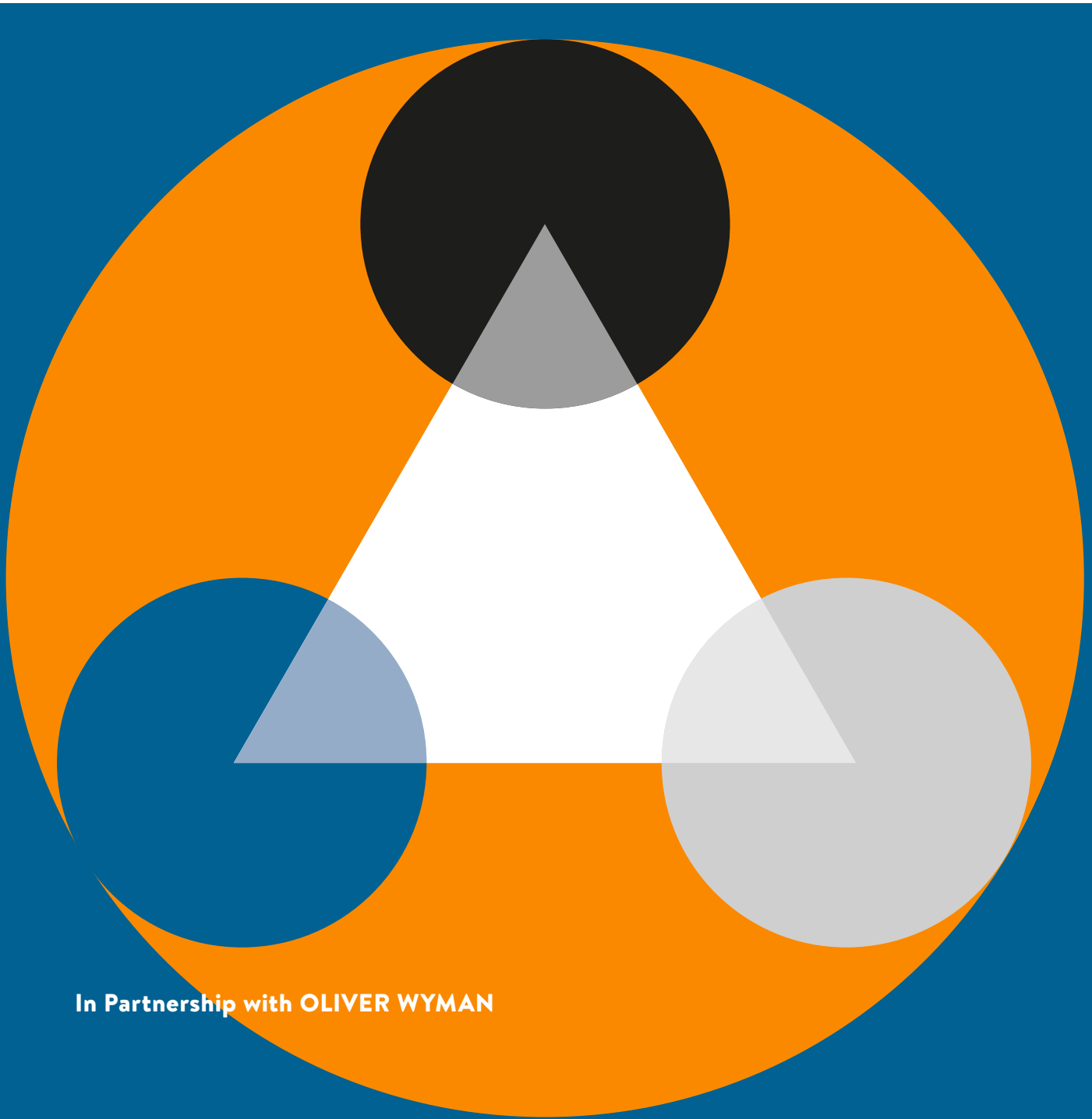
WORLD ENERGY COUNCIL

World Energy Trilemma Index | 2018



In Partnership with OLIVER WYMAN

ABOUT THE 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 is the UN accredited global energy body, representing the entire energy spectrum, with over 3,000 member organisations in over 90 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
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ABOUT THE ENERGY TRILEMMA INDEX

The World Energy Council considers energy sustainability to be defined by three core dimensions– Energy Security, Energy Equity, and Environmental Sustainability. Together, they constitute a 'trilemma', and achieving high performance on all three dimensions entails complex interwoven links between public and private actors, governments and regulators, economic and social factors, national resources, environmental concerns, and individual consumer behaviours.

The World Energy Trilemma Index, prepared annually by the World Energy Council in partnership with global consultancy Oliver Wyman, along with the Global Risk Center of its parent Marsh & McLennan Companies since 2010, is a comparative ranking of 125 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 and use the interactive Trilemma Index tool and its pathway calculator to find out more about countries' trilemma performance and what it takes to build a sustainable energy system:

trilemma.worldenergy.org

Produced in partnership with OLIVER WYMAN

World Energy Trilemma Report 2018, published by the World Energy Council (2018) in partnership with OLIVER WYMAN.

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EXECUTIVE SUMMARY

The World Energy Council's Energy Trilemma Index ranks countries' energy performance on three dimensions: Energy Security, Energy Equity, and Environmental Sustainability, based on global and national data. The results show impacts of decisions and changes, suggesting where policy coherence and integrated policy innovation can help develop well calibrated energy systems in the context of the Grand Energy Transition.

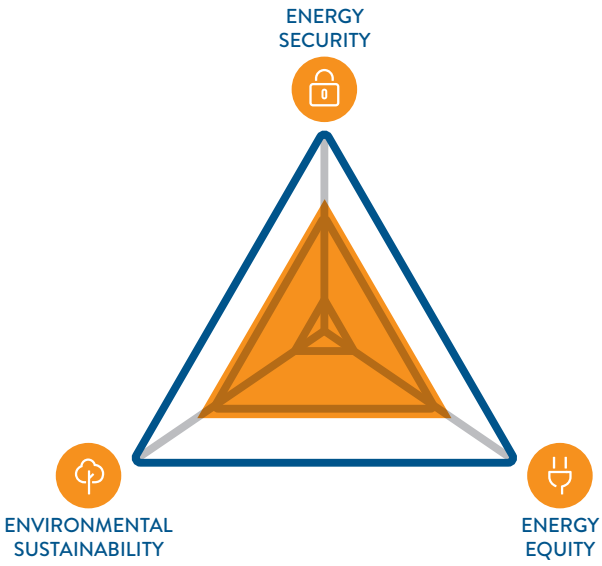
Robust energy systems are secure, equitable and environmentally sustainable, showing a carefully managed balance between the three dimensions. Maintaining this balance in the context of rapid transition to decentralised, decarbonised, and digital systems is challenging: there are risks of passive trade-offs between equally critical priorities. The 2018 Energy Trilemma Index Report shows that many countries are managing the balance successfully, with eight nations achieving a top AAA balance score.

The Energy Trilemma once more ranks Denmark, Switzerland and Sweden at the top, recognising the well-balanced energy systems in these countries. Denmark also achieves the highest score for Energy Security, followed by Slovenia and Canada, all demonstrating secure, diverse and resilient systems. The Energy Equity dimension ranking is topped by smaller countries, where connectivity is managed well, as well as countries where energy is affordable due to government policies: Qatar tops the list, followed by Luxemburg, Bahrain and the Netherlands. The Environmental Sustainability ranking identifies countries with low carbon and energy intensity, resulting in lower emissions: this highlights lower energy users per capita, including the Philippines, Costa Rica and Uruguay.

Figure 1: 2018 World Energy Trilemma top 10 performers overall and per dimension

TOP 10
OVERALL RESULTS

1. Denmark
2. Switzerland
3. Sweden
4. Netherlands
5. United Kingdom
6. Slovenia
7. Germany
8. New Zealand
9. Norway
10. France

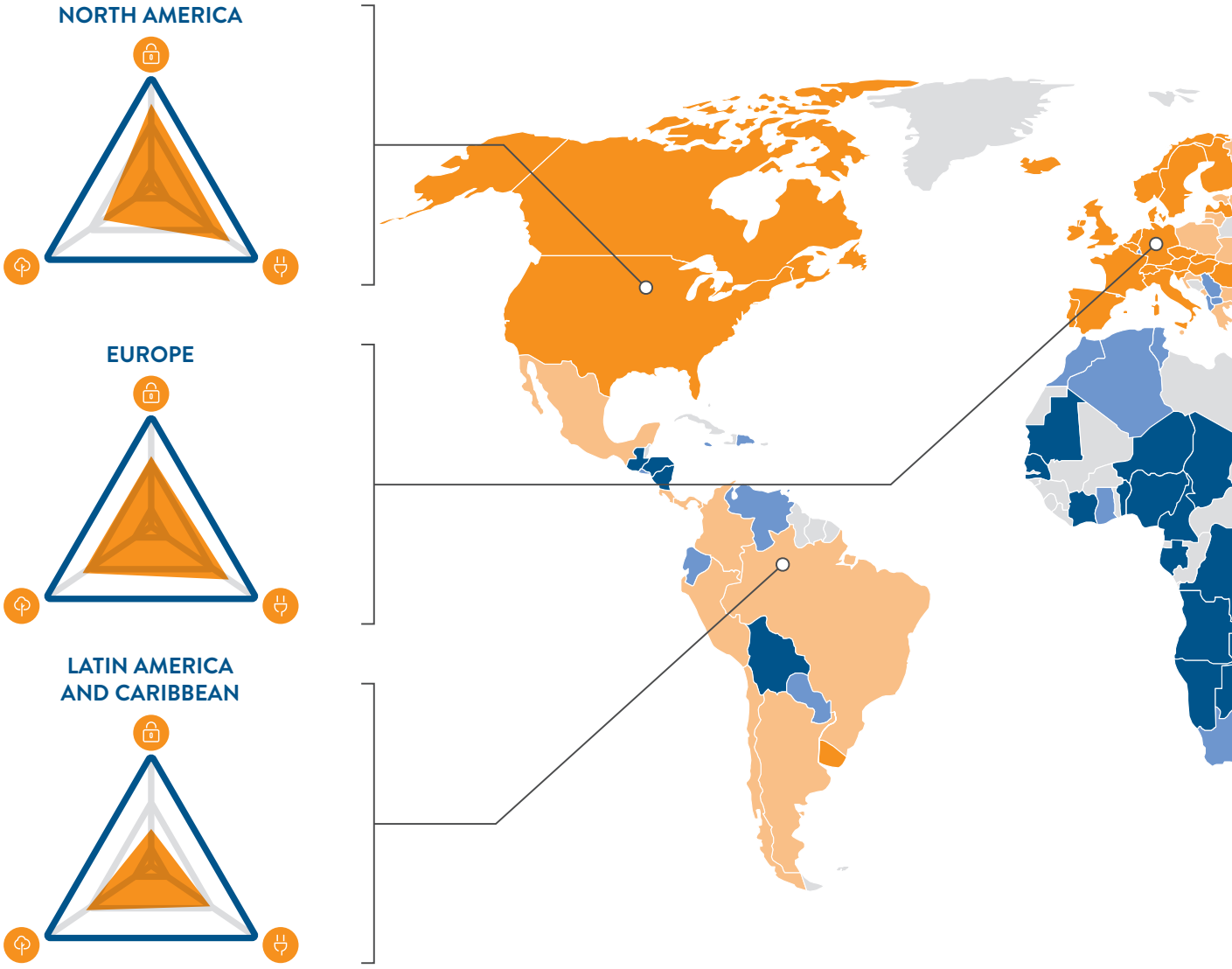


For all the Trilemma regions, the leading countries have not changed from 2017. In Latin America, Uruguay ranks the highest, while in the Middle East, Israel outperforms its regional peers. Additionally, six Gulf Cooperation Council countries have improved their Trilemma performance, with the United Arab Emirates ahead at 36, and the region leads globally in balancing energy access and affordability. In Sub-Saharan Africa, Mauritius performs best, and in Asia and the Pacific, New Zealand remains at the top of the leader board. In South Asia, India improved by four places, and in East Asia Japan and Hong Kong continue to lead sub-regionally with strong performance ranking 30 and 34 respectively.

The biggest Trilemma improvers this year are all Middle East, Gulf States (MEGS) and North Africa countries, with Egypt, Israel, and Bahrain climbing by more than 10 points, and others also improving. This reflects a range of changes in a more stable and diverse electricity supply, certain sustainability policies starting to affect the energy system, and importantly, the affordability of electricity for the population helped by national subsidies; changing politics may see some of this effect reversed in future Trilemmas.

Readers can use the Trilemma assessment to guide the attention of policy makers and energy communities to consider the future preparedness, agility, and adaptability of national energy systems. The Trilemma framework defines energy system sustainability in terms of their agility, adaptability, and transformability needed to keep pace with shifting context and emerging risks.

WORLD ENERGY TRILEMMA INDEX 2018: REGIONAL OVERVIEWS



NORTH AMERICA

STRONG PERFORMANCE IN FACING NEW ENERGY TRANSITION CHALLENGES

With a rich endowment of fossil, renewable and nuclear resources, the region is characterised by sustained reliability and reasonable energy prices. However, the region faces two main challenges: securing energy supply and ensuring grid reliability whilst addressing challenges connected to transitioning to cleaner sources of energy. The US has energy abundance with new unconventional sources, and renewed a push towards cleaner energy policy at the sub-national level. Canada remains committed to the Paris agreement, addressing reliability and sustainability challenges. Mexico's incoming government is yet to announce a position on energy and climate change. The region will need to improve the resilience of aging infrastructure especially in the context of demand, extreme weather and new cyber risks.

EUROPE

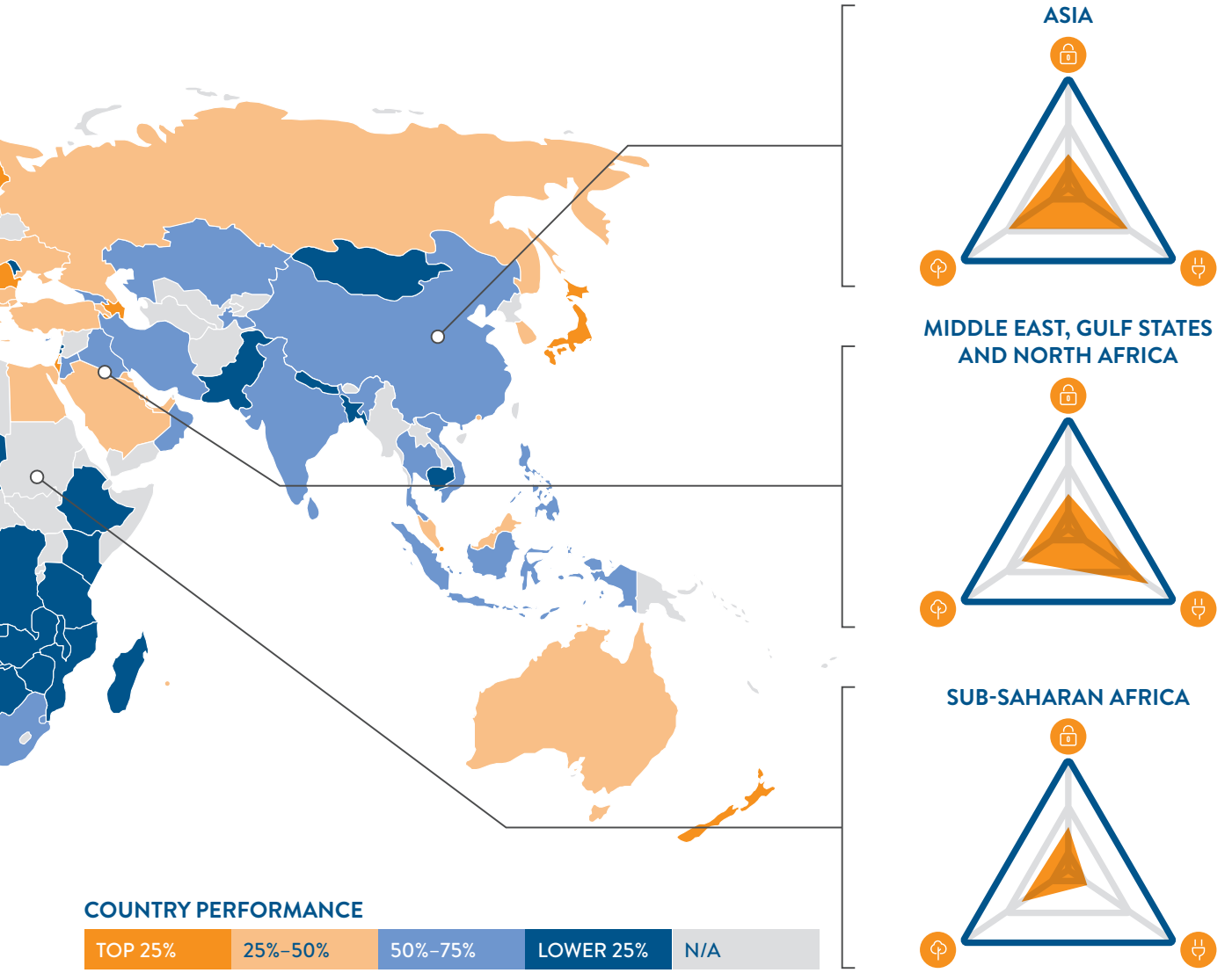
COOPERATION IN POLICY MAKING NEEDED TO MAINTAIN STRONG TRILEMMA PERFORMANCE

The European region is characterised by strong performance on energy sustainability and affordability, while longer term challenges remain in energy security. The harmonisation of market design will realise the potential of regional integration for successfully navigating the energy transition. The continued development of a common European energy market is impacted by divergence in national regulations that need coordination to avoid mixed signals for market players, for example to secure suitable investments to integrate electricity markets. Ensuring energy security while digitising, decarbonising and decentralising the energy system will require stronger cooperation in regional and sub-regional policymaking.

LATIN AMERICA AND CARIBBEAN (LAC)

ENABLING REGIONAL INTEGRATION AND USE OF RENEWABLES

The region has a number of initiatives to increase diversification of energy sources, increase energy security, and improve energy access and affordability. Policy innovations have allowed development of a regional grid and improved use of renewables. Renewables continue to be an action priority issue to improve energy security, but the region's existing hydro infrastructure and further potential is challenged by shifting hydrological cycles and extreme weather. A focus on wind and solar is allowing some countries to balance reliance on hydropower and fossil fuels, and also improve rural energy access in a region challenged by wealth inequalities. Further grid integration and energy diversification will support improved trilemma performance.



ASIA

APPLYING MULTIPLE APPROACHES TO MEET RISING ENERGY DEMANDS

A large and diverse region for energy resources and physical, and economic contexts, Asia faces common challenges of rising energy demands, expanding energy access and meeting climate commitments. Countries are exploring a range of options to improve energy trilemma performance including diversification of the energy mix through renewables and energy storage, energy efficiency and a focus on e-vehicles. Renewable energy has nearly doubled in the region in five years with China and India leading the pace. Yet projected reliance on fossil fuels and imports of fossil fuels remains high, impacting energy security and the area continues to explore options for regional grid and pipeline networks.

MIDDLE EAST, GULF STATES AND NORTH AFRICA

PRESSURES TO IMPROVE ENERGY SECURITY

Many countries perform strongly in energy access and affordability dimensions but face significant challenges with respect to energy security and environmental sustainability of systems. Countries are challenged by high energy intensity and GHG emissions and a high penetration of conventional energy resources. Combined with increasing water scarcity, if the growing demands for electricity, water, and cooling, are not addressed, Energy Security and Environmental Sustainability dimensions could be threatened even further. Going forward, renewable and nuclear energy programmes are expected to be deployed, specifically in the United Arab Emirates, diversifying energy sources, reducing GHG emissions, and improving system resilience.

SUB-SAHARAN AFRICA

BOLD ACTIONS AND POLICIES NEEDED TO IMPROVE ENERGY PERFORMANCE

With 46 countries and a population of nearly one billion, the region continues to be greatly challenged in all three aspects of the energy trilemma due to large infrastructure gaps. The existing stock of power infrastructure is also suffering from inefficiencies and insufficient quality of supply to support growing energy demand. To unlock the region's resource potential and meet future energy demand, the region must to take bold and more collaborative actions to attract investment by improving energy policies and the regulatory framework, building institutional capacity and improving its on-grid and off-grid energy supply. Developing more cross-border infrastructure can improve regional resources exchange.

Introduction
The Energy Trilemma

THE ENERGY TRILEMMA

The World Energy Council considers energy sustainability to be defined by three core dimensions– Energy Security, Energy Equity, and Environmental Sustainability. Together, they constitute a 'trilemma', and achieving high performance on all three dimensions entails complex interwoven links between public and private actors, governments and regulators, economic and social factors, national resources, environmental concerns, and individual consumer behaviours.

Countries take different pathways in the context of energy transition, driven by changes in markets, politics, and society. The Trilemma concept implies that positive growth in each dimension needs to take account of and offset any consequential effects. Unmanaged consumption growth can lead to unbalanced systems. Rapid decarbonisation can impact security of supply. The shape of transition matters: robust transition implies balancing all three fundamental Trilemma aspects in line with growing prosperity and demand. Maintaining a balanced Trilemma 'triangle' - growing in size, but balanced in shape – implies integrated policy solutions and coherent innovation approaches.

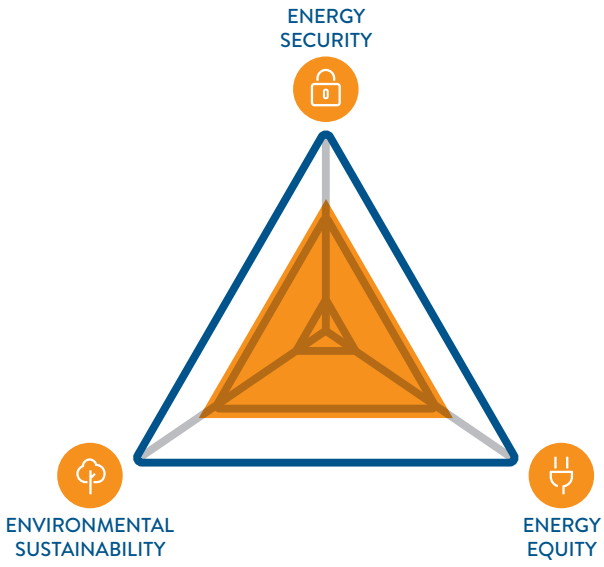
Each year the World Energy Council in partnership with global consultancy Oliver Wyman, runs the Trilemma Index ranking to quantify national energy system performance across the three dimensions. The underlying conceptual framework of three Energy Trilemma dimensions is the philosophy behind the Trilemma. Through these dimensions the Trilemma communicates the importance of robust, secure, and flexible energy systems in the context of change and transition.

Figure 2: The three dimensions of the Energy Trilemma

ENERGY SECURITY
Effective management of primary energy supply from domestic and external sources, reliability of energy infrastructure, and ability of energy providers to meet current and future demand.

ENERGY EQUITY
Accessibility and affordability of energy supply across the population.

ENVIRONMENTAL SUSTAINABILITY
Encompasses achievement of supply- and demand-side energy efficiencies and development of energy supply from renewable and other low-carbon sources.



ABOUT THIS REPORT

The 2018 Energy Trilemma Index Report presents the result of the latest iteration of the Trilemma model, which analyses global energy systems data and comparatively ranks some 125 countries[1] in terms of their ability to develop a secure, affordable, and environmentally sustainable energy system. Each year the Trilemma model quantifies national energy system performance across the three dimensions and their composite sub-indicators. Each country is assigned a three-letter balance score, representing how well the country manages each of the three dimensions, and identifies top performing countries with an 'AAA' score.

The scores and rankings are based on a range of global data sets that capture both energy performance and the national context in which energy is managed. Performance indicators include supply and demand, the affordability of and access to energy, intensity and efficiency of energy use, and emissions associated with energy systems. The contextual indicators consider the broader circumstances of energy performance, including a country's ability to provide coherent, predictable and stable policy and regulatory frameworks, initiate R&D and innovation, and attract investment.

The Trilemma assessment framework has been run annually since 2010 by the World Energy Council in partnership with global consultancy Oliver Wyman, along with the Global Risk Center of its parent Marsh & McLennan Companies. The methodology reflects a changing global context, and a substantial methodological evolution is currently under way for the 2019 report.

Included in this report are:

- 2018 Energy Trilemma Index rankings and balance scores;
- 2018 Watch list, highlighting best improvers over time;
- A focus on the Trilemma approach in evolution;
- Regional profiles by key geographies, prepared by the Word Energy Council regional representatives;
- National Energy Trilemma profiles for 87 of the World Energy Council national Member Committee countries included in the Index[2]; and,
- Appendices including Frequently Asked Questions and Methodology.

As countries have unique resources, policy goals and challenges, the absolute ranking of a country may be less meaningful than its relative individual balance score, communicating the impacts of longer term policies.

1. The World Energy Trilemma Index includes 130 countries but rankings have only been produced for 125 countries due to data limitations. Countries that are tracked but not ranked are: Chinese Taipei, Libya, Barbados, Syria, and Yemen

2. The World Energy Trilemma Index report only features country profiles for the World Energy Council's Member Committees. Results for all 125 countries can be viewed on https://trilemma.worldenergy.org). The World Energy Council's Member Committees in Libya and Syria (Arab Republic) have not been ranked due to data limitations. Therefore, no country profile exists for these countries in the report.

Trends and the balance within the three dimensions also provide valuable information in helping countries address their energy trilemma. Decision makers in both the public and private sectors are encouraged to look at trends in performance over the years, particularly in each dimension, and to compare their countries against peer groups – including regional or GDP group peers.

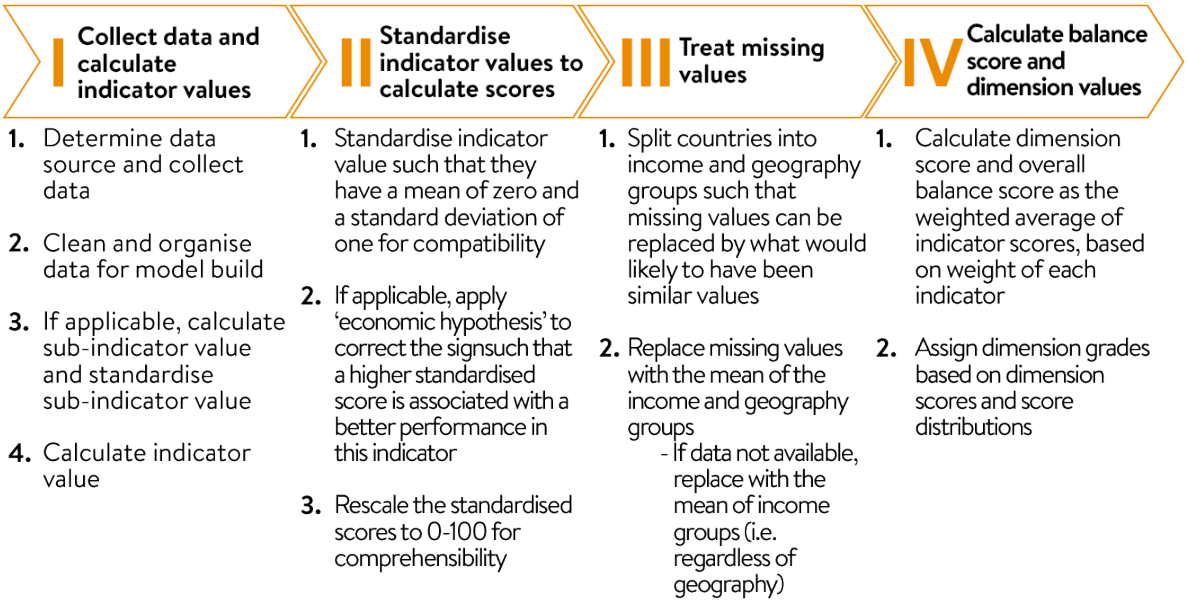
To support decision makers, the World Energy Council and Oliver Wyman have developed an interactive online tool that allows users to view Index results, compare countries' performance against other countries and identify what it takes to improve the energy trilemma performance. The tool can be accessed at: https://trilemma.worldenergy.org

Taken as a whole, the World Energy Trilemma Index is a unique and unparalleled resource and guide for policymakers seeking to develop solutions for sustainable energy systems in a time of transition, and for business leaders to support investment decisions.

METHODOLOGY OVERVIEW

A major, overarching proposition of the Trilemma Index is that the three dimensions are equally important. As such the Trilemma dimensions receive an equal weight in the Index. The sub-indicators are assigned respective weights in the Energy Trilemma Index to signify their relative importance (see Figure 29, page 149), while balancing scientific robustness and simplicity. The choice of indicator is restricted by the availability of globally comparable and timely data. The indicator aggregation methodology can be summarised as the four-step process illustrated below.

Figure 3: The process behind Trilemma scores and grades



Overview
2018 Energy Trilemma rankings

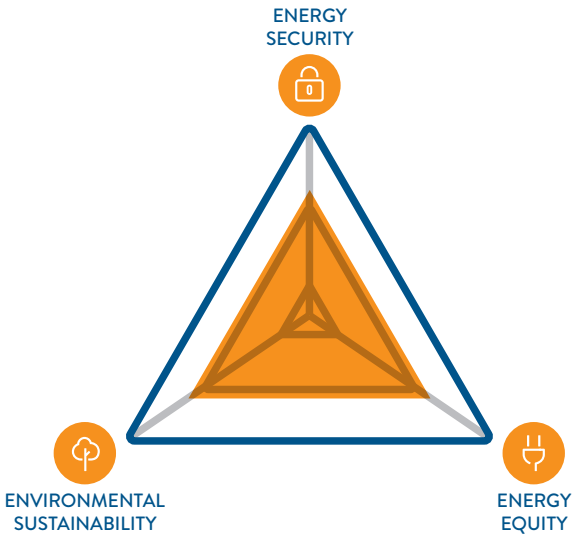
OVERVIEW OF THE 2018 ENERGY TRILEMMA RANKINGS

Healthy energy systems are secure, equitable and environmentally sustainable, showing a carefully managed balance between the three dimensions. Maintaining this balance in the context of rapid transition to decentralised, decarbonised, and digital systems is challenging: there are risks of naïve trade-offs between equally critical priorities. The 2018 Energy Trilemma Index Report shows that many countries are managing the balance successfully, with eight nations achieving a top AAA balance score. The Energy Trilemma once more ranks Denmark, Switzerland and Sweden at the top, recognising the well-balanced energy systems in these countries.

Figure 4: Top 10 Energy Trilemma Index performers overall and per dimension

TOP 10
OVERALL RESULTS

1. Denmark
2. Switzerland
3. Sweden
4. Netherlands
5. United Kingdom
6. Slovenia
7. Germany
8. New Zealand
9. Norway
10. France



The 2018 Energy Trilemma global ranking does not show significant change from 2017. The global top ten remains stable, and there is a clear trend associated with national GDP: richer countries can afford to expand and balance the Trilemma dimensions better. However, some significant improvers with more modest sized economies, such as Slovenia at number six, demonstrate that a balanced energy system is not a luxury, but a product of smart and integrated approaches to transition. The top ten is only part of a bigger story, where managing high per capita rates of energy consumption plays a significant role: countries advance up the index when energy intensity reduces, with growth and production using less energy per unit of wealth created.

LEADERS IN THE THREE DIMENSIONS

Top performers in the Security dimension represent net energy exporters as well as importers with diverse and secure supply systems. Transitions in the energy sector have seen security priorities shift from control of supply to supply flexibility in the context of security. Several European nations perform well in the security rankings due to a regional context which allows for a diverse and flexible energy market, well networked across borders. The Security dimension is a good example of a time

lag in global energy data; energy security is a factor of national stability, so countries going through system shocks will descend down the rankings in future iterations of the Trilemma[1].

The Energy Equity dimension considers metrics of energy access and affordability. The top ten in 2018 demonstrates that, with the exception of Canada, these aspects are a factor of size and population density distribution. Ubiquitous access to electricity and clean cooking, empowered by UN Sustainable Development Goal 7 (SDG), is an easier target for smaller nations, or those where population is clustered in major cities. However, overall, all countries in the Index have shown improved levels of energy access consistently over the last several years. The affordability metric demonstrates that subsidised electricity and gasoline prices also improve equity scores, and the combined effect is reflected in Middle East and Gulf countries at the top of the ranking. As global energy data begins to reflect recent changes, such as the policy change on energy subsidies in Saudi Arabia, the rankings will change, especially if neighbouring Gulf countries follow suite. Additionally, the Equity gains through subsidies can drive up consumption and be reflected adversely in the Sustainability dimension. The top 10 for this dimension recognises a variety of equitable provisions of energy, from low and subsidised prices (Middle East and Gulf States), to improved connectivity in denser geographies with competitive prices (Luxembourg, Netherlands).

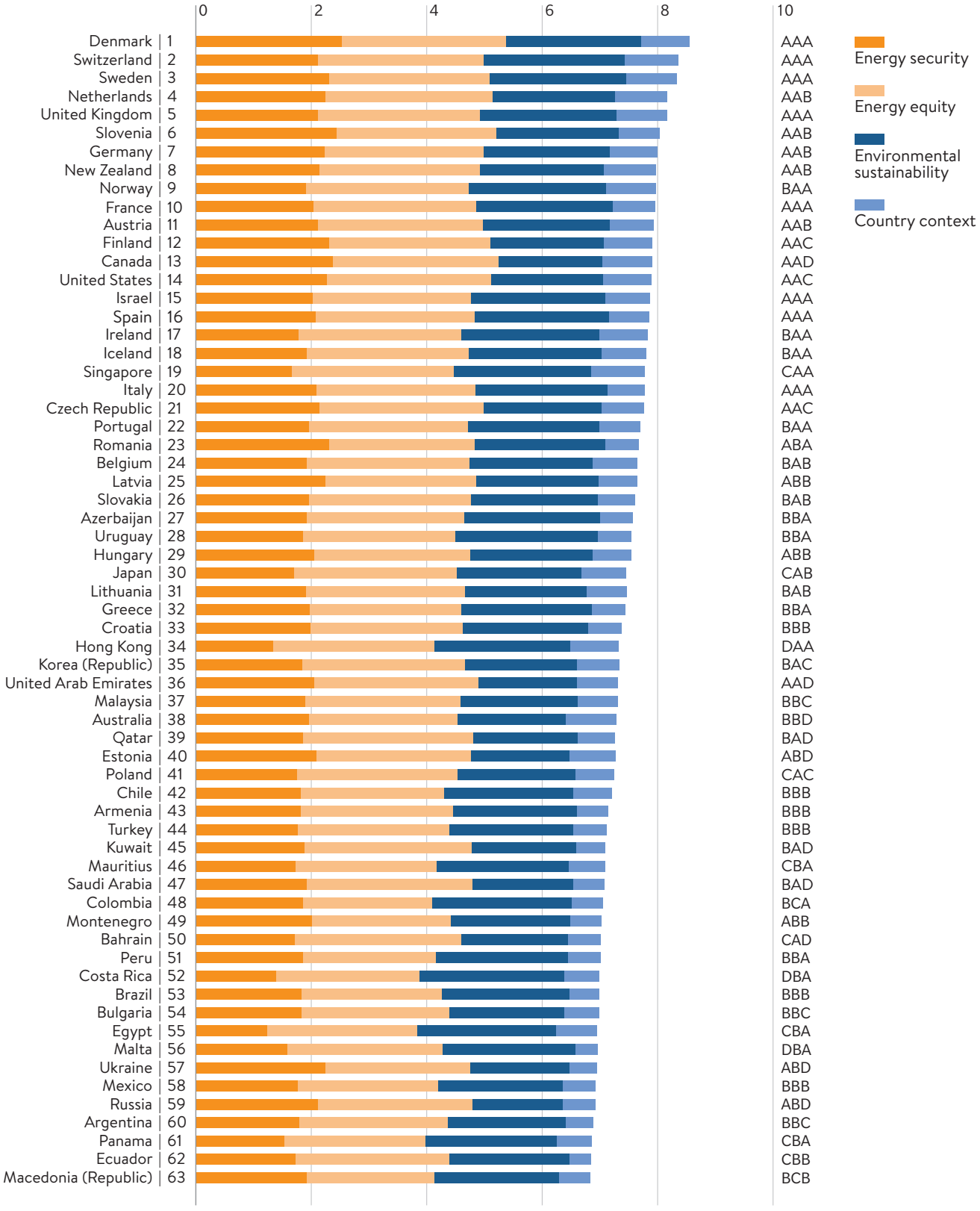
In the Environmental Sustainability top ten, we see some countries with strong renewable generation systems, but also countries with low carbon and energy intensity, resulting in lower emissions: this highlights nations such as the Philippines. The top ten tells only part of a bigger story, where managed energy consumption plays a major role. The Sustainability methodology currently does not fully reflect air pollution, or the decarbonised proportion of the electricity mix – both of which are addressed under other dimensions. As a result, we see smaller, low energy users, with poorer performance in the other two dimensions, higher in the rankings than would be intuitive. The UN SDGs have created a new framework of accountability for sustainable and low carbon energy generation; future Trilemma iterations will reflect the success of countries making progress in this direction.

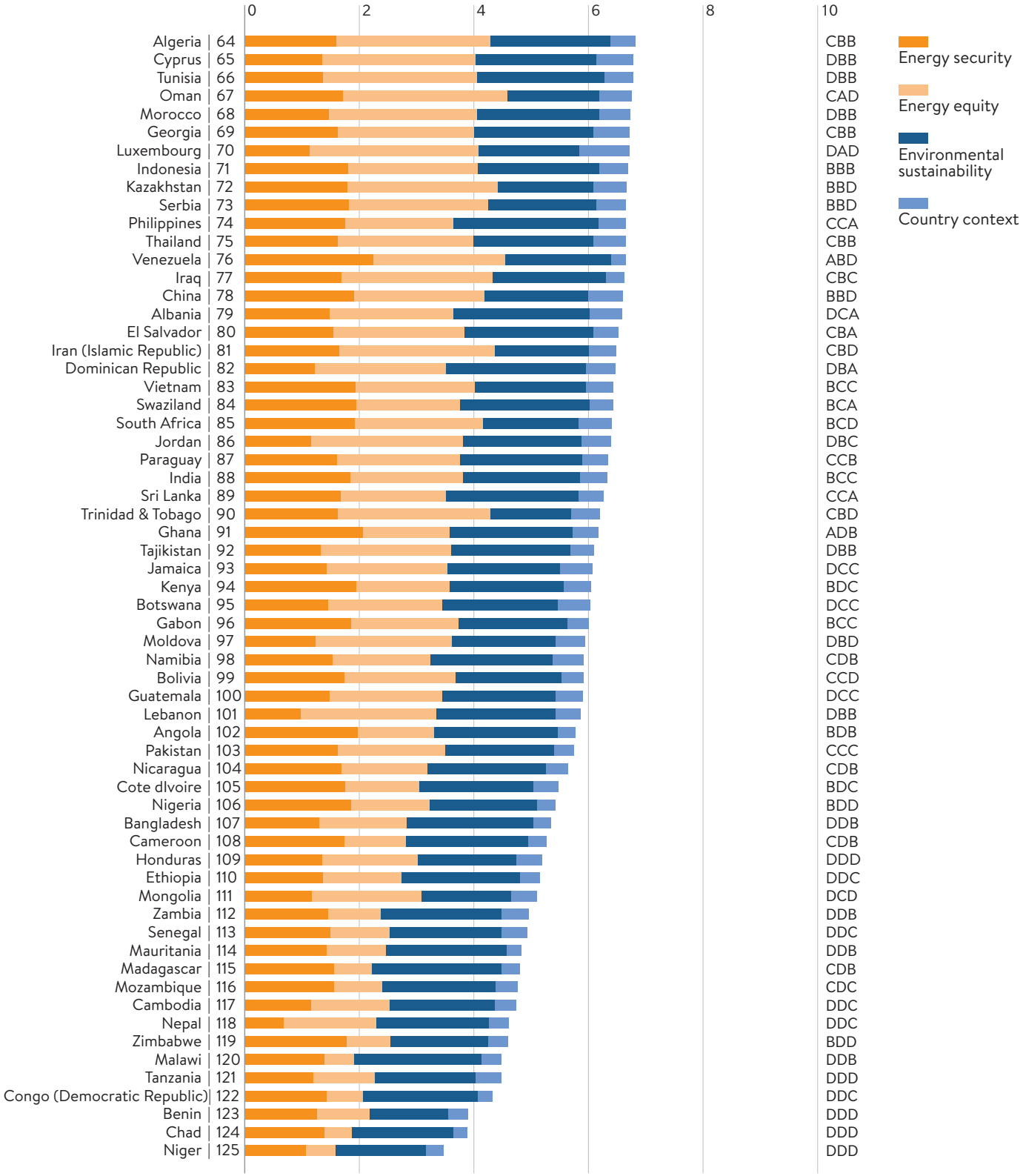
The biggest Trilemma improvers this year are all Middle East, Gulf States and North Africa countries (MEGS & NA), including Egypt, Israel, and Bahrain climbing by more than 10 points, with others also improving. This reflects a range of changes in a more stable and diverse electricity supply, certain sustainability policies starting to affect the energy system, an importantly, the affordability of electricity for the population helped by national subsidies. However, changing politics may see some of this effect reversed in future Trilemma iterations.

