WORLD ENERGY COUNCIL

World Energy **Trilemma Index**

2020

In partnership with Oliver Wyman

ABOUT

WORLD ENERGY COUNCIL

The World Energy Council is the principal impartial network of energy leaders and practitioners promoting an affordable, stable and environmentally sensitive energy system for the greatest benefit of all.

Formed in 1923, the Council represents the entire energy spectrum, with over 3,000 member organisations in over 80 countries, drawn from governments, private and state corporations, academia, NGOs and energy stakeholders. We inform global, regional and national energy strategies by hosting high-level events including the World Energy Congress and publishing authoritative studies, and work through our extensive member network to facilitate the world's energy policy dialogue.

Further details at www.worldenergy.org and @WECouncil

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WORLD ENERGY TRILEMMA INDEX 2020

The World Energy Council's definition of energy sustainability is based on three core dimensions: Energy Security, Energy Equity, and Environmental Sustainability of Energy Systems.

Balancing these three goals constitutes a 'Trilemma' and balanced systems enable prosperity and competitiveness of individual countries.

The World Energy Trilemma Index has been prepared annually since 2010 by the World Energy Council in partnership with global consultancy Oliver Wyman, along with Marsh & McLennan Advantage of its parent Marsh & McLennan Companies. It presents a comparative ranking of 128 countries' energy systems. It provides an assessment of a country's energy system performance, reflecting balance and robustness in the three Trilemma dimensions.

Access the complete Index results, national Trilemma profiles and the interactive Trilemma Index tool to find out more about countries' Trilemma performance and what it takes to build a sustainable energy system: https://trilemma.worldenergy.org

World Energy Trilemma Index 2020, published by the World Energy Council in partnership with OLIVER WYMAN.

TABLE OF CONTENTS

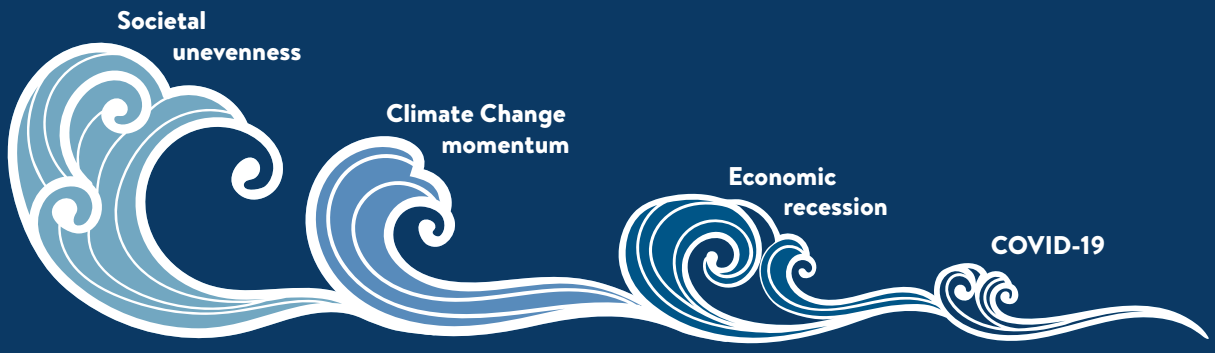
PLACING PEOPLE AT THE CENTRE OF THE ENERGY DEBATE

This has been a turbulent year for economies and societies throughout the world. The COVID-19 global pandemic has affected everyone and has had a significant and uneven impact across the worldwide energy industry. It has also reminded us all why energy matters.

The pandemic has highlighted the many links between multiple national and international policy agendas. The World Energy Council has been active for decades in developing integrated policy approaches to deal with interconnected energy challenges.

The crisis is having a deep – and likely lasting – impact on the pace and direction of the global energy transition. New business patterns, ways of working and societal behaviours are emerging, with implications for future energy demand, as well as the supply mix. Within the energy sector, clear "winners" and "losers" have emerged, with informed commentators and corporate planners, in many cases, having to go back to their drawing boards.

Figure 1: A brutal health shock which impacts on pre-existing tensions in energy systems



Recovery will not be easy, and transformation is also still possible

No crisis happens in a vacuum. A bigger-picture understanding is an essential place to start to make sense of what is happening now. Many governments are concerned to mitigate the risk of global economic contraction, triggered by lockdown-led recessions, whilst also addressing the challenges of climate change.

Figure 2: Enduring mission – better energy for better lives

Even before the pandemic, our worldwide expert energy community was discussing the next era for energy. In recent years, the process of global energy transition has been driven by the interaction of broader trends in Digitisation, Decarbonisation and Decentralisation. The 24th World Energy Congress, held in Abu Dhabi in 2019, noted the emergence of a '4th D' – Disruption-as-usual'. Delegates discussed the emergence of new leadership mindset – a shift from supply-centric to "customer-centric" energy systems. New challenges for the energy industry as a whole were also highlighted, including the sector's ability to maintain its social licence to operate in this new era of disruption-as-usual and social change.

Our new Vision of Humanising Energy

In response, the Council developed a new vision 2025 focused on Humanising Energy that considers:

The migration of value creation towards the end-user and the potential for demand-side disruptive innovation to reshape supply;

Increasing gaps in productive energy access within and between countries – despite some progress in closing the basic energy access gap on a worldwide basis;

The urgent need to plug in people and engage those impacted by energy transition in designing and managing the process – including workers and local communities;

The need to reconnect the "market" price of new technologies and the full cost to society of faster transformation and resilience of the whole energy system.

The World Energy Council has facilitated the exchange of impacts, actions and outlooks throughout its worldwide community to distil emerging lessons from the pandemic in relation to energy. Whilst certain trends, such as digitisation of energy have grown stronger, we note differences in responses and expectations about the possible return to normalcy. This reinforces the Council's role in engaging regional, technological and societal diversity as strengths.

In the space of months, people have adopted new behaviours and learned new ways of working, living, relating and doing business. We even have new vocabulary to describe this – "to Zoom" and to "self-isolate".

We believe that our vision of "humanising energy" has come of age.

The “energy+” (“energy plus”) agenda

Energy affects all aspects of human life – material security, wellbeing, convenience, comfort and community – and impacts planetary health. It also fuels new dreams and ambitions.

We are addressing the connected challenges agenda, which recognises the need for more energy and climate neutrality in a new context of affordability and equity.

We remain committed to providing a neutral and safe space to carefully navigate the new geopolitics of clean energy, which extends beyond oil and gas, to include non-energy resources, data and technology.

Strengthening the worldwide ‘energy+’ community movement

With a strong track record of over 97 years, the World Energy Council has a role to inspire, inform and impact the recovery and transformation ambitions of societies everywhere as they seek to build back better.

We are globally networked and locally strong. Our members come from across the public, private and civil society sectors, and include all energy forms – heat, power, fuels and storage. We engage wider energy system shapers – users, investors, entrepreneurs and policy innovators.

Importantly, we are vehemently impartial – we do not advocate for any form of energy over another – and we are not passive.

Using the World Energy Trilemma Index as an interactive leadership tool

This year, we celebrate the 10th anniversary of the World Energy Trilemma Index. Since 2010, the Report has provided an independent and objective rating of a country’s energy policy and performance using verified global and country-specific data to assess management of three core dimensions: Energy Security, Energy Equity and Environmental Sustainability. The World Energy Trilemma Index enables countries to keep track of their own progress and to learn with and from each other about what’s working and what’s not.

The annual assessment is designed as a tool to be used, not a report to be read and placed on a shelf. In this report we also suggest ‘how to’ use the World Energy Trilemma Index as an energy policy pathfinding tool.

In the highly fragmented, crowded and increasingly polarised energy leadership environment, our interactive ‘energy+’ leadership toolkit is more important than ever. By engaging diversity as a strength and understanding the energy future through the interaction of actions of key players I believe humanity as whole can learn to flourish through this global crisis.

Dr Angela Wilkinson
Secretary General
& CEO

EXECUTIVE SUMMARY

This year we celebrate the 10th anniversary of the World Energy Trilemma Index following its initial launch in 2010 as an energy policy pathfinding tool. Countries develop different energy policies based upon their domestic circumstances with varying natural resources, geographies, and socio-economic systems. This divergence of differing systems and contexts mean that there is no single golden path for successful energy transition, and instead, each country will need to determine its own best energy policy pathway considering its national situation and priorities. This means that direct comparisons between the rankings and scores of countries can be less informative, but instead help provide a conversation opening. But countries can and should learn from each other, by learning what policies work and why such policies might be successful within some contexts but not in others. The Energy Trilemma Index can help countries and energy stakeholders in an on-going dialogue to determine what areas of energy policies need to improve and examples from other countries that may help to determine which options might be more suitable.

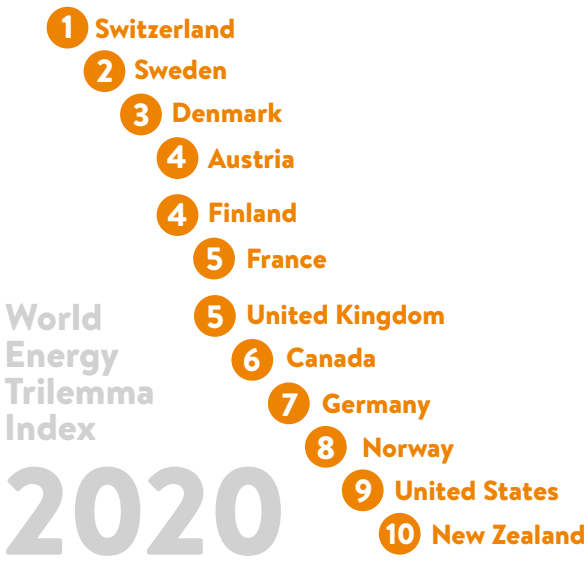
While 2020 has been overshadowed by the COVID-19 pandemic, the Energy Trilemma reflects historical energy policy performance that does not include this year's data. The impact of the pandemic will become evident in the 2021 Trilemma (to be launched in October 2021) as annual data for 2020 becomes available. Some implications of the pandemic for energy are already visible - with the increased focus on digitalisation and depressed global demand, although the longer-term implications for energy systems and transition remain unclear.

2020 RESULTS

In this year's Trilemma, the overall scores top ten ranks remain dominated by OECD countries, which illustrates the benefit of longstanding active energy policies. The top three ranking countries of Switzerland, Sweden and Denmark have overall scores of 84 and above. The top ten ranks have a strong European flavour with Canada, the United States and New Zealand breaking the OECD European monopoly. This year we have introduced tied ranks due to the closeness of some country scores; for example, Austria and Finland have the same score and are ranked 4th while the UK and France also share the same score to be ranked 5th. The closeness of the scores also prompted the use of the broader ranking definition so that the top ten ranks include more than ten countries due to tied ranks with equal scores.

The path followed by the greatest improvers since 2000 reveals the importance of diversifying energy systems and increasing access. The top three countries improving their overall Trilemma performance are Cambodia, Myanmar and Kenya. These countries have low overall ranks but have made significant and sustained efforts to improve their energy systems.

Figure 3: The TOP 10 ranks of World Energy Trilemma Index 2020



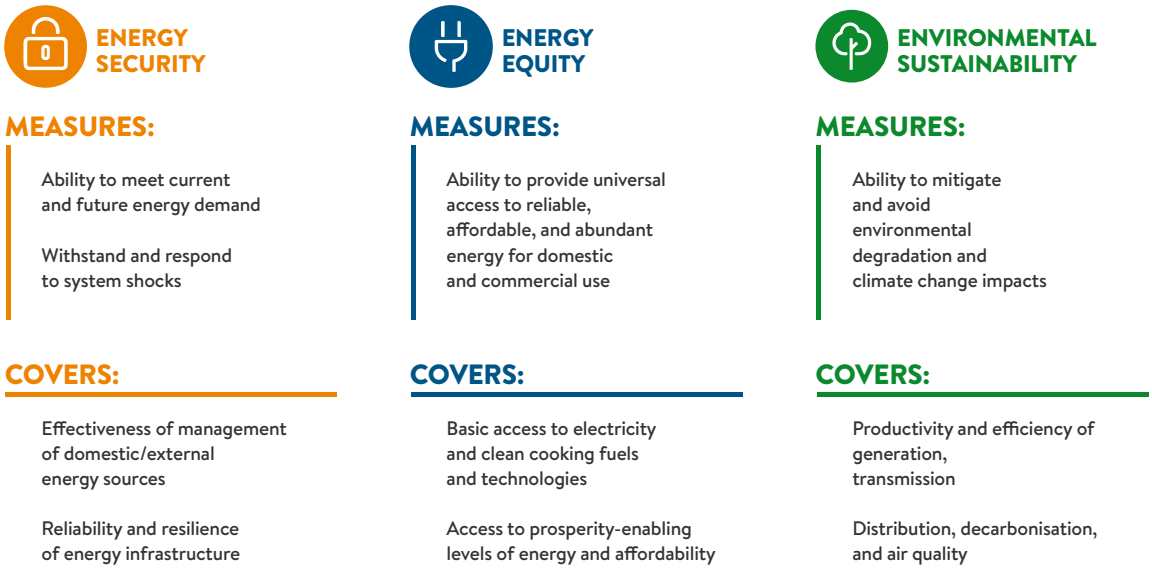
In the **Energy Security** dimension, the top ten ranks include countries with significant hydrocarbon resources alongside countries focused on diversifying and decarbonising their energy systems with Canada, Finland and Romania topping the list of best performers. Significant natural resource endowment strongly underpins good performance, although hydrocarbon resources abundance can also be a "resource" curse: the performance of some hydrocarbon-rich countries is declining as they concentrate their energy systems rather than diversifying them. Diversifying a country's energy mix improves energy security scores and leads to a stronger emphasis on system resilience.

The **Energy Equity** top ten ranks benefit from producer countries with low energy costs for consumers – implicit subsidies – that may be more challenging moving forward in a more volatile price environment post-COVID-19. Luxembourg, Qatar and Kuwait head the list of the top ten performers for the dimension; all are small, wealthy nations with high GDP, strong interconnections, low energy prices through subsidy and/or significant easily extractable energy resources. Price subsidies (either explicit or implicit) tend to hinder energy supply diversification and reduce Trilemma scores in the other dimensions. The greatest improvers since 2000 share a common focus on policies to increase access to energy and to make energy more affordable to consumers. Kenya and Bangladesh have seen massive improvements in access to electricity, largely due to implementation of government policy.

Access to reliable and affordable energy is an enabler of economic prosperity, but increasing emphasis is now being paid to quality of energy supply. More than 800 million people still do not have access to basic energy, particularly in Sub-Saharan Africa – continued progress on UN Sustainable Development Goal 7 is an imperative with pathfinding from top improving countries providing practical examples.

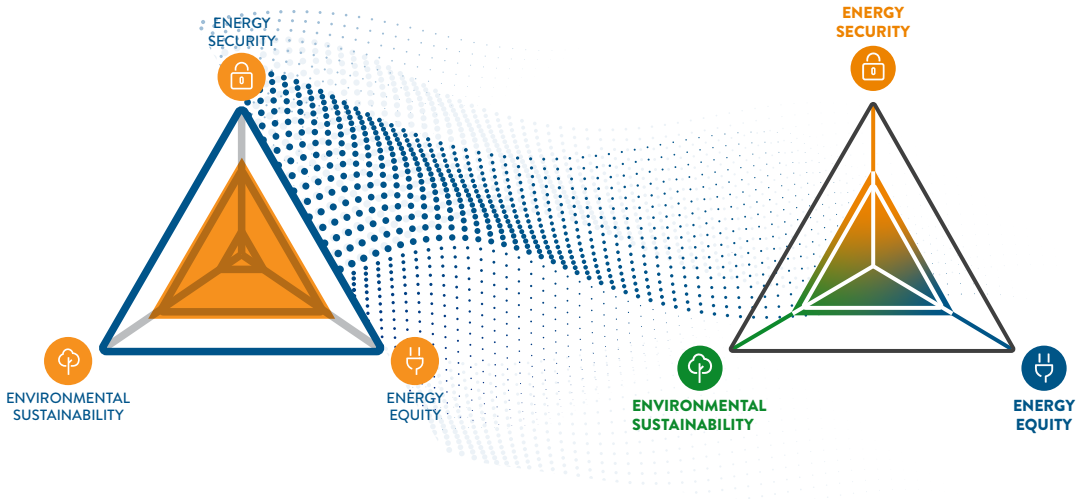
In the **Environmental Sustainability** dimension, the top ten rank showcases strong policy efforts to decarbonise and diversify energy systems with the top three being Switzerland, Sweden and Norway. A diversified energy system, supported by strong policy instruments to reduce GHG emissions significantly, coupled with energy efficiency measures, deliver a strong performance in the environmental sustainability dimension. Driving down energy intensity can assist countries yet to decarbonise their energy mix. Ensuring an inclusive decarbonisation that leaves no communities behind will be essential to humanise energy transition. The greatest improvers since 2000 show continued policy efforts together with some anomalies – Ukraine reduced imports and increased nuclear generation since 2015 – and geopolitical events.

Figure 4: Trilemma Index dimensions



Energy transition brings globally unprecedented change to the energy sector as countries seek to decarbonise while energy policies and regulations themselves tend to lag with incremental step changes. This means that the Energy Trilemma Index needs to evolve continually in order to remain relevant by including the indicators that best reflect the evolving energy sector by modifying data sources or indicator coverage. Changes to the 2020 Trilemma have been incremental and focused on refining the model, although we are evolving the visual presentation. The dimension chapters include summary graphics and text with colour coding to highlight key insights. We have also evolving the graphical presentation of the Trilemma triangle to move away from the orange block towards a colourful composition that better reflects the uniqueness of each Trilemma triangle. The three Trilemma dimension have their own colour aligned with their chapter colouring so the mix for each triangle reflects the differing balances between the dimensions. This multi-colour approach also reflects that energy transition is not single coloured and will reflect a spectrum of differing pathways dependent upon varying national circumstances.

Figure 5: Spectrum of differing pathways are now reflected in the Trilemma balance triangle



Lastly, we cannot lose sight of the impact of the COVID-19 pandemic. We expect the post-pandemic recovery to reshape energy policies and the agenda for Energy Transition, where the Trilemma as a pathfinding tool should become the indispensable guide to a more equitable, sustainable and affordable energy future.

Sir Philip Lowe
Chair
World Energy Trilemma

Martin Young
Senior Director
Business Insights and Scenarios

2020 TRILEMMA RESULTS

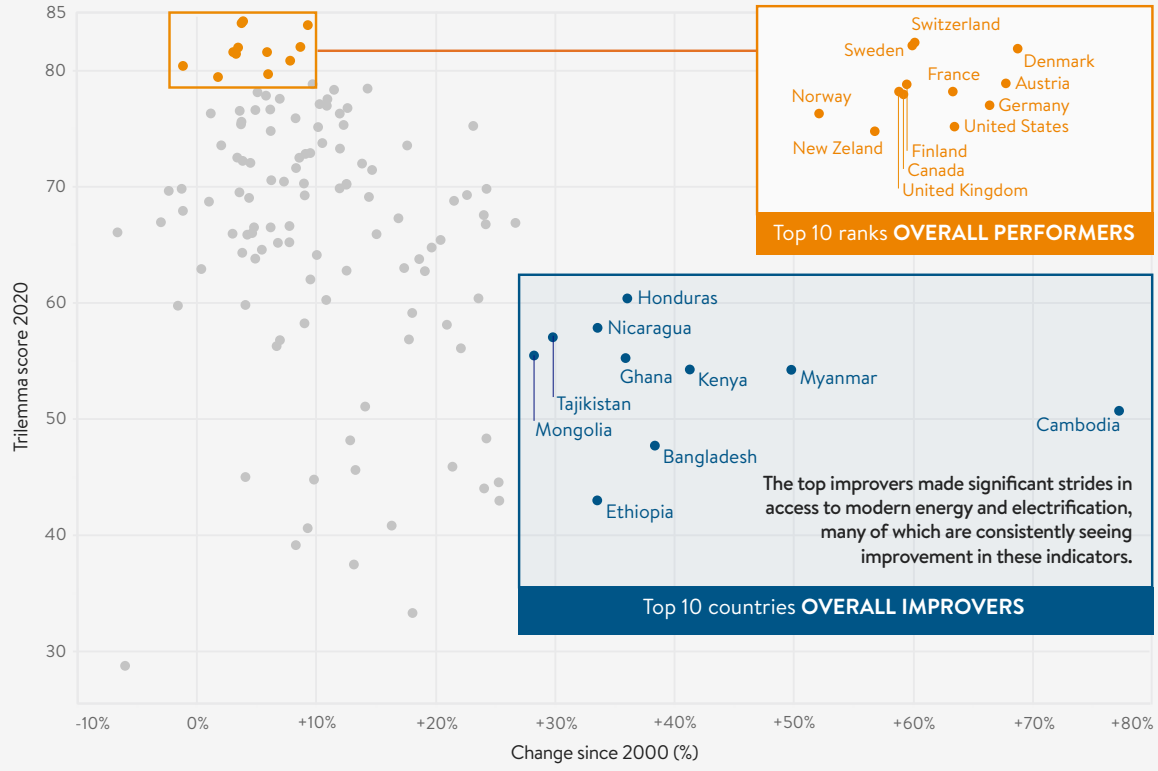
World Energy Trilemma Index

Reflects a nation's capacity to meet current and future energy demand reliably, withstand and bounce back swiftly from system shocks with minimal disruption to supplies.

Assesses a country's ability to provide universal access to affordable, fairly priced and abundant energy for domestic and commercial use.

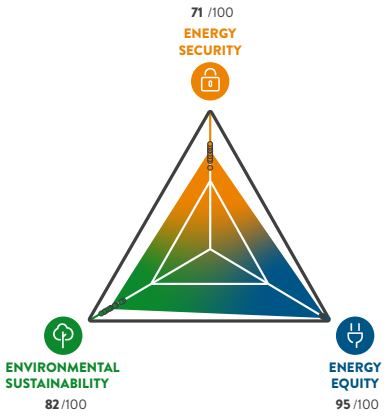
Represents the transition of a country's energy system towards mitigating and avoiding potential environmental harm and climate change impacts.

2020 Trilemma score against the difference of 2000 score



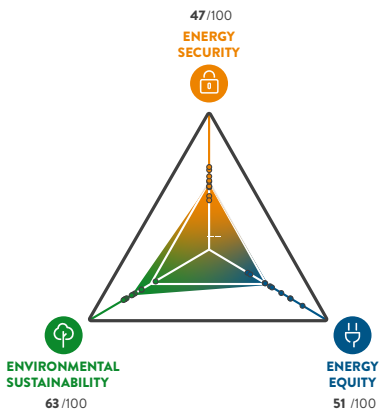
2020 TOP PERFORMERS AND IMPROVERS

TOP 10 RANK OVERALL PERFORMERS



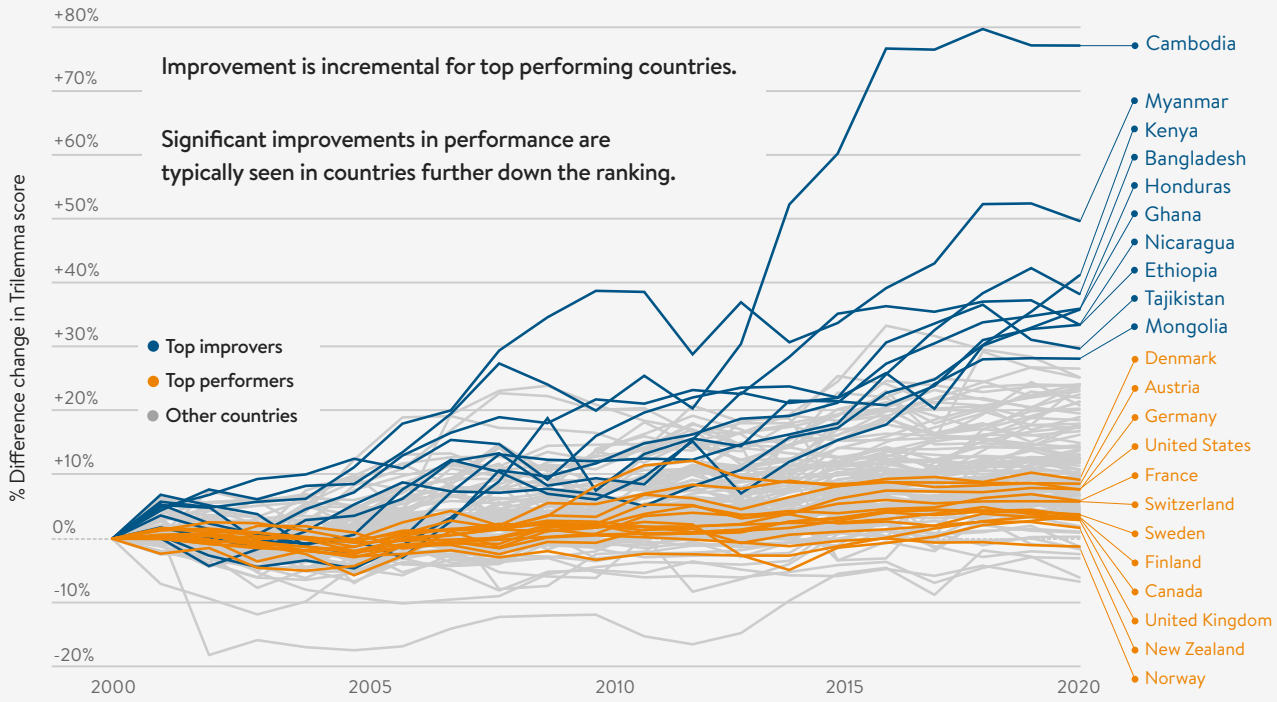
Rank		Grade	Score
1	Switzerland	AAAa	84.3
2	Sweden	ABAa	84.2
3	Denmark	AAAa	84.0
4	Austria	AAAa	82.1
4	Finland	ABAa	82.1
5	France	AAAa	81.7
5	United Kingdom	AAAa	81.7
6	Canada	AABa	81.5
7	Germany	AAAa	80.9
8	Norway	BAAa	80.5
9	United States	AABa	79.8
10	New Zealand	AAAa	79.5

