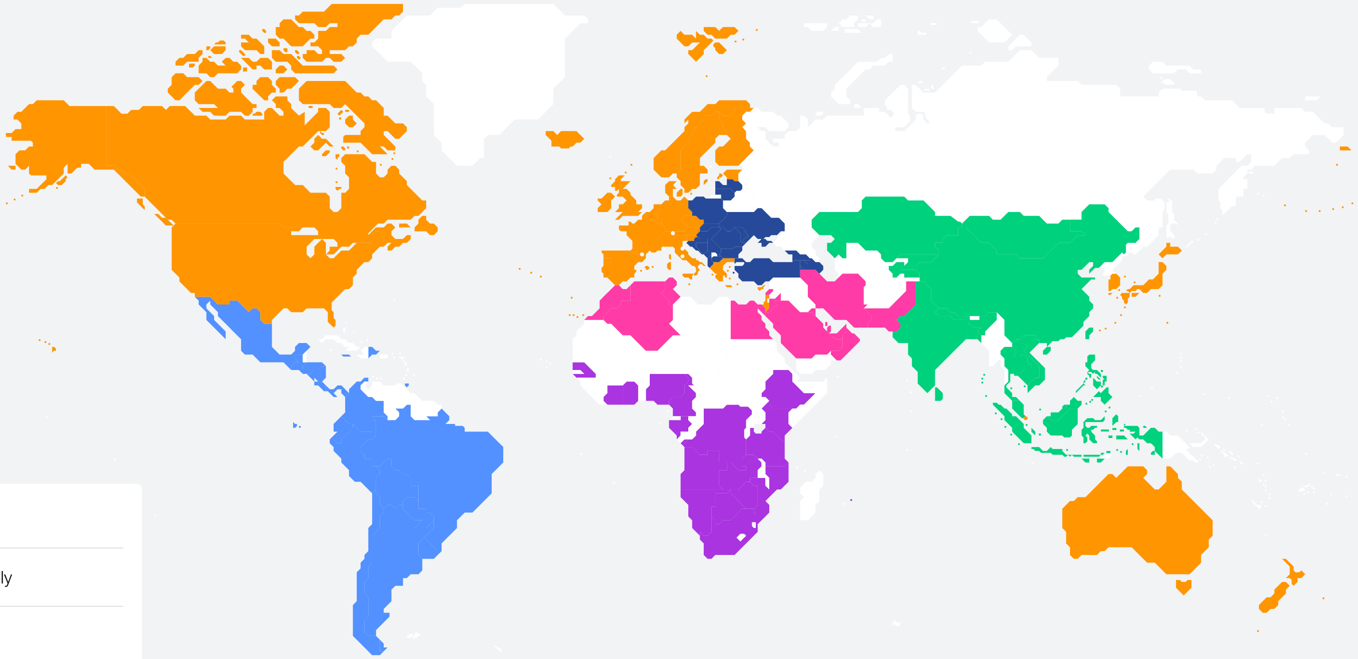
Emerging Asia

53.2
Average ETI score

🌐 46%
🏭 38%
☁ 44%

Security	64.8
Equity	63.9
Sustainability	55.5

Strong momentum is seen in transition readiness, driven by financial investment, regulation and equity. Persistent coal reliance and lack of diversification present challenges.



🌐 Percentage of global population
🏭 Percentage of global total energy supply
☁ Percentage of global CO$_2$ emissions

Latin America and the Caribbean

54.3
Average ETI score

🌐 7%
🏭 5%
☁ 4%

Security	66.4
Equity	64.9
Sustainability	62.8

High renewable penetration supports equity and sustainability, though institutional volatility and financing gaps for clean technology scale-up hinder broader progress.

Sub-Saharan Africa

48.8
Average ETI score

🌐 11%
🏭 3%
☁ 2%

Security	62.4
Equity	50.0
Sustainability	62.8

Gains are seen in rural electrification and regulatory commitment, though progress is uneven due to underinvestment, low access rates and institutional barriers.

Middle East, North Africa and Pakistan

52.1
Average ETI score

🌐 8%
🏭 7%
☁ 7%

Security	65.6
Equity	73.5
Sustainability	39.5

Progress is seen in solar and hydrogen, with equity improvements and political commitment. However, fossil fuel dependency and grid inflexibility remain major barriers.

Note: Data refers to the 118 countries covered by the 2025 ETI, energy supply and emissions data is for the year 2022, and population data is for 2023.
Source: World Economic Forum; World Bank; International Energy Agency.

TABLE 4 **Regional strengths and challenges in the energy transition**

Regions	Strengths	Challenges
Advanced economies	– Strong political commitment and institutional capacity – Access to capital and advanced innovation ecosystems	– Political uncertainty and cost-of-living pressures – Ageing infrastructure and electricity grid stability
Emerging Asia	– Rapid growth in renewable energy investment – Strong industrial policy momentum	– Energy supply insecurity, especially in South-East Asia – Continued reliance on coal markets
Emerging Europe	– Expanding renewables base, clean technology supply chain potential – Conducive policies, EU integration and regional cooperation	– Continued reliance on coal in large markets – Limited financing capacities in select markets and skills gaps due to legacy brown industries
Latin America and the Caribbean	– High renewables share, strong hydro and solar potential – Industrializing economies with leapfrogging potential and young, well-educated populations	– Regulatory and institutional instability and low inclusion – Financing and technology access constraints (limited innovation capacity)
Middle East, North Africa and Pakistan	– Abundant renewables potential, including hydrogen and infrastructure – High fiscal capacities, strong industrial base and clean-energy-driven diversification	– Limited grid flexibility and water-energy nexus risks – Fossil fuel legacy/dependence, subsidy reliance and labour market gaps
Sub-Saharan Africa	– Abundant, well-distributed potential for renewables – Opportunities for leapfrogging fossil-fuel-based growth with distributed energy	– Low energy and clean cooking access/electrification rates – Underinvestment, weak institutions and limited quality education

Source: World Economic Forum (2025). *Accelerating an Equitable Transition: A Data-Driven Approach*.

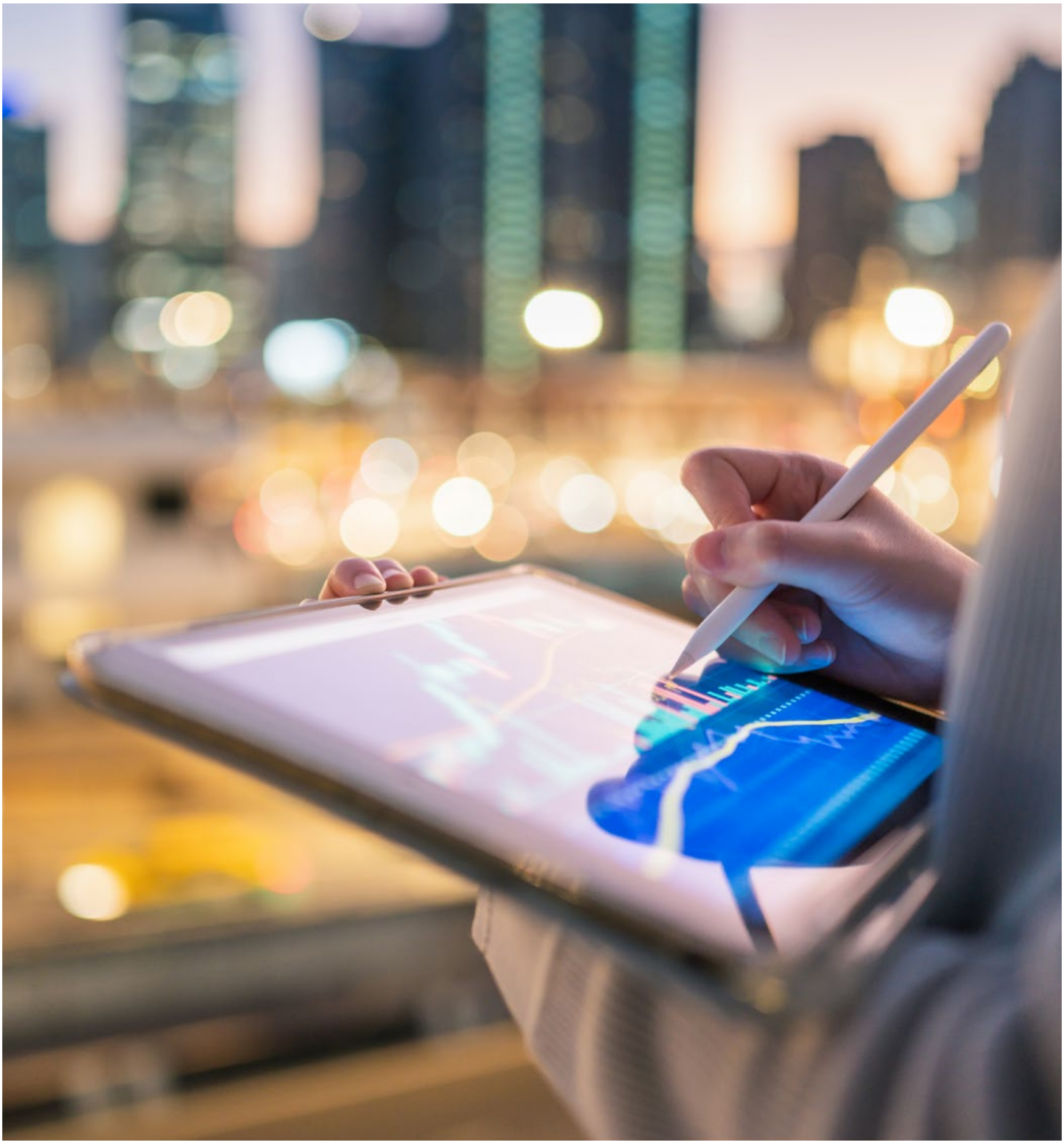
Regional dynamics – from fossil-fuel-rich economies in the Middle East to rapidly growing markets in Asia – underscore the diversity of transition pathways, challenges and enablers shaping the global energy landscape. These country-level and regional spotlights illustrate where momentum is accelerating, where persistent barriers remain and how both emerging and resource-rich economies are redefining their roles within the evolving energy system.

Collectively, these insights reinforce a critical shift: the energy transition will not follow a single, uniform path but will instead require context-specific strategies tailored to local strengths and limitations.

③

Sub-index and dimension trends

Equity rebounded, sustainability held steady, security stagnated and transition readiness slowed, highlighting uneven progress across energy systems.



3.1 System performance

BOX 5

System performance key takeaways

Energy system performance rebounded. 2025 saw improvements in security, equity and sustainability – signalling improved delivery after years of stagnation.

Price shifts and clean energy adoption enabled gains. On average, lower energy prices and subsidy reforms and greater rural access supported equity, while reduced energy and emission intensity and increased use of clean energy drove sustainability gains.

Structural weaknesses persisted. Import dependence, low grid flexibility and uneven infrastructure progress continued to expose systems to disruption.

Progress faces rising headwinds. Trade frictions, supply chain risks and policy uncertainty could stall momentum and deepen regional gaps.

Source: World Economic Forum.

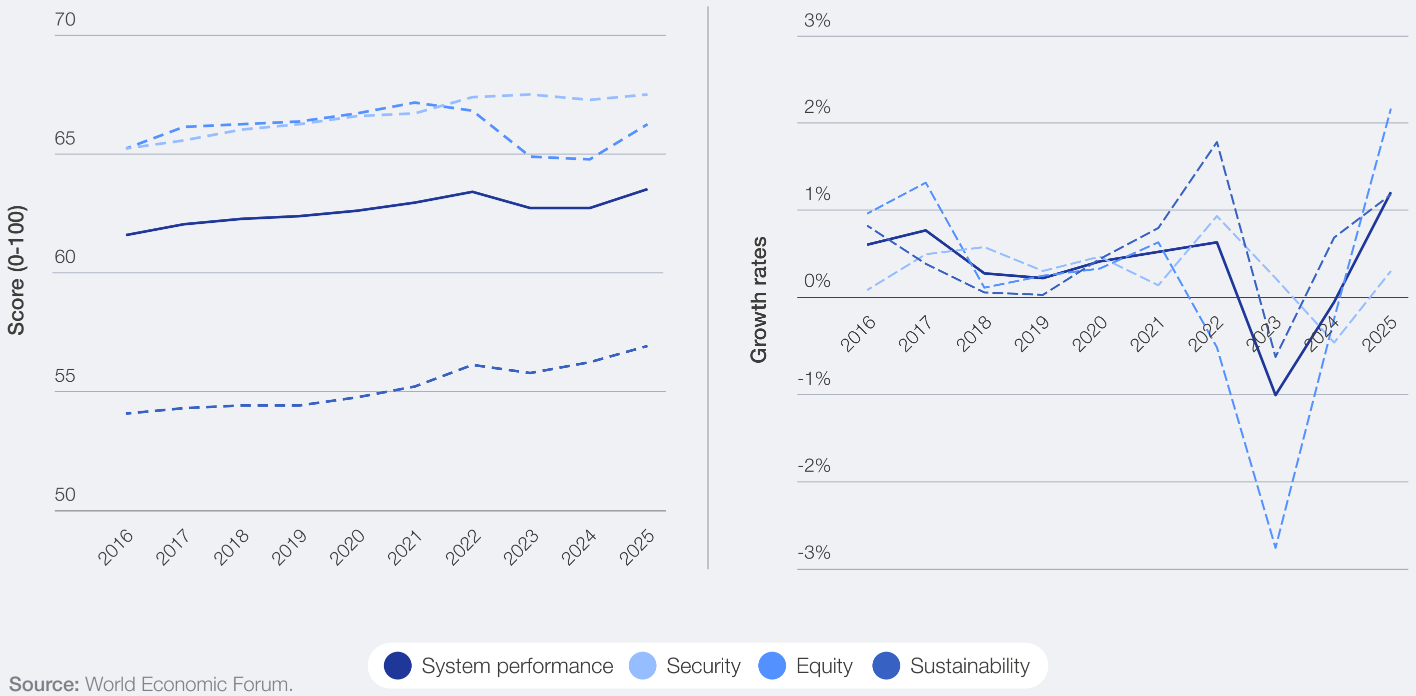
System performance measures how well a country's energy system delivers on the three key dimensions: equity, security and sustainability (Figure 5).

Over the last 10 years, **system performance** improved by 3.3%. Despite recent fluctuations driven by the COVID-19 pandemic, over the past decade, the energy system strengthened across all three underlying dimensions:

- **Equity** scores fluctuated slightly but ended up with only a marginal net increase (+1.5% from 65.1 in 2016 to 66.1 in 2025), highlighting ongoing equity challenges in many countries.
- **Security** scores improved slowly but consistently (+3.4% from 65.3 in 2016 to 67.5 this year), indicating that diversification and supply reliability remain high priorities but are difficult to advance quickly.
- **Sustainability** scores saw the strongest upward trend (+5.3%), driven by cleaner energy mixes and decreased energy and carbon intensity. Despite these gains, sustainability remained the lowest-scoring dimension, highlighting the long path ahead to climate-aligned energy systems.

FIGURE 5

Global average system performance and component performance, 2016-2025



Source: World Economic Forum.

Over the past decade, the security dimension saw modest improvement of 3.4%, marked by slow but steady progress in diversification and grid resilience.

Security

Energy security – the continuous availability of energy sources at a reasonable price – is a cornerstone of economic resilience and societal stability. Today, it requires not only reliability and diversification but also flexibility in order to manage volatility through demand responsiveness, interconnections and variable renewables. As digital systems like smart grids and AI-driven infrastructure expand, cyber resilience is also emerging as a critical dimension of energy security. The International Energy Agency (IEA)/UK Government Summit on the Future of Energy Security[37] reinforced this view, emphasizing the need for resilience, supply chain diversification and international cooperation. The summit's outcomes have been influential in shaping global energy security discussions and refreshing frameworks for energy security. The ETI's security dimension evaluates the reliability and resilience of energy systems.

Security over the past 10 years

Over the past decade, the security dimension saw modest improvement of 3.4%, marked by slow but steady progress in diversification and grid resilience, and reduced exposure to supply risks (Figure 6).

- Between **2016 and 2020**, security scores improved gradually, supported by moderate gains in electricity diversification and reductions in technical transmission and distribution losses.
- In **2021-2023**, progress stalled as the COVID-19 pandemic – combined with geopolitical instability, supply chain disruptions and rising energy demand – placed renewed pressure on energy systems.
- In **2024-2025**, scores recovered slightly by 0.4%, driven by a reduction in import dependence and greater diversification of energy sources, as well as continued investments in renewables and regional interconnections.

Despite the long-term improvement, key sub-indicators revealed underlying fragilities:

- Average energy import dependence scores declined in 2024 but rose again in 2025 (+1.9% y-o-y).
- Score of power system flexibility deteriorated (-1.3% y-o-y in 2025), suggesting that capacity to respond to demand shocks and variable supply was still insufficient.

FIGURE 6

Security dimension trend, 2016-2025

Source: World Economic Forum.

Security scores in 2025

Energy security scores improved slightly in 2025 (+0.4%) but remained the slowest-moving system performance dimension. Modest gains in electricity diversification (+0.8%) and grid integration were offset by declining system flexibility (-1.3%). Grid resilience was found to be under strain, particularly in fast-growing or import-reliant economies.

Regional divergence

Energy security dynamics varied significantly across regions, shaped by different energy mixes, import dependencies, diversification levels and levels of system resilience. While many advanced economies were found to be investing in digital grids and regional links, others faced setbacks from infrastructure gaps and external shocks. The recent large-scale blackouts in Spain and Portugal underscore that even developed markets remain vulnerable to grid instability. Without focused investment in storage, transmission and energy trade, the security gap may continue to grow. In 2025, regional energy security trends were shaped by changing import dynamics, infrastructure reliability and resilience investments (Table 5).

TABLE 5 **Security dimension regional overview, 2016-2025**

Geographic group	2025 average score	One-year trend	10-year trend	Key takeaways	Opportunities	Challenges
Advanced economies	72.9	0.0%	+1.0%	**Advanced economies** continued to lead, supported by diversified supply, robust infrastructure and low disruption levels, but progress plateaued as diversity of supply and flexibility lagged.	– Diversified energy supply routes and sources – High grid reliability and operational performance	– Structural reliance on energy imports, despite diversification – Ageing infrastructure posing long-term risks to system resilience
Emerging Asia	64.8	-0.6%	+5.5%	**Emerging Asia** slipped slightly as demand growth outpaced infrastructure capacity, straining system flexibility.	– Relatively high energy supply diversification	– Rising demand and import dependency – Grid congestion and low flexibility
Emerging Europe	68.2	+2.1%	+8.3%	**Emerging Europe** led security gains in 2025, supported by diversification, lower import reliance and increased grid flexibility.	– Broader diversity of energy import partners	– Persistent reliance on energy imports – Grid inefficiencies and ageing infrastructure
Latin America and the Caribbean	66.4	+0.3%	+0.2%	**Latin America and Caribbean** saw marginal gains, with resilience still constrained by often-unreliable grid infrastructure and substantial T&D losses.	– Stable power system reliability – Expanding diversification of energy sources	– High transmission and distribution (T&D) losses averaging 16%[38] – Declining flexibility in electrical system
Middle East, North Africa and Pakistan	65.6	-0.5%	+2.0%	**Middle East and North Africa** saw a slight dip in energy security due to declining grid flexibility and energy supply diversification.	– Strong domestic energy production in some countries – Limited reliance on energy imports	– Limited grid flexibility and infrastructure investment – Low diversification and grid inflexibility
Sub-Saharan Africa	62.4	+0.7%	+5.9%	**Sub-Saharan Africa** improved in diversification and resilience, but structural gaps in losses and reliability persist.	– Reliable supply in grid-connected areas – Import and energy mix diversification	– Limited infrastructure and grid reach – Persisting high and volatile T&D losses

Source: World Economic Forum.

TABLE 6 **Security frontrunners 2025**

Category	Country	Performance	Key takeaway
Dimension top scorer	US	81.7; +0.9% y-o-y	The US led in energy security due to its robust domestic production capacity, diversified fuel mix and strategic reserves. Major policy efforts – such as the Infrastructure Investment and Jobs Act and the Inflation Reduction Act (IRA)[39] – supported grid modernization, expanded transmission infrastructure and strengthened cybersecurity protections across the energy sector.
Most improved	Albania	62.8; +15.3% y-o-y	Albania boosted energy security through hydropower upgrades, regional interconnections and import diversification. Backed by EU investment and national reforms,[40] these efforts strengthened resilience and reduced reliance on weather-sensitive supply.

Source: World Economic Forum.

Looking ahead: reinforcing security through resilience and flexibility

Energy security will remain a central priority amid rising trade frictions, shifting alliances and surging digital demand. The rapid expansion of AI-driven data centres is straining grids and increasing power demand – potentially crowding out clean energy investments. In this context, security will increasingly depend not just on fuel or technology diversity, but on a system's adaptive capacity (i.e. its ability to absorb shocks and respond to disruptions).

To build resilience, countries must invest in flexible infrastructure, localized manufacturing and regional cooperation while ensuring access to critical technologies and materials. Future gains will depend on:

– **Modernizing and expanding grid infrastructure to support variable generation and system flexibility (e.g. storage, responsive demand)**

– **Strengthening transmission and distribution systems and interconnectivity**

– **Enhancing supply resilience through regional cooperation and resource diversification**

Achieving an equitable energy transition relies on securing affordable, reliable and clean energy access for all.

Equity

Achieving an equitable energy transition is critical for sustainable socioeconomic growth. To realize this, it's crucial to secure affordable, reliable and clean energy access for all while ensuring that benefits and costs are fairly distributed.

The ETI's equity dimension assesses energy system performance in terms of access, affordability and its role in economic development.