Figure 5 (pages 15-16) shows the overall performance and balance score of the 125 countries assessed in 2018.

1. For example, Venezuela's 9th place is influenced by having the world's highest proven oil reserves and being an oil exporter. However, the country suffers from interruptions in electricity supply. The Venezuelan electricity crisis has prompted the government to announce in the spring of 2018 a rationing scheme in several states, including the capital Caracas, cutting supply by four hours a day. This impact has not yet accumulated into the Trilemma Index via globally available data sources, and the current methodology does not fully account for electricity intermittence. Therefore, future interactions will see Venezuela's ranking decline in the Security dimension.

Figure 5: Global ranking and dimension breakdown




0
2
4
6
8
10
Algeria | 64 CBB
Cyprus | 65 DBB
Tunisia | 66 DBB
Oman | 67 CAD
Morocco | 68 DBB
Georgia | 69 CBB
Luxembourg | 70 DAD
Indonesia | 71 BBB
Kazakhstan | 72 BBD
Serbia | 73 BBD
Philippines | 74 CCA
Thailand | 75 CBB
Venezuela | 76 ABD
Iraq | 77 CBC
China | 78 BBD
Albania | 79 DCA
El Salvador | 80 CBA
Iran (Islamic Republic) | 81 CBD
Dominican Republic | 82 DBA
Vietnam | 83 BCC
Swaziland | 84 BCA
South Africa | 85 BCD
Jordan | 86 DBC
Paraguay | 87 CCB
India | 88 BCC
Sri Lanka | 89 CCA
Trinidad & Tobago | 90 CBD
Ghana | 91 ADB
Tajikistan | 92 DBB
Jamaica | 93 DCC
Kenya | 94 BDC
Botswana | 95 DCC
Gabon | 96 BCC
Moldova | 97 DBD
Namibia | 98 CDB
Bolivia | 99 CCD
Guatemala | 100 DCC
Lebanon | 101 DBB
Angola | 102 BDB
Pakistan | 103 CCC
Nicaragua | 104 CDB
Cote dIvoire | 105 BDC
Nigeria | 106 BDD
Bangladesh | 107 DDB
Cameroon | 108 CDB
Honduras | 109 DDD
Ethiopia | 110 DDC
Mongolia | 111 DCD
Zambia | 112 DDB
Senegal | 113 DDC
Mauritania | 114 DDB
Madagascar | 115 CDB
Mozambique | 116 CDC
Cambodia | 117 DDC
Nepal | 118 DDC
Zimbabwe | 119 BDD
Malawi | 120 DDB
Tanzania | 121 DDD
Congo (Democratic Republic) | 122 DDC
Benin | 123 DDD
Chad | 124 DDD
Niger | 125 DDD
Energy security
Energy equity
Environmental sustainability
Country context

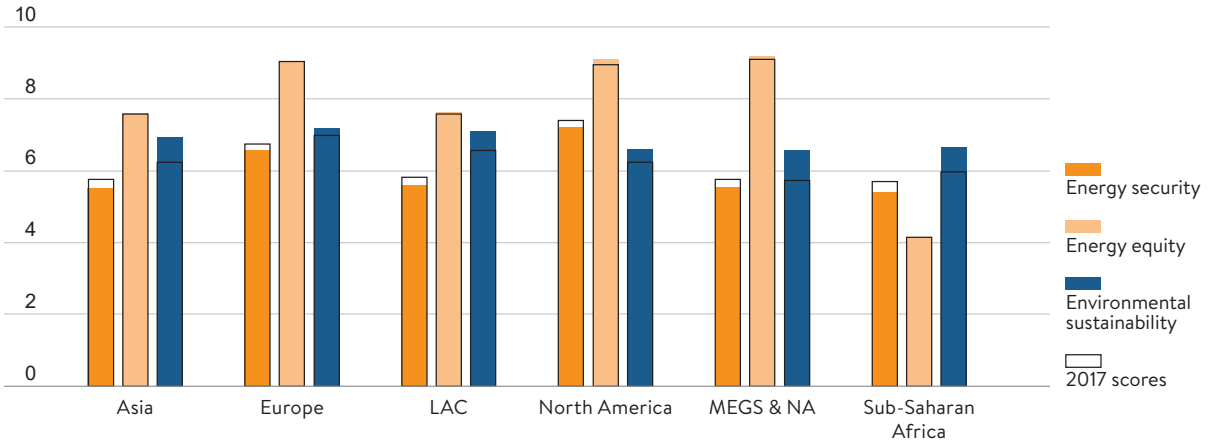
REGIONAL TRENDS

Analysing regional average Trilemma performance shows that not much has changed between 2017 and 2018, as demonstrated in Figure 6. However, there are some clear underlying trends.

Regionally, there is little change in the Energy Equity dimension; this is the result of a gradual global improvement in access, which is offset by more local issues with affordability. Some of the rise in consumer energy prices is connected with the cost of enhanced system flexibility, with some new technology costs passed on to the consumer.

A small drop in average regional Energy Security score is a pattern observed across all regions; this is a likely impact of systems in transition, as the growing flexibility of energy markets is characterised by some uncertainty in the short term. As policy focus continues to shift towards Environmental Sustainability through increasingly rapid decarbonisation, aspects of supply security can sometimes become less important, and grid reliability becomes more prone to system shocks whilst new energy sources take some time to bed in. As energy systems around the world adapt to include more decarbonised and decentralised generation methods, there is often no proper metric for the security of electricity supply. In a fossil-fueled world, security was ensured by the security of supply; today's energy security implies flexibility of a diversified grid, which is hard to measure and even harder to ensure. The fragmentation of the decentralised generation market means most governments no longer have centralised control over their security of supply.

Figure 6: Regional performance by dimension, 2017-2018



EVOLVING THE TRILEMMA FOR AN SDG FUTURE

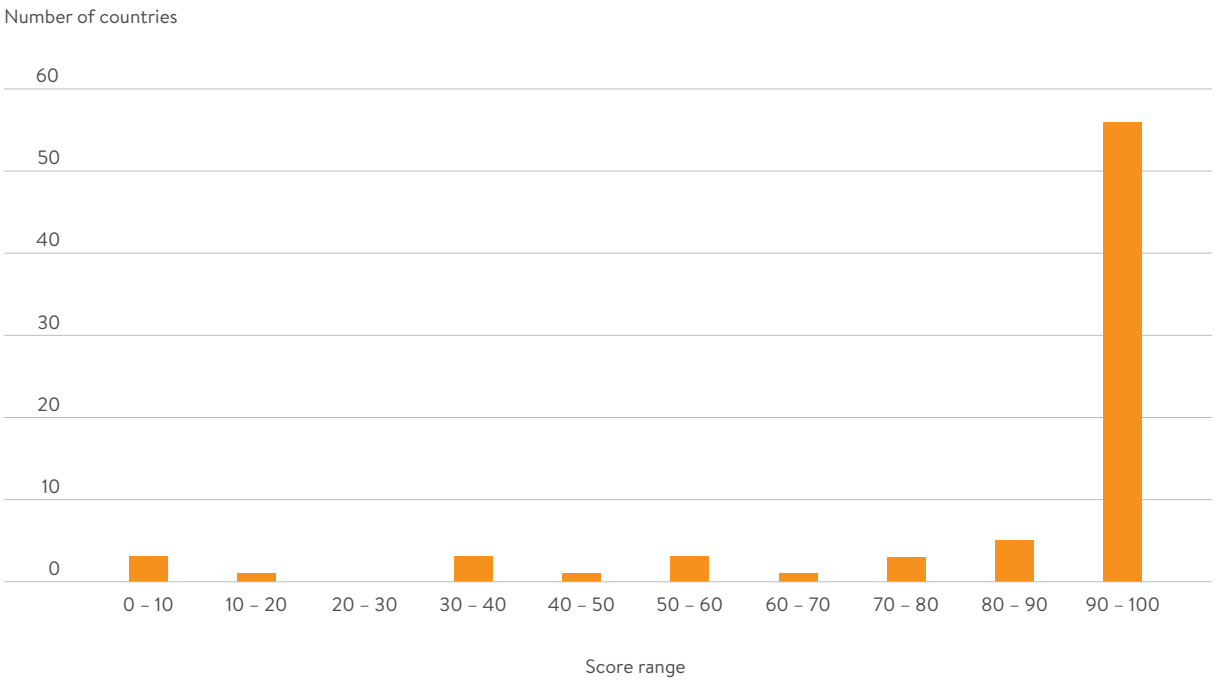
With the new realities of energy transition, analytical tools like the World Energy Trilemma need to adapt to present a more realistic picture of global energy systems in flux. At the same time, the United Nations Sustainable Development Goals, and specifically SDG7 "Affordable and Clean Energy", provide a coherent and accountable framework towards which countries can focus their efforts.

Whilst analysing the results of the 2018 Trilemma scores, the need to evolve the methodology to match new realities and UN SDG approaches becomes clear.

Flexibility of supply, rather than security of oil stocks, is the new desirable state for many governments; Trilemma weightings need to reflect the realities of decentralisation and flexibility.

Similarly, with the rapid uptake and growth of solar power, as well as other encouraging decarbonisation trends driven by SDG7, the Trilemma must strive to measure Environmental Sustainability as low emissions in a context of managed consumption and balance, rather than focus on low energy intensity. Currently, the Trilemma uses GHG emissions as a proxy for a more complex set of environmental impacts: splitting up the sub-indicators will create richer pictures of sustainable energy provision.

Figure 7: Distribution of countries scoring highly in Energy Access dimension



When it comes to Equity, Figure 7 demonstrates that most countries now score highly on access. This reflects the rapid improvement in basic energy access around the world, galvanised by SDG7

reporting frameworks. The story of energy access is a very positive one, and 2018 is a good juncture to consider directions for further improvement, beyond SDG7. There is a need to capture more nuanced data on energy access performance. As basic, low-level electricity access becomes more and more ubiquitous, driving the delivery of UN Sustainable Development Goals, it may be time to redefine top quality access as access to a specific level of power and duration of daily availability, which enables prosperous modern livelihoods and growing economies.

THE WATCHLIST

The relative stability of the Trilemma rankings over time shows that at a global scale, energy policy does not change much year on year, but there is evidence of annual incremental change. There are time lags in globally available energy data, meaning that annual snapshots are sometimes reflecting short term system shocks, rather than established trends. The Trilemma Watchlist addresses this through the use of longitudinal analysis to highlight illustrative examples of more significant changes within the dimensions over time. This approach is a pilot of the evolved Trilemma methodology, which for its 2019 iteration will focus more on longitudinal indexation, rather than year-on-year shifts.

PRIMARY ENERGY SUPPLY DIVERSITY

Primary energy supply diversity describes the flexibility of Total Primary Energy Supply (TPES), the balance of imported and produced primary energy and the change in exports and stocks. A diverse energy supply supports security through a sturdy and flexible supply mechanism, resilient to market shocks and natural disasters. An overreliance on one resource can make a system vulnerable to shocks in energy delivery. As such, it is an important metric used to determine a country's energy security and overall Energy Trilemma score.

An analysis of changes in diversity of energy supply over the last three years indicates that developed countries, with mature energy infrastructure, tend to show greater consistency year to year, with well-established supply systems. Changes to primary energy supply diversity scores tend to be minimal between years. In contrast, developing countries tend to see greater score changes between years[2], as delivery of critical infrastructure shifts the balance of smaller scale systems. This could indicate greater stability in the primary energy systems for developed countries, as compared to developing countries. However, many of these changes were small and fluctuating, and often an increase in 2017 is followed by a decrease in 2018, or vice versa. For primary energy supply diversity scores, only 48 out of 125 countries showed consistent downward or upward trends in TPES across three years, with only 15 reporting more than a 5% change. Often, changes to a country's primary energy diversity score were based on small changes to their primary energy supply mix.

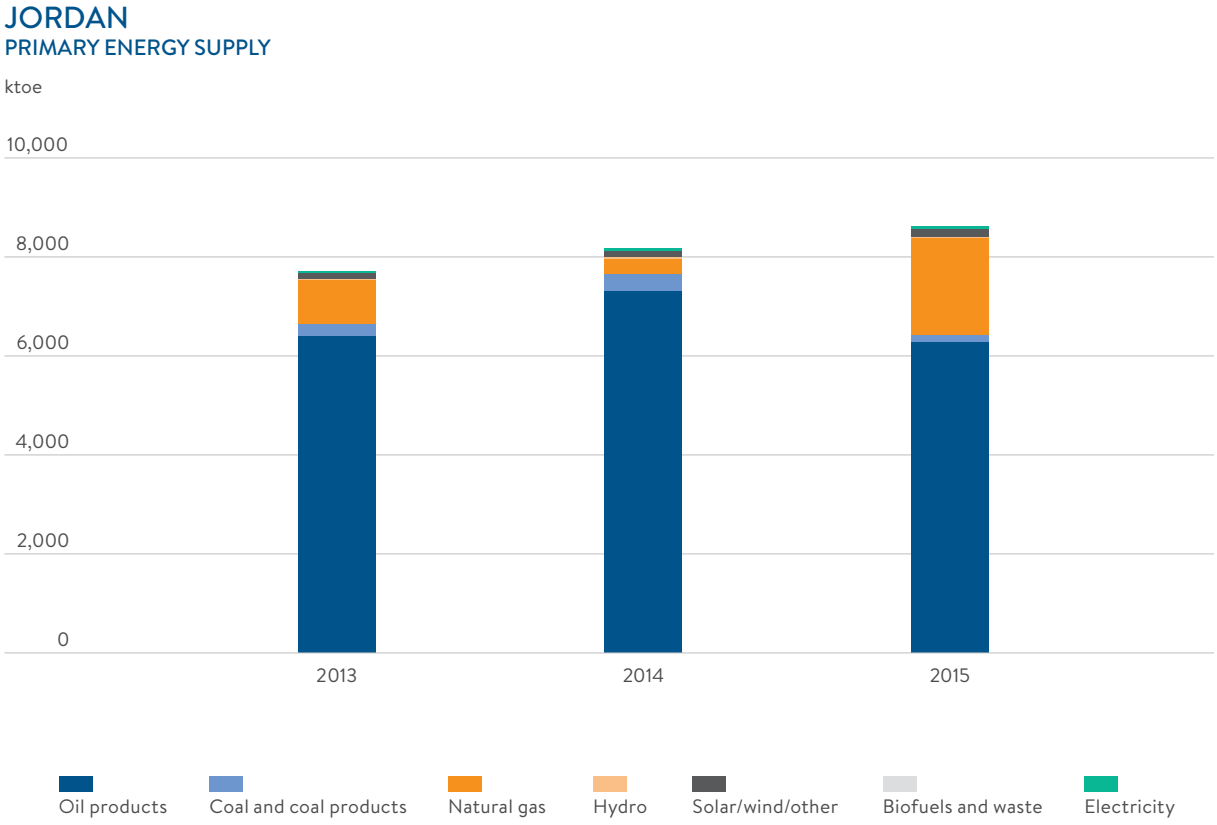
The data indicates that driving country-level changes in energy supply takes a number of years. Developing the necessary energy infrastructure at a country, regional, or local level, can require significant capital, effort, and lead time.

Nonetheless, shifts in primary energy supply are occurring and countries are taking actions to improve their TPES diversity Trilemma performance. For example, Figure 8 shows Jordan's primary energy supply score for the 2016-2018 Trilemmas (corresponding with 2013-2015 data). From 2016 to 2017 Trilemma Index, Jordan's energy diversity score decreased significantly due to an increase in oil product use and decrease in natural gas. In the following year, however, Jordan expanded its

2. Updated primary energy supply data was available for the 2018, 2017, and 2016 Energy Trilemma Index. The corresponding data used in each Index calculation was from 2015, 2014, and 2013, respectively.

natural gas programmes, resulting in a greater diversification of the portfolios. This increased use of natural gas (and decreased use of oil) drove an improvement in Jordan's score significantly and reflects the 2014 agreement by the National Electric Power Company of Jordan with Shell for significant amounts of natural gas through 2019[3].

Figure 8: Jordan Primary Energy Supply 2013-2015



ELECTRICITY GENERATION DIVERSITY

Diversification of domestic electricity generation is critical to resilience in the face of emerging risks, especially those related to extreme weather events and the energy-water-food nexus. Diversity of electricity generation, using natural gas, renewables, nuclear and hydropower, can help mitigate the risk of black-outs due to factors affecting energy supply, provide stability to the grid, and decrease dependence on the supply of particular fuels. In addition, generation diversity can be an indicator of transition towards low carbon electricity generation and GHG emission reduction efforts.

A sub-indicator of energy security, electricity diversity is captured in the Trilemma through raw electricity generation data by source[4]. Over the course of the last 5 years' indicator rankings, many countries showed a significant change in score – both year-on-year and longitudinally in the period between 2014 and 2018.

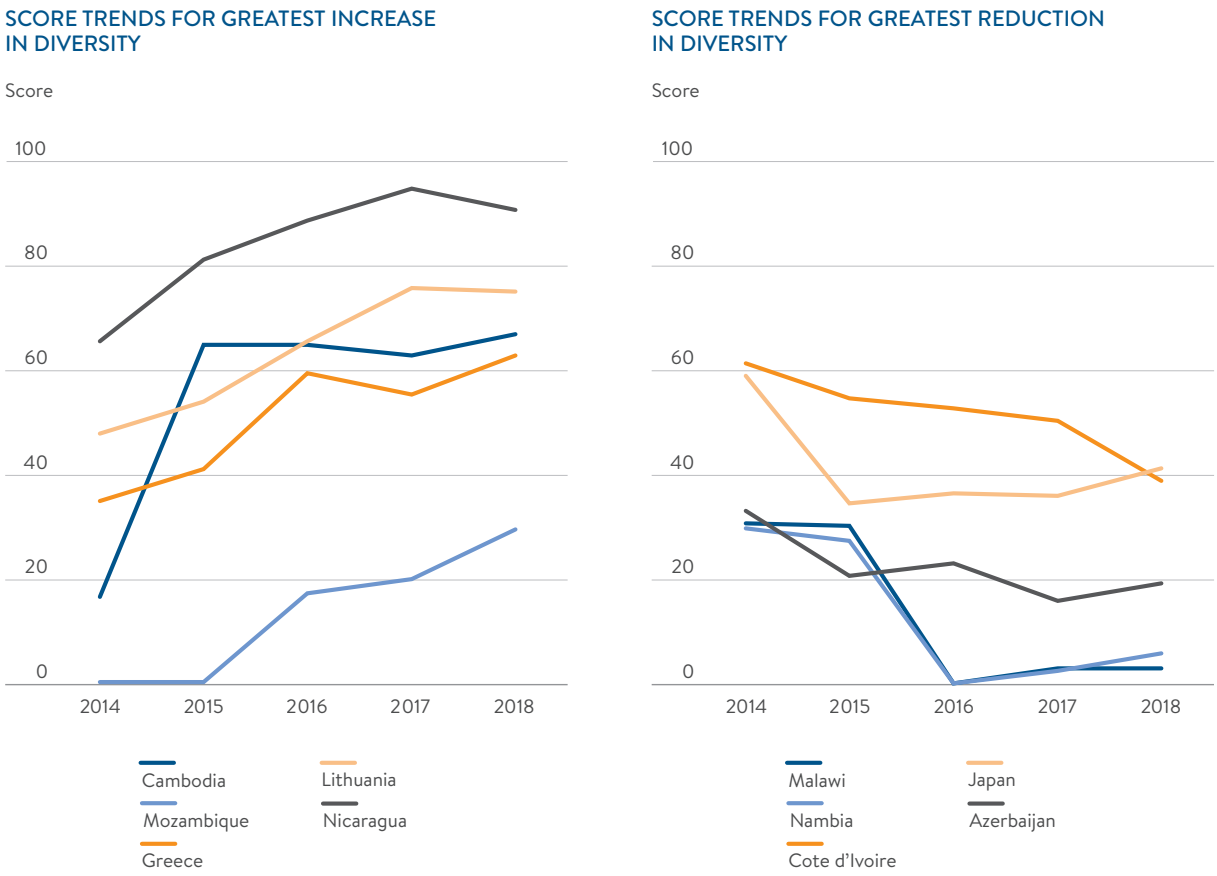
3. http://www.jordantimes.com/news/local/93-cent-jordan%E2%80%99s-electricity-generated-natural-ga

4. There is a roughly 3 year time lag in data e.g., the 2018 Trilemma Index results are based on 2015 electricity generation data, which is the latest globally available data set

Figure 9 shows electricity diversity scores for those countries with the highest 2014-2018 increase and decrease in score. This graphic shows that oftentimes countries can have one dramatic score shift between years, which influences their performance on that indicator over time.

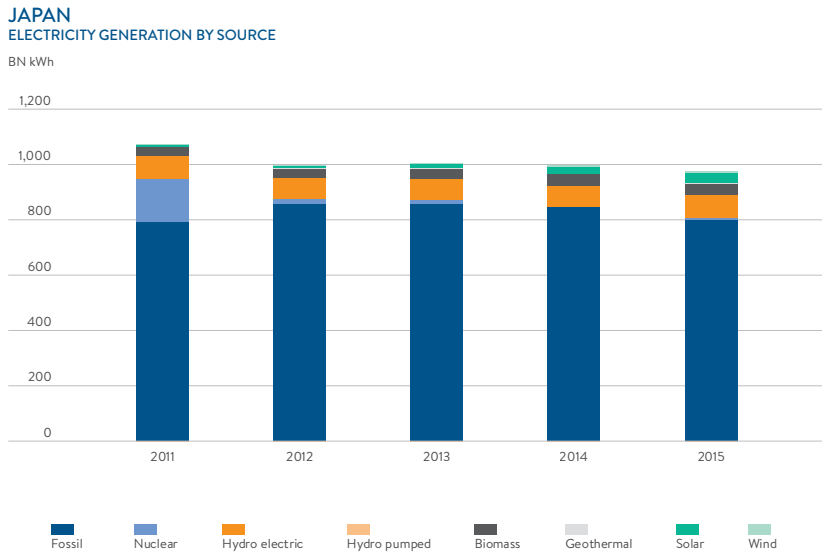
Examining the raw electricity production data behind the trends in electricity diversity highlight various factors that can impact a country's Trilemma performance. Maintaining balance is a constant challenge in the face of a wide range of external events and environmental factors that impact the supply and demand of electricity.

Figure 9: Trilemma Index electricity diversity score trends



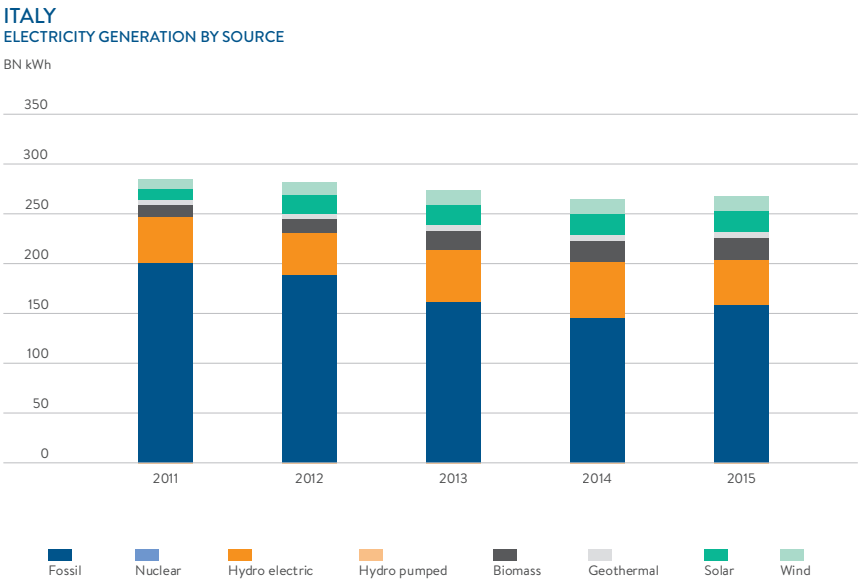
For example, Japan's large decrease in diversity performance from 2014 – 2015 corresponds with the impacts of the 2011 Great East Japanese Earthquake and subsequent tsunami affecting the country's ability to use nuclear power. Figure 10 shows the decrease in nuclear energy production in Japan starting in 2012, which has remained almost negligible subsequently. In recent years, however, Japan has increased its use of renewables – diversifying its portfolio and resulting in a slight improvement in electricity diversity performance, particularly between the 2017 and 2018 Index.

Figure 10: Japan Electricity Generation 2011-2015



In another example, Italy saw a significant increase in diversification of electricity from 2011 to 2013, and thus a jump in score and ranking for electricity diversity corresponding to those years. Correspondingly, the highest average increase in installed renewable capacity in Italy occurred in 2011 and 2012[5]. With this new installed capacity and effort on Italy's part, its Trilemma Index ranking reflected this wider diversification as renewables were added to the Italian grid.

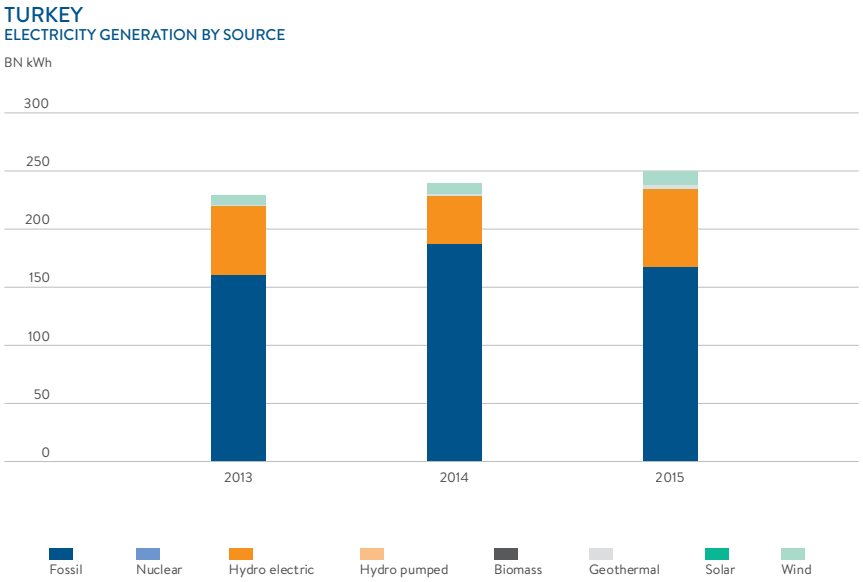
Figure 11: Italy Electricity generation 2011-2015



5. http://www.eniscuola.net/wp-content/uploads/2017/10/pdf_renewable_energy_Italy_2017.pdf

A drought caused Turkey's hydropower production to fall in 2014. As a result, the increased use of fossil fuels in the electric grid was captured by a subsequent decline in electricity diversification score.

Figure 12: Turkey Electricity Generation 2013-2015



Looking forward, the global increases in renewable energy are expected to have a greater impact and will be captured in the Energy Trilemma performance – both in terms of Energy Security and Environmental Sustainability. For example, in 2017, China and the US together accounted for half of the increase in renewables-based electricity generation[6]. In 2017, US had 18% of its electricity generated from renewable sources[7]. While the time lag of the Trilemma model has not captured this effect yet, forthcoming Index may reflect this trend of shifting to renewables. This is particularly relevant as countries look to further diversify their portfolios – an action in line with many countries' resolutions from the 2015 COP21 Paris Agreement and other efforts to curb global climate change.

Currently, the electricity diversity indicator only drives a country's Energy Security Trilemma score. In the future, the amount of electricity generated from renewables in relation to total electricity generation will also be reflected in the Environmental Sustainability score.

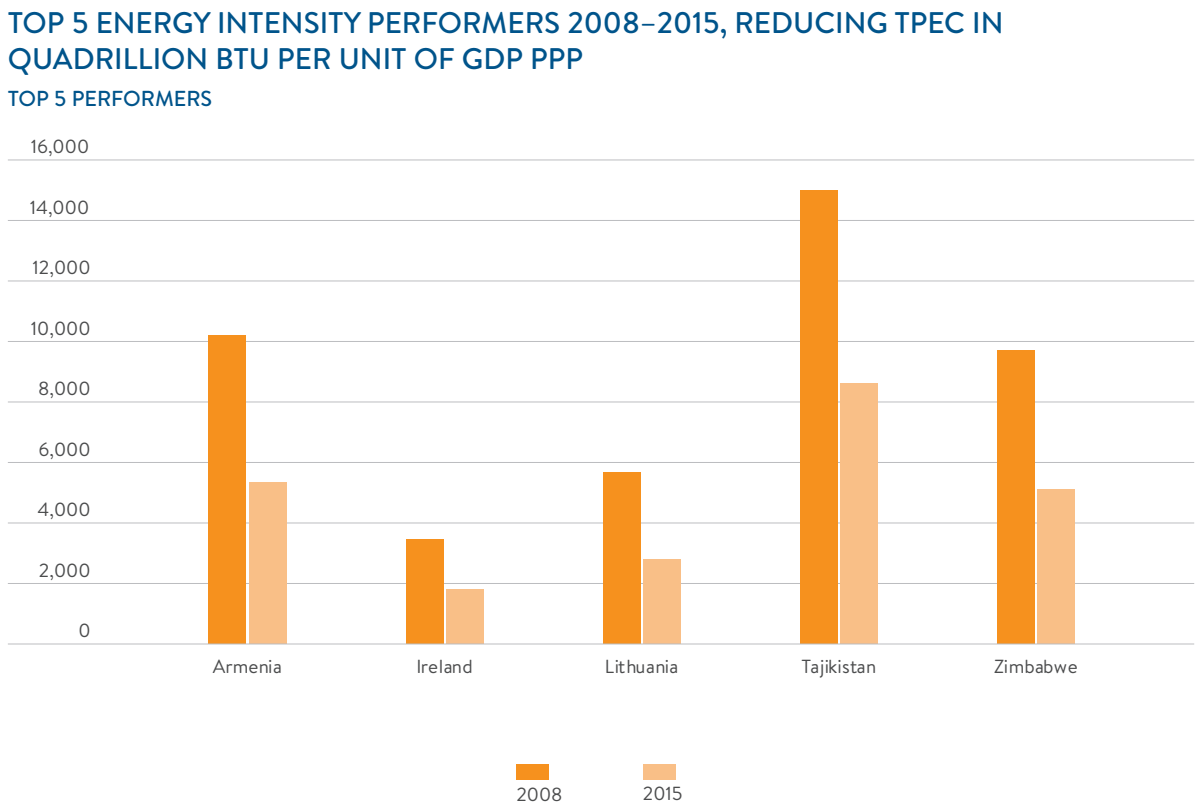
ENERGY CONSUMPTION AND ENERGY INTENSITY

One of the key indicators of energy security is the relationship between energy consumption and economic growth. A country's ability to cope with energy demand changes over time is represented by Total Primary Energy Consumption (TPEC) as a function of GDP. Reducing energy intensity, by generating more units GDP per unit of energy consumed, indicates a transition towards a more efficient and sustainable energy system. The goal is to decouple economic growth from energy demand, so that development and prosperity are not restricted by the energy agenda, but enabled by it.

6. http://www.iea.org/geco/renewables/

7. http://fortune.com/2018/02/18/renewable-energy-us-power-mix/

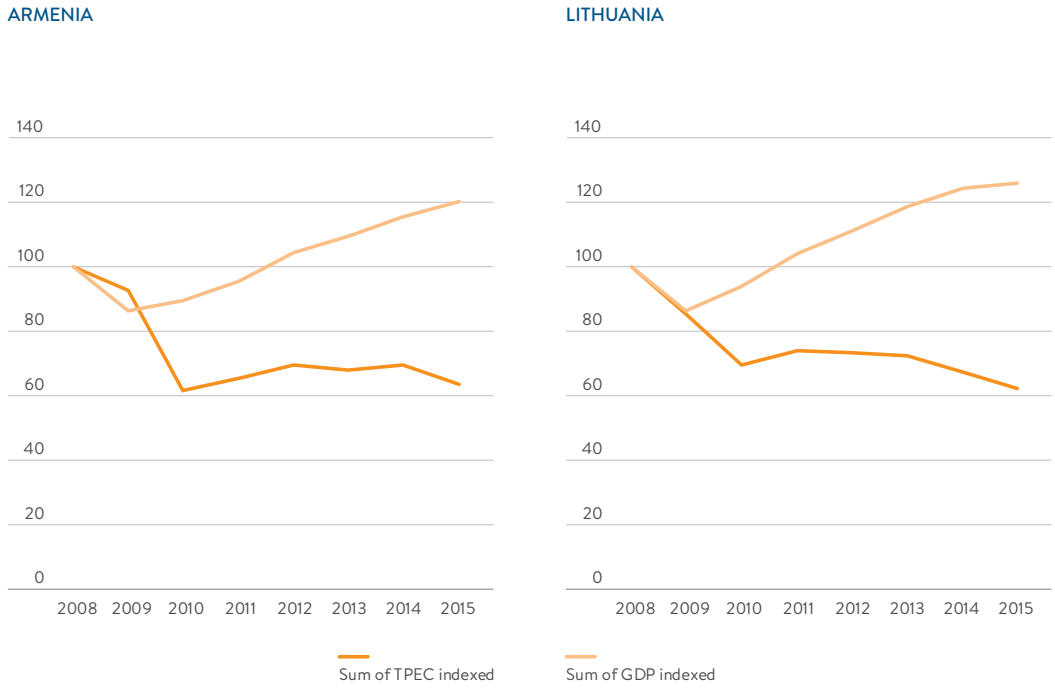
Figure 13: Top five energy intensity performers



Energy consumption in relation to GDP growth is one of the six sub-indicators of security in the Trilemma Index. The performance of these leading countries in consumption intensity in the Security dimension is varied: Armenia, Ireland, and Lithuania have ascended in the last three Trilemma rankings 58, 66, and 46 respectively in Security this year. Tajikistan and Zimbabwe have gone down the rankings. This is explained by trends in the five sub-indicators of the Security dimension and the relative sum performance of other countries. In terms of absolute score, all of these countries have improved their energy security score by between two and five points.

By indexing the change in both TPEC and GDP from 2008, the effect of decoupling and reducing energy intensity can be clearly seen. The sustained rate of indexed GDP growth represents a stable and growing economy. A downward trend in TPEC in this context represents managed energy demand and improved energy efficiency. These shapes of sustainable transition are evident in the indexed graphs for Lithuania and Armenia in Figure 14.

Figure 14: Decoupling energy consumption and a growing economy



Lithuania has seen a reduction in TPEC in the context of modest economic growth due to a policy of diversifying and securing a stable natural gas supply, partly replacing other fossil fuels. Efficiencies are also achieved through the synchronisation of Estonia's and Lithuania's electricity system, which addresses losses and inefficiencies in transmission. Lithuania also supports and encourages domestic power generation through the use of renewable solar and biomass sources, aiming for 20% of energy consumers to become energy producers by 2030.

In a similar range of policies, Armenia is improving energy and electricity supply links with neighbouring countries, including Iran and Georgia. By transitioning large parts of the energy system to solar power generation, with four PV power plants already installed, and a 50 MW facility planned, Armenia is reducing TPEC from fossil fuel sources.

The examples of successful decoupling of energy consumption from economic growth suggest possible best practice pathways for other countries may include linking up energy supply systems, harmonising grids for efficiencies at scale, and progressing with decarbonisation of energy generation.

ELECTRICITY ACCESS

Electricity access is a key element of the Energy Equity Trilemma dimension, and an important part of UN Sustainable Development Goal 7. Increasing electricity access has direct benefits of prosperity and development, encouraging the growth in all sectors of the economy and society. Improved access also promotes investment from within and outside of the country. An indirect advantage of increasing electricity access is the longer term improvement in affordability, as

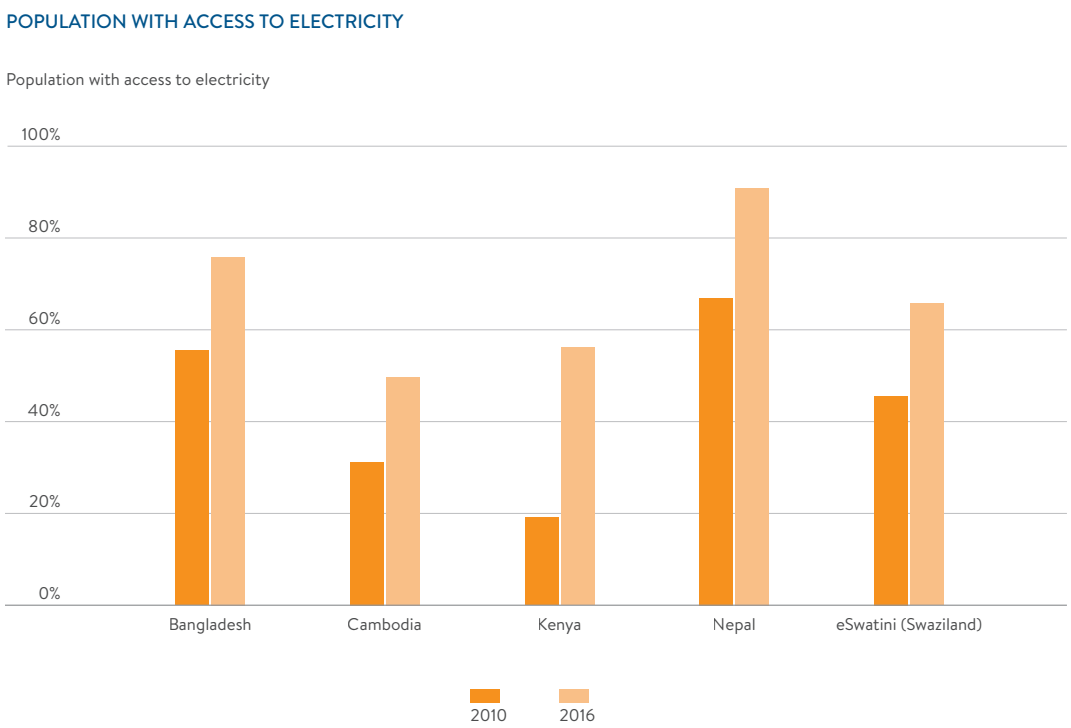
interconnected grids and established infrastructure make electricity delivery more cost effective for the supplier and thus cheaper for end-users.

With direct links to sustainable development, electricity access has improved healthcare provision, reduced death rates and driven up life expectancy. Improved living conditions result as electricity and gas replaces biomass for heating homes ad cooking, reducing the deaths and illness attributed to burning solid fuels as well as fatalities from household fires.

Increased electricity access also provides the opportunity to electrify the public transport network, which would also reduce carbon emissions and pollution in major cities.

Five countries have significantly improved their electricity access performance over the last four years, significantly improving their Energy Equity scores: Bangladesh, Cambodia, Kenya, Nepal, Kingdom of eSwatini (Swaziland). This is reflected by their Trilemma performance, with all five countries climbing between five and 13 ranks in the period. Each country has used different approaches to achieve this increase in electricity access, encompassing micro-hydro, targeted rural access, and microgrid solutions.

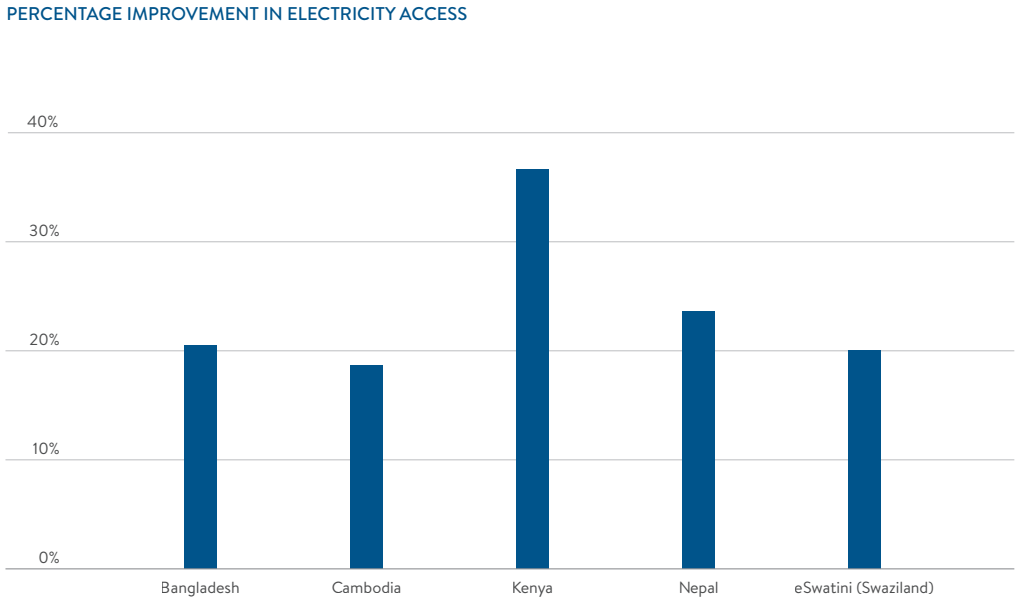
Figure 15: Access to electricity 2010 - 2016



For developing countries as a whole, we observe a set of similar electrification trends. For example, the widespread growth of mini-grids is well documented in countries like India and China. With appropriate planning (including consistent technical standards and protocols, and regulatory alignment for grid interconnection), mini-grids can be integrated into larger networks, achieving leaps in electricity access.