TOP 10 COUNTRIES OVERALL IMPROVERS

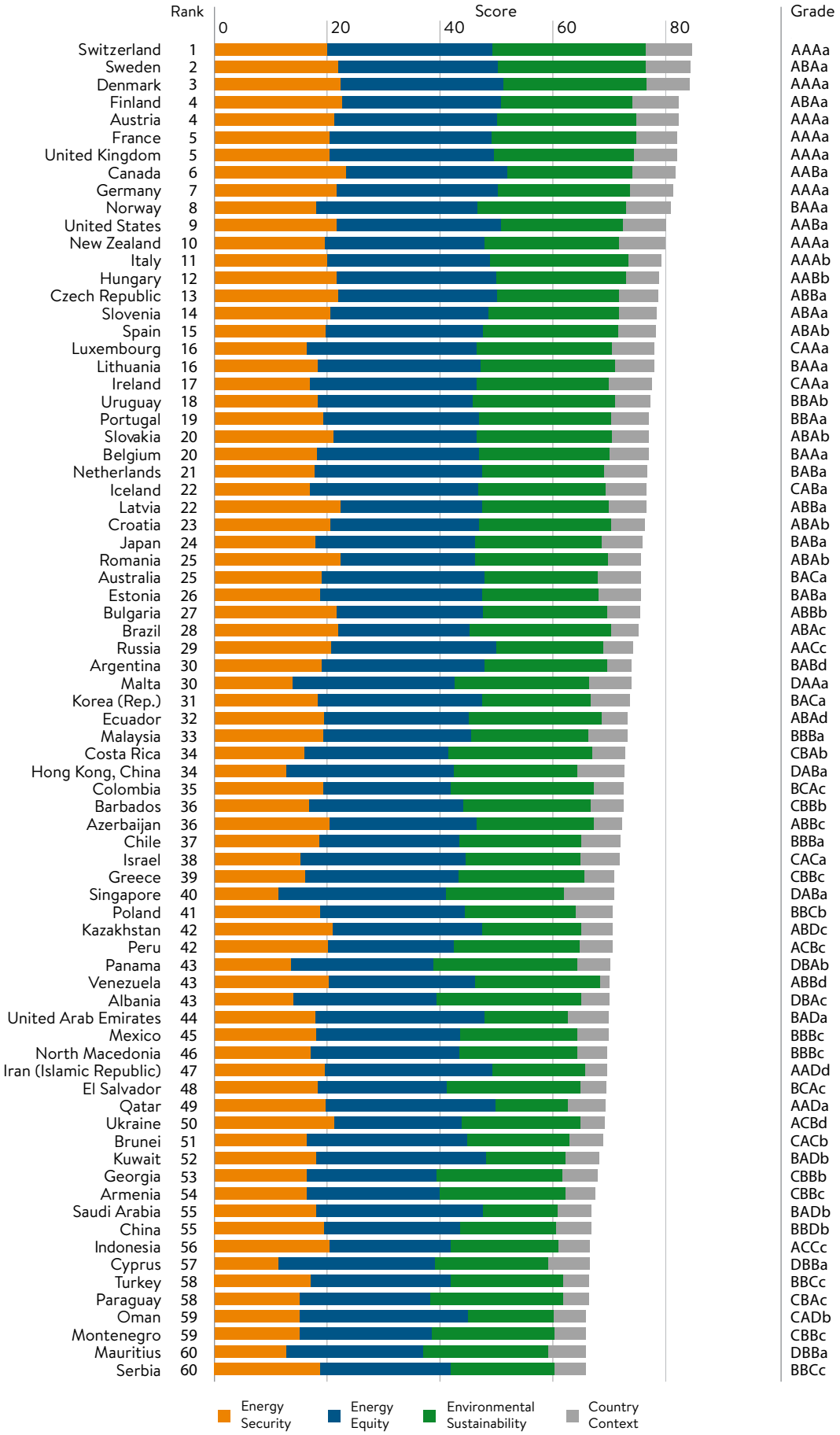


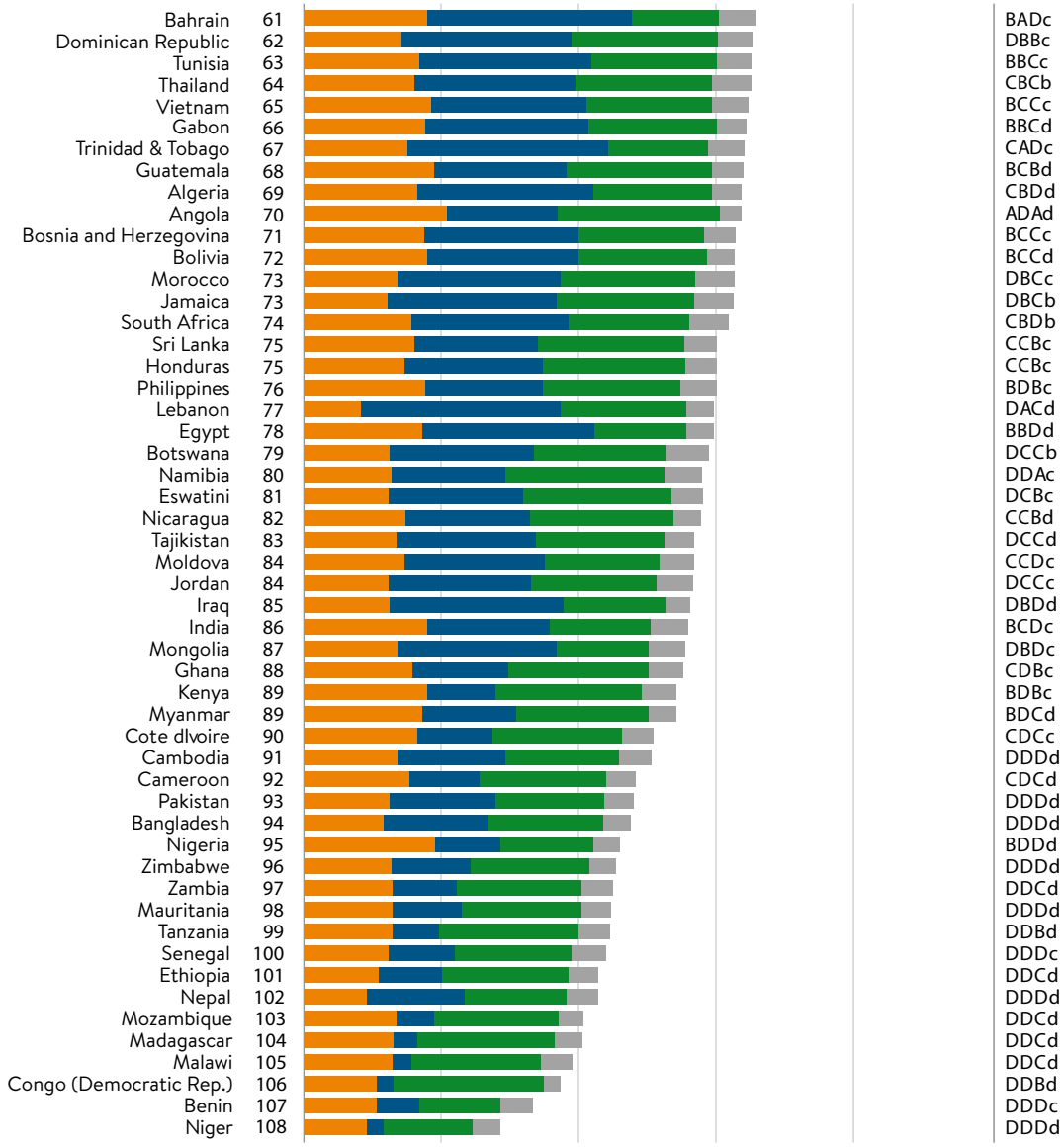
Rank		Grade	Score	Improvement since 2000
91	Cambodia	DDDd	50.8	77%
89	Myanmar	BDCd	54.3	50%
89	Kenya	BDBc	54.3	41%
94	Bangladesh	DDDd	47.8	38%
75	Honduras	CCBc	60.5	36%
88	Ghana	CDBc	55.3	36%
82	Nicaragua	CCBd	57.9	34%
101	Ethiopia	DDCd	43.1	33%
83	Tajikistan	DCCd	57.1	30%
87	Mongolia	DBDc	55.5	28%

2020 Trilemma Indexed trends since the baseline of 2000



WORLD ENERGY TRILEMMA INDEX 2020





What does the country's performance show?

GRADE

Range of values: A (best), B, C, D (worst)
Example: AAAa, ABAc, BCDb, DCDd
Meaning: A grade is given for performance in three main dimensions (1st letter for Security, 2nd Equity, 3rd Sustainability) which cover 90% of the overall grade and an additional dimension (4th letter for Country Context) which covers the remaining 10%. The value of the grade depends on which quartile the country's score falls into:

- Grade A: top 25% countries
- Grade B: between top 25% and 50%
- Grade C: between 50% and 75%
- Grade D: between 75% and 100%

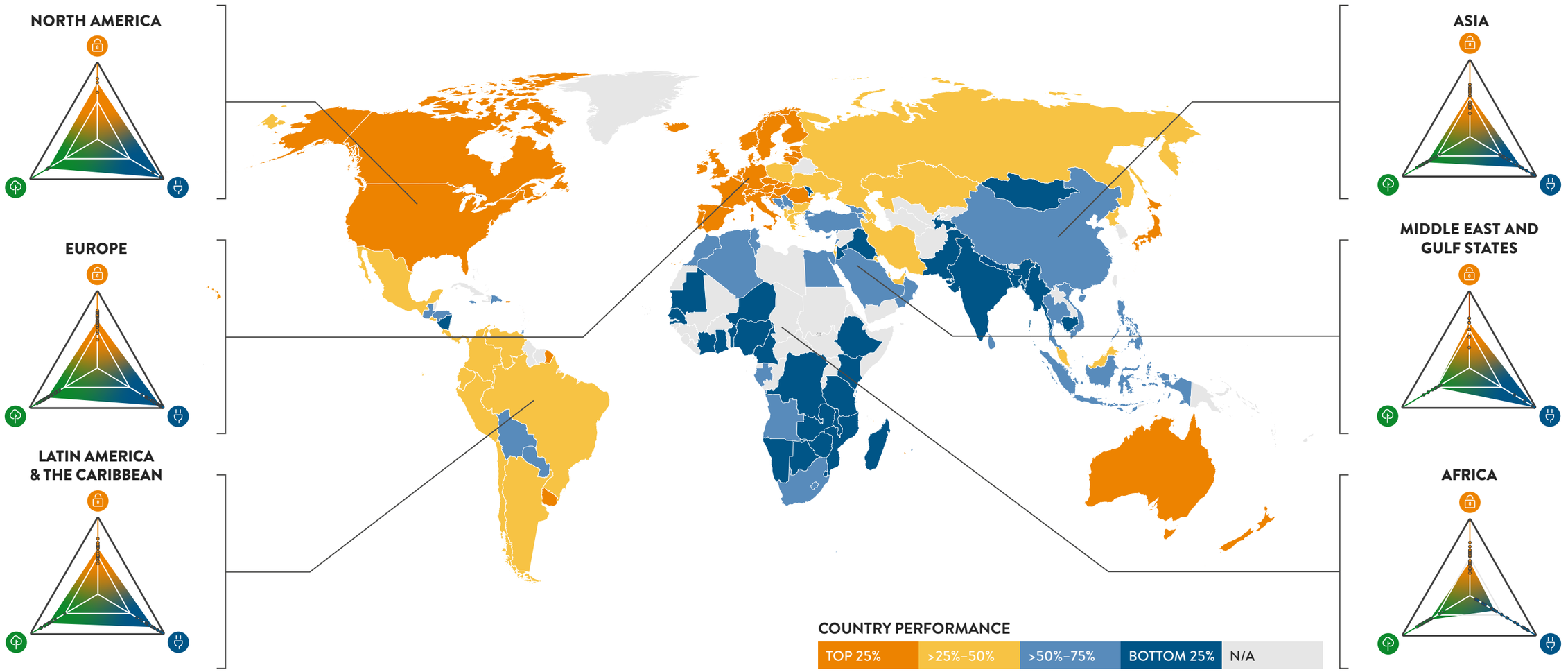
RANK

Range of values: 1 (best) ... 125 (worst)
Example: Shared rank 4 determined by the 4th best score value of 82.1
Meaning: The rank provides only a very short and limited information about a country's performance – it only informs where the country lies in the full Index, therefore the grade, the score, the context and especially the full indexed history of the country's performance should be taken into account when comparing with others.
We have used dense ranking approach because some scores are tied at one decimal place.

SCORE

Range of values: 100 (best) ... 0 (worst)
Example: 84.3, 53.4, 32.1
Meaning: A score value is given for overall performance as well as for each dimension (Security, Equity, Sustainability, Country Context) determined by country's performance in the indicators; the score can change even if the data did not change because the score reflects performance in comparison with other countries who may have improved in a given indicator.

Please note that because the Methodology has evolved direct comparisons of ranking, grades and scores to previous reports is not possible. Historical performance has been recalculated using the same revised Methodology back to the Index year 2000.



NORTH AMERICA

REGIONAL EFFORTS NEED TO BE ALIGNED TO IMPROVE TRILEMMA OUTCOMES

As a significant energy producer, energy plays a critically important and highly valued part in North American economies. Diversity amongst the three countries is greatest in environmental sustainability policy, with the US drifting away from international commitments on climate change, Mexico reverting to energy self-sufficiency by reducing energy imports and providing energy that is abundant and cheap, and Canada working on an action plan to achieve net-zero emissions by 2050.
Energy Security is widely seen as a positive continental strength, although reinforcing cooperation within the region remains crucial on this dimension. Regarding Energy Equity, North America has widespread access to energy and energy services, although there are concerns that some communities are being left behind.

EUROPE

A GREEN RECOVERY TO ACCELERATE THE ENERGY TRANSITION

European countries continue to perform strongly in the overall Trilemma top ten rankings. In general, the region is oriented towards sustainability and affordability of energy sector, while long-term energy security and harmonisation of market designs in national legislations remain as challenges.
The imminent economic crisis looming in the wake of the COVID-19 pandemic is likely to change the scores of many countries in the coming years, and the recovery measures that they apply will determine whether that change is positive or negative.
This crisis might bring about an opportunity to link energy transition with economic recovery, although such opportunity can become a trade-off instead for the most impacted economies.

LATIN AMERICA & THE CARIBBEAN (LAC)

FURTHER EFFORTS FOR AN ADEQUATE REGULATORY FRAMEWORK ARE NEEDED

The Latin America and Caribbean region seems to be moving forward in the right direction, although regulatory support continues to be insufficient to further advance the energy transition in the region. Significant efforts have been made to diversify the energy mix, reduce dependence on hydro, and improve energy security. Those efforts have focused on incorporating renewable power generation into the system, which has consequently improved environmental sustainability. Nonetheless, the top performers of the region in this dimension are not as a result of good policies, but rather, due to the abundance of natural clean energy resources. In contrast, the development of strong social policies have allowed the region to maintain good and stable performance in the energy equity dimension.

ASIA

INNOVATION KEY TO IMPROVING TRILEMMA PERFORMANCE

Asia is one of the most dynamic and diverse regions in the world, with countries among the top and the bottom ranks of the 2020 Trilemma. Energy equity scores have generally increased, primarily due to successful deployment of modern and affordable energy across the region. Asia remains the largest energy importer in the world and its energy security is expected to become even more challenging.
The region presents dramatic improvements in sustainability, with governments investing in transition to clean energy, and increasing private competition and incentives in the renewable sector.
The COVID-19 crisis could have negative and positive effects on the energy systems of the region, which will be exploring further.

MIDDLE EAST AND GULF STATES (MEGS)

THE TIME TO FOCUS ON ENERGY DIVERSIFICATION IS NOW

MEGS countries score highly in the area of energy equity as a result of providing affordable and near-universal energy. However, the uneven distribution of resources and limited cross-border cooperation negatively impact their energy security scores. Environmental Sustainability is also a regional challenge due to low deployment of renewable energy and the absence of energy efficiency measures.
Recently, several countries have undertaken reforms to diversify their economies and set ambitious renewable energy targets for 2030. Nonetheless, given the impact of COVID-19 and the reliance of public funds on oil and gas revenues, it is likely that these reforms will be delayed as spending on infrastructure, health, digitalisation, and fiscal stimuli to kick-start a post-COVID recovery is prioritised.

AFRICA

PROGRESS TOWARDS ENERGY EQUITY AND SECURITY CAN BE ENVIRONMENTALLY SUSTAINABLE

There are large disparities amongst African countries, in terms of demographics, mineral resources, economic development, industrialisation, etc. Consequently, energy performance and the path to energy transition differs across the continent. On the Energy Equity dimension, the region continues to be challenged with the world's lowest level of electricity access – 54 % overall and 45% for Sub-Saharan Africa.
Most African countries tend to score C or D on Energy Security, which means they don't have reliable and secure energy supply systems, due to different country-specific factors.
Lastly, on the Sustainability dimension, the performance of five countries in particular stands out with the implementation of national climate action plans. However, this dimension remains challenging for the other African countries.

SUMMARY

ENERGY SECURITY

Figure 6: Top performers in 2020

Rank	Country	Energy Security Score
1	Canada	77.1
2	Finland	75.4
3	Romania	74.5
4	Denmark	74.4
5	Latvia	74.1
6	Sweden	72.8
7	Brazil	72.6
8	Czech Republic	72.4
9	United States	72.2
9	Bulgaria	72.2
10	Hungary	72.1

Figure 7: Top 10 ranks - Historical movements over 5 year periods

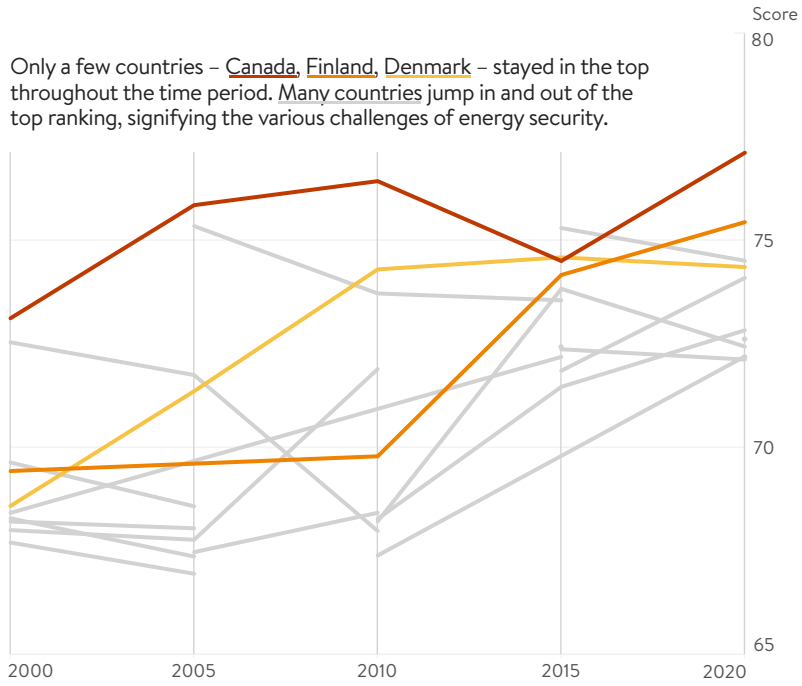


Figure 8: Top improvers in 2020 against their 2000 score

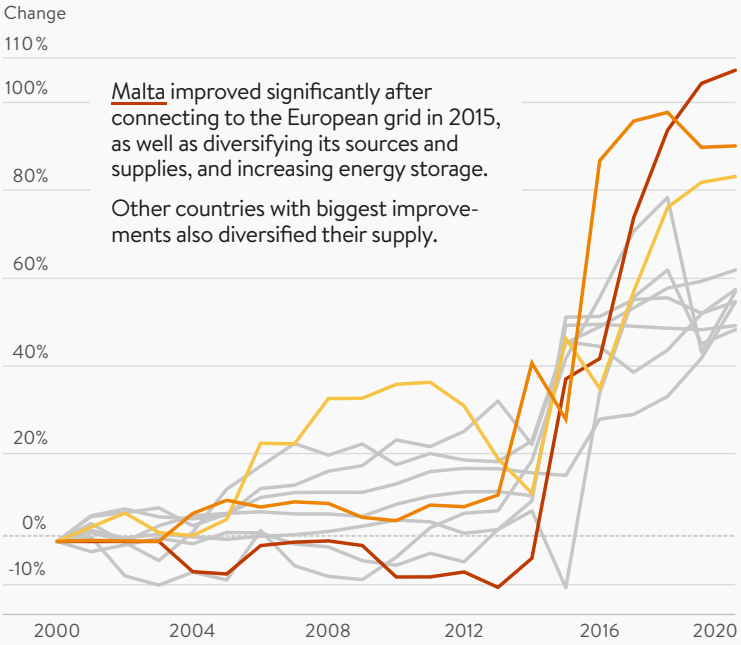
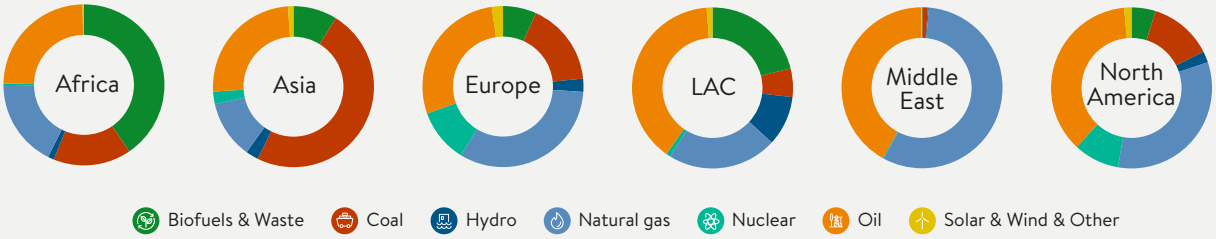


Figure 9: Top improvers in 2020

Rank	Country	% Score Improvement
1	Malta	+107%
2	Cambodia	+90%
3	Jordan	+83%
4	Israel	+62%
5	Dominican Rep.	+57%
6	Jamaica	+57%
7	Cyprus	+55%
8	Kenya	+55%
9	Singapore	+49%
10	Tajikistan	+48%

Figure 10: Primary Energy Supply illustrates differing regional energy contexts for Security



TRENDS IN ENERGY SECURITY

Energy security measures the ability of a country to meet current and future energy demand, as well as to withstand and respond to system shocks minimizing disruption to supplies. The dimension covers the effectiveness of management of domestic and external energy sources, along with the reliability and resilience of energy infrastructure.

While the perception of what countries and stakeholders understand by 'energy security' has been evolving, it is likely that the current experience from the COVID-19 pandemic will lead to further evolution and accentuate the importance placed upon resilience. Energy security has now moved beyond its historic focus on oil to include the resilience issues that arise from energy systems becoming more decentralised, digitalised and decarbonised.

The changes in emphasis in the energy security dimension need to be captured within the Trilemma methodology. For 2020, we have therefore sought to improve data coverage and the calculation of the oil stocks sub-indicators to address concerns about undervaluing resilience from domestic crude oil production and oil refining capability. For further details, see the Methodology section.

The revised approach does not change scores significantly, but has reshaped the top ten performers in the energy security dimension. The top three ranked countries in 2020 are Canada, Finland and Romania, with each reflecting slightly differing approaches. Canada's significant natural resource endowment provided a strong basis for its high energy security score, but the country's consistent efforts to diversify its energy system and maintain a diversified economy lie behind its top ranking. Finland leads a strong Nordic presence in the top ten with their focus on decarbonising energy systems. Finland has reduced its fossil fuel generation and introduced solar and wind to increase its generation diversity. Romania benefits from being a hydrocarbon oil producer that is implementing the European Union's energy policy agenda. All three countries benefit from energy market integration with their neighbours [Figure 11].

Figure 11: Changes between 2000 and 2018 in the diversity of electricity generation of the security top performers

All top ten improvers since 2000 have made significant efforts to diversify their energy systems. The improvements made by Malta and Cyprus most likely stem from their EU accession processes to liberalise their energy markets and improve their oil security by holding higher levels of oil stocks.

While the security top ten includes several resource-rich countries such as Canada, Brazil and the United States, other resource-rich countries are ranked lower than might have been expected, with some included in the list of countries whose performance in the security dimension has declined over the past 20 years. Some resource-rich countries appear to be experiencing a 'resource curse' where their economies have focused on their indigenous natural resources and led to the development of very concentrated and less diverse energy systems. Less diverse energy systems can hinder decarbonisation efforts and slow down energy transition. At the same time, resource-rich countries can also better afford to diversify their systems more quickly although this can be much more challenging in a low- or volatile oil price environment.

But this is not the only story. Norway also appears to have declined in energy security performance since 2000. Here, there is a very different story that illustrates the need to consider different sub-indicators to assess security in its wider perspective. Norway has passed its peak hydrocarbon production but remains a significant exporter, not just of oil and gas, but also of electricity that is almost entirely hydroelectric [Figure 12, Figure 13]. Reliable Norwegian hydroelectricity has helped Denmark adopt high levels of variable wind generation through strong grid interconnection.

Countries have very different socio-economic contexts for energy security dependent on their natural resource endowments and market integration that reflect diverse policy challenges. Several countries have improved the security of their energy systems as a co-benefit of their efforts to improve sustainability and diversify their generation mix. The inclusion of variable renewable generation has reduced import dependency, while creating a new dependency on the weather. Greater interconnectivity with neighbouring grids or by new energy storage technologies can address weather variability and improve system resilience, but also sees the emergence of new energy security challenges such as the risk of cascading cyber events where disruptions in adjacent sectors spread to the energy sector.

Figure 12: Changes between 2000 and 2018 in the Primary Energy Supply of Norway

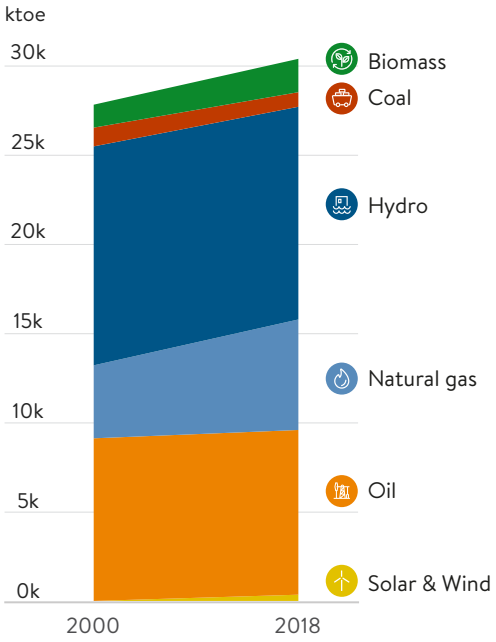
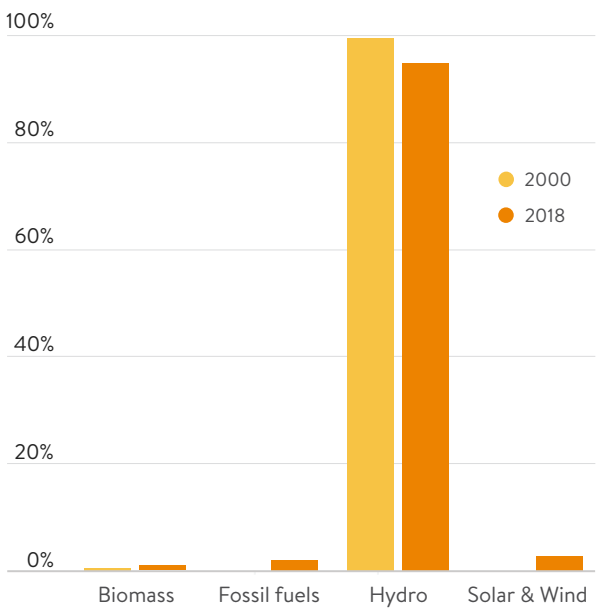


Figure 13: Changes between 2000 and 2018 in the diversity of electricity generation of Norway



As noted previously, while the effects of the COVID-19 pandemic are not included in this year's Trilemma, we can begin to see how many countries will reflect upon the learnings of their energy sector's response and how their experience should reshape their energy policies. Energy supplies have proved to be remarkably resilient during the pandemic with grid operators largely keeping the lights on while energy demand has been significantly affected. Anecdotal evidence suggested that electricity consumption during lockdown shifted towards weekend or holiday demand levels, while oil demand for transport was significantly curtailed. As countries have eased out of lockdown, some of that oil demand has recovered, although some sectors such as aviation look likely to experience a degree of demand destruction with a longer path to recovery. The Council surveyed its global membership to understand the impact of the pandemic on the energy sector and has developed exploratory scenarios to investigate the potential impacts on energy transition.