Equity over the past 10 years

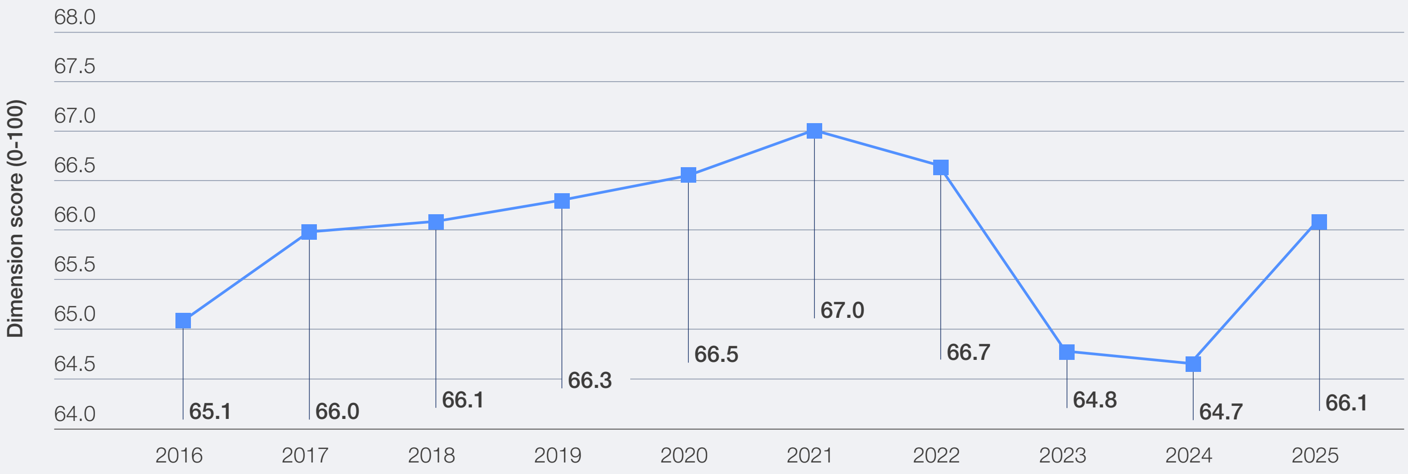
Over the past 10 years, the equity dimension saw a modest net improvement of 1.5%, with a mixed performance across the decade (Figure 7):

- Between **2016 and 2021**, equity improved gradually, reaching its peak in 2021, driven by expanded access to electricity and clean cooking technologies.
- This was followed by a decline from **2022 to 2024** caused by global energy price shocks and inflationary pressures, which pushed equity scores downwards.
- In **2025**, scores rebounded by 2.2%, reflecting easing energy prices and improved affordability, although equity remained slightly below the 2021 high.

Despite the recent recovery, the underlying indicators revealed persistent challenges:

- Energy prices (household and industrial) showed high volatility, limiting long-term equity gains.
- Gains in clean energy access continue, but are incremental rather than transformational.

FIGURE 7 **Equity dimension trend, 2016-2025**



Source: World Economic Forum.

Equity scores in 2025

The equity dimension recorded its strongest annual score improvement in the past decade in 2025 (+2.2%), driven by falling gas prices, reduced subsidies, greater energy self-sufficiency and tech-enabled efficiency gains. Future progress hinges on grid reliability, pricing reforms and low-carbon technology exports more than new connections, although some countries and regions still have major energy access challenges.

Rural access scores improved by 0.4%, yet regions like Sub-Saharan Africa and South Asia continued to face major infrastructure and equity barriers, slowing momentum towards Sustainable Development Goal (SDG) 7.1, which calls for universal access to affordable, reliable and modern energy services.[41] Clean cooking fuel access scores rose (+0.5%) as biomass reliance declined – improving health outcomes in rural areas. Yet, scaling this transition requires more than infrastructure. Social inclusion, consumer awareness and financing tools are essential to sustaining progress.

Energy prices exhibited notable fluctuations – average scores for household electricity costs rose by 0.5%, while industrial prices increased by 2.6%, indicating declining costs. The US experienced significant drops in wholesale prices due to greater reliance on renewables and energy storage,[42] while European prices reached a three-year low.[43]

Regional divergence

Energy equity continued to evolve unevenly across regions, shaped by varying levels of access, pricing structures, subsidy policies and external cost pressures. While most regions achieved high levels of urban electrification over the past decade, rural access and equity remained major differentiators. In 2025, some regions saw improvements in equity linked to reform-driven subsidy reductions while others benefited from improved domestic supply and investment (Table 7).

TABLE 7 **Equity dimension regional overview, 2016-2025**

Geographic group	2025 average score	One-year trend	10-year trend	Key takeaways	Opportunities	Challenges
Advanced economies	71.8	1.6%	-3.2%	**Advanced economies** saw a modest rebound in equity in 2025, reflecting recent price stabilization following a period of high volatility. However, structural challenges such as persistent fossil fuel subsidies[45] and import dependence continue to weigh on long-term transition progress.	– Near-universal energy access – Advantage in low-carbon technology production and agility	– High fossil fuel subsidies[44] – Fuel import dependency
Emerging Asia	63.9	2.6%	4.7%	**Emerging Asia** improved equity through targeted price relief and improved access for rural communities.	– Increasing access to electricity and clean fuels with growth in clean energy value chains – Improving potential for low-carbon technology production	– High subsidies and fossil price risks – Equity gaps in rural regions
Emerging Europe	69.8	5.6%	0.7%	**Emerging Europe** posted the strongest one-year gain, driven by lower electricity and gas prices.	– Near-universal access to electricity – Low volatility in energy price[46]	– Industry-induced price pressure – Higher fuel import dependence among many countries
Latin America and the Caribbean	64.9	0.4%	2.8%	**Latin America and the Caribbean** sustained steady progress through rural electrification and stable electricity industry prices over the years, however, recent gains were minimal due to gas price volatility.	– Near-universal urban access to electricity and progressing clean cooking access – Declining fuel imports and energy subsidies	– Relatively limited advantage in low-carbon technology production – Inequity in rural access
Middle East, North Africa and Pakistan	73.5	2.6%	2.5%	**Middle East, North Africa and Pakistan** led the equity dimension globally due to lower energy prices, high access to electricity, generally low import dependence and recent reductions in energy subsidies.	– World leader in low energy prices – Low fuel import dependence among major energy producers	– High subsidy levels despite recent reform – Limited clean technology capacity
Sub-Saharan Africa	50.0	0.5%	8.6%	**Sub-Saharan Africa** remained the most equity-constrained region, with limited rural access and clean cooking coverage, though the region exhibited modest progress.	– Expansion of access-oriented programmes and off-grid solutions – Improving clean cooking fuel access	– Persistent rural-urban disparities in energy access – Minimal clean tech exports

Source: World Economic Forum.

TABLE 8 **Equity frontrunners 2025**

Category	Country	Performance	Key takeaway
Dimension top scorer	Qatar	85.4; +0.6% y-o-y	Qatar led in equity due to universal energy access and ultra-low prices enabled by vast domestic gas reserves. Projects like the 800 megawatts (MW) Al Kharsaah Solar Plant[47] – or the doubling of solar power capacities with Ras Laffan and Mesaieed plants (875 MW) as part of the 2030 renewable strategy[48] – helped sustain low-cost supply while diversifying energy mix.[49]
Most improved	Romania	72.3; +19.2% y-o-y	Romania made major equity gains through rural electrification, lower prices and a new 2035 energy strategy focused on grid upgrades, renewables and consumer price caps.[50]

Source: World Economic Forum.

Looking ahead: balancing short-term relief with long-term equity

Looking ahead, energy equity must shift from a moral imperative to a strategic priority – especially in regions with persistent poverty and weak infrastructure. As energy systems evolve, gaps in access and affordability could widen, particularly for rural and low-income communities.

While lower fuel prices offer short-term relief, they may delay critical reforms like subsidy phase-outs and targeted electrification. Meanwhile, rising trade barriers are pushing up clean technology costs, threatening progress in price-sensitive markets. To make equity a driver of long-term inclusion and competitiveness, policies must focus on:

- **Expanding access in underserved and rural regions** through grid and off-grid innovation
- **Aligning energy affordability with subsidy phase-out** to protect the vulnerable without distorting long-term signals
- **Positioning affordable energy costs as an economic enabler** for industry, jobs and national competitiveness

> **Over the past decade, the sustainability dimension was the strongest and most consistent of the three system performance components.**

Sustainability

Delivering long-term energy security and climate resilience hinges on the ability of energy systems to decouple growth from environmental degradation. A truly sustainable energy transition prioritizes low-emission, resource-efficient pathways that protect ecosystems, minimize pollution and support global net-zero goals.

The ETI's sustainability dimension evaluates system performance in terms of energy efficiency, emissions intensity, environmental impact and the share of clean energy sources in the overall energy mix.

Sustainability over the past 10 years

Over the past decade, the sustainability dimension was the strongest and most consistent of the three system performance components, with a steady but incremental upward trend (Figure 8). Clean electricity reached 49% of global generation in 2023,[51] signalling meaningful progress towards the 90% target needed by 2050 for net zero.[52] This momentum in the power sector contrasted with lagging progress across other parts of the energy system. Overall, the world remained off-track for 1.5-2.0°C pathways, and rising global temperatures underscored the urgency of more systemic and accelerated action to bend the emissions curve.

- From **2016 to 2022**, sustainability scores improved gradually, driven by gains in energy efficiency, modest emissions intensity reductions and a rising share of clean energy sources in the energy mix.
- In 2023, a temporary reversal in progress occurred, as economic and industrial activity rebounded after disruptions related to the COVID-19 pandemic, prompting many countries to prioritize energy security and equity, which in turn led to increased fossil fuel use in some regions.
- **In 2024-2025**, scores resumed their upward path. For instance, a 1.2% gain was seen in 2025, supported by a rebound in renewable energy deployment and reduced emissions intensity in several large economies.

Despite this improvement, long-term structural challenges persisted:

- Despite a growth in average global scores of 15.8% over the decade, the average share of clean energy in the primary energy mix across ETI countries remained just 14.8% – highlighting slow progress in the decarbonization of heating, transport and industry.
- Energy efficiency progress was uneven. Average global energy intensity scores improved by nearly 8% over the decade, but momentum slowed. IEA reported a drop in improvement to 1.3% in 2023 from 2% in 2022[53] (far below the 4% annual improvement needed to meet net-zero targets).[54]

FIGURE 8 **Sustainability dimension trend, 2016-2025**

Source: World Economic Forum.

Sustainability scores in 2025

In 2025, the sustainability dimension advanced modestly, with a 1.2% gain marking a continued upward trend. The improvement was driven by incremental gains in energy intensity and a steady rise in the share of clean energy within the total primary energy mix (+3.1%). Global emissions intensity also improved slightly (+1.6%), reflecting gradual shifts to cleaner fuel mixes and technological upgrades.

Some regions struggled to maintain momentum due to weak policy enforcement, rising industrial energy demand and limited access to clean energy finance. While CH_4 management and renewable adoption advanced in parts of Asia and Latin America, other regions saw stagnation or minor regressions.

On average, the share of clean energy in the primary energy mix for ranked countries reached 14.8% in 2025, up from 14.4% in 2024 – a positive trajectory, though still far from levels needed to align with long-term climate goals. In particular, clean electricity generation (from renewables and nuclear) rose to 49% of global power generation, an encouraging milestone on the path towards the 90% clean power share needed to reach net zero by 2050. This progress was underpinned by record-breaking growth in installed renewable capacity – with 585 gigawatts (GW) added in 2024 – a 15.1% y-o-y increase and the fastest expansion on record. Renewables accounted for 92.5% of all new power capacity additions, driven largely by solar and wind alongside steady contributions from hydropower and a modest nuclear rebound.[55]

Regional divergence

Regional sustainability outcomes revealed that, while some regions made steady gains, others continued to face rising energy intensity, stagnant clean energy shares or slow emissions reductions.

TABLE 9 **Sustainability dimension regional overview, 2016-2025**

Geographic group	2025 average score	One-year trend	10-year trend	Key takeaways	Opportunities	Challenges
Advanced economies	57.6	2.4%	14.6%	**Advanced economies** had the greatest improvement in sustainability in 2025, supported by greater clean energy shares and a steady decline in carbon intensities. CO_2 emissions fell by 1.1% to 10.9 billion tonnes in 2024 – a level last seen 50 years ago.[56]	– Well above average deployment of clean energy – Decoupling of economic growth and energy demand	– Decarbonization of hard-to-abate sectors – High energy and emissions per capita (despite progress) – High CH_4 emissions, accounting for around 12% of greenhouse gases (GHGs), primarily from agriculture and fossil fuels[57]
Emerging Asia	55.5	0.7%	-0.7%	**Emerging Asia** showed a tentative rebound after years of rising emissions and energy intensity.	– Improved energy intensity	– High emission intensity – High dependence on fossil fuels like coal – Below-average use of clean energy driving considerable growth potential
Emerging Europe	58.2	1.6%	3.6%	**Emerging Europe** sustained progress through lower energy and carbon intensity and increased use of clean energy.	– Improved energy efficiency – Rising clean energy share	– High dependence on coal in some countries – High CH_4 emissions
Latin America and the Caribbean	62.8	0.3%	3.0%	**Latin America and the Caribbean** remained stable, with moderate progress in reducing energy intensity.	– Historically low carbon mix – High renewable potential (hydro)	– Slow(er) diversification beyond hydropower in the energy mix – Lags behind in share of clean energy in the final energy mix
Middle East, North Africa and Pakistan	39.5	0.9%	3.3%	**Middle East, North Africa and Pakistan** improved from a low base, reflecting increased use of clean energy.	– Rapid clean energy growth – Emerging efficiency focus	– Structural reliance on fossil fuels across the region – Clean energy still accounting for a limited share of total supply
Sub-Saharan Africa	62.8	0.5%	2.5%	**Sub-Saharan Africa** made incremental gains despite structural hurdles in clean energy adoption (biomass accounting for two-thirds of energy use)[58] and emissions intensity.	– Low emissions per capita – High clean energy potential	– High energy intensity driven by inefficient biomass use – Insufficient growth in clean energy use

Source: World Economic Forum.

TABLE 10 **Sustainability frontrunners 2025**

Category	Country	Performance	Key takeaway
Dimension top scorer	Albania	78.8; +3.8% y-o-y	Albania led in sustainability, with nearly 100% of its electricity generated from hydropower, resulting in one of the lowest emissions intensities globally. Its push to diversify renewables with solar and wind, combined with efforts to modernize its energy infrastructure, showcased strong commitment to clean and self-sufficient energy systems.[59]
Most improved	Bulgaria	61.0; +12.0% y-o-y	Bulgaria experienced a strong rise in clean energy shares and energy efficiency, backed by EU transition funds, decommissioning of coal assets and rapid growth in solar and wind capacity – all part of a national shift towards a low-carbon economy.[60]

Source: World Economic Forum.

Looking ahead: preserving sustainability amid supply chain strains

As trade tensions intensify, sustainability progress faces new headwinds. The tariffs imposed by the US on imports from China are affecting clean energy technologies – and subsequent retaliatory measures – and fracturing global clean technology supply chains. This may raise costs and delay access to critical technologies in markets affected by trade barriers.

To sustain momentum in this new context, countries can focus on:

- **Doubling down on energy efficiency through industrial process upgrades, vehicle standards and targeted building retrofits**
- **Accelerating clean electrification, grid integration and energy storage to absorb rising renewable supply**
- **Scaling new technology solutions for hard-to-abate sectors such as heavy industry and transport, including hydrogen, carbon capture, utilization and storage (CCUS) and next-generation nuclear energy**
- **Localizing and diversifying clean energy value chains to reduce import dependence while still harnessing trade strategically to manage costs**
- **Integrating decarbonization with industrial resilience and economic competitiveness – building systems that are clean, competitive and geopolitically agile**

Those who integrate decarbonization with industrial resilience – building systems that are clean, competitive and geopolitically agile – will lead.

3.2 Transition readiness

BOX 6

Transition readiness key takeaways

Readiness as the driver of progress: Transition readiness remained the main engine of ETI progress, growing 12.5% since 2016 (versus 3.3% for system performance).

Broad gains, uneven foundations: Regulation, infrastructure and investment advanced most, but education and innovation continued to act as bottlenecks limiting the depth of readiness.

Momentum under pressure: Progress slowed to +0.8% in 2025 as macroeconomic, trade and fiscal pressures strained finance and innovation enablers.

A clear differentiator: Readiness increasingly separates leaders from laggards. Advanced economies lead, and emerging Asia is catching up via investment and infrastructure.

Source: World Economic Forum.

> “ Transition readiness has been the main engine of ETI progress. Starting from a lower base (41.8 in 2016), it rose by 12.5% to reach 47.1 in 2025.

The ETI’s **transition readiness** sub-index is rooted in various factors that are important for enabling the transition, 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.

Transition readiness over the past 10 years

Over the past decade, transition readiness has been the main engine of ETI progress. Starting from a lower base (41.8 in 2016), it rose by 12.5% to reach 47.1 in 2025, reflecting steady gains in regulation, infrastructure and institutional maturity. In contrast, system performance began at a higher baseline (61.5 in 2016) and grew more modestly to 63.5 (+3.3%), due to the slower evolution of mature dimensions like equity, security and sustainability. Transition readiness is now emerging as the key foundation for future success in energy systems.

Some key takeaways include:

- **Regulation and political commitment** saw the sharpest increase (+19.6%), a sign of strengthening policy frameworks and long-term planning in many countries.
- **Infrastructure** steadily improved by 15.4%, highlighting ongoing efforts to modernize grids and energy systems.
- **Education and human capital** experienced a more gradual rise (+6.8%), though with some volatility in recent years, pointing to structural constraints in workforce development (particularly aligning talent pipelines with emerging clean energy and digital skills demands).
- **Innovation** showed the least improvement over the past decade (+3.4%). While some countries recorded isolated gains in environment-related research and development (R&D) and technology diffusion, the overall trend highlights the urgency of establishing more targeted and scaled innovation policies to accelerate transition outcomes.
- **Finance and investments** showed late but notable improvement (+10.3%), indicating growing clean energy capital flows. Yet, investment levels still lagged behind what’s required to meet future system needs, suggesting that risk mitigation and bankability are still barriers in many markets.

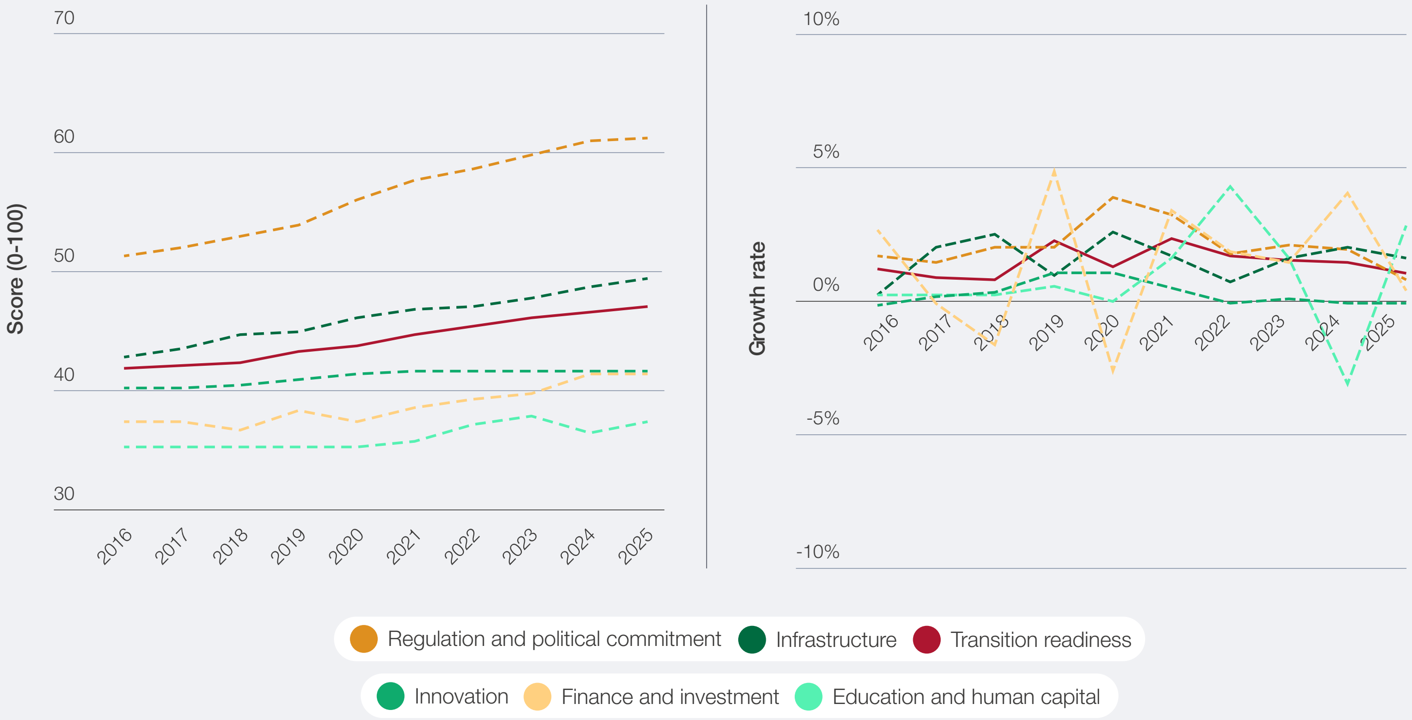


FIGURE 9 | **Global average transition readiness component performance, 2016-2025**

Source: World Economic Forum.

Transition readiness scores in 2025

In 2025, the transition readiness dimension improved by a moderate 0.8%, which is less than its 10-year average of 1.2% and notably slower than system performance, which outpaced readiness growth for the first time in recent years.