On a systems level, developing countries striving to grow electricity access succeed when they prioritise early adoption of new energy technologies, diversify the power generation mix, strengthen grid flexibility and upgrade monitoring and control capabilities, adopt system-wide approaches to electricity markets, including energy-efficiency practices and demand-side management.

Figure 16: Change in electricity access 2010 - 2016



Within their region Bangladesh and Nepal had the lowest rates of access to electricity, while countries like Bhutan attained 100% electrification in 2016 and Afghanistan exceeded 84% in the same year, despite its unstable political environment. However, reports indicate that Nepal is on track to achieving 100% electrification by 2030[8], and the rapid improvement in Trilemma score for electricity access is testament to this trend.

Bangladesh

With a population of 164 million, electricity access is a key issue in Bangladesh and government efforts to address this are well reflected in the longitudinal Trilemma trends. Bangladesh has increased its electricity access score by just over 10 points from 73 in 2014 to 84 in 2018. This is due to its increase in electricity access from 55% to 76% in the same time period[9]. This has resulted in Bangladesh increasing its overall ranking from 112 to 107.

Bangladesh's increased electricity access is largely due to the use of micro and mini solar systems. The delivery vehicle is the Second Rural Electrification and Renewable Energy Development Project[10] (World Bank and Bangladesh Government). The project started in 2012 and when completed will cost US$ 386 million. The project has built 10 solar mini-grids (20 more are still to

8. https://unctad.org/en/PublicationsLibrary/ldcr2017_en.pdf

9. https://data.worldbank.org/indicator/eg.elc.accs.zs

10. http://projects.worldbank.org/P131263/rural-electrification-renewable-energy-development-ii-rered-ii-project?lang=en

be built) in remote areas, including islands, to provide grid-quality electricity. These solar mini-grids will provide 28,000 connections to households and businesses, including small and medium-sized enterprises. The projects also aim to reduce air pollution which causes 107,000 deaths per year, mostly women and children. Traditional cookstoves used in rural areas are a major contributor to this.

Bangladesh has also received support from the Asian Development Bank in the form of loans for projects totaling US$ 800 million to establish grid connections with India and improve power systems efficiency[11].

The political context for a rapidly electrifying Bangladesh is a Pro-Poor Public Private Partnership arrangement, allowing the private sector suppliers of solar technologies to take up a significant role in the development of sustainable systems in areas that were not expected to have grid extensions soon.

Bangladesh's successful off-grid programme is also largely based on the availability of financing for the infrastructure as well as micro-finance loans for customer connections. The World Bank together with other development partners have played a significant role. Between the years 2000 and 2016, 32% of the World Bank's solar home system (SHS) funding has been dispersed to Bangladesh. One of the biggest achievements from the SHS programme is the provision of lighting for students, which has supported the country's effort towards higher literacy rates

Nepal

Out of the five countries, Nepal is the closest to reaching 100% electricity access with nearly 91% access in this year's Trilemma Index. Nepal has seen a 24% increase (from 67%), which has improved its overall ranking by 5 places.

As Nepal pushes for 100% electricity access, several schemes have been implemented. As part of the country is located within the Himalaya Mountains, Nepal has utilised its hydro renewable energy resource since the early 1960s, with the projects slowly increasing in number and capacity to become a major source of off-grid electricity in rural Nepal. In the early 2000s, with the long-term financial support of large institutional donors, the government initiated the Micro-Hydro Village Electrification (MHVE) programme[12]. By 2014, more than 1,000 micro-hydro programmes with the total generation capacity of 22 MW had been developed, providing off-grid electricity access to 20% of the population[13]. The income of communities with micro-hydro units increased by 11%, and the women and children from these communities suffered less from respiratory problems and disease, once again demonstrating the economic and social enabling capacity of cleaner and more sustainable energy systems. These micro-hydro units displace nearly 10 million kilograms of carbon dioxide each year.

11. https://www.adb.org/sites/default/files/publication/30185/bangladesh-increasing-access-energy.pdf
12. http://energy-access.gnesd.org/projects/15-micro-hydro-village-electrification-in-nepal.html
13. http://www.worldbank.org/en/news/feature/2015/09/26/ensuring-sustainable-rural-electrification-in-nepal

One of the models used in South Asia includes a Pro-Poor Public Private Partnership arrangement, where the risks regarding the social responsibility and public interests of the people are managed by the government, civil societies or NGOs and the capital, technology and managerial capacity from the private sector. The Micro-Hydro Village Electrification (MHVE) is part of a larger national Power Development Project in Nepal to improve access to (rural) electricity services (a non-grid connected element) and to promote private participation in the overall power sector, improve efficiency, and to mobilise financing.

In 2017 Nepal was ranked as one of the top four recipient countries of private participation in electricity after Laos, Bangladesh and Uganda with some significant investments from neighbouring China[14].

Kenya

Kenya has seen the largest increase in electricity access (37%) in the last four Trilemma rankings. It went from 19% to 56% which helped it to increase both its electricity access score (15 to 70) and ranking (124 to 108). This has enabled Kenya to improve its overall ranking by 13 places from 107 to 94.

Kenya is implementing a US$ 1.39 billion Electricity Expansion Project[15] which includes a series of sub-projects aimed at increasing the capacity, efficiency, and quality of electricity supply and expanding electricity access in urban, peri-urban and rural areas.

700,000 home solar systems were installed[16] on the pay-as-you-go purchase model, which is a flexible payment plan that makes electricity accessible to more people. Pay-as-you-go models have become increasingly attractive in many markets, expanding rapidly across Africa. One of the biggest advantages of this system is that people can pay in instalments, providing more flexibility where economic circumstances may vary.

Kenya is also harnessing geothermal power, which in 2015 meet 26% (593 MW) of the country's electric generation needs. Geothermal power diversifies Kenya's energy mix, which has resulted in an increase in electricity access, especially in remote rural areas. The use of geothermal has also increased the countries energy security as it reduces their energy import dependency.

One of the critical success factors for enhancing access to energy services is affordability; to address consumer financial barriers, the Kenyan government is implementing a programme called the Last Mile Connectivity Programme which reduces the upfront connection fee through subsidies from US$ 150 to US$ 50 for domestic customers living in rural and peri-urban centers. The retail price per unit has also been revised down by between 36-82% on a graduated scale with target beneficiaries being consumers who do not exceed a monthly consumption of 10 kWh.

14. http://unctad.org/en/PublicationChapters/ldcr2017_ch5_en.pdf
15. http://projects.worldbank.org/P103037/electricity-expansion?lang=en
16. https://www.lightingafrica.org/country/kenya/

The government has also implemented its Rural Electrification Programme where schools and community health facilities in rural arears were equipped with solar home systems. To further enhance accessibility, the government of Kenya has signed a US$ 150 million debt facility with the World Bank for implementation of their Kenya Off-Grid Solar Access project[17] (KOSAP) which will provide decentralised electricity systems to the remaining off-grid sparsely populated remote households.

All five countries have made advances to improve their electricity access, but it is important to note that quality and sustained electricity access is the main goal. Having basic access to electricity is a good start but as a country develops, basic access will become counterproductive and hinder economic growth and development. A good example of where quality electricity access has been introduced on a large scale is Kenya. With the Electricity Expansion Project, Kenya has been able to construct stable and reliable energy infrastructure, enabling high increases in quality and sustained electricity access.

17. http://projects.worldbank.org/P160009?lang=en

BALANCED TRANSITION PATHWAYS

Analysis of energy system performance using the Trilemma dimensions implies that the best systems are balanced between policy priorities and market drivers. Maintaining balance is complex, raising the question: what does a balanced Trilemma look like for any country?

To support such analysis, the Index report provides data to generate country peer group comparisons based on region and economic context. For the deeper Index analysis, countries were organised into four economic groups:

Group I: GDP per capita greater than US$ 33,500

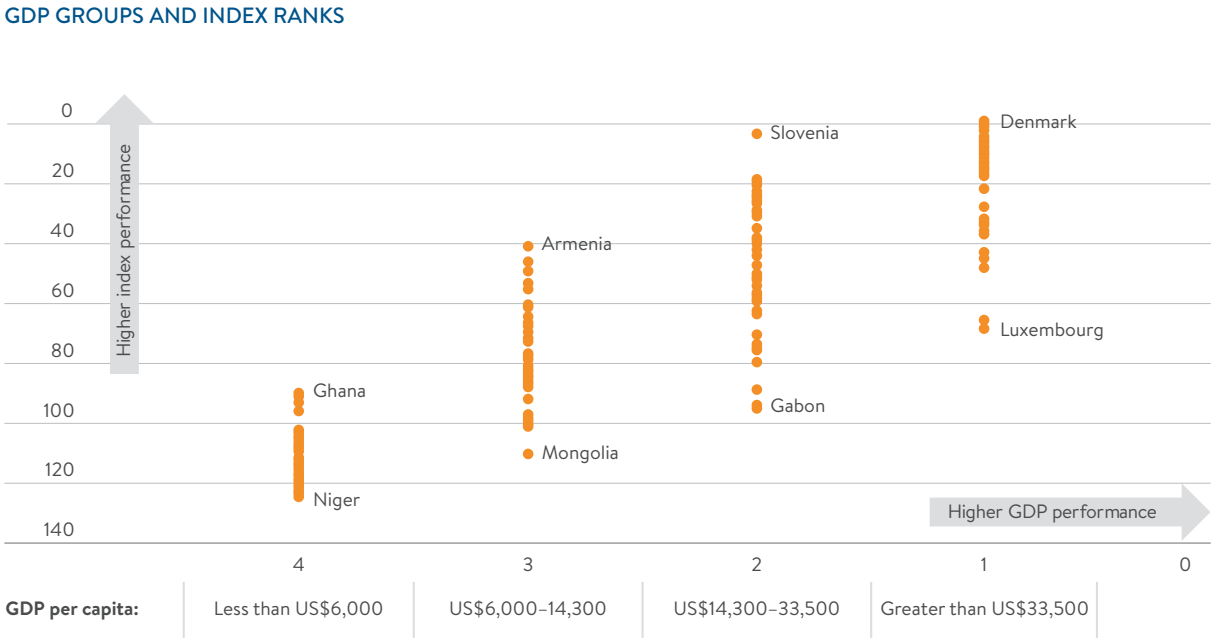
Group II: GDP per capita between US$ 14,300 and US$ 33,500

Group III: GDP per capita between US$ 6,000 and US$ 14,300

Group IV: GDP per capita lower than US$ 6,000.

There are clear trends in the distribution of Trilemma ranks by GDP group, as demonstrated in Figure 17. There is a correlation in favor of high GDP per capita: the top 10 are likely to be a group of developed countries. Strong economies with the ability to invest, as well as the wealth of the population, are strongly correlated with managing balanced systems. Higher levels of income and development represent better conditions for investment in energy infrastructure, either by incorporating innovations, diversifying energy supply or reducing pollutant emissions.

Figure 17: Index ranking by GDP group



Slovenia has made significant improvement in its Energy Trilemma positioning compared to previous years, moving to 6th place in 2018 from 12th in 2016. As one of the relatively new Member States of the European Union (joined in 2004), Slovenia has achieved significant success in terms of its economic and social development in the last twenty years. Along with other Western Balkan countries and parts of the former Yugoslavia, Slovenia has experienced the triple transition: from drastic political changes to stability, from central planning to free-market / market-based economies, and from a more inward-facing socialism to one of more externally-facing interactions with Europe. This success, which is combined with valuable changes in the energy sector, and economic transition have facilitated Slovenia's accession to the EU and membership of the OECD in 2010. Its overall development has taken place at an accelerated pace (comparing to other countries of the region) as its total GDP had increased by 14% between 2008 and 2017, while GDP per capita reached about 70% of the EU-28 value. The EU accession signalled the full adoption of its policies and targets, where the country has made considerable steps in the fields of energy and climate change - for example the share of renewables in TFEC (total final energy consumption) was 21% in 2016.

According to the Energy Trilemma ranking, security of energy supply is Slovenia's strongest dimension. A diversified power mix, competitive and fully developed wholesale and retail electricity and gas markets, an energy import dependency lower than the EU average and ongoing development of energy infrastructure are the main factors for Slovenia's positioning. Wider international cooperation further helps Slovenia navigate the energy transition. For example, Slovenia recently introduced market coupling for a day ahead with Austria and implemented cross-border intraday implicit allocation with Italy in the electricity sector. Considerable investments have been realised and over € 300 million in investments are planned to support energy efficiency in public and residential buildings, renewables and smart distribution systems, on the path towards a low carbon economy. With regard to rising concerns of energy poverty, Slovenia performs well, with 5% of the population faced with the inability to keep homes adequately warm, compared to an EU average of 11% (2016 data) . Additionally, the existing legal and regulatory framework addresses challenges related to the protection rights of electricity and gas consumers through the Energy Act.

The example of Slovenia demonstrates how strong policies, advanced interconnections, and a focus on diversity can result in higher Trilemma performance than group GDP. The consolidate effort to improve energy policy and system performance has wider positive implications for prosperity and sustainable development.

THE INFLUENCE OF GDP ON TRILEMMA PERFORMANCE

INCREASING GDP

1

GDP PER CAPITA GREATER THAN US$33,500

- Includes all top 10 Index performers, except Slovenia
- Index ranks in this group range from 1 to 70 with median rank of 17
- Lower index ranked countries in this group include "fossil fuelled" countries such as UAE (36), Qatar (39), and Oman (67)

2

GDP PER CAPITA US$14,300–33,500

- Index ranks in this group range from 6 to 96 with median rank of 49
- Geographically diverse group and diverse energy resource profiles
- Includes a number of emerging economies, including 3 Sub-Saharan African, including Botswana (95) and Gabon (96) and 4 Asian countries including Malaysia (37), Kazakhstan (72) and Thailand (75)

3

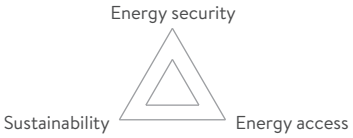
GDP PER CAPITA US$6,000–14,300

- Index ranks in this group range from 43 to 111 with median rank of 80
- Includes countries from all regions except North America
- Includes rapidly growing economies such as China (78), Vietnam (83) and India (88) that are taking actions to increase diversity of energy generation while trying to meet rising energy demand

4

GDP PER CAPITA LESS THAN US$6,000

- Index ranks in this group range from 91 to 125 with median rank of 112.5
- Members are predominantly countries from Sub-Saharan Africa region
- Includes countries with some of the lowest energy access rates in the world



Note: Trilemma triangles represent average scores for countries within each GDP group

COMMENTARY ON INDICATOR SENSITIVITY

A sensitivity analysis was performed to understand how changes in countries' performance on specific indicators can impact the overall Trilemma balance. The analysis focused on the sensitivity of the Energy Equity scores and ranking to four indicators: access to electricity, access to clean cooking, electricity prices, and gasoline and diesel prices. These four indicators were chosen due to their characteristics.

Access to electricity and access to clean cooking rankings are characterised by skewed distributions, as many countries already have 100% access to electricity and to clean cooking. A similar distribution is found for electricity prices. Minor changes in these three indicators might thus result in large changes in the country ranking. Electricity price values are uncertain as a consequence of the limited coverage (41%) of the electricity prices household sub-indicator.

The sensitivity analysis was performed by generating twenty alternative scenarios for each indicator. Each scenario is created by applying random changes to the data underlying one indicator, while keeping all the other quantities unchanged. This approach allows to ascertain the effects of small changes in underlying data on the indicator, as well as on the overall scores and ranking.

Changes in individual indicators were found to not have a large effect on the overall Trilemma Index ranking, which is based on a weighted average of 35 indicators across four dimensions. Likewise, the country ranking for individual dimensions was not found to change substantially across the scenarios. However, the sensitivity analysis showed that when most values of one indicator fall on the high end of the range, small changes can have a large effect on the indicator ranking. As an example, the 2016 access to electricity rate in Mauritius is 98.8% (87th position in that indicator ranking), while many countries have a rate equal to 100% and occupy the first position. The electricity access ranking of Mauritius varies by 88 positions when randomly changing the 2016 access to electricity rate within 5%, with the country reaching the top performers in some of the scenarios. Although this drastic change is not reflected by variations in the Energy Equity ranking, by bridging a small gap with the top performers Mauritius could thus substantially advance in the ranking. Other countries with an access to electricity rate close to 100%, such as Algeria, Colombia, and Pakistan, have the same opportunity.

Although in most cases a country's performance is not significantly affected by changes in individual indicators, the electricity price indicator was found to have the greatest impact on the Energy Equity ranking. This is related to the uncertainty introduced by the large amount of missing data on electricity prices, causing higher variability of electricity price indicator across scenarios and a more pronounced effect on the Energy Equity scores. However, results indicate that missing data do not have a significant impact on the Trilemma scores and the overall country ranking.

Additionally, exchange rate fluctuations may affect the relative position countries in the Equity and Security rankings regardless of any actual changes to their systems: with price data reported in US$, the results also reflect the fluctuating performance of economies and wider commodity prices.

These results show that a thorough understanding of the meaning of each indicator and of the limitations on data availability is required to interpret countries' performance across the dimensions.

THE ENERGY TRANSITION TODAY: ISSUES AND UNCERTAINTIES

The World Energy Issues Monitor is one of five Energy Transition tools provided by the Council. It is a unique instrument which identifies the energy context of specific countries through an analysis of 42 issues affecting the energy system. It provides essential insights that for 10 years have been assisting energy leaders in understanding the complex and uncertain environment in which they must operate and has helped to challenge assumptions on the key drivers within the energy landscape.

An overlay of the Trilemma performance of countries and the findings of the Energy Issues Monitor at the regional and country level can help highlight how the key priorities and uncertainties of energy leaders are conditioned by the status of their energy system.

Countries with a high performance in the Equity dimension are usually more focused on energy subsidies and electricity prices and less concerned about energy access, which has already been solved by the top performers. In contrast, energy access issues are perceived with much higher importance and need for action in countries with a lower Equity score. This contrast is illustrated by comparing Issues Monitor maps for Germany and India, (see figure 18, page 37).

Likewise, a high performance in the Security dimension leads to a similar level of uncertainty and impact attributed to cyber threats, economic growth, digitalisation, market design, weather risks, and talent, indicating growing attention towards these issues. Low energy security has led instead to a dedicated focus on the urgent issue of economic growth to enable improved security, and to a reduced priority towards other issues in this dimension. This can be observed when considering the issues maps for France and Turkey (see figure 19, page 38).

Finally, a high Sustainability performance aligns with low uncertainty regarding most sustainability issues and a consistent perception that there is a need for action to address the challenges and opportunities around renewable energies, energy efficiency and climate framework. A lower performance in this dimension adds a degree of uncertainty to these issues although they continue to be perceived with high importance. Italy's and China's issues maps provide an illustration of this (see figure 20, page 39).

Noting the focus of attention of energy leaders towards energy equity, security and sustainability is a powerful way to understand the characteristics of different stages of the energy transition. Most importantly, it provides energy leaders and practitioners with the information and tools to prepare for emerging issues to be addressed and changes of priorities that accompany countries' evolution in the context of energy transition.

Figure 18: Energy Equity issues comparison: Germany and India

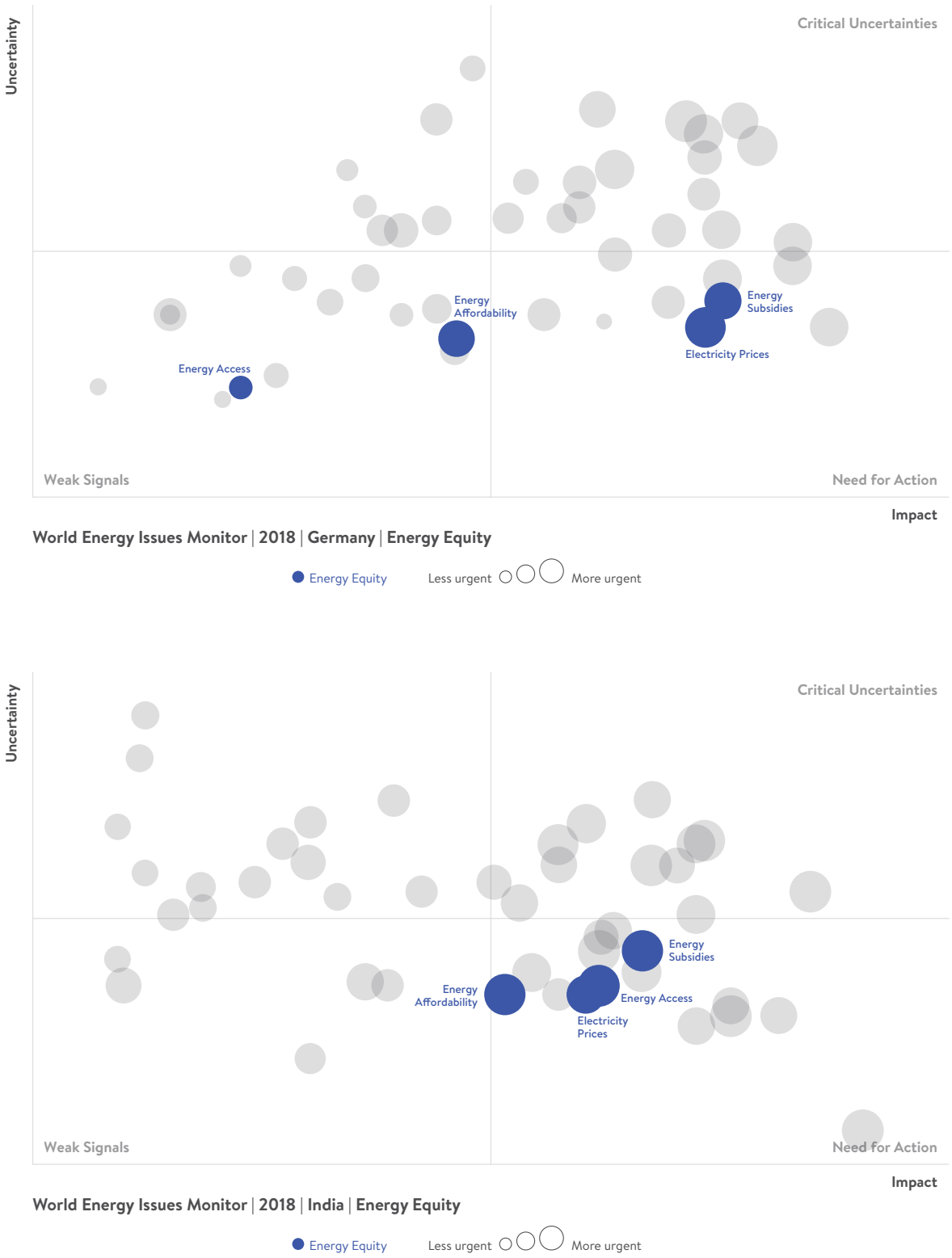
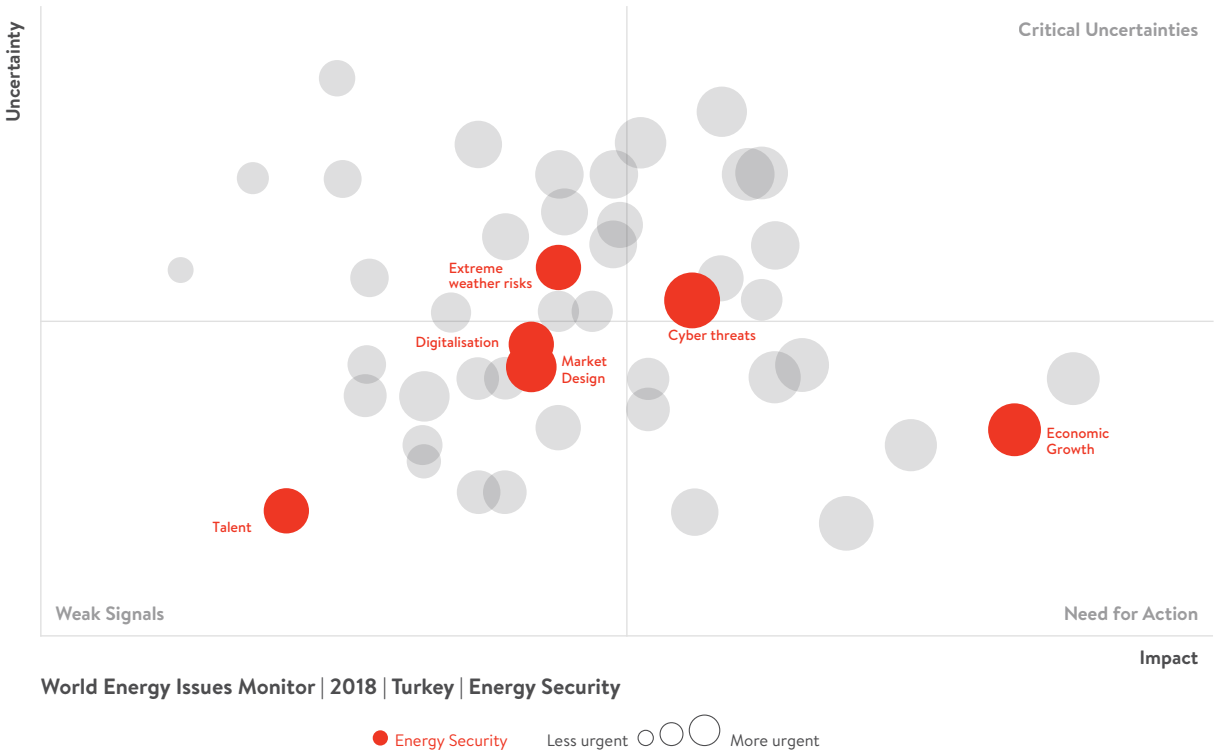
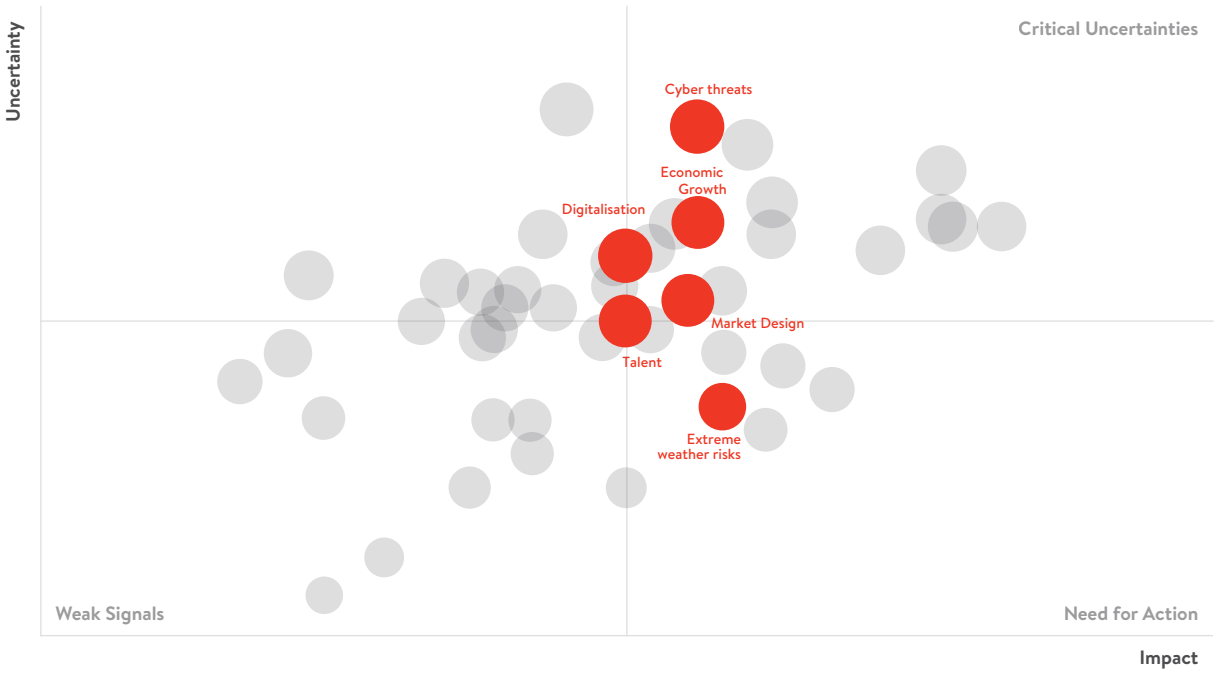


Figure 19: Energy Security Issues Comparison: France and Turkey



World Energy Issues Monitor | 2018 | Turkey | Energy Security

Energy Security Less urgent More urgent



World Energy Issues Monitor | 2018 | France | Energy Security

Energy Security Less urgent More urgent

Figure 20: Energy Sustainability Issues Comparison: Italy and China

TRILEMMA ANALYSIS EVOLUTION

The World Energy Council has gradually refined the Energy Trilemma Index since its introduction in 2009. The Index, calculated at a global level with globally comparable data, has created an appetite for exploring how the Trilemma may be used more locally with national or sub-national data. Currently, the Energy Trilemma is a comparative ranking that provides a robust framework to discuss policy tensions and identify critical issues. As the previous section has shown however, there are areas where the methodology can be improved and adapted to relate more closely to national circumstances.

Work is now underway to review the existing methodology and evolve it for future iterations, incorporating greater transparency and usability to help national and regional stakeholders apply the analysis and thereby improve energy policy. The evolved Trilemma will be based on longitudinal analysis, to reflect performance and transition towards UN SDGs. The evolved methodology will provide a scalable Trilemma tool, which can be applied at national and sub-national level. It will also strive to enable policy innovation through modelling future impacts of decisions and coherent policy approaches.

There are five main areas of methodological evolution, involving input from the Council Trilemma Working Group and external experts.

- **Data sources:** A shift to prioritise primary data sources rather than derived analysis results for input. The tool will be adapted to national level analysis which can be based upon more recent and relevant local data, with the aim to reduce data time lags and generate more timely insights.

- **Indicators:** A revision of the indicators, with a focus on relevance, fit with the overarching dimension, and how they have been calculated. Some indicators will move to more relevant dimensions, for example decarbonised energy generation and air pollution will be accounted for under Environmental Sustainability.

- **Weightings:** Further simplification with the aim of fair and transparent distribution of scores across the ranks. The key change will be the equal weighting of Country Context sub-indicators to improve transparency.

- **Indexation:** A focus on a longer time series of data sources, analysing the longitudinal performance of countries, where data is available. The goal is to identify the best relative improvement and highlight cases where countries have made the greatest transitions. This will also address concerns about potential bias of the Trilemma towards more developed countries with higher GDPs by recognising progress over endowment.

- **Scalable conceptual framework:** Enable scalable Trilemma calculations at a) global; b) regional; c) national; and, d) sub-national levels. These will also use true indexation to generate more useful insight for users, in addition to the comparative ranking.

Implications for the global Trilemma outlook

The evolved methodology will present a transparent and useable Trilemma output, which will see some adjustment in comparative global rankings.

Alignment with UN Sustainable Development Goals will better highlight improvements in decarbonising energy systems, meaning that performance in the Environmental Suitability dimension will better reflect policy efforts for sustainability.

The equity dimension will be less skewed towards the top scores, with a more transparent spread reflecting longitudinal improvements in energy access and affordability.

More generally, the longitudinal analysis – as piloted in this year's Watchlist – will start to identify which countries have made the greatest improvements to their energy systems over time. Identifying improvements relative to context will help establish best practice frameworks and policies enabling robust and balanced energy systems.

The evolved methodology will be launched with the 2019 Trilemma Index Report.

Regional Energy Profiles

REGIONAL ENERGY PROFILES

The transition of energy systems is a long and complex process, tracing multiple trajectories. Scaling the World Energy Trilemma analysis to the regional level can provide useful insights on the pathways to robust and balanced energy systems. Some regions, like Europe and Sub-Saharan Africa, exhibit relatively homogenous trends in expanding the Trilemma dimensions, with common regional policies in parts of Europe, and shared priorities and funding mechanisms in Sub-Saharan Africa. Other regions, like Asia, represent a diversity of pathways for change.

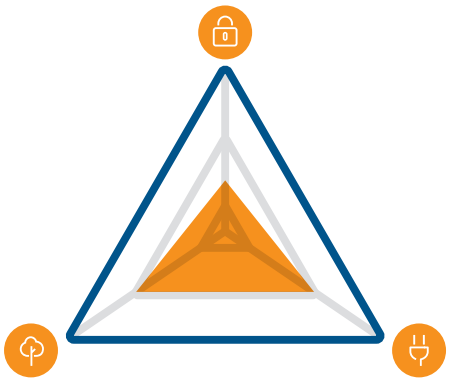
The ultimate Trilemma goal is to enable balanced transition, where each dimension is addressed without detriment to the others. Analysis of regional average performance can provide a big picture of the relative priority balance between multiple countries. Identifying leaders and accelerators in each region, and specific policy priorities which enable their advancement, showcases possible best practice approaches for regional neighbours.

The regional Trilemma profiles are compiled by World Enercy Coun Regional Managers, with the help of Region Committee Chairs and other experts from the region.

ASIA

Asia is the largest and one of the most diverse regions in terms of energy resources and physical, social, cultural and economic backgrounds. This diversity is reflected in the individual country rankings for the 2018 Trilemma, from New Zealand at 8 to Nepal at 118 and other Asian countries falling in between.

Figure 21: Asia region Trilemma balance



ASIAN COUNTRIES

New Zealand (8)	Indonesia (71)	Tajikistan (92)
Singapore (19)	Kazakhstan (72)	Pakistan (103)
Azerbaijan (27)	Philippines (74)	Bangladesh (107)
Japan (30)	Thailand (75)	Mongolia (111)
Hong Kong (34)	China (78)	Cambodia (117)
Korea (Rep.) (35)	Vietnam (83)	Nepal (118)
Malaysia (37)	India (88)	
Australia (38)	Sri Lanka (89)	

The Trilemma outcome for the region shows few changes from 2017. Asia remains relatively weak overall in the three Trilemma dimensions, with nearly 60% of countries assessed falling into the bottom half of the global rankings. While Asia has slightly improved its Energy Equity and Environmental Sustainability scores this year, its Energy Security ranking has gone down slightly, due not only to high energy import dependence and uncertainty about the effect of US policy, particularly trade policy, but also to the region's vulnerability to extreme weather events and the impact of these on its ability to meet increasing energy demand.

Asia remains the world's largest emitter of greenhouse gas, which presents a significant challenge given the need to make progress toward meeting global climate targets. Governments in the region are under pressure to develop policies which help reduce carbon emissions while at the same time, meet rising demand and provide affordable energy.

Asia is still expected to surpass North America and Europe combined in terms of GDP, population, military spending, health, education, governance and technological investment between 2040 and 2050. This surge in economic growth, coupled with increasing demand, uneven distribution of energy resources, import dependence and the movement of people to urban areas sets a daunting challenge for Asia in terms of energy. Increasing use of distributed generation, regional integration through grid and natural gas pipeline networks, the development of hydrogen, further development of renewables and further exploration of new technologies such as blockchain are just a few of the solutions which Asian countries are exploring and deploying.

While there is an ambition to establish grid and pipeline networks among ASEAN countries, no networks have been established yet. However, several sub-regional/bilateral grid and pipeline connections already exist; examples of these include grid connections between Indonesia-Singapore, Thailand-Laos and Vietnam-Cambodia, and bilateral pipeline connections between Indonesia-Singapore, Malaysia-Thailand and Thailand-Myanmar. Grid and pipeline networks in North East Asia between China, Korea, Japan, Mongolia and Russia are under discussion as is regional integration in ASEAN countries and Northeast Asia. Blockchain technology in supply chain management is already being tested in China.

Energy Equity

The region's diversity is reflected in its countries' Energy Equity performance, with access to electricity being at or close to 100% in Asia's highly developed and many rapidly developing countries but much lower in the least developed countries[18]. While nearly 870 million people in developing Asia have gained access since 2000 - with India accounting for nearly 500 million of these[19] -- there are still 65 million people in Southeast Asia without electricity and 250 million who rely on solid biomass as a cooking fuel. However, universal access in Southeast Asia is expected by the early 2030s, using a wide range of fuels and technologies as well as both centralised and decentralised solutions[20].

Energy Security

Energy security is a top priority for countries with a high dependence on imports. Highly developed countries like Japan and Korea are turning to distributed generation and distributed energy resources to improve energy security. For countries like Japan, which have no natural resources, renewable energy and nuclear are important options. After the Fukushima accident, the implementation of distributed generation in Japan has helped contribute to a more reliable, disaster-resilient energy system.

18. World Bank, Sustainable Energy for All (SE4ALL) database from the SE4ALL Global Tracking Framework, 2017
19. Energy Access Outlook 2017, IEA 2017, https://www.iea.org/access2017/
20. Southeast Asia Energy Outlook 2017, IEA 2017, https://www.iea.org/southeastasia/

In Southeast Asia, rapidly increasing demand will push the sub-region's annual net import bill to over US$ 300 billion in 2040, equivalent to around 4% of the region's total gross domestic product[21]. While Southeast Asia overall becomes a net importer of coal, Indonesia remains an important producer as well as an exporter to its Southeast Asian neighbours and India[22]. For island nations, like the Philippines, LNG is expected to displace diesel-based generation to help improve energy security.

LNG demand throughout Asia continues to rise, with Asia being the largest worldwide consumer. Japan, Korea, China, India and Taiwan accounted for over 65% of global LNG shipments in 2017. This trend does not look likely to change in the near future.

Regulatory reform of both electricity and gas markets will help decrease costs to the maximum extent possible and promote the development and implementation of diverse types of energy services through competition.

Environmental Sustainability

Asian countries are seeking ways to meet steeply increasing demand while at the same time, exploring all possible options to reduce GHG emissions, meet their obligations under the Paris Accord and plot a path toward a sustainable energy future. Energy storage has taken centre stage in some countries and could be one possible solution to facilitate greater penetration of renewable energy and accelerate a transition to environmental sustainability.

Renewables offer an attractive option for many countries trying to balance steeply increasing demand from both household and industrial consumers with the need to lower their carbon footprint. For Asia as a whole, including Central Asia, renewable energy capacity has nearly doubled over the past five years, reaching 918 GW in 2017. China and India, two of the world's most rapidly developing economies, are moving more quickly than many highly developed countries to reduce their use of fossil fuels and increase the share of renewables.

China alone accounted for nearly half the growth in worldwide renewable power generating capacity. The country now has nearly 36 times more solar capacity than it did five years ago[23]. India contributed 10% to the global growth in renewable energy capacity in 2017, and the country's solar energy capacity has almost doubled since 2016, reaching 19 GW[24]. And of course, Australia and New Zealand are well known for their governments' policies on renewables, with New Zealand aiming to achieve 100% renewable electricity by 2035 and Australia on target to exceed 41,000 GWh by 2040.

The decreasing cost of electric car batteries has made e-cars a viable option to help reduce carbon emissions, especially in the largest and most densely populated cities, such as Beijing and Mumbai.

21. Southeast Asia Energy Outlook 2017, IEA 2017, https://www.iea.org/southeastasia/

22. Southeast Asia Energy Outlook 2017, IEA 2017, https://www.iea.org/southeastasia/

23. Asia leads the charge in growth of renewable energy, Nikkei Asian Review 2018, https://asia.nikkei.com/Economy/Asia-leads-the-charge-in-growth-of-renewable-energy

24. Asia leads the charge in growth of renewable energy, Nikkei Asian Review 2018, https://asia.nikkei.com/Economy/Asia-leads-the-charge-in-growth-of-renewable-energy

The share of electric vehicles in new car sales in India is expected to reach between 5-10% by 2030, and China is already buying more electric cars than any other nation.

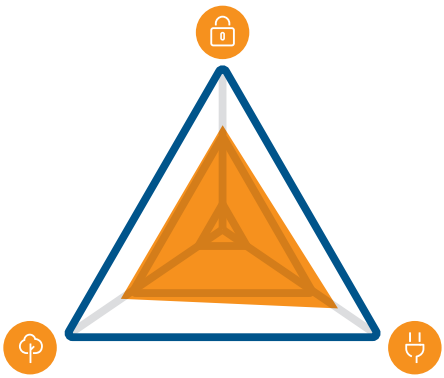
After the Fukushima accident, the Japanese government set its 2030 power generation mix goal of 22-24% renewables, 20-22% nuclear, 27% LNG, 26% coal and 3% oil, which has resulted in Japanese companies promising to source all of their electricity from renewable energy by 2030 to meet this ambitious target. Japan and other Asian countries are also looking at the role of energy conservation, decarbonisation of energy sources, promotion of R&D aimed at reducing the cost of renewable energy, development of hydrogen and electric storage as possible ways to reduce their carbon footprint.

EUROPE

The Council's European region is comprised of 32 Member Committee countries, including also the strongest performing countries of the Trilemma Index 2018: the top 10 is made up only of European countries, with the exception of New Zealand, all of them being members of the European Economic Area. However, there are significant differences in the performances of the countries of the region in different Trilemma dimensions. In general, the European region can be characterised as oriented towards sustainability and affordability of the energy sector while long term energy security and harmonisation of market designs in national legislations remain challenges.

Development of new regulations for the European Union energy markets has been a difficult and controversial process that continues to challenge policymakers. In practice European regulations in national energy markets continue to differ significantly, and this hinders the potential of a common European energy market and delivers controversial signals in system operations and for investments. Introduction of different kinds of national power capacity markets has supported investments in some strategic power plants but has created additional difficulties for integration of electricity markets. Management of the transition in national, sub-regional and regional levels needs to be better aligned by politicians and policymakers.