With respect to energy security, the pandemic has highlighted new risks and challenges that will need to be resolved with the Council's work suggesting two key areas of focus:

Integrated risk and resilience: While energy systems have been largely resilient, questions have emerged about responsibility for cross-sectoral coordination between adjacent sectors, for example in addressing energy-cyber-health issues where energy can be adversely affected by unintended actions by other actors. Emergency response policies will evolve and impact on the need for soft and hard systems resilience (people, value chains and infrastructures), but it is unclear how these will impact energy transition pathways and what new skills and capabilities will need to develop.

New geopolitics of clean energy: The pandemic has illustrated that energy geopolitics have evolved beyond oil to include the new value chains for clean energy technologies and non-energy resources. It is unclear who should take the lead for these clean energy value chains – local communities/cities, global energy businesses and/or national governments? Going digital has been an important enabler, allowing countries and companies to manage through the pandemic, but has also highlighted the emerging geopolitics of data and associated challenges that will need to be addressed.

SUMMARY

- ***Canada, Finland and Romania top the list of best performers in the energy security dimension.***
- ***Significant natural resource endowment strongly underpins good performance in this dimension. But, must be coupled with diversification for a balanced score.***
- ***Countries that focus on indigenous natural resources without diversification risk poorer performance over time – 'resource curse'.***
- ***Diversifying a country's energy mix improves energy security scores, but leads to a stronger emphasis on system resilience.***

SUMMARY

ENERGY EQUITY

Figure 14: Top performers in 2020

Rank	Country	Energy Equity Score
1	Luxembourg	99.9
2	Qatar	99.8
2	Kuwait	99.8
2	UAE	99.8
3	Oman	99.7
3	Bahrain	99.7
4	Iceland	99.3
5	Saudi Arabia	99.0
6	Iran	98.7
7	Singapore	98.1
7	Ireland	98.1
7	Hong Kong, China	98.1
8	Netherlands	98.0
9	Trinidad and Tobago	97.9
9	Switzerland	97.9
10	Israel	97.3
10	Lebanon	97.3

Figure 15: Top 10 ranks - Historical movements over 5 year periods

Luxembourg and Singapore's position in the top is aided by their wealth and size, which sets them apart from the rest of the top 10 which is dominated by countries with extensive natural resources for energy generation.

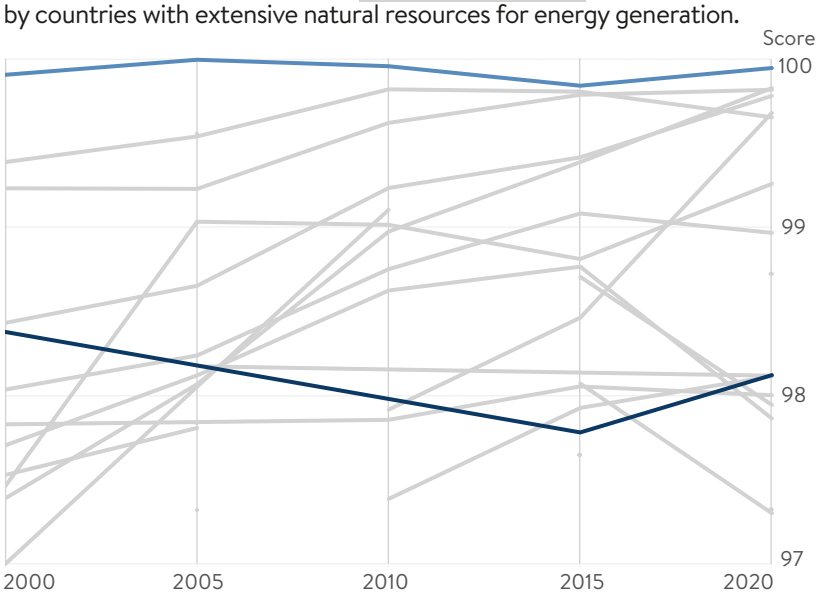


Figure 16: Top improvers in 2020 against their 2000 score

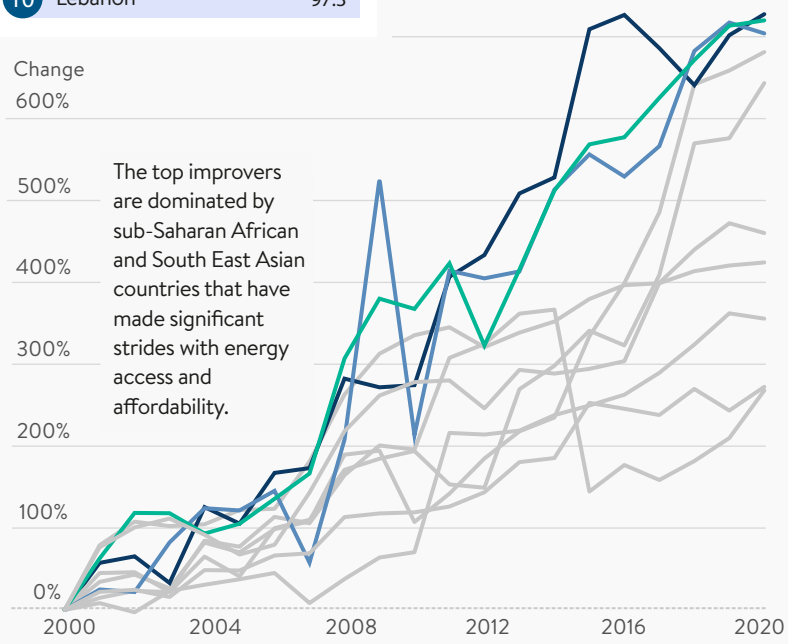
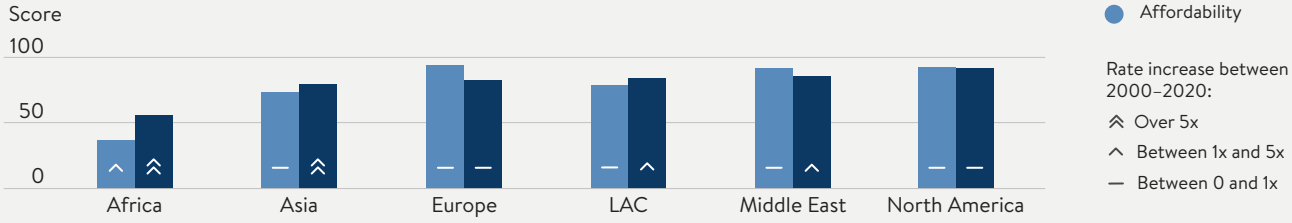


Figure 17: Top improvers in 2020

Rank	Country	% Score Improvement
1	Mozambique	+728%
2	Cambodia	+720%
3	Ethiopia	+705%
4	Tanzania	+682%
5	Kenya	+644%
6	Bangladesh	+460%
7	Nepal	+425%
8	Niger	+356%
9	Benin	+273%
10	Malawi	+268%

Figure 18: Electricity access and affordability by region and the trends since 2000



TRENDS IN ENERGY EQUITY: INCREASING ACCESS FOR ALL

Energy equity assesses a country's ability to provide universal access to reliable, affordable, and abundant energy for domestic and commercial use. The dimension captures basic access to electricity and clean cooking fuels and technologies, access to prosperity-enabling levels of energy consumption, and affordability of electricity, gas, and oil.

Unlike other Trilemma dimensions, where multiple indicators can show synchronous improvement, the two energy equity building blocks of access to reliable energy sources and its affordability are asynchronous – as is their enablement of economic prosperity. Energy access is a prerequisite to quality and availability, both of which must be achieved in a sustainably affordable way for consumers to benefit and enable economic development.

Reliable access to energy is assessed from a binary basic measure e.g. yes/no access to energy, which is aligned to UN Sustainable Development Goal 7 (SDG7), as well as the more nuanced measure of quality and availability of prosperity-enabling energy to support modern lifestyles and economic growth[1]. Energy prices are of course a key determinant of energy affordability, but these are taken in the context of broader socio-economic improvements that influence how affordable a commodity like energy really is.

The nations in the 2020 global energy equity top ten performers are consistently near the top of the ranking each year; although there is some variability in the underlying factors that keep them at the top. All have cracked the energy access challenge, with all but one (at 99.6%) having 100% access to prosperity-enabling modern energy – most developed nations have 100% energy access, the affordability indicator is the key differentiator in their energy equity score.

The top ten energy equity performers are dominated by nations with rich natural energy resources which helps keep energy prices low and affordable. These are predominantly those surrounding the Persian Gulf with abundant, easily extractable hydrocarbon resources, but also includes Iceland whose abundant natural resources produce renewable, zero-low carbon energy via hydro and geothermal generation. Luxembourg and Singapore stand out amongst this group as two nations with zero natural energy resources. Instead, these countries benefit from being small, densely populated and, most importantly, wealthy nations that are well connected to international energy markets.

Luxembourg holds onto the #1 spot for energy equity performance – as a small nation located in the heart of Europe, Luxembourg benefits from excellent interconnections to neighbouring country energy grids. With the highest GDP per capita and amongst the lowest energy prices of its European peers[2], Luxembourg tops out on energy equity. Like Luxembourg, Singapore benefits from being a small, densely populated, highly developed country with high GDP per capita, which helps make energy both accessible and affordable.

Consistent with the size theme, smaller Persian Gulf nations like Bahrain, Kuwait, UAE and Qatar have also consistently featured in the energy equity top ten performers since 2000, with larger counties like Saudi Arabia in and around the top ten during this time. These Persian Gulf nations benefit from an abundance of relatively accessible (and thus low extraction cost) oil and gas reserves which, when coupled with the social norms that these resources and revenues are used to subsidise domestic socio-economic development, result in consistently cheap and affordable transport fuel and power prices.

[1] Using total consumption figures per head of population, and the cost to residents, to set some proxy benchmarks of power demand per head and cost as a percentage of income.

[2] Luxembourg benefits from some of the lowest transport fuel duties.

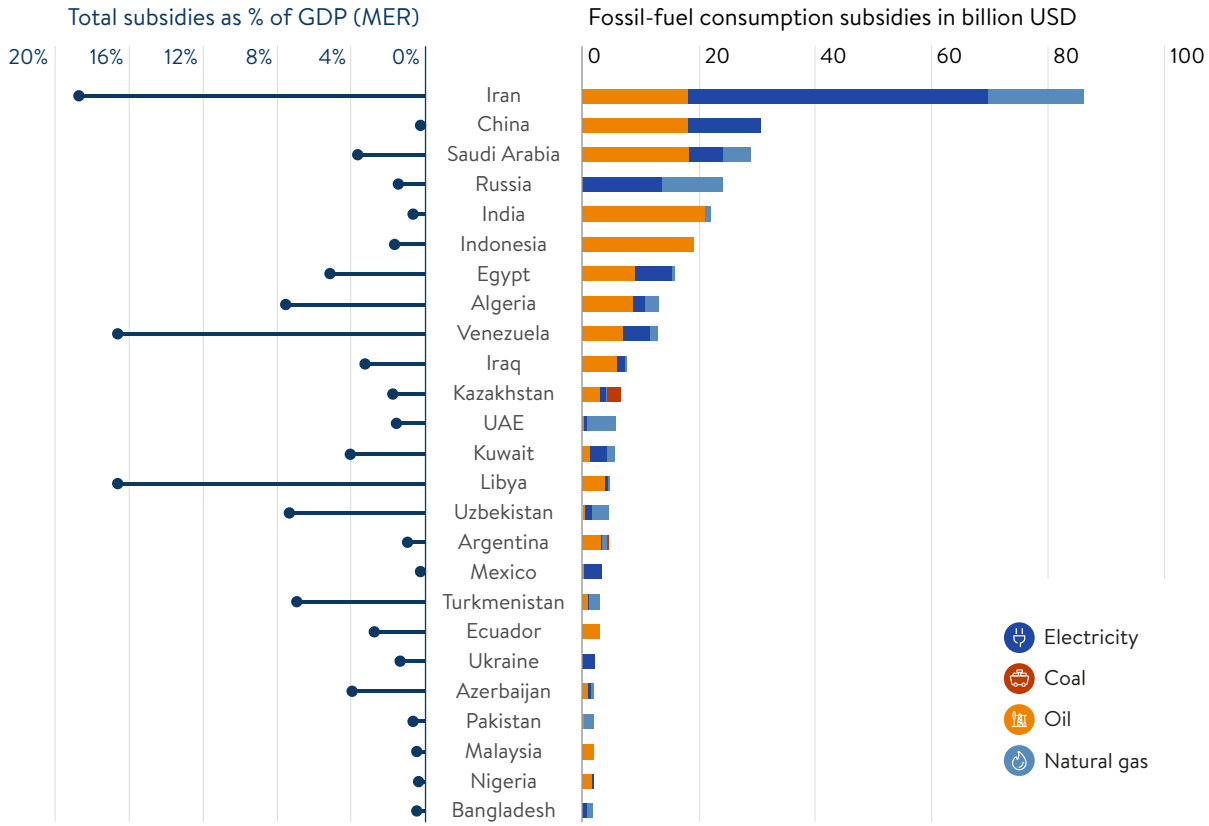
A new entrant in the energy equity top ten this year is Iran – a position buoyed by the fact they are by a long way the highest spender on energy subsidies of any country. The value of Iran's energy subsidies is approximately three times more than the #2 spender China and #3 Saudi Arabia, with most of Iran's subsidies focused on maintaining cheap electricity prices.

While abundant reserves in Iran and Saudi Arabia have enabled subsidised low-cost energy, this has not encouraged energy diversity or efficiency. Hydrocarbon producer countries tend to score poorly on the energy sustainability dimension due to high emission intensities, and as seen in recent times, their energy dependent domestic economies are increasingly susceptible to fluctuations in the price of oil and gas, pressuring the viability of maintaining energy subsidies. Many of these countries have introduced or are planning energy reforms to reduce subsidies – a trend with the potential to accelerate given the current depressed oil and gas market due to lower demand during the COVID-19 pandemic:

- Saudi Arabia implemented a managed energy subsidy reduction programme in 2017.
- Iran have recently increased domestic gasoline prices by ~50%.
- The state-owned utility in Dubai has requested to increase tariffs for the first time in 22 years.

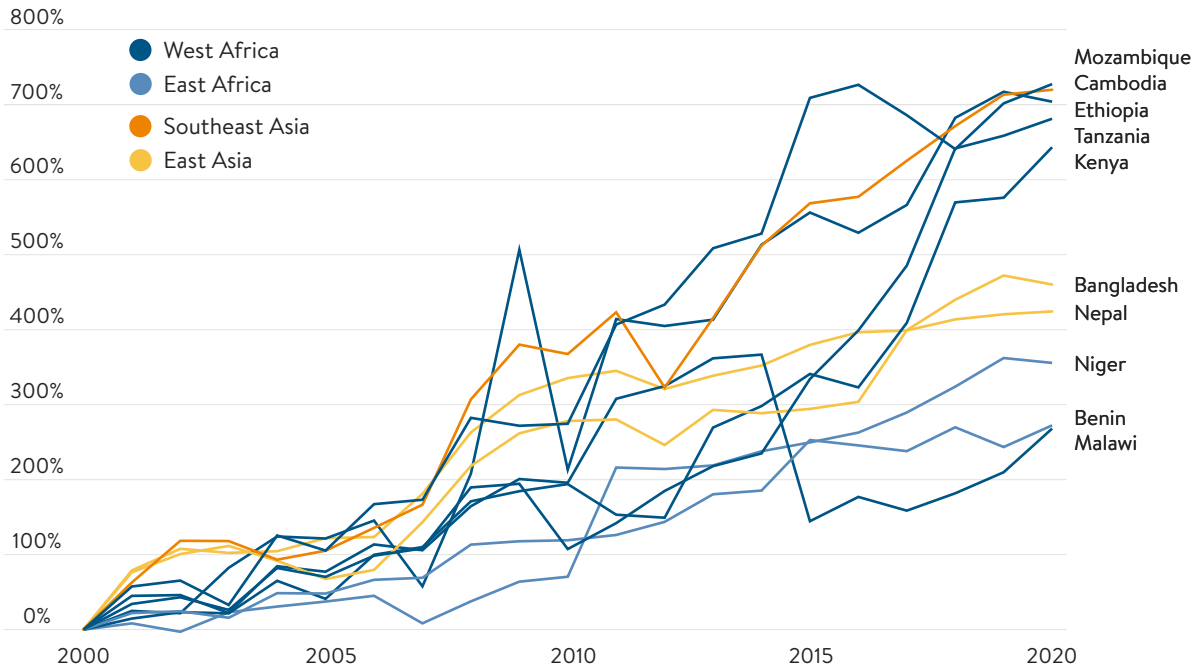
The future performance of these Persian Gulf countries on the energy equity dimension will depend on their ability to diversify their energy mix to improve the long-term sustainability of their energy systems and diversify their broader economies away from oil and gas dependence. We have already seen significant investments in carbon-free energy in the region, with ambitious plans to respond to the energy transition and shift to lower carbon or carbon-free energy.

Figure 19: Value of fossil-fuel subsidies by fuel in the top 25 countries



Data source: International Energy Agency (IEA)

Figure 20: Indexed temporal scores between 2000 and 2020 for the top improvers in Energy Equity



While the energy equity scores amongst the top ten performers changes very little, with relatively minor improvements sufficient for already highly ranked nations to displace another in the top group, a very different story emerges when looking further down the rankings to assess the top ten energy equity improvers since 2000 [Figure 20].

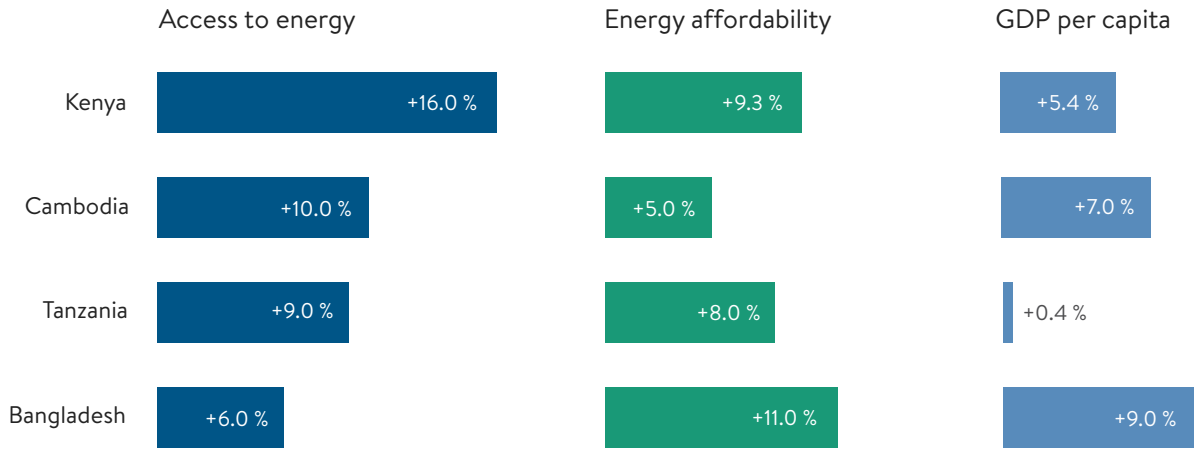
Over the past two decades, many developing countries have made remarkable improvements in both energy access and energy affordability, with the top energy equity improvers seeing close to an eight times increase in their baseline 2000 energy equity scores (for more information, see Index Rankings & Policies).

The top ten energy equity improvers since 2000 are dominated by developing sub-Saharan African and South East Asian countries, and although the improvement trajectory for each country varies significantly, many of the top ten improvers listed here have been consistent energy equity improvers over the period. Analysis of energy equity improvements over five-year windows from 2000-2020 sees sub-Saharan African Kenya, Tanzania, Ethiopia and Niger, and South East Asian countries Cambodia and Bangladesh feature consistently amongst the top ten energy equity improvers over each five-year window.

The impact of SDG7 agreed in 2015 has certainly helped some of these countries accelerate their scores over the latest five-year period, with east African neighbours Tanzania (~80% improvement in energy equity score) and Kenya (~70% improvement) being the fastest improvers over this time. Other sub-Saharan countries Madagascar (~62% improvement) and Malawi (~50% improvement) are the other the fastest improvers over this latest period, albeit not on the top ten improvers since 2000. On the flip side, Mozambique are amongst the top improvers where SDG7 has had little impact. Mozambique successfully improved their energy equity score by around 100% over each five-year period from 2000-2015 via programmes like the Mozambique Electrification Programme to improve urban electrification, but the trajectory has stalled over the latest 5 years, with negligible equity score improvement.

The underlying drivers that support the energy equity performance improvement also vary – with a clear distinction between improvement drivers for sub-Saharan African countries and for South East Asian countries. Comparing the performance data of East African neighbours Kenya and Tanzania against that of South East Asian countries Bangladesh and Cambodia, over the latest five-year window, reveals the different drivers to improve the two sub-indicators of energy access an energy affordability.

Figure 21: Percentage changes of key drivers in the past 5 years illustrating improvements in energy equity



On energy access, all four countries have made significant progress on improving access to electricity over the past five years:

- Kenya and Tanzania have seen the fastest growth in electricity access over the period, with Kenya's ~80% growth from 42% to 75% access in line with their National Electrification Strategy to reach 100% electrification by 2022. Tanzania's stellar ~130% growth from 16% to 37% access sets them on a trajectory to continue to improve.

- Growth rates in Cambodia and Bangladesh were lower, but both South East Asian countries currently have a higher electricity access than their sub-Saharan African counterparts. In addition, both countries improved on the quality of energy provided to support prosperity. Cambodia increased access by ~65% improving from the lowest amongst South East Asian nations at 55% to 92% access. Bangladesh increased by ~35% from 62% to 85% access.

There is divergence on the drivers behind energy affordability performance improvement over recent years:

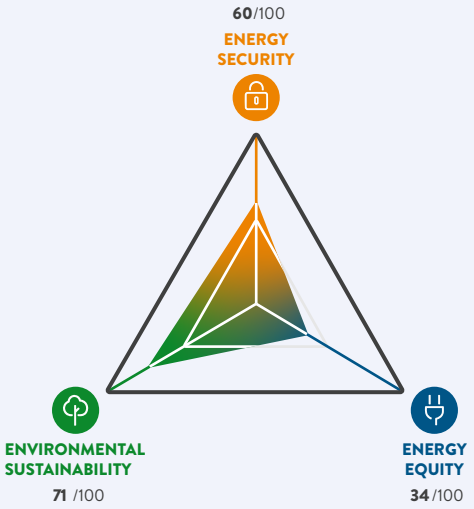
- Energy affordability in Kenya and Tanzania has been demonstrably aided by declining energy costs; especially the price for diesel and gasoline which have decreased >30% in actual dollar terms over the past five years.

- For Cambodia and Bangladesh, the energy affordability improvement is very much driven by wider economic growth, and increased GDP per capita for each country. Actual dollar prices for energy have remained largely flat (a slight decrease in Bangladesh), with the increase in GDP helping to push energy affordability.

CASE STUDY

KENYA

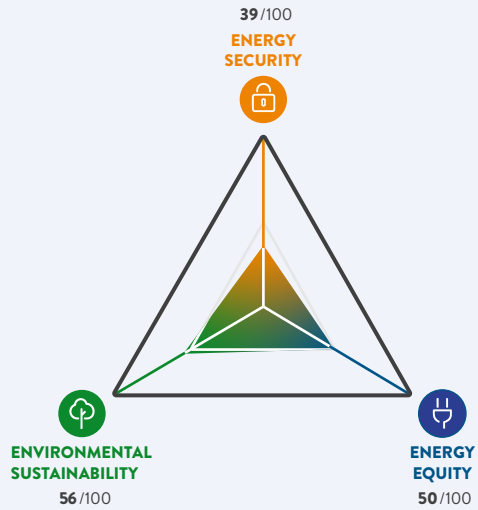
Kenya has seen rapid growth in electricity access over the past five years – increasing from 42% to 75% access (and from as low as 13% in 2000); improvement which is testament to the Kenya National Electrification Strategy (KNES) implemented in 2018 to reach 100% access by 2022. KNES details plans to increase electrification through both expansion and intensification of primary grid networks and implementing off-grid options, mini-grids and standalone solar options for the more remote parts via the Kenya off-grid solar access project (KOSAP). The additional electricity demand will be met primarily by low carbon sources, with both an expansion of solar and significant develop of geothermal resources.



CASE STUDY

BANGLADESH

Bangladesh is considered the fastest growing economy in South East Asia, supported by recent significant grid expansion and electrification efforts as a prosperity enabler to reach 85% access. Reliable supply of electricity for all remains a challenge – rapid grid expansion coupled with a significant increase in demand to fuel their booming economy has led to regular outages as supply struggles to keep up. On the supply side, Bangladesh is heavily reliant on fossil fuels – natural gas (at ~70%) is the primary energy source, with coal, diesel and heavy oil making up most of the remainder, with a ~3% share (and growing) share for wind and solar renewables. To continue to meet growing demand, Bangladesh will diversify its energy mix with increased off-grid solar and wind power – however, Bangladesh also plans to increase coal's share during this diversification.



