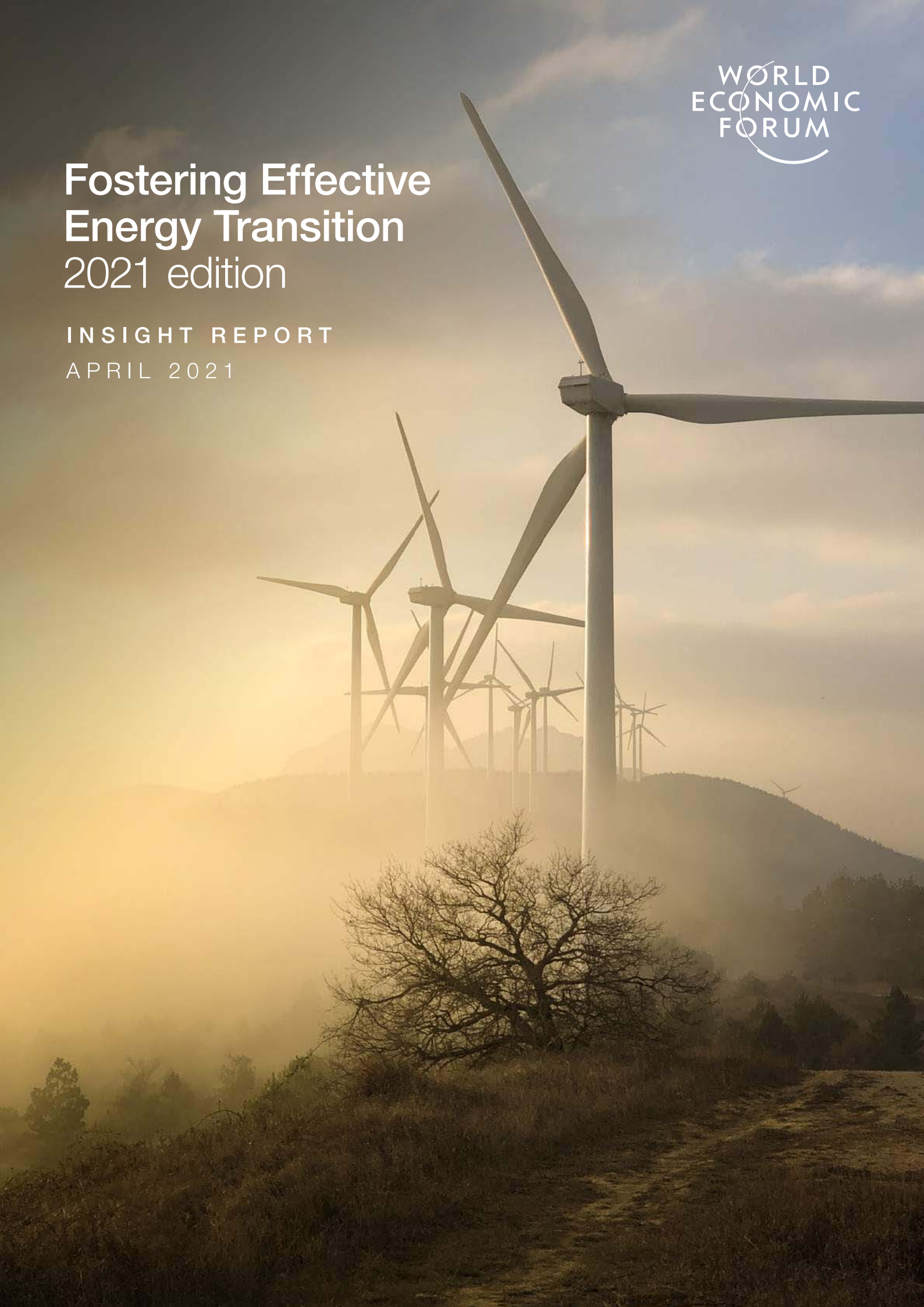


# Fostering Effective Energy Transition 2021 edition

INSIGHT REPORT

APRIL 2021



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# Foreword

This edition marks the 10th anniversary of the Energy Transition Index (ETI). In the past decade, we have witnessed an unprecedented acceleration of the energy transition. Two examples illustrate the point: the growing speed of renewable energy penetration (particularly wind and solar), and the important strides made in energy access. These changes have been facilitated by several factors, among which technological advancement and growing political support stand out. However, extraordinary as this evolution has been, there remain some critical challenges to delivering sustainable and affordable energy while improving access and security.

A year has passed since the world was hit by what became the greatest global health challenge in over a century. The crises generated by the COVID-19 pandemic continue to affect countries across the world in multiple ways, underscoring key unsolved societal issues. For example, as economic development has stumbled or reversed, the health emergency has exacerbated inequality and hampered efforts to tackle energy poverty. Unilateral approaches adopted by governments in their handling of challenges during the pandemic, from personal protective equipment to the approval and dissemination of vaccines, have also raised concerns about the international community's ability to come together in coordinated action across countries and sectors. Moreover, uneven compliance to recommended public health measures, driven either by economic reasons or differences in values, illustrates the challenges in mobilizing all sections of society in a cohesive response to a shared problem. The latter is critical as we look to take effective collective action on energy transition.

When we published last year's ETI and discussed its findings, we were only a few months into the pandemic. We talked about how energy systems were subject to compounded disruptions and we wondered what a new normal would look like. Some of the questions raised at that time have been answered, but many important pieces in this complex, evolving puzzle have not yet been put together. The actions we take in the early years of this decade of delivery and action will be critical in ensuring that strong, long-term ambition is supported by concrete, immediate progress. We are eager to see stimulus and recovery packages playing an important role in this journey.

This report discusses the key findings from the Energy Transition Index 2021. For this report, we have made a few changes in the methodology to reflect the rising sense of urgency of climate change, and we have refreshed some the indicators to use available data more effectively. The ETI supports decision-makers with a transparent fact-base on the progress and gaps in the energy transition, the complexity of that transition, and its interdependence with social, political, environmental, economic and institutional elements. Coming out of a challenging 2020, and based on discussions with key global experts, this edition pays special attention to the climate component. In addition, we address how to improve the robustness and resilience of the transition and how to tackle elements that could derail the successful transformation of our energy systems.

One of the key findings is a call for coordinated, multi-stakeholder action to achieve an effective energy system evolution. To that end, the World Economic Forum encourages the sharing of leading practices and the use of its platform for public-private collaboration to facilitate the process of energy transition around the world.

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# Executive summary

The past decade has established the strong initial momentum to transform the energy system for the decades ahead. The scaling of nascent technologies and an increased focus on climate change have fixed global attention firmly on the decarbonization of energy systems.

This journey is far from over. As of 2018, 81% of the world's energy was still supplied by fossil fuels,<sup>1</sup> global greenhouse gas emissions rose through 2019 and more than 770 million people around the world still lack access to electricity.<sup>2</sup> The transformation of our energy systems needs to increase its momentum to help achieve critical objectives such as the UN's Sustainable Development Goals and the Paris Agreement.

## A decade into the energy transition marks a new high, but acceleration is required

This edition marks the 10<sup>th</sup> anniversary of the World Economic Forum's benchmarking of countries on their energy transition progress. We have taken the opportunity to look back at the lessons learned from the past decade, while also looking forward to the journey ahead.

- Aggregate ETI scores rose over the past decade for countries collectively accounting for 86% of global total energy supply and for 88% of global CO<sub>2</sub> emissions from fuel combustion.
- The ranking of top countries on the ETI has remained broadly consistent over the past decade. **Denmark, Finland** and the **United Kingdom**, highest improvers in the top 10 positions, were able to improve their energy system performance and sustainability outcomes thanks to a stable regulatory environment, diversified energy mix and cost-reflective energy pricing.
- Countries with rising energy demand, such as **China, India** and **Sub-Saharan African** nations, have registered the largest gains, but their scores on the ETI remain low in absolute terms.

## Strides made on energy access; reliability is the next frontier

Over the past 10 years, more than 70% of the countries in the ETI made progress on the **energy access and security** dimension, primarily due to

improvement in levels of electricity access around the world. However, more efforts are needed to improve the quality of electricity supply in newly electrified areas. This is critical for the delivery of public services, such as testing and vaccination programmes for COVID-19. Moreover, increasingly frequent and unpredictable extreme weather events have exposed the vulnerability of grids, underscoring the urgent need to modernize and enhance the resilience of electricity transmission and distribution infrastructure.

## Strong gains made in environmental sustainability, but significant gaps remain

Encouraging progress has been made in **environmental sustainability** over the past 10 years, with countries accounting for 88% of global total energy supply improving their scores on this dimension.

- Global average energy intensity fell by 15% between 2010 and 2018. However, this improvement has yet to fully translate into meaningful gains, as the carbon intensity of the energy mix was broadly flat over the same period.
- While there has been encouraging progress in areas such as rising levels of investment and political commitment, progress has been far slower in translating ambitions into actions and in realizing the transformation of the energy system structure itself.
- The total amount of electricity generated from coal has been on an upward trajectory over the past 10 years. Identifying viable ways for the early retirement of carbon-intensive assets will be needed to accelerate the transition.

## Assessing the resilience of energy transition

Over the past 10 years, only 13 of the 115 benchmarked countries have made consistent gains (defined as consistently above-average performance improvements on the index). This demonstrates the difficulty in sustaining progress and the complexities of the energy transition.

Systemic disruptions such as the pandemic have underscored the impact of external shocks. The energy transition has shown signs of resilience



through COVID-19, which highlighted the resilience of renewables in particular.<sup>3</sup> However, despite the short drop in emissions during the pandemic, global emissions have since rebounded, according to the International Energy Agency.<sup>4</sup> As we head deeper into the decade of action<sup>5</sup> – during which we must accelerate progress towards transition and halve emissions by 2030 to remain on track to meet the 1.5°C Paris Agreement goal – we cannot afford to lose momentum or, worse, go into reverse.

This report identifies three imperatives to increase the resilience of the energy transition:

1. **Deliver a “just transition” for all.** Inequality is on the rise and broad stakeholder buy-in is a pre-requisite for resilience. The energy transition itself will change resource flows and reset sectors of the energy system in ways that, if not planned for, could lead to unintended consequences and leave entire communities adrift. Policy-makers should prioritize measures to support the economy, workforces and society at large as countries shift to a low-carbon energy system. This will require an inclusive approach to evaluating energy policy and investment decisions.
2. **Accelerate electrification and go beyond.** Electrification and the scaling up of renewables are critical pillars of the energy transition and need to be ramped up quickly. However,

coordination on the demand side and the contribution of other energy sources are necessary to achieve the full impact required. Increased R&D funding and cross-sector collaboration are needed to fully decarbonize energy systems, from green hydrogen and negative emission technologies to digitally enabled demand optimization.

3. **Double-down on public-private sector collaboration.** The UN Intergovernmental Panel on Climate Change (IPCC) estimates that annual investments in clean energy and energy efficiency need to increase by a factor of six by 2050,<sup>6</sup> compared with 2015 levels, to limit warming to 1.5°C. Despite the growing inflow of capital into the sector, significant funding gaps remain, particularly in emerging markets and nascent technologies. Collaboration between public and private sectors, including risk-sharing as low-carbon solutions mature, will attract the diversified, resilient sources of capital needed for multi-year and multi-decade investments into energy systems.

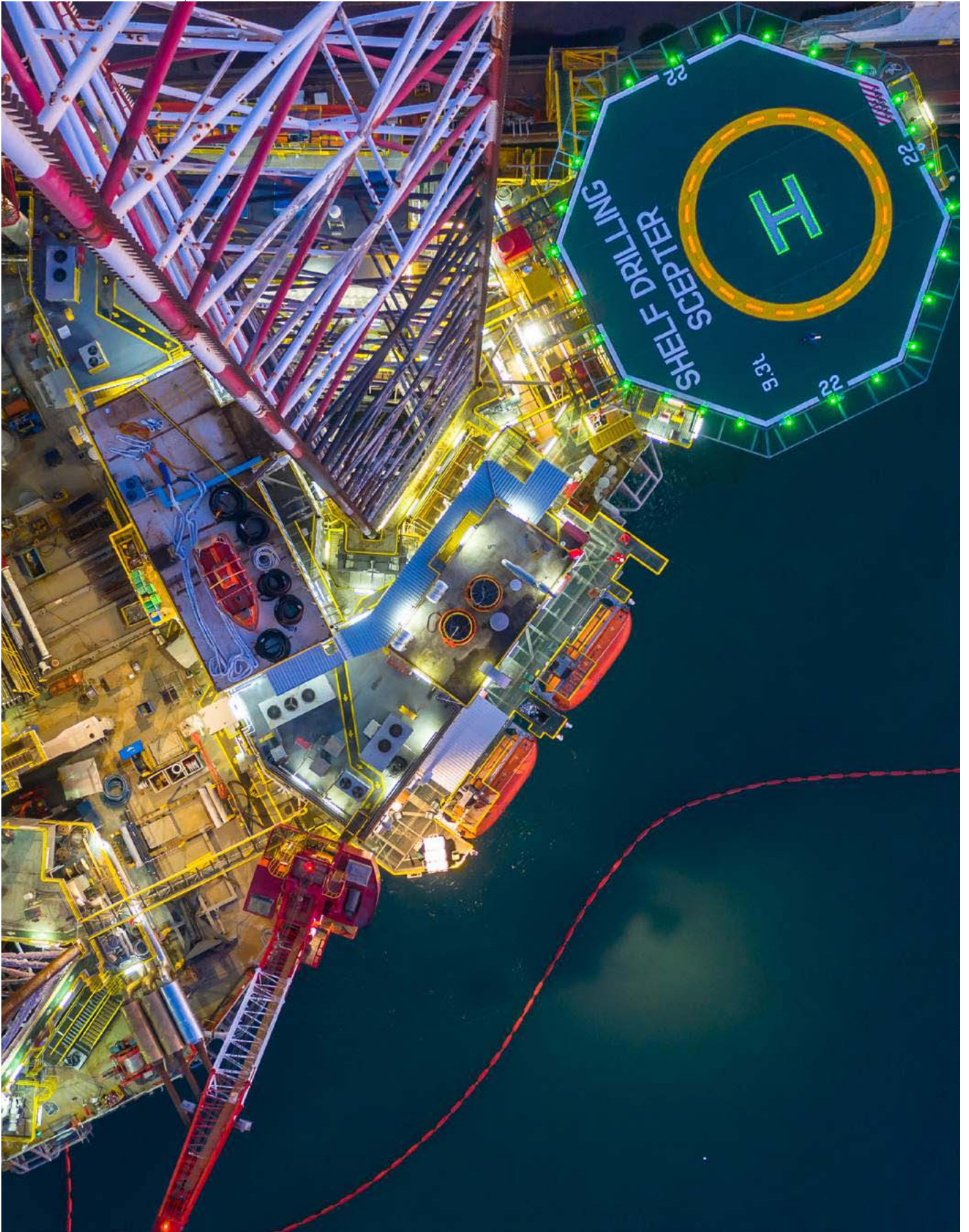
Building an effective and resilient energy transition requires all hands on deck. As countries seek to recover from the impact of COVID-19, there is an opportunity to reset and rethink the way we power our economies, produce materials and even how we travel and live. **It is critical to root the energy transition in economic, political and social practices so that progress becomes irreversible.**





1

# Introduction





The past decade saw transformative changes across the energy system. In 2011, the average price for crude oil was close to \$100/barrel.<sup>7</sup> Solar and wind energy were economically uncompetitive compared to fossil fuel-based electricity generation, and just over 70 GW<sup>8</sup> of solar and 238 GW of wind capacity had been installed globally. From 2011 to 2019, global installed capacity grew sevenfold for solar PV and approximately threefold for wind energy,<sup>9</sup> supported by improving cost competitiveness and operational efficiency. Global investment in the energy transition rose from less than \$300 billion per annum in 2011 to almost \$500 billion by 2020.<sup>10</sup> Eight out of the world's 10 largest economies have committed to achieve net-zero emissions by mid-century.<sup>11</sup>

However, clear challenges remain. As of 2018, 81% of the world's energy came from fossil fuels,<sup>12</sup> global emissions rose steadily over the period to 2019 and more than 770 million people around the world still lack access to electricity.

## Is the energy transition resilient?

This 10<sup>th</sup> anniversary report is the opportunity to reflect and ask the question whether the energy transition is resilient and if the momentum is sufficient. A resilient transition is one that maintains the direction, speed and required rate of progress towards a secure, affordable, sustainable and inclusive energy system even in the face of disruptions.

Throughout 2020, the World Economic Forum engaged global experts from the public and private sectors and across the energy value chain. The broad consensus is one of "cautious optimism" but with clear recognition of the work still needed, especially with respect to climate change and emissions targets.

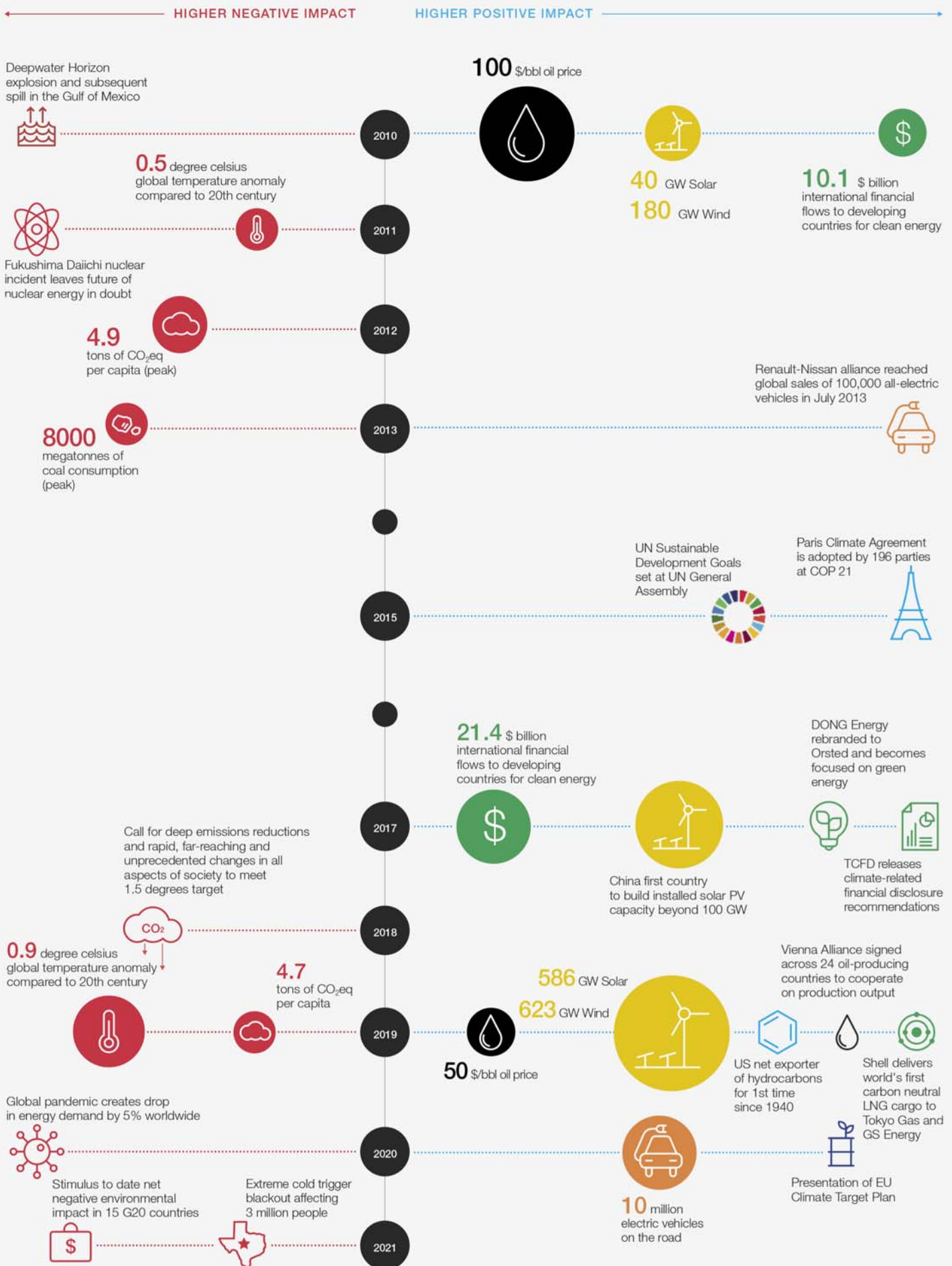
As we continue through the decade of action and delivery on tackling the climate change challenge, it is more urgent than ever to accelerate the energy transition. This report will focus on the environmental sustainability dimension of the energy triangle and how leading countries have achieved progress on that dimension, even in the face of emerging risks and challenges.