Regulation and political commitment scores saw some progress (+0.6%), **supported by advances in energy efficiency and renewable energy policies**. This momentum, however, was partially offset by setbacks in the effective pricing of carbon emissions – including reductions in excise taxes, carbon taxes and/or tradeable permit coverage. Sustaining long-term credibility will require stronger implementation capacity and greater cross-sectoral alignment.

Infrastructure advanced steadily (+1.5%), supported by investment in renewable integration and transport infrastructure development – particularly in advanced economies and emerging Europe. Yet, rollout gaps remained in emerging economies, limiting scalability. Renewable energy was a main driver, and solar energy experienced remarkable growth, reaching over 2.2 terawatts (TW) in 2024 (up from 1.6 TW in 2023). This growth marked a record year for photovoltaic (PV) deployment.[61] Wind power also saw substantial progress (with 117 GW installed in 2024), advancing into new geographies and solidifying its role as a core pillar of the global energy transition.[62] Nuclear power continued its upward trajectory – global capacity reached 371.5 GW by the end of 2023, supported by new reactors in Asia.[63] Hydropower reached 1,412 GW globally in 2023, but investment was found to be lagging, putting the goal of hitting net-zero targets by 2050 at risk.[64]

Education and human capital scores improved modestly (+2.8%) since 2024, driven by improved access to clean energy jobs. Yet, persistent skill gaps and weak talent ecosystems continue to limit broader workforce readiness and global talent competitiveness.

Innovation remained flat (-0.1%), signalling stagnation in innovation ecosystems and R&D spending. Despite isolated advances in clean technology entrepreneurship, the global clean energy innovation pipeline appeared to be losing momentum.

Finance and investments scores showed slow gains (+0.2%), with average renewable energy investment experiencing reduced growth after rapid recent gains. Moreover, financing conditions and access to credit in emerging economies remained constrained by risk perceptions and limited public-private mechanisms for reducing capital costs.

Overall, while 2025 sustained the positive trajectory of transition readiness, unlocking further progress will require sharper focus on innovation, skills and capital enablement – especially in markets where ambition still outpaces deliverability.

> “ Education and human capital scores improved modestly (+2.8%) since 2024, driven by improved access to clean energy jobs.

Regional divergence

Transition readiness remained the clearest differentiator of long-term energy transition potential, shaped by each region's institutional capacity, infrastructure, human capital, innovation ecosystem and investment attractiveness. While emerging Europe, emerging Asia, and the Middle East, North Africa and Pakistan regions improved over the past decade, the scale and speed of readiness gains varied considerably. In 2025, regulatory progress and clean technology investment were key drivers of improvement in several regions, while others faced headwinds in infrastructure delivery and talent retention (Table 11).

- **Advanced economies** saw a slight decline in transition readiness in 2025 (-0.4% y-o-y), driven by a drop in finance and investment conditions (-4.1% y-o-y) and continued stagnation in above-average innovation (despite gains in infrastructure and education, and sustained high regulatory performance).
- **Emerging Asia** recorded solid progress in 2025 (+5.0% y-o-y), driven by improvements in regulation and infrastructure, and, above all, a sharp rise in renewable energy investment.
- **Emerging Europe** saw moderate progress in 2025 (+2.1% y-o-y), driven by gains in infrastructure and workforce, though regulation and innovation declined and structural gaps in investments persisted.
- **Latin America and the Caribbean** saw stagnation in transition readiness in 2025 (0% y-o-y), with modest improvements in infrastructure, innovation, human capital and regulation offset by declines in financial investments.
- **Middle East, North Africa and Pakistan** made modest progress in 2025 (+0.6% y-o-y), with improvements in regulation, education and human capital and financial investments offset by declines in innovation and infrastructure, highlighting persistent structural barriers.
- **Sub-Saharan Africa** saw no net gain in transition readiness in 2025 (0% y-o-y). Improvements in regulation and innovation were offset by setbacks in infrastructure and finance, pointing to an uneven and fragile readiness landscape.

> Transition readiness remained the clearest differentiator of long-term energy transition potential.

TABLE 11 | **Regional transition readiness snapshot**

Geographic group	Regulation and political commitment		Infrastructure		Education and human capital		Innovation		Finance and investment	
	Score	Trend	Score	Trend	Score	Trend	Score	Trend	Score	Trend
Advanced economies	79.9	↓	62.9	↑	51.2	↗	61.6	↓	56.6	↓
Emerging Asia	54.2	↑	44.8	↗	29.1	↗	36.1	↑	36.0	↑
Emerging Europe	59.3	↓	54.6	↑	45.5	↑	36.8	↓	50.5	↗
Latin America and the Caribbean	53.4	↗	46.6	↑	30.0	↗	33.3	↑	28.5	↓
Middle East, North Africa and Pakistan	55.9	↑	34.6	↓	35.6	↑	34.5	↓	38.6	↑
Sub-Saharan Africa	49.4	↑	39.5	↓	21.3	↑	31.7	↑	26.6	↓

Note: Colour-coding reflects each region's relative position within quartile groups, calculated independently for each transition readiness dimension. Country 2025 scores were grouped into quartiles (top 25%, 50-75 percentile, 25-50 percentile and bottom 25%), and regional averages were mapped accordingly. As each dimension is scaled separately, colours are not comparable across columns. Dark green = top quartile; light green = 50-75 percentile; orange= 25-50 percentile; red = bottom 25%.

Arrow direction represents 2024-2025 change: ↑ = upward trend; ↗ = stagnant to low upward trend; ↓ = downward trend.

Source: World Economic Forum.

Looking ahead: recalibrating readiness in a fragmented world

Due to trade tariffs and broader economic and geopolitical uncertainty, 2025 may mark a turning point for transition readiness. Clean energy finance may face diversion risks as governments shift priorities towards domestic industrial protection and inflation control. The looming threat of slower economic growth or recession in some countries could further tighten public budgets and private capital flows, delaying investments in energy innovation and clean energy growth.

Key vulnerabilities include:

- **Financial investments**: Higher trade barriers may raise costs for imported components, tightening margins and deterring investment in clean energy infrastructure and supply chains.
- **Education and jobs**: Economic slowdowns may stall re-skilling efforts and slow momentum in clean job creation – especially in emerging markets.
- **Innovation**: Budget reallocation towards short-term economic relief may undercut public R&D and crowd out long-term clean technology innovation.
- **Digital infrastructure**: Limited data systems and digital capabilities can hinder planning, grid optimization and transparency.

Yet, this phase also offers a **chance for geopolitical and geoeconomic realignment**. Countries can harness this moment to:

- **Localize key segments of clean technology value chains.**
- **Strengthen industrial policy frameworks to align decarbonization with competitiveness.**
- **Diversify trade partnerships and deepen bilateral, regional and South-South cooperation.**

How countries respond now will shape their long-term competitiveness, supply chain security and ability to deliver on energy transition goals.

System performance and transition readiness are not sequential steps but parallel imperatives: one measures how effectively energy systems deliver today, while the other reflects a country's ability to adapt, invest and scale solutions now and into the future. Both are essential to achieving an inclusive, resilient and sustainable transition.

4

Redefining global energy systems

Global energy systems face mounting pressures and rising stakes, necessitating a resilient, regional and market-driven transition.

The global energy system has steadily evolved over the past decade – but 2025 may mark an inflection point as long-building pressures converge to redefine how energy is produced, secured and valued. Technology, policy, trade and geopolitical risks are now playing a greater role in shaping future trajectories. Understanding this shift requires a clear view of the initial starting point, what's changed since that point and what this means for the future resilience, inclusivity and competitiveness of energy systems.

4.1 Historic drivers of energy transformation

BOX 7 Historic drivers of energy transformation – key takeaways

The energy landscape reflects over a decade of gradual shifts. Today's energy system is the result of years of evolving priorities, disruptions and transformation – but 2025 marks a critical inflection point.

The ambition-delivery gap emerged early. Climate regulation surged post-2015, but sustainability progress stalled, revealing that political will was insufficient without implementation and equity alignment.

Resilience rose through crisis. The COVID-19 pandemic and subsequent global shocks exposed deep vulnerabilities – triggering renewed focus on resilience, local manufacturing and energy access.

Clean energy moved from agenda to imperative. By 2022, clean energy was no longer just about climate – it became central to national economic and security strategies.

Source: World Economic Forum.

Today's energy system has been shaped not by sudden disruption, but by a decade of shifting priorities in energy production, consumption and governance.

Transformation momentum began to build in the early 2010s, driven by falling renewable costs, post-2008 financial crisis climate alignment and the 2015 Paris Agreement. Technological breakthroughs in solar, wind and storage precipitated optimism for a low-carbon future.[65]

As the decade progressed, however, rising geopolitical tensions and growing dependence on global supply chains revealed new vulnerabilities. Countries responded by scaling domestic clean energy value chains and emphasizing energy sovereignty, seen in policies like the EU Battery Action Plan.[66]

The COVID-19 pandemic exacerbated these trends. Supply chain shocks, surging gas prices and widening equity gaps underscored the need for resilience and inclusive access. Between 2019 and 2021, gas equity scores dropped sharply – highlighting rising consumer burdens in vulnerable regions.

By 2022, climate risk, supply fragility and competitiveness concerns had converged into strategic urgency. Clean energy became central to economic and geopolitical strategies. Policy shifts in the US, EU and other regions reflected this – aiming to localize production, reduce dependencies and create green jobs. Examples include the US Strategy to Secure the Supply Chain for a Robust Clean Energy Transition (2022),[67] the EU Critical Raw Materials Act,[68] the IRA[69] and the Green Deal Industrial Plan.[70]

> The realization that the energy transition would require a significant rise in critical mineral and material consumption cast light on bottlenecks and dependencies.

The realization that the energy transition would require a significant rise in critical mineral and material consumption cast light on bottlenecks and dependencies in the critical minerals value chain. A rise in the frequency and impact of extreme weather events provided impetus for renewing focus on energy infrastructure resilience and tackling energy-related emissions (through strategies like tripling renewable energy capacity and doubling the rate of energy efficiency). Recent years have seen renewed interest in nuclear energy, growth in electromobility and the rapid emergence of AI – raising both electricity demand and new opportunities to optimize energy systems and improve efficiency.

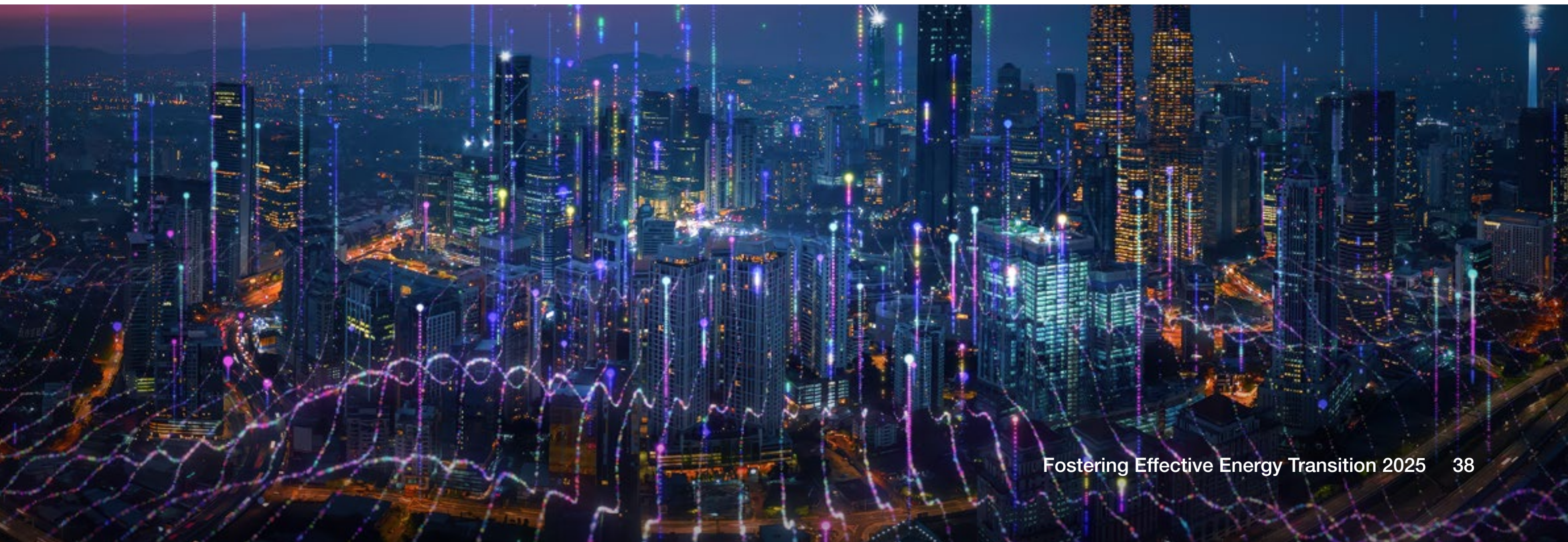
Over the past decade, system performance improved modestly (+3.3%), with gains in sustainability (+5.3%) and security (+3.4%), while equity saw limited progress (+1.5%). In contrast, transition readiness rose more decisively (+12.5%), led by strong momentum in regulation and political commitment (+19.6%) and infrastructure (+15.4%). Finance and investment (+10.3%), education and human capital (+6.8%) and innovation (+3.4%) also improved, though at a slower pace – highlighting uneven capacity to scale solutions and build resilient talent ecosystems.

TABLE 12 **Decade lookback for the energy transition**

Index component	Score change, 2016-2025	Trend takeaways
Overall ETI	+6.2%	A decade of ETI data reveals that overall performance gains were modest and largely driven by improvements in transition readiness, while core system outcomes were steady but uneven.
System performance	+3.3%	Incremental improvements reflect steady but uneven progress across core dimensions of the energy system.
Security	+3.4%	This growth was driven by improved energy mix diversification, investment in domestic infrastructure and efforts to reduce import dependence.
Equity	+1.5%	Energy equity and access gaps – particularly in lower-income regions – underscore the risk of leaving some behind in the transition.
Sustainability	+5.3%	This dimension experienced the strongest gains of any system dimension, driven by rising clean energy use, improved efficiency and lower emissions intensity – but still fell short of the pace needed to achieve net zero.
Transition readiness	+12.5%	This dimension experienced long-term gains in policy frameworks, institutional capacity and infrastructure, that laid the groundwork for resilience and long-term planning.
Regulation and political commitment	+19.6%	This growth signals growing political will and institutional engagement in the energy transition, though coherence and stability remain critical.
Infrastructure	+15.4%	This dimension saw steady progress driven by renewable capacity expansion, yet digital infrastructure lagged, signalling slow progress on smart grids and connectivity updates.
Education and human capital	+6.8%	Gains were driven by clean energy job growth, but broader talent competitiveness was found to be down – revealing gaps in transition-ready skills.
Innovation	+3.4%	This flat trajectory reflects weak momentum in creating breakthrough solutions, with modest R&D and business gains offset by declining diffusion of clean technologies.
Finance and investment	+10.3%	Improvements reflect increased renewable energy investment levels, yet challenges persist in domestic credit access and investor confidence, particularly in emerging markets.

Source: World Economic Forum.

Cumulatively, these trends show that the transformation now under way (further explored in section 4.2) is built on long-term momentum – yet, its future will be shaped by structural disparities, national capacity to act and cooperation across national borders. While sustainability has gained prominence globally, many emerging economies have long prioritized energy access, affordability and industrial growth – often constrained by fiscal and infrastructure limitations. Today's regulatory, infrastructure and equity gaps are not new, but are now intersecting with climate imperatives, reshaping the global energy agenda. Navigating diverse starting points will be key to building an inclusive, context-driven transition.



4.2 Energy systems in a new global context

BOX 8

Energy systems in a new global context – key takeaways

Energy systems are fragmenting. Energy systems are moving from globalized, centralized models towards more localized, resilient and digitally enabled structures.

The narrative has broadened. Transition strategies now prioritize equity, security, competitiveness and tech disruption – alongside climate goals.

Energy is becoming central to economic strategy. Governments are reshaping systems for resilience, security and value, with tighter supply chains and domestic capacity.

Transitions are now multi-speed and multidimensional. Countries and regions face distinct challenges across equity, security and sustainability – necessitating localized approaches and globally aligned action.

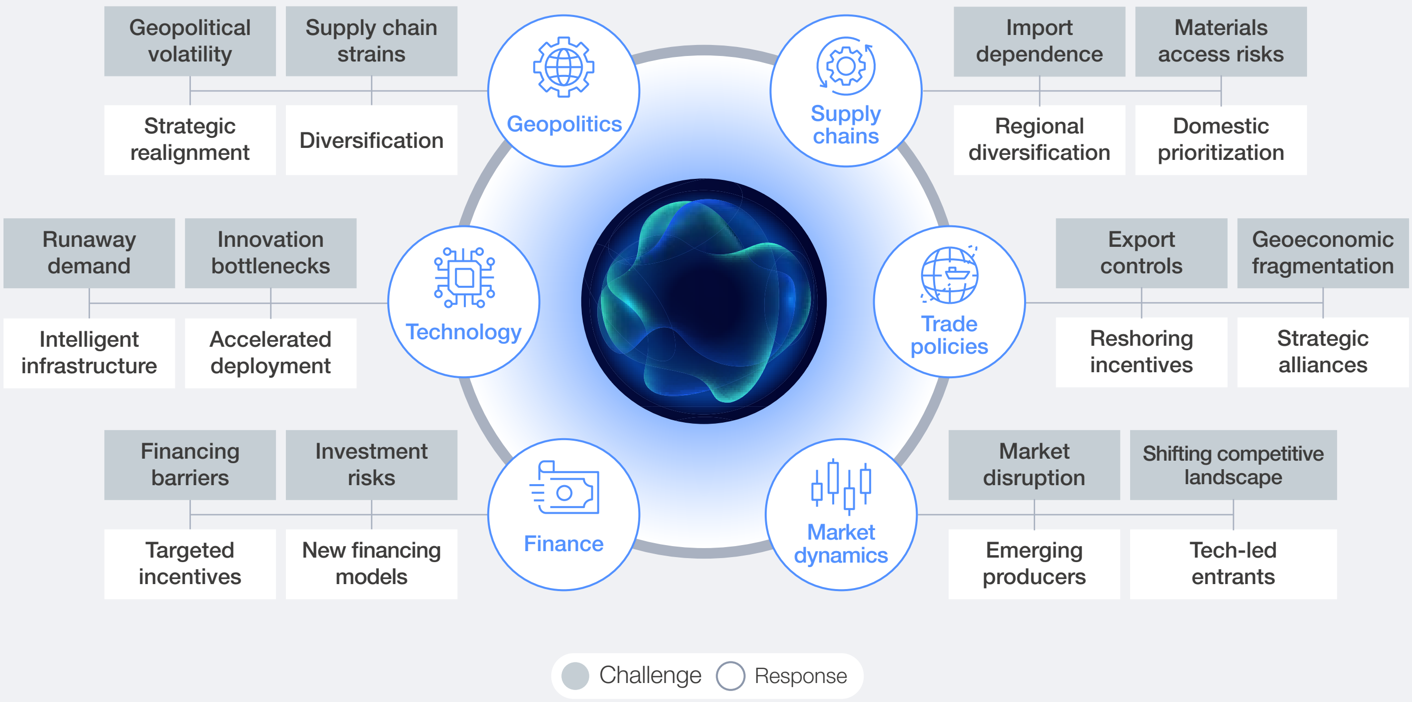
Source: World Economic Forum.

The evolving market reality

As geopolitical tensions, economic competition and rapid technological change intensify (Figure 10), countries are recalibrating their energy strategies to prioritize security, affordability, self-sufficiency and resilience. While climate ambition remains a core pillar, for many emerging and developing economies (EMDEs), concerns around energy access, equity and reliability have long taken precedence – shaped by infrastructure gaps, fiscal constraints and development needs. Recent events, such as the widespread electricity blackout in Spain and Portugal[71] in April 2025, have further underscored the critical importance of energy resilience, even in advanced economies.

FIGURE 10

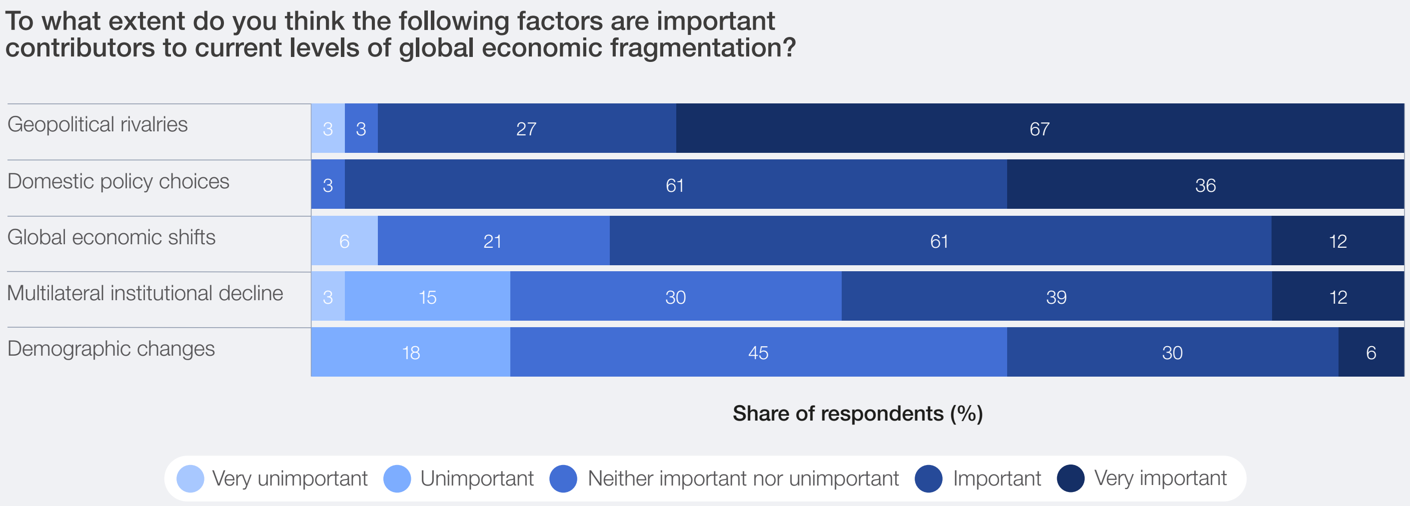
Strategic forces reshaping global energy systems



Note: Challenges = systemic vulnerabilities or stressors. Responses = strategic or structural countermeasures.
Source: World Economic Forum.