While it is important to recognise the great progress that continues to be made to extend energy access, and specifically access to prosperity-enabling reliable and affordable energy, we must also be cognisant of the 800m+ people who still lack basic energy access today. Progress must continue to be made, particularly in sub-Saharan Africa where a handful of countries with <10% energy access should look to emulate the positives from the other sub-Saharan countries amongst the top improvers.

Common to all energy equity improvement and high scoring cases is the underpinning investment in resilient energy and electricity infrastructure, with a diversified energy mix also becoming increasingly important to help balance energy demand and affordability.

High performing energy equity countries tend to have established, resilient energy systems and infrastructure, capable of managing fluctuations in demand; but these are also often complex and poised to become more complex (and hence expensive) due to increasing diversity in the energy mix and the shift to low-carbon energy. The transition to low-carbon energy is gaining momentum for both the obvious sustainability benefits, but also increasingly for economic reasons as low-carbon energy systems become cheaper and some counties look to diversify dependence from subsidised hydrocarbon-based systems. For high performing energy equity countries, the key challenge is on the balance of sustainable affordability and improving affordable equality across all sections of society.

For the top improving countries and in fact all counties needing to improve both energy access and affordability, deploying the appropriate strategies and making the right energy investments to support economic growth is key. Be that enhancing and expanding centralised networks, or leveraging technology advances and decreasing levelised costs of both distributed renewable energy resources and storage solutions; there are increasingly accessible options to improve energy access in a sustainable way that balances the affordability equation. For example, increasing infrastructure investments in innovative off-grid or standalone solutions help reach more remote and dispersed population and utilise the natural resources that exist.

Which returns to the symbiotic relationship between energy equity and economic prosperity – access to reliable and affordable energy is an enabler of growth, which in turn enables further investment in energy systems to improve energy equity performance.

SUMMARY

- ***Luxembourg, Qatar and Kuwait head the list of the top ten performers in the energy equity.***
- ***Small, wealthy nations with high GDP, strong interconnections, low energy prices through subsidy and/or significant easily extractable energy resources characterise the countries at the head of the list.***
- ***Subsidies hinder energy supply diversification.***
- ***Kenya and Bangladesh have seen significant improvements in access to electricity, largely due to implementation of government policy.***
- ***Access to reliable and affordable energy is an enabler of economic prosperity, but increasing emphasis is now being paid to quality of energy supply.***
- ***More than 800 million people still do not have access to basic energy, particularly in Sub-Saharan Africa – continued progress on SDG7 is an imperative with pathfinding from top improving countries providing practical examples of policy success.***

SUMMARY

ENVIRONMENTAL SUSTAINABILITY

Figure 22: Top performers in 2020

Rank	Country	Sustainability Score
1	Switzerland	90.0
2	Sweden	87.5
3	Norway	87.2
4	Albania	85.8
5	France	85.5
6	Panama	84.9
7	Costa Rica	84.7
8	Uruguay	84.2
9	Colombia	83.8
10	Brazil	83.4
10	Denmark	83.4

Figure 23: Top 10 ranks - Historical movements over 5 year periods

Almost all countries have stayed in the top throughout the time period, signifying the importance of long-term planning of low-carbon futures. Switzerland, Sweden and Norway have kept their top positions, despite no significant changes or even drop in their scores.

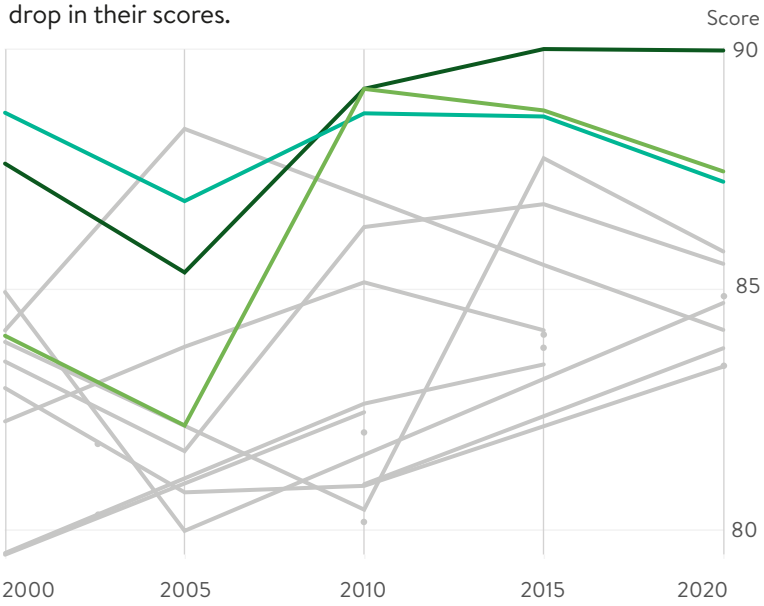


Figure 24: Top improvers in 2020 against their 2000 score

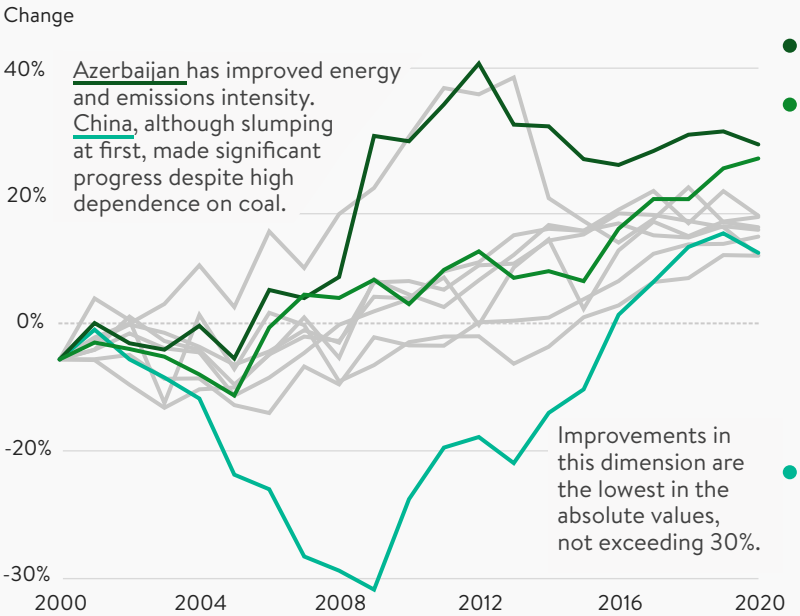
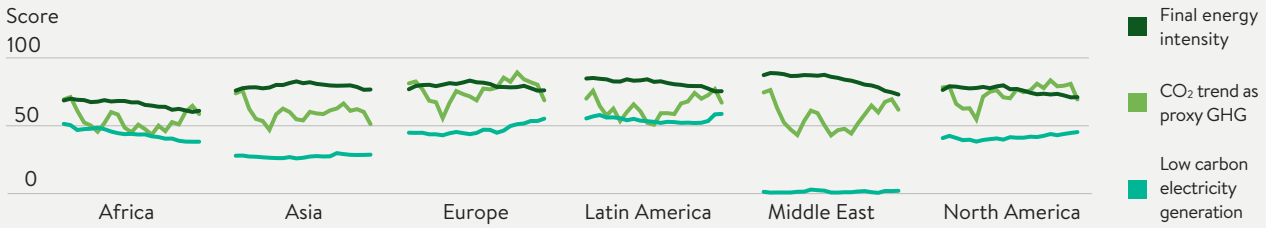


Figure 25: Top improvers in 2020

Rank	Country	Score Improvement
1	Azerbaijan	+30%
2	Ukraine	+28%
3	Denmark	+20%
4	Estonia	+20%
5	Myanmar	+18%
6	Ireland	+18%
7	Malta	+17%
8	China	+15%
9	Poland	+14%
10	Panama	+14%

Figure 26: Key indicators of the regional performance in Sustainability and the trends since 2000



TRENDS IN THE ENVIRONMENTAL SUSTAINABILITY

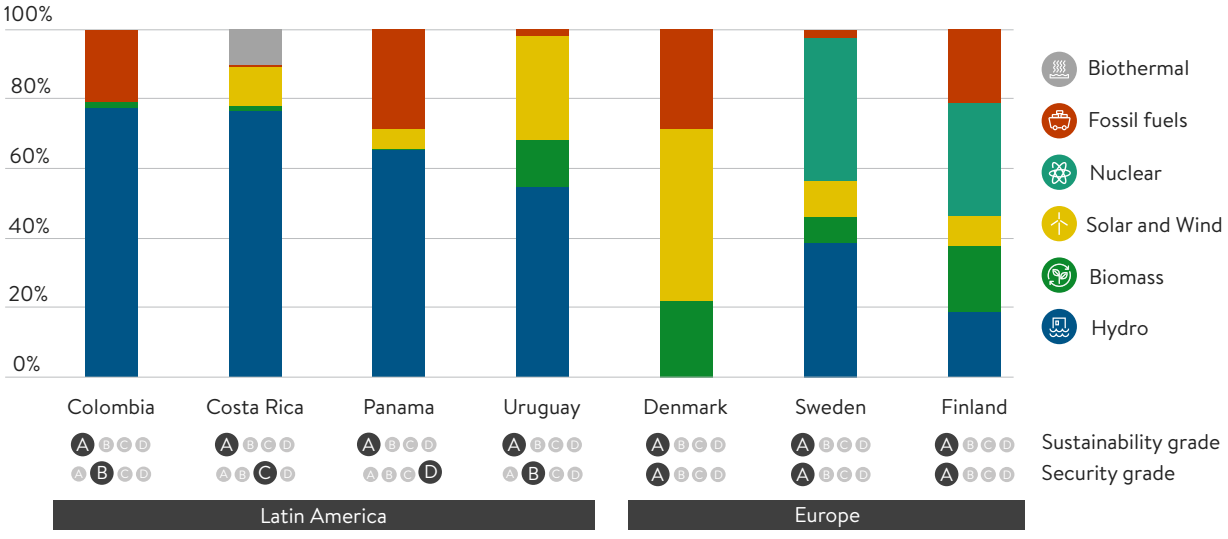
Environmental sustainability of energy systems measures a country's ability to mitigate and avoid environmental degradation and climate change impacts. The dimension focuses on productivity and efficiency of generation, transmission and distribution, decarbonisation, and air quality.

The most sustainable energy systems continue to be found in Europe, characterized by high levels of variable renewables, in terms of different technologies or intermittency, high levels of energy efficiency and lower levels of carbon dioxide and particulate emissions. In 2020, six of the top 10 performers on Environmental Sustainability were European, including the highest scorer – Switzerland. The remaining four places were taken by countries from the Latin America and Caribbean region, owing to high shares of low-carbon generation driven in each case by very high levels of hydropower: all four countries generate more than half of their electricity from this resource. The high reliance on one source of generation is also reflected in these countries' Energy Security scores. These are lower than those of the Nordic countries, which consistently score highly in terms of energy security and sustainability and have comparably high shares of low-carbon generation but from a more diverse range of sources [Figure 27].

Around the world, Energy Systems are becoming more sustainable as energy transition continues to gather pace, driving increasing shares in low-carbon generation and greater energy productivity. Among the strongest improvers in the sustainability dimension of the Trilemma is Denmark, which has dramatically increased its use of renewables to the point where wind now meets almost half of electricity consumption; China, which has been the largest investor in renewable technologies for most of the past decade, and the UK, which has reduced coal use to almost nothing (Case study – United Kingdom). The list also includes some less familiar success stories. Ireland and Estonia – generally not recognized as among the leaders in Europe on decarbonisation – have nevertheless increased their shares of low-carbon electricity generation, leading to strong improvement in their sustainability scores albeit from a relatively low starting point. And resource-rich Azerbaijan has improved its sustainability score by driving down the energy intensity (energy consumption per GDP) and emissions intensity of its GDP.

However, sustained improvement is still not a worldwide phenomenon; 57 countries have experienced declines in their sustainability scores since 2000. Some of the sharpest declines have been among resource rich and developing countries on fossil fuel intensive development pathways. Egypt's sustainability score has declined 25.5%, as its use of fossil fuels has increased, reaching 91.4% of power generation by 2018. Nigeria, Saudi Arabia and Oman have similarly struggled to ween

Figure 27: Countries with high reliance on one source of generation show lower security scores

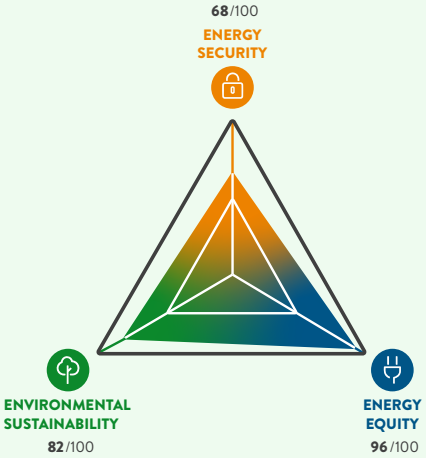


themselves away from fossil fuels, seeing declines in sustainability of 18.3, 16.5 and 15.5 percent, respectively. Zambia's score has dropped by 24% over the past 20 years, with the sharpest deterioration coming in recent years as it has begun to exploit its coal resources with the construction of new thermal coal plants. A similar story can be seen in Mongolia, home to 10% of the world's coal reserves, where coal is the primary source of power generation and a popular fuel for domestic heating. Mongolia's sustainability score has declined by 17%, as its economy has grown by 363% and its carbon dioxide emissions by 227%.

CASE STUDY

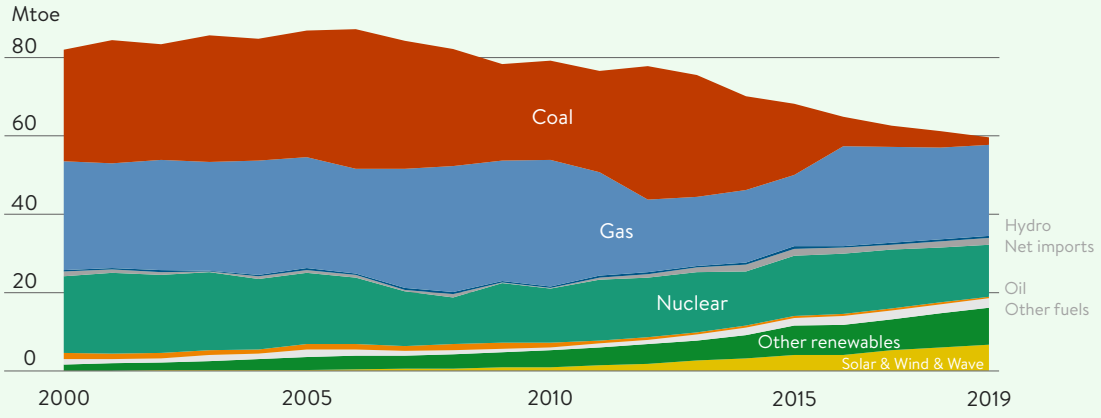
THE UK'S ENERGY TRANSITION

Since 2000, the UK has reduced its carbon dioxide emissions by 31.5 % while growing its GDP by 46.6%. The UK's emissions now stand at levels last seen in 1888.[3] Many factors underpin this. The UK's Climate Change Act has legally obligated governments to meet successive carbon budgets, placing the UK on a decarbonisation pathway consistent with its international commitments. Policy incentives have brought offshore wind to the point today where it almost subsidy free; while coal has been squeezed out of the generation mix by the march of renewables and the UK's imposition of a carbon floor price within the emissions trading scheme, effectively operating as a carbon tax on generators. Since 2000, coal's share of electricity generation has collapsed from 32 to 5 percent and today, the UK routinely has days where no coal power is consumed at all.



Yet, the UK's success also highlights the difficulty of the energy transition. Despite remarkable progress in the power sector and in energy efficiency, the UK has made little progress with transport emissions and now faces the task of decarbonising heating, which is largely dependent on natural gas. The Committee on Climate Change – the independent body that advises the government on meeting its obligations under the Climate Change Act, has warned that the UK is likely to miss its coming carbon budgets without stronger action.

Figure 28: Electricity generation sources changes in the UK since 2000



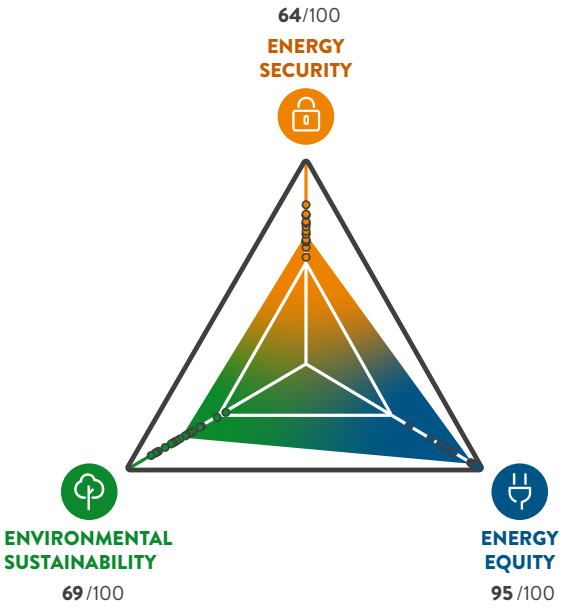
Data source: Digest of United Kingdom Energy Statistics (DUKES), 2020

[3] https://www.carbonbrief.org/analysis-uks-co2-emissions-have-fallen-29-per-cent-over-the-past- decade

IS THE G20 LEADING OR FOLLOWING?

Rapid and sustained improvement in sustainability is critical among the largest carbon dioxide emitters if the Paris Agreement's goals are to be achieved. For example, the G20 is responsible for almost 80% of global greenhouse gas emissions and consumes over 80% of global energy. Clearly, without leadership among the G20 countries, it will be impossible to decarbonise global energy supply by mid-century – which is what is required if global temperature rise is to be limited to no more than 1.5°C.[4]

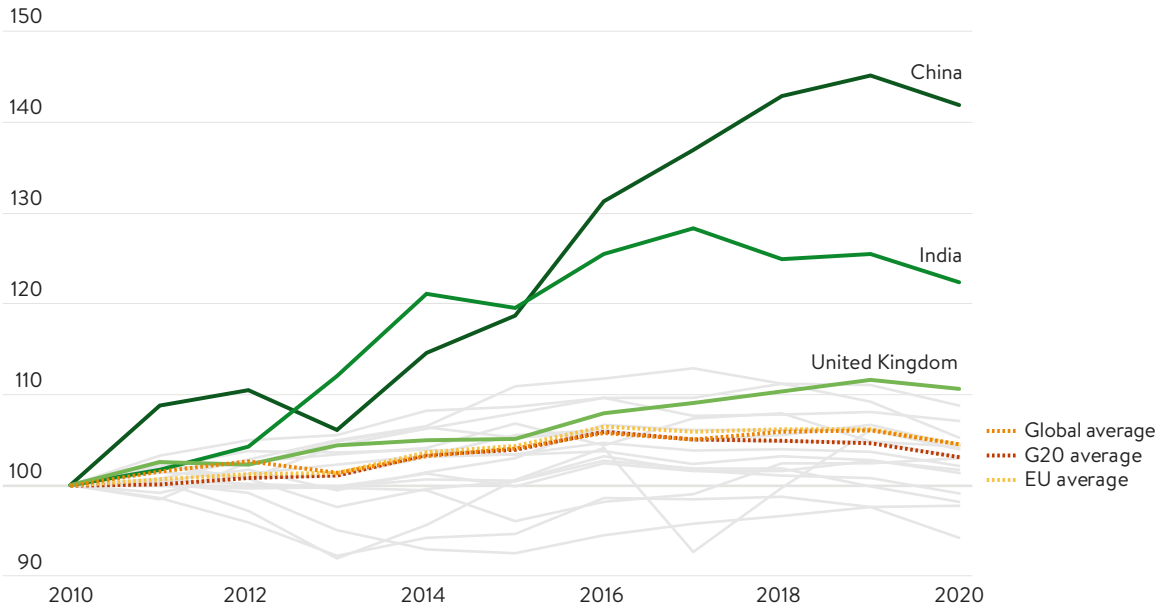
Figure 29: The Trilemma balance for G20



Unfortunately, the Trilemma's tracking of the G20's sustainability performance suggests there is little evidence of strong collective leadership. A decade ago at COP 16, countries made the Cancun Pledges, which set targets to reduce emissions by the end of 2020. Of the seventeen G20 countries that made pledges (Saudi Arabia, Argentina and Turkey chose not to), only eleven are considered likely to achieve them.[5]

Over the lifetime of the Cancun Pledges, the G20's average sustainability score has actually improved more slowly than the global average [Figure 30]. Within the G20, leadership has been most evident from China and India, which have improved their sustainability scores by 42% and 22%, respectively; in both cases driven by strong investment in renewable technologies despite continued dependence on coal.

Figure 30: Sustainability trends of the G20 show only a few strong improvers



[4] https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf
[5] https://www.unenvironment.org/resources/emissions-gap-report-2019

Since 2010, China has improved its energy intensity (energy consumption per GDP) and carbon dioxide intensity (emissions per GDP) by 31% and 16%; India tracks very closely at 33% and 14%, respectively. Large improvements in scores are harder for countries where sustainability is already relatively high, nevertheless the UK still achieved the third best improvement of 11% over the decade.

Among the G20, the weakest performers were South Korea, Japan and Russia, which all recorded declines in sustainability. South Korea and Russia have made little progress in shifting their energy mix away from fossil fuels over the last decade, despite the remarkable declines in the cost of renewables [Figure 31] and Japan's pivot away from nuclear after the Fukushima disaster in 2011 saw a sharp increase in fossil fuel generation that has yet to be fully reversed by growth in renewables [Figure 32].

Figure 31: South Korea, Russia and Japan's electricity generation from renewable sources in the last 10 years

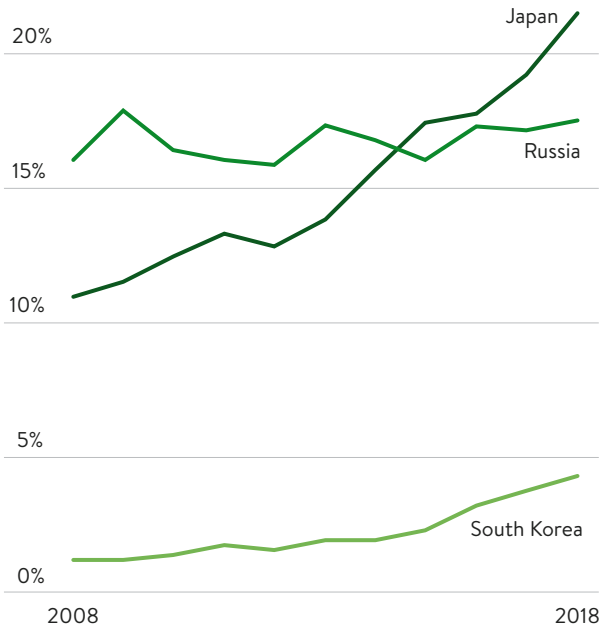
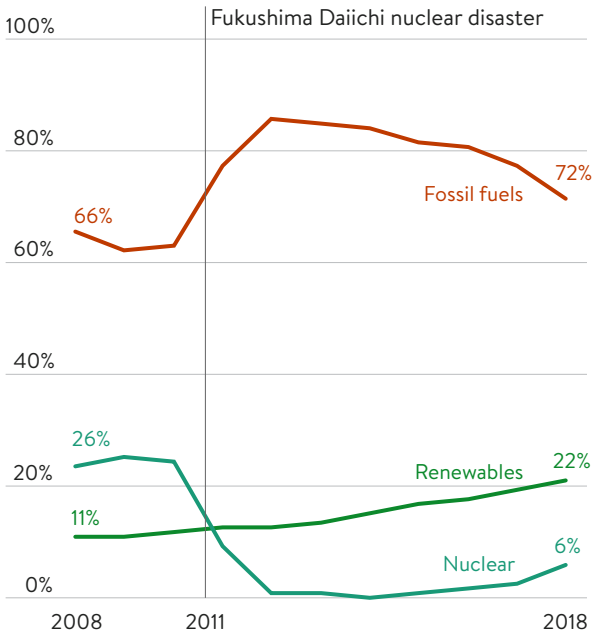


Figure 32: Japan's electricity generation changes over the last 10 years

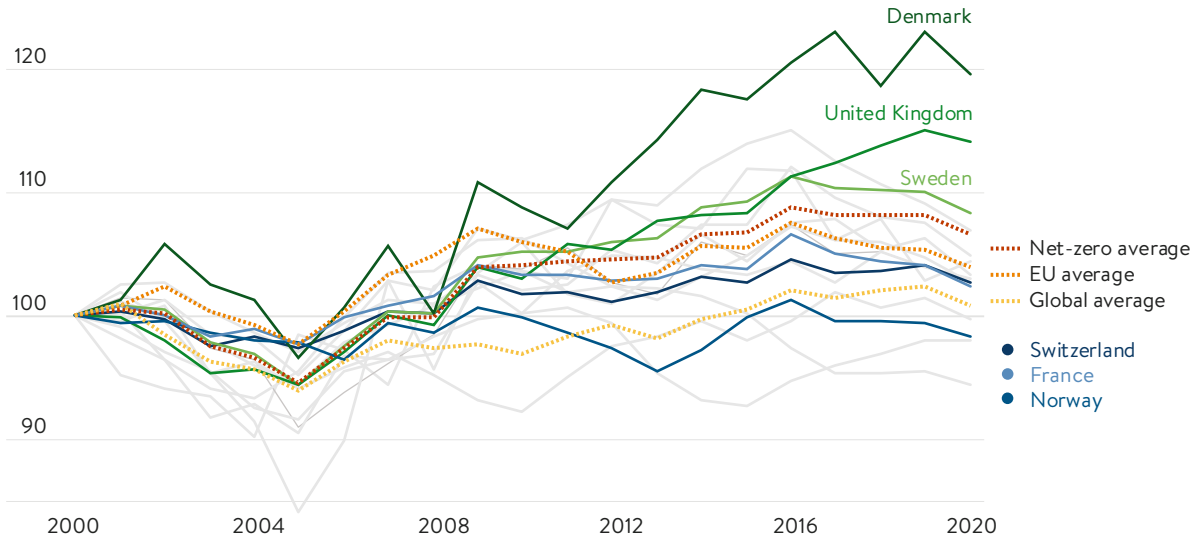


A FOCUS ON NET ZERO

Recent months have seen an explosion of pledges to reach net-zero emissions from state and non-state actors. Currently, 120 countries have joined the Climate Ambition Alliance, which brings together businesses, cities, regions, investors and governments working towards achieving net-zero emissions by 2050. Of the 20 countries and regions that have officially adopted net-zero targets, the Trilemma tracks 16. The past 20 years of data shows this group of ambitious countries are typically outperformers on sustainability. Collectively, they have improved their scores almost eight times faster than the global average [Figure 33]. The list includes 12 countries (all but Hungary, Iceland, Japan and Singapore) with an A grade on Sustainability, and some of the highest scoring countries in 2020, including Switzerland, Sweden, Norway, France, Denmark and the UK.