The report summarizes insights from our analysis of the ETL and the lessons from 10 years of benchmarking countries on energy transition. We then provide an assessment of the evolving risk landscape and some key considerations for increasing the momentum and building resilience into the energy transition





FIGURE 1: Energy transition over the last decade



Source: World Economic Forum



FIGURE 2: | Key trends within the energy transition

2010 → LATEST YEAR

**250**

**\$ billion**

global investment  
in the energy transition



**500**

**\$ billion**

global investment in the  
energy transition (2020)

**0.38**  
**\$/kWh**

solar PV  
LCOE

**0.086**  
**\$/kWh**

onshore  
wind LCOE



**0.07**  
**\$/kWh**

solar PV  
LCOE (2019)

**0.053**  
**\$/kWh**

onshore wind  
LCOE (2019)

**19%**

share of electricity from  
renewables, incl. hydro



**26%**

share of electricity from  
renewables, incl. hydro (2019)

**0.5**  
**million**

cumulative global EV  
and plug-in sales



**10**  
**million**

cumulative global EV  
and plug-in sales (2020)

**5.4**  
**MJ/\$**

energy intensity



**4.6**  
**MJ/\$**

energy intensity (2018)

**33**

**gigatonnes**

emissions fossil fuel  
combustion and industrial  
processes - CO<sub>2</sub>eq, world



**34**

**gigatonnes**

emissions fossil fuel  
combustion and industrial  
processes - CO<sub>2</sub>eq, world (2020)

**1.2**

**billion**

# of people without  
access to electricity



**770**

**million**

# of people without  
access to electricity

Source: Bloomberg New Energy Finance, International Energy Agency, International Renewable Energy Agency, Sustainable Energy for All, and others

2

# The Energy Transition Index in a decade to deliver





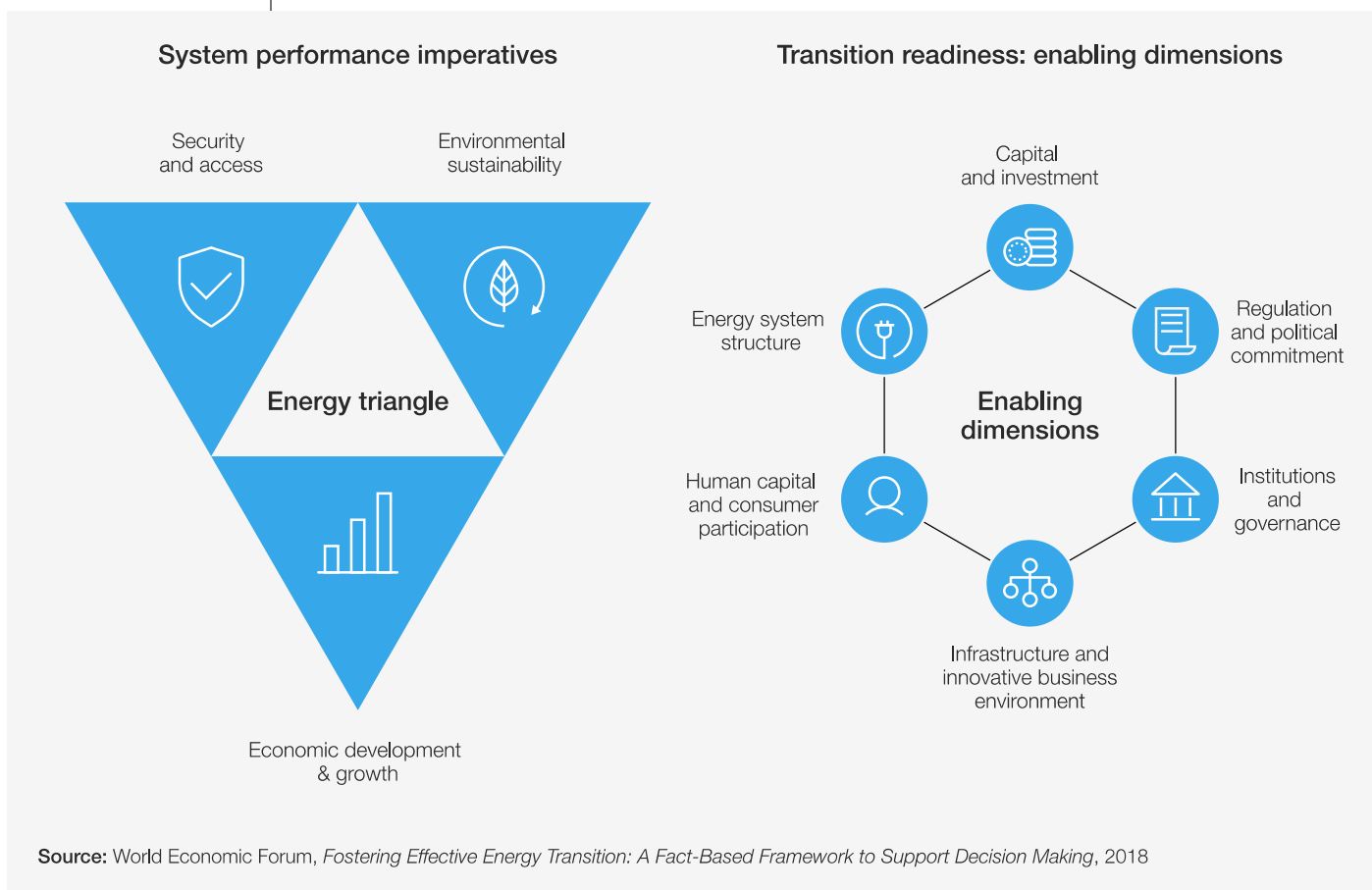
The ETI provides a data-driven framework to foster understanding of the performance and readiness of energy systems across countries for transition. This year's edition includes methodological updates (see Box 1) to reflect changes in the global energy landscape and the urgency of the task ahead, particularly in taking actions that will reduce carbon emissions.

Previously published as the Energy Architecture Performance Index (EAPI) series from 2013 to 2017, the ETI was developed to reflect the interdependencies of energy system transformation with the macro-economic,

political, regulatory and social factors that determine a country's readiness for transition. The ETI framework is composed of two equally weighted sub-indices (see Figure 3): the current energy system performance and the enabling environment for the energy transition.

An effective energy transition can be defined as a timely transition towards a more inclusive, sustainable, affordable and secure energy system that provides solutions to global energy-related challenges, while creating value for business and society, without compromising the balance of the energy triangle.

FIGURE 3: Energy Transition Index framework



Source: World Economic Forum, *Fostering Effective Energy Transition: A Fact-Based Framework to Support Decision Making*, 2018

**System performance** provides an assessment of a country's energy system performance across three key priorities:

- the ability to support economic development and growth
- universal access to secure and reliable energy supply
- environmental sustainability across the energy value chain

The objective of energy transition in a country should be to simultaneously deliver across these three priorities, thereby maintaining a balanced energy triangle. Pursuing a long-term goal of a

balanced energy triangle can support the choice of appropriate policies and instruments as well as synchronize efforts across countries.

The progress on energy transition in a country is determined by the extent to which a robust enabling environment can be created. This includes political commitment, a flexible regulatory structure, a stable business environment, incentives for investments and innovation, consumer awareness and the adoption of new technologies. The ETI measures progress along these dimensions in the transition readiness sub-index. Energy transition is not restricted to linear shifts in fuel mix or the substitution of production technologies. Rather, the social, economic and technological systems need to co-evolve<sup>13</sup> to shape the transition.<sup>14</sup>

Countries are scored along 39 indicators (see Appendix) on a scale of 0 to 100. Countries scoring the global maximum on a given indicator are assigned a score of 100 on that indicator.

Given the systemic and endogenous nature of the energy transition, country scores are the result of a blend of factors including resource endowments, geography, climate, demography and economic

structure. Moreover, country scores in some dimensions are based on factors beyond the scope of national decision-making, such as commodity market volatility, geopolitics, international climate change action and financial market sentiment.

Country rankings should therefore be considered in the context of a country's unique set of circumstances and not a clear-cut diagnosis of energy transition accomplishment.

## BOX 1: Methodological revisions in ETI 2021

The Energy Transition Index (ETI) is regularly refined to reflect changes in the global energy landscape and to improve the quality of insights delivered to stakeholders. Due to the revisions made this year, the results of this year's index are not directly comparable to ETI 2020. For the purpose of trend analysis, we have recalculated historical scores using the revised methodology. Changes have been made in three key categories:

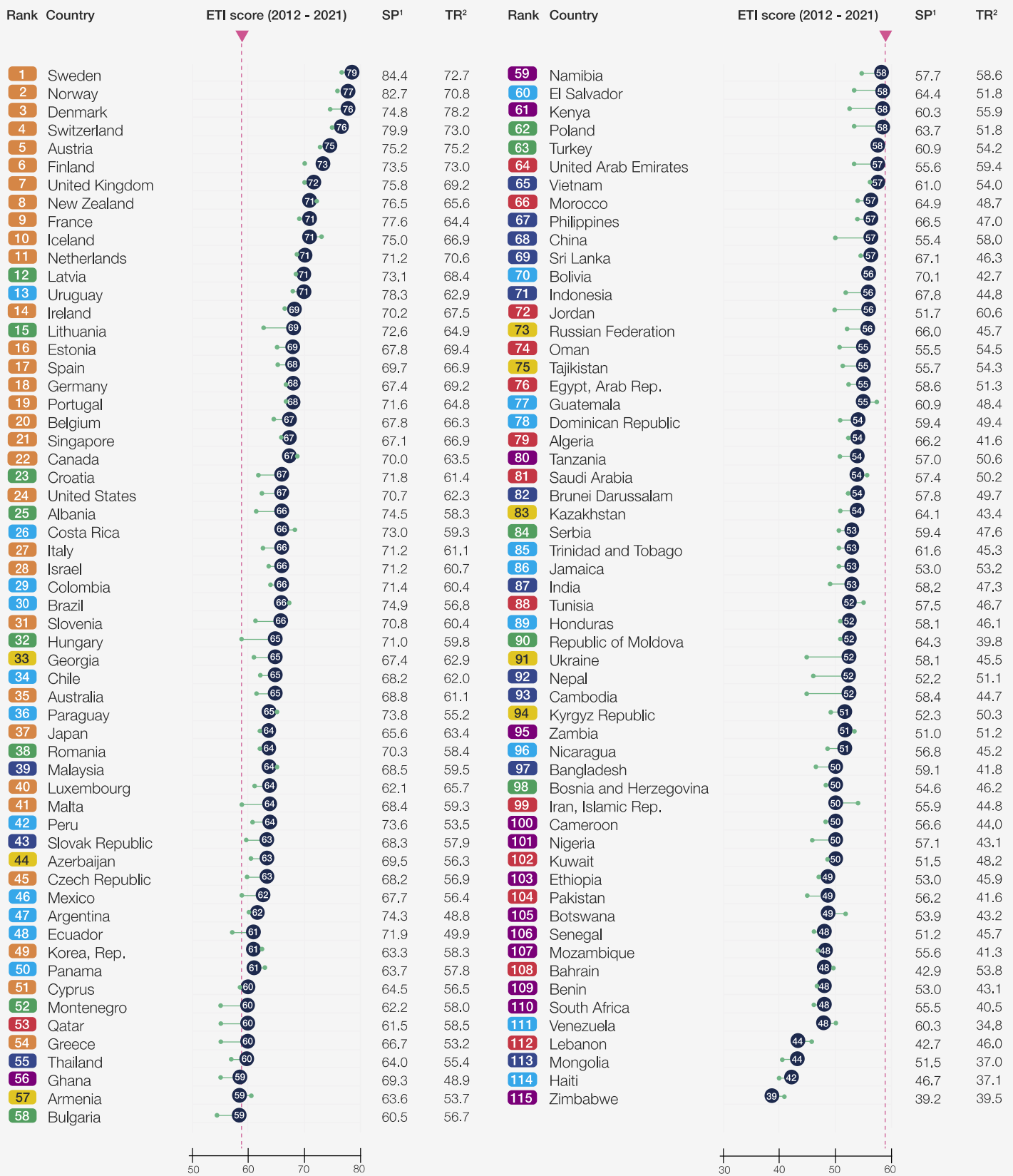
- **Framework weights.** As we enter a crucial juncture of global action towards a sustainable energy future, we have adjusted the weights of several core energy system indicators. We have done this to emphasize the urgency of country action needed to decarbonize their energy systems. Countries that take greater action to shift their energy systems away from fossil fuels will see greater improvements in their scores going forwards.

- **Thresholds.** The ETI adopts a min-max method to normalize indicator scores on a common scale of 0-100. In most cases, the data ranges are narrowed to control for outliers. The min-max thresholds need to be updated at regular intervals to account for natural evolution in the spread of cross-sectional data. This year, in line with the broader methodology review, we have updated the thresholds in line with the most up-to-date data. Out of the 39 indicators, 10 have been updated, covering 30% of total index weight.
- **Data sources.** We have also updated the data sources for several of our indicators due to considerations of data recency and availability.

**Note:** A full account of the methodological changes conducted carefully in conjunction with experts and our advisory board will be published in a separate addendum to this report, along with a full list of data sources.



FIGURE 4: | ETI 2021 results table



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

- ETI 2021 score
- ETI progression since 2012
- ▼ 2021 Global Average (59%)

<sup>1</sup>System performance 2021

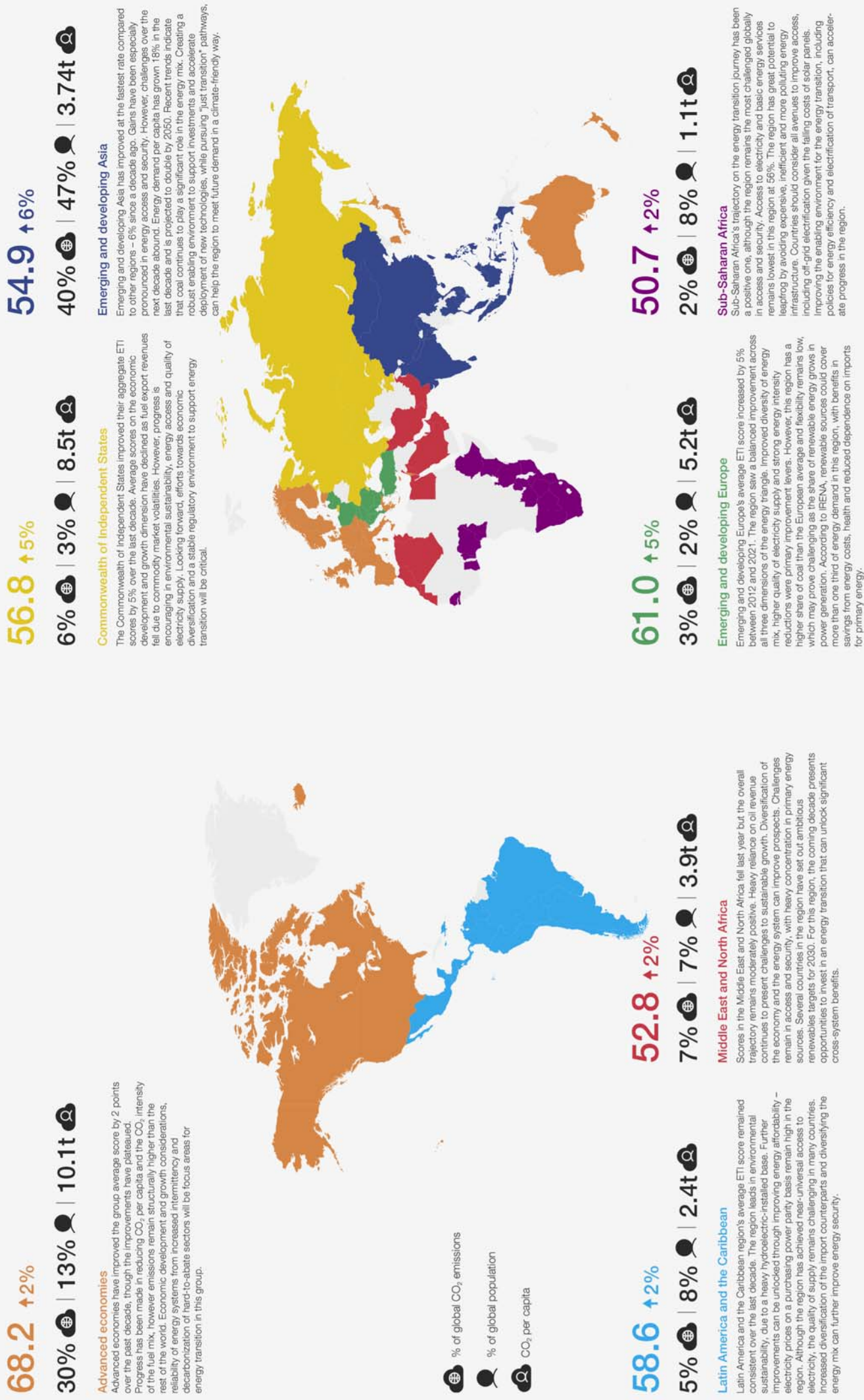
<sup>2</sup>Transition readiness 2021

For the ETI 2021 methodology, see the methodology addendum published separately.