According to the Chief Economists Survey (2024), the following factors are important contributors to current levels of global economic fragmentation – in which the geopolitical climate serves as a significant factor (Figure 11).

FIGURE 11 **Chief Economists Survey: global economic fragmentation factors**



Source: World Economic Forum. (2025). *Chief Economists Outlook: January 2025.*

These structural shifts are reshaping energy markets, influencing investment decisions and redefining the role of key energy sources for the future.

Energy efficiency – the world's first fuel: Beyond the benefit of reducing the need for additional supply, energy efficiency is the most cost-effective lever to boost security, cut emissions and lower costs. Smart grids, AI analytics and demand response programmes are optimizing energy use, while behavioural incentives can drive more conscious consumption – supporting a more resilient, low-carbon system.

Natural gas – still a key transitional asset: Despite climate scrutiny, natural gas remains central to today's energy mix. It supports power system stability, complements variable renewables and serves key industrial applications, including hydrogen production and e-fuels. When paired with carbon capture, it offers a pragmatic path towards near-term security and decarbonization – particularly in regions with established infrastructure.

LNG – from transition fuel to destination fuel: Long seen as a "bridge fuel", LNG is becoming a more permanent feature in the global energy mix. Policy support, technological innovation (e.g. efficiency gains, CCUS) and supply diversification have redefined its role. Demand for LNG surged in 2024-2025,[72] especially in Asia and Europe, as countries sought alternatives to Russian pipeline gas. The Asia-Pacific region remained the largest LNG importer, with China and India securing long-term contracts. The US and Qatar expanded export capacity, and, while global supply growth slowed to 2% in 2024, new projects are set to drive a rebound to nearly 6% in 2025.[73]

The steady comeback of nuclear: Nuclear energy is regaining momentum, led by traditional designs and interest in SMRs, which offer safer, scalable and low-carbon baseload power. Their flexibility makes them an option for coal phase-outs and complements LNG in delivering stable, dispatchable energy. Global investment is rising, especially in China, which is set to surpass the US and Europe in nuclear capacity by 2030. While nuclear power today produces just under 10% of global electricity supply, capacities are increasing, with the majority of projects under construction in China.[74]

Shift to next-generation fuel technologies: In many fossil-fuel-dominated sectors, e.g. the shipping industry, efforts to reduce emissions have led to international deals such as the International Maritime Organization (IMO) agreement.[75] Investment by shipping companies in next-generation fuel technologies, such as green ammonia, is needed (rather than agreements that encourage a shift to LNG, which, although lower-carbon than conventional shipping fuel, still produces substantial emissions). In the aviation sector, efforts to scale sustainable aviation fuels are under way. Although the world needs a range of cleaner fuels to scale, there are hurdles associated with costs, demand and policy that still need to be overcome.

Clean energy technologies – driving low-carbon growth, led by renewable power: Clean energy investments are outpacing fossil fuels,[76] with the power sector leading through rapid deployment of solar, wind and smart grids. As decarbonization efforts expand to harder-to-abate sectors, technologies like CCUS are gaining traction. Over 100 projects[77] are ongoing and under construction globally, supported by policy incentives and growing R&D. The success of clean technologies, however, depends on resilient supply chains and reliable access to critical resources – making supply chain security increasingly pivotal.

Energy storage solutions as the backbone of renewable integration: To manage renewable intermittency, energy storage is essential for grid stability and supply-demand balance. Global capacity is set to surpass 2 terawatt hours (TWh) by 2030, with annual installations increasing at an average rate of 21%.[78] China is projected to lead with a 43%[79] share, followed by the US (14%), Europe and India.[80] Battery systems, hydrogen and pumped hydro are among the key technologies driving flexibility in low-carbon energy systems.

Digital forces in energy – scaling intelligence, managing demand: AI is reshaping energy systems, offering efficiency gains but also driving up electricity and resource demand. Generative AI consumes 33 times more energy than traditional software,[81] and data centres could drive 10% of global power demand growth by 2030 (and up to 30% in hubs like Ireland).[82] They already account for 1% of global energy-related emissions and could use 67% of global copper by 2030.[83] While AI may help cut 5-10% of emissions,[84] its rising power needs risk diverting renewables from other clean uses. Quantum computing may offer yet another means of advancing innovation through its lower energy consumption.

Yet, managing AI's footprint and maximizing its use for energy system efficiency are critical to ensuring that digitalization continues to act as a driver – not a drag – in the energy transition.

Furthermore, electrification is emerging as a defining force in energy system transformation. It is driven not only by climate ambition but also by structural demand shifts – from industrial processes and transport to AI, cooling and digital services. Renewables, often the lowest-cost generation option, are expanding rapidly as a result. Yet, electrification also increases the capital intensity and complexity of energy systems, necessitating major investments in grids and infrastructure, and heightening risks related to cybersecurity and system stability.

“ Energy systems are moving away from heavily globalized supply chains towards more localized and decentralized models.

In parallel, energy trade is undergoing a fundamental transition – shifting from fossil fuels to technology. As solar panels, batteries and critical components replace oil and gas tankers, new trade routes and geopolitical dynamics are taking shape. This shift reduces short-term supply risks but increases strategic dependencies on concentrated clean technology supply chains (especially in minerals and manufacturing). The transformation from “tankers to container ships” is radically altering the state of global energy interdependence.

These developments mark a clear shift away from one-size-fits-all solutions towards a more strategic and diversified energy mix – balancing dispatchable power (LNG, nuclear, storage), decentralized systems and digital innovation while improving energy security, equity and sustainability.

They also signal a departure from a purely globalized energy model – one that’s heavily reliant on cross-border trade for traditional energy resources, centralized infrastructure and concentrated supply chains – towards more localized, resilient and self-sufficient energy systems. Yet, cooperation across borders and sectors remain vital to effective delivery.

A broadening narrative

As energy systems evolve, the narrative is progressing from idealism to pragmatism: Security, economic drivers and resilience are now as influential as sustainability in shaping decisions, as energy systems are now expected to deliver not just clean power, but also reliability, affordability and strategic value.

Governments and businesses are now focusing on:

- **Securing energy supply chains**: Governments are moving to reduce or diversify import dependencies, boost domestic production and tighten control over critical materials like lithium, cobalt and rare earths (e.g. China controls 70% of global rare earth extraction and 90% of processing).[85]

- **Delivering economic value**: Energy projects are now judged on industrial impact, job creation and competitiveness, as well as on emissions impact – e.g. US’s IRA spurred more than $200 billion in clean energy manufacturing,[86] and the EU’s Clean Industrial Deal was presented as a strategy for EU competitiveness and decarbonization.

- **Digitalizing for decentralization**: AI, smart grids and blockchain are facilitating more localized and efficient power systems, especially in emerging markets. Global investment in digital grid technologies alone reached $81 billion in 2024,[87] highlighting the rising importance of digital and cyber resilience.

As global trade dynamics change, energy systems are moving away from heavily globalized supply chains towards more localized and decentralized models. The WTO forecasts that world merchandise trade will contract by 0.2% in 2025 – a three percentage point reversal from earlier expectations – due to rising tariffs and trade uncertainty.[88] This trend reflects the broader “peak trade” phenomenon, where protectionist policies and national resilience strategies are replacing hyper-globalization.

Energy supply chains are increasingly viewed through a national security lens, prompting countries to tighten control from extraction to manufacturing and reduce reliance on single markets. Policies such as the US’s IRA, the EU’s Critical Raw Materials Act and China’s dominance in battery and solar supply chains underscore the geopolitical dimensions of energy security. Countries are securing access to critical minerals like lithium and cobalt, while producers increasingly pursue local beneficiation to capture more value.

At the same time, digitalization is transforming energy markets. AI, blockchain and smart grids are enabling more localized and efficient energy distribution, reducing reliance on centralized power structures. Off-grid solar systems and microgrids expanded access for more than 560 million people worldwide in 2023,[89] especially in emerging markets, further strengthening decentralized energy resilience.

As this narrative broadens, national energy strategies are diverging. Countries are adapting based on their geopolitical positions, economic realities, resource endowments and technological strengths. Some prioritize energy security and selective decarbonization, while others push aggressively towards renewables and full electrification (Box 9).

As chapters 2 and 3 have illustrated, this divergence has created a fragmented global energy landscape. The transformation of energy systems is no longer linear or uniform, but deeply contextual – reinforcing the need for a differentiated, tailored approach to energy transition.

In this context, managing a multi-speed, multidimensional energy transition becomes essential to ensuring no region is left behind.

BOX 9 Regional perspectives on the energy transition priorities

> **Our principle is simple – diversity is our best bet, whether in society or in terms of our energy mix. There are no one-size-fits-all solutions. Given the different pathways countries are on, our pathways for energy transition will be different.**
>
> Narendra Modi, Prime Minister, India[90]

> **Europe will draw lessons from last week's blackout in Spain and Portugal on the need for power storage and investment in grids.**
>
> Teresa Ribera, Executive Vice-President, European Commission for Clean, Just and Competitive Transition[91]

> **We have the opportunity to develop and become a leader in renewable energy, in particular green hydrogen, and wind energy. And to export them to the world.**
>
> Gabriel Boric, President, Chile[92]

> **If we were to say from one day to the other that we close down production from the Norwegian shelf, I believe that would put a stop to an industrial transition that is needed to succeed in the momentum towards net zero. So, we are about to develop and transit, not close down.**
>
> Jonas Gahr Støre, Prime Minister, Norway[93]

Source: World Economic Forum.

Managing a multi-speed, multidimensional transition

As energy systems fragment across equity, security and sustainability dimensions, the emphasis on progress must be strengthened. Rather than relying solely on collective action bound by uniform timelines and approaches, the focus must shift towards enabling a multi-speed transition – one that accommodates diverse national capacities, priorities and starting points. Success will require a dual approach that maintains global alignment on overarching goals while facilitating differentiated, context-specific solutions on the ground that attract sufficient corporate investments (Table 13).

TABLE 13 Regional priorities and strategic needs for energy transformation

Geographic group	Top priorities	Strategy needed
Advanced economies	Energy equity, grid resilience, competitiveness	Strengthen equity measures and accelerate grid modernization and storage to integrate renewables.
Emerging Asia	Coal substitution, grid flexibility, rural access	Reduce coal reliance through solar, wind and hydrogen, and invest in grid flexibility, storage and rural electrification.
Emerging Europe	Energy diversification, resilience, affordability	Diversify energy supply chains and scale renewables while addressing rising equity pressures.
Latin America and the Caribbean	Hydropower resilience, green hydrogen, innovation	Bolster clean technology innovation and grid resilience to reduce overdependence on hydropower.
Middle East, North Africa and Pakistan	Fossil fuel resilience, clean fuel exports, gradual reforms	Implement gradual energy pricing reforms and scale renewables to balance equity and sustainability.
Sub-Saharan Africa	Energy access, clean cooking, decentralized systems, cross-border interconnectivity	Catalyse investment in inclusive access policies, clean cooking and decentralized renewables while ensuring greater energy infrastructure interconnectivity across the African continent.

Source: World Economic Forum.

Delivering a sustainable, secure and equitable energy future in a multi-speed world requires more than coordination – it calls for careful navigation of complex trade-offs and a rethinking of how policies, markets and institutions interact.

Key structural shifts are needed to facilitate adaptation to diverse starting points, resource endowments and transition capacities (Table 14).

TABLE 14 **Strategic shifts for managing fragmentation**

Strategic pillar	Old paradigm	New paradigm	Geographic considerations	Best practice examples
Policy design	One-size-fits-all global policies	**Context-aware policy design**: region-specific energy strategies aligned with international goals, tailored to local capacities and industrial needs	Differentiated by industrial maturity – e.g. heavy industry hubs versus service economies (United Arab Emirates, Singapore)	Chile's *National Green Hydrogen Strategy* (2020): uses regional renewable strengths to design differentiated hydrogen hubs, targeting environmental safeguards, local jobs and exports[94]
Financing	Unequal capital access, market-led	**Closing of the capital gap**: blended finance, risk-sharing and international support mechanisms for emerging economies	Emerging economies (Africa, South Asia) facing highest capital costs	Sustainable Energy Fund for Africa (SEFA): provides blended capital and technical assistance for early-stage, high-risk clean energy projects across Sub-Saharan Africa[95]
Infrastructure	Centralized, uniform tech deployment	**Localized innovation**: context-specific infrastructure like decentralized grids, hydrogen hubs and AI tools adapted to national and regional conditions	Africa: decentralized grids; Europe: hydrogen hubs; Asia: AI-powered energy optimization	Denmark's energy islands: establishes artificial islands in the North Sea to centralize offshore wind generation, enabling local use, storage and cross-border clean energy exports[96]
Cooperation	Globalized trade and tech	**Strategic sovereignty**: national energy independence, balanced with global cooperation on trade, tech and investment frameworks	EU/US: tech alliances; MENA: interconnectors; Asia: supply chain coordination	Laos-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP): a regional power integration project to balance supply and improve resilience[97]
Workforce	One-size-fits-all labour strategies	**Targeted workforce development**: inclusive, localized strategies to build adaptable talent pipelines for diverse energy systems	Fossil-heavy regions need re-skilling e.g. Gulf Cooperation Council (GCC); youth-skewed economies need up-skilling (e.g. Saudi Arabia)	Germany's Ruhr transition model: combines re-skilling, income support and innovation hubs to repurpose a former coal region into a clean technology economy[98]
Business case	Subsidy-heavy and unstable	**Market-driven transition**: competitive, innovation-led conditions supported by stable policies and innovation-driven incentives to ensure a strong business case for needed energy investments and make clean energy the preferred business option	Investment hubs (US, EU, United Arab Emirates) versus markets needing de-risking (Sub-Saharan Africa, Southeast Asia)	US IRA: De-risked over $200 billion in private clean energy investment by linking subsidies to domestic manufacturing and project bankability[99]

Source: World Economic Forum.

Managing a fragmented energy transition is not about enforcing uniformity but about unlocking progress through differentiation. Countries must be empowered to transition at their own speed with strategies adapted to local conditions.

The shift from uniformity to differentiation makes global coordination more essential – but in new ways. Existing mechanisms like the Conference of the Parties (COPs) and regional platforms were built for a more linear transition model. Today's diverse energy landscape, shaped by uneven capacities and multi-speed transitions, demands more flexible, context-aware delivery. The challenge now is not to replace existing structures, but to adapt them. In short, it's crucial to establish fit-for-purpose institutions that preserve shared goals while allowing for differentiated progress (Table 15).

TABLE 15 **Models of cooperation for a multi-speed, multidimensional transition**

Format	Purpose	Structure	Accountability and execution	Prototype example
Global, multilateral frameworks	Setting shared direction and ambition	Inclusive, multilateral negotiations	Voluntary commitments and review mechanisms	COP28 Global Stocktake, net-zero 2050 pledges
Regional cooperation and leadership coalitions	Translating global targets and national energy goals into regionally tailored roadmaps and collaborations	Region-specific intergovernmental collaboration or alliances with flexible memberships	Regional scorecards, joint infrastructure, funding pools, sharing of best practices	African Green Hydrogen Alliance, ASEAN Ministerial Meetings, ASEAN power grid cooperation
Mixed-performance platforms	Supporting just transition, reducing transition divide	Cross-country partnerships based on complementary capabilities	Bilateral or multilateral memoranda of understanding (MoU) with joint investment/technical assistance	United Arab Emirates and Africa's clean energy financing and project development partnerships
Thematic alliances	Coordinating action around technologies or supply chains (e.g. CCUS, green hydrogen)	Industry- or issue-specific groups across regions and stakeholder types	Performance metrics tied to shared innovation and trade frameworks	Clean Energy Ministerial, Critical Minerals Club
Execution hubs	Bridging ambition-delivery gap, supporting bankability and scalability	Multistakeholder consortia – international financial institutions (IFIs), private sector, public sector, philanthropists	Co-financing, blended finance models, project pipeline tracking	Global Infrastructure Facility, Sustainable Energy for All (SEforALL's) Universal Energy Facility

Note: COP28 = the 28th annual Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC); ASEAN = Association of Southeast Asian Nations.

Source: World Economic Forum.

4.3 Growth and competitiveness in energy systems

BOX 10 **Growth and competitiveness in energy systems – key takeaways**

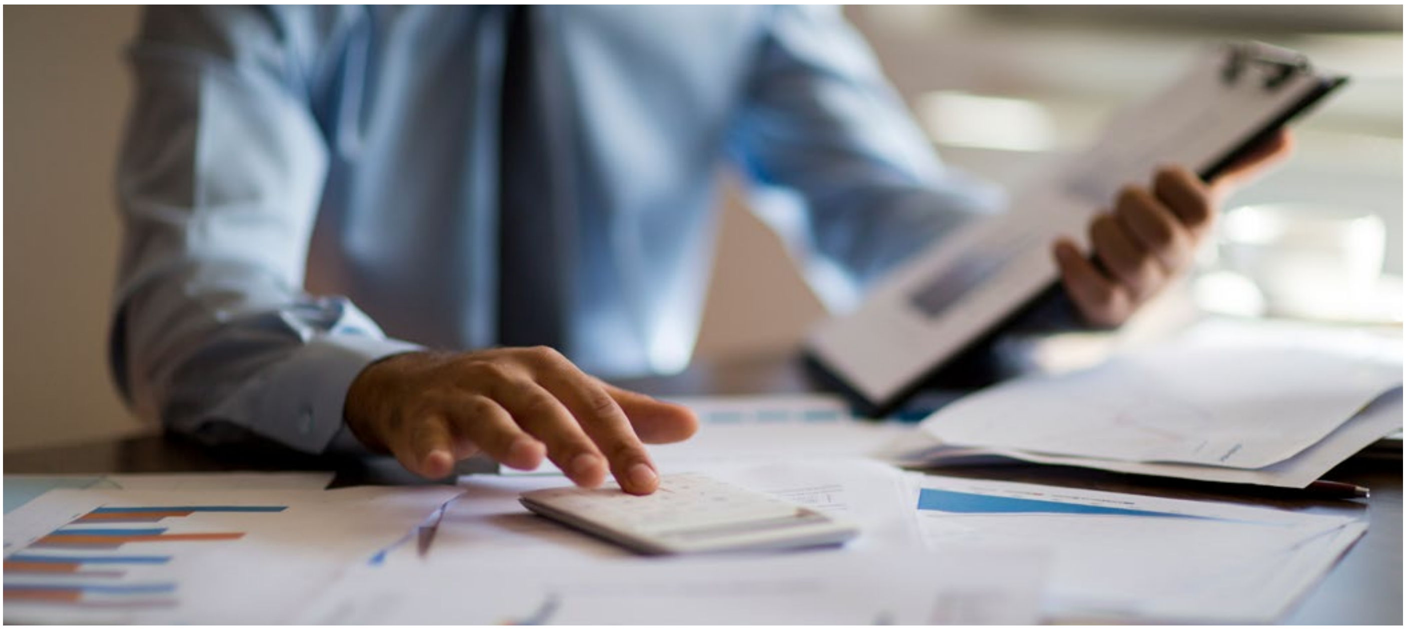
Clean energy investment must triple to $5.6 trillion annually by 2030 to stay on track for net zero[100] – essential for a scalable, investable transition.

Unlocking this capital requires three strategic shifts – mobilizing finance fast, diversifying portfolios and improving clean tech bankability.

Deployment relies on policy-market alignment, stronger accountability and financing tools to unlock capital.

The energy transition is an economic opportunity – but must be market-driven, scalable and cost-competitive.

Source: World Economic Forum.



The investment imperative

Achieving the energy transition is not only a policy challenge – it's a capital challenge too. Attracting long-term investment requires a strong business case, including clear market signals, reduced risk, and stable policy and financial conditions. While public support and multilateral financing once helped close the gap, today's high interest rates and rising uncertainty are making investments harder to realize.

Despite these headwinds, global investment in low-carbon energy systems reached a record $2.1 trillion in 2024 (up 11%). Yet, this marks a notable slowdown from the 24-29% annual growth seen over the previous three years.[101] Investment continues to flow into mature technologies like solar and wind, but funding remains constrained for emerging solutions such as hydrogen, carbon capture and industrial decarbonization.[102] According to the World Economic Forum's *Net-Zero Industry Tracker 2024*, an estimated $30 trillion in additional capital is required by 2050 for the sectors in scope, of which 57% must come from external sources or ecosystems.[103]

Yet, current investment trends fall short of what is needed, both in terms of scale and distribution. In 2025, finance and investment dimension scores slowed to just +0.2% y-o-y, reflecting a slight weakening in overall investment conditions. At the same time, a growing disconnect emerged between demand and capital flows – over 80% of global energy demand growth came from emerging economies,[104] yet more than 90% of the increase in clean energy investment since 2021 was concentrated in advanced economies and China.[105] China alone attracted $818 billion in 2024, a 20% increase from the previous year.[106]

Without structural change, the global investment gap will widen further, especially in EMDEs, where accelerating the transition requires a dramatic scale-up in finance. To align with a net-zero pathway, global energy transition investment must reach $5.6 trillion annually by 2030, according to BloombergNEF.[107] Yet, developing economies alone face an annual investment gap of $2.2 trillion.[108] In 2024, it was projected that clean energy investment in EMDEs (excluding China) will exceed $300 billion for the first time, led by India and Brazil. This accounts for only about 15% of global clean energy investment. Africa accounted for less than 2% of global clean energy investment despite having the highest population growth and electrification needs.[109]

Closing the gap requires more than capital – it demands financing structures that function in high-risk, underserved markets. Capital costs in EMDEs remain up to seven times higher than in advanced economies, limiting project viability despite their cost-effective mitigation potential. Clean energy must now compete on fundamentals: cost, scale and bankability. Profitability is no longer optional – it's essential for long-term energy security and investor confidence. Emerging technologies like generative AI can accelerate this shift by lowering costs, boosting performance and improving returns across the value chain.