This indicates that strong environmental performance underpins greater political ambition, raising the prospect of a virtuous circle of greater ambition driving stronger environmental performance, leading to ever greater ambition. This was the logic of the Paris Agreement's five-year ambition cycle, though it remains to be seen whether governments will make meaningful increases to the ambition of their Nationally Determined Contributions (NDCs) at the rescheduled COP26 in 2021. Countries can use the Trilemma to help them learn from one another about which policies are particularly effective for building sustainable energy systems and could best fit with their national contexts. Using the Trilemma to understand what works and why will help design better policies for inclusive decarbonisation that leaves no communities behind is will become an increasingly important social agenda that is critical to humanise energy transition.

Figure 33: Sustainability score trends of countries with net-zero targets illustrates the importance of ambitious targets



SUMMARY

- ***Switzerland, Sweden and Norway head the top ten in the Environmental Sustainability dimension.***
- ***A diversified energy system, supported by strong policy instruments to significantly reduce GHG emissions, coupled with energy efficiency measures, deliver a strong performance in the environmental sustainability dimension.***
- ***Driving down energy intensity can assist countries yet to decarbonise their energy mix.***
- ***Ensuring an inclusive decarbonisation that leaves no communities behind will be essential part to humanise energy transition.***

NEW GEOGRAPHIES - NEW ALLIANCES

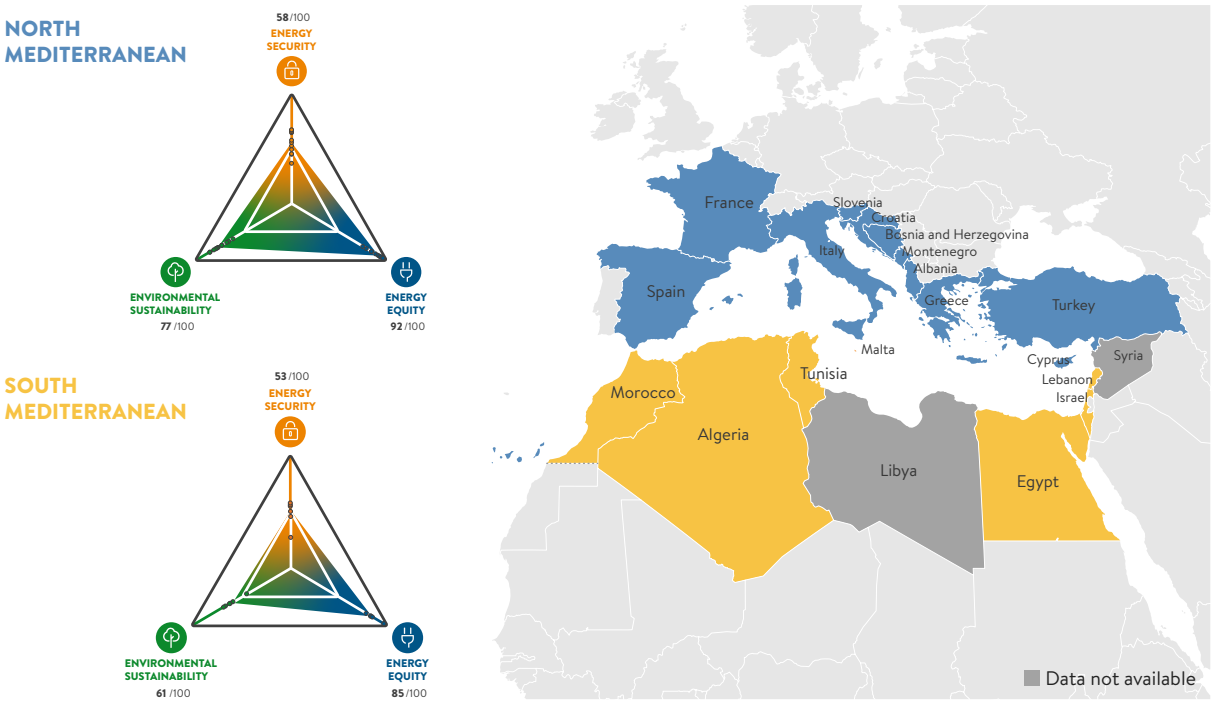
The Trilemma provides the opportunity to compare and contrast the energy policy performance of differing countries and regions. Examining the three dimensions of the energy performance – security, equity and sustainability – enables decision-makers to assess the development of country and regional-specific challenges and the effectiveness of particular policies. The aggregated results of the Trilemma illustrate some of the shared themes and issues within geographic regions but there is also scope to group the countries differently, around cultural clusters or international alliances, to explore new insights into comparative energy policy performance and energy transition.

In this section, we explore the Mediterranean countries and the Association of Southeast Asian Nations (ASEAN). Using the Trilemma framework to analyse the comparative performance of these country groupings provides new insights to their specific challenges that can be overlooked in the broader analysis of a continental region.

The group of Mediterranean countries includes a number of Southern European countries and Middle East / North Africa countries that we have simplistically sub-divided into Northern and Southern Mediterranean countries. The two sub-groups are well connected through longstanding trade and cultural ties but differ in their political contexts and natural resource endowments.

Contrasting the Trilemma triangles for the Northern and Southern Mediterranean countries illustrates that they have similar scores for Energy Security, but diverge on Equity and particularly on Sustainability. Northern Mediterranean countries tend to have higher diversity of primary energy supply and electricity generation that makes up for their import dependence, whereas Southern countries tend to have larger natural reserves of fossil fuels. For Equity, Southern Mediterranean countries have greater challenges ensuring access to electricity and clean cooking but perform better in terms of affordability due to policies on fuel subsidies for electricity – which is broadly fossil-fuels based. Southern Mediterranean countries tend to have more fossil-fueled power generation and less diversity of power generation that leads to lower scores for Sustainability.

Figure 34: The countries of the Mediterranean and their Trilemma Energy Balances



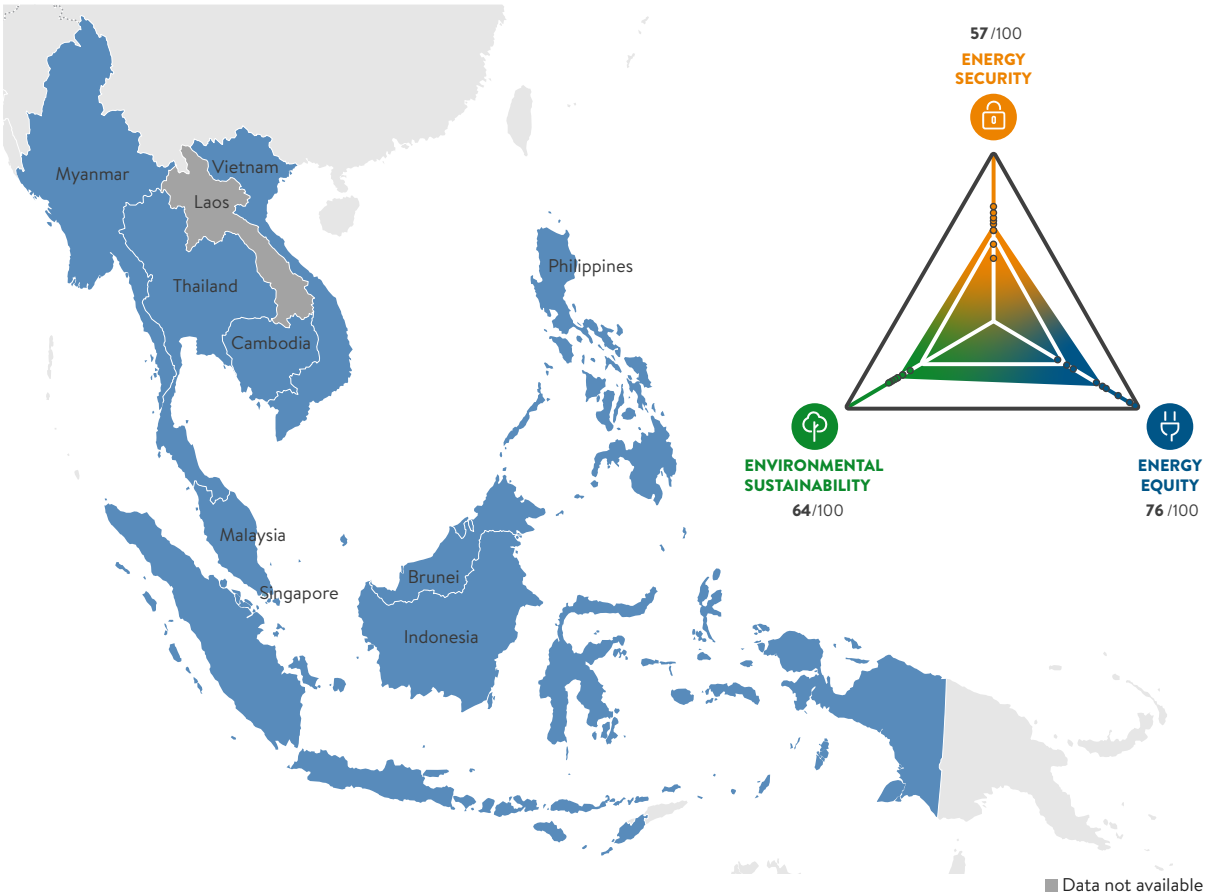
The Southern Mediterranean countries have long exported oil and gas to their Northern neighbours and could soon become new exporters of electricity and hydrogen. The Council will be looking to explore with Mediterranean member committees and other stakeholders how we can develop this regional analysis further to inform a constructive dialogue.

The Association of Southeast Asian Nations (ASEAN) formed in 1968 to accelerate their economic development. While being larger in population than the European Union, their inclusion within the Asia region tends to mask their particular challenges.

The ASEAN countries could use the Trilemma framework to help learn from each other about understanding and improving their energy policies to enable better energy transition. Two ASEAN countries (Cambodia and Myanmar) lead the Trilemma in the overall improvers since 2000 with very successful policies to increase energy access. The Trilemma can help countries and stakeholders such as investors or development banks to prioritise policy areas for attention and monitor progress.

The Council plans to produce further cross-cutting analysis using the 2020 Trilemma over the coming months to be published in a series of short articles.

Figure 35: The Trilemma Energy Balance of ASEAN and the group's countries

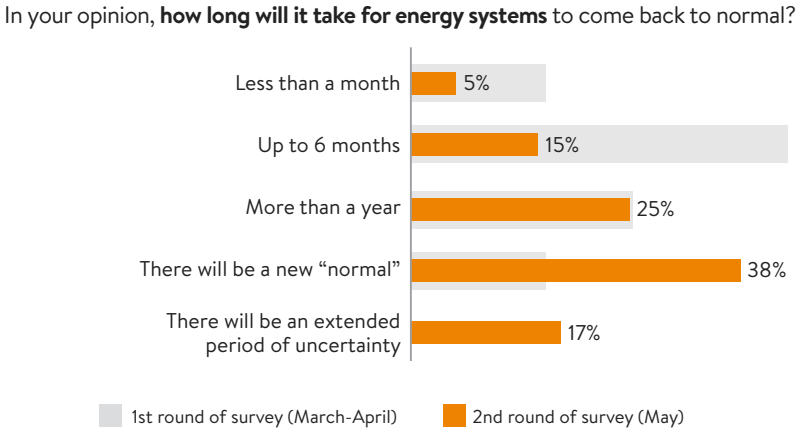


INITIAL IMPACT OF COVID-19

The Energy Trilemma Index is a retrospective metric assessing historic energy policy performance which means the 2020 Trilemma results do not include any impact of the COVID-19 pandemic. The scale of the pandemic's impact on the energy sector and its long-term consequences remains unclear, although there have clearly been substantial impacts on energy demand that will cause significant breaks in the time-series of the Trilemma indices.

In response to the unfolding crisis, the Council surveyed its extensive global network of energy experts across nearly 100 countries to gather the differing perspectives on the impact, response and change in expectations of the worldwide energy industry to the COVID-19 pandemic [Figure 36].

Figure 36: Expectations of going back to normal in the first and the second round of survey of the global network of energy experts



While the energy sector manged to keep the lights on, most organisations have been affected by the pandemic. The **three key impacts** on energy organisations highlighted in the Council's surveys show; a) reduced demand; b) financial liquidity issues; and c) substantial shifts to digital ways of working.

There has also been a rapid shift of perspectives with an increasing expectation that some recent changes in response to the pandemic will become permanent, with almost 40% of respondents anticipating a 'new normal' for the new post-pandemic future.

Lockdowns in many countries have significantly reduced oil demand, most notably in the aviation sector. Electricity demand has also fallen, perhaps to weekend levels of consumption, and led to new challenges for transmission system operators who have successfully ensured that the lights have remained on.

As we move forward, evidence is emerging of the differential impact of the pandemic on different parts of the energy sector. Oil producers are likely to be pessimistic in the short to mid-term with reduced oil demand and lower crude oil prices leading to crude oil producers to slash their upstream investment plans. While oil demand may be recovering, some sectors such as aviation will remain challenged with capacity likely to be reduced. Lower crude oil prices are stressing higher cost producers such as US Shale companies and oil exporting countries whose economies rely upon hydrocarbon export revenues.

By contrast, the electricity sector is likely to be more optimistic about energy transition. The switch to digital fast-forwarded ambitious plans and enabled many companies and countries to reduce the

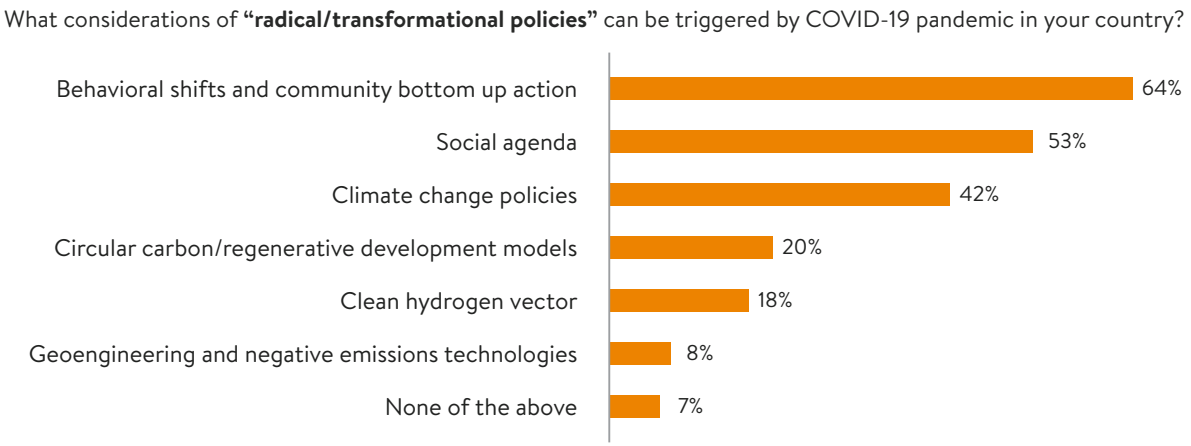
economic disruption of the pandemic and reinforced the critical role of resilient electricity supplies.

While it is too early to assess the pandemic's impact on the energy transition for different countries. All countries will seek to evolve their energy policies and refine their energy systems to incorporate their pandemic learnings. Much will depend upon how countries implement their post-pandemic recovery plans, and whether these plans focus solely on economic recovery or more broadly on climate change in order to build back better with an accelerated energy transition.

The Council's surveys suggest that while climate change remains an integral focus for new policies, there are broader expectations for a more inclusive social agenda and behavioural shifts being part of the post-pandemic recovery as companies and governments design radical and transformational policies based upon their learnings from the COVID-19 crisis [Figure 37].

Opinions on the outlook for the climate change agenda are split three ways: **derail, delay, and (re) design** (leading to more ambitious, behaviour-centric policies).

Figure 37: The transformational policies as expected by the energy experts

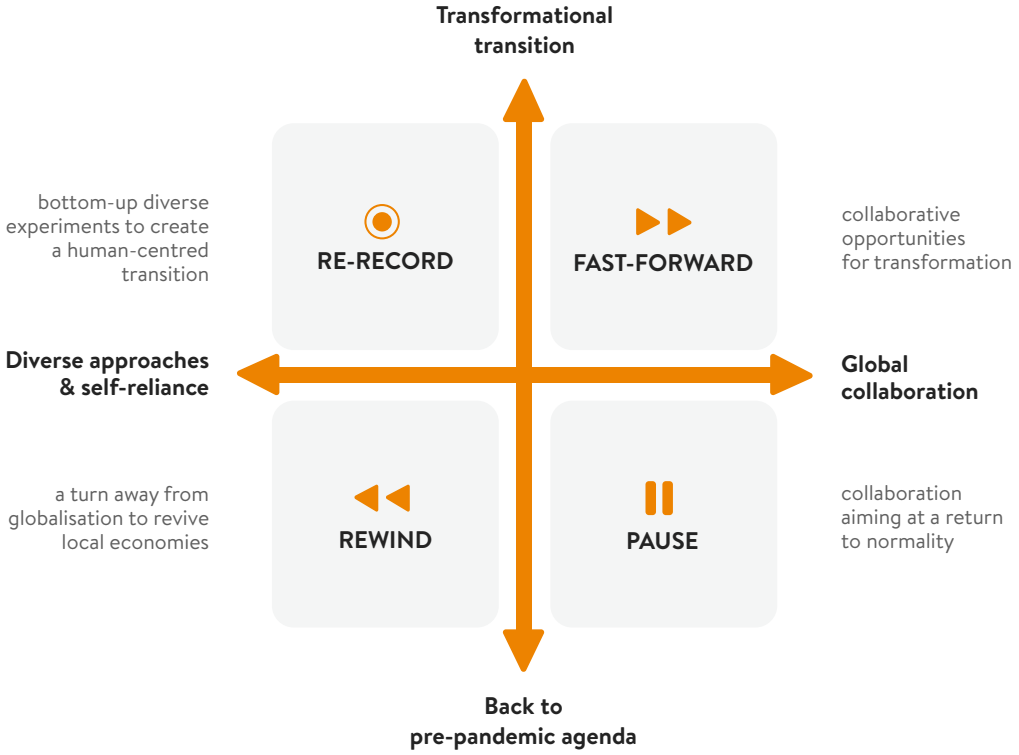


USING THE ENERGY TRILEMMA WITH SCENARIOS TO EXPLORE THE POST-PANDEMIC ENERGY WORLD

Much remains unknown about the COVID-19 virus, while the diversity of national responses also contributes to an unpredictable level of uncertainty. It also remains risky to rely upon only on i) what we know for sure; and ii) what we think should happen next. Instead, energy leaders, their organisations and policy makers ought to engage constructively with uncertainty by exploring what might happen using plausibility-based scenarios. Plausibility-based scenarios explore realistic alternative futures that are different from normative visions (the preferred future) and forecasts (the predicted future).

Scenarios can be used as a platform for a strategic conversation and as a decision support tool for energy leaders and their organisations to stress-test and design post-pandemic strategies. While the Energy Trilemma remains an effective tool to assess energy policy performance and help facilitate a debate about improving energy policy for better energy transition, it can also be used in combination with Scenarios to design new policies that could accelerate energy transition and explore the implications of the differing scenarios.

Figure 38: The Council's Scenarios framework with its medium-term alternatives



Assuming three sets of uncertainties of trust, ambition and control that are most critical to navigate what might happen in the next 3-5 years, the Council has developed a manageable set of four medium-term energy scenarios – **i) Pause, ii) Rewind, iii) Fast Forward and iv) Re-Record** [Figure 38]. Each scenario explores how the overall responses to the current pandemic situation might differ in their impact on the existing energy systems and their future development. This scenarios framework was used to build the world's first World Energy Transition Radar - a data driven sensemaking tool that detects real-time signals of recovery from around the world and helps to see what future starts to dominate and what might be the implications on speed and direction of energy transition.

As the world exits from the pandemic, we need to reflect upon the new learnings and their potential implications for the Trilemma's structure and indicators as part of the continual evolution of the Trilemma to ensure that it remains both relevant and useful. Responses to the pandemic have seen an acceleration of the digital solutions that are likely to remain and need to be reflected within the indicators. But there could also be some more transformational changes to the Trilemma dimensions. Energy security is clearly moving beyond the old oil-based security framework with a broader focus on resilience that will require new indicators. Energy Equity may be too narrowly focused on the UNSDG7 and probably requires a greater focus on affordability and quality energy access (beyond light-bulbs to potentially economically enhancing levels). Environmental Sustainability will likely need to be reframed to include climate neutrality or net-zero targets that are being adopted by many countries are likely to be discussed at the delayed COP26 in November 2021. While the Trilemma continues to evolve, the pandemic's aftermath will provide a particularly strong impetus for change for the Council to explore with its community.

REGIONAL ENERGY PROFILES

AFRICA

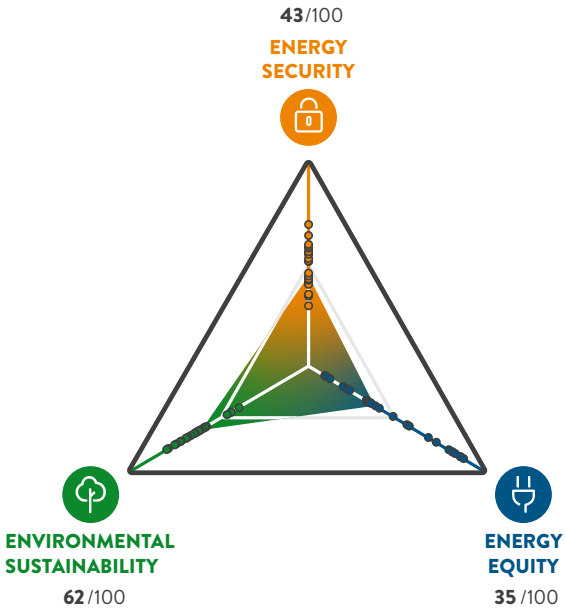
African countries contributing to this year's World Energy Trilemma Index span the continent, including representation from both North and Sub-Saharan Africa. The African continent forms a vast geographic and populous area with an estimated population of more than 1.3 billion people, representing around 17% of the world's population. There are large disparities amongst countries, in terms of demographics, energy and mineral resources, economic development, industrialisation, energy consumption and energy performance, amongst others. Consequently, energy performance across the continent is not equal and the path to energy transition will not be the same for all.

28 African countries have been assessed for this year's Trilemma Report and the aggregated result across the three dimensions of Energy Security, Energy Equity and Environmental Sustainability for the continent is illustrated in Figure 39.

All African countries are still in the bottom half of the global Trilemma rankings. Although, the low rankings reflect individual countries lower starting points, it does not mean that African nations are not improving their energy policy performance. Many nations are making substantive improvements, particularly in access to energy and energy efficiency under the UN Sustainable Development Goal 7 objectives and the African Union 2063 vision.

Africa's low overall performance masks a diverse picture where there are room for improvements across all the Trilemma dimensions. The below figure shows the countries' rankings and each country measured score indexes with regard to Energy Security, Energy Equity, Environmental Sustainability and County Context.

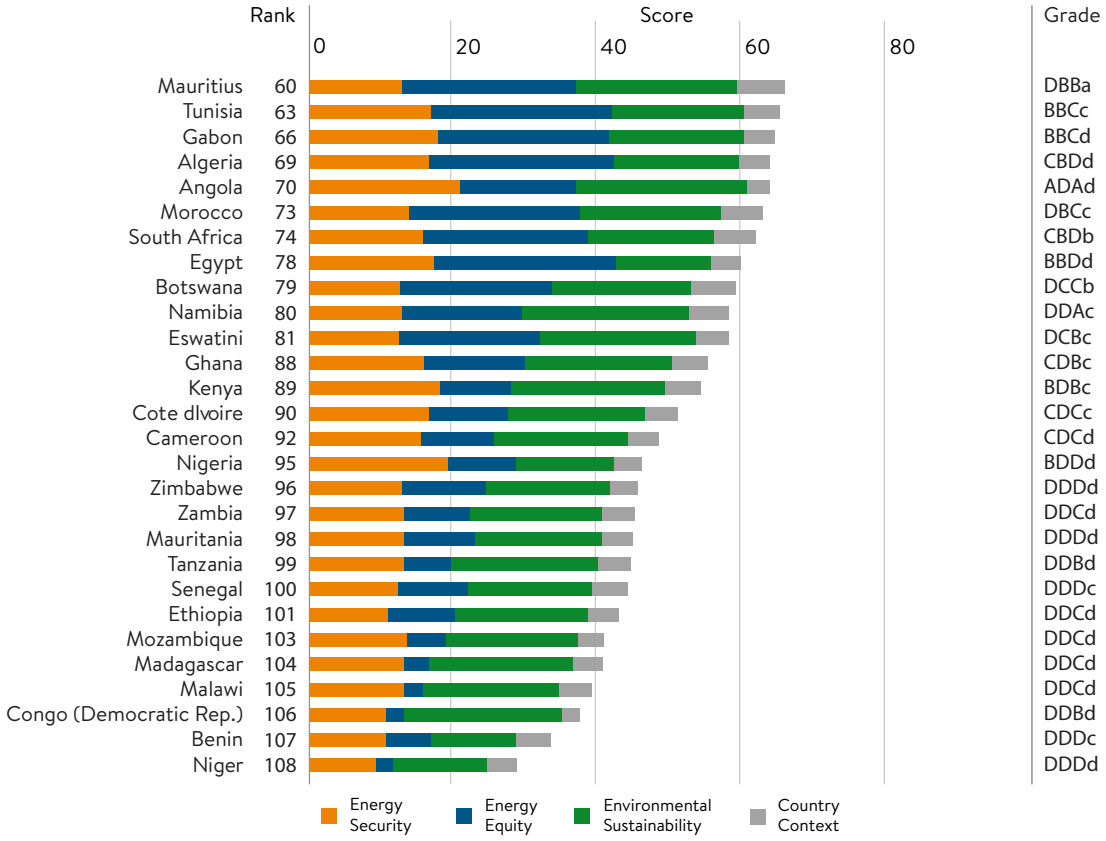
Figure 39: The Trilemma Energy Balance of Africa



Overall, the following outcomes can be highlighted for the three dimensions of the Trilemma.

- Energy Security is progressing in a few countries and could be improved substantially by further developing and exploiting the region's abundant energy resources cost effectively and by enhancing energy infrastructure, to secure a more reliable energy supply.
- Energy Equity remains quite low across the region, but the situation is mixed with North Africa having high levels of access to electricity and clean cooking fuels, while in Sub-Saharan Africa energy affordability and quality access remain very challenging.
- Sustainability is Africa's strongest dimension with many countries in the region resolved to act upon the Paris Climate Change Agreement, accompanied by the African Development Bank financing facilities.