**Note:** The Energy Transition Index benchmarks countries on the performance of their energy system, as well as their readiness for transition to a secure, sustainable, affordable, and reliable energy future. ETI 2021 scores on a scale from 0 to 100.

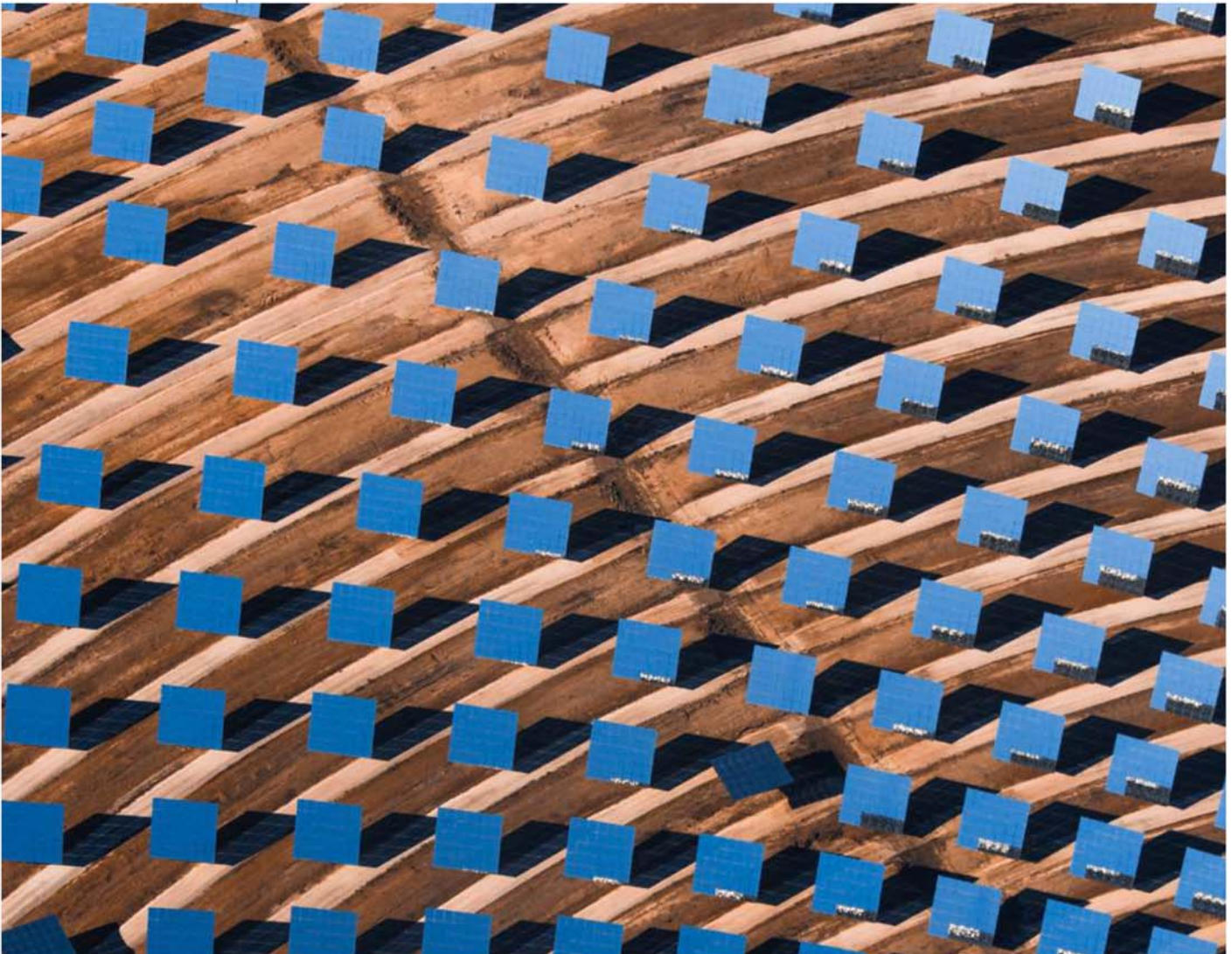
Source: World Economic Forum

FIGURE 5: | Regional scores and key insights: average scores by peer group – ETI 2021 and change from ETI 2012 (recalculated)



Source: World Economic Forum





## Key highlights:

1. Global average ETI scores have increased in 8 out of the last 10 years
2. Only 25% of countries have balanced the three imperatives of the energy triangle
3. Progress in energy access and environmental sustainability is strong, but economic growth challenges remain
4. Top 10 countries account for only 3% of global CO<sub>2</sub> emissions from fuel combustion
5. Only 13 out of 115 countries have made steady gains in the past decade
6. Speed of energy transition is fast in emerging economies, but large gaps remain

**This year marked the highest global average scores since the inception of the ETI, with progress made across both system performance and transition readiness.**

Figure 6 shows global average scores across the ETI in energy system performance and transition readiness for 2012 and 2021. However, progress is uneven. High-income countries are making more progress in environmental sustainability relative to the rest of the world. Progress in emerging economies has tended to come from improved access and security as countries develop.

**Sweden** leads the global rankings, followed by **Norway** and **Denmark**. Among the world's 10 largest economies, only the **United Kingdom** and **France** feature in the top 10. The top 10 account for only around 3% of energy-related CO<sub>2</sub> emissions and around 2% of the global population.

The list of top performers in the ETI has stayed broadly consistent over the course of the decade. Although each country's energy transition pathway is different, they all share common attributes including:

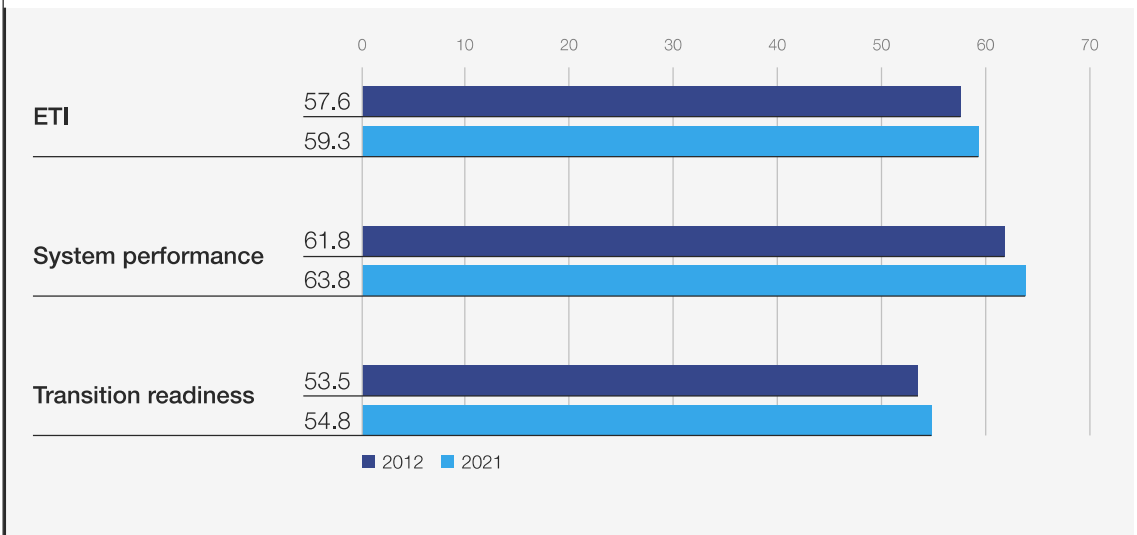
- low levels of fossil fuel subsidies,
- enhanced energy security from a diversity of fuel mix and import partners,
- improving carbon intensity,

- reduced dependence on fossil fuels in the energy mix, and
- a strong regulatory environment to drive the energy transition.

**Denmark, Finland** and the **United Kingdom** – the top improvers in the top 10 – were able to translate developments in leading indicators such as regulatory environment and energy mix into improved outcomes in system performance, particularly on the environmental sustainability dimension.

Figure 7 shows countries' ETI score progression between 2012 and 2021. Out of 115 countries, 92 countries have made progress over this period, but only 68 have improved their scores by more than two percentage points. Notably, large emerging centres of demand, such as **China** and **India**, have seen strong improvements. Meanwhile, scores in **Brazil, Canada, Malaysia, Singapore** and **Turkey** have been relatively stable. Only 13 out of the 115 countries have made steady gains (defined as consistently above-average performance improvements on the ETI). This demonstrates the difficulty of sustaining progress and the inherent complexity of the energy transition. In the next decade, consistent, accelerated progress is key to meeting the world's climate targets as well as the UN's Sustainable Development Goals.

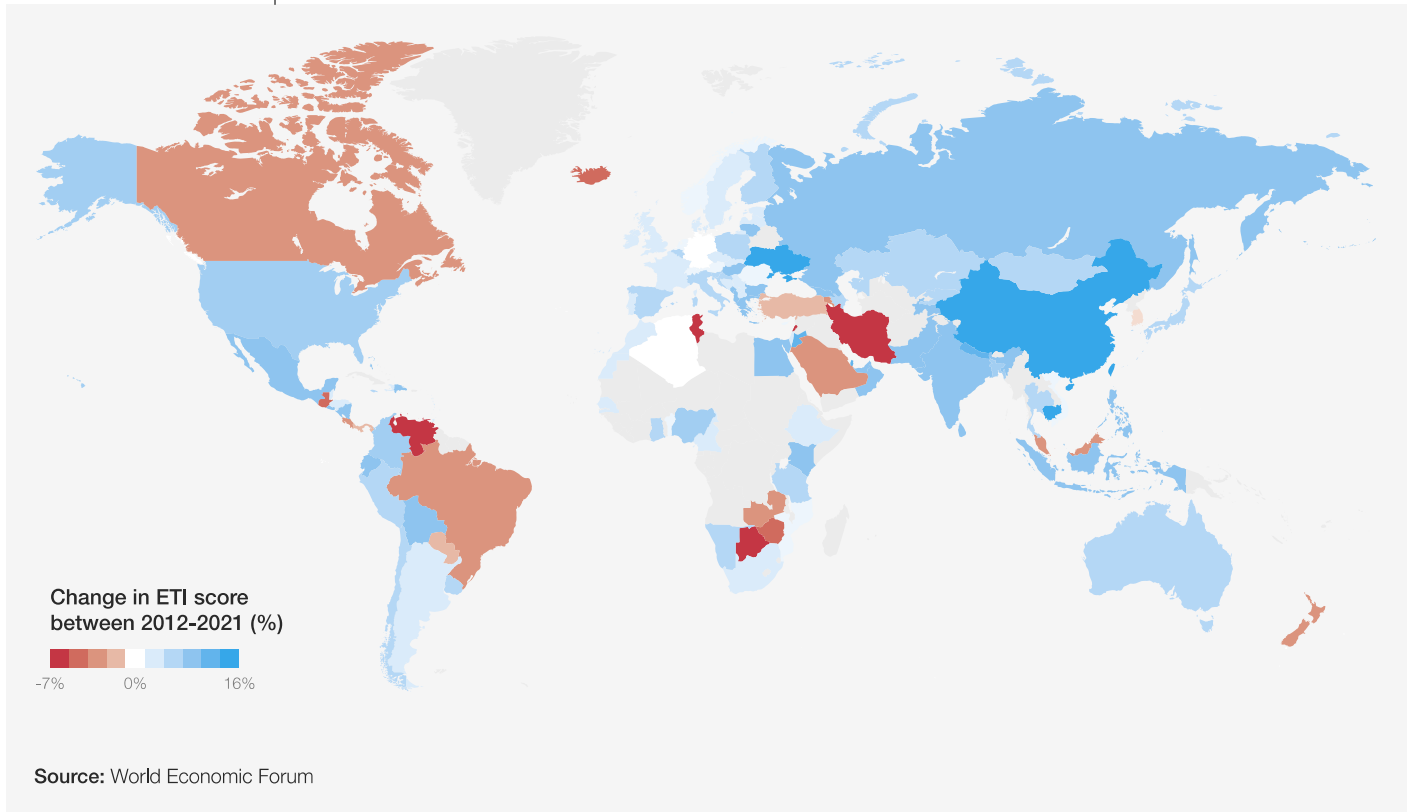
FIGURE 6: ETI 2021 Global average scores



Source:  
World Economic Forum

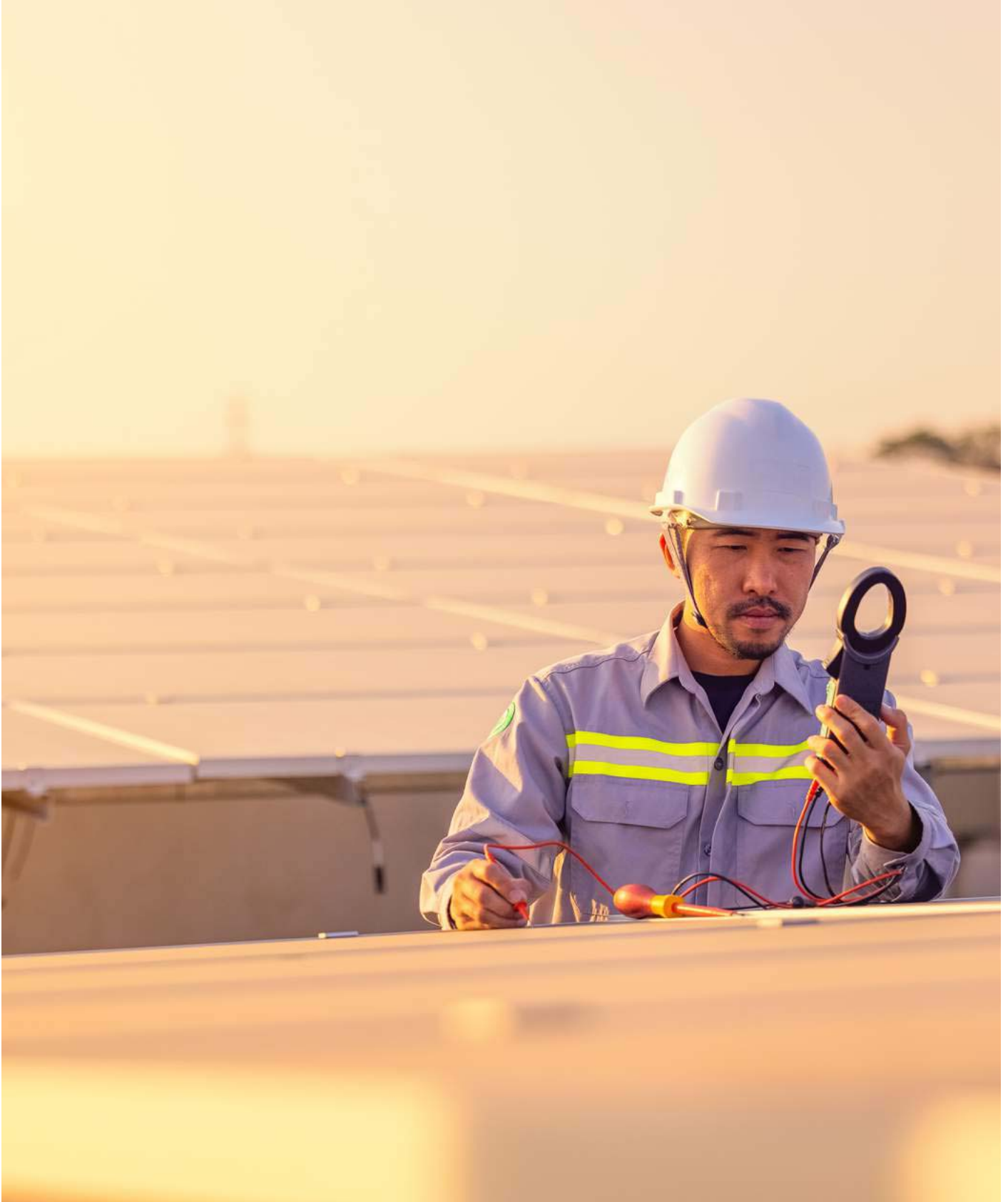


FIGURE 7: Countries' change in Energy Transition Index score, 2012-2021



4

# Sub-index and dimension trends





## 4.1 Key findings

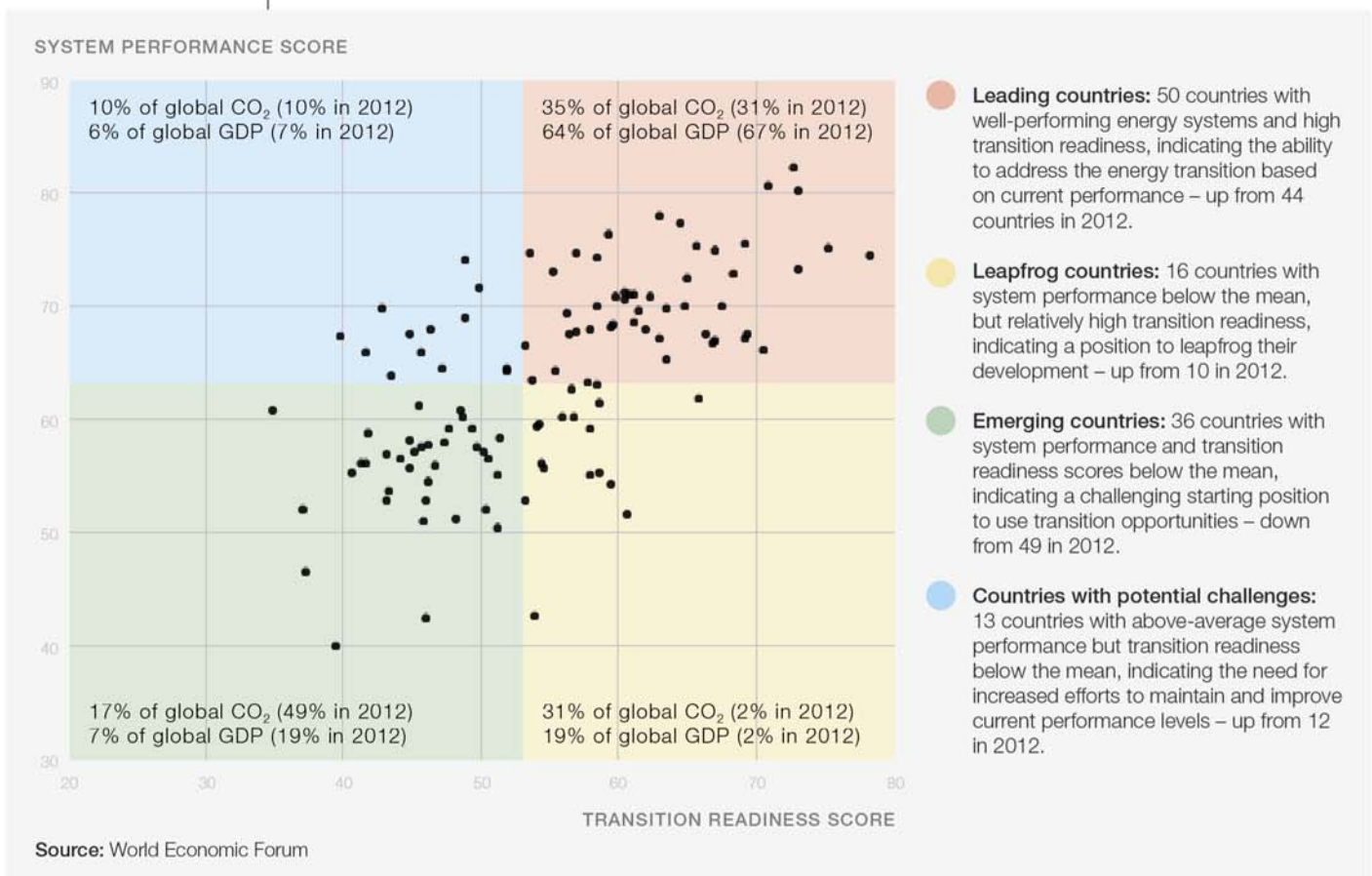
The overall ETI score is composed of two sub-indices as described in the previous section: energy system performance and transition readiness. Figure 8 shows the distribution of countries across four quadrants, depending on their scores on these two sub-indices in 2021, and the cumulative GDP (nominal) and CO<sub>2</sub> emissions from fuel combustion of countries in the respective quadrants in 2021 and 2012 to reflect net progress over this period. The figure assigns each country to one of four quadrants:

- Leading countries – with well-performing energy systems and high transition readiness
- Leapfrog countries – with below-average system performance but high transition readiness
- Emerging countries – with below-average system performance and below-average transition readiness
- Countries with potential challenges – with above-average system performance but below-average transition readiness

In the category of countries with potential challenges, with a high level of current system performance but a weak enabling environment, there has been relatively less movement since 2012. The strong performance of energy systems in these countries is supported by abundant natural resource endowments and the robustness of legacy energy infrastructure. However, these attributes can be impediments for accelerated progress on energy transition, given the inertia from a legacy-installed base.