Scaling clean energy deployment cost-effectively at speed will depend on tackling three core investment challenges:

1. **Mobilizing capital at speed and scale, especially in high-risk, underserved EMDE markets**
2. **Diversifying energy investment portfolios**
3. **Enhancing the bankability of clean technology projects**

These challenges are addressed in the strategic playbook below (Table 16).

> “ Closing the gap requires more than capital – it demands financing structures that function in high-risk, underserved markets.

TABLE 16 **Strategic levers to unlock energy investment**

Strategic question	What it means	Why it matters	Real-world examples
1. How can sufficient capital be mobilized at speed and scale?	Expand blended finance models, risk-sharing mechanisms and public-private partnerships to unlock institutional and private investment – particularly in high-risk and underserved markets.	Without accelerated capital flows, especially in emerging markets, deployment will fall short of demand and targets.	Egypt's $12 billion green hydrogen zone (Suez Canal Economic Zone) is co-financed by public-private consortia.[110]
2. How can energy investment portfolios be diversified across technologies and geographies?	Balance funding between mature (solar, wind) and emerging (hydrogen, CCUS) technologies; allocate capital more equitably across regions to ensure balanced progress and reduce systemic risk.	Diversification reduces systemic risks and ensures a more inclusive, resilient transition.	Examples include Brazil's wind-solar hybrid auctions,[111] India's rooftop solar lending,[112] South Korea's CCUS roadmap[113] and Kenya's geothermal scaling programme.[114]
3. How can the bankability of clean technology projects be enhanced?	Improve project risk profiles through policy stability, clear revenue frameworks, expanding offtake frameworks and strengthening project development capacity to attract long-term financing.	Making projects investable is essential to attracting institutional capital and enabling large-scale deployment.	Examples include the United Arab Emirates' green hydrogen offtake MoU (e.g. Masdar)[115] and Chile's regulatory clarity for green ammonia.[116]

Source: World Economic Forum.

Without answering these questions, the capital transition will lag behind technological potential, leaving clean energy deployment stalled and economic opportunity untapped.

Policies and market forces

Yet, the mobilization of capital at scale doesn't occur in a vacuum. The ability to unlock investment hinges on the broader policy and market environment in which decisions are made. As governments recalibrate their policy mechanisms (e.g. subsidies, incentives, regulations) and investors grow more risk-aware, the tension between policy ambition and market realism is becoming a defining feature of the energy landscape. Understanding how these forces interact is critical to turning capital strategy into real-world deployment.

The defining challenge of 2025 is the tension between policy ambitions and market realities. Governments have set ambitious targets, but financing gaps and shifting investment priorities threaten to slow progress.

Several structural challenges are shaping this landscape.

TABLE 17 **Financing focus areas for the energy transition**

Focus area	Old paradigm	New paradigm	Implications
Policy signals and alignment	Fragmented (voluntary) ambitions and weak delivery frameworks disconnected from market needs	**Market-responsive policy design**: aligning climate and other energy transition ambitions with investor needs and delivery constraints	Misalignment creating uncertainty and slowing deployment; adaptive (yet stable and market-informed) policy and accountability mechanisms growing increasingly essential
Investment drivers and capital mobilization	Mix of public, concessional and private capital, with reliance on subsidies in many early-stage or unproven technologies	**Mobilizing private capital through market signals and commercial viability**: with public finance used strategically to de-risk and scale investment in harder markets or technologies	Investment model increasingly shifting towards blended finance structures that emphasize co-investment, local market depth and scaled commercial deployment
Financial conditions and expectations	Favourable interest rates[117] and low-cost capital enabling impact-first investments with lower return thresholds	**Bankability-focused capital strategy**: navigating higher interest rates[118] and fiscal constraints in a competing environment by demonstrating stronger returns and financial resilience	Return on investment (ROI)-focused investors and rising interest rates shifting focus to bankability; the need for clean energy to stand out against competing investment priorities, offer strong returns and manage risk in a tougher financial climate

Source: World Economic Forum.

To accelerate progress, policy-makers and market actors must work in concert to de-risk investment, strengthen market signals and ensure that clean energy technologies can compete on a level playing field. A well-calibrated mix of policies, pricing mechanisms and private capital will be essential to shift from a transition fuelled by ambition to one driven by economic momentum.

Only then can the full potential of energy systems be realized and scalable, secure and sustainable outcomes be delivered in a world of growing complexity.

Energy transformation as an economic opportunity

Unlocking the full potential of energy systems will require more than a navigation of policy and market friction – it will require a repositioning of the transformation itself as a strategic lever for economic growth. What has long been seen as a climate obligation must now be reframed as an engine of job creation, innovation and competitiveness.

Governments, businesses and financial institutions need to recognize that decarbonization is not just an environmental necessity but a pathway to long-term economic competitiveness (Table 18).

TABLE 18 **Strategic benefits of the energy transition**

Benefit area	Strategic value
Job creation and economic growth	The transition can drive job creation across the energy value chain, from renewables and grid modernization to hydrogen and advanced energy storage. The IEA's Net Zero Emissions by 2050 Scenario anticipates the creation of 14 million new clean energy jobs by 2030, and projects that an additional 16 million workers will transition to roles related to clean energy.[119]
Industrial competitiveness	Clean energy and energy efficiency can lower operational costs, enhance energy security and create new high-value industries, ensuring competitiveness in global markets.
Resilient energy systems	Secure, affordable and sustainable energy is a foundation for economic stability, reducing exposure to fossil fuel volatility and geopolitical risks.
Technology leadership	Countries that invest in energy innovation and infrastructure today will be well positioned to dominate the energy markets of tomorrow.
Environmental co-benefits	Emissions reduction improves public health, lowers healthcare costs and increases workforce productivity – while building resilience against climate-related shocks.

Source: World Economic Forum.

> Governments, investors and businesses must work together to build a market-driven energy transformation that delivers strong financial returns.

Failing to accelerate the energy transformation would prompt significant economic consequences. Delayed action would not only make decarbonization more expensive and disruptive later – it would also **expose economies to escalating risks**.

- **Higher adaptation and disaster recovery costs** as climate impacts intensify
- **Growing investor uncertainty** in carbon-intensive assets and sectors
- **Loss of competitiveness** in global markets where clean technologies are the new standard
- **Widening inequality and social instability**, particularly in fossil fuel-dependent regions left behind

In short, the cost of inaction is not only environmental – it is **economic, financial and geopolitical**. The real risk lies not in moving too fast, but in moving too slowly.

To ensure that market forces drive the transition forward, three critical shifts are needed:

- **Align financial incentives with energy goals**: De-risk clean energy through innovative and blended finance, public-private partnerships and robust carbon markets to unlock private capital at scale.
- **Improve market conditions for clean energy**: Modernize grids, scale storage and implement effective carbon pricing to level the playing field and reduce system costs.
- **Drive innovation and cost competitiveness**: Invest in next-generation technologies and scale up clean technology manufacturing to accelerate deployment and lower costs.

The energy transformation is at a crossroads, and policy ambition alone will not be enough. Economic viability must take centre stage. Governments, investors and businesses must work together to build a market-driven energy transformation that delivers strong financial returns while addressing the energy trilemma. Success will depend on one critical factor: making this transformation a profitable, scalable and self-sustaining economic opportunity.

Conclusion: Top five actions

Energy systems must deliver clean, secure and affordable energy amid rising disruption. These five priorities chart a path towards strengthening security, equity and sustainability moving forward.

1. **Adopt stable, adaptive policy frameworks that drive long-term investment and support cooperation.**

   Design globally aligned policy frameworks that adapt to local contexts and are reinforced by strategic partnerships, tailoring incentives to national strengths and enabling regional cooperation on infrastructure, supply chains and energy integration.

   Example: India's National Green Hydrogen Mission (2023)[120] provides targeted incentives based on each state's industrial strengths, such as Gujarat's petrochemical capacity, Tamil Nadu's renewables base and Odisha's steel production, supporting domestic manufacturing and export potential while aligning with national and global decarbonization goals.

2. **Modernize energy infrastructure, especially grids and storage.**

   Modernize grid infrastructure and planning using digital tools to better integrate renewables, storage and distributed assets, ensuring clean energy can be delivered reliably and efficiently across power and fuels. Meanwhile, minimize energy losses and improve overall system efficiency.

   Example: Saudi Arabia's Saudi Electricity Company[121] installed 11 million smart meters, improving real-time energy monitoring, enhancing grid reliability and laying the foundation for increased renewable integration.

3. **Invest in skilled talent to help boost innovation and execution capacity.**

   Align education, vocational training and workforce planning with real-time labour market needs to cultivate a skilled, inclusive workforce that can support clean energy deployment, energy efficiency upgrades and a just transition.

   Example: Australia's Clean Energy Training Hubs[122] partner with technical and further education institutions (TAFEs), energy companies and unions to deliver practical training in solar, wind and battery installations – bridging the gap between market demand and workforce supply.

4. **Accelerate clean technology commercialization, especially in hard-to-abate sectors.**

   Cultivate international collaboration in R&D and innovation, and link R&D, pilot support and early offtake to reduce testing time, hasten identification of unviable technologies and accelerate the scaling of breakthrough solutions in heavy industry, transport and hydrogen (including technologies that optimize energy use across industrial processes).

   Example: The US Department of Energy's $7 billion investment in regional hydrogen hubs connects public-private partnerships to scale early-stage hydrogen technologies, supporting industrial decarbonization across transport and manufacturing.[123]

5. **Enhance capital investment in developing economies.**

   Evolve beyond isolated projects by combining risk-sharing tools, local capital market development and targeted public-private platforms, making clean energy and energy efficiency investment more viable where it's needed most.

   Example: India's National Investment and Infrastructure Fund (NIIF) serves as a sovereign-backed platform that partners with global investors to co-finance infrastructure, using credit enhancements to de-risk clean energy projects and attract private capital at scale.

Together, these five actions can help deliver a more resilient, inclusive and investable energy transition – globally and locally.

Appendices

A1.1 ETI methodology

This section provides details about the methodology of the 2025 edition of the ETI. It is comprised of the following parts:

- Index design, composition and calculation
- Coverage and indicator selection criteria
- Comparability and updates in the 2025 ETI

Index design, composition and calculation

The ETI framework is structured to ensure:

- **Balanced perspectives** on current performance and future readiness
- **Diversity in energy transition pathways**, accounting for context-specific challenges
- **Alignment with international frameworks** and energy goals
- **Comparability across time**, with data going back to 2015
- **Contextualized, data-driven analysis** for meaningful insights
- **Forward-looking orientation**, enabling actionable outcomes

The ETI score is calculated as a weighted average of two sub-indices. Each sub-index is the arithmetic average of its component dimensions, which in turn are based on the index's 43 underlying indicators (Figure 12). The ETI 2025 results reflect the latest available data at the time of collection.

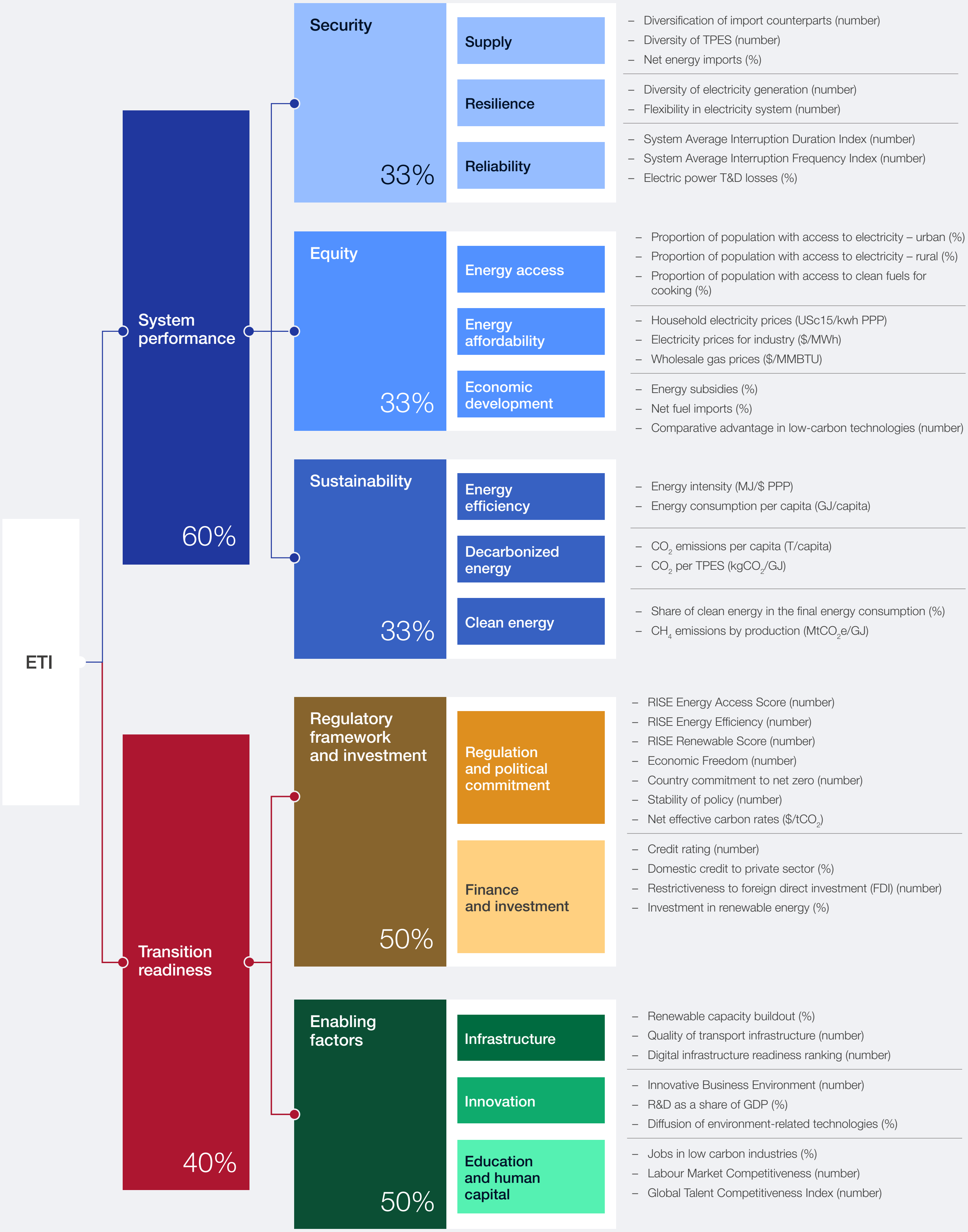
The ETI score uses a 0-100 scale, where 100 represents the best possible value and 0 the worst. To allow comparability and aggregation, each indicator is normalized to the 0-100 scale using a minimum-maximum formula.

$$100 \text{ x } \left(\frac{\text{country value} - \text{sample minimum}}{\text{sample maximum} - \text{sample minimum}} \right)$$

The sample minimum and sample maximum are the lowest and highest values for countries covered by the ETI. For those indicators for which a higher raw value indicates a worse outcome (e.g. wholesale gas prices), the study relies on a normalization formula that, in addition to converting the series to a 0-100 scale, reverses it, so that 0 and 100 still correspond to the worst and best, respectively.

In many cases, however, adjustments are made to the sample minimum and maximum to account for issues such as outliers, with winsorization being the most common technique.

FIGURE 12 | **Methodology and indicators**



- **ETI**
  - **System performance** 60%
    - **Security** 33%
      - **Supply**
        - Diversification of import counterparts (number)
        - Diversity of TPES (number)
        - Net energy imports (%)
      - **Resilience**
        - Diversity of electricity generation (number)
        - Flexibility in electricity system (number)
      - **Reliability**
        - System Average Interruption Duration Index (number)
        - System Average Interruption Frequency Index (number)
        - Electric power T&D losses (%)
    - **Equity** 33%
      - **Energy access**
        - Proportion of population with access to electricity – urban (%)
        - Proportion of population with access to electricity – rural (%)
        - Proportion of population with access to clean fuels for cooking (%)
      - **Energy affordability**
        - Household electricity prices (USc15/kwh PPP)
        - Electricity prices for industry ($/MWh)
        - Wholesale gas prices ($/MMBTU)
      - **Economic development**
        - Energy subsidies (%)
        - Net fuel imports (%)
        - Comparative advantage in low-carbon technologies (number)
    - **Sustainability** 33%
      - **Energy efficiency**
        - Energy intensity (MJ/$ PPP)
        - Energy consumption per capita (GJ/capita)
      - **Decarbonized energy**
        - CO_2 emissions per capita (T/capita)
        - CO_2 per TPES ($kgCO_2/GJ$)
      - **Clean energy**
        - Share of clean energy in the final energy consumption (%)
        - CH_4 emissions by production ($MtCO_2e/GJ$)
  - **Transition readiness** 40%
    - **Regulatory framework and investment** 50%
      - **Regulation and political commitment**
        - RISE Energy Access Score (number)
        - RISE Energy Efficiency (number)
        - RISE Renewable Score (number)
        - Economic Freedom (number)
        - Country commitment to net zero (number)
        - Stability of policy (number)
        - Net effective carbon rates ($\$/tCO_2$)
      - **Finance and investment**
        - Credit rating (number)
        - Domestic credit to private sector (%)
        - Restrictiveness to foreign direct investment (FDI) (number)
        - Investment in renewable energy (%)
    - **Enabling factors** 50%
      - **Infrastructure**
        - Renewable capacity buildout (%)
        - Quality of transport infrastructure (number)
        - Digital infrastructure readiness ranking (number)
      - **Innovation**
        - Innovative Business Environment (number)
        - R&D as a share of GDP (%)
        - Diffusion of environment-related technologies (%)
      - **Education and human capital**
        - Jobs in low carbon industries (%)
        - Labour Market Competitiveness (number)
        - Global Talent Competitiveness Index (number)

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; $MtCO_2e$ = million tonnes of carbon dioxide equivalent; T = tonnes; MWh = megawatt-hour; GJ = gigajoule.
Source: World Economic Forum.

Coverage and indicator selection criteria

The ETI 2025 assesses 118 countries. To be covered in the index, a country needs to have data for most of the index's 43 indicators, including sufficient coverage for each dimension.

The following principles guide the selection of indicators:

1. **Relevance**: alignment of parameters with core aspects of the energy transition
2. **Recency and comparability**: use of the most recent and cross-country comparable data
3. **Source quality and objectivity**: reliance on credible, widely recognized and independent data sources

Comparability and updates in the ETI 2025: The ETI is a dynamic benchmark, with structural and indicator-level refinements applied each year to reflect evolving transition priorities and data availability. Moreover, data sources frequently revise data, changing historical results. As a result, direct comparisons of country rank and score between the ETI 2025 and previously published editions should be made with caution.

The following updates have been made to the 2025 ETI:

1. Indicator removals

The following indicators have been excluded from ETI 2025 due to data limitations, redundancy or methodological changes:

- Gas supply resilience
- International financial flows
- Regulatory Indicators for Sustainable Energy (RISE) Cook Score
- Rule of law
- Investment in renewable energy

2. Indicator name changes

To better reflect the parameters measured, the following indicators have been renamed:

- Carbon prices → **Net-effective carbon rates**
- Quality of education → **Labour market competitiveness**
- Public R&D spend → **R&D as share of GDP**

3. New indicator addition

Economic freedom and investment in renewable energy has been introduced as a new indicator under the **regulation and political commitment** and **finance and investment** sub-dimensions, respectively, to improve coverage of macroeconomic enablers in the energy transition.