Figure 40: The African countries and their 2020 Trilemma performance



Analysing the trends and performance all three Trilemma dimensions, highlights the following key points:

For the Energy Security dimension, the top five African performers are Angola, Nigeria, Kenya, Gabon and Egypt. Angola is amongst the top ten global performers for the past two consecutive years. The country is successfully exploiting its oil reserves while maintaining a low-carbon generation mix which includes 58% hydro and has developed an integrated transmission network to improve electricity supply across the country. All five top performers have developed their energy resources to meet their domestic energy demands, while also establishing energy efficiency programmes and increasing deployment of renewable energies, which together have improved the reliability of their energy systems.

Most African countries tend to score C or D on the Security dimension, and this low performance is generally due to lack of capacity to develop a reliable and secure energy supply. However, a number of additional factors need to be taken into consideration on a country-specific basis, including , the lack of adequate investment, significant energy infrastructure gap, shortage of energy supply and energy services, insufficient power generation capacities, inadequate transmission and distribution networks, non-reliability of the power supply with increased power shortages, substantial technical and commercial electricity losses, terror attacks and sabotages of pipelines, political and social instability.

Consequently, many countries in the region need to promote centralised and decentralised grids (including micro-grids for off-grid and grid-connected), and innovative and disruptive distributed generation, adoption (pay-as-you-go solar power systems and product bundles). Distributed generation supported by distributed energy resources and storage facilities can offer a promising opportunity to provide electricity in a sustainable and efficient way to rural areas.

For the Energy Equity dimension, the region continues to be challenged with the world's lowest level of electricity access – 54 % overall and 45% for Sub-Saharan Africa, so that more than 600 million people in Africa still do not have access to electricity. The five top performing countries are Algeria, Egypt, Tunisia, Mauritius and Morocco, while 20 African countries (including the five high-need and most populated countries: Nigeria, Ethiopia, DR Congo, Tanzania and Kenya), and representing 94% of the total African population are scoring D in energy equity, as for the previous year.

Addressing Africa's Energy Equity challenge requires bold action that includes improving infrastructure with more power generation and better transmission / distribution capacity, promoting regional energy integration and supporting viable cross-border projects across the continent, undertaking suitable energy policy reforms and regulatory frameworks, improving public sector governance, and increasing electricity affordability. Macro-policies that help reduce poverty and boost poor people incomes are also crucial.

For the Environmental Sustainability dimension, the five top performers (Namibia, Angola, Mauritius, Eswatini and Kenya), have all developed and implemented national climate action plans (INDCs) further to the Paris COP 21 Agreement, promoting deployment of renewable energy, committing to reducing carbon emissions in electricity generation and in the transportation sector, and supporting the development of UN SDG7 in their respective countries. Namibia performed well this year and is again amongst the top ten globally.

However, environment sustainability remains very challenging for the other 23 countries (including the largest fossil fuels users in the transportation and/or power generation): Algeria, Nigeria, South Africa, Morocco, Egypt, DR Congo, Ethiopia and Zimbabwe achieving either a 'C' or 'D' ranks.

Despite some national and sub-regional focus on clean energy deployment and actions to protect the local and global environment, there are still emerging environmental challenges, which require better governance of energy resources, infrastructure investments, access to appropriate technologies and policies to improve the overall energy systems management and development in a more sustainable way.

Substantial use of renewable resources including hydropower would help Africa improve its Environmental Sustainability performance. However, it is assumed that the current pandemic will negatively impact deployment of renewable projects, due to a number of factors including disrupted supply chains, rarefaction of investments dedicated to projects and less available financing in the short term. Although, it is expected that once the current crisis is overcome, clean energy deployment will move ahead strongly.

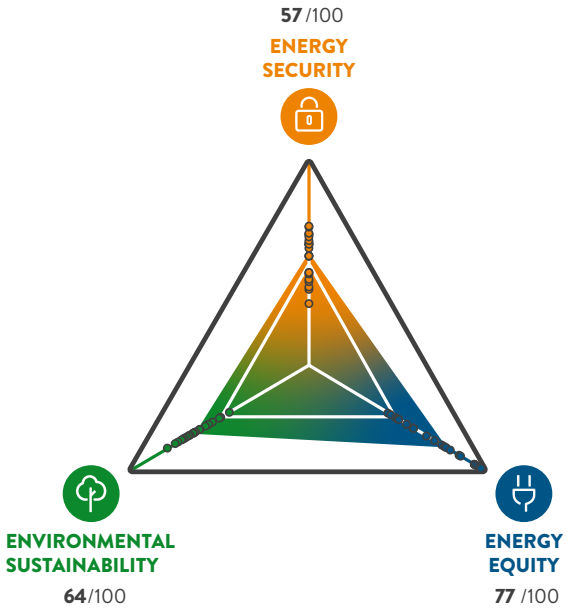
ASIA

Asia Pacific is one of the most dynamic and diverse regions in the world. The region spans countries with advanced economies such as Japan, Australia, New Zealand, Hong Kong, South Korea and Singapore that are very capable of meeting the UN's Sustainable Development Goals and their commitments to the Paris Accord signed in 2016. Whilst, at the other end of the spectrum, countries like Bangladesh, Pakistan, Myanmar all struggle to meet the basic needs of their vast population. The rapidly growing economies of countries such as China, India and Vietnam are positioned in the middle of these two extremes, illustrating just how diverse the 23 economies covered by this year's report are.

Our latest 2020 Trilemma rankings reflect this regional diversity. Consistent performer, New Zealand, tops the regional rankings, still hanging on the top 10th world position. It is joined by Australia and Japan in the top 30. While at the opposite end of the scale, countries such as Nepal and Bangladesh trail towards the bottom of the index. However, overall, Asia has made noticeable improvements on all three dimensions of the Trilemma.

Asia has made remarkable strides with respect to energy equity with a consistently high score of 77. This is primarily due to successful deployment of modern and affordable energy across the region, despite the depressing fact that 120 million people in the ASEAN region alone are still without access to electricity. Countries such as Singapore (ranked at 10 last year) have set very high standards and could share their success criteria with underperforming countries such as Bangladesh, Pakistan, Myanmar, etc. However, the negative impact from COVID-19, which is anticipated to result in a decrease in growth and concomitant increase poverty and unemployment is likely to dampen momentum.

Figure 41: The Trilemma Energy Balance of Asia

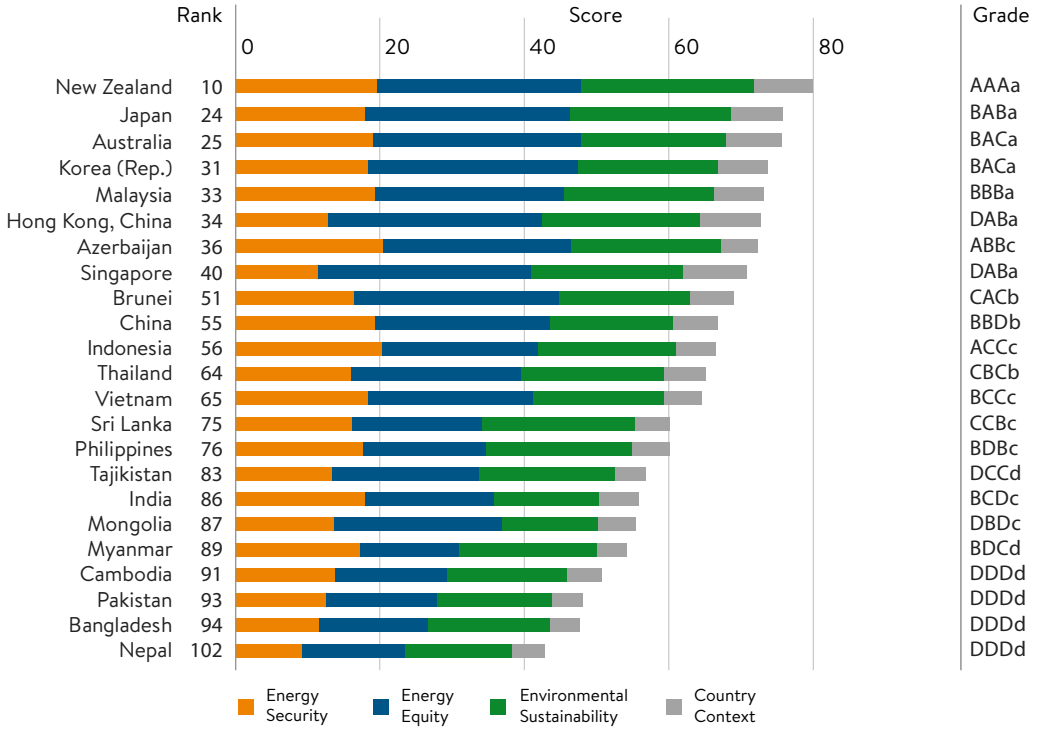


Overall, we are optimistic that Asia will continue to improve in the equity dimension thanks to faster-than-normal implementation of new technologies such as 5G, Internet of Things, artificial intelligence and blockchain, which are slated to make energy consumption more accessible for people in remote areas. Fierce competition across the renewables sector also offers incentives for some governments to adopt green alternatives to fossil fuels much faster than normal circumstances. However, greater strides need to be made to upgrade from basic energy to high quality access across the whole region.

Disappointingly, there has only been a marginal increase in the energy security dimension in the past year.

Regardless of the publicity surrounding the region's aim of embracing renewables. Asia remains the largest energy importer in the world. And, as the only global region predicted to show positive GDP growth this year, led by China and Vietnam, energy security is only going to become more challenging as the supply from renewables cannot meet the surging demand.

Figure 42: The Asian countries and their 2020 Trilemma performance



Energy security scores are generally below the global average for most of the listed 23 Asian countries covered by this year's Trilemma, including island nation Singapore, with few exceptions such as Azerbaijan, New Zealand and Indonesia.

The current COVID-19 crisis however, might deliver some positive outcomes, with communities seeing the benefits of working together to solve supply issues. Regional integration will become a norm in the coming years as the region comes together to discuss ambitious collaborative projects such as the Northeast Asia power-interconnection or ASEAN & South Asia super grid.

There are some mixed developments on the environmental sustainability dimension. The good news is that Asian governments' consistent investment in clean energy transformation has paid dividends with the region's environmental sustainability score improving to 64 from 59 last year – a commendable achievement. Cambodia, Myanmar and China have been the top 10 most improved nations in this category over the 20-year span of the Trilemma (ranked 1, 2 and 8, respectively).

However, there are worrying signs that major carbon emitters such as China, India and Indonesia have witnessed a rebound in coal production following recent policy changes such as the removal of clean energy subsidies and new technology breakthroughs in carbon capture and storage.

Despite significant progress in energy equity, energy security and environmental sustainability lag across the region and need to be addressed to improve the region's overall score.

Asia is likely to encounter serious headwinds during the post-COVID recovery period, such as the delicate balance of re-starting domestic economic growth without undermining improvements in sustainability and targets for greenhouse gas reduction. Highly volatile geopolitical uncertainty in the region and around the world might also contribute to the slowdown in the encouraging progress already made on energy transition before the crisis.

To improve their overall Trilemma performance, many governments are proactively drafting energy policy with a specific focus on upgrading to clean energy and decarbonisation. Yet, the unprecedented disruption caused by the pandemic is likely to increase the challenges facing all countries in their endeavours. Now, more than ever, the Trilemma will have a role in guiding regional energy policy makers and business decision makers adjusting their strategies to the significant and necessary measures required for energy transition.

Inevitably there will be winners and losers during this extremely difficult time. The Council's new mandate of pursuing Humanising Energy will be a very timely and welcome initiative for all stakeholders in Asia to share best practices in energy sustainability going forward.

It is critical that all governments in the region incorporate the Trilemma Index into their long-term energy transition policy and strategy, with the aim of enhancing their nation's standing on each dimension. For Asia in particular, energy security and environmental sustainability require urgent attention.

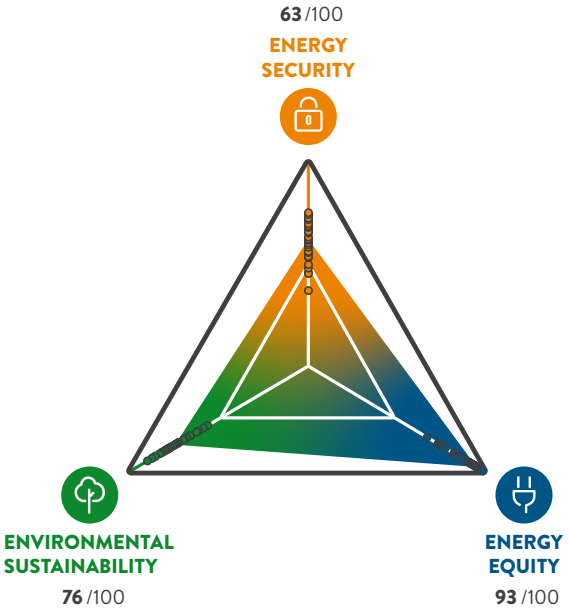
EUROPE

European countries consistently perform strongly in the overall Trilemma top ten rankings. And this is once again the case for 2020. In general terms the region is oriented towards sustainability and affordability of energy, while long-term energy security and harmonisation of market designs in national legislations remain as challenges. The imminent economic crisis looming in the wake of the COVID-19 pandemic is likely to change the scores of many countries in the coming years.

The European Union (EU) has moved forward robustly in setting a framework for its ambitious climate neutrality goals. The update of the regulatory framework in the energy sector and the introduction of a political commitment known as the 'Green Deal' have set the basis for accelerating energy transition. This political commitment is supported with strategies for networks integration and hydrogen. In addition, the European Commission has put forward a proposal for an economic recovery instrument of €750 billion for 2021-2024 and a reinforced long-term budget of the EU for 2021-2027 of € 1,100 billion that have created a clear financial signal towards clean energy transition. Nevertheless, the economic downturn due to COVID-19 pandemic has put many energy companies under financial pressure and it remains to be seen whether these measures will be sufficient to trigger necessary investments.

Controversially, the reduction in energy consumption due to the economic crisis has supported the fulfilment of 2020 climate targets in many EU countries by increasing the share of renewables and diminishing carbon emissions from fossil fuels. This position is not believed to be sustainable as economic recovery is expected to lead to a rebound in emissions in coming years. However, some European countries have already pledged to become carbon neutral by 2040.

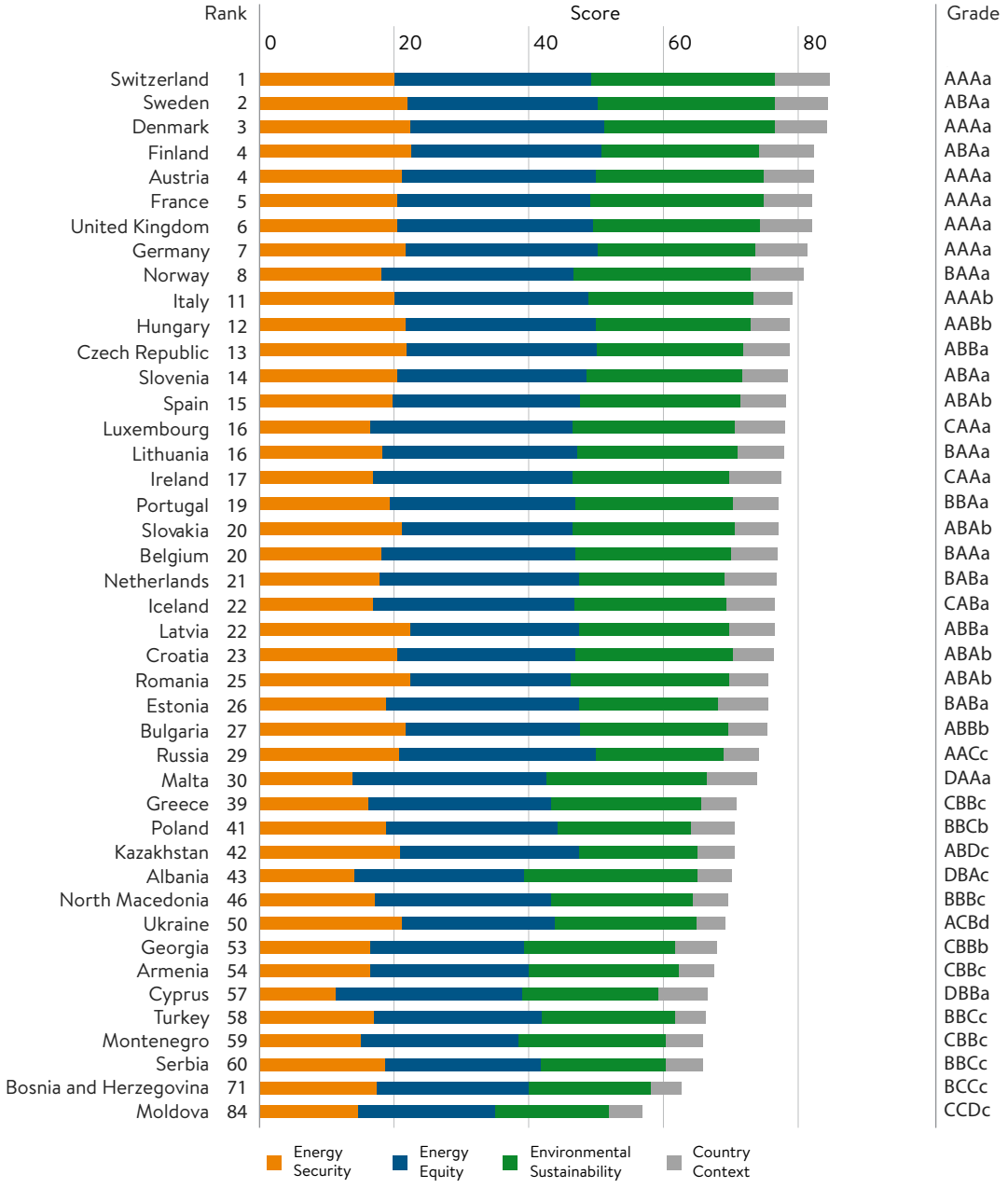
Figure 43: The Trilemma Energy Balance of Europe



Development of new regulations for the European Union energy and carbon markets has been a difficult and controversial process that continues to challenge policymakers. European regulations in national energy markets continue to differ significantly hindering the potential of a common European energy market.

Affordability and competitiveness of energy prices remain a strength of the European region. Although energy and carbon prices have increased slightly in recent years, they have somewhat decreased during economic recession. A decrease in the cost of PV and battery technologies have created booms of investments into more decentralised solutions in a number of European countries. Furthermore, pilot projects for digitalisation involving demand response and sectoral coupling have delivered some new efficiencies in European countries where they are well implemented. However, more countries have witnessed high power price spikes due to tight balancing situation that will require special attention in coming years.

Figure 44: The European countries and their 2020 Trilemma performance



European countries have also balanced their energy taxation systems compared to their economic strength successfully. Despite higher energy taxation than in other regions of the world, the affordability and competitiveness of energy in Europe has not been hampered. In many countries energy taxation revenues are used to support energy efficiency investments that have delivered clear reductions in energy costs, especially for more vulnerable households.

Nevertheless, energy poverty is an increasing issue for many vulnerable households, particularly in Eastern and South Eastern European countries. Of increasing concern is the inability of vulnerable customers to invest in energy transition, and who may also witness higher network prices in coming years due to an increase in the number of prosumers that reduce the flows in transmission and distribution networks.

In terms of security of energy supply, European countries have been among the most highly ranked countries, although the overall score is lower than other dimensions. Energy balances of individual countries tend to be well diversified and include fossil fuels, increasing penetration of renewable energy sources and, in some countries, utilisation of nuclear energy for electricity generation. Recently, some countries have also put forward their hydrogen strategies in order to transform the transport sector towards cleaner solutions and to be able to balance the flexibilities of renewable power production.

However, according to the European Network of Transmission System Operators for Electricity (ENTSO-E), the adequacy of power supply in the majority of European countries where old capacities are shut down and new capacities are mainly reliant on variable renewable sources is an issue of increasing concern. Foreseen closures of nuclear and fossil capacities in many European countries serve to heighten these concerns. As a result, power prices are likely to increase and might in the longer run also affect the affordability and competitiveness of power prices in many European countries.

Most countries in the European region do not have significant oil and gas resources and so focus on improving their energy security through increasing the diversity of energy sources and supply while increasing interconnection. The EU has played a significant role in energy security through a traditional focus on oil security, encouraging the building of oil stocks above commercial levels and by actively encouraging energy market integration. Increasingly, the use of biofuels in different forms is increasing in many countries. The influence of the EU on energy security has been felt beyond its membership with the work of groups such as Energy Community and programmes including the EU-for-energy working with other European countries to improve their energy policies, usually focusing on market function and security.

The Russian Federation remains the main supplier of gas and oil for European countries, but has started to develop in parallel its remarkable renewable energy potential, including wind, solar, biomass, geothermal and hydro. However, economic challenges and low oil prices that provide cheap access potentially restrict the country's ability to support a higher uptake of renewable energy in the short term. In addition, Russia's relatively poorly insulated housing stock requires attention to encourage energy efficiency investments.

In South Eastern Europe, affordability remains an important issue as energy poverty rates remain high, with a growing number of households spending more than 10% of their income on their energy bills. In order to further promote access to cleaner energy resources, policy makers need to mitigate rising electricity prices while increasing willingness to pay and explore how to raise community awareness about carbon-neutral energy access solutions, energy efficiency and other measures.

Modernising and optimising fossil-based infrastructure and integrating it with new renewable infrastructure is essential to achieve sustainable development across the continent. This is a long-term undertaking and must embrace all pillars of sustainable development seeking to leave nobody behind and maintain social cohesion. The European region has long been at the forefront of encouraging environmentally sustainable development with the EU supporting policy efforts to improve energy efficiency and reduce greenhouse gas (GHG) emissions. The European region includes the strongest performers under the Environmental Sustainability dimension, but also a number of countries outside of the EU that rely heavily on fossil fuels and score lower in this dimension. Coordinated efforts are required to ensure a technology-neutral, level playing field of fiscal policies that allow investment in carbon abatement and other technologies to position them in parity with other low carbon/ no carbon electricity generation technologies.

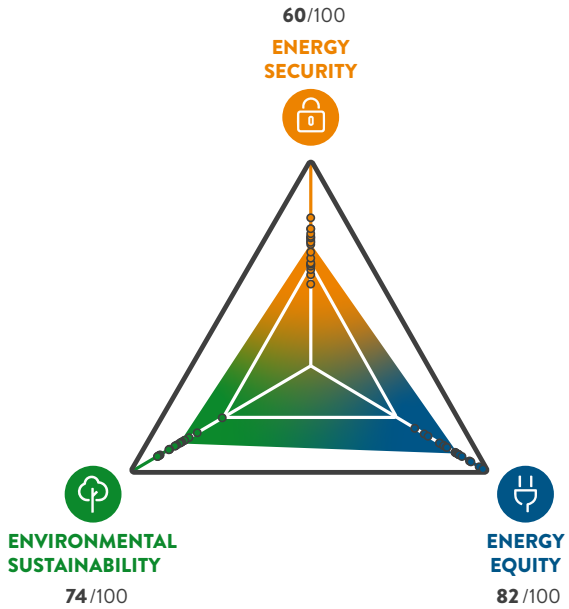
LATIN AMERICA AND CARIBBEAN

The Latin America and Caribbean region has continued to face uncertainties such as extreme weather events, poor diversification of energy sources, inequality of wealth distribution, inadequate and inefficient methods of tax collection, as well as weak utilisation of interconnections and grid infrastructure. This year, the region faced a "perfect storm". The COVID crisis, coupled with the collapse of oil prices pushed governments in the region into a very tight situation. Not only did they need to increase their spending in aid due to COVID-19, but they had to do so with restricted incomes due to lower oil export revenues.

The region's dependence on oil exports is one of the major issues and uncertainties. In particular countries such as Venezuela, Colombia, Ecuador, Bolivia and Brazil are highly dependent on oil revenues. However, as net energy importers, many countries in the Central American region have seen slight improvements in their regional security index. Nevertheless, more work in diversification of the matrix and investment in storage technologies needs to be done.

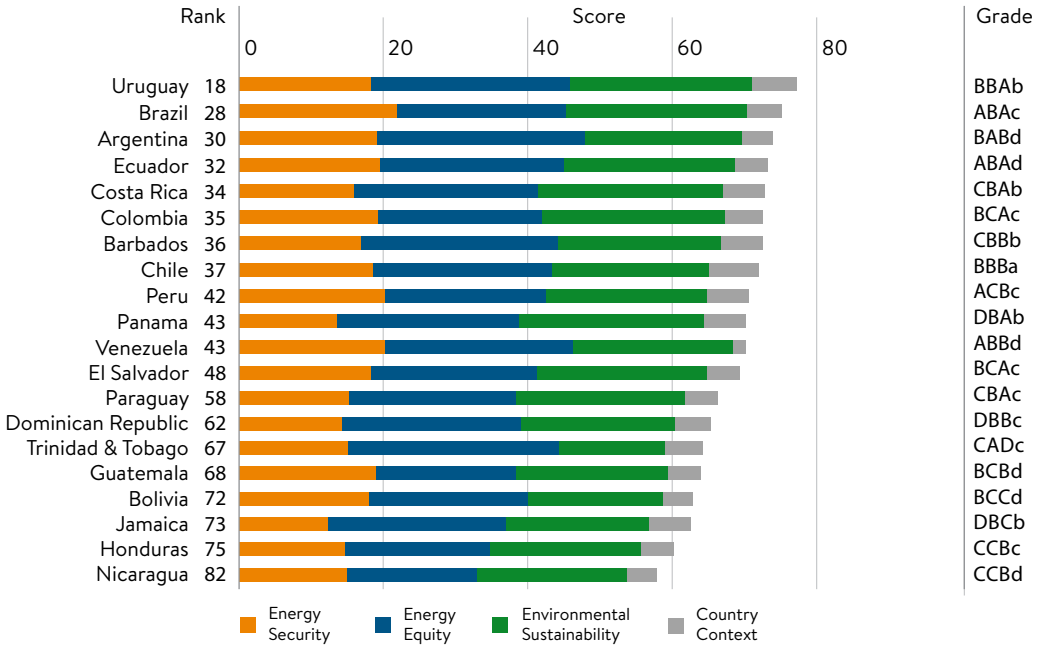
The LAC region derives a significant amount of electricity from hydropower, accounting for 60% of the overall electricity mix in 2017. As a result, 11 countries in the region make it to the top 50 in the Environmental Sustainability dimension, including Costa Rica and Uruguay. For Brazil, Ecuador and Colombia in particular, the extensive use of hydropower has led to lower GHG emissions, but their strong performance in the dimension is not the result of good policies, but rather, is due to the abundance of natural clean energy resources in these countries. There is still much room for policy improvement in the region particularly in energy efficiency system and transportation, which is a significant contributor to the region's GHG emissions.