The trajectory of leading countries over the past decade has been largely consistent, displaying the advantages of building a strong enabling environment and continuing the momentum of policies that support the energy transition. For countries with below-average energy system performance (mainly those countries with an increasing demand for energy), there has been significant movement from the “emerging” to the “leapfrog” category, signalling the gradual strengthening of enabling environments in emerging demand centres. **The energy transition is an opportunity for emerging economies to avoid the risk of carbon lock-in by leveraging the increasing cost-competitiveness of new energy technologies.**

FIGURE 8: ETI system performance and transition readiness scores, 2021



## 4.2 System performance

Over the past decade, 70% of the countries tracked by the ETI have improved their energy system performance scores, providing a strong indication of the growing capacity of their energy systems to deliver across the following three performance dimensions:

- Economic development and growth
- Energy access and security
- Environmental sustainability

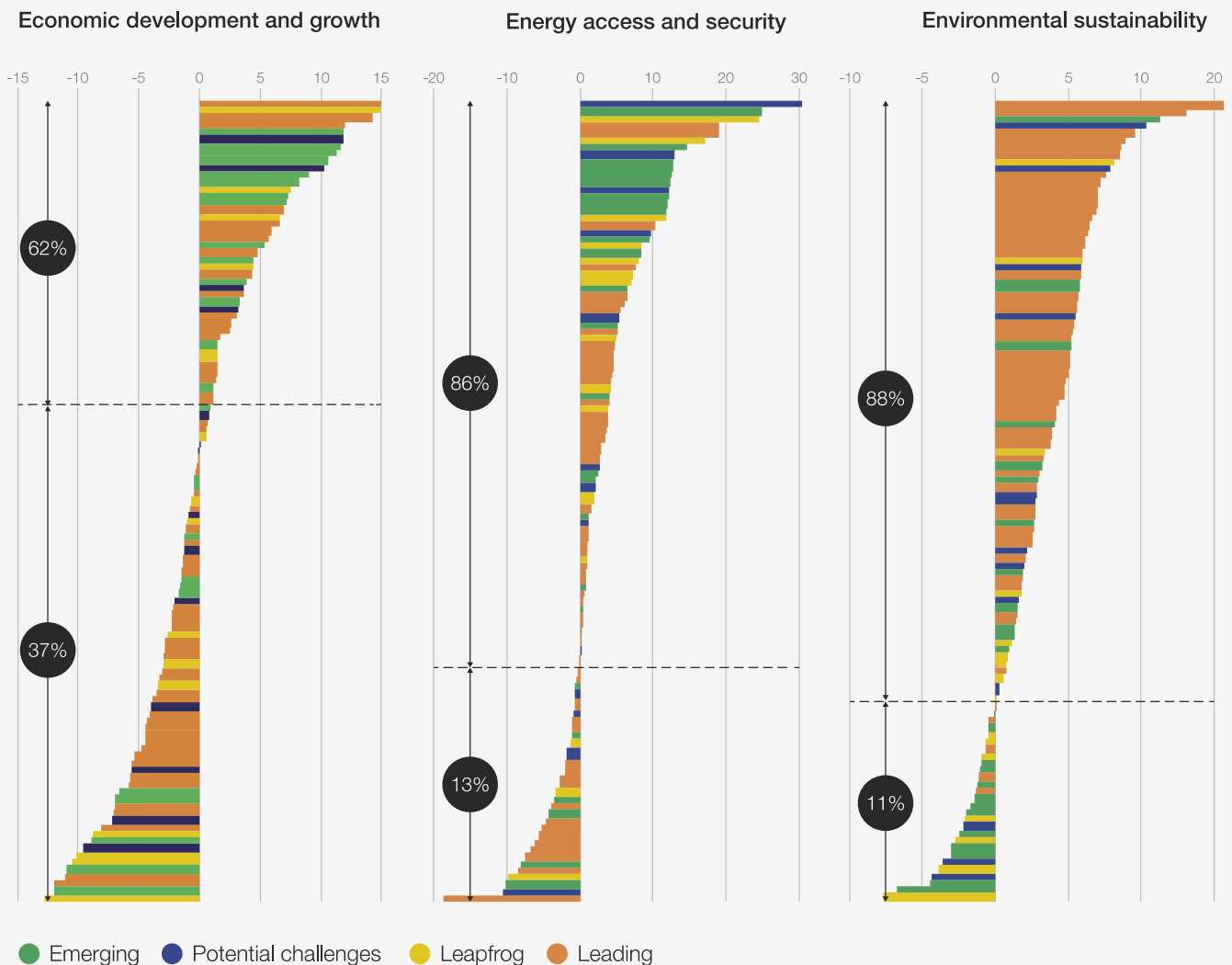
However, the pattern of improvements on system performance varies by dimension. More than 70% of countries (representing 86% of global total energy supply) have improved their scores on energy access and security since 2012. Higher relative gains were achieved by countries in emerging and leapfrog categories, driven by improvements in energy access. Leading countries have only

managed to achieve marginal improvements, which is to be expected given the maturity of their current energy system infrastructures. The environmental sustainability dimension displays similar trends, with a comparable number of countries improving on this dimension. However, the gains on environmental sustainability are higher for countries in the emerging and leapfrog categories, supported by the strengthening of their enabling environments.

The trends on the economic growth and development dimension have been mixed, with more than half of countries regressing over the past decade. In relative terms, economies in the emerging category have been able to make faster progress on this dimension, but their average scores remain 30% lower than leading countries.

The following sections provide further insights into the evolution of countries on these dimensions over the past decade.

FIGURE 9: Change in system performance dimension scores by country archetype, 2012-2021



Source: World Economic Forum



## 4.2.1 Economic development and growth

The economic development and growth imperative of energy transition stems from the critical role played by the energy sector in socio-economic development. Current economic growth pathways rely on the availability of abundant, secure and affordable energy supplies. As is evident in emerging economies around the world, the demand for energy is growing as they progress along their economic growth journeys. While economic growth may not be the sole objective of energy transition, the economic benefits should outweigh the costs.

The ETI's economic development and growth dimension tracks the affordability, competitiveness and fiscal implications of the energy sector in countries. Over the past decade, the average global scores for this dimension have been largely flat, reflecting the continuing challenge to decouple economic growth from energy production and consumption. However, the trends vary depending on the stage of each country's economic development.

While more than three-quarters of the countries tracked increased their aggregate ETI scores over the past decade, fewer than half were able to do so while also increasing their scores on the economic development and growth dimension. The effect is more pronounced for advanced economies, with the primary factor being a 25% real-terms increase in average household electricity tariffs over the past decade for this peer group. For example, the increase in the retail electricity price across the European Union (EU) outpaced the consumer price inflation index between 2010-2019.<sup>15</sup> At the same time, the externalities of energy consumption continue to be inefficiently priced, which risks

exacerbating the affordability challenge. **While the cost of failing to deliver on energy transition might be higher than the cost of energy transition, distributional considerations remain at the centre of this challenge, especially in a global climate of widening income inequality.**<sup>16</sup>

The impact of the energy transition on labour markets is central to the “just transition” challenge (see Box 2). While energy transition will create substantial employment because of policies and investment, it is also leading to job losses in the fossil fuel sector. According to the International Labour Organization (ILO), the shift towards sustainable practices is expected to create 18 million net jobs by 2030.<sup>17</sup> As shown in Figure 10, countries leading on the ETI have a larger share of jobs in low-carbon sectors as a share of total domestic labour force. Evidence suggests that jobs in renewable energy and energy efficiency are geographically more diversified, more gender-diverse<sup>18</sup> and more likely to employ young people – as opposed to the more localized, gender-biased and ageing workforce of the fossil fuel sector.<sup>19</sup> However, in the short term, geographical redistribution and timing of availability of new jobs can create labour market dislocations, disproportionately affecting communities reliant on fossil fuel sectors. **Focused social programmes for the reskilling and rehabilitation of fossil fuel workers, and investment in development of low-carbon value chains locally. These measures are critical to gaining employment dividends from the energy transition.** The ongoing reallocation of public funds to fuel the economic recovery from COVID-19 is an opportunity for countries to address this imbalance.

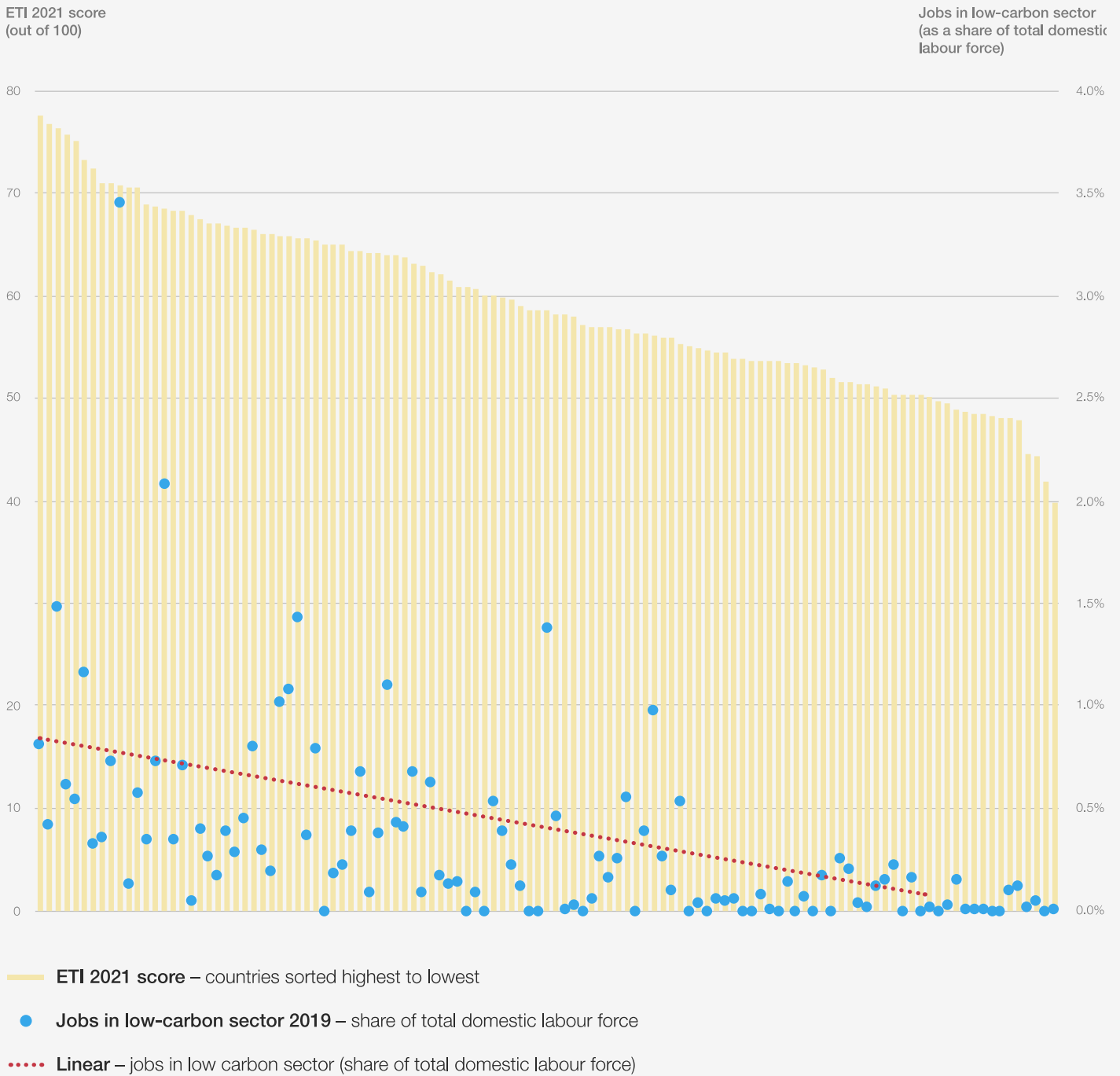
### BOX 2: Just transition

A just transition is commonly defined as the move towards an environmentally sustainable economy while contributing to the goals of decent work for all, social inclusion and the eradication of poverty. Decent work, poverty eradication and environmental sustainability are three of the defining challenges of the 21<sup>st</sup> century. Economies must be productive to meet

the needs of the world's growing population. Societies must be inclusive, providing opportunities for decent work for all, reducing inequalities and effectively eliminating poverty. This will ensure that no-one is left behind as the world's economies adapt and adjust to the changes required to mitigate the impacts of climate change.<sup>20</sup>

**Source:** UN Framework Convention on Climate Change

FIGURE 10: | ETI 2021 scores and percentage of jobs in low-carbon sectors



Sources: World Economic Forum, International Renewable Energy Agency (IRENA), World Bank<sup>21</sup>

The COVID-19 pandemic has led to a shift in energy consumption patterns – primarily due to remote working arrangements, a decline in business travel and the exponential rise of digitally enabled services. Additionally, an increasing number of major automobile manufacturers are aggressively pursuing electrification of their product lines. These trends could have a lasting impact on the demand for oil. While forecasts of peak oil demand vary considerably, some analysts argue that the pandemic might have fast-tracked the timeline, with implications for countries across the oil supply chain.<sup>22</sup> For oil-producing countries, this

increases the urgency to diversify their economies to maintain a steady source of fiscal revenue, and to harness the synergies from legacy technological and operational expertise to obtain competitive advantage in the new energy landscape. For energy-consuming countries, consumption tax on road transport is a significant component of their tax base (e.g. 5% for OECD countries), which risks erosion from potential changes in travel habits and the electrification of transportation.<sup>23</sup> **This underscores the need for efficient pricing of the externalities of fossil fuel consumption and fiscal reforms to design a tax system for a low-carbon future.**

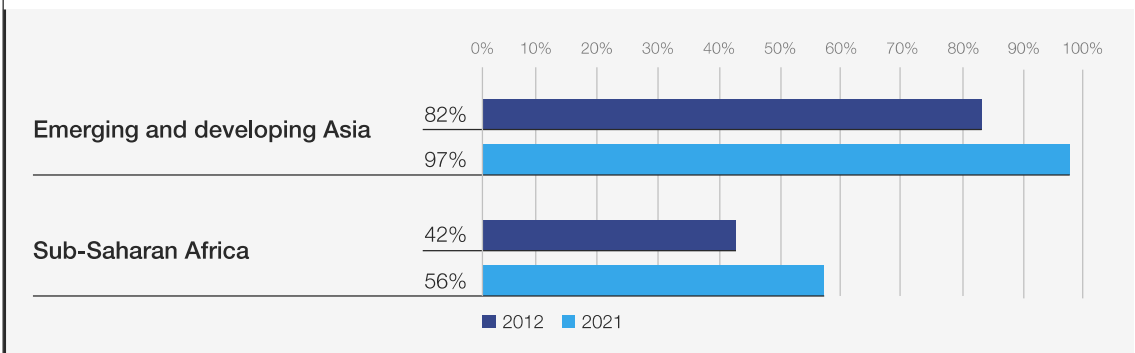


## 4.2.2 Energy access and security

Global average scores remain the highest in the energy access and security dimension. More than 70% of countries have improved their scores in this dimension since 2010. Advanced economies and large fuel exporters score highly, due to more mature energy infrastructure and domestic reserves. The highest improvements in this dimension come from lower middle-income and low-income countries, notably in Sub-Saharan Africa and emerging and developing Asia (e.g. Ghana, Kenya, Mozambique, Cambodia and Vietnam) that have steadily increased electricity access over the past decade. According to the International Energy Agency (IEA), energy security is defined as “the uninterrupted availability of energy sources at an affordable price.” For countries dependent on imported energy supplies, maintaining diversity of import counterparts is critical. Trends from the ETI indicate positive developments over the past decade, with the majority of countries diversifying both import counterparts and their energy mix. **Renewable energy and energy efficiency have a synergistic effect of reducing import dependence while adding diversity to the energy mix, underscoring the security gains from energy transition.**