A1.2 Indicator definitions and sources

TABLE 19 **ETI model framework**

	Sub-dimension	Indicator	Definition	Data sources
Security	**Supply**	Diversification of import counterparts (number)	Index for diversity of energy (e.g. oil, gas and coal) imports among trade partners	United Nations Conference on Trade and Development (UNCTAD) Stats
		Diversity of TPES (number)	Index for diversity of the total primary energy supply, based on the relative contributions of different energy types	IEA World Energy Balances
		Net energy imports (%)	Net energy imports, expressed as a percentage of total energy use	IEA World Energy Balances
	Resilience	Diversity of electricity generation (number)	Index of diversity of energy sources (bioenergy, coal, gas, hydro, nuclear, solar, wind) contributing to total electricity generation	EMBER Climate
		Flexibility in electricity system (number)	Measure of ability of a power system to cope with the variability and uncertainty of renewable generation by modifying electricity production or consumption Calculated as the square root of the sum of electricity generated from fossil fuels, hydro, bioenergy and other renewables divided by total electricity generated	EMBER Climate
	Reliability	System Average Interruption Duration Index (number)	Average total duration of outages experienced by a customer in a year	World Bank
		System Average Interruption Frequency Index (number)	Average number of service interruptions experienced by a customer in a year	World Bank
		Electric power T&D losses (%)	Electricity lost during the T&D process, expressed as a percentage of the total electricity output	IEA World Energy Statistics
Equity	**Energy access**	Proportion of population with access to electricity – urban (%)	Population with electricity access in urban areas as a ratio of total urban population	World Bank
		Proportion of population with access to electricity – rural (%)	Population with electricity access in rural areas as a ratio of total rural population	World Bank
		Proportion of population with access to clean fuels for cooking (%)	Percentage of a country's population primarily using clean cooking fuels like gaseous fuels, electricity etc. (excluding kerosene)	World Bank
	Energy affordability	Household electricity prices – (USc15/kwh PPP)	Average price of electricity paid by a country's household (including taxes) in 2015 USc/kwh, adjusted for PPP	Enerdata
		Electricity prices for industry ($/MWh)	Average cost of electricity per MWh for a country's industrial consumers in US dollars	Enerdata
		Wholesale gas prices ($/MMBTU)	Cost of average natural gas in bulk transactions in $/MMBTU, influenced by diverse price formation mechanisms	International Gas Union

TABLE 19 **ETI model framework** (continued)

	Sub-dimension	Indicator	Definition	Data sources
Equity	**Economic development**	Energy subsidies (%)	Spending on fossil fuel subsidies, including subsidies for coal, petroleum, natural gas and electricity, as a percentage of GDP	Organisation for Economic Co-operation and Development (OECD), IEA, IMF, World Bank
		Net fuel imports (%)	Net fuel imports as a percentage of GDP, measuring a country's reliance on imported fuels relative to its economic output	WTO
		Comparative advantage in low-carbon technologies (number)	Proportion of a country's exports that are low-carbon technologies (e.g. wind turbines, solar panels, biomass systems and carbon capture equipment) to the proportion of global exports that are low-carbon technology products	IMF
Sustainability	**Energy efficiency**	Energy intensity (MJ/$ PPP)	Amount of energy consumed, expressed in MJ/$ using the PPP method, indicating the energy efficiency of the economy	IEA World Energy Balances, World Bank
		Energy consumption per capita (GJ/capita)	Total energy (GJ) consumption as a ratio of total population, reflecting the average energy use per individual	IEA World Energy Statistics, World Bank
	Emissions	CO_2 emissions per capita (t/capita)	Tonnes of CO_2 emissions from fuel combustion as a ratio of total population, showing the average carbon footprint per person	IEA Greenhouse Gas Emissions, World Bank
		CO_2 per TPES ($kgCO_2$/GJ)	CO_2 emissions per unit of total primary energy supply, expressed in kilograms of CO_2 per GJ, indicating the carbon intensity of the energy mix	IEA Greenhouse Gas Emissions, IEA World Energy Balances
		CH_4 emissions by production ($MtCO_2e$/GJ)	CH_4 emissions from the energy sector per TPES	ClimateWatch, IEA World Energy Balances
	Clean energy	Share of clean energy in the final energy consumption (%)	Percentage of clean energy (renewables, nuclear or other low-carbon sources) consumption in total energy consumption	US Energy Information Administration
Regulatory framework and investment	**Regulation and political commitment**	RISE Access Score (number)	RISE index score for the electricity pillar, which measures the strength and effectiveness of a country's regulatory framework in promoting universal access to electricity	RISE
		RISE Energy Efficiency (number)	RISE index score for the energy efficiency pillar, which measures the strength and effectiveness of a country's regulatory framework in promoting energy conservation and efficiency	RISE
		RISE Renewables Score (number)	RISE index score for the renewable energy pillar, which measures the strength and effectiveness of a country's regulatory framework in promoting the development, deployment and integration of renewable energy	RISE
		Economic freedom (number)	Average score of the rule of law (property rights, government integrity, judicial effectiveness), regulatory efficiency (business, labour and monetary freedom) and open market (trade, investment and financial freedom) pillars of the Index of Economic Freedom	Heritage Foundation

TABLE 19 **ETI model framework** (continued)

	Sub-dimension	Indicator	Definition	Data sources
Regulatory framework and investment	**Regulation and political commitment**	Country commitment (number)	Assessment of a country's commitment to energy transition and emissions reduction, based on presence, scope and implementation of its net-zero target Country score on the basis of net-zero targets communicated in nationally determined contribution (NDC), long-term low GHG emissions development strategy (LTS), domestic law, policy or high-level political pledge such as head of state commitment	ClimateWatch
		Stability of policy (number)	Response to the survey scale question "In your country, to what extent does the government ensure a stable policy environment for doing business?" in the Forum's Executive Opinion Survey (EOS)	World Economic Forum, Executive Opinion Survey
		Net-effective carbon rates ($/t$CO_2$)	Total carbon pricing through fuel excise taxes, carbon taxes and tradeable permits, reflecting the extent of explicit emission pricing in a country	OECD
	Finance and investment	Credit rating (number)	Average sovereign debt credit rating scores from Moody's, S&P Global and Fitch	S&P Global, Fitch, Moody's
		Domestic credit to private sector (%)	Total credit provided to the private sector by financial institutions including loans, securities, trade credit and other repayment claims as a proportion of GDP	World Bank
		Restrictiveness to FDI (number)	Score for the FDI Regulatory Restrictiveness Index, which measures statutory restrictions on foreign direct investment in 22 economic sectors Captures four main types of restrictions: foreign equity limits, screening and approval mechanisms, restrictions on key foreign personnel and "other restrictions" faced by foreign investors, such as restrictions on the acquisition of land and real estate for business purposes	OECD
		Investment in renewable energy (%)	Renewable energy investment in US dollars as a share of GDP, covering renewables	BloombergNEF, International Monetary Fund
Enabling factors	**Infrastructure**	Renewable capacity buildout (%)	Renewable energy electricity capacity buildout measured as an average of renewable energy's share of total capacity at the start of the year and new renewable energy's share of total capacity at end of the year	International Renewable Energy Agency, US Energy Information Administration
		Quality of transport infrastructure (number)	Average score of scaled survey questions assessing the quality of road infrastructure and the efficiency of train, air transport and seaport services	World Economic Forum, Executive Opinion Survey
		Digital infrastructure readiness (number)	Score for the Network Readiness Index, which measures the performance of a country's national digital readiness across technology, people, governance and impact	Network Readiness Index

TABLE 19 **ETI model framework** (continued)

	Sub-dimension	Indicator	Definition	Data sources
Enabling factors	**Innovation**	Innovative business environment (number)	Average scores for survey scale questions assessing the degree to which companies adapt their business models to embrace risky or disruptive business ideas, the extent to which they participate in mutually beneficial collaboration on R&D, the extent to which new companies with innovative ideas grow and disrupt established firms, and the extent to which there is a culture of taking risks to pursue entrepreneurial projects	World Economic Forum, Executive Opinion Survey
		R&D as a share of GDP (%)	R&D spend as a percentage of GDP, across business enterprises, government, higher education and private non-profit sectors	World Bank
		Diffusion of environment-related technologies (%)	Ability to convert R&D investment into environmental innovation; captures a country's capability to generate targeted environmental technologies from R&D efforts Measured as the number of inventions in a defined set of environmental technology areas (e.g. GHG capture, storage, sequestration and disposal, climate change mitigation) as a share of total environment-related inventions (environmental management, water-related adaptation, climate mitigation), normalized by total R&D spending	OECD
	Education and human capital	Jobs in low-carbon industries (%)	Share of industrial employment in low-carbon jobs relative to total population, indicating workforce shift to sustainable sectors Low-carbon sectors including: solar PV, wind, biogas, biofuels, geothermal, hydropower, ocean energy, waste-to-energy, concentrated solar power and solar heating/cooling	International Renewable Energy Agency, World Bank
		Labour market competitiveness (number)	Average score of scaled survey questions on local skilled labour availability, education system quality and systems' ability to teach digital and technological skills	World Economic Forum, Executive Opinion Survey
		Global Talent Competitiveness Index (number)	A country's ability to attract, develop, and retain talent, as measured by the Global Talent Competitiveness Index average scores for mid-level and high-level skills	INSEAD

Note: USc/kwh = US cents per kilowatt-hour; PPP = purchasing power parity; \$/MWh = US dollar per megawatt hour; \$/MMBTU = US dollar per metric million British thermal units; TPES = unit of total primary energy supply; MJ/\$ = megajoules per unit of GDP in US dollars; GJ/capita = gigajoule per capita; t/capita = tonnes per capita; $kgCO_2/GJ$ = kilogram of carbon dioxide per gigajoule; $MtCO_2e/GJ$ = megatonnes of CO_2 equivalent per gigajoule; $\$/tCO_2$ = US dollar per tonne of carbon dioxide.

Source: World Economic Forum.

A1.3 Country group classifications

The following country group classifications were used for the index and report:

TABLE 20 **Country group classifications**

Advanced economies	Emerging Asia	Emerging Europe	Latin America and the Caribbean	Middle East, North Africa and Pakistan	Sub-Saharan Africa
Australia	Bangladesh	Albania	Argentina	Algeria	Angola
Austria	Brunei Darussalam	Armenia	Bolivia	Bahrain	Botswana
Belgium	Cambodia	Azerbaijan	Brazil	Egypt	Cameroon
Canada	China	Bosnia and Herzegovina	Chile	Iran, Islamic Rep.	Côte d’Ivoire
Cyprus	India	Bulgaria	Colombia	Jordan	Congo, Dem. Rep.
Czechia	Indonesia	Croatia	Costa Rica	Kuwait	Ethiopia
Denmark	Kazakhstan	Georgia	Dominican Republic	Lebanon	Gabon
Estonia	Kyrgyz Republic	Hungary	Ecuador	Morocco	Ghana
Finland	Lao PDR	Latvia	El Salvador	Oman	Kenya
France	Malaysia	Lithuania	Guatemala	Pakistan	Mauritius
Germany	Mongolia	North Macedonia	Honduras	Qatar	Mozambique
Greece	Nepal	Montenegro	Jamaica	Saudi Arabia	Namibia
Iceland	Philippines	Poland	Mexico	Tunisia	Nigeria
Ireland	Sri Lanka	Republic of Moldova	Nicaragua	United Arab Emirates	Senegal
Israel	Tajikistan	Romania	Panama		South Africa
Italy	Thailand	Serbia	Paraguay		Tanzania
Japan	Viet Nam	Slovak Republic	Peru		Zambia
Luxembourg		Türkiye	Trinidad and Tobago		Zimbabwe
Malta		Ukraine	Uruguay		
Netherlands					
New Zealand					
Norway					
Portugal					
Republic of Korea					
Singapore					
Slovenia					
Spain					
Sweden					
Switzerland					
UK					
US					

Source: World Economic Forum.

A2.1 Security leaders: top five

Average ETI score **66.1**

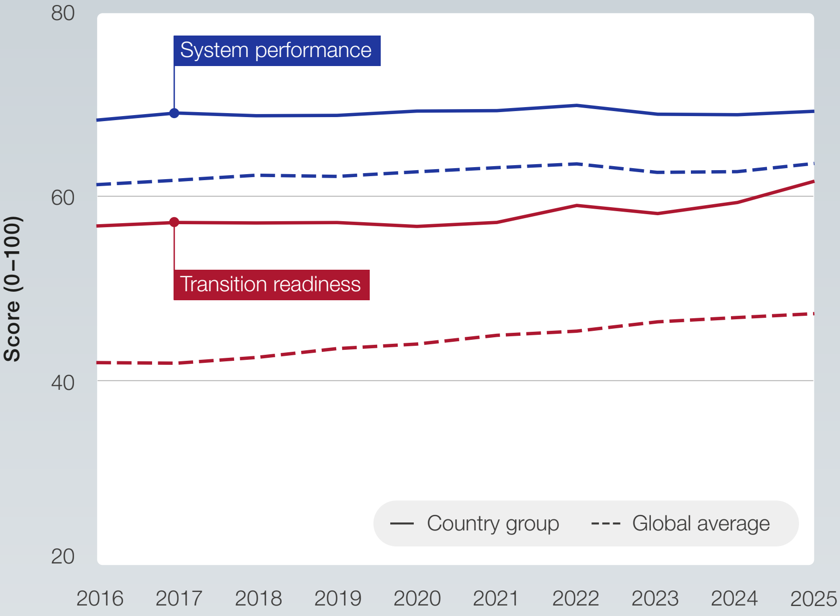
Average 2025 score change **2.00%**

Key energy indicators

Average net energy imports (% of energy use)	24.0%	Average energy intensity (MJ/$2017 PPP GDP)	3.0
Average share of clean energy (%)	16.8%	Average CO_2 intensity (CO_2/TES)	43.6

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply.
Source: International Energy Agency (IEA); US Energy Information Administration (EIA); World Bank.

Top five security leaders 2025 (from highest to lowest):
US, Latvia, Austria, New Zealand, Malaysia.



Source: World Economic Forum.

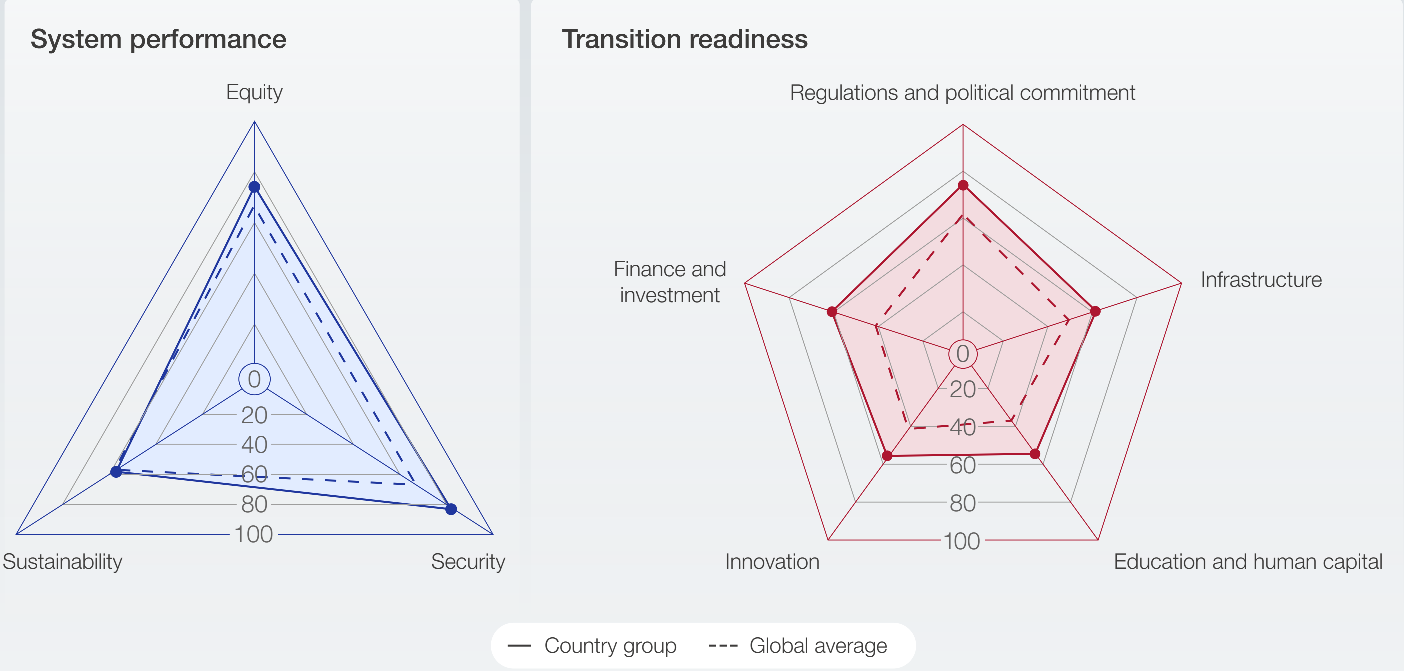
Overall narrative

Diverse energy mix at the core: Security leaders have a diverse energy mix, integrating oil, gas, coal, nuclear, solar, wind and hydropower. This balanced composition enhances their resilience against supply disruptions and price volatility.

Diversity in import counterparts: Most of these countries have strategically built a diversified pool of energy import partners or strengthened domestic production and infrastructure, ensuring redundancy and flexibility.

Grid reliability: These countries show high performance on grid reliability, with consistent investments minimizing transmission and distribution losses, as well as customer service interruptions.

Risk of imbalance: While energy security remains a key strength, several of these countries face the risk of over-prioritizing it at the expense of equity and sustainability – potentially slowing their long-term energy transition progress.



Source: World Economic Forum.

A2.2 Equity leaders: top five

Average ETI score **60.4**

Average 2025 score change **0.58%**

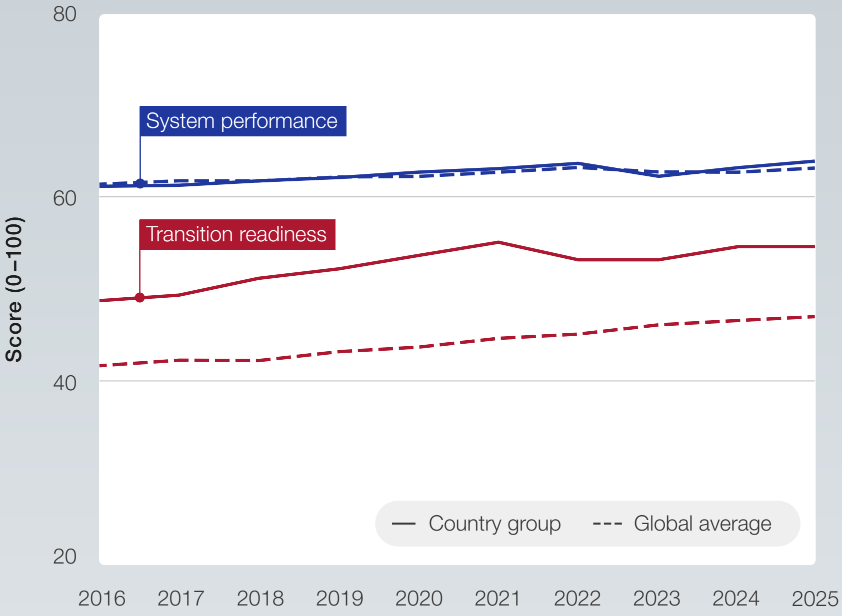
Key energy indicators

Average net energy imports (% of energy use)	-306.1%	Average energy intensity (MJ/$2017 PPP GDP)	4.5
Average share of clean energy (%)	13.3%	Average CO_2 intensity (CO_2/TES)	48.7

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply.
Source: International Energy Agency (IEA); US Energy Information Administration (EIA); World Bank.

Top five equity leaders 2025 (from highest to lowest):

Qatar, Oman, United Arab Emirates, Norway, US.



Source: World Economic Forum.

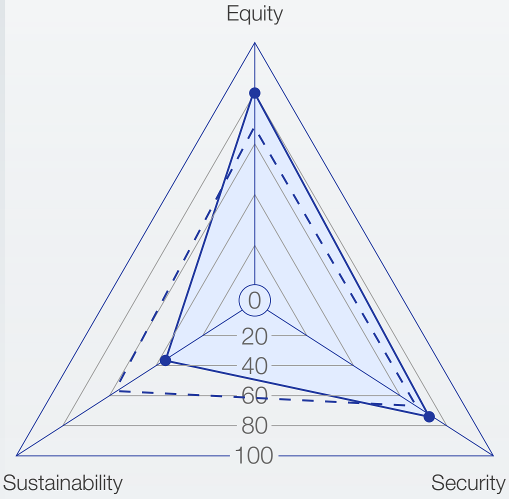
Overall narrative

Balancing equity and sustainability: Most equity leaders maintain low household energy prices through substantial fossil fuel subsidies or price controls – particularly in Gulf states like Qatar, Oman and the United Arab Emirates. While these measures support equity by improving affordability, they can strain fiscal space and slow progress on clean energy deployment, creating tension between equity and sustainability goals.

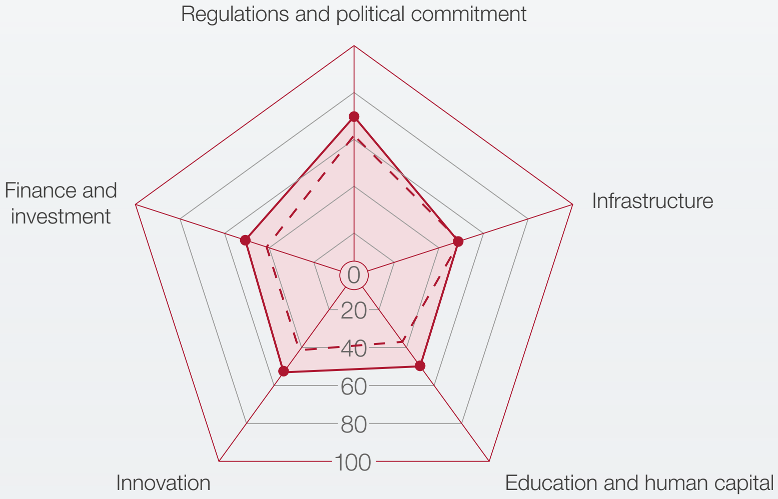
Domestic energy resource advantage: These countries benefit from rich local fossil fuel reserves, ensuring low-cost, secure energy access. While fossil fuels still dominate, there is growing integration of renewables – such as solar energy in the Gulf, Norway' near-total hydropower, and the US' rapid growth in wind and solar, supported by policy frameworks.

Incentives driving green equity: Some countries set themselves apart by using dual approaches – keeping energy affordable while pushing for clean transformation through policies like tax incentives and public investments. These measures help make clean technologies more accessible and cost-effective.

System performance



Transition readiness



— Country group --- Global average

Source: World Economic Forum.