Figure 22: Europe region Trilemma balance



EUROPEAN COUNTRIES

Denmark (1)	Italy (20)	Turkey (44)
Switzerland (2)	Czech Rep. (21)	Montenegro (49)
Sweden (3)	Portugal (22)	Bulgaria (54)
Netherlands (4)	Romania (23)	Malta (56)
United Kingdom (5)	Belgium (24)	Ukraine (57)
Slovenia (6)	Latvia (25)	Russia (59)
Germany (7)	Slovakia (26)	Macedonia (Rep.) (63)
Norway (9)	Hungary (29)	Cyprus (65)
France (10)	Lithuania (31)	Georgia (69)
Austria (11)	Greece (32)	Luxembourg (70)
Finland (12)	Croatia (33)	Serbia (73)
Spain (16)	Estonia (40)	Albania (79)
Ireland (17)	Poland (41)	Moldova (97)
Iceland (18)	Armenia (43)	

Affordability and competitiveness of the energy prices remains the strength of the region despite a slight decrease in final score. Energy prices have stayed low and have supported the economic recovery of Europe. Decreasing prices of PV and battery technologies have created investment booms in a number of European countries into developing more decentralised solutions. Furthermore, digitalisation projects involving demand response and sectoral coupling have delivered new efficiencies in European countries where they are implemented well. However, often such opportunities are hindered by missing or incomplete regulations.

European countries have also balanced quite well their energy taxation systems compared to their economic strength. Despite the higher energy taxation than in other regions of the world, it has not hampered the affordability and competitiveness of energy in Europe. Furthermore, in some countries it is well coupled with energy efficiency investments that have delivered clear reductions in energy costs.

The Europe region includes the strongest performers in Environmental Sustainable, however there also a number of countries that score much lower in this dimension. The 20-20-20 targets are strong political drivers for the countries of the European Union: it is likely that the Union will meet its greenhouse gas reduction and energy efficiency targets. However, the target on renewable energy appears to be more challenging for a number of large countries and might require a use of statistical transfers. Also, economic recovery and weather conditions might in the short term influence progress in the trend of decreasing emissions.

Despite the fact that carbon price of the Emission Trading Scheme has started to deliver higher levels, investments in cleaner technologies still require additional support schemes. These schemes have been revised across Europe in order to reflect the significant decreases in the costs of cleaner technologies. For the longer term, the European Union sustainability targets for 2030 and 2050 also provide a strong political framework for continued progress. The wider introduction of biofuels and development of gas infrastructure in the transport sector have reduced the greenhouse gas emissions, while the share of electric vehicles has been steadily increasing in the region, supported by the development of charging stations.

Energy security of the European region scores lower compared to other dimensions and is performing low in the majority of these countries. The process of integration of national electricity and gas markets into regional energy markets is ongoing. It has already delivered new flexibilities and diversity into operations that also provide additional energy security, with more improvements to come. The majority of European countries keep their oil reserves well above EU required levels.

However, the adequacy of power supply seems to raise more and more concerns in the majority of European countries where old capacities are shut down and new capacities are mainly reliant on more variable renewable sources. Foreseen closures of nuclear and fossil capacities in many European countries are just adding to these concerns. This is likely to drive up power prices and might in the long term also affect the affordability and competitiveness of power prices in many European countries. In addition, political tensions in the region have raised further concerns, especially regarding the cyber security of energy systems which has seen them elevated on the agenda of the European Union.

Some of those risks can be reduced by stronger integration of national energy markets into regional

ones and by the introduction of new technologies that would create additional flexibility in terms of demand response and system operation in a number of European countries. For example, Power-to-X and storage technologies appear to provide additional flexibilities to current system operations. Energy efficiency action, especially on buildings, can have a strong impact on power and heat energy demand trends. However, those developments largely depend on political, economic and legal frameworks. The key for improvement of the European energy sector lies in the successful policy management of the energy transition that will require stronger cooperation in regional and sub-regional policymaking.

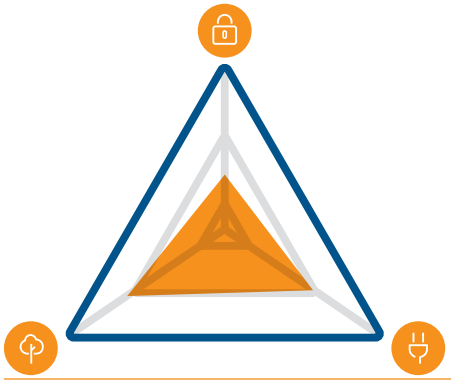
LATIN AMERICA AND CARIBBEAN

Results from this year's Trilemma Index indicate a mixed Trilemma profile overall for the Latin America and Caribbean (LAC) region, with a little improvement on the Environmental Sustainability dimension. The region continues to respond to key challenges, such as dealing with extreme weather phenomena, poor diversification of energy sources, inequality of wealth distribution, inadequate and inefficient methods of tax collection, weak utilisation of interconnections and grid infrastructure, and corruption and instability due to political changes.

However, there are positive signs to be highlighted. Latin America and the Caribbean have invested US$ 14 billion in renewable energy in the year 2013, with the main investors Brazil, Mexico, Chile and Uruguay. In 2017 Argentina joined this effort and promoted the implementation of solar power, with 59 projects in 17 provinces as part of the RenovAr[25] program. Also in Argentina, the Generation of Distributed Energy Law was approved, which introduces "autoconsumption" and the "energy-generating user". Countries like Bolivia and Peru are also promoting the use of solar power; for instance, Peru plans to supply energy to 2.2 million people in rural areas through an extension of grids and up to half a million solar panels. Many countries in LAC are also setting ambitious goals to reduce emissions and increase the target for the number of EV vehicles.

Large scale investments in infrastructure are key to the diversification of the energy mix in Latin America. In terms of policy innovation, Central America and its SIEPAC (Central American Integrated System Project) regional grid and accompanying Mercado Eléctrico Regional (Regional Electricity Market), are enabling clean energy to flow freely across national borders to the region's seven nations.

Figure 23: Latin America and Caribbean region Trilemma balance



LAC COUNTRIES		
Uruguay (28)	Panama (61)	Jamaica (93)
Chile (42)	Ecuador (62)	Bolivia (99)
Colombia (48)	Venezuela (76)	Guatemala (100)
Peru (51)	El Salvador (80)	Nicaragua (104)
Costa Rica (52)	Dominican Republic (82)	Honduras (109)
Brazil (53)	Paraguay (87)	
Argentina (60)	Trinidad & Tobago (90)	

25. http://global-climatescope.org/en/insights/risk-management/

Given the centralised energy systems present in most LAC countries, the use of distributed energy resources is generally still viewed as secondary due to the high cost of infrastructure investment required, and although showing a significant increase recently, alternative energy sources such as wind, solar and geothermal still only account for around 2% of Latin America's electricity generation. Nevertheless, notable progress has been made to promote wider adoption of distributed generation in the region, and examples of such projects are present in many countries. Countries like Costa Rica have embraced the Paris Agreement, announcing that the country should lead by becoming a global laboratory of decarbonisation. The government[26] will promote the use of hydrogen as fuel and wants Costa Rica to be one of the first countries, if not the first, to completely abandon the use of fossil fuels.

Looking at the energy security dimension, the Chilean government's long term energy policy, is based on four main pillars: security and quality of the energy supply, energy as a development driver, energy compatible with the environment, and efficiency and energy education. The country has decided not to build new coal plants and to gradually close down the existing ones. This is to make way for renewable energy as part of the country's energy transition, where coal currently represents 40% of electricity generation.

Among the region, renewables continue to be an action priority to improve the energy security challenge. LAC has a significant hydro potential; countries such as Ecuador have implemented strong policies to take advantage of these resources, and at the moment, 78% of their energy mix comes from hydro generation. Nevertheless, the risks associated with hydro potential are closely related to the variability of hydrological cycles and extreme weather events such as El Niño. That is the reason why this is an area which requires action to adapt, and increase the resiliency of the energy systems, allowing the sustainable and balanced development of LAC's hydro potential.

As mentioned in the Council's LAC Scenarios report[27], a few countries have started structural economic and energy reform programmes to raise productivity and competitiveness; however, it is clear that the recent slowdown of economic growth has made the reform process more difficult. Meanwhile, the increased frequency and severity of extreme weather events are of particular concern for the resilience of energy systems in the LAC region. For example, whilst the extensive use of hydro power, particularly in Brazil and Colombia, has enabled lower CO2 emissions and faster electrification rates, the region's strong reliance on hydro power is also a risk – particularly in a future where climate change impacts will combine with resource scarcities and intensify the challenges of an energy-water-food resource stress nexus.

MIDDLE EAST, GULF STATES AND NORTH AFRICA

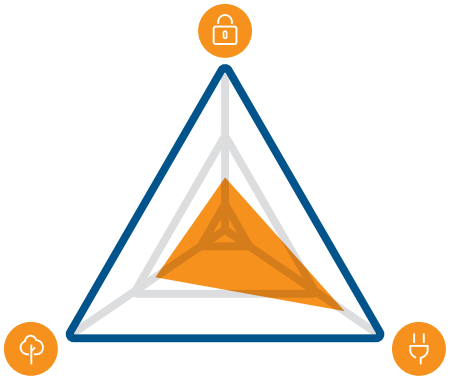
Middle East, Gulf States and North Africa (MEGS & NA) countries are regionally clustered for the purposes of the Trilemma analysis because of some common policy challenges. The cluster performs strongly in energy access and affordability dimensions but faces significant challenges with respect

26. https://theglobepost.com/2018/07/10/costa-rica-fossil-fuel/

27. https://www.worldenergy.org/publications/2017/2017-world-energy-scenarios

to energy security and environmental sustainability. Countries are challenged by high energy intensity and GHG emissions and a high penetration of conventional energy resources. Combined with growing water scarcity, if the region's increasing demands for electricity, water, and cooling, are not addressed, energy security and environmental sustainability dimensions could be threatened even further. Going forward, renewable and nuclear energy programs are expected to be deployed increasingly throughout the region, diversifying energy sources, reducing GHG emissions, and improving system resilience.

Figure 24: Middle East and North Africa countries Trilemma balance



MEGS & NA COUNTRIES		
Israel (15)	Bahrain (50)	Morocco (68)
United Arab Emirates (36)	Egypt (55)	Iraq (77)
Qatar (39)	Algeria (64)	Iran (Islamic Rep.) (81)
Kuwait (45)	Tunisia (66)	Jordan (86)
Saudi Arabia (47)	Oman (67)	Lebanon (101)

Balancing energy security

MEGS & NA countries have comparatively weaker energy security performance than other regions despite tremendous fossil fuel resources, with the Middle East accounting for 43% of global oil and 41% of global gas reserves. The MEGS region countries have young populations that are expected to help grow their economies and substantially increase energy consumption by 2040[28]. The region is challenged by energy demand management and low energy diversity. The Middle East is expected to see energy consumption grow by 61% from 2015 to 2027 - nearly twice the global increase in primary energy demand. Meanwhile, fossil fuels continue to supply the majority of the region's primary energy needs, with renewable energy only contributing approximately 1% of the total energy mix. As a result, most countries in the region score poorly in the environmental sustainability dimension. This status quo is being increasingly challenged by the implementation of energy diversification initiatives.

The region has vast potential for renewable energy – with enough solar radiation reaching the surface to meet the entire world's electricity needs. With long sunshine hours and extensive land available for the deployment of solar panels, the region has ideal conditions for the adoption of solar energy, both at utility and distributed generation level. The region also has significant wind power potential that a number of countries are beginning to explore.

Overall, the region currently has relatively modest use of renewables and is substantially lagging behind the world average renewable use of 13.2% of all energy supply. But change is underway, with countries like Tunisia focusing on renewable development over recent years, with wind power

28. https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/energy-outlook/bp-energy-outlook-2018-region-insight-middle-east.pdf

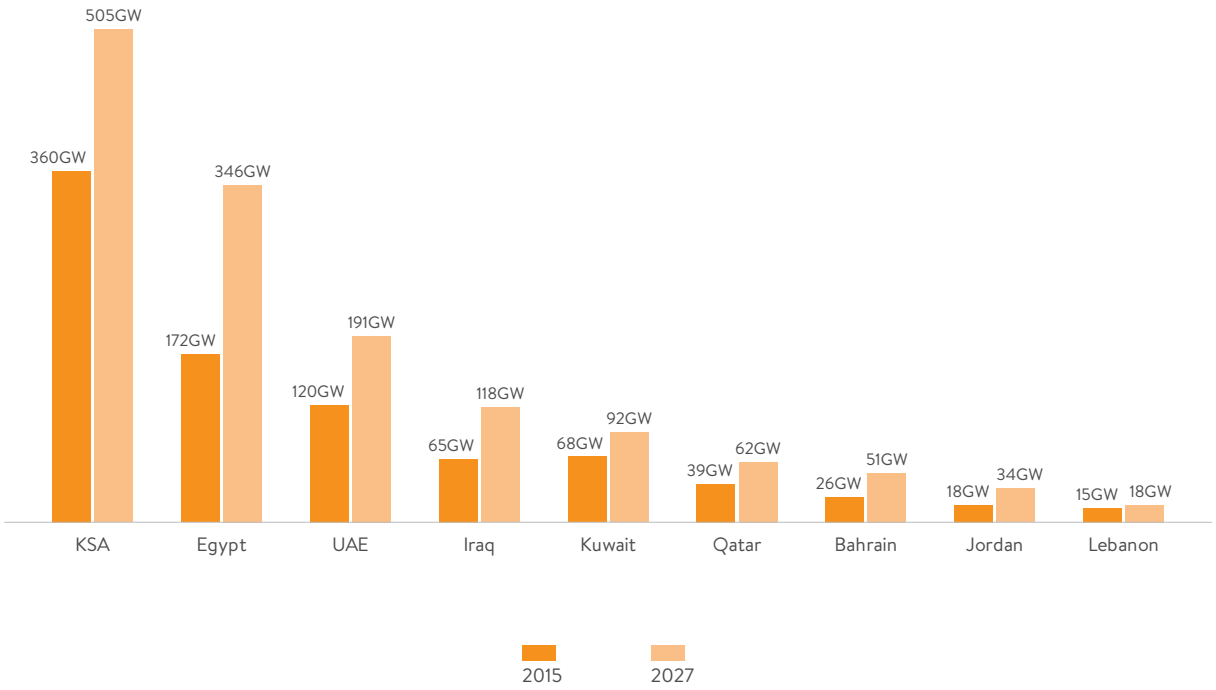
capacity increasing eightfold from 2008 to 2012. Compared with the marginal use of renewable energy in the region, Tunisia has been leading the way with a 14% renewable energy share in 2013[29]. Morocco has been pioneering concentrated solar power at the Nour Solar Complex at Ouarzazate[30] where the second phase 200 MW plant was commissioned in January 2018.

The MEGS & NA region also has significant wind power potential that a number of countries are beginning to explore. Egypt, Morocco and Saudi Arabia are all expected to increase their use of wind power with capacity of wind generation across the region forecast to reach 23 GW by 2027[31].

MEGS countries are looking to deploy nuclear power: Saudi Arabia has plans to build a number of nuclear plants to diversify their energy mix[32] with Abu Dhabi's first nuclear plant expected to be online in 2019[33].

Countries are also examining how distributed generation (on-grid and off-grid) and distributed energy resources can help address Energy Trilemma challenges and meet energy goals. However, it should be noted that the implementation of renewable generation initiatives has been slow, with mature, well known initiatives such as distributed generation lagging in adoption.

Figure 25: Middle East and Gulf countries current and projected consumption



29. IRENA, MENA Renewables status report

30. http://www.irena.org/newsroom/articles/2018/Aug/IRENA-Director-General-Visits-Worlds-Largest-CSP-Site-in-Morocco

31. http://newenergyupdate.com/wind-energy-update/middle-east-and-north-africa-wind-capacity-forecast-hit-23-gw-2027

32. https://www.washingtonpost.com/business/why-oil-rich-saudi-arabia-is-turning-to-nuclear-power-quick-take/2018/03/20/08f92d34-2c1d-11e8-8dc9-3b51e028b845_story.html?noredirect=on&utm_term=.0e2b98d598f1

33. http://www.world-nuclear.org/information-library/country-profiles/countries-t-z/united-arab-emirates.aspx

Increasing energy affordability and access

Many countries are launching efforts to improve energy performance by leveraging distributed generation and renewables. Dubai, for example, has initiated several interrelated programmes to control electricity consumption substantially, decrease the rate of growth in energy demand, and promote renewable energy. As a part of the Distributed Resources Generation programme, the Shams Dubai initiative encourages households and building owners to install PV panels for local electricity supply and to connect them to DEWA's (Dubai Electricity and Water Authority) grid to export any surplus to the national network. In addition, to encourage more efficient energy consumption habits, smarter urban electrical grids are being adopted to monitor usage over time. Taken together, these measures have saved more than 1,100 GW of electricity and reduced carbon dioxide emissions by over 536,000 metric tonnes in Dubai from 2009 to 2014.

Distributed generation is also being used to improve rural electrification, though distributed generation to improve electrification with some 20 million people in the MEGS & NA region estimated to live without access to electricity[34]. Rural areas without grid access are particularly problematic but where off-grid renewables can provide good solutions. Morocco's Global Rural Electrification Programme (PERG) is a successful example of a rural electrification programme using solar and wind technologies in decentralised mini-grids to replace expensive, inefficient and polluting diesel generators. The programme has been so successful that it has achieved almost 100% electrification in the country[35].

Low fossil fuel prices have contributed to making the fossil fuel-based energy supplies of Middle East countries competitive. This has, in-turn, reduced pressure on public finances; a much needed relief in the heavily subsidised economies of the region. With plans for electricity subsidy reduction or removal in the context of greater reforms in countries like Jordan, UAE, and Saudi Arabia, alternative sources of electricity are an increasingly appealing option to help keep prices down.

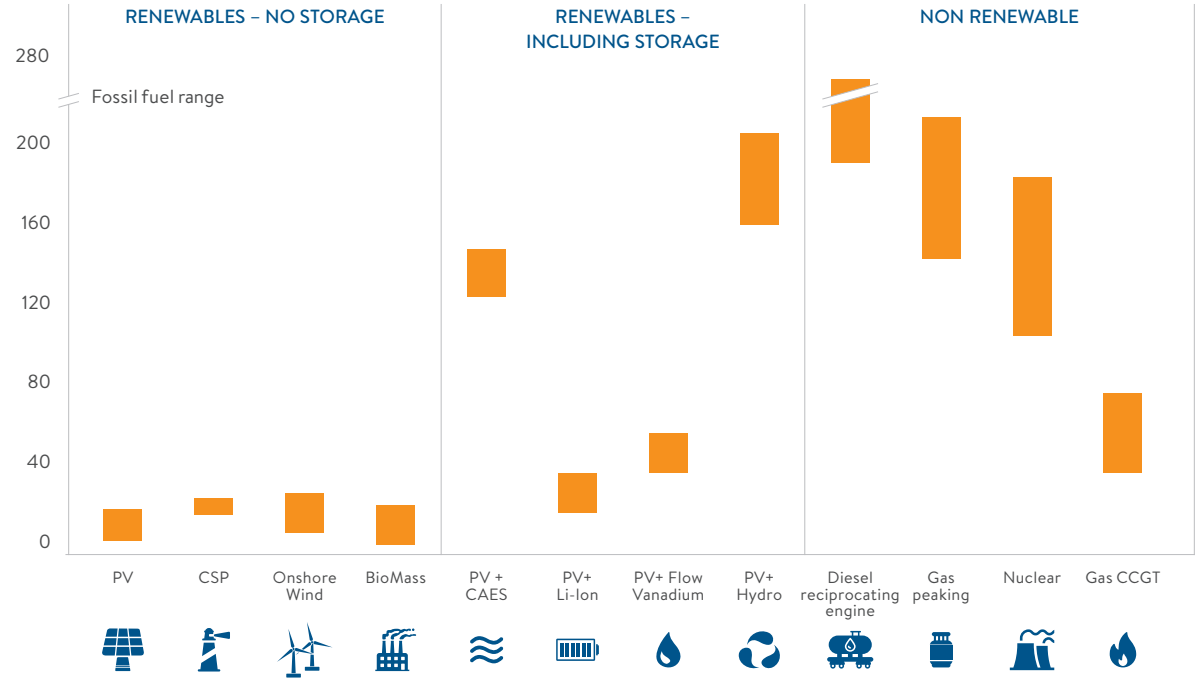
Recent developments in renewable energy technology have resulted in price declines of over 60% in the past decade with future developments expected to further reduce prices and make renewable generation competitive with conventional generation (Source: Lazard). This is illustrated by recent bids in Saudi Arabia for PV and CSP of 20 USD/MWh and 38 USD/MWh, respectively. MEGS countries, with their plentiful renewable energy resources, are well positioned to leverage decreasing prices by setting up generation capacities and subsequently maintaining low electricity prices. Ambitious deployment targets and recent achievements are encouraging signs of large-scale adoption of renewables.

34. http://www.ren21.net/Portals/0/documents/activities/Regional%20Reports/MENA_2013_lowres.pdf

35. https://www.afdb.org/en/news-and-events/morocco-making-giant-strides-in-electrification-18376/

Figure 26: Middle East renewable energy and storage price projections

2030 LCOE, USD/MWh
(Source: Lazard and Oliver Wyman analysis)



Improving environmental sustainability

Renewable energy is also being deployed to improve performance on the environmental sustainability dimension. The commitment of all MEGS & NA countries to the Paris Agreement highlights the desire for increased sustainability, with the Paris Agreement framework and targets providing structure for the transition towards increased sustainability. In countries where economic diversification and job creation is a priority, encouraging development of sustainable energy solutions is a lever many countries are eager to aggressively pull. The development of distributed generation is a sustainable energy generation option that many MEGS & NA governments are increasingly pursuing. For example, net metering and power wheeling transmission schemes have supported the expansion of small distributed generation PV in Jordan, and both Saudi Arabia and Kuwait have plans to roll out a program for multi-home rooftop PV across the countries.

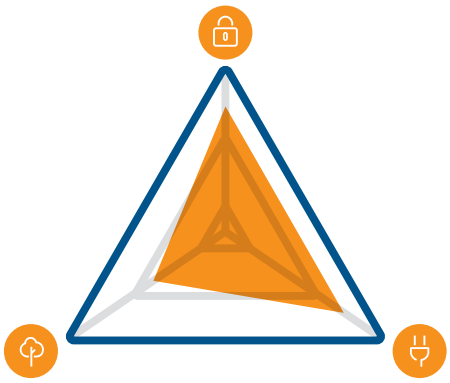
However, there are barriers that create significant challenges for MEGS & NA economies when considering adopting renewable energy and distributed generation more generally. Firstly, most Middle East countries subsidise domestic consumption of hydrocarbons. Subsidies are intended to promote social stability; nevertheless, it comes at the expense of government spending capability on other sectors and hinders energy-efficient practices and consumer-led distributed generation adoption in the region. In addition, despite growing recognition of renewable energy, factors such as insufficient transmission grid capacity and inadequate regulatory frameworks as well as low investor confidence and low levels of foreign direct investments due to the complex political and security landscape in many ME countries are also challenging renewable energy and distributed generation development in the region.

NORTH AMERICA

The Council's North America region, comprised of Canada, the United States (US) and Mexico, is the second highest performing geographic region on the Index after Europe. The economies of the three countries are soundly based on production and export of energy commodities drawn from their rich endowment of fossil, renewable and nuclear resources. In general, the region is characterised by sustained reliability, reasonable energy prices, and a continued push toward cleaner energy policy, particularly at the sub-national level. The longer-term issue for this region will be dealing with an aging infrastructure and extreme weather events which continue to test the resilience of its energy systems.

The United States national position to leave the Paris Agreement and focus on rebuilding the coal industry has created uncertainty in North America, but that has been softened by strong state-level response toward adopting goals that are even stronger than the Paris Accord. States such as California, New York, Arizona, and many others have adopted aggressive climate goals to curb the US Federal agenda. Unlike the agenda shift taking place in the United States federal government, Mexico's new president-elect has already indicated that existing contracts stemming from Mexico's energy reforms will continue as planned thereby bringing some level of stability in that market for now. Canada on the other hand is moving in the opposite direction to the US national policy and is more aligned with individual states who are pushing forward toward a clean energy policy agenda.

Figure 27: North America region Trilemma balance



NORTH AMERICAN COUNTRIES

- Canada (13)
- United States (14)
- Mexico (58)

Despite its strong performance, the region faces two main trilemma challenges: securing supply of energy while transitioning the energy system over the long term and improving environmental sustainability. The current and expected increases in the use of distributed energy resources, especially distributed generation, can help address performance on both the energy security and environmental sustainability dimensions, but raises questions on how to ensure system resilience and the role of baseline power generation whilst ensuring an affordable supply of energy for all consumers.

Environmental sustainability performance improved for the region and rose last year from 61.8 to 65.3. This improvement is due to both Mexico and the United States. The biggest improvement came from the United States' growth in renewable energy. According to data from the International

Energy Agency (IEA) the United States reduced its emissions by 0.5%, marking the third consecutive year of reductions. While coal-to-gas switching played a major role in reducing emissions in previous years, last year the drop was the result of higher renewables-based electricity generation and a decline in electricity demand. The share of renewables in electricity generation reached a record level of 17%[36]. Even though the United States has seen modest reduction greenhouse gas emissions, it still continues to be the second largest emitter in the world behind China.

This region's performance on energy security and sustainability is lower than one would expect, because all three countries are operating aging energy infrastructure. For instance, Canada's oil and gas infrastructure is rapidly approaching the end of its useful life. Thirty percent of Alberta's (Canada's largest oil and gas producing province) pipelines are older than 25 years and 5% older than 50 years. This level of aging infrastructure also poses a concern about environmental sustainability due to the risk of ongoing accidents[37]. For example, in the United States in 2010 California's largest utility experienced the biggest and deadliest pipeline explosion[38]. The pipe was more than 50 years old — similar in age to some in Canada referenced above.

The United States, Canada and Mexico are all demonstrating progress in developing decentralised electricity generation. Canada in particular, continues to invest heavily in traditional, centralised options like building new, HVDC-connected hydropower and refurbishing Ontario's significant nuclear power generation facilities. Eight out of ten of Canada's top infrastructure projects are directly related to the large-scale provision of clean electricity and represent a total current investment of almost CDN$ 70 billion.

There continues to be a major change in the development of oil and gas in North America. Mexican energy reforms and US deregulation signal new oil and gas investment for these two countries. New natural gas and oil shale production in the United States is turning the country into a hydrocarbon exporter. Canada, who traditionally viewed the United States primarily as an oil and gas customer, is increasingly seeing the US as a competitor. Mexico promises to become a greater investment destination for both countries.

In the near term, the biggest issue after infrastructure upgrades are cyber security and decentralisation of electricity generation for North America. During the third quarter of 2017 41.8 MW of energy storage was deployed across the US. According to GTM Research, approximately 295 MW of energy storage will be deployed in 2017 in the United States. This is a 28% increase from 2016[39]. Energy storage is key to a more resilient and reliable decentralised system.

Finally, an issue that has been identified but not yet resolved is cyber security which poses a significant source of risk to energy production and to pipeline and electricity transmission systems.

36. http://www.iea.org/geco/emissions/

37. http://nyenergyweek.com/aging-infrastructure-challenges-north-american-energy-integration/

38. https://www.google.com/search?q=pg%26e+pipeline+explosion&ei=xD9YW5S0BYfYgQbKiq6g-Dg&start=0&sa=N&biw=1280&bih=624

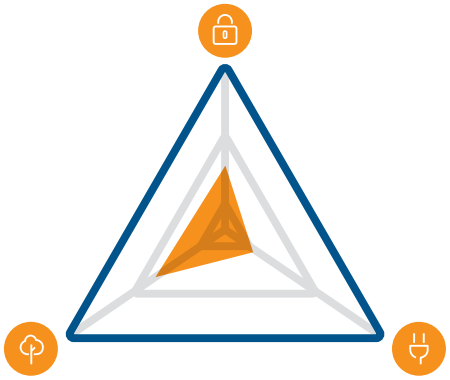
39. GTM Research Snapshot December 07, 2017

Addressing these concerns is the growing continental-scale integration of energy systems which provides the potential for increased reliability in the event of cyber-attack; additionally, Mexico recently joined the North American Electric Reliability Corporation.

SUB-SAHARAN AFRICA

Sub-Saharan Africa comprises 46 countries, with a population of nearly one billion inhabitants, representing about 16% of the global population[40]. There are large disparities amongst the countries, in terms of demographics, economic development, energy and mineral resources, and energy performance, amongst others. The energy sector is vital to the future development of the region yet remains poorly developed in terms of access to modern energy services and sustainable energy supply, despite a huge endowment of energy resources, including fossil fuels, hydropower, high potential of renewable energies, and rich uranium resources in some countries. To unlock the region's resource potential and meet future energy demand, the region must attract adequate investment by improving energy policies and the regulatory framework, build institutional capacity, improve its on-grid and off-grid energy supply, and leverage the potential on inter-country connectivity.

Figure 28: Sub-Saharan Africa region Trilemma balance



SUB-SAHARAN AFRICAN COUNTRIES		
Mauritius (46)	Cote d'Ivoire (105)	Zimbabwe (119)
eSwatini (84)	Nigeria (106)	Malawi (120)
South Africa (85)	Cameroon (108)	Tanzania (121)
Ghana (91)	Ethiopia (110)	Congo (Dem. Rep.) (122)
Kenya (94)	Zambia (112)	Benin (123)
Botswana (95)	Senegal (113)	Chad (124)
Gabon (96)	Mauritania (114)	Niger (125)
Namibia (98)	Madagascar (115)	
Angola (102)	Mozambique (116)	

In the context of the 2018 World Energy Trilemma study, the performance of 25 countries has been assessed. Energy Equity trend remains the same for the region as a whole, with a poor performance normalised score at 41.1 over the two years; the Energy Security dimension has slightly decreased from 56.5 to 53.5; and the Environmental Sustainability dimension score shows an improved trend, moving from 59.2 to 65.8, despite some local and sub-regional focus of climate change concerns.

Going through the trends and performances of the three dimensions of the Trilemma, the following key specific points which contribute to explain the outlook, changes and perspectives of the region for 2018.

Twenty countries amongst the 25 assessed this year, (including the five high-need and most populated countries: Nigeria, Ethiopia, DR Congo, Tanzania and Kenya), and representing 94% of the

40. http://www.africa.undp.org/content/rba/en/home/regioninfo.html

total population are rated as D in Energy Equity, as for the previous year. Moreover, 21 out of the 25 countries rank outside the global top 100.

In general, for the Energy Equity dimension, the region continues to be challenged by the world's lowest level of electricity access - 35% overall and only 19% in rural areas - (i.e. about 632 million people do not have access to electricity) and commercial energy use (less than 700 kg of oil-petrol equivalent per capita - compared to the North American average of 7,844 kg)[41].

In the same trend, energy affordability also remains a serious concern, with high levels of electricity prices and high connection fees, affecting low-income household budgets, and both limiting the expansion of electricity access. Affordable electricity tariffs would improve living standards, and boost access to modern energy services by bringing electricity to a greater proportion of the population[42].

Addressing sub-Saharan Africa's Energy Equity challenge would require bold actions in areas such as increasing power generation, transmission, and distribution capacities; facilitating identification and completion of viable cross-border power projects across the continent, reforming energy policy and regulatory framework, improving power sector governance; and increasing electricity affordability. Macro policies that help reduce poverty are also crucial in the same way and intended to help reduce income inequality. Importantly, the consistency of policies and stability of regulatory environments are key factors behind potential investment decisions, so addressing this can also attract further investment in the region's infrastructure.

Energy Security has reduced this year in 21 countries of the 25 assessed. This is generally due to a number of cumulative factors depending on the countries' specific circumstances, the most relevant being: slow-down in economic growth, 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 & commercial electricity losses in many countries, reduction in non-solid fuels supply, terror attacks and sabotages of pipelines, political and social instability, etc.

The region continues to suffer from a large infrastructure gap, and the stock of existing power infrastructure is also suffering from inefficiencies and insufficient quality of supply to support the growth of the energy demand. Closing the gap in energy infrastructure and adopting better project management policies are crucial to improving the Energy Security dimension. In addition, to take advantage of the region's abundant energy resources and improve the Energy Security dimension, countries in the region need to promote centralised and decentralised grids (including micro-grids for off-grid and grid-connected), and innovative and disruptive digital technologies 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. The reasons for this expected positive

41. IEA – Africa Energy Outlook, 2014.

42. World Energy Council – 2017 Issues Monitor report.

development include the falling cost of solar and wind energies, advances in energy storage, and the savings associated with minimising fossil fuels in generation systems.

The region remains challenged by Environmental Sustainability, with 15 out of 25 countries (including the largest energy users – Nigeria, South Africa, DR Congo, Ethiopia, Tanzania and Kenya) achieving either a 'C' or 'D' grade in the Trilemma. In general, the region is highly vulnerable to climate change impacts and such global threats add another level of complexity when trying to balance the Trilemma across the region. Due to the region's high levels of poverty and limited adaptation capabilities, areas of scarce water and rain-fed agricultural production are particularly at risk.

Over the two years, climate change has induced severe effects in the region, with many countries hard hit by the impacts of El Nino and/or La Nina, and some countries have become "climate hotspots" (Malawi), with new deadly threats appearing in DRC (landslides), Sierra Leone (mudslides) and Côte d'Ivoire (rain flooding)[43].

One of the key solutions for improving the Environmental Sustainability dimension is through a switch away from carbon-intensive technology towards the use of a greater proportion of renewable resources. To that effect, it is worth mentioning that there is a growing push and adoption of renewable energies: almost all African countries are now promoting renewable energy solutions, particularly solar and wind, which have increased markedly due to improved efficiencies and the falling cost of technologies, making them competitive and suitable for energy decentralisation as they can smoothly operate both on-grid and off-grid systems. Recent studies are increasingly highlighting the viability of renewable projects as a feasible option in some areas. Furthermore, in the transportation sector, increasing efficiencies of the vehicle fleet (reducing / stopping imported old second-hand vehicles), and improving road infrastructure are also a must-have solution that should focus stakeholders and energy leaders' priority actions.

43. World Energy Council – 2017 Issues Monitor report.

Country Profiles

COUNTRY PROFILES

Country profiles indicate the overall and per dimension rankings for each of the World Energy Council's member country represented in the 2018 Trilemma Index as well as their balance score. The Trilemma graph on each country profile illustrates the balance score, which highlights the relative balance of the three critical dimensions: Energy Security, Energy Equity, and Environmental Sustainability. The table on the right-hand side shows the Index rankings from three consecutive years broken down by dimension and trends in performance over the longer term. Furthermore, the country profile provides an indication of trends and future developments, an overview of the country's energy endowment, contributions of energy sources to total primary energy supply and electricity generation as well as relevant key metrics to provide more context. The contextual data is the basis of the model calculations, based on globally available datasets for all countries in the model; there is a time lag in some of the data entries.

Interactive country profiles and associated data can also be viewed on the Index web tool, which has been developed by the World Energy Council, in partnership with global management consultancy Oliver Wyman and the Global Risk Center of its parent Marsh & McLennan Companies. The tool can be accessed via: https://trilemma.worldenergy.org

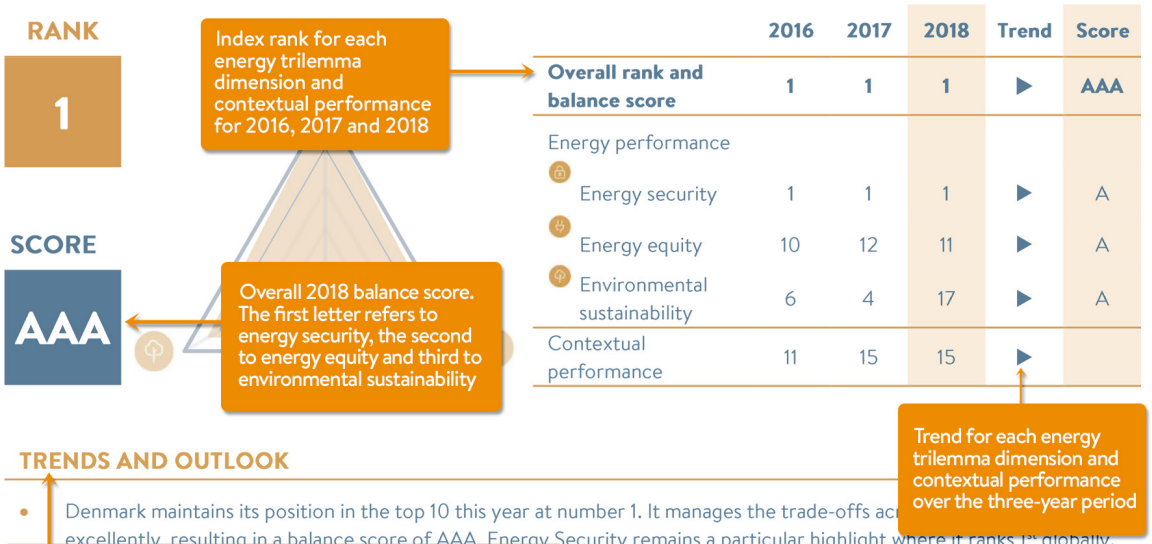
How to interpret country profiles: definitions

Industrial sector (% GDP)	% of total GDP that is in the industrial sector (World Bank, 201
GDP per capita, PPP US$ (GDP Group)	Gross domestic product (World Bank 2015) and Index GDP group
Energy intensity (koe per US$)	Measures how much energy is used to create one unit of GDP (Enerdata & World Energy Council, 2016)
Diversity of international energy suppliers	Indicates to what extent the country is dependent on energy trading partners. Diversity of international energy suppliers calculated through the Herfindahl-Hirschman Index (HHI), (UNCTAD, 2014).
Population with access to electricity (%)	Share of population with access to electricity (SE4All, 2016)
Access to clean cooking in urban | rural areas (%)	% of households that have access to non-solid fuels (SE4All, 2016)
Household electricity prices (US$/kWh)	Average cost of electricity (IEA, Eurostat, World Energy Council, World Bank, 2015)
Rate of transmission and distribution losses (%)	The ratio between the quantity of energy lost during transport and distribution and the electricity consumption. Indicates efficiency of infrastructure (Enerdata and World Energy Council, 2015
CO2 intensity (kgCO2 per US$)	Measures CO2 from fuel combustion to generate one unit of GDP in PPP (Enerdata and World Energy Council, 2015/16
GHG emission growth rate 2010 – 2014 (%)	Greenhouse gas emission growth rate from the energy sector between 2000 and 2014, (WRI/CAIT, 2014)

Fossil fuel reserves	Coal, oil, and natural gas reserves (BP, 2016/17)
Diversity of total primary energy supply	Diversity of energy supply & diversity of electricity generation: Contributors of energy sources to total primary energy supply and electricity generation, indicating current resilience on fossil fuels or other energy sources in the energy and electricity sector respectively (IEA, 2015)
Diversity of electricity generation	

DENMARK

TRILEMMA INDEX RANKINGS AND BALANCE SCORE



	2016	2017	2018	Trend	Score
Overall rank and balance score	**1**	**1**	**1**	▶	**AAA**
Energy performance					
Energy security	1	1	1	▶	A
Energy equity	10	12	11	▶	A
Environmental sustainability	6	4	17	▶	A
Contextual performance	11	15	15	▶	

TRENDS AND OUTLOOK

Overview of current Index rating and commentary on recent trends and outlook for a country's energy performance

- Denmark maintains its position in the top 10 this year at number 1. It manages the trade-offs acr… excellently, resulting in a balance score of AAA. Energy Security remains a particular highlight where it ranks 1st globally.

…enmark. The Agreement contains a wide range of ambitious initiatives. This should bring Denmark closer to reaching the target of 100% renewable energy in the energy and transport sectors by 2050 by committing to large investments up to 2020 in energy efficiency, renewable energy and the overall energy system. Targets to reach by 2020 include approximately 50% of electricity consumption supplied by wind power, and more than 35% of final energy consumption supplied from renewable energy sources.

- To overcome the challenges and reach its ambitious targets of becoming independent of fossil fuels and reducing CO_2 emissions, Danish policymakers are focusing on the implications of: being fossil fuel free for the transport sector; the future role of the Danish natural gas grid; and the introduction of huge amounts of fluctuating renewable energy in the electricity grid.