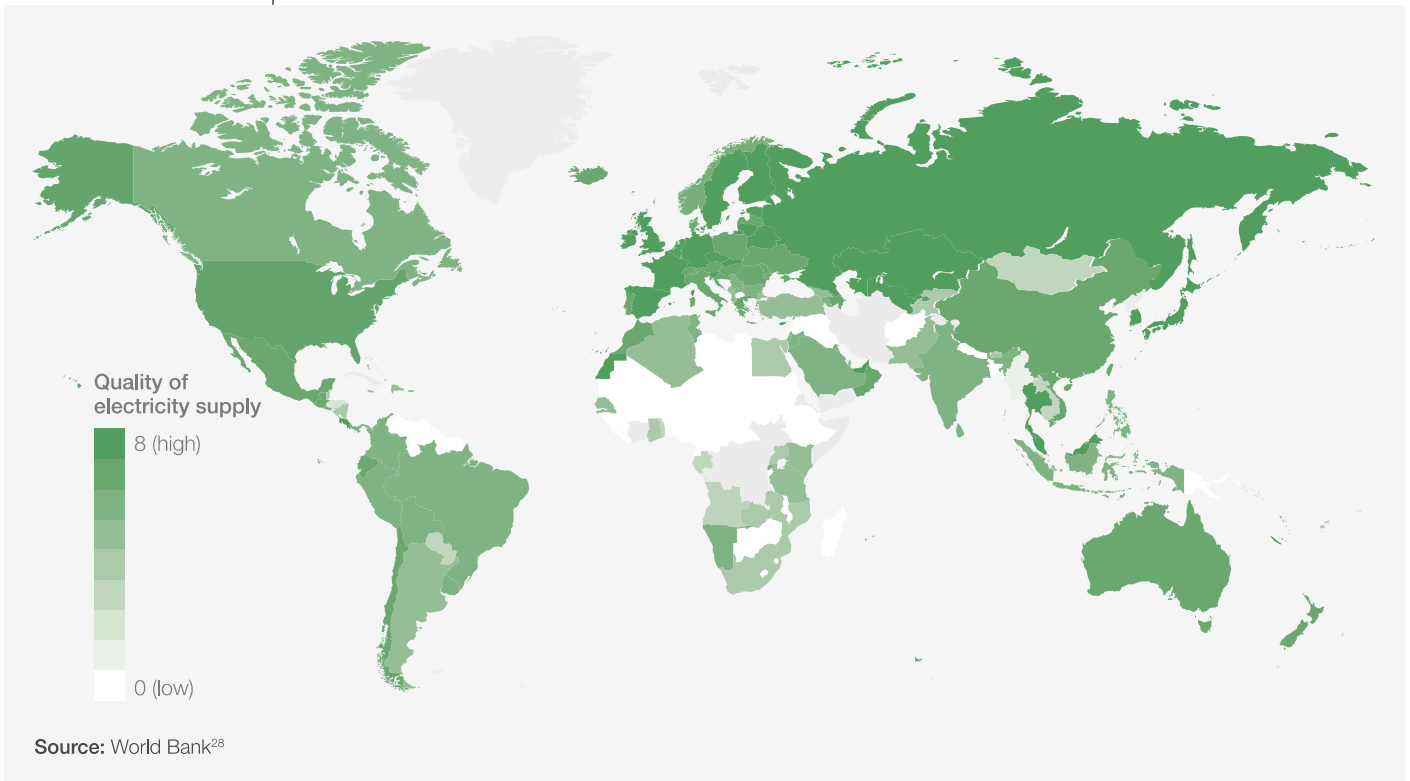
The number of people without access to electricity has declined to 770 million in 2019 – the lowest on record. However, progress remains uneven and 75% of the population without access now lives in Sub-Saharan Africa, a share that is rising due to a growing population, according to the IEA. Further, past progress is threatened by COVID-19. The IEA suggests that the number of people without access to electricity in Sub-Saharan Africa is set to increase in 2020, pushing many countries farther away from achieving the goal of universal access by 2030. Beyond energy access, the quality and reliability of electricity are of top importance. Figure 12 shows the challenge in quality of electricity supply, particularly in Sub-Saharan African countries. Reliable power supply is critical for the delivery of public services, including healthcare.<sup>24</sup> Lack of reliable electricity is one of the bottlenecks in rapid COVID-19 testing and vaccination programmes in African countries.<sup>25</sup> In almost all countries, the top 10% income group consumes 20 times more energy than the bottom 10%.<sup>26</sup> **Energy access programmes need to focus on the quality of energy supply, the diversity of energy services available to households and the distribution of consumption across the country.** Addressing inequalities in energy access is an important mechanism to ensure the resilience of the energy transition.

FIGURE 11: Electrification rates in emerging and developing Asia and Sub-Saharan Africa, 2010 and 2020



Source: World Bank<sup>27</sup>

FIGURE 12: Quality of electricity supply (2019)



A focus on grid resilience is especially crucial as energy systems transition to a system with more variable and distributed generation. Recent extreme weather events – including wildfires in California and Australia, and cold snaps in Texas<sup>29</sup> and Japan<sup>30</sup> – have shown that grid operators also need to be cognizant of tail-risks and plan for a grid that can bounce back quickly from crises. In the face of extreme weather events, levers for improving grid safety and reliability include: enhancing system

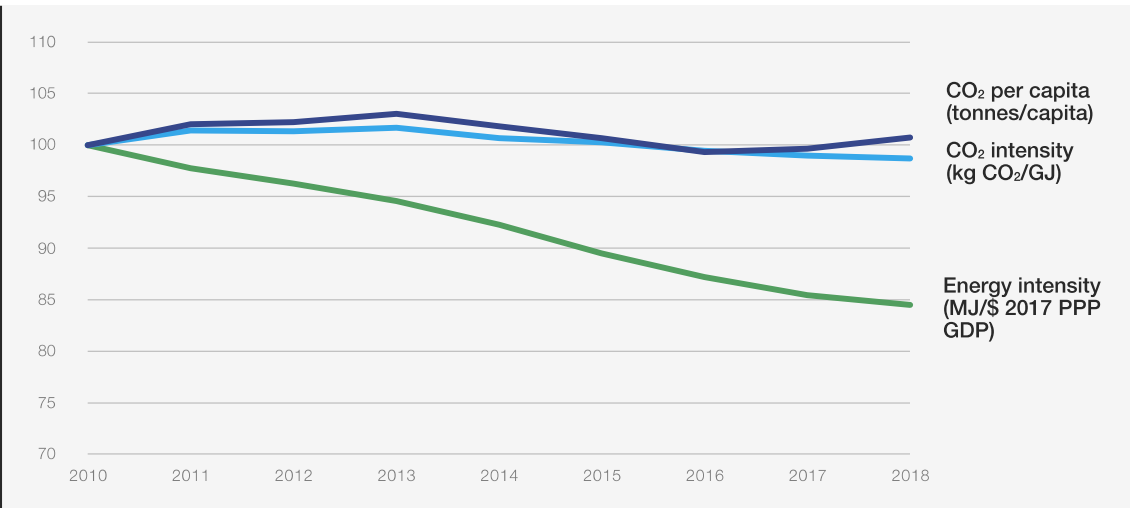
flexibility, increasing grid restoration effectiveness, network hardening, effective communication with stakeholders and accurate forecasting of weather and its impact, according to a recent study by Accenture.<sup>31</sup> **With an increasing share of electricity in final demand due to the electrification of end-use, the risks from the rising unpredictability and frequency of extreme weather events are compounded, making grids a serious area of vulnerability in the energy transition.**

### 4.2.3 Environmental sustainability

Encouraging progress has been made in this dimension in recent years, with global average scores reaching an all-time high in ETI 2021 and improvements across all indicators. Much of the progress can be attributed to reductions in energy intensity – the quantity of energy required per unit of output or product (a basic measure of energy efficiency). Progress in this space can lead to a reduction in carbon emissions and can also improve the marginal contribution of energy to livelihoods, through co-benefits such as better air-quality and reduced energy costs for households and businesses.

Figure 13 shows a tale of two intensities. Globally, energy intensity fell by 15% between 2010 and 2018, indicating a decoupling between primary energy use and GDP growth, driven by factors such as improved energy efficiency. While reducing the economy's reliance on energy is vital, equally important for improvements in environmental sustainability is reducing the carbon intensity of energy use – measured in the ETI as units of CO<sub>2</sub> per unit of energy supply. Globally, the CO<sub>2</sub> intensity of energy use has remained broadly flat since 2010, suggesting a continued dependence on high-carbon energy sources and ongoing inertia from legacy energy infrastructure.

FIGURE 13: Environmental sustainability indicators – a tale of two intensities (2010 = 100)

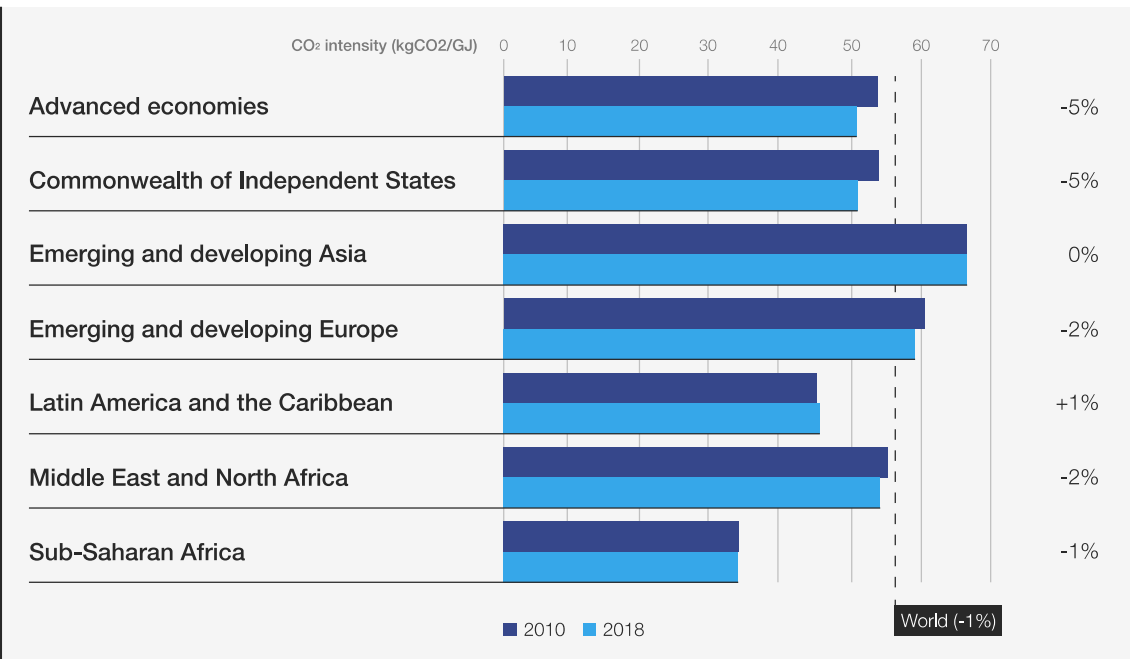


Sources: International Energy Agency, World Bank<sup>32</sup>

A regional view reveals significant variation (see Figure 14). CO<sub>2</sub> intensity has fallen in advanced economies and in much of Europe due to sustained reduction in the carbon content of energy production. This is mainly a result of switching from coal to gas for power generation. However, CO<sub>2</sub> intensity is stagnant or rising in regions where energy demand is growing – in emerging Asia, Latin

America and Sub-Saharan Africa. This suggests that CO<sub>2</sub>-intensive sources continued to fuel incremental demand over the past decade. Trends in per capita emissions support this conclusion. While absolute emissions in North America and Europe remain structurally higher than the rest of the world, CO<sub>2</sub> per capita is falling. However, CO<sub>2</sub> per capita has risen in regions where energy demand growth is the highest.

FIGURE 14: CO<sub>2</sub> intensity by region (kg CO<sub>2</sub>/GJ), 2010 and 2019



Sources: International Energy Agency, World Bank

Boosting progress across these lagging variables, including in advanced economies where headway has been made, will be a key measure of success over the next decade. Countries should seek to lower the carbon content in energy production across all end-uses. **More efforts are needed to transfer technology, provide access to finance, and foster international cooperation to enable developing countries to meet new demand growth with less CO<sub>2</sub> intensity than the pathway taken by developed nations.**

Attention also needs to turn to cutting emissions intensity beyond electricity in other sectors such as transport, manufacturing and the built environment. Countries with highly energy-intensive industries, including oil and gas producers, can make improvements in this dimension by focusing on reducing emissions intensity. In Canada, for example, the government has set new regulations that require the oil and gas sector to reduce its methane emissions by 40% from 2012 levels by 2025.<sup>33</sup>



## 4.3 Transition readiness

The energy system's ability to deliver on the imperatives described in the preceding sections depends on the presence of an enabling environment for energy transition, measured in the ETI framework by the transition readiness sub-index. Readiness for energy transition is determined by factors including: stability of the policy environment and level of political commitment, investment climate and access to capital, level of consumer engagement, and development and adoption of new technologies.

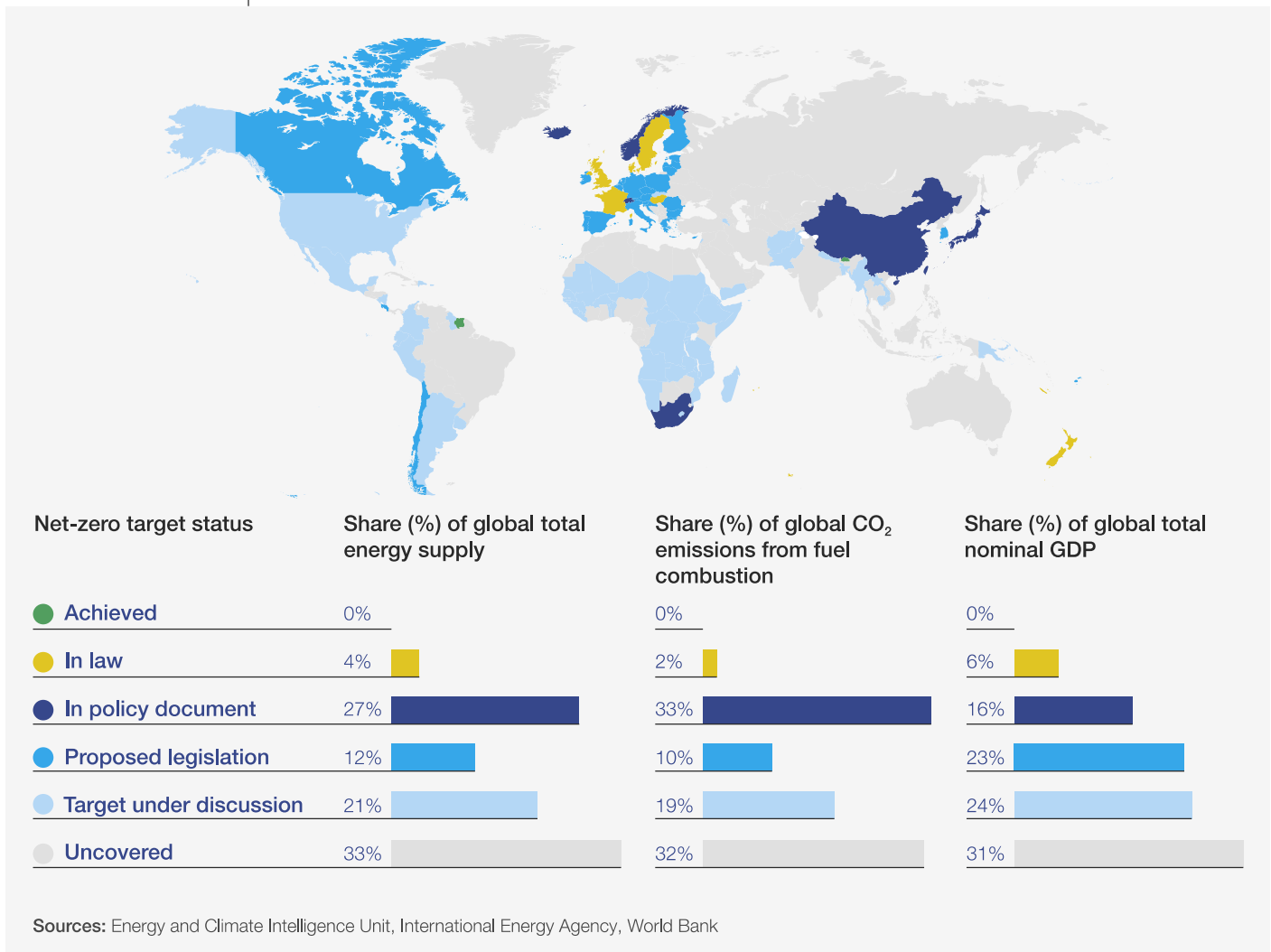
While the average transition readiness score reached a high this year (54.7 compared to 53.5 in 2012), progress across dimensions shows a mixed picture. Data since 2012 shows marked progress in the dimensions of regulation and political commitment, and capital and investment, borne out by increased international commitment to climate action and growing levels of energy transition finance.<sup>34</sup> Progress is slower in other readiness dimensions, including energy system structure, which tracks the transformation of a country's energy demand and sources of supply.

### 4.3.1 Regulation and political commitment

Enhanced political commitment and improved regulatory support for the energy transition is encouraging. Last year saw a proliferation of net-zero announcements and targets. Now around 68% of the world's emissions from fuel combustion are covered by some type of net-zero target.<sup>35</sup> This compares with just 16% a

year earlier. One of the most significant announcements came from China, with a policy mandate to achieve net-zero by 2060. However, **this ratcheting up of ambition needs to be reflected in legislation, policy and regulation, and supported by concrete roadmaps and milestones.**<sup>36</sup>

FIGURE 15: Status of countries' net-zero targets, 2020

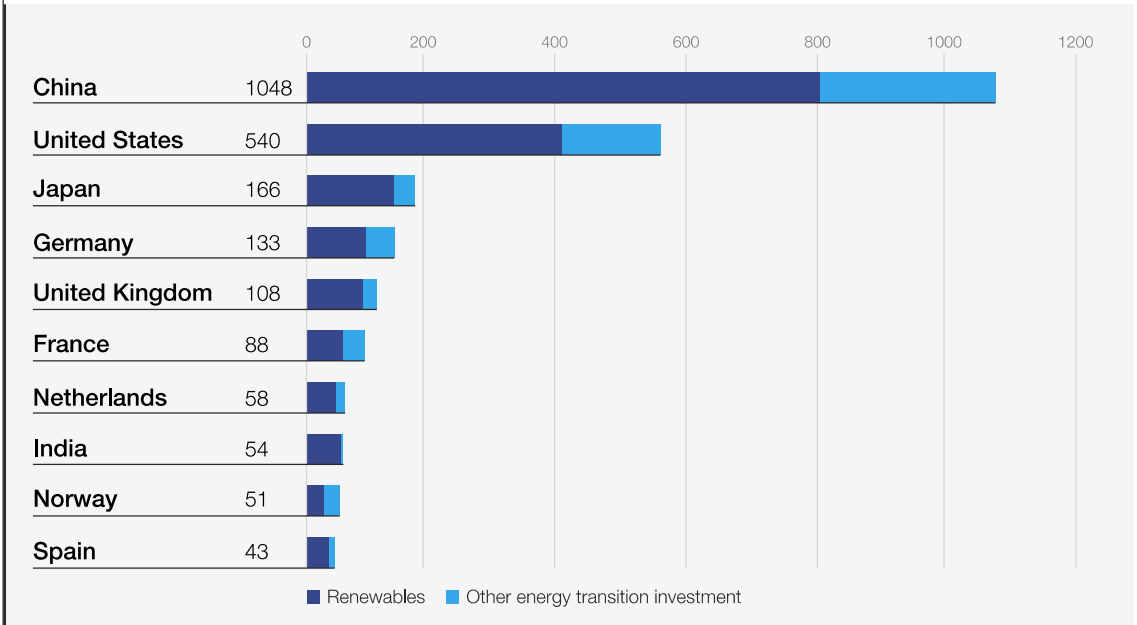


### 4.3.2 Capital and investment

The capital and investment dimension is another enabler showing strong improvement over the past decade, primarily supported by improvements in access to credit and investment freedom levels. This lays the foundation for investments in the energy transition. Record flows of finance have been pouring into the energy transition, totalling

\$501 billion of global investment in 2020, up from \$458 billion in 2019.<sup>37</sup> However, mature renewable energy technologies account for most of this investment, while other energy transition areas such as mobility, electrified heat, storage, and carbon capture and storage (CCS) account for a small proportion of the total investment.