A2.3 Sustainability leaders: **top five**

Average ETI score **64.5**

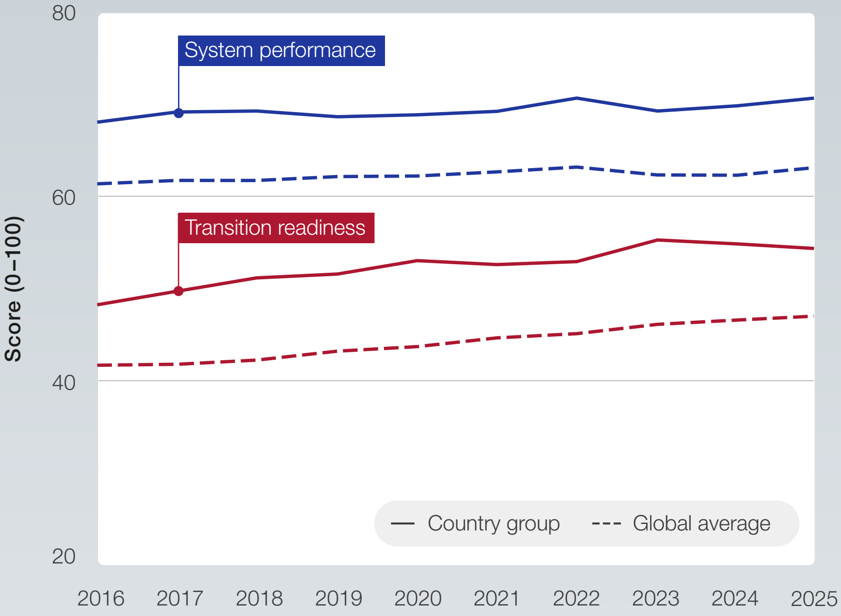
Average 2025 score change **0.97%**

Key energy indicators

Average net energy imports (% of energy use)	32.7%	Average energy intensity (MJ/$2017 PPP GDP)	2.0
Average share of clean energy (%)	40.4%	Average CO_2 intensity (CO_2/TES)	30.1

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply.
Source: International Energy Agency (IEA); US Energy Information Administration (EIA); World Bank.

Top five sustainability leaders 2025 (from highest to lowest):
Albania, Costa Rica, Paraguay, Sweden, Switzerland.



Source: World Economic Forum.

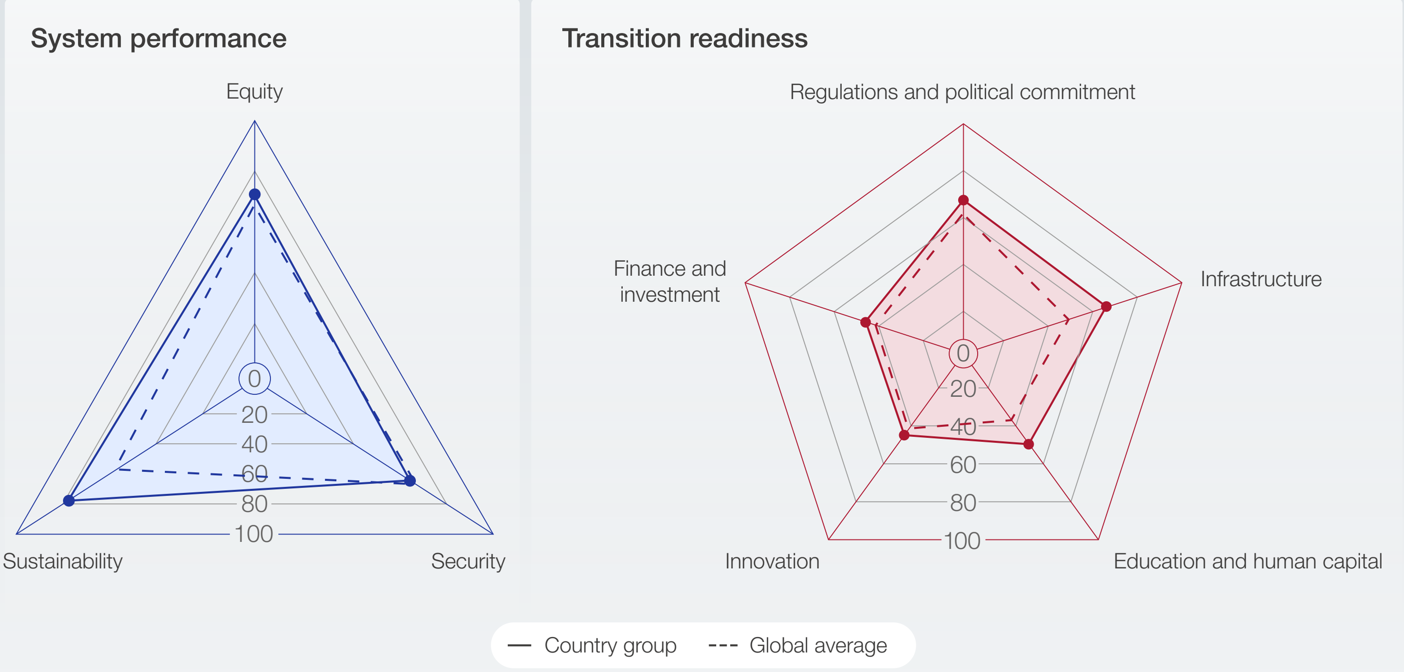
Overall narrative

Improved energy efficiency and low energy intensity: Through stringent regulations and targeted incentives, these nations have successfully reduced energy consumption relative to GDP, contributing to decarbonization while maintaining economic momentum.

High reliance on clean energy sources: Their energy systems are increasingly powered by renewables such as hydropower, solar and wind – enabled by both natural resource endowments and deliberate policy efforts like reducing fossil fuel subsidies to unlock the full potential of sustainable energy.

Enabling policy frameworks: These countries have implemented carbon pricing mechanisms that shift the economic balance in favour of cleaner technologies while also incentivizing emissions reductions across sectors.

Attractive investment climate: Most of these countries benefit from political stability, robust infrastructure and clear regulatory pathways creating favourable conditions for long-term investments in clean energy.



Source: World Economic Forum.

A2.4 Transition readiness leaders: top five

Average ETI score **70.9**

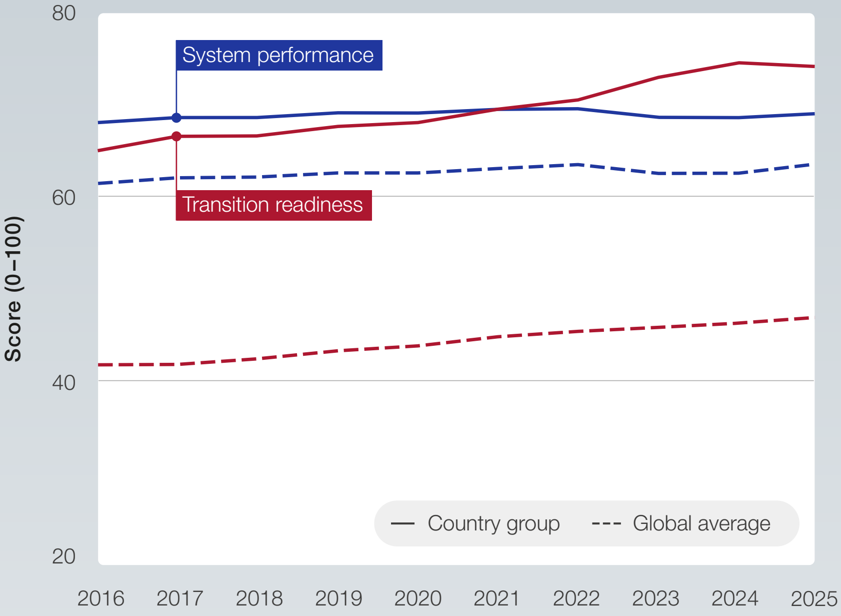
Average 2025 score change **0.01%**

Key energy indicators

Average net energy imports (% of energy use)	50.2%	Average energy intensity (MJ/$2017 PPP GDP)	2.7
Average share of clean energy (%)	22.4%	Average CO_2 intensity (CO_2/TES)	43.5

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply.
Source: International Energy Agency (IEA); US Energy Information Administration (EIA); World Bank.

Top five transition readiness leaders 2025 (from highest to lowest): Sweden, Netherlands, Denmark, Germany, China.



Source: World Economic Forum.

Overall narrative

Strong policy frameworks driving innovation and resilience: These countries lead in establishing robust regulatory environments that encourage clean technology development, infrastructure modernization and emissions control, strengthening their transition readiness across sectors.

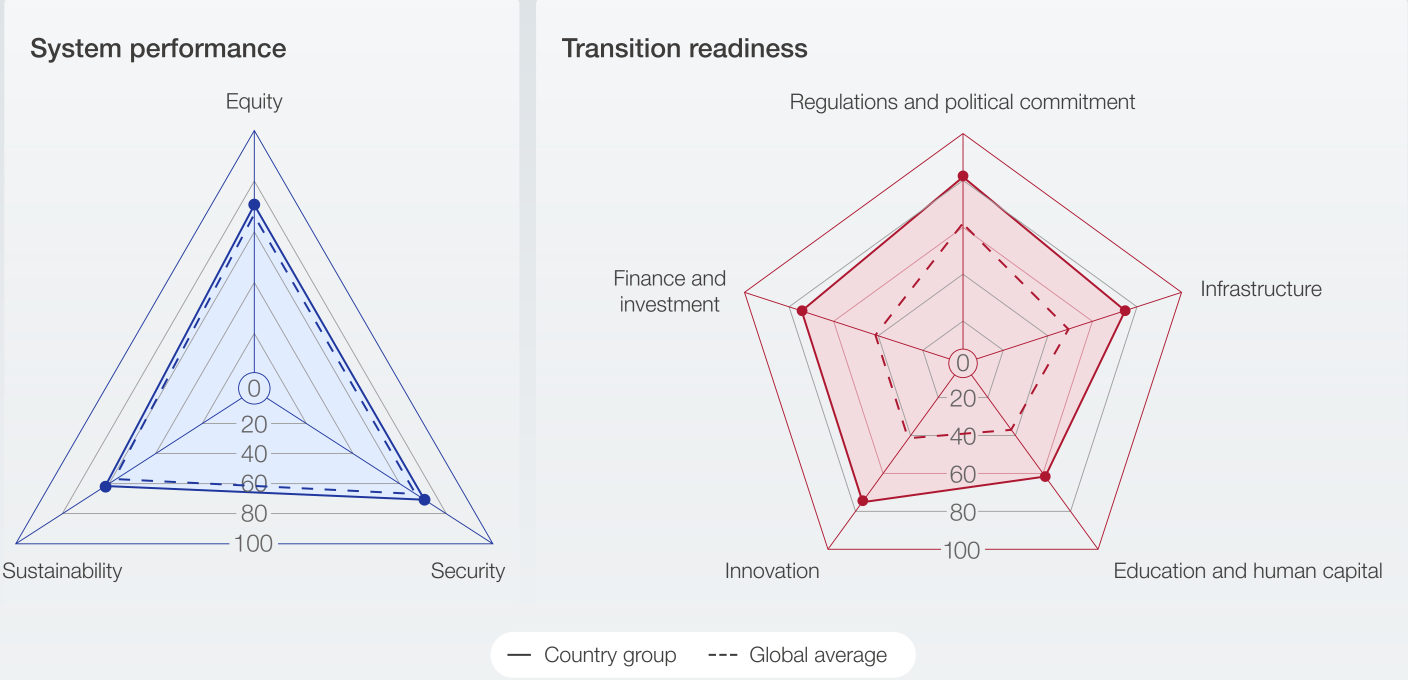
High levels of infrastructure and technology deployment: Significant investments in grid modernization, smart technologies and efficient transport networks have enhanced system reliability and adaptability, positioning these countries at the forefront of the energy transition.

Strong education and human capital foundations: These countries benefit from well-established education systems and targeted workforce development programmes, ensuring a steady pipeline of skills essential for energy transition and clean technology deployment.

Strategic financial investments accelerating transition pathways: Targeted public- and private-sector investments – ranging from green bonds to venture capital for clean technologies – have supported the scaling of sustainable energy projects and emerging technologies across industries.

Innovation leadership: Sustained investments in R&D and active support for clean tech industries have positioned these nations as global leaders in developing and scaling decarbonization technologies.

Global influence in shaping sustainable transition standards: These countries not only advance their domestic energy transitions but also play a key role in international collaboration, influencing global climate policy, technology transfer and sustainable finance frameworks.



Source: World Economic Forum.

A2.5
G20 nations

Average ETI score **61.4**

Average 2025 score change **0.37%**

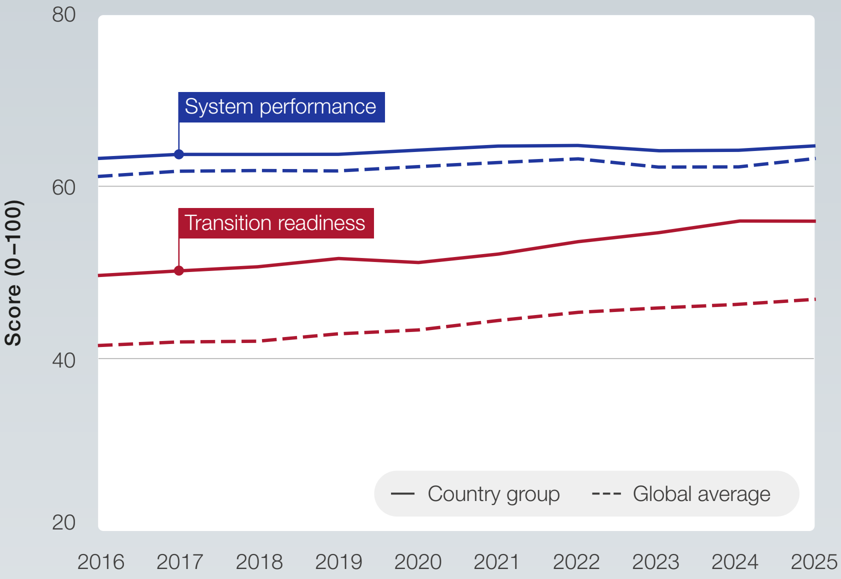
Key energy indicators

Average net energy imports (% of energy use)	–1.9%	Average energy intensity (MJ/$2017 PPP GDP)	3.4
Average share of clean energy (%)	12.6%	Average CO_2 intensity (CO_2/TES)	52.6

Note: MJ = megajoule; PPP = purchasing power parity; TES = total energy supply.
Source: International Energy Agency (IEA); US Energy Information Administration (EIA); World Bank.

G20 nations:

(G20 country members covered by the ETI: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Saudi Arabia, South Africa, Türkiye, UK and US).



Source: World Economic Forum.

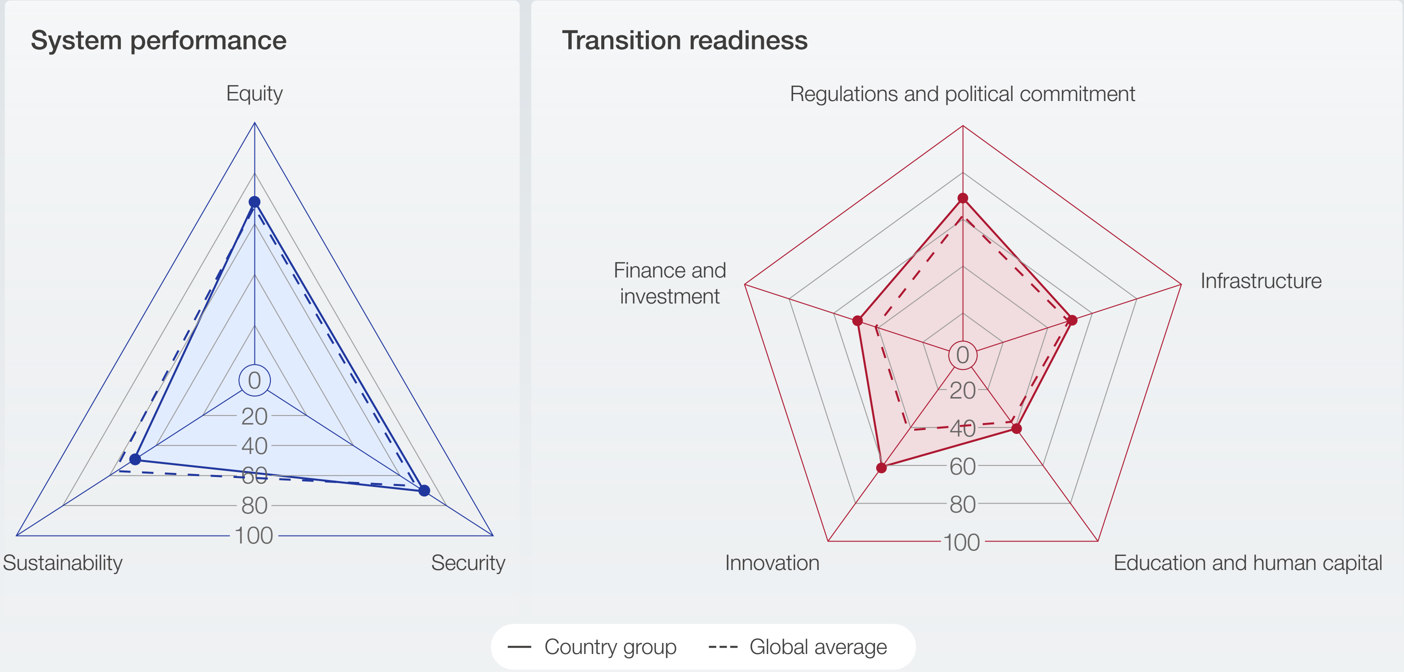
Overall narrative

Continued reliance on fossil fuels despite renewable growth: While renewable energy deployment has expanded – particularly in solar and wind –many G20 (Group of 20) countries remain heavily reliant on fossil fuels, with energy transitions hindered by existing infrastructure lock-ins and market dependencies.

Strengthened but uneven policy frameworks: Policy measures such as carbon pricing, green industrial strategies and clean energy incentives are increasingly evident across the G20, but significant disparities in ambition, coverage and implementation continue to impact the pace of decarbonization.

Growing renewable energy investment with regional imbalances: Investment in renewable energy infrastructure and innovation is rising steadily, supported by favorable financing mechanisms and corporate net-zero commitments. Yet, flows are disproportionately concentrated in advanced economies, leaving emerging G20 members trailing.

Heightened focus on energy security and supply diversification: In response to global market disruptions, G20 countries are prioritizing energy resilience through supply diversification and strategic reserves. While enhancing short-term security, this shift has, in some cases, delayed structural clean energy reforms.



Source: World Economic Forum.

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Endnotes

1. World Economic Forum. (2025). *The Global Risks Report 2025 20th Edition*. https://www.weforum.org/publications/series/global-risks-report/.
2. Ibid.
3. International Energy Agency. (2025). *Growth in global energy demand surged in 2024 to almost twice its recent average*. https://www.iea.org/news/growth-in-global-energy-demand-surged-in-2024-to-almost-twice-its-recent-average.
4. World Meteorological Organization. (2025). *WMO confirms 2024 as warmest year on record at about 1.55°C above pre-industrial level*. https://wmo.int/news/media-centre/wmo-confirms-2024-warmest-year-record-about-155degc-above-pre-industrial-level.
5. International Energy Agency. (2025). *Growth in global energy demand surged in 2024 to almost twice its recent average*. https://www.iea.org/news/growth-in-global-energy-demand-surged-in-2024-to-almost-twice-its-recent-average.
6. International Energy Agency. (2025). *Global Energy Review 2025*. https://iea.blob.core.windows.net/assets/5b169aa1-bc88-4c96-b828-aaa50406ba80/GlobalEnergyReview2025.pdf.
7. Statista. (2024). *Artificial intelligence (AI) market size worldwide from 2020 to 2030.* https://www.statista.com/forecasts/1474143/global-ai-market-size#:~:text=AI%20market%20size%20worldwide%20from%202020%2D2030&text=The%20market%20for%20artificial%20intelligence,billion%20U.S.%20dollars%20in%202030.
8. Heatmap. (2024). *The IEA Isn't Sweating Data Center Electricity Demand*. https://heatmap.news/technology/iea-world-energy-outlook-2024.
9. International Energy Agency. (2024). *What the data centre and AI boom could mean for the energy sector*. https://www.iea.org/commentaries/what-the-data-centre-and-ai-boom-could-mean-for-the-energy-sector.
10. The White House. (2025). *Fact Sheet: President Donald J. Trump Declares National Emergency to Increase our Competitive Edge, Protect our Sovereignty, and Strengthen our National and Economic Security*. https://www.whitehouse.gov/fact-sheets/2025/04/fact-sheet-president-donald-j-trump-declares-national-emergency-to-increase-our-competitive-edge-protect-our-sovereignty-and-strengthen-our-national-and-economic-security/#:~:text=President%20Trump%20will%20impose%20an,at%2012%3A01%20a.m.%20EDT.
11. The White House. (2025). *Annex-I*. https://www.whitehouse.gov/wp-content/uploads/2025/04/Annex-I.pdf.
12. These rankings provide a high-level snapshot of relative progress and set the stage for deeper regional and country-level insights in the next section. The ETI is a dynamic benchmark, with methodological refinements and framework updates applied each year to reflect evolving transition priorities and data availability. As a result, year-on-year comparisons of rank positions between editions may not be directly comparable and should be interpreted with caution.
13. Netherlands, Germany, Portugal, Estonia, Iceland, the UK, the US, Israel, Chile, New Zealand, Japan, Republic of Korea, Belgium, Bulgaria, Luxembourg, Canada, Albania, Ireland, Czechia, Viet Nam, Panama, Indonesia, Nigeria, Jordan, Sri Lanka, El Salvador, India, Bosnia and Herzegovina, Cambodia, Philippines, Kyrgyz Republic, Paraguay, Oman, Bangladesh, Cote d'Ivoire, Tajikistan, Guatemala, Pakistan, Islamic Republic of Iran, Mozambique, Nicaragua.
14. Financial Times. (2024). *Strategic interests galvanise Gulf's renewables spending*. https://www.ft.com/content/275ad801-0862-4123-8028-158ec18205f0.
15. Emirates Nuclear Energy Company. (2024). *Barakah Nuclear Energy Plant*. https://www.enec.gov.ae/barakah-plant/.
16. Swedish Energy Agency. (2024). *Our strategic priorities in energy research and innovation*. https://www.energimyndigheten.se/en/innovations-r--d/Our-strategic-priorities-in-energy-research-and-innovation/.
17. World Intellectual Property Organization. (2024). *Sweden ranking in the Global Innovation Index 2024*. https://www.wipo.int/gii-ranking/en/sweden.
18. European Parliament. (2024). *Finland's climate action strategy*. https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/767180/EPRS_BRI(2024)767180_EN.pdf.
19. World Economic Forum. (2023). *Finland is on track to meet some of the world's most ambitious carbon neutrality targets. This is how it has done it*. https://www.weforum.org/stories/2023/06/finland-carbon-neutral-2035-goals/.
20. European Parliament. (2024). *Denmark's climate action strategy*. https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/767173/EPRS_BRI(2024)767173_EN.pdf.
21. International Energy Agency. (n.d.). *Energy system of Finland*. https://www.iea.org/countries/finland.
22. International Energy Agency. (n.d.). *Energy system of Norway*. https://www.iea.org/countries/norway.
23. World Economic Forum. (2022). *Norway's massive sovereign-wealth fund sets net-zero goals*. https://www.weforum.org/stories/2022/09/norways-massive-sovereign-wealth-fund-sets-net-zero-goal/.
24. Government of Switzerland. (2024). *Switzerland's information necessary for clarity, transparency and understanding in accordance with definition 1/CP.21 of its updated and enhanced first nationally determined contribution (NDC) under the Paris Agreement (2021–2030)*. https://unfccc.int/sites/default/files/2024-11/Switzerlands%20First%20NDC_2021_2030_Update%202024_including%20ICTUs.pdf.