KEY METRICS

Industrial sector (% of GDP)	22.93	GDP per capita, PPP US$ (GDP Group)	49,029 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 1,818)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.34	Rate of transmission and distribution losses (%)	5.86
CO_2 intensity (kCO_2 per US$)	0.17	GHG emission growth rate 2010 – 2014 (%)	-2.90

ALGERIA

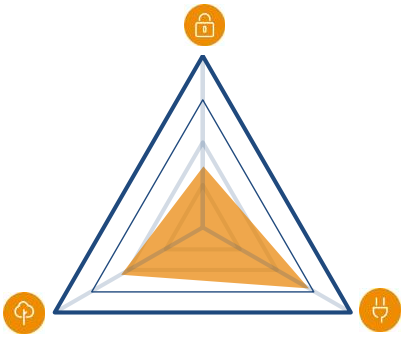
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

64

SCORE

CBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**66**	**65**	**64**	▶	**CBB**
Energy performance					
Energy security	88	81	87	▶	C
Energy equity	37	37	41	▶	B
Environmental sustainability	80	79	63	▶	B
Contextual performance	108	101	101	▶	

TRENDS AND OUTLOOK

- Algeria improves by 1 place in this year's Index, to rank 64. Algeria performs well in energy equity and environmental sustainability, resulting in a balance score of CBB.
- Algeria has continuously developed its economy and improved its energy system. Hydrocarbon exploration efforts have intensified by revising the law to be more attractive and less complicated. New petrochemical projects and refining capacity will improve Algeria's energy security further. At the same time, Algeria pursues its policy to promote renewable energy and energy efficiency, aiming to increase the share of renewables 40% by 2030.
- The following are priority actions for the country: 1) accelerate the implementation of the national renewable energy and energy efficiency. Plan through the involvement of local operators and improvement of regulation. 2) integrate combined cycle power plants and cogeneration. 3) develop the concept of smart grids.
- Policymakers should continue to focus on: 1) increasing the proportion of renewable energy in electricity generation; 2) the development of energy efficiency; 3) the development of a local industry in renewable energy and in hydrocarbon branches that is economically sustainable; and 4) the development and support of research and development (R&D).
- Regarding the energy efficiency, Algeria is: 1) strengthening the legislative and regulatory framework by including efficiency control system and obligation for corrective energy intensity investment programs; 2) the launch of a massive program of conversion of vehicles to LPG/C; 3) the launch of a massive introduction program of new indoor and outdoor lighting technologies (LED technology); 4) a redeployment of the financial support system for the development of renewable energies by separating the financial mechanisms dedicated to activities in the field of renewable energies for the production of electricity from those dedicated to the promotion of renewable energies in small and medium-sized applications.

KEY METRICS

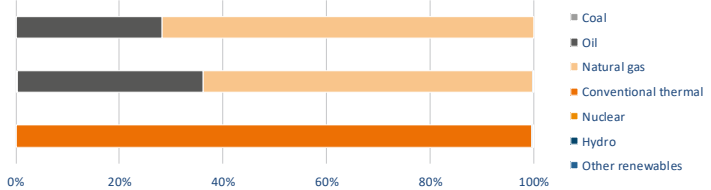
Industrial sector (% of GDP)	**38.89**	**GDP per capita, PPP US$ (GDP Group)**	**15,013 (II)**
Energy intensity (koe per US$)	**0.07**	**Diversity of international energy suppliers**	**High (HHI = 1,015)**
Population with access to electricity (%)	**99**	**Access to clean cooking (%)**	**93**
Household electricity prices (US$/kWh)	**N.A**	**Rate of transmission and distribution losses (%)**	**16.28**
CO_2 intensity (kCO_2 per US$)	**0.26**	**GHG emission growth rate 2010 – 2014 (%)**	**4.18**

ENERGY PROFILE

Fossil fuel reserves: 5,438 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ARGENTINA

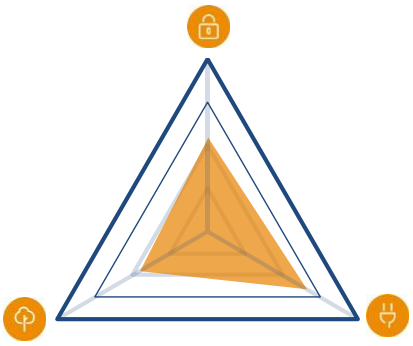
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

60

SCORE

BBC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**58**	**58**	**60**	▶	**BBC**
Energy performance					
Energy security	48	52	63	▶	B
Energy equity	69	61	59	▶	B
Environmental sustainability	69	72	78	▶	C
Contextual performance	92	92	84	▶	

TRENDS AND OUTLOOK

- Argentina drops by 2 places this year to rank 60. The country performs well in energy security and equity. The sustainability rank drops slightly this year due to the relative performance of other countries, however Argentina's combined score in this dimension shows a stable and gradually improving trend, resulting in a balance score of BBC.
- The country expects to boost gas and oil production, especially from unconventional sources. The gas production of the first semester of 2018 grew by 4.6% against the first semester of the previous year. Oil production was 1.9% higher than in the first half of 2017. Unconventional gas production (shale and tight gas) grew 34% over the first half of 2017, and unconventional oil production grew 36%. Unconventional gas production has been rising and makes up about a third of the country's gas production.
- The Argentine Renewable Energy Act, sanctioned in 2016, targets a strong increase in power generation from renewable sources. In 2018 it is expected to be installed more than 600 MW of new capacity. In the following years, 2 GW in addition are expected. The Government has also implemented policies to spur private investments in new conventional power plants, which will still be needed to secure energy demand. The integration of variable renewable energy in power systems and optimal back up investments will represent a challenge to take advantage of benevolent conditions for solar and wind generation.
- The Government keeps gradually reducing inefficient subsidies for gas and electricity demand and applying new tariffs. Market normalization and long term stability are the key drivers for policy design.

KEY METRICS

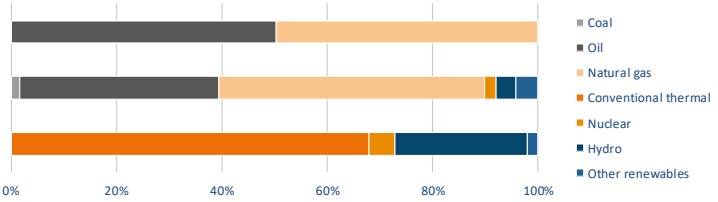
Industrial sector (% of GDP)	28.06	GDP per capita, PPP US$ (GDP Group)	19,940 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,123)
Population with access to electricity (%)	100	Access to clean cooking in (%)	99
Household electricity prices (US$/kWh)	0.01	Rate of transmission and distribution losses (%)	17.69
CO_2 intensity (kCO_2 per US$)	0.25	GHG emission growth rate 2010 – 2014 (%)	2.41

ENERGY PROFILE

Fossil fuel reserves: 593 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ARMENIA

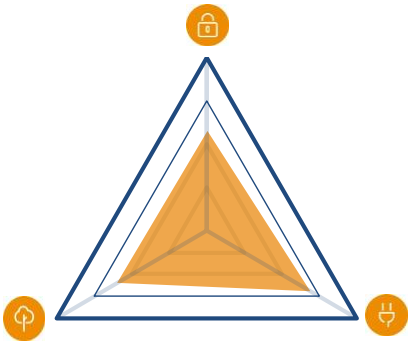
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

43

SCORE

BBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**69**	**52**	**43**	▶	**BBB**
Energy performance					
Energy security	84	72	58	▶	B
Energy equity	65	53	56	▶	B
Environmental sustainability	78	63	52	▲	B
Contextual performance	70	59	62	▶	

TRENDS AND OUTLOOK

- Armenia shows continued improvement in the Trilemma rank, climbing 9 places this year to rank 43. The improvement is most tangible in the Security dimension. An improvement across all trilemma dimensions results in a balanced and improved profile of BBB.
- Armenia strengthens regional electrical ties with neighbouring states: the Islamic Republic of Iran and Georgia. A 400kV line with Iran is under construction, and there is continuing research into the development of a 400 kV line and the HVDC of 400/500 kV with Georgia.
- Solar energy has been developing rapidly in Armenia over the past year. Four photovoltaic power plants with a total installed capacity of 4 MW have been put into operation. A contract has been signed and the construction has started of a 50 MW photovoltaic power plant.
- In the coming years, Armenia will continue to develop the potential of renewable sources of energy, in particular solar energy. Armenia plans to modernize its existing nuclear facilities and build a new generation nuclear power unit.
- In addition, Armenia is participating in the creation of a General Electricity Market of the Member States of the Eurasian Economic Union.

KEY METRICS

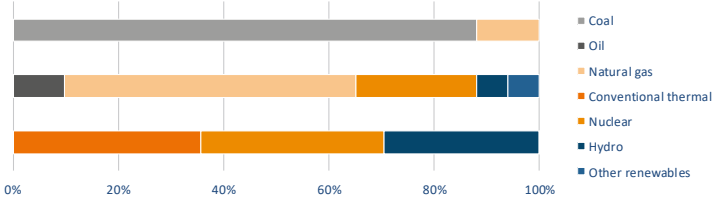
Industrial sector (% of GDP)	28.78	GDP per capita, PPP US$ (GDP Group)	8,833 (III)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Low (HHI = 5,176)
Population with access to electricity (%)	100	Access to clean cooking (%)	97
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	13.16
CO_2 intensity (kCO_2 per US$)	0.23	GHG emission growth rate 2010 – 2014 (%)	3.27

ENERGY PROFILE

Fossil fuel reserves: 129 Mtoe

Total primary energy supply composition

Diversity of electricity generation



AUSTRIA

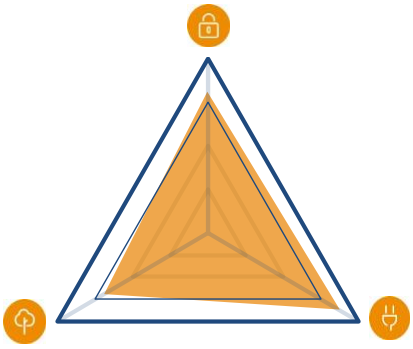
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

11

SCORE

AAB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**10**	**12**	**11**	▶	**AAB**
Energy performance					
Energy security	20	18	15	▶	A
Energy equity	6	8	13	▶	A
Environmental sustainability	23	30	37	▶	B
Contextual performance	16	22	22	▶	

TRENDS AND OUTLOOK

- Austria improves by 1 place in this year's Index, to rank 11. A strong performance across the board, especially for energy security and energy equity, results in a well-rounded trilemma profile of AAB.
- The Austria internal energy supply is based on a balanced mix of energy sources. The following numbers represent the energy consumption of 2017, which are in total: appr. 36% oil, 33% renewables, combustible waste and others, 22% gas, and 9% coal. The production of nuclear energy has been banned since 1978 according to the Federal Law for a non-nuclear Austria. 36% of Austria's energy needs are produced locally and the country relies on energy imports in order to satisfy its energy demand.
- Austria's energy supply is of a high quality and at affordable prices, making energy poverty is less stringent than in many other EU countries.
- Energy policy developments in Austria and targets for 2020 are compatible and in line with EU policy, including: an increase of the share of energy consumption produced from renewable resources to 34% by 2020; reducing greenhouse gas emissions by 16% from 2005 levels for sectors not included in the EU Emissions Trading Scheme (EU ETS) and 21% from 2005 levels for sectors included in EU-ETS; and a 20% improvement in energy efficiency till 2020.
- Austria is already close to achieving its 2020 renewable energy target of 34%. Austria is at risk of missing its 2020 target for energy efficiency. The GHG-emission target will be missed without further efforts.
- The Austrian government unveiled its new energy and climate strategy on April 3rd, 2018. The paper called "#mission2030" is to help Austria reach the EU climate goals. The Austrian government is aiming for all electricity to come from renewable sources by 2030 (2017: about 70%) and for a fully decarbonised energy sector by 2050.

KEY METRICS

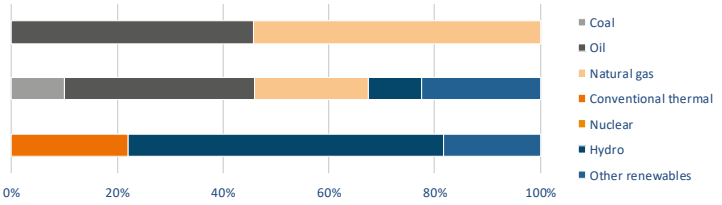
Industrial sector (% of GDP)	28.34	GDP per capita, PPP US$ (GDP Group)	50,552 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Medium (HHI = 1,506)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.23	Rate of transmission and distribution losses (%)	4.96
CO_2 intensity (kCO_2 per US$)	0.20	GHG emission growth rate 2010 – 2014 (%)	-0.13

ENERGY PROFILE

Fossil fuel reserves: 15 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BAHRAIN

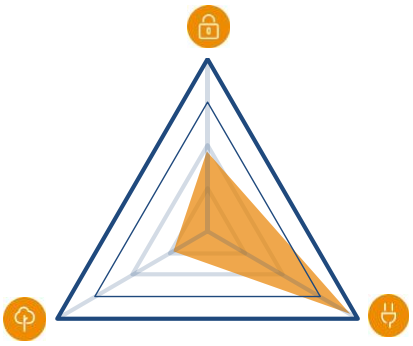
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

50

SCORE

CAD



	2016	2017	2018	Trend	Score
Overall rank and balance score	**59**	**62**	**50**	▶	**CAD**
Energy performance					
Energy security	80	84	77	▶	C
Energy equity	7	5	3	▶	A
Environmental sustainability	104	107	101	▶	D
Contextual performance	58	54	55	▶	

TRENDS AND OUTLOOK

- Bahrain's Trilemma balance score improves to rank 50 in the 2018 model. One of the top-ranking countries for energy equity, Bahrain has also improved in the other Trilemma dimensions, although Security and Environmental sustainability indicators remain low.
- Bahrain has some of the lowest electricity and diesel prices in the world, with Bahrain families owning one residence paying approximately ¢0.79/kWh and $37.1/million BTU for electricity and diesel in 2017, respectively. This helps contribute to Bahrain's excellent score for energy equity
- In 2017, the government endorsed Bahrain's National Plan for Energy Efficiency (NEEAP) and the National Plan for Renewable Energy (NREAP) via the cabinet Resolution Number 2384/8. The National Plan for Energy Efficiency includes 22 initiatives that affect building design, electricity supply, industrial programmes designed to encourage companies to improve energy efficiency, and initiatives relating to the government and economic sectors. The National Plan for Renewable Energy includes six initiatives relating to solar rooftop projects, renewable energy requirements for some new infrastructure projects, as well as the development of larger, central solar power plant projects. Targets include increasing the share of renewables in the energy mix to 5% by 2025, and to 10% by 2035. Efficiency of energy consumption will also be increased to 6% by 2035. The Kingdom of Bahrain Energy Efficiency Plan, an energy strategy plan relating to the establishment of smart metering, new energy building codes and solar applications etc. that was previously the responsibility of the World Bank, is now under the jurisdiction of the Sustainable Energy Unit (SEU).

KEY METRICS

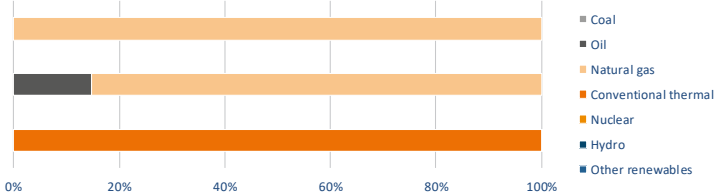
Industrial sector (% of GDP)	40.3	GDP per capita, PPP US$ (GDP Group)	46,776 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 7,805)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	3.96
CO_2 intensity (kCO_2 per US$)	0.59	GHG emission growth rate 2010 – 2014 (%)	4.9

ENERGY PROFILE

Fossil fuel reserves: 139 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BELGIUM

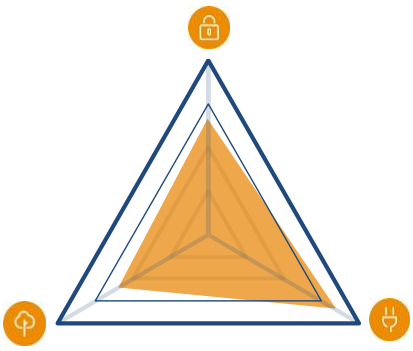
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

24

SCORE

BAB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**23**	**19**	**24**	▶	**BAB**
Energy performance					
Energy security	38	27	41	▶	B
Energy equity	14	20	20	▶	A
Environmental sustainability	37	31	56	▶	B
Contextual performance	24	19	17	▶	

TRENDS AND OUTLOOK

- Belgium ranks 24th in this year's Index. Whilst performing well on energy equity, where it ranks 20h globally, energy security and environmental sustainability have dropped. This results in a balance score of BAB.
- In March 2018, the federal and regional governments reached an agreement on a so-called 'Energy Pact'. The 'Energy Strategy', as it is now called, outlines the country's energy and climate policy until 2050, including the 'in principle' shutting down of the nuclear plants by 2025, as foreseen by the law. The actual closing down of *all* plants by that date will, however, depend on reaching the set of conditions such as security of electric power supply, 'acceptable' electricity prices (compared to the neighbours), fulfilling the climate-change commitments of Paris COP 21, and the safe operation of the (nuclear) facilities. Belgium has already chosen to move away from coal, as there are no operating coal-fired plants left. The no-coal option is confirmed: the 'Energy Strategy' chooses for an electric generation mix based of gas and renewable energy along with a gradual reduction of global consumption of fossil fuel.
- Electricity prices, especially those for large industrial consumers, are still a concern. Large consumers call for the application of an 'energy norm' so that so that energy prices in Belgium, particularly for electricity and natural gas, would no longer be superior to those in the neighbouring countries.
- In 2017 and 2018, the Belgian Federal Climate Change Service has organized a national debate with stakeholders on carbon pricing, to discuss a possible implementation of such an instrument in the non-ETS sectors (mainly in the transport and housing sector). The conclusions presented in June 2018 were favourable to the mechanism.

KEY METRICS

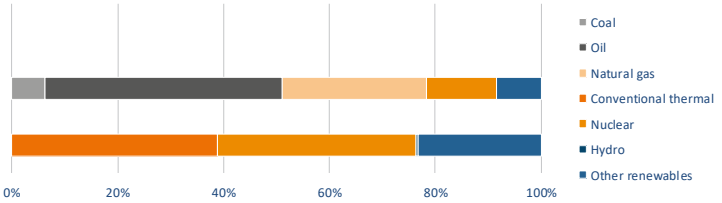
Industrial sector (% of GDP)	22.18	GDP per capita, PPP US$ (GDP Group)	46,429 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 2,742)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.28	Rate of transmission and distribution losses (%)	4.51
CO_2 intensity (kCO_2 per US$)	0.23	GHG emission growth rate 2010 – 2014 (%)	-1.95

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BOLIVIA

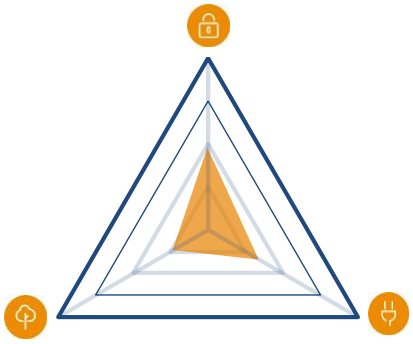
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

99

SCORE

CCD



	2016	2017	2018	Trend	Score
Overall rank and balance score	**100**	**101**	**99**	▶	**CCD**
Energy performance					
Energy security	73	71	72	▶	C
Energy equity	97	90	94	▶	C
Environmental sustainability	107	110	99	▶	D
Contextual performance	110	106	103	▶	

TRENDS AND OUTLOOK

- Bolivia improves by 2 places to rank 99 in this year's Index. It receives relatively low scores across all trilemma dimensions, with Environmental Sustainability remaining its weakest dimension, resulting in a score of CCD.
- Bolivia exports natural gas to Brazil and Argentina and it has the fifth largest proven natural gas reserves in South America. Proven oil reserves are relatively small, and the country has become a net oil derivative products importer as production fails to keep pace with consumption. There is good potential for renewable energy, especially from by-products of sugar cane and hydroelectric, which has not yet been fully exploited. The government started a program of biofuels from sugar cane to mix alcohol with gasoline, between 5% to 10%, and new legislation it's been implemented. It is planned to start the mixtures until the end of the year. Recent developments focus on the oil and gas sector, aiming to replenish oil and natural gas reserves, and maintain natural gas exports to Brazil and Argentina, and supply the growing internal market, through new contracts motivated by a Law of Incentives for the oil sector, and a law on prior consultation.
- In the electricity sector, the country has significant surpluses of energy derived from new thermoelectric plants and new hydroelectric projects that are being implemented. It is foreseen to export electricity to Argentina by completing the transmission line starting next year. In addition, there are ongoing negotiations with Brazil to export electricity.
- Key issues for policymakers to focus on: 1) creation of an attractive, enabling environment for investment to flow into transport of hydrocarbons in both the internal network and future export markets; 2) continuous assessment of exploration and production potential of domestic natural gas resources, conventional and unconventional; 3) engagement with the general public in order to increase public acceptance, shorten the time of pre-consultation with indigenous peoples and allow for a speedier approval of contracts; and 4) further development of renewables, including hydropower.

KEY METRICS

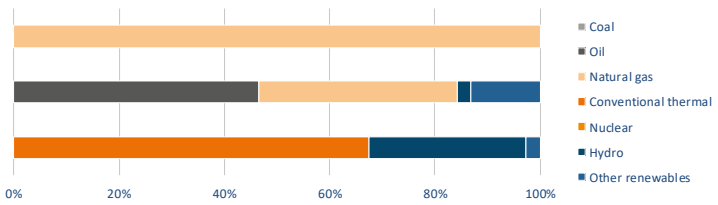
Industrial sector (% of GDP)	32.58	GDP per capita, PPP US$ (GDP Group)	7,234 (III)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	Medium (HHI = 1,708)
Population with access to electricity (%)	93	Access to clean cooking (%)	64
Household electricity prices (US$/kWh)	0.09	Rate of transmission and distribution losses (%)	9.40
CO_2 intensity (kCO_2 per US$)	0.30	GHG emission growth rate 2010 – 2014 (%)	7.29

ENERGY PROFILE

Fossil fuel reserves: 243 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BOTSWANA

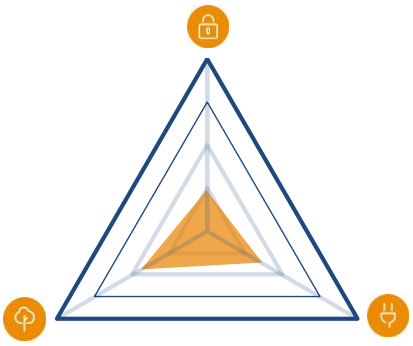
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

95

SCORE

DCC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**94**	**98**	**95**	▶	**DCC**
Energy performance					
Energy security	105	103	100	▶	D
Energy equity	90	93	91	▶	C
Environmental sustainability	92	94	80	▶	C
Contextual performance	45	49	59	▶	

TRENDS AND OUTLOOK

- Botswana has a rank of 95 in this year's Index. It receives relatively low scores across all trilemma dimensions, with Energy Security remaining its weakest dimension, resulting in a score of DCC.
- Botswana's power sector relies heavily on coal generated electricity which contributes about 97% of domestic production. The country's total electricity supply is 4,043 GWh of which 41.53% is from imports and back up diesel power plants at Orapa and Matshelagabedi. Botswana Power Corporation (BPC) which is a vertically integrated government-owned utility is the sole custodian of electricity generation, transmission and distribution.
- The Renewable Energy Strategy has been finalised and the contribution of renewables to domestic electricity generation is to be increased to 15% by 2030. In particular, Renewable energy currently accounts for less than 2% of the country's generation mix. The 100MW (2 X 50 MW Solar PV project) project is being executed by BPC as a Joint Venture. An Expression of Interest was floated in 2017. During 2018 it is expected that a request for Quotation (RFQ) will be sent to the shortlisted companies.
- The country relies on imports of finished petroleum products and consumes about 1.2 billion litters/annum which is mostly routed through South Africa, which may expose the economy to risk of supply disturbances. Currently Botswana maintains 18 days strategic stock and is expected to increase to 60 days after the completion of the on-going 180 million litters Tshele Hills bulk oil storage facility.

KEY METRICS

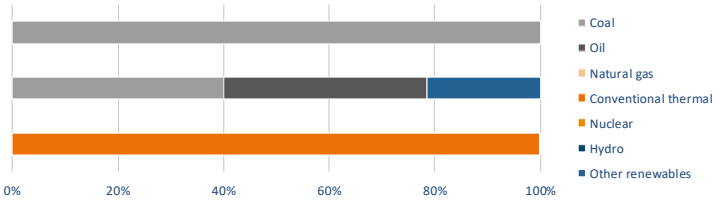
Industrial sector (% of GDP)	33.24	GDP per capita, PPP US$ (GDP Group)	16,957 (II)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	Low (HHI = 7,413)
Population with access to electricity (%)	61	Access to clean cooking (%)	64
Household electricity prices (US$/kWh)	0.06	Rate of transmission and distribution losses (%)	6.79
CO_2 intensity (kCO_2 per US$)	0.23	GHG emission growth rate 2010 – 2014 (%)	3.70

ENERGY PROFILE

Fossil fuel reserves: 28 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BRAZIL

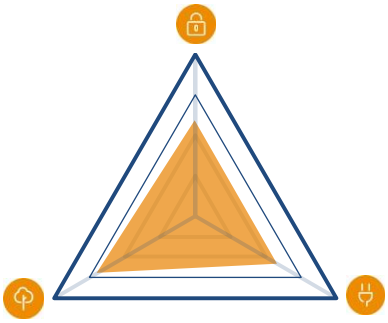
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

53

SCORE

BBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**57**	**54**	**53**	▶	**BBB**
Energy performance					
Energy security	68	46	56	▲	B
Energy equity	70	74	71	▶	B
Environmental sustainability	46	47	36	▶	B
Contextual performance	75	74	74	▶	

TRENDS AND OUTLOOK

- Brazil improves by 1 place in this year's Index, to rank 53. An improvement in Energy Equity and Environmental Sustainability results in a well-rounded trilemma profile of BBB.
- The final energy consumption (FEC) in 2017 reached 260.0 Mtoe, 1.8% more than in 2016 (-2.2% in 2016 and -1,8% by 2015). This increase in FEC was equal to that of the Internal Energy Supply (IES) and well higher than the 1.0% GDP rate. By 2018 the IES is expected to continue growing at this level (+1%) and the FEC also has a projected increase slightly above this percentage.
- Brazil continued reducing the external dependence on energy, decreasing to only 0.5% of its total energy needs (2.1% in 2016, 7.4% in 2015). Oil production increased by 4.2%, reaching 2,720 thousand bbl / day. In this context, net exports of oil and oil products are gradually increasing, reaching 534 thousand bpd in 2017 (436 thousand bpd in 2016 and 230 thousand bpd in 2015); There was also an expansion in the domestic production of natural gas from 5.9% in 2017 from 103.8 (2016) to 109.9 Mm^3 /day; enabling greater availability of gas to meet demand by 6.1% over 2016 (a drop of 14.3% in 2016) and also decreases in the import of this fuel.
- Fluctuations in oil products prices are aligned to the behaviour of prices in the international market. Thus, in 2018 both gasoline and diesel continue to show price increases (11% in diesel and 13% in Gasoline - 1st four-month period). In 2017 the increases were 2.1% (diesel) and 3.1% (gasoline). Electricity prices remain at very high levels, which may be mitigated only by regulatory reviews, which are under discussion in the political arena. Consequently, in the dimension of Energy Equity Brazil's position in the ranking remained close to that of 2016.
- The ratio of emissions to OIE was 1.47 tCO2 / tep, slightly lower than that of 2016, of 1.48 tCO2 / tep. The political context continues to generate uncertainty. It is expected that with the new government, starting in 2019, the country will advance in regulatory initiatives (electricity and natural gas), providing conditions for the country to obtain a better position in the Index in the coming years.

KEY METRICS

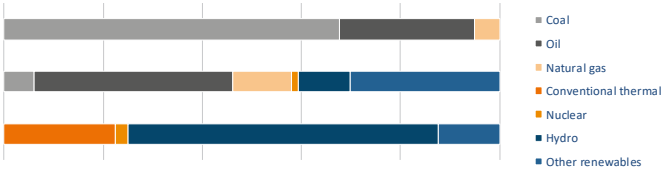
Industrial sector (% of GDP)	22.35	GDP per capita, PPP US$ (GDP Group)	15,124 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 1,200)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	96
Household electricity prices (US$/kWh)	0.13	Rate of transmission and distribution losses (%)	15.56
CO_2 intensity (kCO_2 per US$)	0.16	GHG emission growth rate 2010 – 2014 (%)	3.79

ENERGY PROFILE

Fossil fuel reserves: 9.023 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BULGARIA

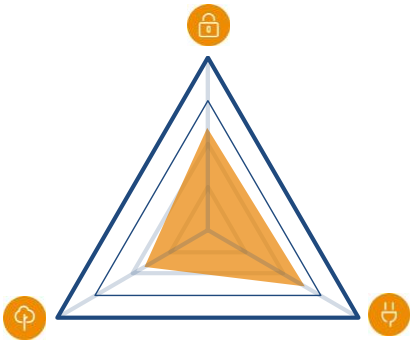
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

54

SCORE

BBC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**48**	**43**	**54**	▶	**BBC**
Energy performance					
Energy security	67	45	55	▶	B
Energy equity	55	62	62	▶	B
Environmental sustainability	67	62	81	▶	C
Contextual performance	49	48	47	▶	

TRENDS AND OUTLOOK

- Bulgaria's rank has dropped in the 2018 Trilemma to 54 overall with a relatively balanced score of BBC. However, the longitudinal trends for each indicator remain stable, which indicates that the change can be largely attributed to the relative improvements of other countries in the ranking. A new baseline for Environmental Sustainability reveals that this is a dimension with opportunities for improvement in Bulgaria.
- In the spring of 2015, the Bulgarian Parliament amended the existing Energy Act to: increase the political independence of the national regulatory commission; financially stabilise the electricity sector; improve market transparency; promote trans-border trade; and enhance end-user rights. The new legal framework was expected to improve the sustainable use of renewable energy sources, market liberalisation and social equity during the period prior to full liberalisation of the market. The amendments have not yet resulted in the expected improvements.
- Key issues policymakers need to focus on are: 1) improved energy security through stimulation of investments in reliable energy infrastructure, further diversifying sources and routes of energy supply, and optimising the use of indigenous energy resources; 2) increased energy efficiency; 3) prompt actions focused on financial stabilisation of the energy sector; 4) increased social protection; 5) pursuing the ambitious targets of giving 30% of households access to natural gas by 2020 as set out in the national energy strategy; and 6) respect for the rule of law.

KEY METRICS

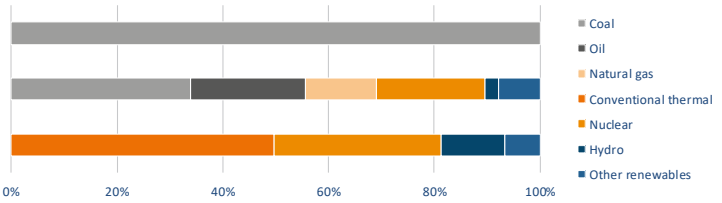
Industrial sector (% of GDP)	27.87	GDP per capita, PPP US$ (GDP Group)	19,243 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Low (HHI = 4,278)
Population with access to electricity (%)	100	Access to clean cooking (%)	89
Household electricity prices (US$/kWh)	0.11	Rate of transmission and distribution losses (%)	12.18
CO_2 intensity (kCO_2 per US$)	0.47	GHG emission growth rate 2010 – 2014 (%)	0.07

ENERGY PROFILE

Fossil fuel reserves: 1,656 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CAMEROON

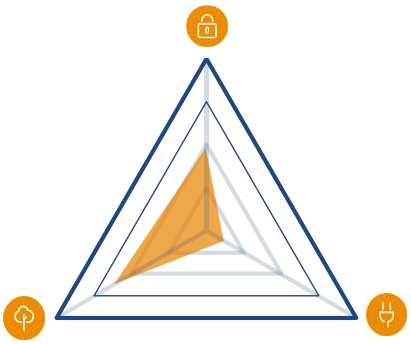
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

108

SCORE

CDB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**105**	**105**	**108**	▶	**CDB**
Energy performance					
Energy security	43	41	71	▶	C
Energy equity	112	116	114	▶	D
Environmental sustainability	51	46	47	▶	B
Contextual performance	112	115	117	▶	

TRENDS AND OUTLOOK

- Cameroon drops by 2 places this year to rank 108. It receives relatively low scores in Energy Security and Energy Equity, resulting in a score of CDB.
- Significant energy issues affecting Cameroon are (a) the intermittence and (b) supply of energy to the population. Disruption of energy supply is currently significant as it is largely dependent on rainfall. Consequently, in dry periods supply can significantly decrease.
- Cameroon's Energy Sector Development Plans aims to achieve a 75% electrification rate by 2030. These plans are prioritising large-scale hydropower as they aim at installing hydropower facilities with a capacity estimated at 720 MW by 2020. Cameroon has additionally implemented policies such as the 'thermal emergency programme' initiative, which assists in reducing energy supply intermittency. The ambitious programme for economic emergence on which Cameroon has embarked is due to be completed in 2035 and will endow the country with a more diversified energy mix, moving away from over-reliance on hydropower.
- However, the government will need to ensure significant investment takes place. It's planned that Cameroon will use fossil fuels in the short term to create and speed economic growth and re-invest the financial gain from growth into the development of clean energy supplies (mainly from hydro, and also solar and biomass) and greater mix. Cameroon has experienced a slow but steady increase in GDP and economic growth in the last five years and figures provide positive signs for the investment needed to achieve 'energy emergence'.

KEY METRICS

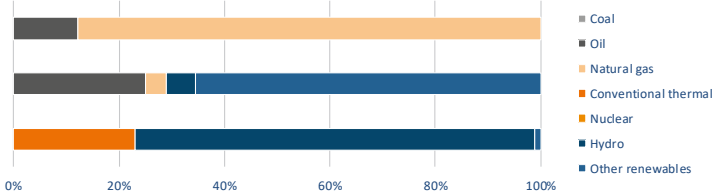
Industrial sector (% of GDP)	28.47	GDP per capita, PPP US$ (GDP Group)	3,609 (IV)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	Low (HHI = 4,171)
Population with access to electricity (%)	60	Access to clean cooking (%)	23
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	11.03
CO_2 intensity (kCO_2 per US$)	0.10	GHG emission growth rate 2010 – 2014 (%)	1.09

ENERGY PROFILE

Fossil fuel reserves: 147 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CANADA

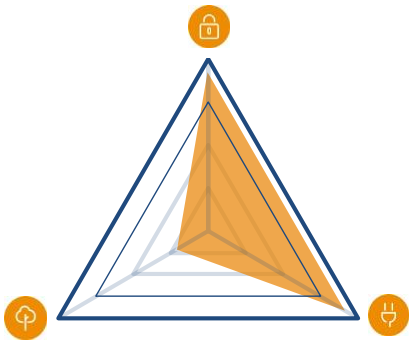
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

13

SCORE

AAD



	2016	2017	2018	Trend	Score
Overall rank and balance score	22	21	13	▶	AAD
Energy performance					
Energy security	5	4	3	▶	A
Energy equity	11	22	7	▶	A
Environmental sustainability	96	100	107	▶	D
Contextual performance	14	11	8	▶	

TRENDS AND OUTLOOK

- Canada improves by 8 places this year to rank 13. The gains are mostly driven by new energy price statistics, which show Canada as one of the leaders in energy affordability. The change in sustainability score results from shifting grade boundaries in the model, so while Canada's combined score in this dimension shows a gradually improving trend, other countries' have had relatively greater improvements. However, this dimension still provides opportunities for policy impact in Canada. The result is an imbalanced trilemma grade of AAD.
- Canada's provincial governments have primary authority for natural resources, energy and environmental matters, and have implemented many innovative carbon policies. Examples include the elimination of coal-fired power from the generation mix of Canada's largest province, regulations to eliminate coal-fired power by both the federal and provincial governments elsewhere in Canada, and investments in advanced technology such as the world's first fully integrated project to capture, use and permanently store CO2 from a coal-fired power plant. In addition, several provinces have transformations towards green electricity generation underway. These developments should support the continuing improvement in Canada's future rankings. Canada's existing electricity generation is approximately 80% non-emitting however, Canada's primary energy consumption remains more than 65% fossil fuel based.
- Three key issues of current focus are: 1) managing the environmental/climate impacts of energy end-use applications (58% of total emissions come from transport, buildings, industry, and electricity), and also from oil and gas development (25% of total emissions); 2) a more predictable, inclusive and comprehensive overall review process for energy infrastructure projects to attract investment, access new export markets and secure social acceptance; and, 3) ensuring wider engagement and the sharing of benefits from resource development projects, most notably with Canada's indigenous population on whose traditional lands most major energy projects will be located.

KEY METRICS

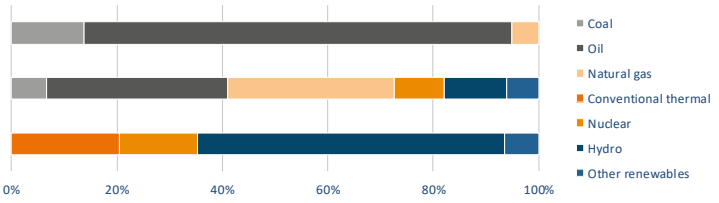
Industrial sector (% of GDP)	27.69	GDP per capita, PPP US$ (GDP Group)	44,819 (I)
Energy intensity (koe per US$)	0.12	Diversity of international energy suppliers	Low (HHI = 4,204)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.11	Rate of transmission and distribution losses (%)	9.84
CO_2 intensity (kCO_2 per US$)	0.40	GHG emission growth rate 2010 – 2014 (%)	0.64

ENERGY PROFILE

Fossil fuel reserves: 33,533 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CHAD

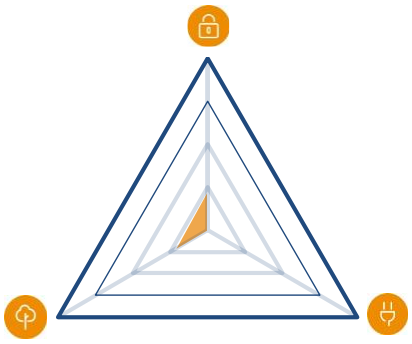
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

124

SCORE

DDD



	2016	2017	2018	Trend	Score
Overall rank and balance score	**119**	**122**	**124**	▶	**DDD**
Energy performance					
Energy security	93	113	106	▶	D
Energy equity	123	124	125	▶	D
Environmental sustainability	52	56	108	▶	D
Contextual performance	124	124	125	▶	

TRENDS AND OUTLOOK

- Chad drops 2 places this year to rank 124. It receives relatively low scores across all trilemma dimensions, with Energy Equity remaining its weakest dimension, resulting in a score of DDD.
- Consumption of electricity and petroleum products accounts for only 10% of national consumption. Wood and charcoal provide 90% of the energy consumed in Chad, while natural gas consumption is very limited as fewer than 11,000 households are equipped with gas heaters. Most of energy production and consumption occurs in the capital. Output of electricity was 103 GWh in 2008, from thermal sources only. High costs and scarcity of electricity hamper Chad's economic development.
- The country is highly dependent on oil imports from Nigeria, Cameroon and other neighbouring countries. STEE, the utility responsible for electricity production and distribution, does not have the capacity to meet the country's ever-growing electric energy demand. Therefore, the country is in the process of implementing a national energy policy, with considerations given to renewable energy due to its great solar potential.
- The Sustainable Energy Fund for Africa (SEFA) has approved in 2015 a US$780,000 preparation grant for the development of a first phase 40 MW of Starsol solar PV plant near N'Djamena in Chad as the first Independent Power Producer (IPP) scheme to be connected to the national grid.

KEY METRICS

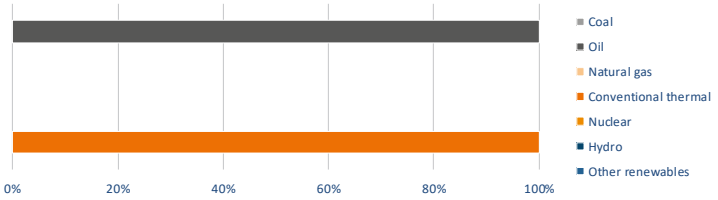
Industrial sector (% of GDP)	14.19	GDP per capita, PPP US$ (GDP Group)	1,991 (IV)
Energy intensity (koe per US$)	0.04	Diversity of international energy suppliers	Low (HHI = 8,617)
Population with access to electricity (%)	9	Access to clean cooking in (%)	3
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	12.24
CO_2 intensity (kCO_2 per US$)	0.01	GHG emission growth rate 2010 – 2014 (%)	31.85

ENERGY PROFILE

Fossil fuel reserves: 216 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CHILE

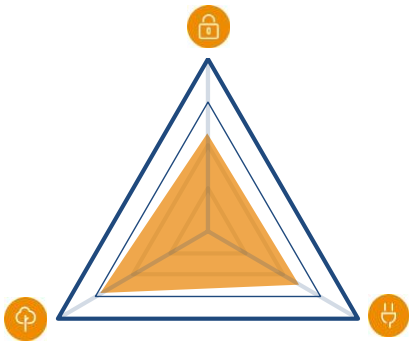
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

42

SCORE

BBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**38**	**36**	**42**	▶	**BBB**
Energy performance					
Energy security	44	62	59	▶	B
Energy equity	66	49	66	▶	B
Environmental sustainability	48	44	35	▶	B
Contextual performance	23	32	32	▶	

TRENDS AND OUTLOOK

- Chile continues to maintain a balance of all three Trilemma dimensions, with a solid BBB performance all indicators. Relative to other countries, Chile slips to rank 42, which is mostly reflected in the Equity dimension and driven by the relative improvements of other countries, while Chile remains stable.
- Chile currently imports 60% of its total primary energy, exposing it to the international volatility of commodity prices. The greatest challenges are perceived as: the development of medium and small-scale renewable energies; developing a regulatory framework for the electricity distribution sector and energy efficiency; promoting regional grid integration, electric mobility and smart cities.
- The interconnection of north and central regions of Chile is already showing improvements for affordability, which will continue to benefit users. The imminent closure of two coal powered plants will deliver further decarbonisation benefits.
- For the long term, Chile's Energy Policy 2050 establishes four main pillars: security and quality of the energy supply, energy as a development driver, energy compatible with the environment, and efficiency and energy education. The new "Energy Road Map 2018-2022: Leading "Energy Transition" focused on our citizens" is the key policy for the near future. Some of the goals defined in this document are: build a map of energy vulnerability of the country; modernize the institutions of the energy sector; reduce un 25% the time of the environmental proceedings, reach 4 times the current capacity of distributed generation, reach 10 times de number of electric vehicles, modernize the distribution regulatory framework, set a regulatory framework for solid biofuels like firewood, set a regulatory framework for energy efficiency, initiate a decarbonisation process in the energy matrix, and train 6000 operators, technicians and professionals of the energy sector.