FIGURE 16: Global energy transition investment, 2016 - 2020 (\$ billion)



Source: Bloomberg New Energy Finance

Figure 16 shows that energy transition investment is concentrated in a handful of economies, with China and the United States (US) accounting for the large share of investments. However, investment outside the top 10 is growing steadily. Countries such as Vietnam, Kenya, Brazil, South Africa and Chile have shown that a combination of the right enabling policies, infrastructure and

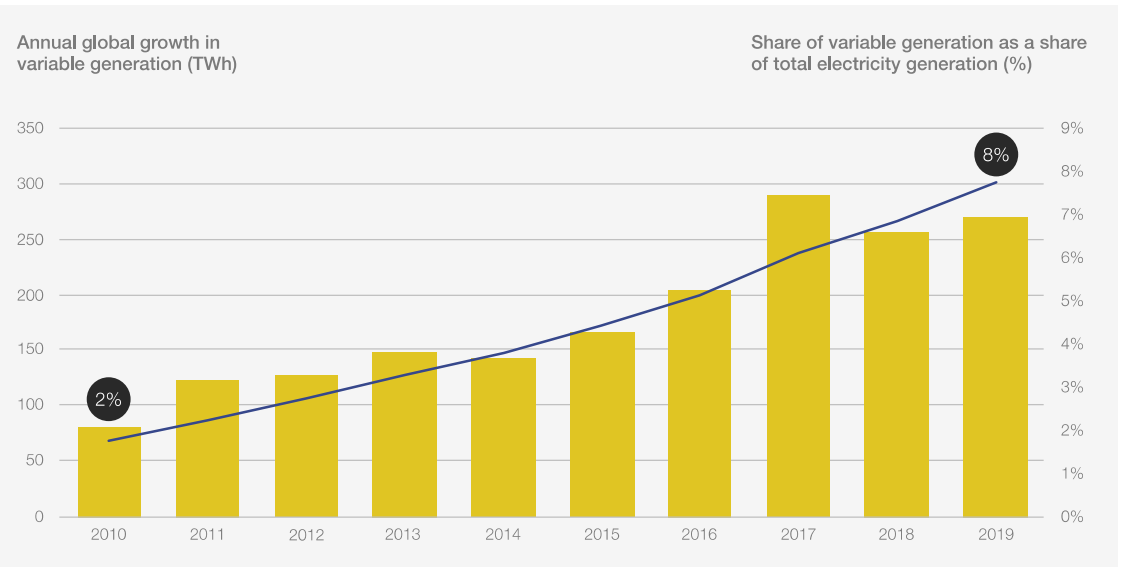
better integration into global financial markets can lead to record levels of new investment. By enacting measures including deepening national capital markets, developing new risk management solutions and generating healthy returns from low-carbon solutions, countries can create a pipeline of bankable projects that will attract the capital needed to propel their energy transitions.

### 4.3.3 Energy system structure

In the next decade, political commitment and increased capital will need to translate into structural shifts in the energy mix. Progress has been made in renewable capacity and generation. The share of renewables in the global electricity mix grew from 18% in 2000 to 26% in 2019.<sup>38</sup> Much of this progress has been driven by additions in solar and wind capacity. Solar and wind generation

is growing at record pace, with solar up 22% and wind up 12% between 2018 and 2019.<sup>39</sup> The latest estimates suggest that renewables have been resilient throughout the pandemic. As the world went into lockdown, the power mix shifted towards renewables due to depressed demand, low operating costs and renewables' priority access to the grid.

FIGURE 17: Change in global variable generation, 2010 - 2019



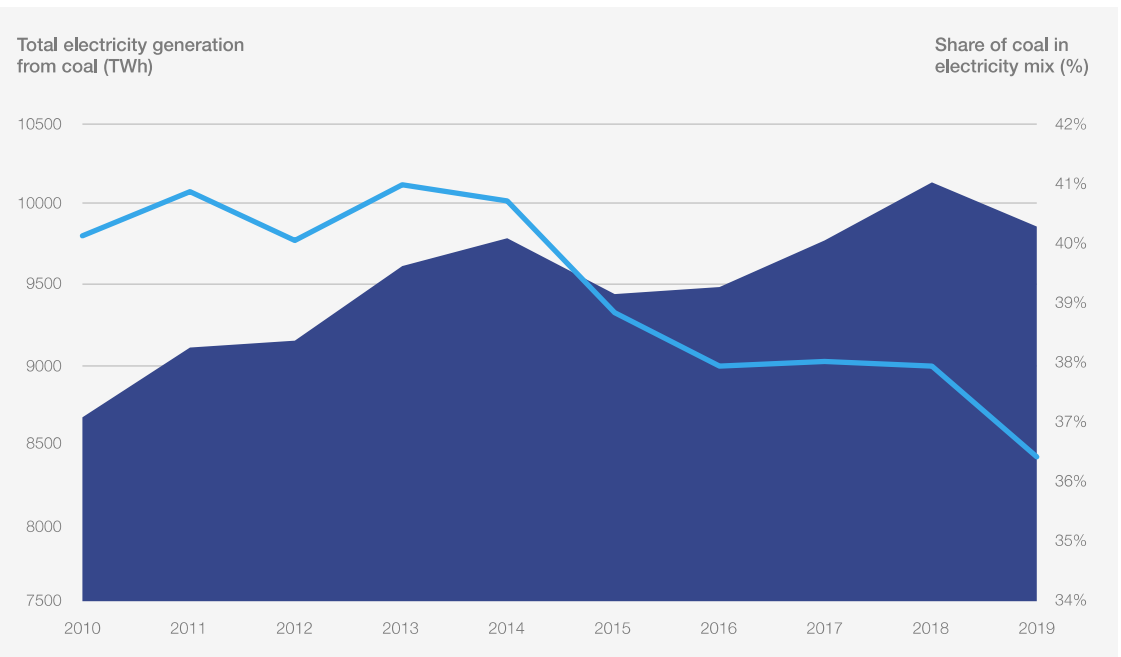
Sources: BP, *Statistical Review of World Energy 2020*; Ember, *Global Electricity Data*

Decarbonizing the rest of the energy sector is critical over the next decade. Achieving our climate goals will require electrification across other sectors of energy end-use, notably industries, HVAC (heating, ventilation and air conditioning) and transport. This means that renewables will need to meet approximately 80% of global electricity demand growth in the next 10 years.

Recent progress in renewables is tempered by the view that if Europe and the US are excluded, coal's share in the electricity mix has been

rising, not falling. In advanced economies, coal generation appears to be in structural decline, due to continued growth in renewables and coal-to-gas switching. In 2019, the strongest declines in coal-fired power generation were in the EU, which saw coal use decline by 19% or 111 million tonnes, and in the US where coal use fell by 14% or 87 million tonnes. However, coal generation remains high and growing in many parts of the world. For example, in the Asia-Pacific region, coal consumption increased by 1.2% or 69 million tonnes in 2019.<sup>40</sup>

FIGURE 18: Global coal generation vs share of generation, 2010 - 2019



Source: BP, *Statistical Review of World Energy 2020*

Moreover, while coal's share in the electricity mix globally has been declining, electricity generation from coal in absolute terms has been on an upward trajectory since 2010, despite a slight dip in 2019 (see Figure 18). New coal power

plants have long operating lifetimes and can lock in future emissions for decades. Breaking the carbon lock-in will require early retirement of existing assets and revisiting the long-term viability of assets not yet in operation.



5

# Building resilience to overcome new risks



## Key highlights:

1.

The risks facing energy transition are evolving, threatening to derail momentum for change

2.

Rising social inequalities, international cooperation challenges and geopolitical shifts call for inclusive and holistic approach

3.

For robust and resilient progress, energy transition needs to be firmly rooted in legislation, consumer awareness, infrastructure and investments

The previous chapter showed that despite growing momentum, progress in the energy transition requires further acceleration. For this reason, and considering the impact of the COVID-19 pandemic, it is critical to focus on the *resilience* of the energy transition. As the risk landscape evolves, the transition will fail to deliver the step change required without building in greater resilience.

Resilience is a holistic concept that embraces the enablers of transition readiness and cuts across the following dimensions:

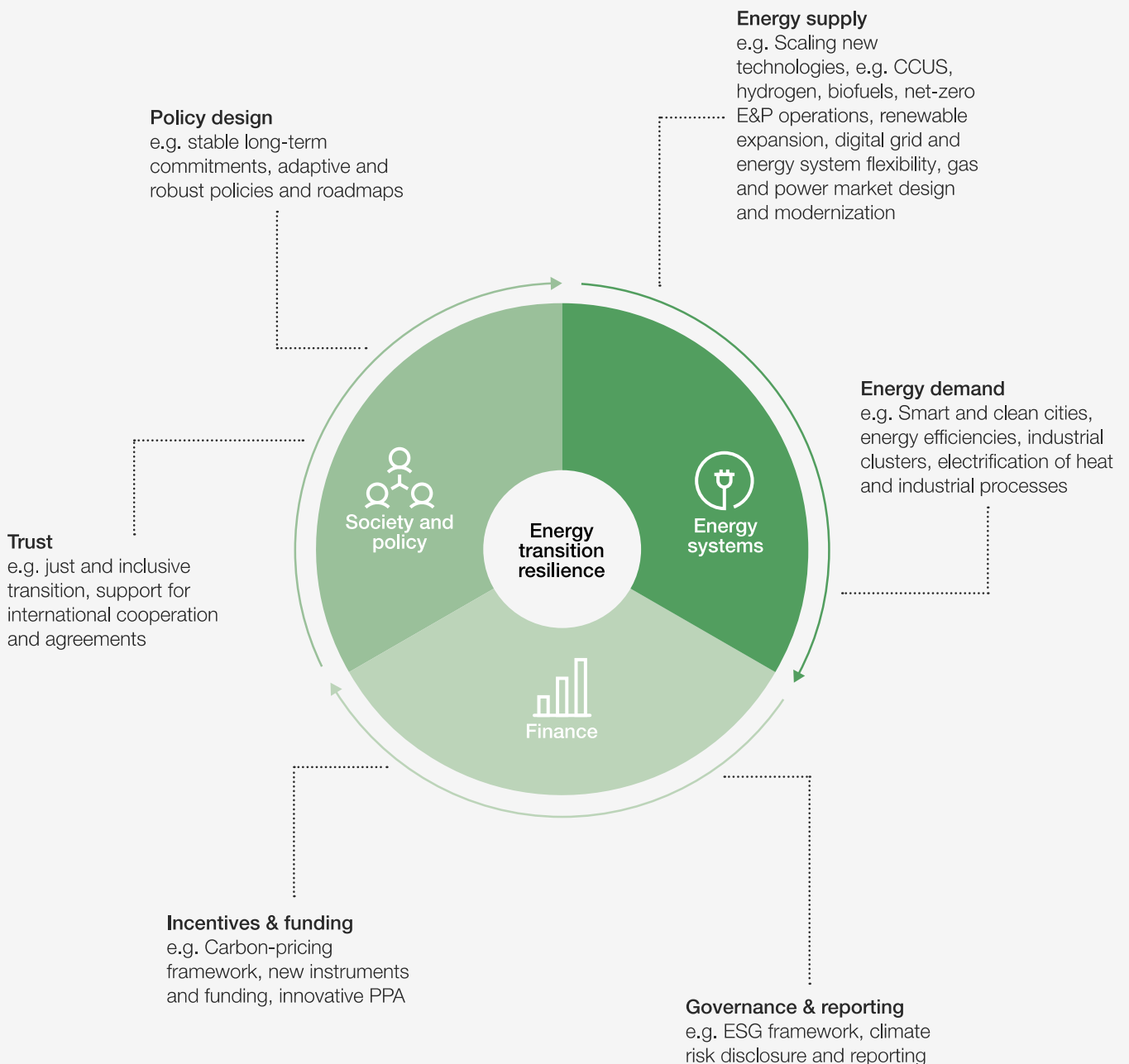
- Societies and policy
- Energy systems and technologies
- Finance

In this chapter, we look at how each of these dimensions is impacted by heightened or new risks, we examine the implications for the energy transition, and we analyse key considerations and case studies for those seeking to embed resilience in the energy transition.

A definition for the resilience of the energy transition

“The ability of the energy transition to absorb, recover from and adapt to disruptions and continue along a pathway to deliver a secure, sustainable, affordable and inclusive low-carbon future.”

FIGURE 19: Energy transition resilience dimensions and illustrative mechanisms



Source: World Economic Forum



## 5.1 Societies and policy



### 5.1.1 The risk landscape

As demonstrated by the COVID-19 pandemic, the negative impacts of major socio-economic disruptions fall hardest on the most marginalized members of society. Climate change is no different. Inequality has been increasing across the world, both between and within countries, and climate change is one of the contributing factors.<sup>41</sup> To be resilient, the energy transition will require the active participation of all sections of society. It must be rooted in every country's laws, politics, societies and patterns of consumer behaviour.

**Costs.** The energy transition will not come without costs. Carbon taxes, removal of fossil fuel subsidies and levies on electricity bills could all add to the cost of electricity and fuels, leading to affordability challenges for some. Significant infrastructure investments will be required. The pandemic-related recovery packages drafted by governments around the world provide a one-off opportunity to fund some of these investments. However, research from Vivid Economics and the Climate Action Tracker suggests that recovery measures announced to date across the G20 may have a regressive environmental impact.<sup>42</sup>

**Workers.** An additional challenge comes from the potential impact of the transition on existing workforces. While it is estimated that renewable energy could employ more than 100 million people in the energy sector by 2050—boosting global GDP by 2.5%—these gains are not evenly distributed. Some countries and communities, especially those that rely heavily on fossil fuels, will lose out as a result.

**Consumer behaviour.** Household consumption – through, for example, heating, lighting, cooking and commuting – accounts for around two-thirds of global greenhouse gas (GHG) emissions.<sup>43</sup> Changes in behaviour – especially on measures relating to energy efficiency, transportation, diet and responsible consumption – are proving increasingly challenging to lock in, given the varying consumer preferences and abilities to act that we see across different countries.

**International cooperation.** Energy transition requires collective commitment and international cooperation, but trust in the ability of countries to act collectively for the common good has been steadily eroded. This was highlighted by the COVID-19 crisis, when many countries became more inwardly focused in their approaches. Examples of vaccine nationalism,<sup>44</sup> ranging from conditional subsidies through to export controls, demonstrated the tension between international cooperation and competition when near-term national interests are at stake.

International cooperation is also needed to create viable carbon markets. The effects of carbon taxes on trade and competitiveness require cooperation between governments and between companies and governments, to ensure efficient and fair pricing of carbon across the global economy.<sup>45</sup> However, the acceleration of climate action and the shifting of trade flows away from fossil fuels to cleaner technologies could disrupt existing geopolitical alliances and reshape global power dynamics. An uncoordinated transition is inherently more uncertain than one underpinned by stability and agreed rules of engagement.



## 5.1.2 Considerations to build a resilient transition

**Just transition.** A prerequisite for resilience is to build a just transition – one that not only addresses environmental sustainability but also provides decent work, enhances social inclusion and helps eradicate poverty.<sup>46</sup> Policy-makers should prioritize policies and incentives to support economies, workforces and wider society as countries shift to low-carbon energy systems. This may take the form of fiscal transfers, expanded welfare and social protection, and labour market schemes such as reskilling and training to support affected communities. The EU's Just Transition Mechanism<sup>47</sup> is one example of how governments are looking to support affected communities and businesses, and encourage them to take an active role in preparing

for the new jobs and opportunities that will arise from the energy transition.

**System value framework.** Building resilience must also start with business leaders and policy-makers concurrently evaluating the economic, environmental, social and energy system outcomes of potential energy solutions. One example of a framework to guide this approach is the system value framework developed by the World Economic Forum in partnership with Accenture and others. This quantitative approach shifts the political and commercial focus beyond cost to include value creation and provides a common agenda for stakeholder decision-making.

### Case study: A system value framework approach to evaluating policy and investment decisions

The system value framework,<sup>48</sup> jointly developed between the World Economic Forum, Accenture and 30+ CEOs of global energy companies, provides a framework to evaluate policy, investment and solutions. It comprises 12 dimensions, each representing an outcome that delivers value, such as jobs, emissions reductions, air quality and health, reliability, resilience and investment competitiveness.



**Laws and policies to back ambitions.** Long-term ambitions alone are insufficient to achieve the energy transition. To turn decarbonization ambitions into climate action that is resilient to political cycles, countries such as the UK have embedded net-zero emissions targets into law.<sup>49</sup> This legal foundation and the UK's stable climate policy framework have the effect of stimulating the investments required to convert commitment into action. The UK, for example, reduced its emissions by 44% from 1990 to 2019, while its economy grew by two-thirds. This is 1.8 times faster than the EU average since 1990 and significantly faster than the US, which saw its emissions rise slightly over the same period.<sup>50</sup> The financial sector has become an increasingly strong voice stressing the need for a stable policy framework to build investor confidence.

**Stronger international cooperation.** Governments must align to define a common set of rules to ensure players have a level playing field in the market. Tools such as a common international carbon market or carbon border-adjustment mechanisms can be considered. International cooperation on energy transition will once again come under the spotlight during the delayed COP26, expected in November 2021. Global trade will also play a key role. Reforms of global trade agreements – including the reduction of trade

barriers, reduction of fossil fuel subsidies and the facilitation of global technology transfers – will help ensure that emerging markets can access new energy technologies in an equitable and affordable way. For example, the EU called for greater focus on clean energy transition and sustainable development as part of its proposed World Trade Organization reforms in February 2021.<sup>51</sup>

**Incentives for consumers.** Consumers need incentives to change their behaviour and embrace the energy transition. The right economic, legal and infrastructure policies, plus fiscal interventions, can change consumption patterns and incentivize sustainable behaviour. Countries will not all follow the same path, but it is critical to identify ways to make change at the individual level more attractive and accessible. One example is Norway's drive to adopt electric vehicles (EVs). The government has adopted a mix of measures: mandates to phase out internal combustion engines by 2025, incentives for the purchase of zero-emission vehicles (e.g. 0% VAT), urban road-toll exemptions for EVs, and the installation of accessible, efficient charging infrastructure. By starting early with incentives and adapting infrastructure and technology to fit demand, Norway has fostered an eco-conscious society that sees EVs as a preferred choice.<sup>52</sup>

## How governments can drive a faster, bigger, better energy transition

By Nigel Topping, UK High Level Climate Action Champion for the UN's COP26 climate summit

The very first automobiles, introduced in the 1880s, were expensive, niche and used only by the rich. Within 30 years, Ford's Model T entered mass production, pushed the number of car-owning households in the US from 8% in 1918 to 60% by 1928, and triggered the spread of electrification, suburbs, cinemas, shopping centres, sophisticated advertising and much more.