Figure 45: The Trilemma Energy Balance of Latin America and the Caribbean



The Latin American region has, however, made significant efforts to diversify its energy mix and reduce dependence on hydro by incorporating renewable power generation into the system, predominantly through wind and solar. Strong growth is observed in Panama and Colombia. The latter, has undertaken strong investment in renewable generation with the objective of diversifying the generation mix, and this investment has been driven by a clear and ambitious policy set by the government. Continued growth in renewable penetration has not only helped improve performance on the environmental sustainability dimension, but has also had a positive impact on energy security across the region. Hydrological cycles are complementary to the wind and solar resources, meaning a greater penetration of renewables makes the region's energy system more resilient to extreme weather events. In countries like Chile, it has been the solution for mitigating risks associated from importing other generation fuels from neighbouring countries. The current COVID-19 crisis poses an opportunity for countries in the region to strengthen their current policies

Figure 46: The LAC countries and their 2020 Trilemma performance



and lead a green recovery, allowing for smarter, more efficient and cleaner energy and transportation systems to be put in place.

Latin America has some of the most abundant and competitive renewable energy resources in the world; in particular, hydroelectric, wind and solar power. The elements that make the region a world leader in renewable energy may facilitate a similar stimulus for clean hydrogen production this decade. But it is important to note that to stimulate investment, economies must be supported and improved through policies and market incentive programs. Today, Chile is the indisputable regional leader, followed by Costa Rica, Colombia, Brazil, and Uruguay and Argentina. The Chilean national government will launch its clean hydrogen strategy by the end of 2020, which it sees as key for Chile to reach carbon neutrality by 2050. Part of this strategy includes the vision to export hydrogen to Asia, which could see Chile becoming competitive with countries such as Australia.

As well as the deployment of large-scale renewables, distributed energy generation is on the rise in the LAC region and could contribute significantly to improving the region's performance across the three dimensions of the trilemma. Firstly, distributed generation is allowing remote communities to access electricity where the long distance to generation plants would make electricity transmission costly and unstable. Secondly, it is improving the efficiency of power transmission and distribution, as less electricity is lost in the distribution process and risks associated with terrorist attacks on key transmission lines in countries with internal conflicts are mitigated. Finally, distributed generation is facilitating increasing penetration of renewables, resulting in diversification of electricity generation and a reduction in carbon emissions. The main challenge for most countries remains the lack of comprehensive regulatory frameworks to bring certainty and stability to this arena and stimulate private investment.

There are localized efforts in some countries to expand their existing regulation to support the connection of distributed generators to the grid, long-term maintenance of infrastructures, access to finance, and fiscal incentives. However, a cross-country collaboration is desirable to align efforts and share resources. Costa Rica, for example, passed a new law in May 2020 to move 5% of the country's energy generation to distributed solar energy generation, considering a number of incentives for households

connected to the national grid as well as for remote households that can become energetically self-sufficient with the help of batteries. In 2017, Colombia also approved two ordinances that established public policy guidelines in self-generation on a large scale and small scale, respectively.

In the LAC region, the major decarbonisation opportunities that have been identified, are in transportation and in mining and other large industries. The abundant and cost competitive renewable energy resources that allow the production at very competitive prices, and long-term look into exports. Diversification of the oil and gas sector is key for the region's energy matrix, particularly to remove the impact of price volatility. The opportunities presented for diversification include large public companies taking a lead, the development of a robust energy infrastructure and an increase in the technical capacities, distribution channels and know-how to produce alternative fuels such as hydrogen.

Sustained efforts in the development of strong social policies in the energy sector have allowed the region to maintain good and stable performance in the energy equity dimension. Significant improvement is observed in Argentina where new tax policies have been put in place to allow higher spending on social matters to tackle a poverty crisis resulting from sustained historical political instability.

Social protests in the LAC region in 2019 showed how important it is to have social acceptance and highlighted the importance to governments and companies of taking the social agenda into consideration in their decision making. In Colombia, for example, the debates on fracking that are taking place demonstrate how the country's energy security is facing social acceptability. Some countries in the region are facing similar challenges, especially for big hydro power plants and electricity transmission grids that need an specific approach to obtain social and environmental licences.

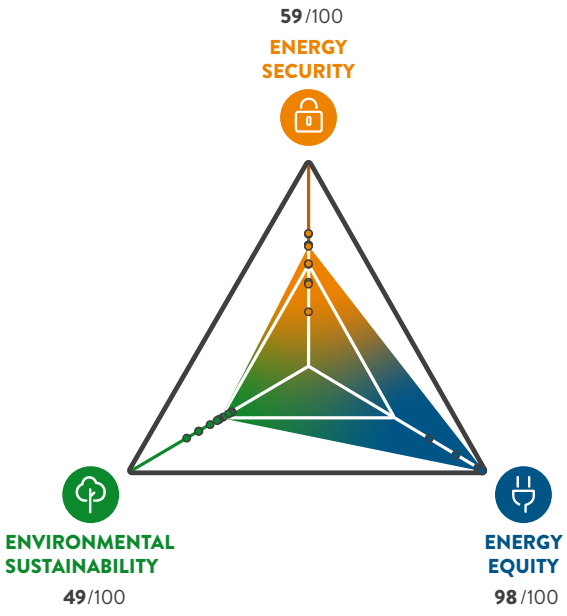
MIDDLE EAST

The Middle East and Gulf States make up a geographic cluster of countries that face common environmental challenges, though they are not homogeneous with respect to energy resource distribution and economic diversification. The region's oil producers were facing strains because of subdued oil prices and production in 2019, a situation that was exacerbated in early 2020 by the COVID-19 pandemic, which led to energy demand destruction across the board and pushed oil and gas prices down to historic lows. Despite stepped up economic diversification, efforts by some of the major economies of the region, among them Saudi Arabia and the UAE, the global economic slowdown has had an impact on revenues from hydrocarbon sales, which the Gulf Arab states rely on to a large extent for their foreign earnings.

Economic reforms undertaken by several countries in the region remain tied to oil and gas revenues to stimulate growth in the non-oil sector and encourage private sector investment. COVID-19 is likely to delay investment in the region's non-oil sectors as governments prioritise spending on infrastructure, health and digitalisation, while providing significant fiscal stimuli to kick-start a post-COVID recovery. The economic recession brought about by COVID-19 has negatively impacted the sectors that were expected to contribute to non-oil growth, particularly aviation, hospitality and services.

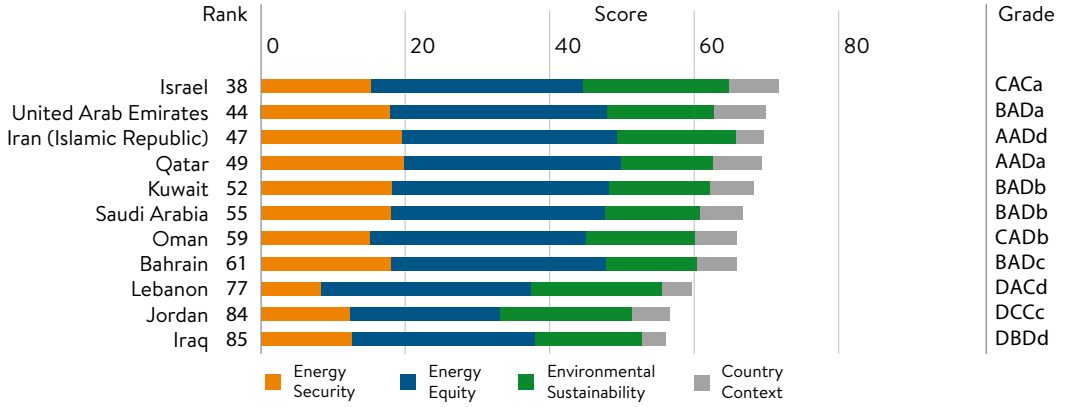
For the energy-importing nations in the Middle East, falling oil and gas prices provide a welcome relief, but economic slowdown in the oil-rich Gulf states has resulted in lower remittances from expatriate workers who rely on jobs provided in the wealthier Arab nations. Iran stands out as an outlier despite its vast oil and gas wealth, as its economy has been hit hard by US sanctions that have forced its oil exports down to zero.

Figure 47: The Trilemma Energy Balance of Middle East



The average Trilemma scores for the region as a whole remain unchanged from the previous year. The Middle East scores highly in the area of Energy Equity because most countries in the region provide affordable and near-universal energy to their respective populations. However, it does not score as highly as would be expected for a region that contains roughly 60% of global oil reserves and 40% of natural gas reserves, because the resources are not spread evenly and there is little cross-border cooperation that would enhance energy security. There are signs, however, that this is being addressed with moves to improve interconnectivity of gas and electricity grids. The weakest area is Environmental Sustainability, partly because of the uneven deployment of renewable energy and the absence of energy efficiency measures by several countries, notably Iraq, which is one of the world's biggest emitters of carbon dioxide from oil and gas operations. At the other end of the scale, Jordan, which relies on imports for around 94% of its energy needs, has made

Figure 48: The Middle Eastern countries and their 2020 Trilemma performance



great strides in the deployment of renewable energy, which now accounts for 20% of its electricity generation capacity.

Several Middle Eastern countries have set ambitious renewable energy targets to be reached by 2030 and 2050 while also committing to reducing emissions from the hydrocarbon industry. The concept of creating a circular carbon economy is gaining traction, though cost is still preventing large-scale implementation of technologies to extract, store and utilise carbon dioxide in the effort to decarbonise the energy and industrial sectors. To date, the UAE has the largest carbon capture storage and utilisation projects at a steel plant, where carbon dioxide emissions from the production process are captured and transported to an oil field to improve extraction rates.

The UAE remains the leader in diversifying its energy mix and has the highest percentage of installed renewable energy capacity. The UAE has set a revised clean energy target of 27% by 2021 and a longer-term target to increase the share of renewables to 50% by 2050.

The UAE's large-scale solar projects have drawn record breaking bids, the latest being a 2GW solar plant that is slated to become the world's largest solar installation. Dubai is building what has been billed as the world's largest single-site concentrated solar power project. It is also testing innovative technologies such as floating solar power plants and other off-grid solutions.

In 2020, the UAE became the first Arab country to operate a nuclear power plant when it started commissioning the Barakah nuclear power station. At full capacity, the plant will meet 25% of the UAE's electricity, which currently runs mainly on natural gas, some of which is imported by pipeline from Qatar and as LNG from the world market.

Saudi Arabia, meanwhile, has stepped up its renewable energy programme and has launched a number of tenders for solar and wind projects. It commissioned the 300 MW Sakaka solar project in 2019 and is inviting bids for two projects with total capacity of 1470 MW and 1200 MW. Under the Saudi Vision 2030 economic reform programme, 30% of power generation would come from renewables and nuclear. Riyadh has also allocated significant funds to developing shale gas resources, due to come on stream in 2024, in an effort to secure more natural gas for its expanding petrochemicals industry, and for power generation and desalination plants. The addition of non-associated gas to the energy mix has helped to reduce the volumes of crude oil and other liquid fuels used for power generation, thereby improving the country's sustainability scores. Overall, Saudi Arabia's Trilemma indices have improved across all dimensions.

Kuwait, meanwhile, lags behind the other Gulf Arab states and has yet to implement a renewable energy policy and projections indicate that it will miss its renewables target of 15% by 2030. As it

provides heavily subsidised energy to its population, Kuwait scores very highly on energy equity. However, delays to developing its gas reserves and slow diversification of its domestic energy mix, has turned the OPEC oil-producing states into a net importer of LNG. The country scores very poorly on environmental sustainability.

The UAE and Saudi Arabia have also started to explore the potential for hydrogen production. The first green hydrogen production in the UAE is in the commissioning stage at Dubai's solar park. The project aims to test and showcase an integrated megawatt-scale plant to produce green hydrogen using renewable energy, store the gas, then deliver it for use in electricity generation, transportation and other industrial uses. Saudi Arabia has launched a tender to build a world-class production facility powered by renewable energy generated by wind and solar to supply 650 mt/day of carbon-free hydrogen, some of which will be exported.

The gradual easing of energy subsidies and, in some instances, the elimination of price controls, coupled with energy efficiency measures, have helped to slow the previously unsustainable growth in energy demand, while freeing up some capital for investment in infrastructure necessary to sustain expansion of supply from wind and solar. However, subsidy reform is not being applied uniformly, which is why the region continues to score strongly on the energy equity dimension as prices remain far below international market rates in some countries.

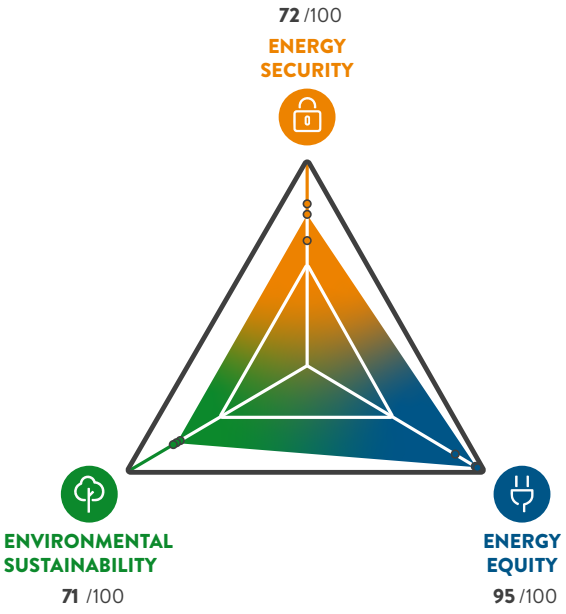
The oil-producing countries remain highly exposed to oil price volatility and need to adopt a more sustainable economic model and diversify their revenue sources to prepare for the inevitable peak in demand for fossil fuels. The reverberations of COVID-19 will complicate the effort as priorities shift to the more immediate effort of managing the post-COVID recovery amid rising debt levels and sluggish economic growth.

NORTH AMERICA

As significant energy producers, energy plays a critically important and highly valued part in the North American economies. The transition to clean energy therefore creates both large challenges and major opportunities. Various opportunities to accelerate energy transition are being actively pursued and include: expanding clean continental-scale electricity generation from further development of large-scale hydropower; replacement of coal and fuel oil for power generation; aggressive development of the continent's rich endowment of wind, solar, and small-scale hydro resources; and leadership in innovation to manage and optimise the electricity grid at both regional and local scale.

When assessing the North American energy picture, two important contextual factors need to be considered. First, the responsibility for energy is divided in the United States and Canada between national and state or provincial governments, while energy remains a federal responsibility in Mexico. This division of power means that a full assessment needs to reflect the energy policies of both levels of government. Second, while elections of new governments can result in sudden shifts or reversals in policy directions, the situation in the United States and Canada is compounded by election dates for national and sub-national governments typically being out-of-phase. Given the capital-intensive, long-term nature of the energy sector, sudden policy changes can undermine the effectiveness of previous policies and potentially discourage energy investment.

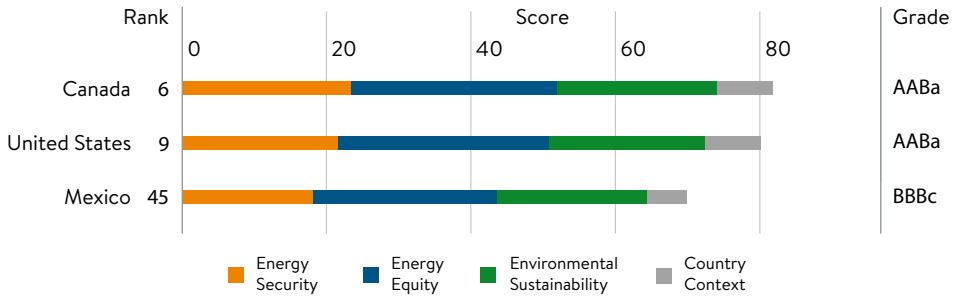
Figure 49: The Trilemma Energy Balance of North America



Diversity amongst the three North American countries is greatest in environmental sustainability policy. The US withdrawal from the Paris Agreement will become effective in November this year, shortly after the US elections, and could formalise the US drift away from international commitments on climate change. There are now federal level plans on climate change with efforts instead focused at the state level where policies differ significantly between states. Some US states, such as California have adopted ambitious targets to achieve carbon neutrality by 2045, while others have minimal plans. The Council's 2020 Issues Monitor highlighted that North American energy leaders continue to identify "US Policy" as having the most significant impact and uncertainty. Despite the recent ratification of the 'United States – Mexico – Canada Agreement', the upcoming US elections highlight continued short-term political uncertainty.

Mexico is reverting to its previous energy policy perspective to work towards energy self-sufficiency by reducing energy imports and to providing energy that is abundant and cheap. Although it remains a party to the Paris Agreement, López Obrador's administration has not yet presented its programme on climate change required by national law in 2019. This breaks with the policy of the previous

Figure 50: The North American countries and their 2020 Trilemma performance



administration, which set up a cross-ministerial committee to coordinate climate change policies and actively promoted energy efficiency and renewable electricity generation to help decouple economic growth and energy intensity. The Mexican government has prioritised energy self-sufficiency above environmental sustainability, increasing the budget allocation to the modernisation of fossil-fuelled power plants and the construction of oil refineries, while decreasing support to solar and wind power.

By contrast, Canada re-elected the Trudeau administration with an explicit promise to target net-zero emissions by 2050 and is preparing a detailed action plan to achieve this goal. Although the plans are still to be approved, the Canadian policy direction on climate change remains guided by the Pan-Canadian Framework on Clean Growth and Climate Change, to meet the country's emissions reduction targets, to grow the economy, and to build resilience to a changing climate. Some provinces have set their own emissions reduction goals with sector-specific targets; for example, increasing the share of renewable energy supported by incentives.

Energy Security in North America is widely seen as a positive continental strength, based on a long track record of developing abundant and diverse energy resources. The large energy trade flows between the three countries further enhances energy security through supply diversity and the redundancy inherent in the continental transmission networks with mutual aid cooperative arrangements in place to restore supply in times of regional outages or supply interruptions. Canada has been joined by the US as a net exporter of energy, due to the US becoming the biggest global oil producer during 2020, while Mexico is a net energy importer to meet its energy demand. Reinforcing cooperation within the North American region remains crucial to improving the Trilemma scores for the three countries in Energy Security dimension. The recent 'United States – Mexico – Canada Agreement', effective since July 2020, seeks to interconnect the grids between the three countries, while enabling free energy trade. For example, there is a proposed project to build a power line to supply hydropower from Quebec to Massachusetts that would be more cost-effective than building new domestic US power generation.

Energy Equity generally remains a relatively low-profile policy issue for North America. With widespread access to energy and energy services, there is a perception that prices are highly competitive. However, there are energy cost concerns for some remote Canadian communities due to the high transportation cost for supplying fuel and power. In urban areas, energy price increases can lead to difficulties for poor households. In the US, there is growing recognition that some American consumers are having difficulty paying their energy bills and are being disconnected despite nearly universal access, historically low energy prices and, pre-COVID, a strong economy and low unemployment. Mexico still faces some challenges to guarantee access to "modern" energy to vulnerable households in rural areas. In previous years, the government tried to tackle this through energy safety nets, although the effectiveness of these policies was uncertain with the schemes not being properly evaluated before being further revised.

The impact of the COVID-19 pandemic in North America has been significant. On the human level, substantial numbers of people have been affected, while energy systems have successfully managed the sharp

fluctuations in energy demand with lockdown restrictions. As an energy exporter region, fluctuations in the global energy demand has affected the revenues of the countries with lower export levels compounded by reduced oil prices from the second quarter of the year. Oil companies have been particularly affected, with lower prices making higher cost production uneconomic and leading to rationalisation and job losses.

The pre-pandemic trend shows the three North American countries taking divergent paths of energy transition that could be exacerbated with their post-pandemic economic recovery plans. At the same time, the region has demonstrated its ability to swiftly realign, which could produce a coherent regional energy transition perspective.

ANNEX A

HOW TO USE THE TRILEMMA INDEX TOOL

Users are encouraged to read this report in conjunction with the online Trilemma Tool, which presents full results per country, as well and commentary and insights from national experts.

On the image below, you can see an example of the Country Profile for United Kingdom.

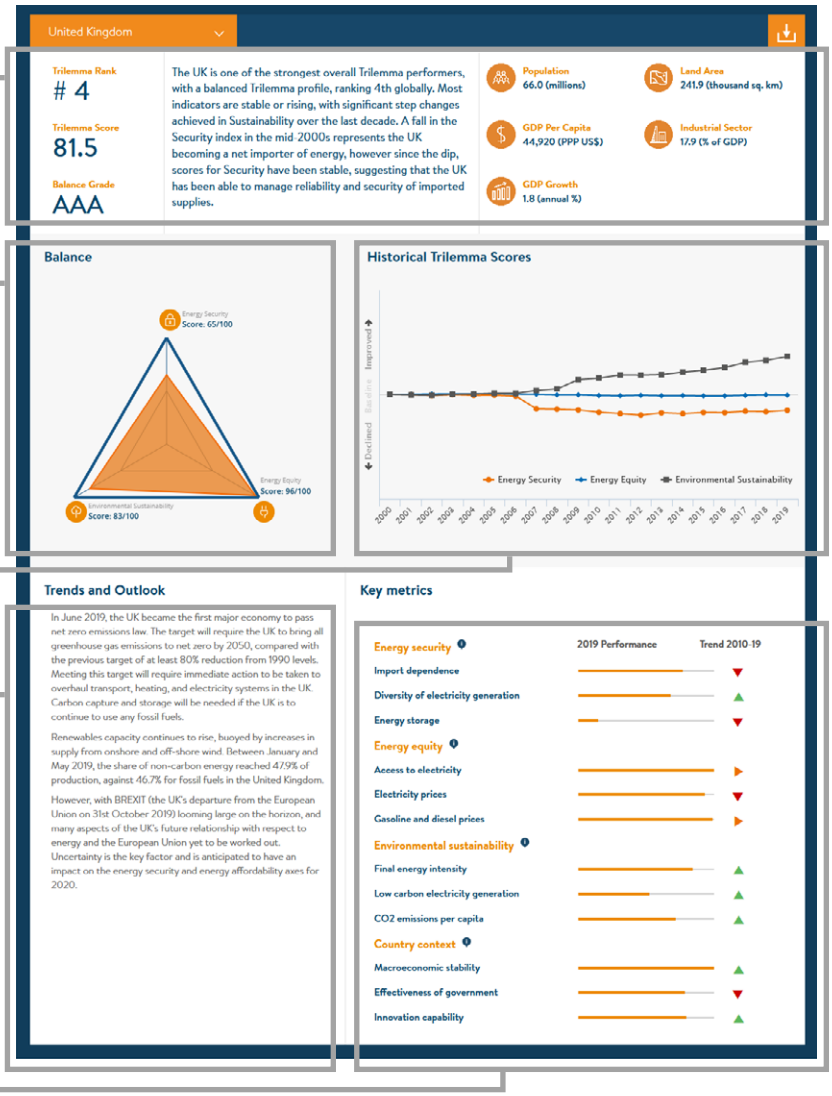
The 2020 Rank, Score and Grade; including a short introduction of the country accompanied by high level statistics.

The Trilemma Triangle is a snap-shot of the balance of a national energy system.

Historical Trends for all three dimensions using 2000 as a base year; each dimension is tracked from a base score in the base year to show improvements or declines over time compared to a national baseline.

Commentary on national trends and outlook of the country's energy system; written by Council Member Committee experts to help understand the historical trends and policies that affect the Trilemma scores.

Key indicators driving the scores in each dimension are presented: the 2020 score and a trend since 2010 (rising, falling or stable).



Scalable conceptual framework for analysis: Global, Regional, National and Sub-national. The Index is calculated at a global level with globally comparable data, delivering a global level ranking of most countries in the world. For some indicators, using the same "ruler" to measure vastly different nations, of different size, geography, reserve and governance structure blurs the detail. The global Trilemma is just the

start of the conversation. Beyond it is the opportunity to explore dimension performance at regional, national, and sub-national level.

National Trilemma pilot projects are under way with some Member Committees of the Council. These look to use nationally relevant indicators and nationally reported data to track dimension progress, comparing country performance to aspirational targets and real, observed baselines, rather than international comparisons. Feedback from the potential regional or national Trilemma pilot studies will also help develop the broader programme and continued improvement of the Trilemma concept, encouraging iterative Trilemma learning.

USING THE TRILEMMA FOR ENERGY POLICY PATHFINDING

A comparative ranking is not sufficient to provide guidance on how to improve a country's energy policy. One could look at the top-ranking countries for the different dimensions to understand the reasons for their better performance, although whether or not their policies would be relevant to other countries would require further analysis of the differing domestic contexts. Another limitation of only considering the comparative rankings comes from the fact that improving performance by one country may not be recognised if other countries have improved more. These limitations are addressed by a nuanced analysis of trend indices through longitudinal insights.

A time-series analysis in Index trends enables performance to be assessed over time against a country's own baseline to understand whether a policy intervention has made a positive impact or if further refinement might be necessary. It also provides guidance for identifying the more effective policy interventions that enables the Energy Trilemma to become a policy pathfinding tool.

By seeing performance at a country level over time, it becomes easier to identify where a policy intervention might be best targeted and then to subsequently track its impact. This follows an evidence-based policy assessment approach. The Trilemma provides potentially greater insight by assessing performance across the three related dimensions so that unintended consequences can be spotted but also by enabling comparison with other countries with similar contexts.

EXTENDING IMPACT: WHAT'S NEXT FOR THE TRILEMMA?

The Trilemma methodology follows a "Kaizen" philosophy of continuous improvement in order to maintain and build its relevance. This can already be seen this year, where the evolution has highlighted several areas where we need to build better metrics and create new sub-indicators to understand the impact of the energy transition on energy policy performance.

At the same time, we will build upon the scalable Trilemma conceptual framework with more pilot studies at regional and national levels using local data and revising indicators to reflect the local context. There is also scope to cluster countries with similar characteristics to explore which policies are performing best and understand why this might be so.

We are particularly keen to develop the longitudinal analysis. The underlying time-series data provides a sound basis to explore some of the sub-indicators going forward. Using this approach, we will build Trilemma Trajectories to explore future possible Trilemma performance, with the intention to combine these with the World Energy Scenarios to create a policy gaming framework investigating differing policy pathways under alternative possible futures.

Our goal is to be able to present completed pilot studies of the city-level Trilemma and Trilemma Trajectories at the 25th World Energy Congress in St Petersburg in 2022 with intermediate progress presented to the intervening World Energy Week.