KEY METRICS

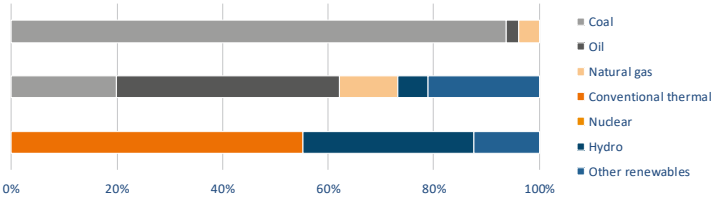
Industrial sector (% of GDP)	32.41	GDP per capita, PPP US$ (GDP Group)	23,194 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Medium (HHI = 2,457)
Population with access to electricity (%)	100	Access to clean cooking (%)	92.8
Household electricity prices (US$/kWh)	0.07	Rate of transmission and distribution losses (%)	6.66
CO_2 intensity (kCO_2 per US$)	0.27	GHG emission growth rate 2010 – 2014 (%)	3.36

ENERGY PROFILE

Fossil fuel reserves: 878 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CHINA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

78

SCORE

BBD

	2016	2017	2018	Trend	Score
Overall rank and balance score	**87**	**86**	**78**	▶	**BBD**
Energy performance					
Energy security	62	58	43	▶	B
Energy equity	77	76	81	▶	B
Environmental sustainability	117	117	104	▶	D
Contextual performance	62	47	45	▶	

TRENDS AND OUTLOOK

- China's overall ranking has improved from 86 in 2017, to 78 in 2018. It performs relatively well in terms of energy security and energy equity but its ranking in environmental sustainability results in an imbalanced score of BBD.
- China has become the world's largest energy consumer. Ongoing industrialisation and urbanisation have led to significantly increased demand, making energy security a major concern. In 2017 China's energy self-sufficiency dropped to about 80%, with external dependency on oil and gas reaching 70% and 35% respectively. China is seeking to address energy security issues through comprehensive measures including conservation, efficiency, technological solutions and energy system reform.
- In 2017, China was still the world's biggest emitter of greenhouse gases, but the country is making significant strides in shifting away from fossil fuels. Over the last 10 years, the proportion of coal has dropped from over 70% to 60%, while the contribution of non-fossil fuels has almost doubled. China plans to invest nearly $400 billion by 2020 in renewable power sources and is also moving toward a technology manufacturing and service-based economy and closing older, less efficient coal-fired plants. A vast UHV-transmission based distribution grid has helped bring electricity from the west of China, where its renewable power sources are based to the demand-heavy east. In 2017, China's carbon intensity decreased by over 40% compared with the 2005 level, which means it reached its original goal of 40%-45% by 202 three years ahead of schedule.
- Data from the World Bank shows 100% access to electricity for China's population of 1.415 billion people, although access for those in remote rural areas only came about in the last three years. The country's Electricity for All plan, launched in 2012, extended the power grid to rural areas and provided connectivity through small hydro, distributed wind power and PV connected to local grids. A PV poverty alleviation program is an innovative measure to promote energy equity while contributing to energy mix optimisation.
- Technology is seen as the most promising solution to address many of China's energy issues, with such initiatives as blockchain technology already being tested in supply chain management.

KEY METRICS

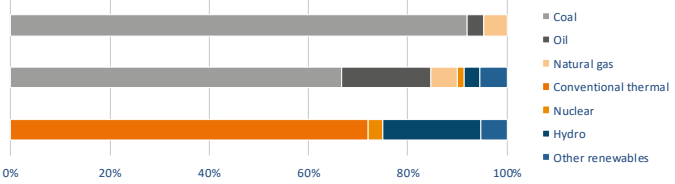
Industrial sector (% of GDP)	40.93	GDP per capita, PPP US$ (GDP Group)	15,529 (II)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	High (HHI = 518)
Population with access to electricity (%)	100	Access to clean cooking (%)	59
Household electricity prices (US$/kWh)	0.08	Rate of transmission and distribution losses (%)	5.84
CO_2 intensity (kCO_2 per US$)	0.51	GHG emission growth rate 2010 – 2014 (%)	8.42

ENERGY PROFILE

Fossil fuel reserves: 105,606 Mtoe

Total primary energy supply composition

Diversity of electricity generation



COLOMBIA

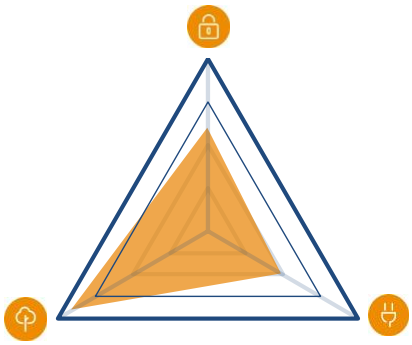
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

48

SCORE

BCA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**41**	**45**	**48**	▶	**BCA**
Energy performance					
Energy security	36	43	53	▶	B
Energy equity	80	84	84	▶	C
Environmental sustainability	10	16	6	▶	A
Contextual performance	68	66	71	▶	

TRENDS AND OUTLOOK

- Colombia drops 3 places in this year's Trilemma to rank 48. Good performance in both energy security and environmental sustainability, combined with a relatively low score in energy equity, results in an overall grade of BCA.
- The Colombian energy mix, mostly hydroelectric, is vulnerable to extreme climatic events that are becoming more frequent, severe and alter the country's hydrological cycles. A diversification of the energy mix would alleviate the pressure on Colombian hydropower. By incorporating other technologies, mainly non-conventional renewable energy (NCRE), the energy sector could guarantee security of supply, accessibility of modern energy services and their affordability. It would also reduce GHG emissions and respect the country's international commitments.
- Recent policies aim to facilitate the integration of NCRE into the energy system. These include the Ministry of Mines and Energy's resolution 40072 of 2018 regulating intelligent measurement as well as resolution 030 of 2018 regulating small-scale self-generation and distributed generation in the National Interconnected System. They build upon the Law 1715 of 2014, promoting the development and use of the NCRE. Besides, ordinance 570 of 2018 presents the guidelines for public policy and favours the participation of other non-conventional resources in the energy mix. Its aim is to expand the energy market, introducing important changes in the management of transmission and distribution networks. These policy developments empower the user to produce their own energy and improve the supply to non-interconnected areas.The Colombian administration aims to guide the country along the path of greater well-being for the people and achieving a more competitive and productive sector.

KEY METRICS

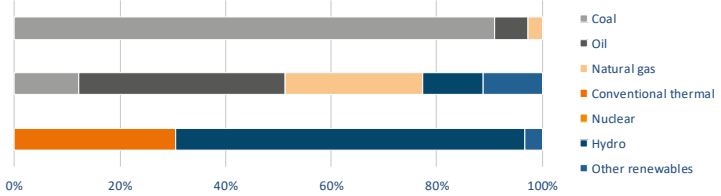
Industrial sector (% of GDP)	33.44	GDP per capita, PPP US$ (GDP Group)	14,154 (III)
Energy intensity (koe per US$)	0.04	Diversity of international energy suppliers	Low (HHI = 6,872)
Population with access to electricity (%)	99	Access to clean cooking (%)	92
Household electricity prices (US$/kWh)	0.18	Rate of transmission and distribution losses (%)	11.33
CO_2 intensity (kCO_2 per US$)	0.11	GHG emission growth rate 2010 – 2014 (%)	2.62

ENERGY PROFILE

Fossil fuel reserves: 3,756 Mtoe

Total primary energy supply composition

Diversity of electricity generation



COTE DIVOIRE

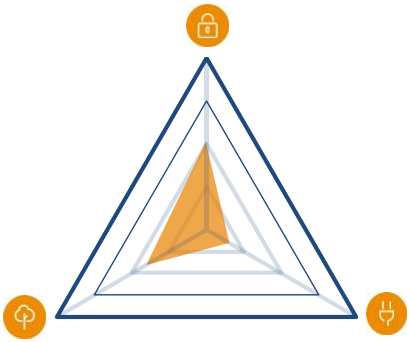
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

105

SCORE

BDC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**101**	**103**	**105**	▶	**BDC**
Energy performance					
Energy security	30	48	68	▶	B
Energy equity	105	107	112	▶	D
Environmental sustainability	94	86	83	▶	C
Contextual performance	102	98	96	▶	

TRENDS AND OUTLOOK

- Côte d'Ivoire ranks 105 in this year's Index, dropping 2 places from 2017. Although performing well in Energy Security, Energy Equity remains particularly weak, resulting in a balance score of BDC.
- Côte d'Ivoire has a large renewable energy potential. However, the country's ability to develop and implement energy policies to harness these energy resources has been hampered by political crisis during the last decade. However, following this crisis, the succeeding government has implemented relevant reforms and actions with a view to improving the image of the country, boosting economic growth and enhancing the living conditions of the population.
- An ambitious "Electricity for All Program" has been implemented by the government that allowed to electrify all localities of at least 500 inhabitants by 2017, as well as 4512 localities out of the 8513 localities in Côte d'Ivoire, thus bringing the national electrification rate a 62% at present, according to latest national figures. These have been combined with reforms of the energy sector and the implementation of an ambitious investment program estimated at about 10 billion of euros over the period 2014-2020. Although there is extensive grid supply, the prohibitive cost of accessing the grid presents a barrier to access to modern electricity services for a population with modest revenues. As a result, there is a large disparity between the number of people who live in a grid-connected locality and most households living in rural and remote areas.
- The government agreed in 2012 on an energy sector plan that promotes investment in fossil-fuelled power generation and transport infrastructure, while also implemented a RE development strategy with the aim of achieving a 15% share of renewables in final energy consumption by 2020. While there are some efforts to increase the use of renewables (such as reduced taxes for the use of solar), policies to reduce the cost and further promote the deployment of renewables are required to achieve this target, and with that an improvement in its Trilemma ranking and balance.

KEY METRICS

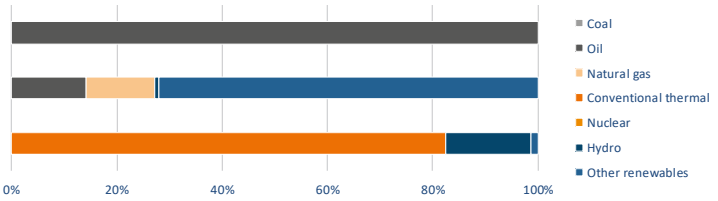
Industrial sector (% of GDP)	31.75	GDP per capita, PPP US$ (GDP Group)	3,693 (IV)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	Low (HHI = 5,278)
Population with access to electricity (%)	64	Access to clean cooking in urban | rural areas (%)	18
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	16.97
CO_2 intensity (kCO_2 per US$)	N.A	GHG emission growth rate 2010 – 2014 (%)	3.84

ENERGY PROFILE

Fossil fuel reserves: 14 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CROATIA

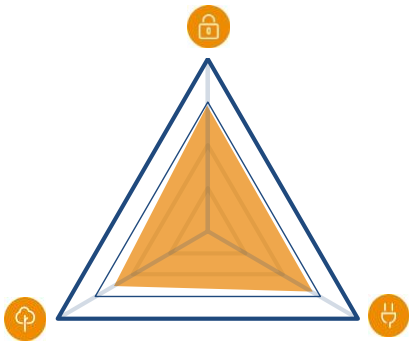
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

33

SCORE

BBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**29**	**32**	**33**	▶	**BBB**
Energy performance					
Energy security	41	35	28	▶	B
Energy equity	43	43	49	▶	B
Environmental sustainability	26	33	46	▶	B
Contextual performance	54	51	52	▶	

TRENDS AND OUTLOOK

- A drop of 1 place this year sees Croatia rank 33. A well-balanced trilemma profile across the board results in a trilemma grade of BBB.
- The government is revising its National Action Plan (NAP) adopted in 2013. The new NAP focuses on the implementation of the low-carbon energy strategy through to 2030 primarily based on the EU 2030 framework for climate and energy. The targets aim to enable Croatia to achieve a more competitive, secure and sustainable energy system and to meet its long-term 2050 greenhouse gas reductions target.
- The government is committed to invest in development of the energy infrastructure and seek new alternative sources of energy supply. Connecting the gas system within the region with Serbia, Bosnia and Hercegovina and expanding it to Hungary and Ukraine is of strategic importance. Amongst the most notable projects remain the Ionian Adriatic Pipeline (IAP) and the LNG terminal on island Krk.
- Energy efficiency will remain to play important role in the overall domestic energy strategy. Based on the EU Energy Efficiency Directive, Croatia is committed to reach energy savings target of 27% by 2030. In addition, the mid-term focus will remain on deploying highly efficient central heating systems and thermal energy generation in cogeneration plants.

KEY METRICS

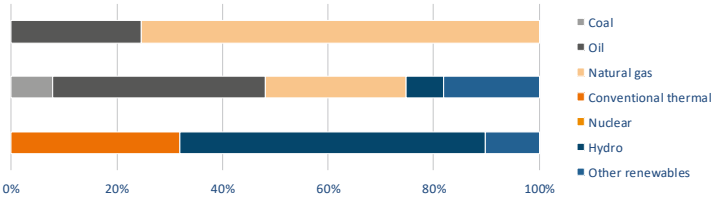
Industrial sector (% of GDP)	26.56	GDP per capita, PPP US$ (GDP Group)	23,422 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	High (HHI = 1,031)
Population with access to electricity (%)	100	Access to clean cooking (%)	93
Household electricity prices (US$/kWh)	0.15	Rate of transmission and distribution losses (%)	10.59
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2010 – 2014 (%)	-0.75

ENERGY PROFILE

Fossil fuel reserves: 28 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CYPRUS

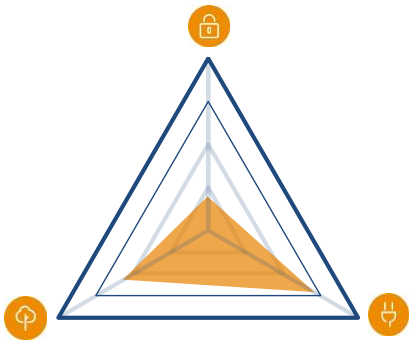
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

65

SCORE

DBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**60**	**61**	**65**	▶	**DBB**
Energy performance					
Energy security	112	116	109	▶	D
Energy equity	58	51	46	▶	B
Environmental sustainability	32	35	60	▶	B
Contextual performance	38	37	38	▶	

TRENDS AND OUTLOOK

- A drop in 4 places this year sees Cyprus rank 65. Whilst it performs well in Energy Equity and Environmental Sustainability dimensions, Energy Security remains particularly weak, resulting in a balance score of DBB.
- One of the priorities of the hydrocarbons sector is to develop the 'Aphrodite' natural gas discovery in the Exclusive Economic Zone (EEZ) of Cyprus. Following the announcement of the commerciality of the discovery in 2015, the Government together with the contractors of the discovery are currently in the final stages of concluding the development and production plan of the Aphrodite field. The Aphrodite field is estimated to contain over 125 billion cubic metres of natural gas. The development of the gas field should bring new opportunities to the hydrocarbons sector of Cyprus and financial growth.
- Cyprus is proceeding through a tendering procedure undertaken by the Public Natural Gas Company (DEFA) with the import of Liquefied Natural Gas (LNG), to begin in 2020. LNG will be bought through state-owned. These activities are expected to improve the country's energy security and environmental performance.
- The electrical interconnection plans with Greece and Israel will be the next major challenge for the country's energy sector, with the Israeli and Greek interconnections due to be completed in 2019 and 2022 respectively. The project will effectively contribute to increased security of energy supply and reduction in CO_2 emissions by allowing the countries in the region to use natural gas deposits as well as renewable energy sources for electricity generation.

KEY METRICS

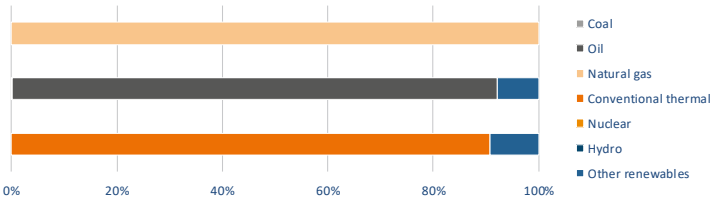
Industrial sector (% of GDP)	10.56	GDP per capita, PPP US$ (GDP Group)	32,708 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 1,961)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.17	Rate of transmission and distribution losses (%)	3.96
CO_2 intensity (kCO_2 per US$)	0.31	GHG emission growth rate 2010 – 2014 (%)	-0.68

ENERGY PROFILE

Fossil fuel reserves: 121 Mtoe

Total primary energy supply composition

Diversity of electricity generation



DENMARK

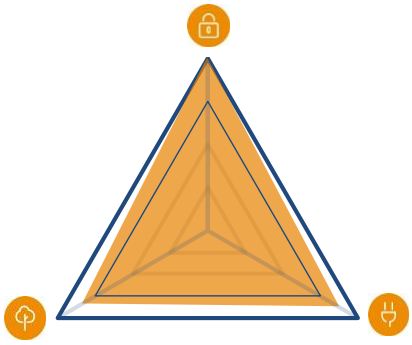
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

1

SCORE

AAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**1**	**1**	**1**	▶	**AAA**
Energy performance					
Energy security	1	1	1	▶	A
Energy equity	10	12	11	▶	A
Environmental sustainability	6	4	17	▶	A
Contextual performance	11	15	15	▶	

TRENDS AND OUTLOOK

- Denmark maintains its position in the top 10 this year at number 1. It manages the trade-offs across all dimensions excellently, resulting in a balance score of AAA. Energy Security remains a particular highlight where it ranks 1st globally.
- In March 2012 a new Energy Agreement was reached in Denmark. The Agreement contains a wide range of ambitious initiatives. This should bring Denmark closer to reaching the target of 100% renewable energy in the energy and transport sectors by 2050 by committing to large investments up to 2020 in energy efficiency, renewable energy and the overall energy system. Targets to reach by 2020 include approximately 50% of electricity consumption supplied by wind power, and more than 35% of final energy consumption supplied from renewable energy sources.
- To overcome the challenges and reach its ambitious targets of becoming independent of fossil fuels and reducing CO_2 emissions, Danish policymakers are focusing on the implications of: being fossil fuel free for the transport sector; the future role of the Danish natural gas grid; and the introduction of huge amounts of fluctuating renewable energy in the electricity grid.

KEY METRICS

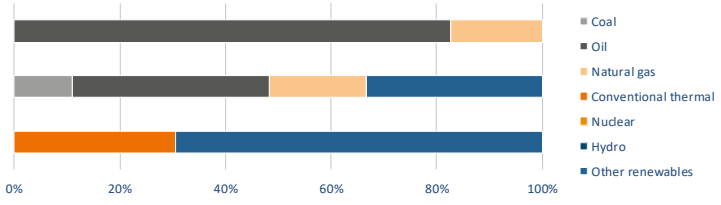
Industrial sector (% of GDP)	22.93	GDP per capita, PPP US$ (GDP Group)	49,029 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 1,818)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.34	Rate of transmission and distribution losses (%)	5.86
CO_2 intensity (kCO_2 per US$)	0.17	GHG emission growth rate 2010 – 2014 (%)	-2.90

ENERGY PROFILE

Fossil fuel reserves: 71 Mtoe

Total primary energy supply composition

Diversity of electricity generation



DOMINICAN REPUBLIC

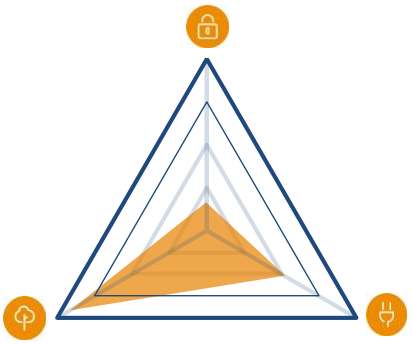
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

82

SCORE

DBA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**77**	**79**	**82**	▶	**DBA**
Energy performance					
Energy security	121	119	117	▶	D
Energy equity	75	77	77	▶	B
Environmental sustainability	13	14	5	▶	A
Contextual performance	67	73	73	▶	

TRENDS AND OUTLOOK

- Dropping by 3 places this year, Dominican Republic ranks 82 in this year's Index. While scoring excellently regarding environmental sustainability, its energy security dimension is particularly low, resulting in an imbalanced trilemma profile of DBA.
- The Dominican Republic for electricity generation has a well-diversified energy matrix, in which fossil fuels have a share of 70.7% (LNG, HFO, LFO), coal 15% and renewables 14.3% (water, wind and solar). The government since 2013, is focused on reducing dependence on fossil fuels, increasing the share of renewable energy and coal; for better energy security. In 2017 the installed capacity increased by about 153 MW; with the start of commercial operation of the first plant operated with biomass as the primary fuel of about 30 MW, and the increase of 123.25 MW combined cycle unit Los Mina. The construction of two coal-fuelled power plants with a capacity of 720 MW is also expected to be finalised in 2018, and the government has established a medium-term framework for the power purchase agreement (PPA) process in order to promote diversification and expansion of the energy matrix.
- The primary challenge in the Dominican electricity sector is the reduction of technical and nontechnical losses in distribution companies; as well as the reduction of power cuts to regulated users by financial problems of these. At present, the multilateral international banking and government are developing the nationwide project for the installation of secure networks, revenue assurance, and installation of macro and micro-measurement. Another point to improve is that the electricity tariff does not reflect changes in the cost of providing electric service.

KEY METRICS

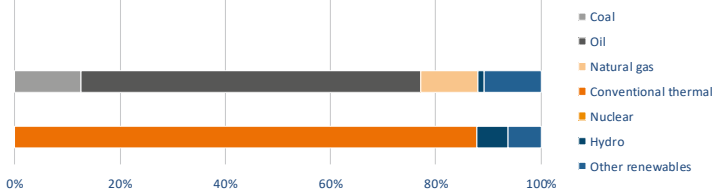
Industrial sector (% of GDP)	27.3	GDP per capita, PPP US$ (GDP Group)	15,205 (II)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Low (HHI = 3,703)
Population with access to electricity (%)	100	Access to clean cooking (%)	90
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	12.31
CO_2 intensity (kCO_2 per US$)	N.A	GHG emission growth rate 2010 – 2014 (%)	0.52

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CONGO (DEMOCRATIC REPUBLIC)

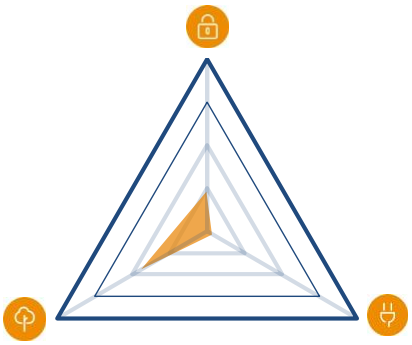
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

122

SCORE

DDC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**117**	**121**	**122**	▶	**DDC**
Energy performance					
Energy security	98	91	103	▶	D
Energy equity	113	120	122	▶	D
Environmental sustainability	85	82	79	▶	C
Contextual performance	122	125	122	▶	

TRENDS AND OUTLOOK

- The Democratic Republic of the Congo (DRC) drops 1 place this year to rank 122. A drop in Energy Security results in a grade change from C to D from 2017-2018. Besides, Environmental Sustainability has seen slight progress over the years, resulting in an overall balance score of DDC.
- The DRC meets its energy needs mostly through biomass and hydropower. The country currently exploits only 2% of its hydroelectric resources from the Congo River, which is estimated to have the potential to supply 100 GW of power, the highest in Africa. Current hydro installed capacity is 2,420 MW, of which only 1,281 MW is operational. The World Bank and the African Development Bank are supporting the country to develop an additional 4,800 MW at the Inga 3 site.
- Despite such rich hydroelectric potential and 2009 reforms, the DRC has one of the lowest rates of electrification in the world, amounting in 2013 to 1% in rural areas and 19% in urban areas. This is due to a limited length of high voltage transmission lines (only 4,600 km).
- All these conditions have favoured the development of small and independent power producers and distributors, through which the country has been liberalising the sector, promoting private investment in generation and distribution.

KEY METRICS

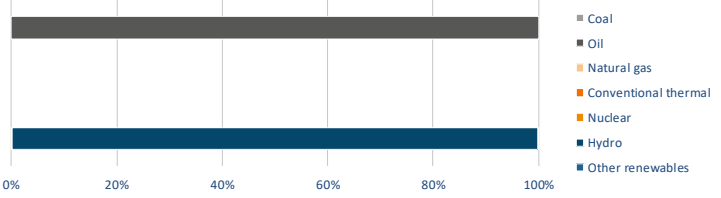
Industrial sector (% of GDP)	35.18	GDP per capita, PPP US$ (GDP Group)	802 (IV)
Energy intensity (koe per US$)	0.44	Diversity of international energy suppliers	Low (HHI = 3,286)
Population with access to electricity (%)	17	Access to clean cooking (%)	4
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	N.A
CO_2 intensity (kCO_2 per US$)	N.A	GHG emission growth rate 2010 – 2014 (%)	2.21

ENERGY PROFILE

Fossil fuel reserves: 24 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ECUADOR

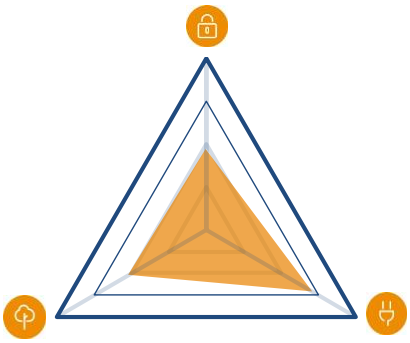
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

62

SCORE

CBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**50**	**64**	**62**	▶	**CBB**
Energy performance					
Energy security	50	61	74	▶	C
Energy equity	46	54	47	▶	B
Environmental sustainability	79	77	68	▶	B
Contextual performance	101	108	108	▶	

TRENDS AND OUTLOOK

- Ecuador improves by 2 places in this year's Index, to rank 62. Ecuador performs particularly well in Energy Equity, resulting in a balance score of CBB.
- The Ecuadorian government has been pushing several initiatives to create a more sustainable energy sector. The Ecuadorian National Development Plan 2017-2021, states the following overarching policy: Guarantee the supply of energy with quality, continuity and safety, with an energy matrix that is diversified, efficient, sustainable and sovereign, as a pillar for productive and social transformation.
- The National Development Plan 2017-2021 set the following specific goals: 1) increase of the share of renewable energy in the electricity generation mix from 68.8% to 90% by 2021; 2) increase fuel savings through the optimisation of power generation and energy efficiency in the oil sector from 9.09 to 26.6 million barrels of oil equivalent by 2021. In addition, the plan states the need to reduce dependency on fossil fuel derived products, reduce losses of transmission and distribution, and deliver an overall increase in energy efficiency.
- For this purpose, the government has developed several projects, which include: 1) the construction of eight hydroelectric power plants, three of them have been commissioned by 2016 and the following five should enter the system by 2020; 2) the switch from LPG-based cooking to efficient electric induction-based cooking; and 3) the construction of a large oil refinery. The impact of the new hydro power plants on the diversity of electricity generation will become apparent in future versions Trilemma. Latest national figures report hydro generation at 83%.

KEY METRICS

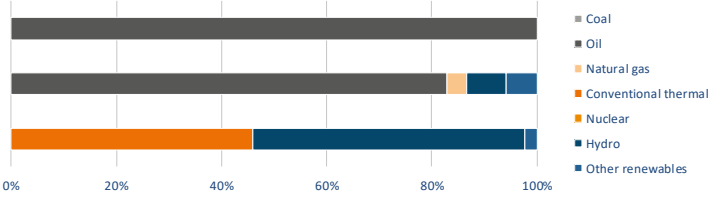
Industrial sector (% of GDP)	34.08	GDP per capita, PPP US$ (GDP Group)	11,242 (III)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 5,278)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	96
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	12.79
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2010 – 2014 (%)	5.26

ENERGY PROFILE

Fossil fuel reserves: 1,215 Mtoe

Total primary energy supply composition

Diversity of electricity generation



EGYPT

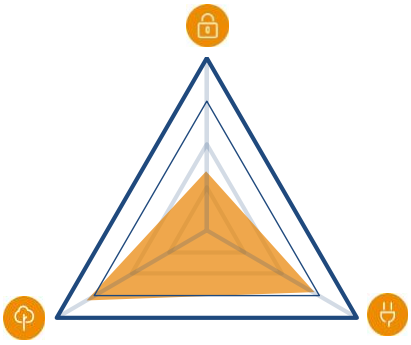
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

55

SCORE

CBA



	2016	2017	2018	Trend	Score
Overall rank and balance score	68	69	55	▶	CBA
Energy performance					
Energy security	90	93	89	▶	C
Energy equity	60	60	42	▶	B
Environmental sustainability	49	34	20	▶	A
Contextual performance	113	103	104	▶	

TRENDS AND OUTLOOK

- Egypt ascends the Trilemma by 14 places to rank 55. With relative improvements across all three dimensions, Egypt still has opportunities to improve Energy Security. Suppliers diversity improves Egypt's resilience, but other security indicators lag slightly behind. A new baseline for Environmental Sustainability shows a relatively strong performance in Egypt. The overall balance grade is CBA.
- Improvements to energy equity and environmental sustainability have been due to the implementation of numerous projects which include the construction of power plants (like Suez 650 MW power plant) and the incorporation of combined cycle gas power plants. The adoption of clean coal as an energy source has enabled Egypt to continue to use coal without it negatively affecting its environmental sustainability score as well as encourage international investment. Oyoun Moussa power plant is a 1320 MW clean coal power plant currently under construction.
- Renewable energy projects are also playing a key part in Egypt's energy transition. In collaboration with the Hydro Power Plants Executive Authority (HPPEA), Chinese Sino Hydro Co. and ARTELIA (consulting company), work has been done to construct the largest pumped storage power plant in Africa and the Middle East with a capacity of 2400 MW on Mount Ataqa.
- Improving energy efficiency and expanding the electrical network are important steps in Egypt's energy transition. Strengthening the electrical network to be able to generate capacities to meet the expected loads either by developing the existing components or expanding the network and its facilities to assimilate the added capacities of the fast-track plan and Siemens projects as well as the planned generation projects.

KEY METRICS

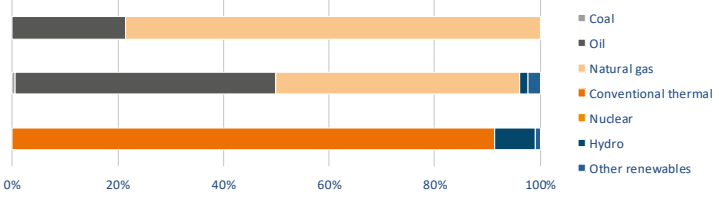
Industrial sector (% of GDP)	36.23	GDP per capita, PPP US$ (GDP Group)	11,129 (III)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	High (HHI = 818)
Population with access to electricity (%)	100	Access to clean cooking (%)	98
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	17.4
CO_2 intensity (kCO_2 per US$)	0.22	GHG emission growth rate 2010 – 2014 (%)	4.23

ENERGY PROFILE

Fossil fuel reserves: 2,036 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ESTONIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

40

SCORE

ABD

	2016	2017	2018	Trend	Score
Overall rank and balance score	**40**	**38**	**40**	▶	**ABD**
Energy performance					
Energy security	22	22	19	▶	A
Energy equity	50	42	44	▶	B
Environmental sustainability	111	108	114	▶	D
Contextual performance	20	18	19	▶	

TRENDS AND OUTLOOK

- Dropping by 2 places this year, Estonia ranks 40 in this year's Index. While performing well regarding Energy Security and Energy Equity dimensions, its Environmental Sustainability remains particularly low, resulting in an imbalanced trilemma profile of ADB.
- Estonia has successfully improved its security of energy supply by diversifying its energy imports through greater interconnection with its Baltic neighbours and increasing domestic electricity production capacity to exceed domestic demand. The rising oil prices have increased the profitability for Estonian shale oil producers with new investments being under consideration, which should have a further positive impact on energy security. Energy security will further increase by the desynchronization of the Baltic electricity system from the Russian synchronization area by 2025, a process that is currently being actively discussed by the TSO-s of the Baltic States. Security concerns are presented by the threat of cyber-attacks and the increasing number of extreme weather events.
- Meanwhile, Estonia still struggles with environmental sustainability due to a high share of electricity export. To remedy this, the government has recently enacted an auction-based market premium model to support new renewable energy projects for electricity generation. The existing projects will benefit from the old feed-in tariffs. Also, a support scheme for the usage of biomethane in the transportation sector has been introduced.
- Concerning the energy equity, the government has proposed a reduction of excise duty on natural gas for gas intensive entrepreneurs to increase their competitiveness and attract new investments.
- Policymakers should focus on successfully implementing tariff reforms and increasing the share of renewable energy to improve the environmental sustainability dimension of the trilemma and to decrease the effect that fluctuations in global oil prices have on energy security. Meanwhile, the existing infrastructure will have to be rendered more resilient to cyberattacks and extreme weather events.

KEY METRICS

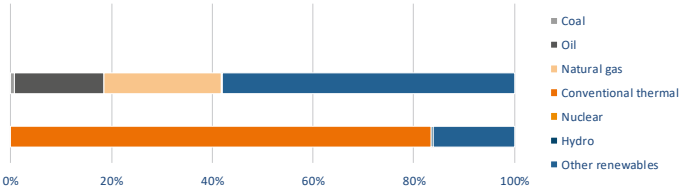
Industrial sector (% of GDP)	27.44	GDP per capita, PPP US$ (GDP Group)	29,743 (II)
Energy intensity (koe per US$)	0.10	Diversity of international energy suppliers	Low (HHI = 3,448)
Population with access to electricity (%)	100	Access to clean cooking in (%)	93
Household electricity prices (US$/kWh)	0.13	Rate of transmission and distribution losses (%)	8.57
CO_2 intensity (kCO_2 per US$)	0.65	GHG emission growth rate 2010 – 2014 (%)	1.41

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ETHIOPIA

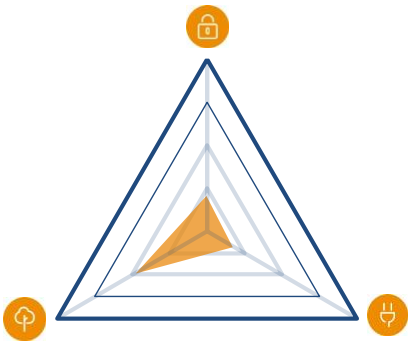
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

110

SCORE

DDC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**118**	**116**	**110**	▶	**DDC**
Energy performance					
Energy security	102	110	108	▶	D
Energy equity	117	111	108	▶	D
Environmental sustainability	90	91	73	▶	C
Contextual performance	111	110	113	▶	

TRENDS AND OUTLOOK

- Ethiopia improves once again this year, climbing 6 places from rank 116 in 2017 to rank 110 in 2018. A new baseline for Environmental Sustainability reveals that Ethiopia performs better than previously in this is a dimension. Low scores across all trilemma dimensions result in a trilemma grade of DDC.
- Ethiopia's GDP growth of approximately 11% for the past eight consecutive years and population growth at an average rate of 2.5% annually, both contributed to increased energy demand. Through the Growth and Transformation Plan, Ethiopia aims at becoming a middle-income country by 2025. The Climate-Resilient Green Economy (CRGE) strategy focuses on enhancing development with minimum carbon emission. The vision for the Ethiopian energy sector is to ensure access to affordable, clean and modern energy for all citizens by 2025, and to become a renewable energy hub in the Eastern Africa Region.
- While Ethiopia has abundant renewable energy sources, the country imports petroleum fuels and coal. Over the past ten years the volume of petroleum imports has been growing at approximately 8% per year. Projections indicate that unless action is taken to change the traditional development path, annual petroleum and fuel wood consumption will rise significantly. Policymakers need to address: 1) high levels of energy poverty; 2) low private sector participation and competition; 3) high dependence on and unsustainable use of biomass; 4) high dependence on imported petroleum fuels; 5) wasteful and inefficient energy production, transportation, and use; and 6) development of renewable energy technologies, energy conservation and sustainable forest and woodland managing practices.

KEY METRICS

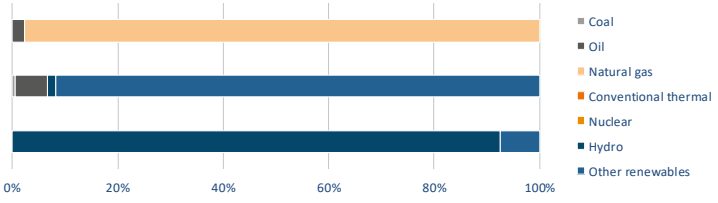
Industrial sector (% of GDP)	17.73	GDP per capita, PPP US$ (GDP Group)	1,734 (IV)
Energy intensity (koe per US$)	0.30	Diversity of international energy suppliers	Low (HHI = 4,126)
Population with access to electricity (%)	43	Access to clean cooking (%)	4
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	21.38
CO_2 intensity (kCO_2 per US$)	0.07	GHG emission growth rate 2010 – 2014 (%)	4.14

ENERGY PROFILE

Fossil fuel reserves: 22 Mtoe

Total primary energy supply composition

Diversity of electricity generation



FINLAND

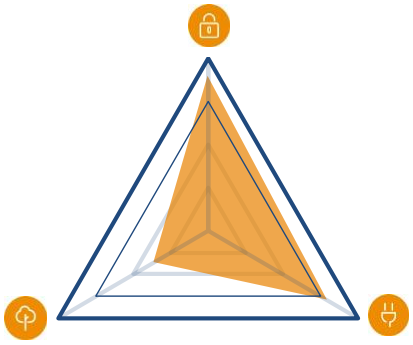
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

12

SCORE

AAC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**8**	**11**	**12**	▶	**AAC**
Energy performance					
Energy security	3	3	5	▶	A
Energy equity	24	27	26	▶	A
Environmental sustainability	71	67	88	▶	C
Contextual performance	2	12	10	▶	

TRENDS AND OUTLOOK

- Comparatively low sustainability ranks of the Finnish energy system can be explained by the fact that Energy Intensity (TJ per capita) and CO2 indicators (CO2 per capita and per capita of energy consumption and production) are both high in Finland in comparison to other countries due to the energy intensive industry structure. However, GHG emissions declined in 2017 by nearly 5% compared to the previous year, reaching 2015 levels. The decrease in GHG emissions was due to the decline in the consumption of major fossil fuels and the increase in the share of biofuels in transport.

- In terms of security, Finland has a good score on the diversity of energy mix and diversity of electricity generation mix indicators. The long economic downturn in Finland was reflected in the renewal of energy supply and systems. There is a decline in investments in non-publicly supported electricity production capacity before 2018. However, a change of subsidy policy will take place in the autumn of 2018, as the price solar and wind power production is decreasing. Some wind power projects are being delivered without subsidies.

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KEY METRICS

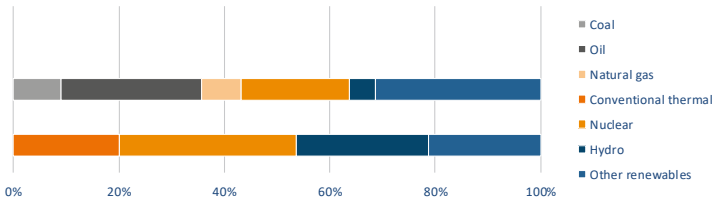
Industrial sector (% of GDP)	26.93	GDP per capita, PPP US$ (GDP Group)	43,378 (I)
Energy intensity (koe per US$)	0.13	Diversity of international energy suppliers	Low (HHI = 4,095)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.17	Rate of transmission and distribution losses (%)	3.0
CO_2 intensity (kCO_2 per US$)	0.25	GHG emission growth rate 2010 – 2014 (%)	-1.37

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



FRANCE

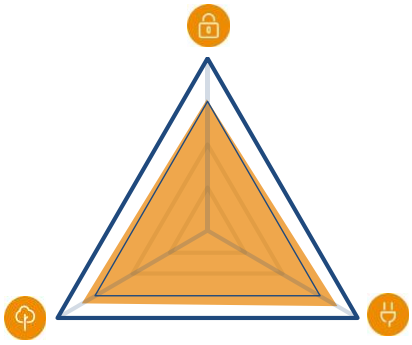
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

10

SCORE

AAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**6**	**8**	**10**	▶	**AAA**
Energy performance					
Energy security	16	25	26	▶	A
Energy equity	9	13	16	▶	A
Environmental sustainability	11	6	15	▶	A
Contextual performance	19	21	23	▶	

TRENDS AND OUTLOOK

- France remains amongst the leading countries of the Trilemma, ranking 10 overall this year. There is an excellent balance of scores across the trilemma dimensions – resulting in score of AAA.
- France has little fossil fuel production, relying heavily on nuclear for electricity as well as oil and gas imports for transport. Nuclear power constitutes approximately 79% of total electricity generation. In order to avoid future GHG emissions, a bill ending hydrocarbon search and exploitation was adopted in 2017. Besides, in 2015, the former government passed the energy transition law aiming to develop renewables and decrease the reliance on nuclear power. The legislation includes the commitment to increase the target price of carbon, for which discussions are ongoing.
- The energy programme of the new President is structured along two main lines: the development of renewables and the improvement of energy efficiency, in line with the 2015 energy transition law. The main objectives are reducing energy consumption, decrease the share of nuclear in the energy mix and diversify the sources of energy production.
- In 2018, the revision of the multi-year energy programming (MEP) was initiated. Developed by the Ministry of the Ecological and Solidary Transition in consultation with all stakeholders, it is the country's main energy steering tool, along with the low-carbon national strategy (a multi-sectoral roadmap towards a low-carbon economy). It expresses the orientations and action priorities of the public authorities for the management of all forms of energy in order to achieve the objectives of the 2015 law.