That's not linear growth, it's exponential. We've seen it happen time and again throughout history, whether from horses to cars or valves to transistors, and each time it has fundamentally changed the way we live and operate. Our race to a zero-carbon energy system will be no different.

But in the same way that pro-business policies spurred the American economic boom and innovation like the Model T in the 1920s (following the Spanish flu pandemic), the clean energy transition must be backed by holistic government policy.

Key to this is getting more specific in nationally determined contributions (NDCs) under the Paris Agreement – setting out how and when each sector will reach zero emissions, and involving all economic actors and government ministries. The benefits of decarbonizing energy extend well beyond the sector – to health, jobs, education,

equality, nature conservation. But the work behind it does too.

This is the year to do it, ahead of November's COP26 climate summit in Glasgow, where all countries must raise their NDCs. As a first step, governments must rally their ministers of energy, climate, transport, health and other portfolios around the same goal: zero-carbon energy. Ministers can then align their policies with the NDC targets and start implementing.

The energy sector is already leading the charge to zero emissions, with breakthroughs and rapid price declines across the auto, power and lighting sectors. Globally, the number of electric vehicles on the road has jumped from 17,000 in 2010 to more than 7.2 million today. The installation of solar power went from 290 megawatts (MW) in 2001 to around 100,000 MW in 2020. The share of LED bulbs in the lighting market is growing from 1% in 2010 to an expected 69% in 2020 and nearly 100% by 2025.

The growth is happening even where governments lag behind. But it's faster if led by policy. China has 420,000 electric buses on the road, driven by Beijing's war on air pollution. Norway last year became the first country to sell more electric vehicles than petrol, diesel and hybrid, backed by Oslo's target to end internal combustion engine sales in 2025.

## All-of-society transformation

These advancements drive all-of-society transformation. They create well-paying jobs,<sup>53</sup> prevent premature deaths through reduced air pollution<sup>54</sup> and introduce affordable energy to rural areas, allowing people to refrigerate produce or medication and children to study by light after sunset.

But reaching the necessary pace and scale requires what UN Secretary-General António Guterres called “inclusive, networked multilateralism”.<sup>55</sup> The more ambition political leaders demand, the more businesses, investors, cities and regions are challenged to advance. The farther they go, the higher governments can push their targets, and so forth. It’s an ambition loop. Platforms like the Marrakech Partnership’s Climate Action Pathways,<sup>56</sup> the Mission Possible Partnership<sup>57</sup> and the Race to Zero Breakthroughs<sup>58</sup> are enabling this kind of pre-competitive collaboration, reducing the risk of the transition.

Change is gaining momentum, in the midst of the COVID-19 health and economic crisis, with large emitting countries setting net-zero emissions goals: China by 2060; the EU, US, Canada, South Korea, Japan and South Africa by 2050.

The UK’s new NDC<sup>59</sup> is rooted in the plan for a green industrial revolution,<sup>60</sup> creating 250,000 British jobs this decade. In 2030, London intends to have ended the sale of petrol and diesel cars, reached 5 gigawatts of green hydrogen production capacity and quadrupled offshore wind capacity, among other plans.

South Africa’s new goal for net zero by 2050 is backed by a strategy to cut coal-fired power supply from around 90% now to 46% by 2030 and 30% by 2050, while boosting wind, solar and hydro. This falls short of the Paris goals, but the ambition – set against a serious economic battering from high COVID-19 rates – is laudable.

Yet the bigger signs of transformation are coming from the private sector. International Airlines Group<sup>61</sup> and Oneworld Alliance<sup>62</sup> are

ahead of the International Civil Aviation Organization in setting net-zero targets. General Motors is aiming for net zero by 2040 and calling on the US government to forge a national zero-emissions vehicle programme.<sup>63</sup> Nestlé intends to halve its emissions by 2030 by supporting the shift to regenerative agriculture and planting hundreds of millions of trees.<sup>64</sup>

Government policy will help realize this ambition and continuously ramp it up the way Paris demands. NDCs could drive decarbonization by ending fossil fuel subsidies and pricing carbon, shifting investments from fossil fuels to renewables, ending the sale of petrol and diesel vehicles, and ending deforestation, the NDC Partnership recommends.<sup>65</sup> Investing in cities – including low-carbon buildings and mobility, renewable power and green spaces – would also enhance national COVID-19 recoveries and Paris contributions, the Coalition for Urban Transitions states.<sup>66</sup>

Of course, all these policies must uphold two pillars in the race to a healthy, resilient, zero-emissions world: the just transition and nature regeneration.

We know the transition will create jobs, but those jobs must be made available in places where workers and communities rely on fossil fuels. The just transition is a local challenge, and political and business leaders should treat it as such.

And we know that slashing emissions will only get us part of the way to greater health and resilience – we must simultaneously regenerate nature. By reforming their measure of economic success, and placing the premium on working and living sustainably rather than destroying nature, governments can restore humanity’s relationship with its most “precious asset”, the *Economics of Biodiversity: Dasgupta Review* makes clear.<sup>67</sup>

The world we live in today has been shaped by the breakthroughs of our past – from the Model T’s assembly line, to the spread of mobile phones across previously unconnected rural areas. Such breakthroughs continue to propel us towards a safer future, as long as governments make sure the whole of society comes along for the ride.



## 5.2 Energy systems and technologies



### 5.2.1 The risk landscape

The shifts within and across the energy supply chain, alongside the greater need for flexibility across increasingly diversified energy sources, will present new challenges and requirements for change.

**Market reforms.** A recent analysis on the European electricity market, completed by the World Economic Forum, shows that Europe could reach 60% annual penetration of wind and solar by 2030. At such levels, power market reforms, increased demand-side participation and significant changes to how the network operates will be needed as the grid transforms towards variable generation.

**Cybersecurity.** Energy companies, particularly in the power sector, are increasingly digitalizing their operations to optimize the end-to-end value chain. More digitalization means higher exposure to cyber-attacks. The number of identified groups targeting the energy sector has risen from 87 in early 2015 to 155 by the end of 2019.<sup>68</sup> Grid infrastructure, nuclear plants, gas pipelines and safety systems for oil production operations have all been the target of cyber-attacks in the past five years.

**Rare minerals.** The production of minerals such as graphite, lithium and cobalt could increase by nearly 500% by 2050<sup>69</sup> to meet the growing demand for clean energy technologies. These materials are

generally produced in developing countries, and sometimes in challenging environmental and social conditions. The scramble to acquire these minerals has resulted in a high concentration of resources in the hands of a few countries, increasing potential risks to timely supply.

**Deep decarbonization.** For industries that require higher energy density to function, such as heavy industries or heavy transportation, progress to significantly reduce carbon emissions has been slower to date. For example, despite the Paris Agreement taking effect in 2016, there was no emissions-related commitment from the shipping industry until 2018, when the International Maritime Organization (IMO) committed to a 50% reduction in emissions by 2050 (compared to 2008).<sup>70</sup>

**Innovation risk.** Within the fossil fuel industry, low-carbon technologies – including hydrogen and carbon capture, utilization and storage (CCUS) – provide a potential path forward. The ability to scale each of the technologies depends on collaboration across sectors (and with policy-makers and financial institutions) as no sector alone can fund and take on the risk of scaling these technologies. The increasing investment into industrial clusters, where these solutions can be scaled up, suggests a path ahead and speaks to the types of partnership required for success.

## 5.2.2 Considerations to build a resilient transition of energy systems and technologies

Building resilience in the transformation of our energy systems and its technologies will require increased flexibility, greater collaboration among and across stakeholders, and a change in behaviour.

**Regional interconnections and interoperable markets.** Cross-border, connected infrastructure can provide flexibility in demand / supply balancing. In 2020, 38% of the EU's electricity was supplied from renewables, making renewables a higher source of Europe's energy mix than fossil fuels.<sup>71</sup> Interconnections and increased interoperability of market design across Europe's national electricity markets have been central in enabling the continent to achieve this high share of wind and solar penetration while maintaining grid resilience and flexibility. ENTSO-E – the European Network of Transmission System Operators for Electricity that represents 42 electricity transmission system operators (TSOs) from 35 countries across Europe – is tasked with continuously coordinating and evolving the EU's electricity grid system operations as the continent accelerates its clean energy transition and prepares for more distributed and variable resources to be added to the electricity network.

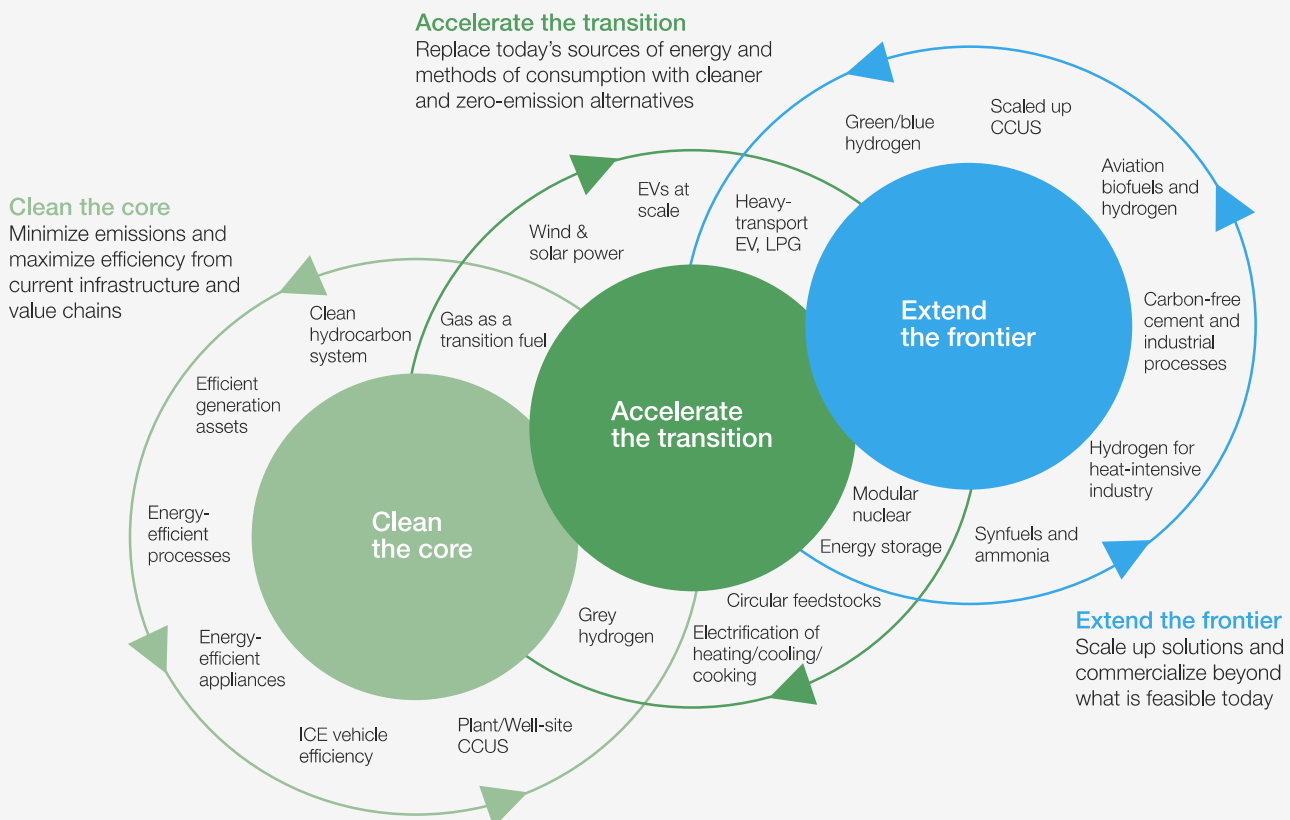
**Optimize non-build solutions.** An estimated 185 GW of electricity could be freed up by system flexibility and digitally enabled smart demand

response – roughly equivalent to the installed capacity of Australia and Italy combined. This would obviate the need for around \$270 billion of investment in new electricity infrastructure – funding that could be redirected towards transition-linked opportunities instead.<sup>72</sup>

**Weather-proof infrastructure.** The energy transition journey is not fully predictable and, as experienced in Texas with the February 2021 winter storm, increasingly volatile climate events can lead to exceptional demand in combination with failures of supply. Subsequent diversions of funding for repairs and maintenance could starve investment in cleaner energy sources and lead to questions regarding short-term versus long-term priorities. Resilience of the transition may therefore require legacy energy assets to play a critical bridging role as the overall system transitions.

**Low-intensity oil and gas.** Reducing the carbon intensity of oil and gas industry core operations is needed to achieve shorter-term objectives, while providing the platform for longer-term, more structural shifts. The largest share of the potential emissions improvement between now and 2050 will be due to actions that improve the performance of current core energy supply and demand assets.

FIGURE 20: Three sets of actions to achieve the decarbonization transition



Source: Accenture analysis

Scale up through collaboration. New models of cross-industry collaboration can create the necessary solutions to support investment in low-carbon technologies and extend the possibility frontier for the transition. The Northern Lights project,<sup>73</sup> part of the Norwegian full-scale carbon capture and sequestration project, is a collaboration between Equinor, Shell and Total in partnership with heavy industries in the Oslofjord region. Northern Lights captures CO<sub>2</sub> from the production of cement and waste-to-energy, transports it and stores it offshore under the North Sea.

Public-private sector collaboration and international cooperation will be crucial in the scaling up of hydrogen. Chile, for example, has set an ambition to become a leading green hydrogen exporter, with at least 5 GW of electrolysis capacity by 2025. Its National Green Hydrogen Strategy<sup>74</sup> identified cross-sector collaboration and

international cooperation—especially in common standard-setting and infrastructure planning – as crucial pillars for success. The imperative is to kick-start domestic production through public-private sector collaboration, particularly in areas such as ammonia, oil refining and mining.

**Focus on cities.** Urban areas account for two-thirds of global final energy demand and 70% of global GHG emissions.<sup>75</sup> Today, 55% of the world's population lives in urban areas and this is expected to grow to 68% by 2050. Consequently, cities are a primary focus for the energy transition. Building resilience into the transition of urban energy demand requires both technological and behavioural change. Best-practice examples include electrified mass-transit systems, intelligent power, smart meters, and smart buildings that feature automated systems for lighting- and climate-control along with micro-generation and solar heating.

## Trust in our energy future

By Julie Sweet, Chief Executive Officer, Accenture, and Patrick Pouyanné, Chief Executive Officer, Total Group

As co-chairs of the World Economic Forum's Partnering Against Corruption Initiative (PACI), we are committed to strengthening trust and transparency between public and private stakeholders. The transition to a more inclusive, affordable and sustainable energy future provides a unique opportunity for stakeholders to come together to transform intent into impact.

Delivering the transition will require integrity, trust and collaboration across the entire ecosystem. Accenture's analysis suggests that 25% of potential emissions reductions achievable up to 2050 – equivalent to over 10 GT per year – are dependent on collaboration between energy suppliers and their customers. The message is clear: when it comes to creating the new energy future, no one company or country can do it alone. Companies, partners, suppliers, customers, communities and governments all play a role.

Simply yet boldly said, we are at an inflection point. By accelerating the global consciousness of the fragility of our planet, COVID-19 has triggered the single biggest change in human behaviour in the world's history and, in turn, has triggered the single biggest reinvention of industry in living memory. Collectively, there is an urgency like never before to put our trust in one another and our institutions to come through the pandemic stronger and more resilient. To succeed in the energy transition, we will need to similarly rally around a shared purpose, collective action and, above all, the belief that we are all in this together.

### Three levers of trust

Securing the public's trust during the energy transition is good for both the planet and the

bottom line. Accenture's Competitive Agility Index, which measures the value of a company's interdependent growth, profitability and sustainability strategy, has found that companies that experience a loss in trust also see their index score decline and this can lead to an almost 10% negative impact on EBITA growth.

To galvanize the trust that's needed, we believe companies must activate three levers.

- **Purpose.** Leaders must articulate their energy-transition goals and demonstrate a commitment to deliver on promises made. Doing so is not just the right thing to do. It's what consumers expect. Accenture research revealed that almost two-thirds of consumers are eager for companies to take a stance on issues.<sup>76</sup>

At Total and Accenture, we have been outspoken about our intentions to be responsible business leaders. We are embedding sustainability and responsible business practices in all we do, so that we may create a better, more inclusive future for all and deliver access to reliable, affordable and clean energy. In the context of energy sustainability, [Total](#) and [Accenture](#) have both publicly committed to getting to net zero, together with society, to support the carbon-neutrality objective outlined in the Paris Agreement.

- **Actions.** Sustainability is a business imperative for leaders in all industries.<sup>77</sup> For that reason, companies involved in the transition must be committed to delivering on their goals – and helping others do the same whenever possible.



The latter could mean, for example, running offices with 100 percent renewable energy and working with suppliers to reduce their emissions.<sup>78</sup> Another key lever in this journey comes from combining sustainability and digital technologies to drive future competitiveness.<sup>79</sup> Migrating to “greener cloud” solutions, for example, can reduce on-premise enterprise IT-related carbon emissions by up to 84% – and total cost of ownership by up to 40%.<sup>80</sup>

For energy companies, this could mean drastically decreasing emissions from their operations, transforming the mix of energy products that they sell to their customers, and steering them towards low-carbon energy products and solutions. Additional paths could mean investing massively in renewable electricity production and expanding activities in biofuels, energy storage and green gases, be they biogas or hydrogen. By the same token, the use of a carbon price in project assessment would ensure projects and long-term strategy are viable. Furthermore, investments in carbon sinks based on technologies such as carbon capture, utilization and storage (CCUS) or on nature-based solutions are an important part of this puzzle. It is increasingly important to keep in mind that while contributing to their net-zero ambition through innovations, energy companies must also boost energy efficiencies and lower emissions for their customers.

Action on energy transition requires working with partners to enable change beyond a company’s own operations and customers. To deliver energy access in remote areas, international energy companies can partner with local businesses and development agencies to scale up off-grid energy solutions. The Oil and Gas Climate Initiative (OGCI), for example, is a CEO-led initiative that aims to accelerate the industry response to

climate change.<sup>81</sup> OGCI has formed several partnerships to explore CCUS technology.<sup>82</sup>

- **Transparency.** Companies leading the transition must continually measure their progress and clearly communicate the results of their efforts. Doing so not only builds trust, but also serves to encourage others to follow suit.

