WORLD ENERGY COUNCIL

World Energy **Trilemma Index**

Frequently Asked Questions

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.

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?

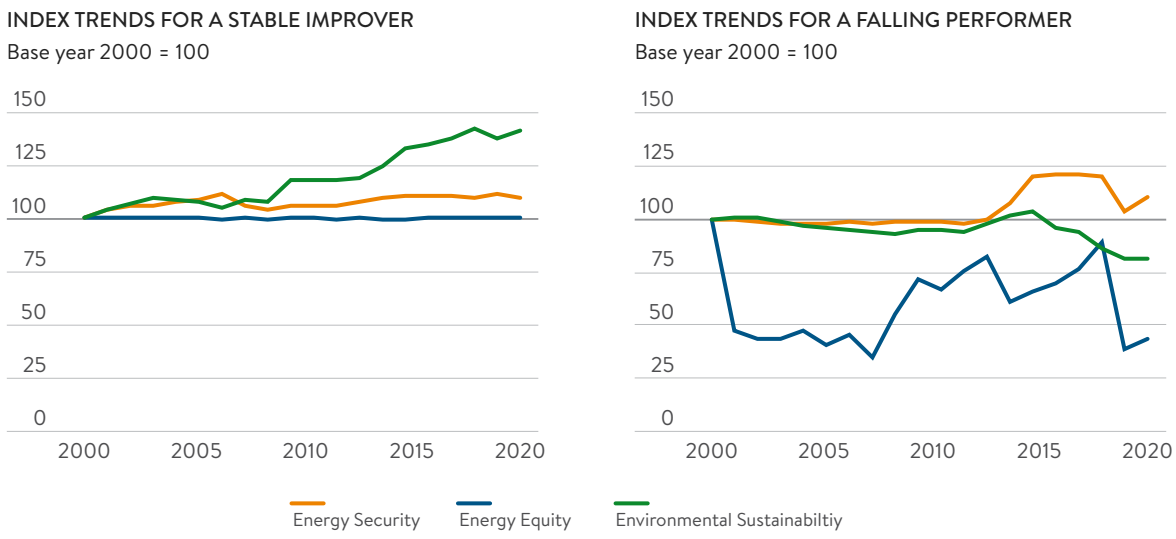
The 2020 Index ranking reflects data from 1998 to 2020 using the most recent available data at global levels. The online Trilemma Tool presents Index performance since 2000 using longitudinal data with individual country profiles. Particular indicators feature some data delays, which mean recent world 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



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.

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.

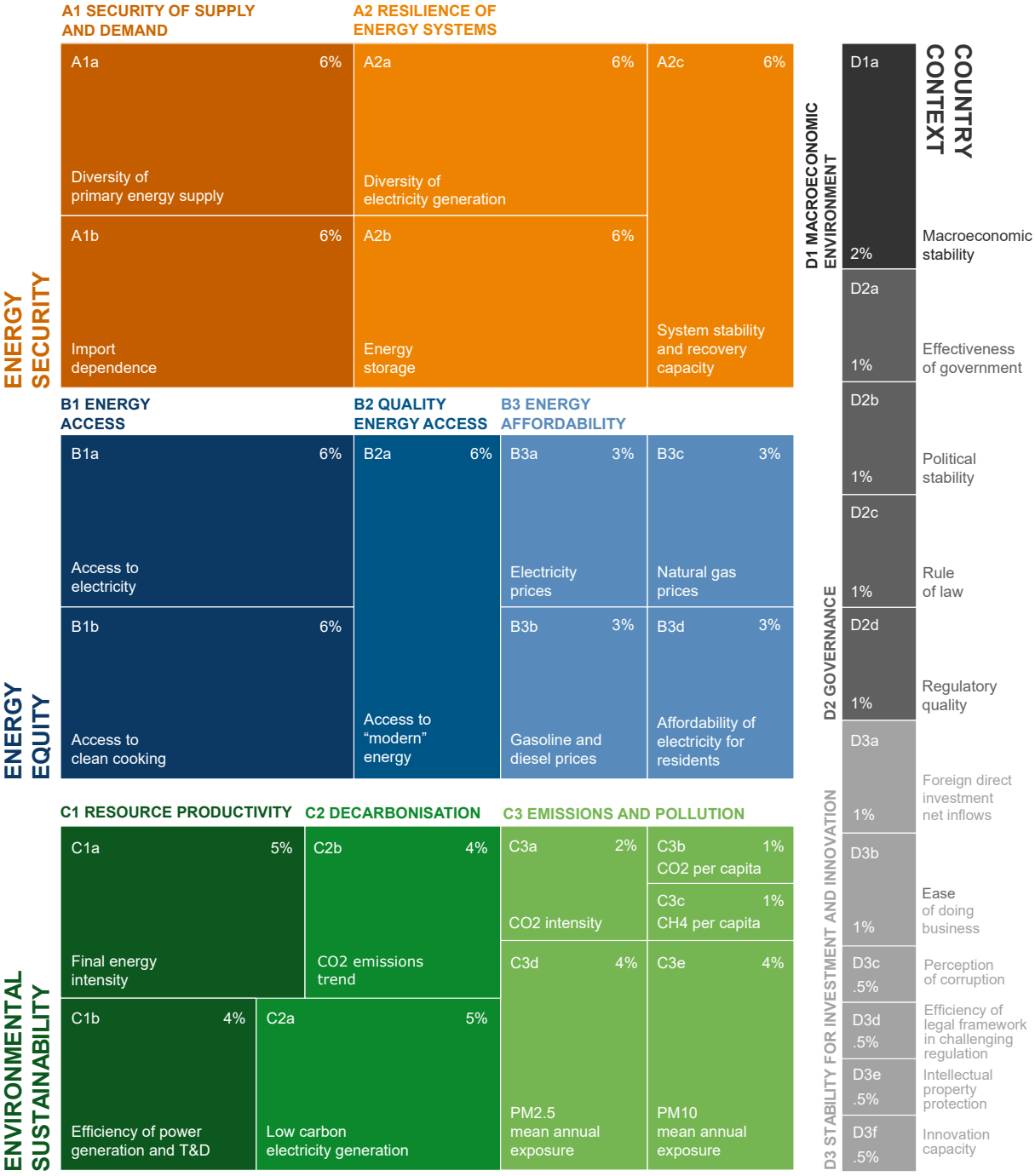
Robustness: Indicator scores are computed from data made available by reputable sources with the most current information available at sufficient coverage.

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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