KEY METRICS

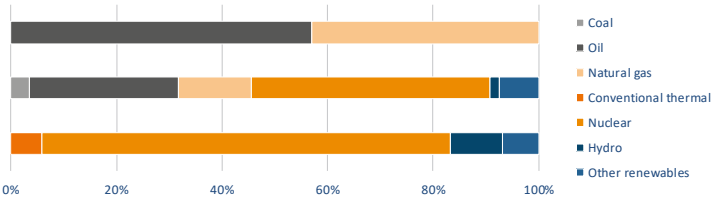
Industrial sector (% of GDP)	19.5	GDP per capita, PPP US$ (GDP Group)	41,343 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 698)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.19	Rate of transmission and distribution losses (%)	7.74
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2010 – 2014 (%)	-1.88

ENERGY PROFILE

Fossil fuel reserves: 19 Mtoe

Total primary energy supply composition

Diversity of electricity generation



GERMANY

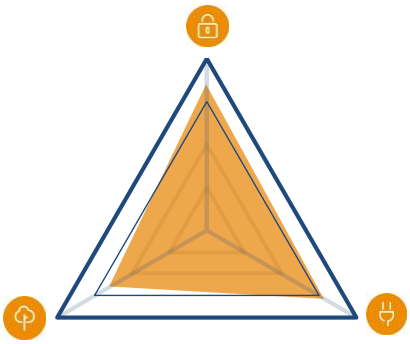
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

7

SCORE

AAB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**5**	**6**	**7**	▶	**AAB**
Energy performance					
Energy security	7	12	12	▶	A
Energy equity	15	17	29	▶	A
Environmental sustainability	31	32	40	▶	B
Contextual performance	15	16	16	▶	

TRENDS AND OUTLOOK

- Dropping by just 1 position, Germany maintains a place in the top 10 at number 7. There are relative adjustments across the equity and sustainability dimensions, and a new baseline for the latter, which results in the adjusted scores. Overall, Germany balances the trilemma dimensions very well, giving an overall balance score of AAB.
- The German Energy Transition now focuses on a strong increase in power generation from renewable sources with a new political aim of 65% by 2030 of total power generation, a reduction of primary energy usage and CO2 emissions as well. While Germany will miss it´s 40% reduction aim compared in 2020 compared to 1990. The discussions about sector coupling between power, buildings, transport and industrial processes have been started, but integrated and technology open solutions are pending.
- The 2011 decision to phase out nuclear by 2022 constitutes a challenge to Germany's energy mix and electricity distribution. To solve social and economic challenges of phasing out coal-fired plants, the commission "Growth, Structural Change and Employment" has been instituted in 2018. Due to low wholesale prices and regulatory uncertainty, investors are reluctant to invest in new conventional power plants (e.g. gas power plants), which will still be needed to secure energy demand.
- Aiming towards a more economical and affordable transition, the decision to transform the electricity market from a feed-in-tariff based system towards a bidding process for green power producers represented an important change in 2016. Renewable energies and their integration into the existing system remains a major challenge for the German energy policy, therefore the expansion of the electricity grid and the development of relevant storage facilities are the backbone for the successful integration of renewables. Also, policymakers must set the right framework towards a free and efficient European electricity market to limit the burden.

KEY METRICS

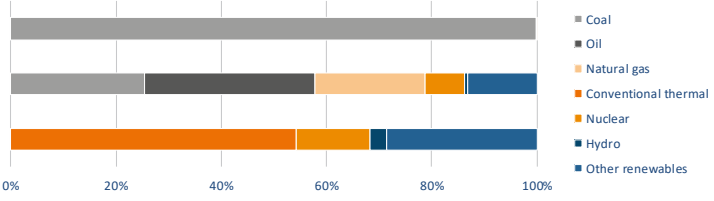
Industrial sector (% of GDP)	30.49	GDP per capita, PPP US$ (GDP Group)	48,861 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,457)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.33	Rate of transmission and distribution losses (%)	4.65
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2010 – 2014 (%)	-0.93

ENERGY PROFILE

Fossil fuel reserves: 25,275 Mtoe coal, 31 Mtoe oil, 29 Mtoe gas

Total primary energy supply composition

Diversity of electricity generation



GHANA

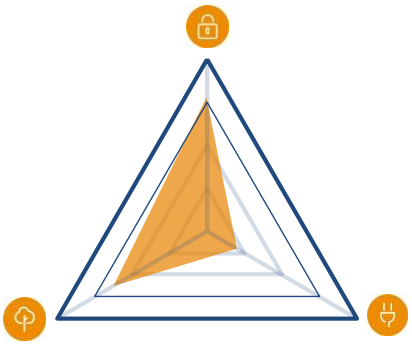
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

91

SCORE

ADB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**99**	**96**	**91**	▶	**ADB**
Energy performance					
Energy security	35	28	23	▶	A
Energy equity	106	106	106	▶	D
Environmental sustainability	81	76	45	▶	B
Contextual performance	91	82	90	▶	

TRENDS AND OUTLOOK

- Ghana improves by 5 spots this year, rising from rank 96 in 2016 to rank 91 in 2018. Whilst performing well in Energy Security, Energy Equity remains weak. This results in an overall balance score of ADB.
- In order to improve energy security, energy equity and environmental sustainability, Ghana needs to address a number of related challenges, such as: 1) the lack of a credible, sustained and focused energy policy; 2) the inability to execute policies; 3) governmental interference; and 4) ineffective regulatory authorities.
- Recent policy developments include: the enactment of Electricity Regulations, 2008 (L.I 1937), which is intended to provide for the planning, expansion, safety criteria, reliability and cost-effectiveness of the Interconnected Transmission System, and to regulate the wholesale electricity market; the enactment of the Renewable Energy Act, 2011 (Act 832) to improve the development, management and utilisation of renewable energy sources for production of heat and power in an efficient and environmentally-sustainable manner; the enactment of the Energy Commission (Local Content and Local Participation) (Electricity Supply Industry) Regulations, 2017 (L.I 2354) which seeks to provide the enabling environment to ensure the maximum use of local financial capital, expertise, goods and services to create employment for Ghanaians, promote businesses in the Electricity Supply Industry, and retain the benefits in the republic; and the incorporation of Ghana Gas Company in July 2011 with the responsibility to build, own, and operate infrastructure required for gathering, processing, transporting and marketing natural gas in Ghana.

KEY METRICS

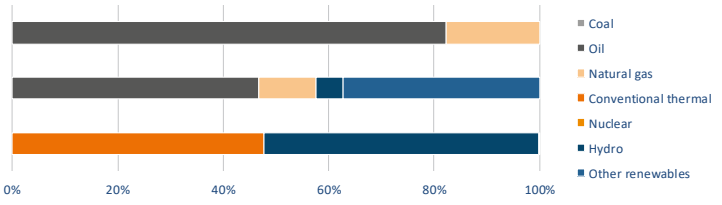
Industrial sector (% of GDP)	27.6	GDP per capita, PPP US$ (GDP Group)	4,292 (IV)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 2,441)
Population with access to electricity (%)	79	Access to clean cooking (%)	22
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	23.6
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2010 – 2014 (%)	6.56

ENERGY PROFILE

Fossil fuel reserves: 109 Mtoe

Total primary energy supply composition

Diversity of electricity generation



GREECE

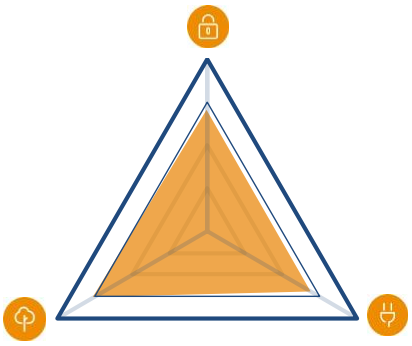
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

32

SCORE

BBA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**33**	**29**	**32**	▶	**BBA**
Energy performance					
Energy security	56	42	31	▶	B
Energy equity	44	48	51	▶	B
Environmental sustainability	19	18	30	▶	A
Contextual performance	46	53	56	▶	

TRENDS AND OUTLOOK

- Greece drops 3 places to rank 32 in this year's Index. The country continues to balance the energy trilemma well, with noticeable improvement seen in the Energy Security dimension, resulting in a letter grade of BBA.
- Greece has put in place a number of policy instruments to meet the ever-increasing electricity demand, favouring the market uptake of renewable energy sources. The aim is also to attempt to reduce the share of coal in electricity generation. If successful, such plans can help to improve the country's energy security and environmental sustainability Trilemma performance.
- A remuneration policy framework for renewables allows feed-in tariffs (FITs) only for small PV systems, while large installations participate via competitive schemes. This requires healthy competition among electricity generators and encourages renewable energy investors to step in without generous FITs. Some PV capacity has been installed, but to accelerate the domestic PV market, the country has implemented a net-metering scheme, applicable only to solar PV installations for self-consumption (both rooftop and ground-mounted systems).

KEY METRICS

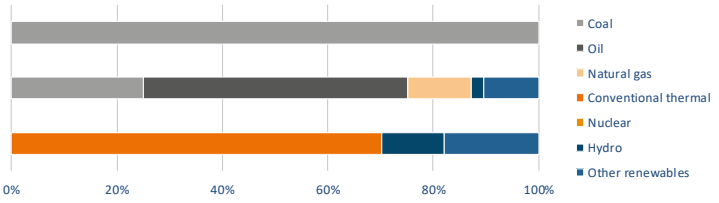
Industrial sector (% of GDP)	15.69	GDP per capita, PPP US$ (GDP Group)	26,779 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,473)
Population with access to electricity (%)	100	Access to clean cooking	94.29
Household electricity prices (US$/kWh)	0.19	Rate of transmission and distribution losses (%)	7.5
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2010 – 2014 (%)	-2.13

ENERGY PROFILE

Fossil fuel reserves: 2,013 Mtoe

Total primary energy supply composition

Diversity of electricity generation



HONG KONG

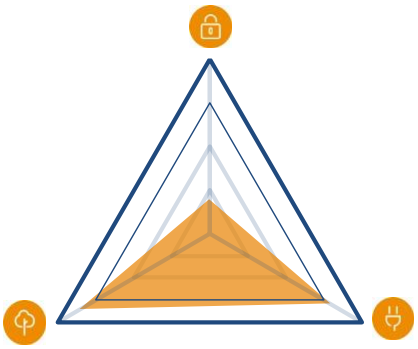
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

34

SCORE

DAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**37**	**34**	**34**	▶	**DAA**
Energy performance					
Energy security	117	111	111	▶	D
Energy equity	31	32	28	▶	A
Environmental sustainability	20	22	13	▶	A
Contextual performance	7	10	13	▶	

TRENDS AND OUTLOOK

- Hong Kong maintains its rank this year at 34. Whilst receiving excellent scores in both Energy Equity and Environmental Sustainability dimensions, the country performs less well in Energy Security, resulting in an imbalanced trilemma score of DAA.
- The economy has scarce indigenous energy sources. Hong Kong has been importing power from the Mainland for more than 20 years and at present around 25% of Hong Kong's electricity is reliably imported from the Mainland. Transmission and distribution losses in 2017 showed an improving trend at 4.04%. Natural gas accounts for around 28% of Hong Kong's overall fuel mix. Hong Kong signed a Memorandum of Understanding with the National Energy Administration of the Central People's Government in 2008 guaranteeing continued nuclear supply and enhanced supplies of natural gas for the next two decades. The Hong Kong Special Administrative Region (HKSAR) Government has put in place a contingency plan for oil in the event of disruption. A code of practice requires major oil companies to maintain a minimum of 30 days' supply of gas oil and naphtha.
- To help combat climate change and further improve air quality, Hong Kong has set a 2020 fuel mix target whereby natural gas will generate around half of its electricity by 2020. In July 2018, the HKSAR Government approved an offshore LNG terminal and connecting pipelines to allow secure access for gas from world markets. The HKSAR Government also approved the enhancement of the clean energy transmission system with the Mainland.
- Hong Kong's low-carbon transformation target I to reduce carbon intensity by 65%-70% by 2030 compared with the 2005 level. Hong Kong will continue to phase down coal-fired electricity generation and use more clean energy (i.e. natural gas and non-fossil fuel sources), promoting development of renewable energy (RE) where technically and financially feasible. A Feed-in Tariff Scheme from the fourth quarter of 2018 will encourage the development of distributed RE by the private sector. Looking ahead, a Public Engagement exercise on Long-term Decarbonisation Strategy will be conducted at the end of 2018 to explore possible options of utilising more zero carbon energy.

KEY METRICS

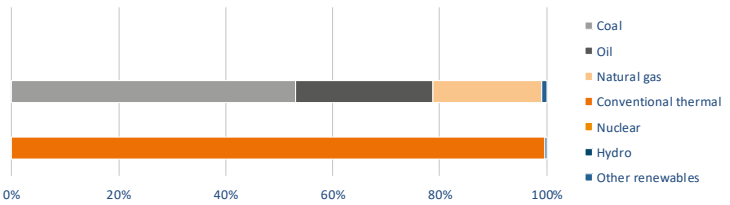
Industrial sector (% of GDP)	7.28	GDP per capita, PPP US$ (GDP Group)	58,618 (I)
Energy intensity (koe per US$)	0.03	Diversity of international energy suppliers	Low (HHI = 2,604)
Population with access to electricity (%)	100%	Access to clean cooking in urban | rural areas (%)	N.A. | N.A.
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	9.39
CO_2 intensity (kCO_2 per US$)	N.A	GHG emission growth rate 2010 – 2014 (%)	N.A

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



INDIA

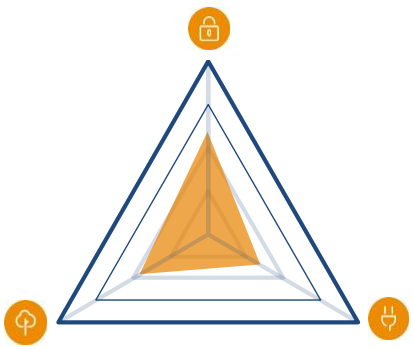
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

88

SCORE

BCC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**91**	**92**	**88**	▶	**BCC**
Energy performance					
Energy security	51	66	54	▶	B
Energy equity	93	96	93	▶	C
Environmental sustainability	97	92	75	▶	C
Contextual performance	100	86	81	▲	

TRENDS AND OUTLOOK

- India improves by 4 places this year to rank 88 with a balance score of BCC. While the Energy Security score moves from C to B, the country also demonstrates substantial improvement in Environmental Sustainability rank.
- India's Nationally Determined Contribution to the 2015 Paris agreement, aiming to achieve a 33% decrease in GHG intensity of GDP compared to 2005 and 40% renewable installed capacity by 2030, guide energy policy in India.
- India's energy policy schemes cover the following categories:
  1) Energy diversity: the target is to achieve 175 GW renewable energy capacity by 2022 (from 70GW in 2018), including 100 GW solar and 60 GW wind, while increasing the share of gas in the energy mix. Steps for gas include expansion of city gas distribution and plans for an LNG trading hub; regulation encourages the implementation of energy storage for large solar plants, domestic PV manufacturing and combination of wind and solar in hybrid systems.
  2) Energy access: the targets are 100% Household Electrification by December 2018 and '24x7 Power for all' by March 2019. The use of cooking gas is subsidised by the 2013 Direct Benefit Transfer programme.
  3) Energy security. The implementation of the common Hydrocarbon Exploration Licensing Policy (HELP) aims to boost domestic production. The national policy on biofuels frames and subsidises the use of several types of biomass for fuel.
  4) Energy efficiency measures include demand-side management through the Smart Meter Programme and industrial energy efficiency certifications delivered by the third cycle of the Perform, Achieve and Trade (PAT) scheme.
- Key challenges include: 1) Improving the financial performance of distribution companies; 2) mitigating rising oil prices and import dependence; 3) expanding energy access; 4) integrating large variable renewable energy capacity.

KEY METRICS

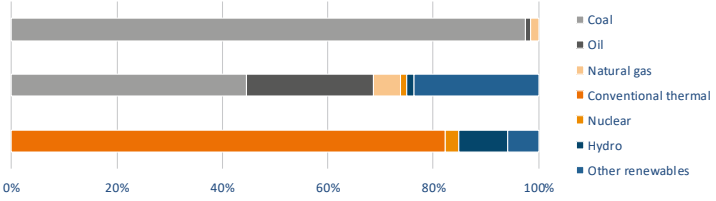
Industrial sector (% of GDP)	29.61	GDP per capita, PPP US$ (GDP Group)	6,571 (III)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 800)
Population with access to electricity (%)	85	Access to clean cooking (%)	41
Household electricity prices (US$/kWh)	0.08	Rate of transmission and distribution losses (%)	19.93
CO_2 intensity (kCO_2 per US$)	0.29	GHG emission growth rate 2010 – 2014 (%)	6.09

ENERGY PROFILE

Fossil fuel reserves: 70,131Mtoe

Total primary energy supply composition

Diversity of electricity generation



INDONESIA

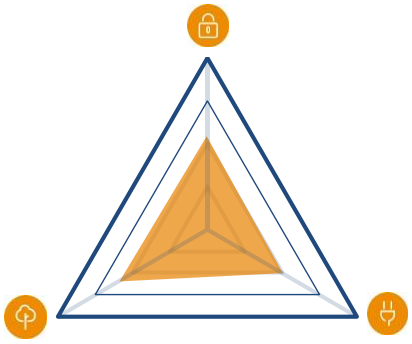
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

71

SCORE

BBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**85**	**75**	**71**	▶	**BBB**
Energy performance					
Energy security	63	59	61	▶	B
Energy equity	88	82	82	▶	B
Environmental sustainability	77	68	57	▲	B
Contextual performance	77	83	80	▶	

TRENDS AND OUTLOOK

- Indonesia improves by 4 places this year to rank 71. It exhibits a good performance in both Energy Security and Environmental Sustainability, but slightly lags behind in Energy Equity, resulting in a balance score of BBB.
- Fossil fuels remain the dominant energy source for Indonesia. Levels of development and deployment of efficient, low-carbon and carbon-free energy technologies are slower than expected to fulfil sustained energy demand growth, which remains positive under significant energy subsidies, US$ 7.29 billion in 2017 (0.72 % of GDP).
- National energy policy has set targets of supply and utilization of Primary Energy and Final Energy shall be as follows: a) the fulfilment of Primary Energy supply in 2025 around 400 MTOE and around 1000 MTOE in 2050; b) the achievement of per-capita primary energy utilisation around 1.4 TOE in 2025 and around 3.2 TOE in 2050; c) the fulfilment of power generation capacity provision around 115 GW in 2025 and around 430 GW in 2050; and d) the achievement of per-capita electricity utilization around 2500 KWh in 2025 and around 7000 KWh in 2050.
- To meet the targets, the National Energy Master Plan stipulates a targets for the optimal Primary Energy mix shall be achieved: 1). the role of the new energy & renewable energy at least 23% in 2025 and to be at least 31% in 2050 provided that its economical fulfilled; 2) the role of oil shall be less than 25% in 2025 and to be less than 20% in 2050; 3). The role of coal at least 30% in 2025, and 25% at the minimum in 2050; and 4) the role of natural gas at least 22% in 2025 and at least 24% in 2050.
- Key issues for policymakers continue to include: 1) increase the role of low-carbon and carbon-free energy technologies and embed them in the long-term energy plan; 2) increase energy efficiency on both supply and demand sides; 3) provision of subsidies is specifically targeted for intended recipients (low-income communities); 4) provide incentives for private institutions or individuals who develop key technologies in the field of new energy and renewable energy; and 5) encourage diversification of energy sources and new & renewable energy development programs by providing incentives fiscal and non-fiscal at national & regional levels.

KEY METRICS

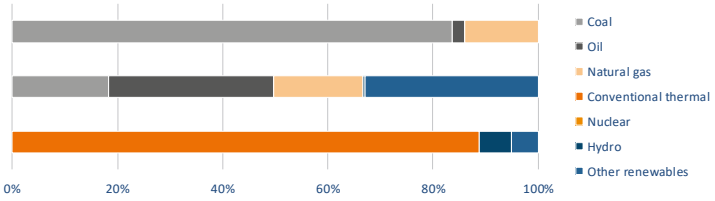
Industrial sector (% of GDP)	40.04	GDP per capita, PPP US$ (GDP Group)	11,609 (III)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	Medium (HHI = 1,915)
Population with access to electricity (%)	98	Access to clean cooking	58.37%
Household electricity prices (US$/kWh)	0.10	Rate of transmission and distribution losses (%)	9.77
CO_2 intensity (kCO_2 per US$)	0.19	GHG emission growth rate 2010 – 2014 (%)	3.57

ENERGY PROFILE

Fossil fuel reserves: 18,880 Mtoe

Total primary energy supply composition

Diversity of electricity generation



IRAN (ISLAMIC REPUBLIC)

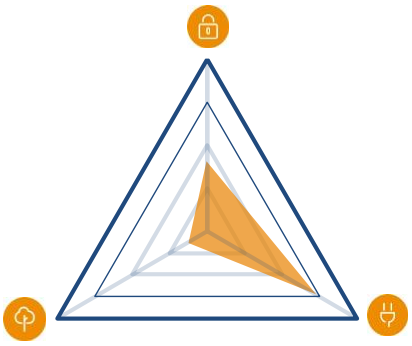
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

81

SCORE

CBD



	2016	2017	2018	Trend	Score
Overall rank and balance score	**78**	**81**	**81**	▶	**CBD**
Energy performance					
Energy security	58	79	82	▶	C
Energy equity	40	40	38	▶	B
Environmental sustainability	119	119	119	▶	D
Contextual performance	105	90	83	▶	

TRENDS AND OUTLOOK

- Iran maintains a stable position at rank 81 in this year's Index. A good score for Energy Equity is offset by weak performance in Energy Security and Environmental Sustainability, resulting in a balance score of CBD.
- Home of the world's fourth largest proved crude oil reserves and second largest natural gas reserves, Iran's energy sector has not managed to develop, due to international sanctions. After sanctions were lifted in early 2016, Iran's oil exports have tripled compared to figures from late 2015, now exceeding 2 million barrels per day.
- Further, Iran has managed to attract significant foreign investment and more efficient technologies for energy generation and transformation are now being employed. This includes a contract with Turkey to build 5,000 MW of advanced combined-cycle power plants with about 60% efficiency, to be completed within the next three years.
- The country is also taking steps to address the trilemma's environmental sustainability dimension, with plans to install 5 GW of both solar panels and wind turbines by 2021. These could help to render Iran's renewable energy infrastructure more resilient to extreme weather events: recurring droughts have significant negative effects on the country's hydroelectric power plants. Due to droughts in early 2016, hydropower plants are only able to operate at around 15% capacity.

KEY METRICS

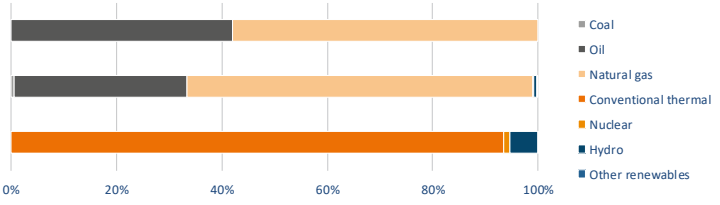
Industrial sector (% of GDP)	24.46	GDP per capita, PPP US$ (GDP Group)	19,949 (II)
Energy intensity (koe per US$)	0.14	Diversity of international energy suppliers	High (HHI = 1,347)
Population with access to electricity (%)	99	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.02	Rate of transmission and distribution losses (%)	11.2
CO_2 intensity (kCO_2 per US$)	N.A	GHG emission growth rate 2010 – 2014 (%)	4.25

ENERGY PROFILE

Fossil fuel reserves: 51,487 Mtoe

Total primary energy supply composition

Diversity of electricity generation



IRELAND

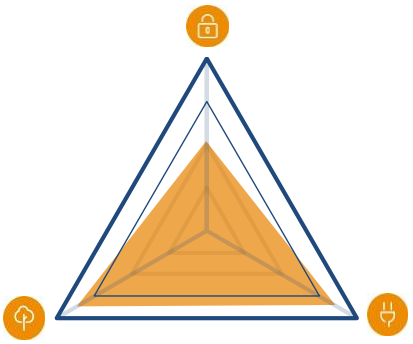
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

17

SCORE

BAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**20**	**20**	**17**	▶	**BAA**
Energy performance					
Energy security	77	85	66	▶	B
Energy equity	16	10	18	▶	A
Environmental sustainability	7	2	10	▶	A
Contextual performance	10	6	12	▶	

TRENDS AND OUTLOOK

- Ireland improves by 3 places to rank 17 in this year's Index. It improves its Energy Security score and performs well in Energy Equity and Environmental Sustainability, resulting in a balance score of BAA.
- In 2015, Ireland imported 88% of its energy needs. At the same time, total primary energy use in Ireland increased by 4.9% in 2015 with the economy growing strongly. Fossil fuels accounted for 91% of all energy used in Ireland with oil remaining as the dominant fuel source (48%), followed by gas (27%), coal (10%), renewable energy (8%) and peat (6%), with the balance comprising electricity imports and energy from waste. Ireland has set one of the world's most ambitious renewable energy targets: to produce 40% of its electricity from renewable energy by 2020, with the majority of this expected to come from wind-powered generation. In 2015, 27.3% of gross electricity consumption came from renewable sources.
- A full review of Irish national energy policy was undertaken and the outcome is set out in the December 2015 White Paper; 'Ireland's Transition to a Low Carbon Energy Future.' It envisages a reduction of 80–95% in energy-related emissions by 2050. The White Paper identifies the non-traded sector as the primary focus of government policy, which would involve decarbonising the heat and transport sectors.

KEY METRICS

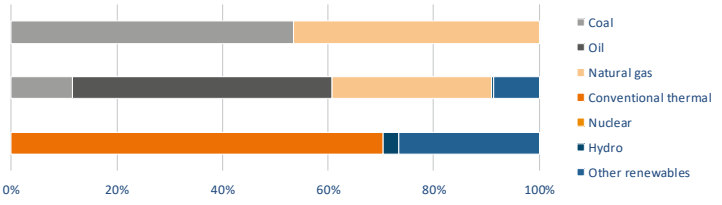
Industrial sector (% of GDP)	41.65	GDP per capita, PPP US$ (GDP Group)	71,472 (I)
Energy intensity (koe per US$)	0.04	Diversity of international energy suppliers	Low (HHI = 3,578)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.26	Rate of transmission and distribution losses (%)	7.44
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2010 – 2014 (%)	-1.41

ENERGY PROFILE

Fossil fuel reserves: 18 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ISRAEL

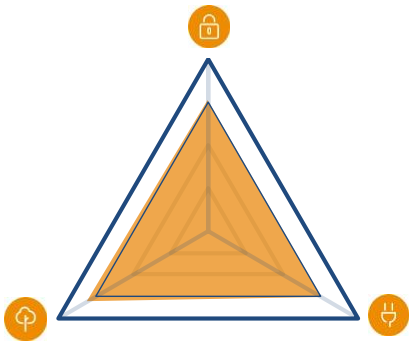
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

15

SCORE

AAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**34**	**26**	**15**	▶	**AAA**
Energy performance					
Energy security	85	49	25	▶	A
Energy equity	36	36	34	▶	A
Environmental sustainability	29	28	19	▶	A
Contextual performance	22	23	21	▶	

TRENDS AND OUTLOOK

- Israel continues to improve its Trilemma performance, rising to rank 15 this year. Further improvements in energy security, building upon those reported last year, lead to a balanced and strong performance across the three dimensions, with a balance score of AAA.
- Recent progress on natural gas volume estimations in the Leviathan gas field, discovered in 2010, can bring about significant change to the country's energy landscape, and potentially beyond. Israel has largely relied on fossil fuel imports to meet its growing energy needs; the exploitation of the natural gas reserves could be critical to the country's energy security. The identified reserves are reflected in Israel's Energy Security score, but with technical, environmental, and political challenges around exploitation of the resource, Israel's energy mix is unlikely to change rapidly.
- Recent policy developments driving the sustainability agenda in Israel include: 1) the National Energy Efficiency Programme; and 2) a target for renewable electricity generation – set at 10% by 2020 – to help counteract increasing energy demand and reduce GHG emissions.
- The greatest challenges for policymakers are to: 1) ensure that production of new resources is carried out efficiently; 2) set a binding target for reducing GHG emissions; and 3) closely monitor the implementation of the energy efficiency programme.

KEY METRICS

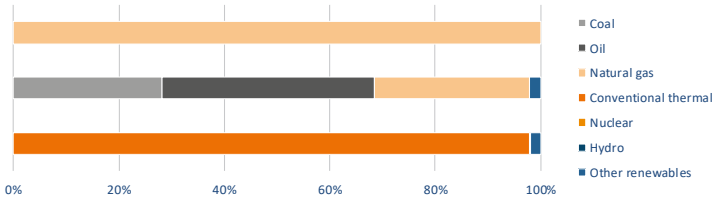
Industrial sector (% of GDP)	31.4	GDP per capita, PPP US$ (GDP Group)	37,258 (I)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	High (HHI = 1,172)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	3.22
CO_2 intensity (kCO_2 per US$)	0.26	GHG emission growth rate 2010 – 2014 (%)	1.34

ENERGY PROFILE

Fossil fuel reserves: 410 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ITALY

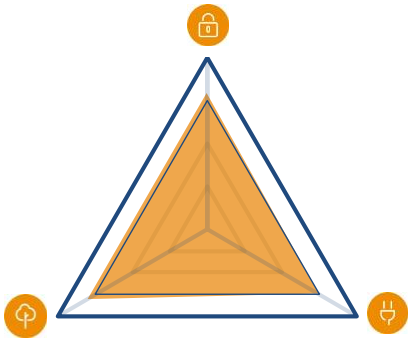
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

20

SCORE

AAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**17**	**16**	**20**	▶	**AAA**
Energy performance					
Energy security	19	17	20	▶	A
Energy equity	32	35	35	▶	A
Environmental sustainability	14	13	21	▶	A
Contextual performance	40	40	40	▶	

TRENDS AND OUTLOOK

- Italy's rank adjusts slightly to 20 this year. Good scores across the board result in a very well-balanced trilemma profile grade of AAA. Future iterations of the trilemma will continue to reflect the benefits of ongoing policy implementations.
- Italy proceeded on its path to strengthen its environmental sustainability, reduce its greenhouse gas (GHG) emissions, and improve the efficiency and security of its energy system: RES covered 17.7% of gross final energy consumption; energy efficiency continued to grow: the GDP energy intensity dropped by 4.9% as compared to 2013; Italy's dependence on foreign supply sources continued to reduce: energy imports (76,5%) were down by 6 percentage points versus 2010; there remains an energy cost gap between Italy and the EU on which Italy is working in order to close the gap. This target is going to be achieved through the reduction of the average cost of power generation from RES, the convergence of power generation mixes across European countries, the natural-gas cost alignment, the liberalisation of final markets, and the progressive reduction of system charges.
- Italy's National Energy Strategy 2017, the most relevant and recent general policy development, lays down the actions to be achieved by 2030 which provides for a reduction of emissions by at least 80% from their 1990 levels. The targets to be achieved by 2030 are i) enhancing Italy's competitiveness, by continuing to bridge the gap between Italian energy prices and costs and European ones; ii) attaining Europe's environmental and decarbonisation targets by 2030 in sustainable ways, in line with the future targets set by COP211; iii) continuing to improve the security of energy supply and the flexibility of energy systems and infrastructures.

KEY METRICS

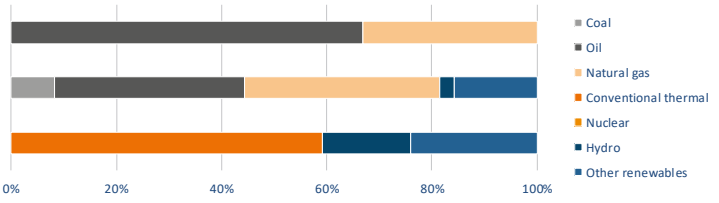
Industrial sector (% of GDP)	23.73	GDP per capita, PPP US$ (GDP Group)	38,380 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 861)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.27	Rate of transmission and distribution losses (%)	6.19
CO_2 intensity (kCO_2 per US$)	0.20	GHG emission growth rate 2010 – 2014 (%)	-2.03

ENERGY PROFILE

Fossil fuel reserves: 117 Mtoe

Total primary energy supply composition

Diversity of electricity generation



JAPAN

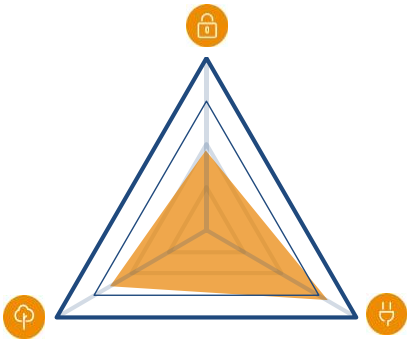
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

30

SCORE

CAB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**30**	**30**	**30**	▶	**CAB**
Energy performance					
Energy security	78	77	76	▶	C
Energy equity	23	18	23	▶	A
Environmental sustainability	41	40	41	▶	B
Contextual performance	21	20	20	▶	

TRENDS AND OUTLOOK

- Japan maintains a stable Trilemma balance score of CAB and holds position ranking 30. Challenges associated with energy security remain, but longer trends show that the country has been able to maintain a steady performance across all dimensions.
- The second "Basic Energy Plan" after Fukushima nuclear accident was publicized by the government in July 2018. The plan is almost same as the first one released three years ago. The energy mix in 2030 will be 22% to 24% renewable, 20 to 22% nuclear and 56% fossil fuel. The basic policy of this plan is "Renewable energy will be the main power source for 2050 and the dependence on nuclear shall be decreased as much as possible", is unchanged from the previous policy.
- Considering the current share of power sources (2% of nuclear, 15% of renewable, about 80% of fossil fuel), it is essential to restart the nuclear power plants more smoothly. The plan pinpoints Japan's high reliance on fossil fuel overseas. It also emphasizes the need of promoting energy conservation and decarbonization of energy sources to mitigate climate change. Clean coal technologies such as ultra -supercritical power plants (USC) should be promoted by exporting coal fired thermal power plants to the Southeast Asian countries.
- Towards the year 2050, the promotion of R&D aiming at cost reduction of renewable energy, hydrogen utilization and electricity storage is an essential issue. The biggest concern is the future of nuclear. Nuclear is positioned as a base load power source for the time being, although its share is to be decreased in the long term. Therefore, the necessity restoring public trust in nuclear is frequently repeated. This means nuclear power is an indispensable energy source for Japan.

KEY METRICS

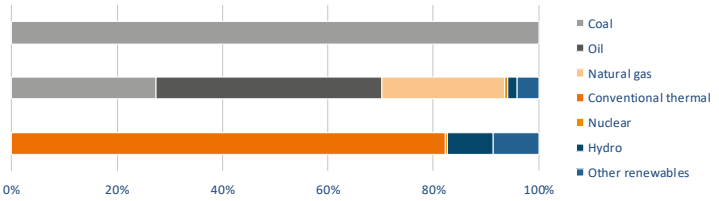
Industrial sector (% of GDP)	28.89	GDP per capita, PPP US$ (GDP Group)	42,281 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,050)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.22	Rate of transmission and distribution losses (%)	4.56
CO_2 intensity (kCO_2 per US$)	0.27	GHG emission growth rate 2010 – 2014 (%)	0.29

ENERGY PROFILE

Fossil fuel reserves: 245 Mtoe

Total primary energy supply composition

Diversity of electricity generation



JORDAN

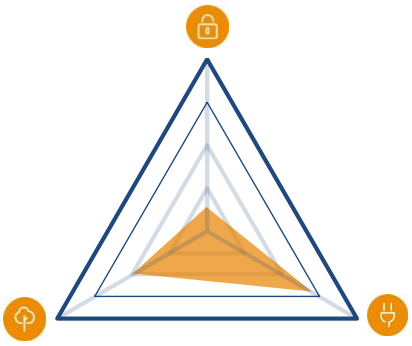
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

86

SCORE

DBC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**75**	**87**	**86**	▶	**DBC**
Energy performance					
Energy security	106	121	121	▶	D
Energy equity	52	56	50	▶	B
Environmental sustainability	82	78	72	▶	C
Contextual performance	72	69	70	▶	

TRENDS AND OUTLOOK

- Jordan ascends one place in the ranking this year to 86. Energy equity remains the top performing dimension, while energy security is particularly weak, due to high import dependence and limited diversity of power generation, resulting in a balance score of DBC.
- The major current challenges for the country are an extremely high dependence on imports, 94% of energy demand annually met through imports. This carries a heavy cost burden, representing about 8.5% of the GDP in 2017. The Noble Energy Agreement of 2016 secured 300 million BTU supply from 2020-2035. Although Where the percentage of insurance supply of oil derivatives for the year 2017 to continue to 100%.
- Energy demand is projected to continue to grow 5% annually with the flow of refugees, national population growth, and expansion of development projects. The country's current and future top priorities are to achieve a diversification of energy sources by introducing alternative energy, exploiting domestic reserves, and switching from imported of Piped Natural Gas (PNG) to Liquefied Natural Gas (LNG).
- Jordan has set several ambitious targets as follows: renewable energy in the total energy mix to reach 10% by 2020; build three new LPG storage facilities, a 70 BFC floating natural gas vessel, and increase oil and oil products capacity to 100 kt; continue to negotiate the implementation of the Iraqi oil pipeline project to provide crude oil and Natural Gas; growing shale oil to 6% of the energy mix by 2020; improving energy efficiency by 20%, aiming for GHG emissions of 962kt CO2 per year, with a further view to reduce emissions by 14% by 2030 in line with the Paris agreement commitment.

KEY METRICS

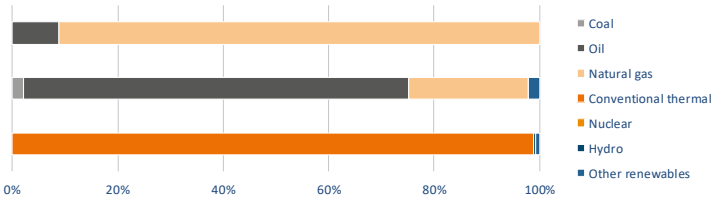
Industrial sector (% of GDP)	29.64	GDP per capita, PPP US$ (GDP Group)	9,048 (III)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Medium (HHI = 2,280)
Population with access to electricity (%)	100	Access to clean cooking (%)	99
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	10.9
CO_2 intensity (kCO_2 per US$)	0.34	GHG emission growth rate 2010 – 2014 (%)	4.03

ENERGY PROFILE

Fossil fuel reserves: 6 Mtoe

Total primary energy supply composition

Diversity of electricity generation



KAZAKHSTAN

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

72

SCORE

BBD

	2016	2017	2018	Trend	Score
Overall rank and balance score	**82**	**78**	**72**	▶	**BBD**
Energy performance					
Energy security	65	65	62	▶	B
Energy equity	54	59	57	▶	B
Environmental sustainability	122	120	117	▶	D
Contextual performance	50	45	50	▶	

TRENDS AND OUTLOOK

- Kazakhstan continues to climb up the Trilemma ranking, gaining 6 places to rank 72 this year. There is relative improvement across all dimensions, reporting strong equity performance, and a poor score in environmental sustainability, resulting in a balance grade of CBD.
- Recent policy developments in Kazakhstan include: strengthening state institutions responsible for energy efficiency in production, extraction and consumption of energy; clear and comprehensive energy saving programmes to reduce the energy intensity of industry (a 25% reduction by 2020 compared to 2008); the adoption of policies to support the development and inclusion of available renewable energy sources (RES) into the energy mix (renewable and alternative sources by 2050 should provide 50% of the country's electricity); and plans and programmes to facilitate the modernisation of existing power generation, power grids and oil refining installations. The diversification of the generation portfolio will be enhanced by Kazakhstan's Transition to a Green Economy, approved by the Order of the President of Kazakhstan in 2013.
- Policymakers will continue existing successful practices to maintain a favourable investment climate, which allows improvements to the country's trilemma balance, and attracts investment into the exploration and production of energy resources for export to world markets. There is a need to further develop power generating facilities by introducing cutting-edge technologies that will not only ensure domestic supply, but also enable the country to offer significant amounts of electricity to markets in neighbouring countries.