This means measuring actions across the board and publishing these results regularly and externally – from how effectively energy companies are reducing emissions and adjusting the mix of energy products, to encouraging behavioural changes among customers. Beyond measuring their own sustainability progress, companies can also help clients measure theirs. For example, a carbon-intensity indicator can be used to evaluate the average GHG emissions for the energy products sold to customers on a full-lifecycle basis.<sup>83</sup> This indicator can track customers’ demand for lower-carbon products and measure the transitioning of a company’s energy mix. Another example is the [Green Navigator](#), a tool that enables customers to measure their carbon reductions when they move to the Cloud.<sup>84</sup>

#### **Transitioning with momentum**

This is the moment for business, government and society to come together to reimagine, rebuild and transform our global economy into one that works for the benefit of all. At Total and Accenture, we are excited that so many companies, organizations and governments are aligning around a common purpose of affordable, reliable, sustainable energy – as shown by last year’s doubling of government and businesses commitments to reach net zero.<sup>85</sup> Now is the time for all of us to build on this momentum. To step up our actions. To deliver on our promises. And to provide the transparency needed to build and sustain trust.

## 5.3 Finance



The absence of sufficient capital and investment supporting the transition remains one of the greater risk areas. Hastening progress and

rooting the energy transition for the long term will require a critical transformation in how and where investments are allocated.

### 5.3.1 The risk landscape

Global investment in clean energy grew from \$60 billion in 2004 to an average of \$311 billion per year over the past decade.<sup>86</sup> Finance institutions are increasingly aligning their objectives to the Paris Agreement. Asset managers representing more than \$9 trillion of assets under management (AUM) have launched the Net Zero Asset Managers Initiative, in which they commit to support investing aligned with net-zero emissions by 2050. While welcome, the IPCC estimates that annual investments in clean energy and energy efficiency would need to increase by a factor of six by 2050, compared with 2015 levels, to limit warming to 1.5°C above pre-industrial levels.<sup>87</sup> At the same time, IEA estimates show that investment trends are failing to lead to a large enough reallocation of capital to support the energy transition.<sup>88</sup>

**Beyond power.** Investments are concentrated in the power sector. Even though electrification will play a leading role in the transition, it is imperative to attract clean energy investment into sectors such as steel and cement, heavy transport and HVAC to achieve our climate objectives. Part of the reason that finance to non-power sectors has lagged is the lack of scale in technologies and the difficulty in abating some industrial emissions. It is also due to

the “crowding-out” effect created by headline wind and solar PV opportunities. However, the increase in net-zero commitments in Europe, China and Japan will force countries to put policies in place to support investments that address emissions outside the power sector.

**Emerging markets.** Insufficient investments are flowing into emerging markets. Despite making strides, far greater resources are needed in those regions where most of the growth in economies, populations, energy demand and emissions is expected. This year’s ETI results continue to highlight the structural gap in carbon-related metrics, with CO<sub>2</sub> intensity rising in regions such as emerging Asia and Sub-Saharan Africa, where energy demand is growing. This trend is driven by continued growth in coal power sector emissions.

**Carbon lock-in.** Capital is still being channelled into energy assets that have long operating lifetimes, locking in future emissions. Breaking the carbon lock-in will require a new approach to investment in fossil fuels and, in some cases, the early decommissioning of existing assets. Limiting global temperature increase to 1.5°C implies that a significant share of existing oil, gas and coal assets and reserves are outside the carbon budget.<sup>89</sup>

## 5.3.2 Considerations to build resilient finance to support the transition

**More diverse finance.** To date most of the finance for the energy transition has been attracted by tariffs and premium guarantees awarded by governments directly to project developers or through regulated bodies. Innovation in financial products and arrangements is required to increase the diversity of available finance and to stimulate investment in clean energy.

Corporate power purchase agreements (PPAs) are long-term procurement contracts that give project developers and banks revenue certainty to invest in clean energy. The corporate PPA market is growing rapidly, although it is still primarily concentrated in the US and Europe. Recently, however, it has started to gain traction globally, in particular with large power consumers.

**Green bonds and sustainability-linked bonds.** Green debt issuance linked to sustainability has grown from around \$1 billion in 2009 to \$270 billion in 2020.<sup>90</sup> The Climate Finance Leadership Initiative suggests that sustainability bonds are useful to fund the transition, particularly in more carbon-intensive sectors.<sup>91</sup> For example, in 2019, the international energy group Enel was the first company<sup>92</sup> to launch sustainability-linked bonds in US and European markets. Enel linked its sustainability strategy to the terms of general corporate debt, using a pricing mechanism that incentivizes the achievement of ambitious sustainability targets within a pre-determined timeline. These instruments have since been recognized internationally, including by the International Capital Market Association<sup>93</sup> and the European Central Bank.<sup>94</sup>

**Public sector role.** Governments can also take the lead in deploying innovative financing solutions, such as “climate auctions”, and through regulatory standards mandating cuts in emissions. The World Bank’s climate auction model, for example, is a performance-based mechanism to stimulate investment in projects that reduce GHGs. This model of climate auction was trailed by the Bank’s Pilot Auction Facility, which hosted three auctions between 2015 and 2017, allocating nearly \$54 million in climate finance with the potential to abate over 20 million tons of CO<sub>2</sub>e.<sup>95</sup>

Public sector finance will also have to take the lead in developing new technologies whose long R&D cycles are difficult to support on corporate timescales. Public budgets will be needed to support the commercialization of technologies through subsidies or risk-sharing mechanisms like loan guarantees.

**Bankable projects.** In emerging economies, the key to increasing capital flows is to improve the bankability of infrastructure projects by allocating the risks fairly across all parties. The Asia Pacific Risk Centre<sup>96</sup> has created a set of bankability guidelines critical to unlocking international finance in emerging markets. These include appropriate covenants and funding structures, the presence of legal and economic recourse, thorough due diligence, a robust right to payment, and well-structured concession rights. Standardizing contracts so they reflect international leading practice on key bankability dimensions can reduce transaction costs, ease due diligence for investors and banks, and shorten investment cycles.

### Case study: Investing in homegrown energy transition champions

Investment in local capital and developing local champions can be a key transmission mechanism for social capital, jobs, skills and other economic benefits, adding further resilience to the energy transition. A good example of this is ReNew Power, India’s leading renewable energy independent power producer. Goldman Sachs was an early investor, providing \$470 million in cumulative funding at different stages. As ReNew Power grew,

it attracted a network of institutional investors, including the Asian Development Bank, the Canada Pension Plan Investment Board and JERA, the largest power generation company in Japan. This early investment in ReNew Power allowed it to become a leader in India and catalysed development of the domestic capital market through a first-of-its-kind public-private partnership green bond issue.

**Concessional finance.** Development Finance Institutions (DFIs) can unlock private capital by partnering with banks and asset managers to finance projects. Concessional finance provided by DFIs can reduce the time needed for low-carbon technologies to become more cost competitive than their carbon-intensive counterparts.

**Securitization of stranded assets.** A financial framework can be applied to accelerate the shift away from coal power into renewables and mitigate the risk of stranded assets. An example of this is

securitization, where the regulated returns of the asset owner are collateralized as part of new debt issuance. Proceeds from the debt issuance to retire the asset can be used to reinvest in renewables, and even support communities impacted by the closure. Some US states such as Colorado, New Mexico and Montana have proposed legislation to authorize securitization.<sup>97</sup>

**Stakeholder capitalism metrics.** Accelerating the adoption of a minimum set of common metrics to report progress on sustainability performance will



catalyse greater cooperation and alignment among business leaders, investors and policy-makers. The World Economic Forum, in collaboration with Bank of America, Deloitte, EY, KPMG and PwC, has curated a set of 21 core and 34 expanded metrics over the past two years, with the support of more than 140

stakeholders. The metrics comprise non-financial disclosures resting on the four pillars of people, planet, prosperity and principles of governance. Intentionally drawing on existing standards, the pillars include metrics such as GHG emissions, pay equality and board diversity among others.

## Rethinking the global financial system with a common ESG framework

By Brian Moynihan, Chairman and Chief Executive Officer, Bank of America

### **A common, global ESG disclosure framework will help accelerate the transition to a low-carbon economy and build greater financial resilience to the impacts of climate change.**

The challenges we faced as a society in 2020 and continue to face today are a reminder of our global interdependency and our shared opportunity to create positive change. From the health crisis to economic inequalities to the ongoing impacts of climate change, the events of the past year showcased how leaders in every sector – government, business, civil society – are working together to help society move forward.

For the private sector, the past year has underscored the importance of stakeholder capitalism – a framework defined and championed by the World Economic Forum for half a century.

A growing number of companies around the world are embracing this model: committing to delivering great shareholder returns *and* helping drive progress on societal priorities, including climate change.

There is, of course, ample evidence supporting this approach. The Bank of America global research team, for example, has found that companies that pay close attention to environmental, social and governance (ESG) priorities are much less likely to fail than companies that do not.

However, companies need a framework for measuring and demonstrating progress on societal priorities. With that in mind, in 2017, the Forum's International Business Council (IBC), which I have the honour to chair, began a journey to identify a set of common metrics for sustainable value creation. We aligned the concept of long-term value with progress on the UN's Sustainable Development Goals (SDGs), to help ensure corporate goals were aimed at well-defined and agreed-upon societal needs. Working in close collaboration with Deloitte, EY, KPMG and PwC – and in consultation with CEOs, investors and the most widely recognized standard-setters, such as the Sustainability Accounting Standards Board (SASB) and the Global Reporting Initiative (GRI) – we looked across the diverse landscape of existing measurements and metrics in an effort to find common ground and help promote convergence towards a single system of global and universal standards.

In 2020, the IBC published a core set of "Stakeholder Capitalism Metrics", providing companies with a set of industry-agnostic ESG indicators to include in their mainstream reports to investors. Having a common language gives investors and other stakeholders the opportunity to look across industries and compare companies' ability to create long-term value. In turn, this helps drive investment towards progress on the SDGs. To date, nearly 70 global companies have committed to voluntarily adopt these metrics in their reporting – and that number continues to rise.

A common ESG framework, which includes reporting consistent with the widely adopted Task Force on Climate-related Financial Disclosures (TCFD), can have a profound impact on how the private sector manages environmental sustainability, helping accelerate the transition to a low-carbon economy and building greater financial resilience to the impacts of climate change. For example, it allows investors to more precisely track the progress a company is making to reduce greenhouse gas emissions from operations (Scope 1 and Scope 2) and benchmark it against companies around the world and across industries.

The Stakeholder Capitalism Metrics also enable greater transparency in environmental sustainability practices up and down a company's value chain (Scope 3), helping investors assess the overall resilience of the business. This will help manage a just transition towards the low-carbon, sustainable future we need. And, over time, the hundreds of billions of dollars that companies spend each year dealing with the impact of climate change can start to flow to clean energy and innovation.

The resources required to drive progress on this priority will come from companies that can commit all their activities to the task. For example, at Bank of America:

- We are carbon neutral in our operations today and have announced our goal to achieve net-zero emissions in our operations, supply chain and financing activities before 2050.
- We have a 10-year, \$300 billion commitment to help finance the transition to a low-carbon, sustainable economy.



- We are a leading underwriter of green bonds.
- We have helped companies raise \$40 billion that they have earmarked to support their move to carbon neutrality and to help them fund over 200 environmental projects.
- We help shepherd client demand for ESG products and investing. With more than \$3 trillion of client assets under management, we help investors put their money with the companies that are making progress on climate change and other important issues.

And we're just one company. As more companies align their activities to demonstrate how they can help drive progress on the SDGs, while also delivering long-term value for shareholders, we

will help meet the sustainable, clean-energy and other societal goals we have set. A global standard would give us the disclosure framework to do exactly that. We are seeing concrete progress and sustained momentum towards that objective. The five main sustainability and integrated reporting organizations have outlined their vision of consolidation and convergence, and the International Financial Reporting Standards (IFRS) Foundation, with the support of securities regulators, is considering its role in overseeing a global system of comprehensive corporate sustainability reporting. For now, reporting on the common set of Stakeholder Capitalism Metrics will provide a running start for companies to demonstrate the progress they are making in integrating sustainability into their business activities.





# Conclusion

Analysis of the Energy Transition Index has shown encouraging progress on the energy transition over the past decade. But more progress is needed. Evolution in areas such as environmental sustainability remains uneven and insufficient, while progress on other dimensions such as economic growth has been mixed. Recent disruptions, whether caused by COVID-19 or the climate, have challenged the resilience of the energy transition. As energy systems become more variable, distributed and digitalized, new risks are emerging that threaten the reliability, resilience and affordability of future energy. Understanding how to boost the resilience of the energy transition and identifying the levers required to do so will become increasingly critical during this decade of action and delivery.

Policy-makers, business leaders and consumers all have a part to play in delivering a balanced, resilient transition which continues to speed progress regardless of disruptions and opposition. While there is no single approach, some common key themes are emerging across different geographies:

- **Energy transition must be a just transition.** This challenge is about more than simply energy system performance. The energy transition is a systemic transformation of entire economies and societies. It follows that transition measures must address the issues of equity, jobs, public health, access and affordability. Policy-makers and investors must consider all these issues when evaluating and communicating their decisions, to gain cooperation from a broad coalition of stakeholders.
- **Electrification is necessary but not sufficient.** Accelerating electrification and shifting to renewables will be critical to achieve the emission reduction goals of the next decade.

But that alone will not be enough. Jump-starting the transition in other areas of the energy system, from heavy-duty transport to hard-to-abate industries such as cement and steel, is now a necessity. We need to commercialize and scale up a wide range of emerging clean energy technologies to fully decarbonize all energy systems. We will also need to foster and fund innovation and collaboration across industry sectors.

- **Collaboration between public and private sectors** is vital to share risks, scale up funding and de-risk investments made with multi-year and even multi-decade time horizons. This is crucial for emerging markets and new, clean technologies, where the economics are not yet competitive with more-established energy investments.

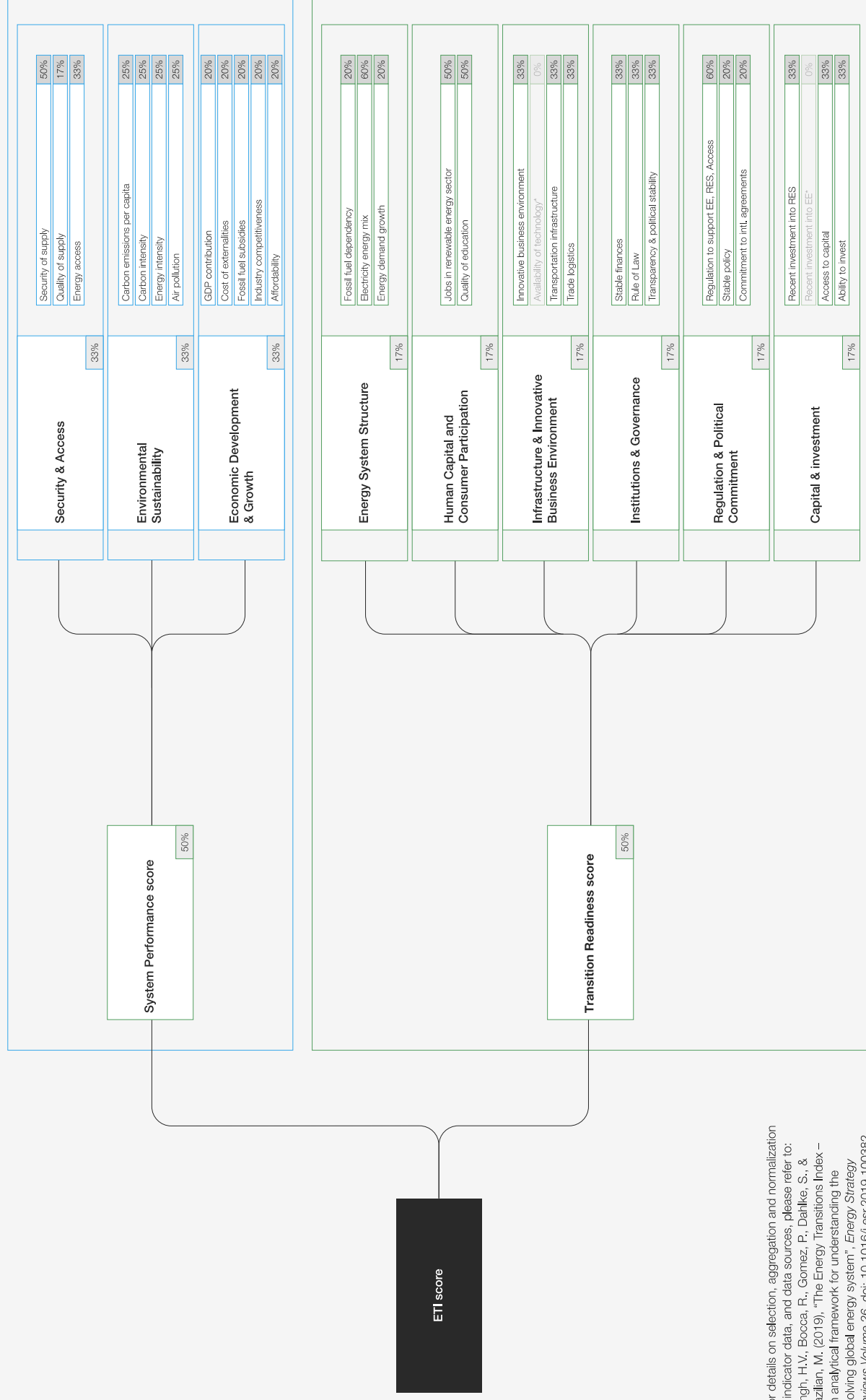
Looking ahead, there are two major opportunities which will have profound impacts for the coming decades. First, the unprecedented level of government stimulus to combat the social and economic impacts of COVID-19 could be targeted to build resilience in the energy transition and provide a near-term focus on energy transition. Second, the upcoming COP26 summit in November holds the potential to set the tone and trajectory for coordinated international action on climate change.

Developments in this decade will be crucial in resetting our economies and in our fight against climate change. Policy-makers and private sector actors must work together and seize the opportunities to build the foundation for a resilient energy transition – one that not only ensures long-term sustainability but also delivers inclusive growth and long-term prosperity.



# Appendix

## Methodology



For details on selection, aggregation and normalization of indicator data, and data sources, please refer to: Singh, H.V., Bocca, R., Gomez, P., Dahlke, S., & Bazilian, M. (2019), "The Energy Transitions Index – An analytical framework for understanding the evolving global energy system", *Energy Strategy Reviews Volume 26*. doi: 10.1016/j.esr.2019.100362.

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