ANNEX B

FREQUENTLY ASKED QUESTIONS

The Energy Trilemma Index aims to support an informed dialogue about improving energy policy by providing decision-makers with an objective relative ranking of countries' energy system performance across three core dimensions of Energy Security, Energy Equity and the Environmental Sustainability of energy systems. The 2020 Index is based on an evolved methodology and focuses on a historical index of progress. This means that while the results cannot be directly compared with previous report iterations, the Index builds upon last year's new time-series analysis capability that has calculated Trilemma performance back to 2000.

WHAT IS THE WORLD ENERGY TRILEMMA INDEX?

The Index is a quantification of the Energy Trilemma, which is defined by the World Energy Council as the triple challenge of providing secure, equitable and affordable, environmentally sustainable energy. Balancing these priorities is challenging but is also the foundation for the prosperity and competitiveness of individual countries.

The Energy Trilemma Index assesses current and past performance across the three dimensions of Energy Security, Energy Equity, and Environmental Sustainability. A fourth dimension of Country Context is also included within the calculations, to capture important differences in countries' institutional and macroeconomic contexts.

Energy Security measures a nation's capacity to meet current and future energy demand reliably, withstand and bounce back swiftly from system shocks with minimal disruption to supplies. The dimension covers the effectiveness of management of domestic and external energy sources, as well as the reliability and resilience of energy infrastructure.

Energy Equity assesses a country's ability to provide universal access to reliable, affordable, and abundant energy for domestic and commercial use. The dimension captures basic access to electricity and clean cooking fuels and technologies, access to prosperity-enabling levels of energy consumption, and affordability of electricity, gas, and fuel.

Environmental Sustainability of energy systems represents the transition of a country's energy system towards mitigating and avoiding potential environmental harm and climate change impacts. The dimension focuses on productivity and efficiency of generation, transmission and distribution, decarbonisation, and air quality.

Country Context focuses on elements that enable countries to develop and implement energy policy effectively and achieve energy goals. The dimension describes the underlying macroeconomic and governance conditions, reports on the strength and stability of the national economy and government, the country's attractiveness to investors, and capacity for innovation.

The Energy Trilemma Index has been prepared annually by the World Energy Council in partnership with global consultancy Oliver Wyman and Marsh & McLennan Advantage since 2010.

The goal of the Index is to provide insights into a country's relative energy performance with regards to Energy Security, Energy Equity and Environmental Sustainability. In doing so, the Index highlights a country's challenges in balancing the Energy Trilemma and opportunities for improvements in meeting energy goals now and in the future. The Index aims to inform policy makers, energy leaders, and the investment and financial sector. Index rankings provide comparisons across countries on each of the three dimensions, whilst historical indexed scores provide insights into the performance trends of each country over time.

WHERE CAN I FIND THE FULL RESULTS?

- The results are published once a year and can be **downloaded for free** from the **Council's website.**

- The **online tool**, presenting full results: https://trilemma.worldenergy.org/

- The **full report** with insights and regional profiles: https://www.worldenergy.org/publications/

WHAT IS THE SCOPE OF THE INDEX?

The Index tracks **133 countries, 84 of which are member countries** of the World Energy Council. However, rankings have only been produced for 128 countries, with five countries not being ranked due to political instability and/or poor data coverage. The countries that are tracked but not ranked are: Chad, Chinese Taipei, Libya/ GSPLAJ, Syria (Arab Republic) and Yemen.

The Index aggregates **72 datasets into 32 indicators** to create a snapshot energy profile for each country. Furthermore, it calculates a historical index for each dimension back to a baseline year of 2000.

WHAT TIME PERIOD DOES THE 2020 INDEX CAPTURE?

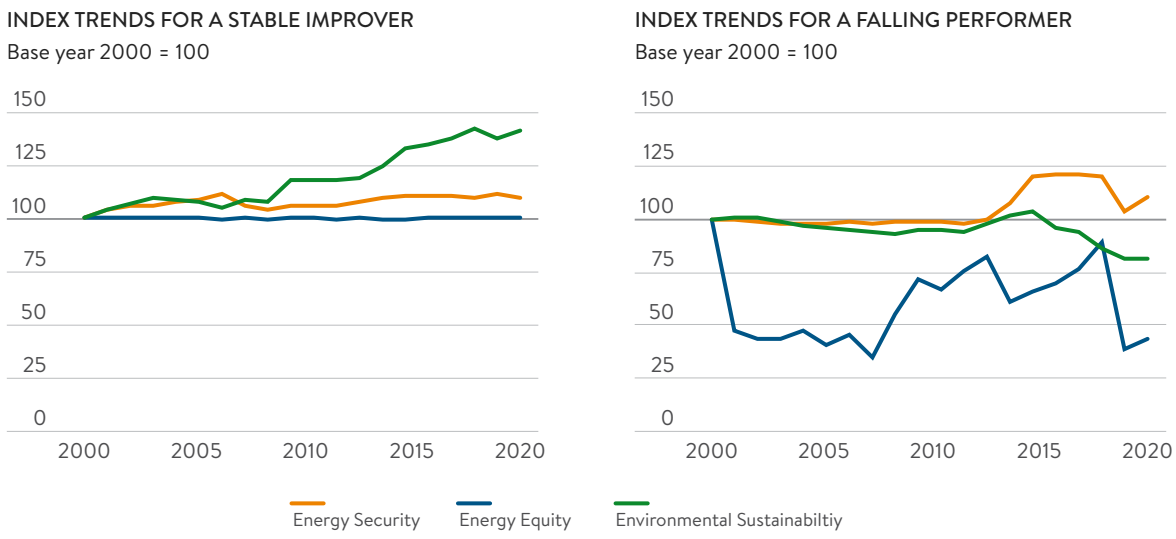
The 2020 Index ranking reflects data from 1998 to 2020 using the most recent available data at global levels. The online Trilemma Tool presents Index performance since 2000 using longitudinal data with individual country profiles. Particular indicators feature some data delays, which mean recent world events or the most recent transitions in the energy sector that could affect the Index's outcomes may not be fully captured (as mentioned in the previous chapters, the pandemic as well as geopolitical or social unrest in the Middle East or Venezuela).

HOW ARE THE INDEX RESULTS PRESENTED?

Countries are provided with an overall Index ranking from #**1 to** #**128,** as well as rankings for each dimension of Energy Security, Energy Equity and Energy Sustainability of their energy systems. The top performing country is awarded a #1 ranking, while the lowest ranking country is assigned rank #**128 generally (in 2020 the lowest rank is #108 because some countries shared the same rank)**. In addition, scores for the three dimensions of Energy Security, Energy Equity, and Environmental Sustainability are distributed into four balance grades (A, B, C and D).

Every country is thus assigned a set of balanced grades (e.g. 'ABC'). Each letter reflects one dimension of the Energy Trilemma: the first letter refers to Energy Security; the second letter to Energy Equity and the third letter to Environmental Sustainability. The mean and standard deviation of the scores in each dimension is calculated; balance grades for each dimension are then assigned using bands based on the mean and standard deviation. High performance across all three dimensions is awarded 'AAA'. Sets of grades such as 'ABC' or 'CBD', highlight the balance or imbalance across a country's energy performance. An imbalance in energy performance suggests current or future challenges in the country's energy policy. Index results and analysis are also complemented by regional overviews as well as individual country profiles with expert commentary form the Council's national Member Committees.

Figure 51: Differences between index trends for a stable improver and a falling performer



ANNEX C

INDEX RANKINGS & POLICIES

WHAT DOES THE INDEX TELL ABOUT PERFORMANCE AND POLICY?

The Index shows how well each country is performing on the Energy Trilemma and captures the aggregate effect of energy policies implemented over time. Because the Index shows aggregate policy effects, it does not identify the effectiveness of a particular policy; each policy interacts with a set of policy specific and contextual factors unique to that country over different periods. Nonetheless, by broadly measuring aggregate policy outcomes, the Index provides important insights into the efficacy of energy policies and choices.

Historical calculations for each of the three energy dimensions indexed to the year 2000 provide performance trends for Security, Equity and Sustainability, which can be compared to policies and exogenous factors over time, providing potential insights on the effects of different factors on energy outcomes.

WHAT WILL AFFECT A COUNTRY'S RANKING IN THE INDEX?

The Index is weighted in favour of energy performance (Energy Security, Energy Equity and Environmental Sustainability dimensions) versus contextual performance (Country Context dimension). Therefore, changes in energy performance will have a greater effect on a country's ranking than changes in its macroeconomic and governance conditions.

Few countries manage to perform well across all three energy dimensions, just 8 out of 128 countries managed to achieve AAA grades across the energy Trilemma dimensions. Currently, many countries achieve stronger performance in two dimensions but falter in one, suggesting trade-offs between energy dimensions. For example, the abundance of oil in some energy-exporting countries means that they enjoy highly secure and affordable energy. However, low prices limit incentives to reduce energy consumption and to engage in energy efficiency programs affecting their performance in Environmental Sustainability due to higher greenhouse gas emissions.

HOW CAN A COUNTRY MOVE UP OR DOWN THE INDEX?

It is important to note that the Index is a comparative ranking and shows the performance of a country relative to all other countries. To move up in the Index, a country must improve its overall score. For example, a country's ranking on the indicator "Diversity of electricity generation" will depend on how its diversity of electricity generation (from hydroelectricity, biomass and waste, geothermal, solar and wind) ranks against other countries.

Similarly, if a country's score remains stable but those of its peers improve, it will move down in the rankings. Put differently, a country's underlying indicator data can remain the same year-on-year, but its Index position can move due to changes within other countries. Thus, performance stagnation could impact the Index position in the same way as retrograde motion of the energy performance data.

In 2020, the World Energy Council, in partnership with Oliver Wyman and Marsh & McLennan Advantage, used a revised methodology from 2019 to calculate indicator scores. The use of a refined methodology has resulted in a new set of relative performance rankings, strengthened by historical trend analyses. It should however be stressed that the results published in 2019 are not directly comparable to those published in 2020 due to the changes in methodology.

HOW DOES THIS YEAR'S RANKING COMPARE WITH PREVIOUS YEARS?

It has been challenging to compare Trilemma rankings across years due to the historical methodology used, which comparatively ranked countries solely on that year's Trilemma calculation. Using the rankings alone, it was not possible to judge whether a country had improved its own performance or not, and instead only whether a country's ranking had improved in comparison to others in that year.

The inability to provide insight into country performance year-on-year was a key driver in evolving the methodology to include indexation so that direct comparison with earlier years' performance could be made. While direct comparison with between 2019 and 2020 Index rankings is not possible given changes in methodology, the indexation illustrates now how performance by key dimension indicators has evolved for each country.

It should be noted that the magnitude of 2000-2020 energy equity improvements are significantly higher than in previous Trilemma reports due to two changes in this year's modelling:

- Improved raw data coverage (especially in early years) resulting in a lower starting 2000 baseline than used in previous Trilemma models.
- A small change to the calculation methodology for this dimension to ensure calculation consistency across the Trilemma model – a switch from 'fixed' maximum and minimum caps (where any country scoring over the cap was held to the maximum or scoring under got the minimum) to 'floating' maximum and minimum caps, calculated as the average of the five best / worst scores.

WHAT POLICIES WILL AFFECT THE SCORE AND POSITION?

Policies can affect multiple data points aggregated by the Index such that their effects are not exclusive to a single indicator or even a dimension. Thus, it is often difficult to pinpoint how any single policy affects a country's performance against an indicator or dimension. For example, policies to increase penetration of renewable energy could affect security (by diversifying energy mix and reducing demand for imports) and sustainability (by reducing carbon dioxide emissions). If the policies contributed to higher electricity prices, the policies could also impact the equity dimension. External factors like technological change (e.g. changes in renewables technology) can also have an impact, and are not directly measured by the Index.

Those factors noted, countries that implement a range of clear and predictable energy policies resulting in an overall framework that addresses the three aspects of Energy Trilemma typically rank higher in the Index.

WHY ARE NON-TRIPLE-A GRADES INCLUDED IN THE TOP 10?

A country's overall score is determined by the weighted average of dimensions A to D scores. A country with triple-A balance grades highlights their superiority within a dimension compared to other countries which do not have A grades. However, they may not fall into the top 10 as the values based on which the grades are assigned may be at the lower threshold for the specific grade category. A country's triple-A grades may be composed of relatively 'lower-score' As. In practice, this could result in a lower overall weighted average score than an AAB country where the A grades and B grade are well beyond the threshold levels.

ANNEX D

INDEX METHODOLOGY

HOW ARE INDICATORS SELECTED FOR THE INDEX?

Each indicator category is composed of a set of carefully selected indicators that meet our selection criteria and are highly relevant to the World Energy Council's understanding of the Energy Trilemma.

It is also critical that the indicators can be consistently and readily derived from reputable sources and cover a high proportion of the World Energy Council's member countries; some potential indicators were excluded from the Index due to low member country coverage. The key data sources for the Energy Trilemma Index model are:

- IEA World Energy Balances, Indicators, World Energy Prices, and Emissions
- World Bank/UN SDG 7 tracking data
- World Bank Getting Electricity report
- JODI and IGU data
- Global Competitiveness Index, WEF

Indicator selection criteria includes:

Coverage: The World Energy Council includes indicators that are critical to the Index's methodology and strives to ensure that each indicator possesses a strong coverage of data (more than 75% coverage across the **133 tracked countries**).

Comparability: Data to calculate indicator scores are derived from as unique and comprehensive sources as possible, focusing on a single source per indicator as far as practical, to ensure comparability between countries.

Relevance: Indicators are chosen or developed to provide insight into country situations in the context of the project goals and in line with the narrative.

Distinctiveness: Each indicator focuses on a different aspect of the issue being explored and avoids overlaps or redundancy with other indicators.

Contextual sensitivity: Indicators capture different country situations (e.g. wealth, size) and, where appropriate, indicators are normalised by GDP (PPP), GDP (PPP) per capita, population, or other relevant metrics.

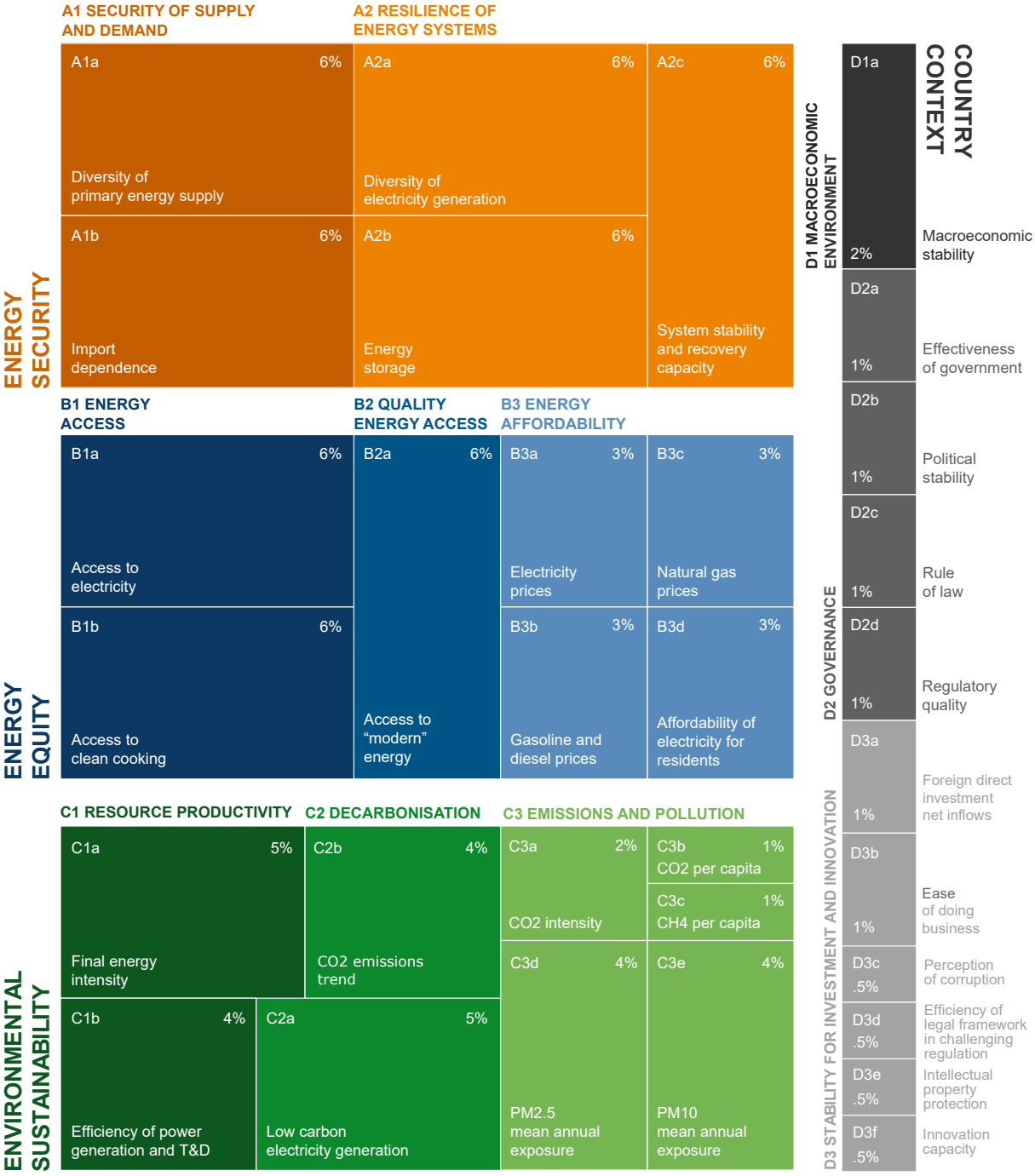
Robustness: Indicator scores are computed from data made available by reputable sources with the most current information available at sufficient coverage.

Balance: Indicators within each dimension (and dimensions across the Index) exhibit coverage of different issues.

WHAT IS THE 2020 INDEX BASED ON?

Each country's overall Index ranking is based on the calculation of **32 underlying indicators which aggregate up to 11 categories** across the four dimensions (including country context). Some of these indicator calculations are based on multiple datasets, others rely on just one. For example, the category "Affordability" is measured using four indicators, each of which is supported by multiple datasets. Two additional indicators (A2d. System resilience and C2c. Transport sector decarbonisation) and one sub-indicator (A2b.c. Energy storage – electricity) were not included in the model due to lack of available data, and remain placeholders for future Trilemma iterations. Figure 52 provides an overview of the indicators and their weighting.

Figure 52: 2020 Energy Trilemma Index structure and weighting of the indicators



WHY WAS THE INDEX METHODOLOGY REFINED IN 2020?

The Trilemma Index has been gradually refined since its introduction and now ranks **128 countries**. The original methodology has been revised throughout the years with the aim of improving transparency and offering stakeholders better insights to help improve their energy policies. Until 2019, the Energy Trilemma had been a comparative ranking of about 130 countries assessed across the dimensions of security, sustainability and equity. A comparative ranking is a great way to start a conversation about energy policy by tapping into competitive instincts and highlighting which dimension might need the most focus. A comparative ranking is less helpful in providing guidance on how to improve a country's energy policy. One could look at the top-ranking countries for the different dimensions to understand the reasons for their better performance, although whether or not their policies would be relevant to other countries would require further analysis of the differing domestic contexts. The main criticism of comparative rankings comes from the fact that improving performance by one country may not be recognised if other countries have improved more, which is where time-series or longitudinal analysis can be more insightful.

A time-series analysis enables performance to be assessed over time to understand whether a policy intervention has made a positive contribution or if further refinement might be necessary. Presenting a dynamic picture of the performance over time also helps to identify the most effective policy interventions and enables the Energy Trilemma to become a policy pathfinding tool. By seeing performance at a country level over time, it becomes easier to identify where a policy intervention might be best targeted and subsequently to track its impact. This follows the usual evidence-based policy assessment approach.

WHAT ARE THE KEY CHANGES TO THE 2020 INDEX?

The 2020 Index is based on the significantly updated 2019 Methodology, with some additional methodological refinements aimed at strengthening the data coverage. The resulting analysis provides a richer view of a country's energy performance, incorporating contemporary indicators and datasets that better represent the current world energy context.

The most significant changes to 2020 methodology are in the A2b. Energy storage indicator, where a better coverage was made possible due to creation of countries' estimates of oil stocks. The investigation of the oil stocks sub-indicator revealed the underlying oil stocks data to be less complete than the comparable oil demand and supply data with some countries reporting production and consumption but did not stock levels. This can arise from oil stock levels being more politically sensitive but also stem from weaker reporting systems. Previously we only estimated missing stock levels for countries where data were completely missing and not for partially missing data where countries were reporting zero stocks. In this current iteration, stock levels for partially reporting countries have been approximated to regional average levels.

We have also revised how the oil stocks sub-indicator is calculated. The sub-indicator previously averaged only non-zero components. However, this methodology meant that for many countries which had available domestic crude oil production and refining capacity data, their additional resiliency against disruption of international energy supply was not well reflected vis-a-vis their peers without. The sub-indicator is now calculated as a simple average across all four components, with nulls treated as zeros.

In addition, more accurate representation of countries' energy storage is achieved by lowering the cap used in natural gas storage indicator, since natural gas is far less prevalent an energy source than oil.

The second indicator with significant change was made in the C2b. GHG emissions trend indicator, where the greenhouse gas emissions were replaced by CO_2 data that acts as a proxy due to unavailability of latest worldwide data on greenhouse gas emissions, specifically from fuel combustion. Although the fundamental methodology of tracking the emissions trend within last five years remains unchanged, the use of CO_2 data as a proxy

allows us to adopt much more recent datapoints than the previous iteration.

Lastly, in generating the overall and dimensional rankings, we have opted to use a dense ranking approach, giving the same ranks to countries whose scores are tied at one decimal place.

As such, comparisons between 2019 and 2020 rankings are not comparing like with like. Updated data sources have also been introduced. Typically, changes in a country's energy performance evolve slowly over several years which will be reflected in gradual upward or downward trend in the Index graph, which can be tracked via the online tool.

WHY ARE CATEGORY AND INDICATOR WEIGHTS GIVEN UNIQUE WEIGHTS INSTEAD OF EQUAL WEIGHTS?

Unique weights are assigned for indicator categories and indicators in the 2020 World Energy Trilemma Index to account for their relative importance, while balancing scientific robustness and transparency. The indicator categories have been set up to provide a comprehensive picture of each dimension. Their weights are determined by the number of indicators included in it and its relevance to the dimension.

The individual indicators reside at a level under dimension categories; they serve as the building blocks of the dimension categories. Their weights are determined by their relevance to the indicator category.

WHY ARE SCORES NORMALISED? WHAT IS THE BENEFIT OVER STANDARDISATION USED WITH NORMALISATION?

Aggregating scores using normalisation rescales them to the range 0 to 100. Scores with different ranges of values are thus adjusted to a common scale for comparison, allowing for a more accurate reflection of the data within Index results. As analogous results can be obtained by applying both standardisation and normalisation, an approach involving normalisation only is preferable as it is simpler and increases transparency.

WHY IS THE RESCALING RANGE DETERMINED BY CALCULATED AND/OR DERIVED VALUES?

When using actual minimum and maximum values for normalising, outliers can cause the distribution of normalised data to be skewed. Furthermore, actual minimum and maximum values may not be meaningful and/or accurate in representing the indicator if there is a theoretical minimum and maximum involved, or it does not consider the nature and significance of the indicator in relation to the status quo and goals of the energy system. By contrast, using calculated or derived values help to mitigate the effects of outliers. For example, taking the average of the bottom and top five performing countries for the indicator C2c. CH_4 emissions per capita as the minimum and maximum values mitigates the impacts of countries with extremely high or low values. Additionally, such values help to better represent indicator scores with a theoretical minimum and maximum. For example, indicator B1a. Access to electricity, which is represented as a percentage of total population has a natural minimum value of 0% and a maximum value of 100%. Moreover, it helps indicators to accurately depict the status quo and goals of the energy system. For example, indicator C3a. CO_2 intensity uses a minimum score calculated by the global average CO_2 intensity targets to reach the 2030 1.5°C IPCC target.

WHY ARE GATE CRITERIA USED?

Gate criteria were introduced to address heavily skewed data and address the differences in countries' natural endowments and macroeconomic positions. This is to ensure that cross- country comparisons across the three dimensions are meaningful. For example, a gate criterion for electrification rate was introduced for the indicator B3d. Affordability of electricity for residents. Only countries with more than 90% access to electricity are assigned a score for this affordability indicator, as it is mostly relevant for countries that are already largely electrified. A gate criterion helps group similar countries (e.g. those with a high rate of electricity access) and thereby prevents the skewed data from excessively influencing outcomes.

Which (sub)-indicators are subject to a gate criterion? The following indicators and sub-indicator are subject to a gate criterion:

- A1a. Diversity of primary energy supply
- A1b. Import dependence
- A2b.b Energy storage (gas)
- B3c. Natural gas prices
- B3d. Affordability of electricity for residents

Please refer to the section Indicators description in the Index Methodology document for a detailed explanation of the gate criteria and the rationale behind the gate criteria for each of the indicators and sub-indicator.

WHY IS MISSING DATA REPLACED BY THE COUNTRY GROUP AVERAGE?

The country group average is a good representative of countries in the same region in terms of economic development, social situation, political conditions, etc. This representativeness renders missing values less likely to distort country outcomes[6]. The groups are based (jointly) on economic groups and geographic region.

Economic groups are defined as depending on the value of GDP per capita in USD:

- GDP Group I: greater than 33,500
- GDP Group II: between 14,300 and 33,500
- GDP Group III: between 6,000 and 14,300
- GDP Group IV: lower than 6,000

Geographic regions are defined as:

- Asia
- Europe
- Latin America and Caribbean (LAC)
- Middle East and North Africa (MENA)
- North America
- Sub-Saharan Africa (SSA)

For example, Gabon lacks PM10 data. It will be given a PM10 score equal to the average score of the countries in the country group with similar GDP and geographic location, which would be more reflective of the economy and energy profile of Gabon.

[6] Please note that only the A2b. Energy storage sub-indicator Crude oil production uses proxy or estimated values for missing data as these provide better accuracy, considering the general low coverage of Energy storage indicator.

WHAT ARE THE LIMITATIONS OF THE INDEX?

The Index cannot capture real-time Energy Trilemma performance due to the challenges of capturing large volumes of reliable data for a wide range of countries.

The Index cannot isolate the impact of a single policy.

The Index uses **76 data sets**. In a few instances, data for specific countries is not available (i.e. the data set has missing data), in which case missing data is replaced by the country group mean.

Full details on the Index Methodology, including the sources of all datasets and how each indicator is calculated and treated, are provided in the comprehensive Methodology document that is available to the Council's Community.

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