25. Think Tank European Parliament. (2024). *Austria's climate action strategy*. https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2024)767170#:~:text=Austria's%20government%20aims%20to%20achieve,see%20trajectory%20in%20Figure%201).

26. Emirates News Agency. (2025). *Austria cuts CO_2 emissions by 350,000 tonnes in H1-24*. https://www.wam.ae/en/article/b5s17dg-austria-cuts-co$_2$-emissions-350000-tonnes-h1-24.

27. Eurostat. (2024). *Shedding light on energy in Europe – 2024 edition*. https://ec.europa.eu/eurostat/web/interactive-publications/energy-2024.

28. European Commission. (2025). *Baltic States join the European continental electricity grid after fully disconnecting from Russian and Belarussian networks* [Press release]. https://ec.europa.eu/commission/presscorner/detail/en/ip_25_436.

29. Reuters. (2025). *Dutch Gasunie expects to invest $13 billion in power grid through 2030*. https://www.reuters.com/sustainability/climate-energy/dutch-gasunie-expects-invest-13-billion-power-grid-through-2030-2025-03-31/.

30. Clean Energy Wire. (2025). *Germany's Climate Action Law*. https://www.cleanenergywire.org/factsheets/germanys-climate-action-law-begins-take-shape.

31. Bundesnetzagentur. (2024). *Hydrogen core network*. https://www.bundesnetzagentur.de/EN/Areas/Energy/HydrogenCoreNetwork/start.html.

32. Reuters. (2024). *Portugal plans to raise share of renewables in electricity consumption to 93% by 2030.* https://www.reuters.com/business/energy/portugal-plans-raise-share-renewables-electricity-consumption-93-by-2030-2024-07-22/.

33. Portuguese Trade & Investment Agency (AICEP). (2024). *Portugal approves €611m investment in national grid development*. https://www.portugalglobal.pt/en/news/2024/august/portugal-approves-611m-investment-in-national-grid-development/.

34. Directorate-General for Energy and Geology. (2020). *National Strategy for Hydrogen*. https://www.dgeg.gov.pt/en/transversal-areas/international-affairs/energy-policy/national-strategy-for-hydrogen/.

35. Reuters. (2025). *Portugal keen to create offshore wind cluster, could reach 10 gigawatts*. https://www.reuters.com/sustainability/climate-energy/portugal-keen-create-offshore-wind-cluster-could-reach-10-gigawatts-2025-01-17/.

36. Carbon Brief. (2025). *Analysis: Clean energy just put China's CO_2 emissions into reverse for first time*. https://www.carbonbrief.org/analysis-clean-energy-just-put-chinas-co$_2$-emissions-into-reverse-for-first-time/.

37. International Energy Agency. (2025). *Summit on the Future of Energy Security*. https://www.iea.org/events/summit-on-the-future-of-energy-security.

38. International Energy Agency. (2024). *Bottom-up energy transitions: Managing the rise of energy communities in Latin America*. https://www.iea.org/commentaries/bottom-up-energy-transitions-managing-the-rise-of-energy-communities-in-latin-america.

39. US Department of Energy. (2024). *Sparking Transmission Deployment: Inflation Reduction Act*. https://www.energy.gov/gdo/articles/sparking-transmission-deployment-inflation-reduction-act.

40. Ministry of Infrastructure and Energy of Albania. (2024). *National Energy and Climate Plan of the Republic of Albania*. https://www.infrastruktura.gov.al/wp-content/uploads/2024/12/The-National-Energy-and-Climate-Plan-NECP.pdf.pdf.

41. International Energy Agency (IEA), International Renewable Energy Agency (IRENA), United Nations Statistics Division (UNSD), World Bank, World Health Organization (WHO). (2024). *Tracking SDG 7: The Energy Progress Report*. https://iea.blob.core.windows.net/assets/cdd62b11-664f-4a85-9eb6-7f577d317311/SDG7-Report2024-0611-V9-highresforweb.pdf.

42. US Energy Information Administration. (2025). *US wholesale electricity prices were lower and less volatile in 2024*. https://www.eia.gov/todayinenergy/detail.php?id=64284.

43. European Union Agency for the Cooperation of Energy Regulators. (2025). *Key developments in European electricity and gas markets*. https://www.acer.europa.eu/sites/default/files/documents/Publications/2025_ACER_Gas_Electricity_Key_Developments.pdf.

44. International Institute for Sustainable Development. (2025). *How the G7 Can Advance Action on Fossil Fuel Subsidies in 2025*. https://www.iisd.org/articles/how-g7-can-advance-action-fossil-fuel-subsidies-2025.

45. International Energy Agency. (2023). *Electricity Market Report 2023*. https://iea.blob.core.windows.net/assets/255e9cba-da84-4681-8c1f-458ca1a3d9ca/ElectricityMarketReport2023.pdf.

46. European Commission. (2024). *REPowerEU - 2 years on*. https://energy.ec.europa.eu/topics/markets-and-consumers/actions-and-measures-energy-prices/repowereu-2-years_en.

47. Enerdata. (2022). *Qatar inaugurates the 800 MW Al Kharsaah solar power plant*. https://www.enerdata.net/publications/daily-energy-news/qatar-inaugurates-800-mw-al-kharsaah-solar-power-plant.html.

48. Gulf Times. (2025). *Qatar's strategy to position renewable energy as core pillar in national energy mix*. https://www.gulf-times.com/article/704086/opinion/qatars-strategy-to-position-renewable-energy-as-core-pillar-in-national-energy-mix.

49. KAHRAMAA. (n.d.). *Renewable Energy*. https://www.km.qa/RenewableEnergy/Pages/BeSolar.aspx.

50. Mihai, C. (2024). Romanian government approves energy strategy. *EURACTIV*. https://www.euractiv.com/section/politics/news/romanian-government-approves-energy-strategy/.

51. World Economic Forum. (2025). *Clean energy's share of electricity reaches 40%, and other nature and climate news*. https://www.weforum.org/stories/2025/04/clean-energy-electricity-nature-and-climate-stories-this-week/.

52. International Energy Agency. (2023). *Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach*. https://iea.blob.core.windows.net/assets/8ad619b9-17aa-473d-8a2f-4b90846f5c19/NetZeroRoadmap_AGlobalPathwaytoKeepthe1.5CGoalinReach-2023Update.pdf.

53. International Energy Agency. (2024). *Energy Efficiency 2024*. https://www.iea.org/reports/energy-efficiency-2024.

54. International Energy Agency. (2023). *Energy Efficiency 2023*. https://iea.blob.core.windows.net/assets/dfd9134f-12eb-4045-9789-9d6ab8d9fbf4/EnergyEfficiency2023.pdf.

55. International Renewable Energy Agency. (2025). *Record-Breaking Annual Growth in Renewable Power Capacity* [Press release]. https://www.irena.org/News/pressreleases/2025/Mar/Record-Breaking-Annual-Growth-in-Renewable-Power-Capacity.

56. International Energy Agency. (2025). *Growth in global energy demand surged in 2024 to almost twice its recent average*. https://www.iea.org/news/growth-in-global-energy-demand-surged-in-2024-to-almost-twice-its-recent-average.

57. International Energy Agency. (2024). *Tracking pledges, targets and action – Global Methane Tracker 2024.* https://www.iea.org/reports/global-methane-tracker-2024/tracking-pledges-targets-and-action.

58. Science Direct. (2024). *Overview of bioenergy use and production in sub-Saharan Africa.* https://www.sciencedirect.com/science/article/pii/S1364032124005264.

59. International Renewable Energy Agency. (2024). *Energy Profile: Albania*. https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Europe/Albania_Europe_RE_SP.pdf.

60. International Energy Agency. (n.d.). *Energy system of Bulgaria*. https://www.iea.org/countries/bulgaria.

61. International Energy Agency. (n.d.). *Snapshot 2025*. https://iea-pvps.org/snapshot-reports/snapshot-2025/.

62. Global Wind Energy Council. (2025). *The Global Voice of the Wind Industry*. https://www.gwec.net/.

63. World Nuclear Industry Status Report. (2024). *The World Nuclear Industry Status Report 2024 (HTML)*. https://www.worldnuclearreport.org/The-World-Nuclear-Industry-Status-Report-2024-HTML.

64. International Hydropower Association. (2024). *2024 World Hydropower Outlook*. https://www.hydropower.org/publications/2024-world-hydropower-outlook.

65. International Renewable Energy Agency. (2024). *Energy Profile: Albania* [Press release]. https://www.irena.org/News/pressreleases/2015/Jan/Renewable-Power-Costs-Plummet-Many-Sources-Now-Cheaper-than-Fossil-Fuels-Worldwide; International Energy Agency. (2015). *World Energy Outlook 2015*. https://iea.blob.core.windows.net/assets/5a314029-69c2-42a9-98ac-d1c5deeb59b3/WEO2015.pdf.

66. European Commission. (2018). *Strategic Action Plan on Batteries*. https://eur-lex.europa.eu/resource.html?uri=cellar:0e8b694e-59b5-11e8-ab41-01aa75ed71a1.0003.02/DOC_3&format=PDF.

67. US Department of Energy. (2022). *America's Strategy to Secure the Supply Chain for a Robust Clean Energy Transition*. https://www.energy.gov/sites/default/files/2022-02/America%E2%80%99s%20Strategy%20to%20Secure%20the%20Supply%20Chain%20for%20a%20Robust%20Clean%20Energy%20Transition%20FINAL.docx_0.pdf.

68. European Commission. (2023). *Strategic Energy Technology Plan*. https://energy.ec.europa.eu/topics/research-and-technology/strategic-energy-technology-plan_en.

69. US Department of Energy. (2023). *Inflation Reduction Act of 2022*. https://www.energy.gov/lpo/inflation-reduction-act-2022.

70. European Commission. (n.d.). *The Green Deal Industrial Plan*. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan_en.

71. Foreign Policy. (2025). *Spain's Blackout Brings a New Meaning to Energy Security*. https://foreignpolicy.com/2025/05/01/portugal-spain-blackout-cause-energy-security-europe-solar-renewables/.

72. International Energy Agency. (n.d.). *Global Gas Security Review 2024*. https://www.iea.org/reports/global-gas-security-review-2024/executive-summary.

73. Ibid.

74. International Energy Agency. (2025). *A new era for nuclear energy beckons as projects, policies and investments increase*. https://www.iea.org/news/a-new-era-for-nuclear-energy-beckons-as-projects-policies-and-investments-increase.

75. Financial Times. (2025). *Shipping's Imperfect New Carbon Scheme may yet make an Impact*. https://on.ft.com/4iEZxi2.

76. International Energy Agency. (2024). *Investment in clean energy this year is set to be twice the amount going to fossil fuels*. https://www.iea.org/news/investment-in-clean-energy-this-year-is-set-to-be-twice-the-amount-going-to-fossil-fuels.

77. International Energy Agency. (2025). *CCUS Projects Database*. https://www.iea.org/data-and-statistics/data-product/ccus-projects-database#.

78. BloombergNEF. (2024). *Global Energy Storage Market Records Biggest Jump Yet*. https://about.bnef.com/blog/global-energy-storage-market-records-biggest-jump-yet/.

79. International Energy Agency. (2024). *Batteries and Secure Energy Transitions*. https://www.iea.org/reports/batteries-and-secure-energy-transitions.

80. World Economic Forum. (2024). Explainer: *The role of energy storage technologies in the energy transition*. https://www.weforum.org/stories/2024/11/the-role-of-energy-storage-technologies-in-the-energy-transition/.

81. World Economic Forum. (2024). *AI and energy: Will AI help reduce emissions or increase power demand? Here's what to know*. https://www.weforum.org/stories/2024/07/generative-ai-energy-emissions/.

82. Heatmap. (2024). *The IEA Isn't Sweating Data Center Electricity Demand*. https://heatmap.news/technology/iea-world-energy-outlook-2024.

83. International Copper Association. (2019). *Copper demand growth in data centres*. https://internationalcopper.org/wp-content/uploads/2021/08/Data-centres-factsheet.pdf.

84. World Economic Forum. (2024). *AI and energy: Will AI help reduce emissions or increase power demand? Here's what to know*. https://www.weforum.org/stories/2024/07/generative-ai-energy-emissions/.

85. Chatham House. (2025). *China's rare earth export restrictions threaten Washington's military primacy*. https://www.chathamhouse.org/2025/04/chinas-rare-earth-export-restrictions-threaten-washingtons-military-primacy.

86. Financial Times. (2023). *Inside the $220bn American cleantech project boom*. https://www.ft.com/content/3b19c51d-462b-43fa-9e0e-3445640aabb5.

87. ABI Research. (2025). *Global Grid Digitalization Investment to Hit US$150 Billion by 2030 Amid Growing Demand for Energy Capacity and Flexibility*. https://www.abiresearch.com/press/global-grid-digitalization-investment-to-hit-us150-billion-by-2030-amid-growing-demand-for-energy-capacity-and-flexibility.

88. World Trade Organization (WTO). (2025). *Global Trade Outlook and Statistics*. https://www.wto.org/english/res_e/booksp_e/trade_outlook25_e.pdf.

89. World Bank Group. (2024). *Off-grid Solar Could Provide First-time Electricity Access to Almost 400 Million People Globally by 2030* [Press release]. https://www.worldbank.org/en/news/press-release/2024/10/08/off-grid-solar-could-provide-first-time-electricity-access-to-almost-400-million-people-globally-by-2030.

90. The Economic Times. (2023). *Diversity best bet, no one-size-fits-all solution to energy transition: PM Modi*. https://economictimes.indiatimes.com/industry/renewables/diversity-best-bet-no-one-size-fits-all-solution-to-energy-transition-pm-modi/articleshow/103325905.cms.

91. Reuters. (2025). *EU's Ribera urges against hasty conclusions on Iberia blackout*. https://www.reuters.com/business/energy/eus-ribera-urges-against-hasty-conclusions-iberia-blackout-2025-05-05/.

92. TIME. (2022). Read the Transcript of TIME's Interview With Chile's President Gabriel Boric. https://time.com/6209557/gabriel-boric-transcript/

93. Natural Gas World. (2021). *Norway makes case for continued oil and gas production*. https://www.naturalgasworld.com/norway-criticises-eu-call-to-ban-arctic-oil-and-gas-93312.

94. Ministry of Energy, Government of Chile. (2025). *National Green Hydrogen Strategy*. https://energia.gob.cl/sites/default/files/national_green_hydrogen_strategy_-_chile.pdf.

95. African Development Bank Group. (n.d.). *Sustainable Energy Fund for Africa*. https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/sustainable-energy-fund-for-africa.

96. International Energy Agency. (2022). *Energy Island Project in the North Sea*. https://www.iea.org/policies/11562-energy-island-project-in-the-north-sea.

97. ASEAN Centre for Energy. (2023). *Growing Momentum of LTMS-PIP and Its Impact on Regional Integration*. https://aseanenergy.org/post/growing-momentum-of-ltms-pip-and-its-impact-on-regional-integration/.

98. World Resources Institute. (2021). *Germany: The Ruhr Region's Pivot from Coal Mining to a Hub of Green Industry and Expertise*. https://www.wri.org/update/germany-ruhr-regions-pivot-coal-mining-hub-green-industry-and-expertise.

99. US Department of Energy. (2024). *How Tax Credits are Driving Clean Energy Growth Two Years into Inflation Reduction Act*. https://www.energy.gov/policy/articles/how-tax-credits-are-driving-clean-energy-growth-two-years-inflation-reduction-act.

100. BloombergNEF. (2025). *Global Investment in the Energy Transition Exceeded $2 Trillion for the First Time in 2024*. https://about.bnef.com/blog/global-investment-in-the-energy-transition-exceeded-2-trillion-for-the-first-time-in-2024-according-to-bloombergnef-report/.

101. Ibid.

102. Ibid.

103. World Economic Forum. (2024). *Net-Zero Industry Tracker*. https://reports.weforum.org/docs/WEF_Net_Zero_Industry_Tracker_2024.pdf.

104. International Energy Agency. (2025). *Growth in global energy demand surged in 2024 to almost twice its recent average*. https://www.iea.org/news/growth-in-global-energy-demand-surged-in-2024-to-almost-twice-its-recent-average.

105. World Economic Forum. (2025). *Rethinking clean energy investment in EMDEs is a dual opportunity. Here's why*. https://www.weforum.org/stories/2025/01/rethinking-clean-energy-investment-in-emdes/#:~:text=Although%20recent%20investment%20has%20grown,economies%20and%20China%20since%202021.

106. BloombergNEF. (2025). *Global Investment in the Energy Transition Exceeded $2 Trillion for the First Time in 2024*. https://about.bnef.com/blog/global-investment-in-the-energy-transition-exceeded-2-trillion-for-the-first-time-in-2024-according-to-bloombergnef-report/.

107. Ibid.

108. United Nations Development Programme. (n.d.). *Sustainable Energy Revolution*. https://www.undp.org/energy.

109. International Renewable Energy Agency. (2024). *The energy transition in Africa: Opportunities for international collaboration with a focus on the G7*. https://www.irena.org/Publications/2024/Apr/The-energy-transition-in-Africa-Opportunities-for-international-collaboration-with-a-focus-on-the-G7.

110. World Economic Forum. (2024). *Egypt targets $40 billion of green hydrogen investment - plus other top energy stories*. https://www.weforum.org/stories/2024/03/egypt-green-hydrogen-investment-plus-other-top-energy-stories/.

111. Valor International. (2025). *Energy auctions in Brazil could attract up to R$57bn in 2025*. https://valorinternational.globo.com/business/news/2025/04/22/energy-auctions-in-brazil-could-attract-up-to-r57bn-in-2025.ghtml.

112. RMI. (2025). *Can Rooftop Solar Power India's Cities?*. https://rmi.org/insight/can-rooftop-solar-power-indias-cities/.

113. Carbon Herald. (2025). *South Korea Launches Ambitious Plan To Boost CCU*. https://carbonherald.com/south-korea-launches-ambitious-plan-to-boost-ccu/.

114. International Trade Administration. (2025). *Kenya Energy Announcement of $1.8 billion geothermal expansion for electricity*. https://www.trade.gov/market-intelligence/kenya-energy-announcement-18-billion-geothermal-expansion-electricity.

115. Masdar. (2023). *Masdar Signs Agreement to Explore Exporting Green Hydrogen*. https://masdar.ae/en/news/newsroom/masdar-signs-agreement-to-explore-exporting-green-hydrogen

116. International PtX Hub. (2024). *Solar NH3-Pool Chile*. https://ptx-hub.org/wp-content/uploads/2025/02/h$_2$uppp-ppp-result-chile-soventix-en.pdf.

117. International Renewable Energy Agency. (2023). *Low-cost finance for the energy transition*. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2023/May/IRENA_Low_cost_finance_energy_transition_2023.pdf.

118. International Renewable Energy Agency. (2023). *Low-cost finance for the energy transition*. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2023/May/IRENA_Low_cost_finance_energy_transition_2023.pdf.

119. International Energy Agency. (2022). *Global energy employment rises above pre-Covid levels, driven by clean energy and efforts to strengthen supply chains*. https://www.iea.org/news/global-energy-employment-rises-above-pre-covid-levels-driven-by-clean-energy-and-efforts-to-strengthen-supply-chains.

120. Ministry of New and Renewable Energy, Government of India. (2023). *National Green Hydrogen Mission*. https://mnre.gov.in/en/national-green-hydrogen-mission/.

121. Saudi Electricity Company. (2024). *Sustainability Report 2024*. https://www.se.com.sa/-/media/sec/Investors/Sustainability-Reports/SEC-Sustainability-Report-2024_English.ashx.

122. Department of Climate Change, Energy, the Environment and Water, Australian Government. (2024, 17 September). *Queensland's new clean energy training centre* [Press release]. https://www.energy.gov.au/news/queenslands-new-clean-energy-training-centre.

123. The White House. (2023, 13 October). *Biden-Harris Administration Announces Regional Clean Hydrogen Hubs to Drive Clean Manufacturing and Jobs* [Press release]. https://bidenwhitehouse.archives.gov/briefing-room/statements-releases/2023/10/13/biden-harris-administration-announces-regional-clean-hydrogen-hubs-to-drive-clean-manufacturing-and-jobs/.

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