KEY METRICS

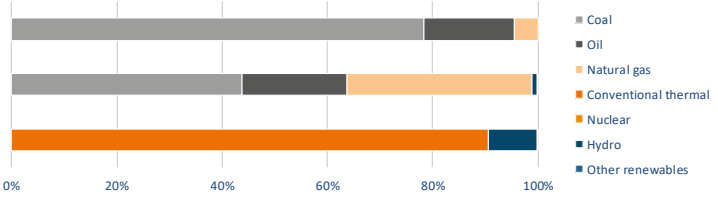
Industrial sector (% of GDP)	32.53	GDP per capita, PPP US$ (GDP Group)	25,286 (II)
Energy intensity (koe per US$)	0.10	Diversity of international energy suppliers	Low (HHI = 5,196)
Population with access to electricity (%)	100	Access to clean cooking (%)	95
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	7.55
CO_2 intensity (kCO_2 per US$)	0.60	GHG emission growth rate 2010 – 2014 (%)	5.11

ENERGY PROFILE

Fossil fuel reserves: 22,885 Mtoe

Total primary energy supply composition

Diversity of electricity generation



KENYA

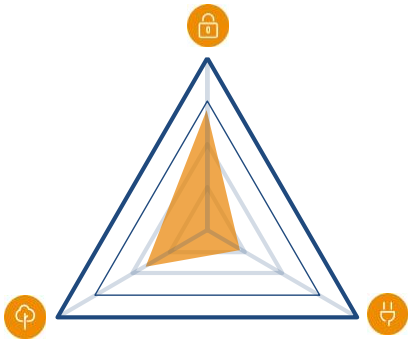
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

94

SCORE

BDC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**107**	**100**	**94**	▶	**BDC**
Energy performance					
Energy security	47	24	34	▶	B
Energy equity	118	109	103	▶	D
Environmental sustainability	58	80	82	▶	C
Contextual performance	89	85	88	▶	

TRENDS AND OUTLOOK

- Kenya improves its ranking to 94 in this year's Index. Whilst the country performs well when it comes to energy security, poor scores in both energy equity and environmental sustainability result in grades of D and C respectively, resulting in a balance score of BDC.
- Kenya's power supply situation has transformed significantly recently in terms of generation capacity, having addressed perennial supply shortages that have affected the country for over a decade. In the past Kenya had to rely heavily on diesel fired plants including emergency thermal power plants (EPPs), especially during periods of drought when hydro reservoirs were low. This has since improved with the increase in generation from geothermal and other renewable sources, allowing the retirement of a total of 120 MW of Emergency Power Producers (EPPs), with the last 30 MW phased out in mid-2016. Currently, the installed capacity stands at 2,333 MW, while peak demand is 1,665 MW.
- Power supply reliability is another area of great importance to Kenya. Recent initiatives include system overhauls and the construction of dedicated or alternative supply routes for industrial and commercial consumers, as well as for urban areas. Recently, the country has achieved a major milestone through the energisation of the 400kV Suswalsinya-Rabai line. This will evacuate excess power from the geothermal plants at Olkaira to the coast, reducing dependence on thermal generation in the region.
- In its long-term development strategy 'Vision 2030', energy was identified as one of the critical foundations and enablers of the socio-economic transformation envisioned for the country. To this effect, a number of policies and regulations have been developed: the 2015 Energy Bill to consolidate all laws relating to energy, the National Energy and Petroleum Policy 2015 to support the administration of all the proposed laws and the Petroleum Exploration, Development and Production Local Content Regulations 2014 Act for local content provisions, to name a few.

KEY METRICS

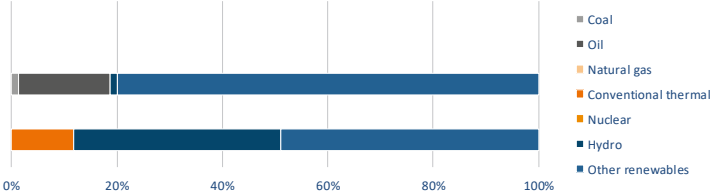
Industrial sector (% of GDP)	19.09	GDP per capita, PPP US$ (GDP Group)	3,155 (IV)
Energy intensity (koe per US$)	0.16	Diversity of international energy suppliers	Medium (HHI = 1,945)
Population with access to electricity (%)	56	Access to clean cooking (%)	13
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	16.26
CO_2 intensity (kCO_2 per US$)	0.11	GHG emission growth rate 2010 – 2014 (%)	2.85

ENERGY PROFILE

Fossil fuel reserves: N/A

Total primary energy supply composition

Diversity of electricity generation



KOREA (REP.)

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

35

SCORE

BAC

	2016	2017	2018	Trend	Score
Overall rank and balance score	**44**	**39**	**35**	▶	**BAC**
Energy performance					
Energy security	72	64	57	▶	B
Energy equity	35	26	17	▶	A
Environmental sustainability	88	84	92	▶	C
Contextual performance	28	28	27	▶	

TRENDS AND OUTLOOK

- Korea (Rep.) improves by 4 places this year to rank 35. It is performing particularly well on Energy Security and Energy Equity, resulting in a balance score of BAC. The sustainability rank drops slightly this year due to the relative performance of other countries, however Korea's combined score in this dimension shows a stable and gradually improving trend.
- Recent policy measures to enhance energy security include: increasing reliance on renewables; expanding cooperation with resource-rich countries and strengthening the competitiveness of new energy business models and innovative energy start-up companies.
- Environmental Sustainability policy measures include the gradual reduction in the use of coal and nuclear fuel and the country's energy policy shift from traditional energy resources to renewables, with goals of increasing the share of renewable energy from the current 7% up to 20% by 2030.
- Policymakers need to continue focusing on: 1) continued efforts in making energy transition to safe and clean energy for a sustainable environment; 2) the expansion of renewable energy with strong R&D support and broadening public acceptance; 3) Distributed power generation with a focus on ensuring sub-national energy sustainability.

KEY METRICS

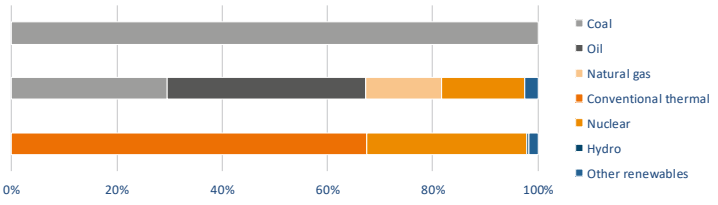
Industrial sector (% of GDP)	38.33	GDP per capita, PPP US$ (GDP Group)	2,109 (IV)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 850)
Population with access to electricity (%)	100	Access to clean cooking (%)	97
Household electricity prices (US$/kWh)	0.12	Rate of transmission and distribution losses (%)	3.5
CO_2 intensity (kCO_2 per US$)	N.A	GHG emission growth rate 2010 – 2014 (%)	2.14

ENERGY PROFILE

Fossil fuel reserves: 228 Mtoe

Total primary energy supply composition

Diversity of electricity generation



LATVIA

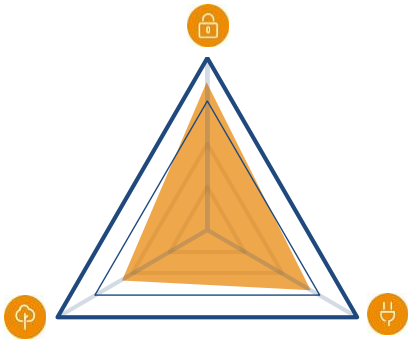
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

25

SCORE

ABB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**25**	**23**	**25**	▶	**ABB**
Energy performance					
Energy security	18	5	11	▶	A
Energy equity	38	46	55	▶	B
Environmental sustainability	56	45	59	▶	B
Contextual performance	26	33	35	▶	

TRENDS AND OUTLOOK

- Latvia drops by 2 spots this year to rank 25. The country exhibits a well-balanced trilemma profile, especially for Energy Security, resulting in a balance score of ABB.
- The Latvian Energy Long Term Strategy 2030 sets a target of 50% energy from renewable energy sources and a 50% reduction in energy imports from third country (Non-EU country) suppliers by 2030. An ongoing renovation of Latvia's hydroelectric power plants as well as a reconstruction of natural gas CCGT plants has meant that Latvia has so far managed to sustain its low level of GHG emissions in the power sector due the focus on the renewables sector. CHP projects using biomass are also in progress and wind projects are awaiting RES support schemes.
- The regional gas market development by 2020, as well as increased diversification of gas imports via a new LNG terminal in Lithuania and ongoing BEMIP-G projects, mean that Latvia's energy security and equity dimensions of the trilemma are all expected to improve in the future. In addition, the opening of the Latvian natural gas market to free trade and progress on the implementation of a planned connection from Latvia to Estonia, to be completed by 2020 as a part of the Baltic Energy Market Interconnection Plan (BEMIP) are also expected to have benefits for energy security and equity.
- The main political propositions for Latvia lie in preventing market failures, achieving energy policy neutrality and avoiding improperly promoted economic incentives, in the light of ensuring a balanced development of renewable energy. In addition, the opening of the Latvian natural gas market to free trade and progress on the implementation of Latvia - Estonia 3rd interconnection to be completed by 2020 as well as Kurzeme Ring project - construction of 330 kV power transmission line in the western part of Latvia to be completed by 2019 as a part of the Baltic Energy Market Interconnection Plan (BEMIP) are also expected to have benefits for energy security and equity.

KEY METRICS

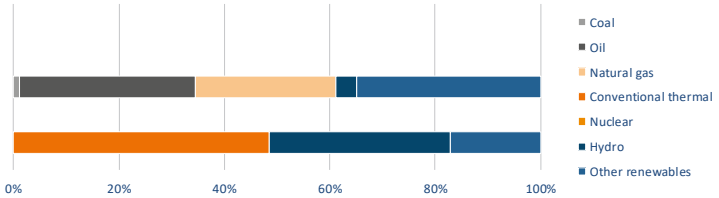
Industrial sector (% of GDP)	22.89	GDP per capita, PPP US$ (GDP Group)	25,587 (II)
Energy intensity (koe per US$)	0.1	Diversity of international energy suppliers	Low (HHI = 2,975)
Population with access to electricity (%)	100	Access to clean cooking (%)	95
Household electricity prices (US$/kWh)	0.18	Rate of transmission and distribution losses (%)	6.52
CO_2 intensity (kCO_2 per US$)	0.19	GHG emission growth rate 2010 – 2014 (%)	-0.03

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



LEBANON

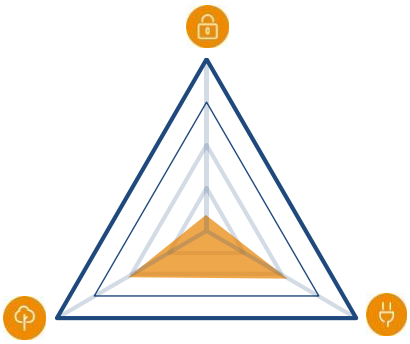
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

101

SCORE

DBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**86**	**95**	**101**	▶	**DBB**
Energy performance					
Energy security	113	122	124	▶	D
Energy equity	74	75	76	▶	B
Environmental sustainability	61	71	66	▶	B
Contextual performance	95	95	97	▶	

TRENDS AND OUTLOOK

- Lebanon moves 6 places in this year's ranking to rank 101, a new milestone achieved for sustainability in Lebanon reflecting efforts being made in this dimension. However, energy security remains a challenge with an overall balance score for this year at DBB.
- In 2010, the government approved a strategy for the rehabilitation of the power sector, including the development of energy efficiency and renewable energy to address the country's energy security concerns. Most recent data for Lebanon report energy intensity at 1.24 MJ/US$.
- Renewable energy in Lebanon takes the lead in the action priorities. Lebanon's commitment to 12% renewable energy by 2020 is on track and all actions, both from the private and public sectors are focused on expanding investments in this field. Energy efficiency and renewable energy strategies for Lebanon are documented in two official documents prepared by the Lebanese Center for Energy Conservation (LCEC) and the Lebanese Ministry of Energy and Water: The National Renewable Energy Action Plan 2016-2020 (NREAP) and the National Energy Efficiency Action Plan 2016-2020 (NEEAP). This further confirms the Ministry's adopted systematic approach to reach national goals. The launching of these action plans in addition to the deficit in electricity supply have set the ground for many renewable energy initiatives.

KEY METRICS

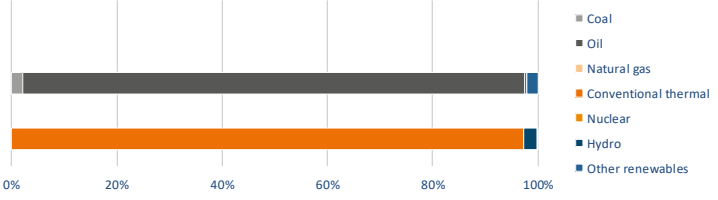
Industrial sector (% of GDP)	20.92	GDP per capita, PPP US$ (GDP Group)	14,309 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,485)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.12	Rate of transmission and distribution losses (%)	10.39
CO_2 intensity ($kgCO_2$ per US$)	0.33	GHG emission growth rate 2010 – 2014 (%)	3

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



LITHUANIA

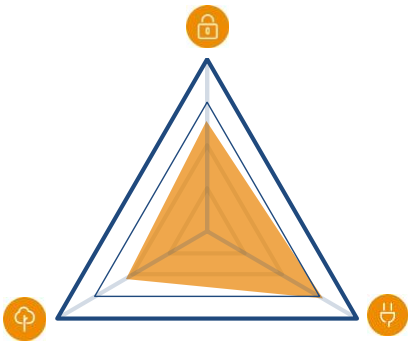
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

31

SCORE

BAB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**28**	**28**	**31**	▶	**BAB**
Energy performance					
Energy security	46	55	46	▶	B
Energy equity	34	29	31	▶	A
Environmental sustainability	40	26	64	▶	B
Contextual performance	34	34	31	▶	

TRENDS AND OUTLOOK

- Lithuania drops 3 places in this year's Trilemma rank. Strong score in Energy Equity is complemented by a good score in Energy Security, resulting in a balance grade of BAB.
- Lithuania expects to see improvements on the energy security and energy equity in the coming years due to the recent shift from relying on district heating and imported natural gas towards producing their own domestic biomass. The newly created biomass energy equipment and technology manufacturing industry has created over 7,000 jobs, with Lithuania also exporting this equipment and technology abroad.
- An important policy challenge will be to strengthen regional energy integration via the synchronisation of Lithuania's and both Latvian and Estonian electricity system with Continental Europe by 2025. Lithuania opened power links with Poland and Sweden in December 2015 and the establishment of an LNG terminal in December 2014 was another effort to enhance its independence from a monopoly exporter. Lithuania is a regional LNG leader and is focusing its attention on creating a LNG hub in Klaipeda. Security of regional gas supply and competitive gas prices will be ensured after the gas interconnection Lithuania – Poland is put into operation in 2021.
- Lithuania is making a major shift towards increasing electricity producing consumers up to 30 % by 2030 and no less than 50% in 2050. Green power generation both heat supply from biomass, wind and solar energy will constitute share of electricity – 45 % and for heat supply – by 90 %.
- Digitalisation of energy sector and smart installations will help to save energy in every house and to increase Lithuania's security of energy supply.

KEY METRICS

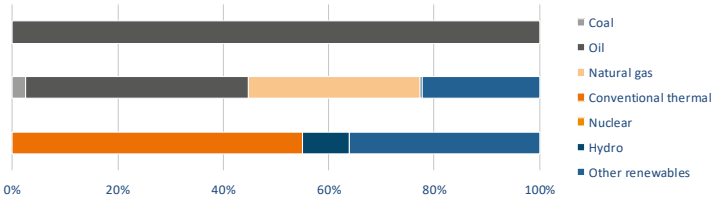
Industrial sector (% of GDP)	29.84	GDP per capita, PPP US$ (GDP Group)	29,862 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 4,256)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.14	Rate of transmission and distribution losses (%)	7.59
CO_2 intensity (kCO_2 per US$)	0.19	GHG emission growth rate 2010 – 2014 (%)	0.09

ENERGY PROFILE

Fossil fuel reserves: 1 Mtoe

Total primary energy supply composition

Diversity of electricity generation



MALAYSIA

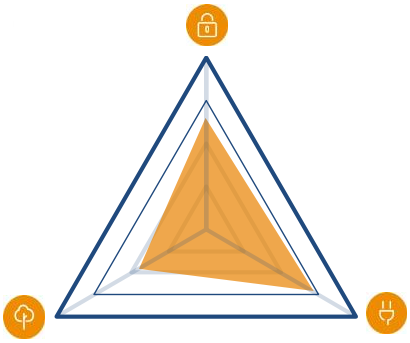
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

37

SCORE

BBC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**35**	**41**	**37**	▶	**BBC**
Energy performance					
Energy security	37	53	44	▶	B
Energy equity	41	39	39	▶	B
Environmental sustainability	83	85	77	▶	C
Contextual performance	33	30	33	▶	

TRENDS AND OUTLOOK

- Malaysia improves by 4 places this year to rank 37. It scores well across all trilemma dimensions, with a slightly lower score received for environmental sustainability, resulting in an overall balance score of BBC.
- Malaysia continues to face some challenges when it comes to developing Renewable Energy. These include the high cost of biomass feedstock for energy production, highly convoluted approval processes for small-scale hydro projects, lack of successful examples of municipal waste-to-energy-conversion projects, and remoteness of Palm Oil Mill Effluent biogas projects.
- Since energy consumption is identified as one of the major causes in climate change issues, the Government will give a major focus to prudent and efficient management of resources under the 11th Malaysia Plan, 2016-2020. As a precursor, the Government has approved the National Energy Efficiency Action Plan (2016-2025). Under the National Energy Efficiency Action Plan, the government aims to tackle issues pertaining to energy supply by managing demand efficiently. The Plan presents the instruments for a successful implementation of energy efficiency strategies in the country with a well-coordinated and cost-effective implementation of energy efficiency measures in the industrial, commercial and residential sectors to be implemented over a 10-year period, which will lead to reduced energy consumption and economic savings for the consumers and the nation.

KEY METRICS

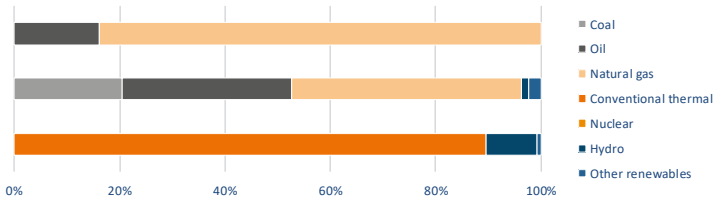
Industrial sector (% of GDP)	36.43	GDP per capita, PPP US$ (GDP Group)	27,683 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,250)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	6.07
CO_2 intensity (kCO_2 per US$)	0.33	GHG emission growth rate 2010 – 2014 (%)	4.77

ENERGY PROFILE

Fossil fuel reserves: 2,934 Mtoe

Total primary energy supply composition

Diversity of electricity generation



MEXICO

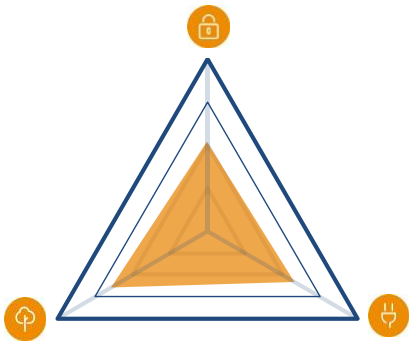
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

58

SCORE

BBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**52**	**57**	**58**	▶	**BBB**
Energy performance					
Energy security	59	57	65	▶	B
Energy equity	71	73	70	▶	B
Environmental sustainability	55	50	42	▶	B
Contextual performance	55	55	61	▶	

TRENDS AND OUTLOOK

- Mexico drops by 1 place in this year's Index to rank 58. The country performs well across the board, receiving a balance score of BBB.
- The Mexican energy sector is facing a dual challenge: a) the transition from a monopolistic structure to a competitive market scheme, following the market liberalisation in 2013; and b) the transition from a high-carbon to a low-carbon economy.
- Mexico is the second country, after the UK, which has enacted a law that frames the actions to be taken with regards to climate change (2012 General Law on Climate Change, LGCC), both from an emission mitigation point of view as well as measures of adaptation. Mexico's Intended Nationally Determined Contributions for COP21 include a 25% reduction in GHG emissions by 2030 (compared to a business-as-usual projection), with 35% of electricity generation to come from clean energies by 2024 and an aspirational goal of a 50% reduction in GHG emissions by 2050. Some delays have been observed in the implementation of the new renewable power plants which have increased the risk that the stated goals may not be reached.
- The greatest challenges policymakers need to focus on to meet the targets are: 1) the continuation of a renewable energy programme and the re-initiation of a nuclear programme; 2) continued increase of production of both oil and natural gas on and offshore as well as the development of shale gas resources; and 3) improved energy efficiency and energy conservation including cogeneration in order to reduce Mexico's energy intensity.

KEY METRICS

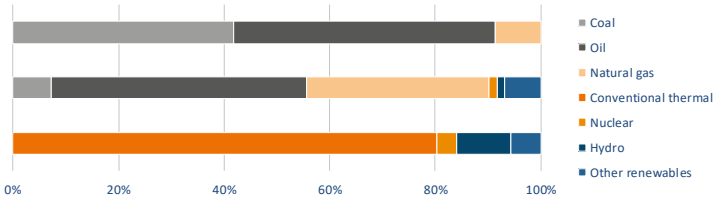
Industrial sector (% of GDP)	32.69	GDP per capita, PPP US$ (GDP Group)	17,275 (II)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	Low (HHI = 7,675)
Population with access to electricity (%)	100	Access to clean cooking (%)	85
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	14.27
CO_2 intensity (kCO_2 per US$)	0.25	GHG emission growth rate 2010 – 2014 (%)	1.13

ENERGY PROFILE

Fossil fuel reserves: 2,024 Mtoe

Total primary energy supply composition

Diversity of electricity generation



MONGOLIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

111

SCORE

DCD

	2016	2017	2018	Trend	Score
Overall rank and balance score	**114**	**106**	**111**	▶	**DCD**
Energy performance					
Energy security	114	102	119	▶	D
Energy equity	95	92	95	▶	C
Environmental sustainability	124	124	122	▶	D
Contextual performance	65	77	89	▶	

TRENDS AND OUTLOOK

- Mongolia drops by 5 places in this year's Index to rank 111. With relatively low score in all Trilemma dimensions, Mongolia has a balance score of DCD.
- An important challenge for the Mongolian energy sector is to develop a national integrated energy system. Currently four separate electricity grids are in operation. Therefore, the country is planning to connect these grids and expand the distribution system under the Programme on Mongolian Integrated Power System (2007–2040).
- Modernisation and increasing electric production capacity are priorities for the country. According to the Asian Development Bank, the share of electricity which is being imported from Russia to manage peak demand has been increasing over the past years. Due to ageing power plants it is essential to reduce losses by improving existing plants and operational management and to develop new plants to secure a reliable energy supply.
- Lastly, the government is aiming to increase the share of renewables in the national energy mix to 20% by 2020. The government is strengthening its international cooperation and working with international companies to develop the country's renewables potential, which has been estimated by the Mongolian National Renewable Energy centre to be approximately 2,600 GW.

KEY METRICS

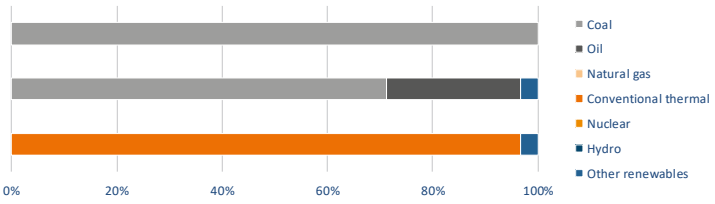
Industrial sector (% of GDP)	33.82	GDP per capita, PPP US$ (GDP Group)	12,252 (III)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	Low (HHI = 6,387)
Population with access to electricity (%)	82	Access to clean cooking (%)	43
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	12.83
CO_2 intensity (kCO_2 per US$)	0.56	GHG emission growth rate 2010 – 2014 (%)	5.51

ENERGY PROFILE

Fossil fuel reserves: 1,764 Mtoe

Total primary energy supply composition

Diversity of electricity generation



MOROCCO

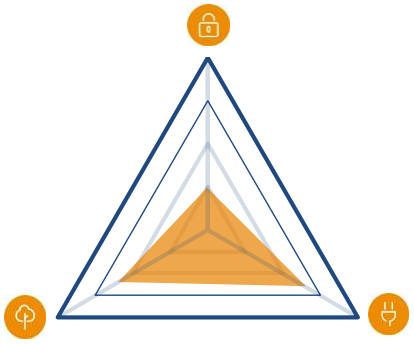
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

68

SCORE

DBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**80**	**77**	**68**	▶	**DBB**
Energy performance					
Energy security	111	109	96	▶	D
Energy equity	59	66	61	▶	B
Environmental sustainability	75	74	55	▶	B
Contextual performance	81	70	66	▶	

TRENDS AND OUTLOOK

- Morocco improves its ranking by 9 places to rank 66 this year Index. Relative gains in the equity dimension, as well as a new baseline for sustainability result in strong scores. The country performs poorly on energy security, although relatively stronger than in previous years. Morocco receives an overall balance score of DBB.
- Morocco has taken a strong initiative to develop renewable energy since 2008 in order to deal with high levels of energy imports and to reduce its dependency on fossil fuels. The country set a target to establish 6GW of renewable energy from solar, wind and hydropower, which will lead to 42% of installed power capacity in 2020 compared with 13% in 2015.
- According to the Climate Investment Funds, the first phase of the NOOR project, a group of 5 solar plans that was opened in 2016, can play a vital role to improve energy security and sustainability by producing enough energy to power over one million homes by 2018 and reducing emissions by an estimated 760,000 tons of CO2 per year. At the same time, the country is focusing on promoting energy efficiency. The goal for energy efficiency is to achieve a 20% improvement by 2030.
- Renewable energy and energy efficiency will keep its position as the heart of the national energy strategy in the country as US$11bn is projected to be invested in solar and wind over the next five years in Morocco.

KEY METRICS

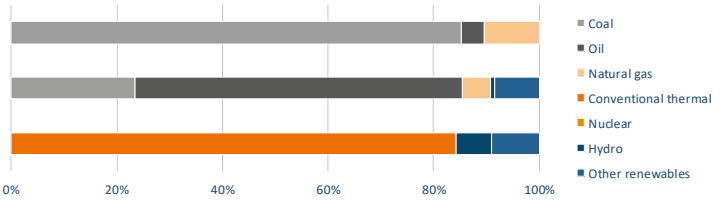
Industrial sector (% of GDP)	29.22	GDP per capita, PPP US$ (GDP Group)	7,857 (III)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	High (HHI = 1,009)
Population with access to electricity (%)	100	Access to clean cooking (%)	97
Household electricity prices (US$/kWh)	0.12	Rate of transmission and distribution losses (%)	13.02
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2010 – 2014 (%)	4.43

ENERGY PROFILE

Fossil fuel reserves: 11 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NAMIBIA

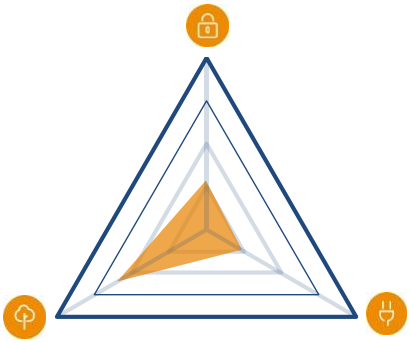
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

98

SCORE

CDB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**96**	**97**	**98**	▶	**CDB**
Energy performance					
Energy security	103	105	93	▶	C
Energy equity	100	100	101	▶	D
Environmental sustainability	45	53	51	▶	B
Contextual performance	59	60	65	▶	

TRENDS AND OUTLOOK

- Namibia ranks 98th in this year's Trilemma. Environmental sustainability is the strongest dimension, the energy security score has improved; however, energy equity dimension remains low, resulting in a balance score of CDB.
- Namibia has significant unextracted gas reserves offshore on the southwest coastline. Plans for a 442MW power station will improve the country's security of power supply, but for now Namibia relies on its neighbours (Zimbabwe, Zambia and South Africa) for 60% of its electricity supply. Currently Independent Power Producer projects, mostly for renewable energy, have been approved. Namibia also seeks to explore crude oil reserves and build an oil refinery.
- Since Namibia is a semi-arid country and does not have many rivers, extreme climatic phenomena such as droughts affect the country's ability to generate electricity through hydropower production.
- The National Energy Policy (NEP), replacing the 1998 White Paper on Energy, is now updated and in place, with other associated policies undergoing development, including the Renewable Energy Policy and the Independent Power Producer Investment Framework. The National Integrated Resource Plan is also an energy document that supports the NEP. Challenges remain around maintaining low energy prices for consumers and securing capital for projects.
- Namibia's energy landscape is undergoing a definite change. IPPs are driving innovative smart technologies, taking advantage of solar and wind resources to close existing gaps, establishing smart mini grids. Reducing emissions through cleaner and more efficient energy options is generally well received, although there are associated costs.

KEY METRICS

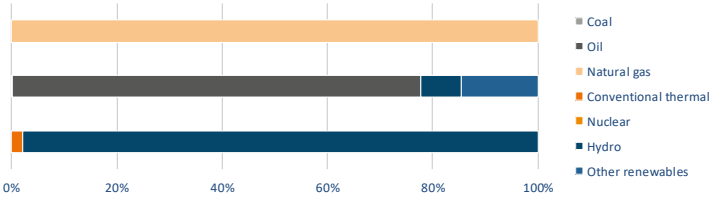
Industrial sector (% of GDP)	30.97	GDP per capita, PPP US$ (GDP Group)	10,625 (III)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Medium (HHI = 1,844)
Population with access to electricity (%)	52	Access to clean cooking (%)	42
Household electricity prices (US$/kWh)	0.11	Rate of transmission and distribution losses (%)	8.88
CO_2 intensity (kCO_2 per US$)	0.17	GHG emission growth rate 2010 – 2014 (%)	4.8

ENERGY PROFILE

Fossil fuel reserves: 53 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NEPAL

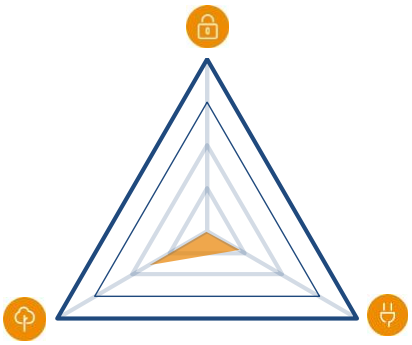
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

118

SCORE

DDC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**123**	**117**	**118**	▶	**DDC**
Energy performance					
Energy security	125	125	125	▶	D
Energy equity	111	103	104	▶	D
Environmental sustainability	86	81	84	▶	C
Contextual performance	115	116	112	▶	

TRENDS AND OUTLOOK

- Nepal drops by 1 place in this year's Index to rank 118. Energy security and equity remain in need of drastic improvement. Environmental sustainability is the highest performing dimension, resulting in an overall score of DDC.
- The key energy challenges for Nepal are to improve access to modern energy in rural communities, and to increase electricity supply to provide reliable energy services to the population.
- Nepal has one of the lowest levels of electrification among South Asian countries and the rural population is highly dependent on traditional biofuel for heating and cooking. At the same time, energy demand is expected to increase at over 8% per year until 2027, according to the Nepal Electricity Authority (NEA), resulting in ever increasing levels of unmet energy demand.
- To provide reliable and sustainable energy, several programmes have been carried out in Nepal, some with help from outside actors. The 'Rural Energy Development Programme' was launched in 1996, supported by the United Nations Development Programme (UNDP). The National Rural and Renewable Energy Programme (2012–2017) built on the Rural Energy Development Programme by building small hydropower and solar heating systems. Besides, the Nepalese Electricity Authority (NEA) is implementing the Community Rural Electrification Programme (CREP) consisting of registering and connecting rural communities. They notably benefit from support from the German Society for International Collaboration (GIZ).

KEY METRICS

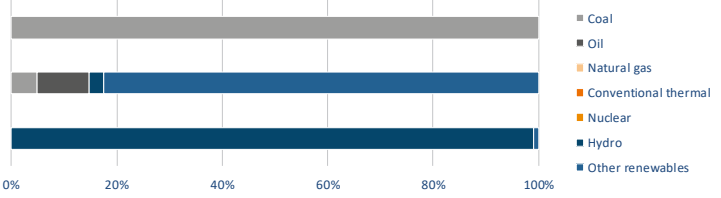
Industrial sector (% of GDP)	15.44	GDP per capita, PPP US$ (GDP Group)	2,478 (IV)
Energy intensity (koe per US$)	0.20	Diversity of international energy suppliers	Low (HHI = 8,693)
Population with access to electricity (%)	90	Access to clean cooking (%)	27
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	22.76
CO_2 intensity (kCO_2 per US$)	0.09	GHG emission growth rate 2010 – 2014 (%)	3.10

ENERGY PROFILE

Fossil fuel reserves: 1 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NETHERLANDS

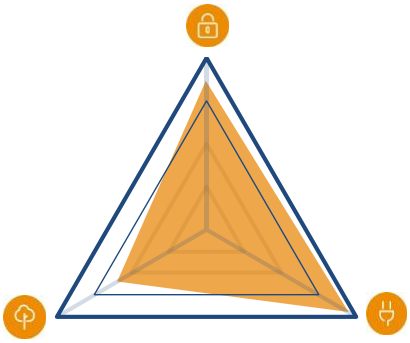
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

4

SCORE

AAB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**4**	**4**	**4**	▶	**AAB**
Energy performance					
Energy security	9	10	10	▶	A
Energy equity	3	3	4	▶	A
Environmental sustainability	42	38	54	▶	B
Contextual performance	6	5	5	▶	

TRENDS AND OUTLOOK

- Netherlands maintains its rank at number 4 in this year's Index, performing strongly across the board with a balance score of AAB. Its energy equity score is particularly good, achieving 4th place globally.
- The Netherlands is well-positioned in the Index, but still faces a number of challenges. These include: the public debate around installation of additional on and offshore wind capacity; high expectations of biomass in the face of challenging markets; ensuring solar surges and geothermal meet expectations given the low starting base and research into hydrogen options. Furthermore, energy efficiency progress is fairly slow.
- Key energy policy developments are: the green deals; energy innovation top sector approach designed to strengthen market steering, market involvement and market resources for energy; and the SDE+ (stimulation of sustainable/renewable energy) feed-in scheme that is fully operational and funded (over €1.5bn per annum).
- A key trend is the strong decentralisation of power generation, especially wind power on the North Sea. Policymakers have to create the framework and the finance to stimulate or facilitate this development, including the upgrade of the existing network such as smart grids. This is just more important as the gas production of the Groningen Field will be diminished to zero over a period of years. The government has committed itself to 49% reduction of CO2 by 2030, which makes them dependant on offshore wind in the North Sea. Plans to that extent will be presented by the end of 2018.

KEY METRICS

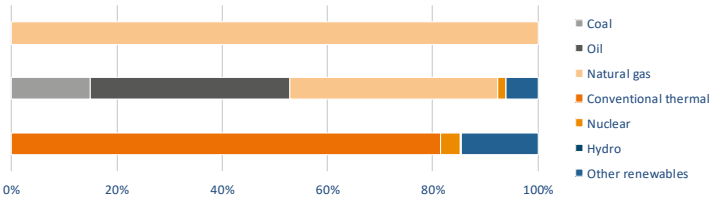
Industrial sector (% of GDP)	20.03	GDP per capita, PPP US$ (GDP Group)	50,539 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,126)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.18	Rate of transmission and distribution losses (%)	4.3
CO_2 intensity (kCO_2 per US$)	0.26	GHG emission growth rate 2010 – 2014 (%)	-0.63

ENERGY PROFILE

Fossil fuel reserves: 589 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NEW ZEALAND

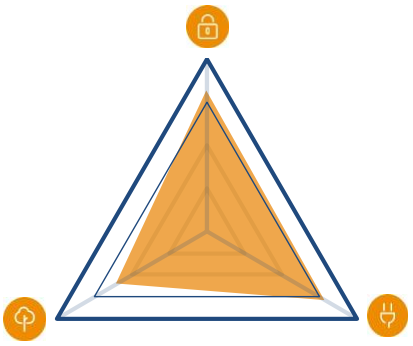
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

8

SCORE

AAB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**9**	**9**	**8**	▶	**AAB**
Energy performance					
Energy security	13	15	13	▶	A
Energy equity	20	19	30	▶	A
Environmental sustainability	36	42	50	▶	B
Contextual performance	8	3	3	▶	

TRENDS AND OUTLOOK

- New Zealand improves one place to rank 8th, continuing as the only non-European country to rank in the global top ten. New Zealand continues to manage the energy trilemma well across all dimensions, with a balance score of AAB. While New Zealand's combined sustainability score shows a stable and gradually improving trend, the country's ranking has dropped slightly due to some other countries more rapid improvement.
- With around 85% electricity supply (and 40% of total energy) coming from renewable sources, New Zealand has the third highest rate of renewable electricity in the OECD. Building on this, the new Government has ambitious energy decarbonisation goals that are embedded in a commitment to a just transition to a low-emissions economy. The Government is consulting on a legislated emissions net zero economy by 2050, with a new independent Commission to oversee carbon budgeting. At the same time, work is underway on how to achieve 100% renewable electricity generation in an average hydrological year by 2035 and reviewing the emissions trading scheme. The Government has also banned new shore oil and gas exploration permits. An electricity price inquiry will cover many aspects of the electricity system with a focus on affordability and the adoption of new, low emissions technology.
- New Zealand's energy sector is positively disposed to taking a more proactive approach to climate change, including actively participating in the BusinessNZ Energy Council's 2060 scenario refresh.
- Trends to watch are: 1) the implications of the shifts in policy emphasis for energy demand, competition and affordability, energy security, network and data regulation; 2) the ability of major energy users to leverage off these changes and compete internationally, especially with regard to the greater electrification of transport and process heat; and 3) the impact of emerging technology and digitalisation on the customer experience.

KEY METRICS

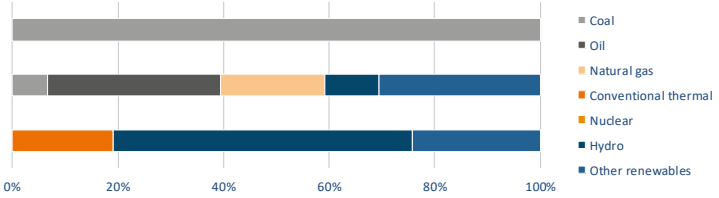
Industrial sector (% of GDP)	21.8	GDP per capita, PPP US$ (GDP Group)	38,565 (I)
Energy intensity (koe per US$)	0.10	Diversity of international energy suppliers	High (HHI = 1,303)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.20	Rate of transmission and distribution losses (%)	6.61
CO_2 intensity (kCO_2 per US$)	0.26	GHG emission growth rate 2010 – 2014 (%)	0.59

ENERGY PROFILE

Fossil fuel reserves: 5,303 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NIGER

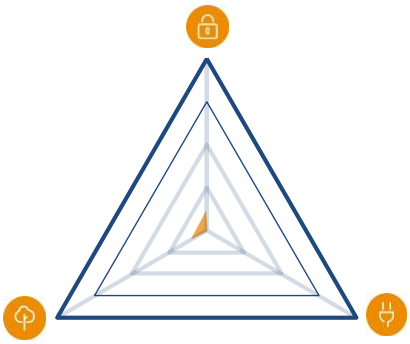
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

125

SCORE

DDD



	2016	2017	2018	Trend	Score
Overall rank and balance score	**124**	**125**	**125**	▶	**DDD**
Energy performance					
Energy security	119	124	123	▶	D
Energy equity	125	125	124	▶	D
Environmental sustainability	120	121	121	▶	D
Contextual performance	114	112	120	▶	

TRENDS AND OUTLOOK

- Niger stays in the same position in this year's Index, ranking last at 125. It performs poorly across all trilemma dimensions, resulting in an overall balance score of DDD.
- Despite the richness of Niger's resources, energy is still a challenge for the authorities. This is mainly a result of low economic productivity and investment, and also the limited access that the majority of the country has to energy. Niger has significant natural energy resources such as biomass, uranium, mineral coal, natural gas, hydro and solar. It is estimated that 90% of Niger's population accesses energy through the use of biomass, and 74,34% of energy supply comes from biomass. The second largest contributor is oil at 21,84%.
- National law and the liberalisation of the energy market result in Niger being an attractive investment opportunity, but infrastructure for delivering energy remains a key barrier. The Law on Public private partnership has been revised in order to improve the conditions of establishment of this type of financing. Attracting investment into capital energy projects aims to grow the country's energy security and access dimensions.
- With regards to the renewable energy sector, there is still lack of sufficient legislation to attract incoming investment, specifically competitiveness, transparency and security of the market. The legislative and regulatory framework evolved in 2016 with a new law concerning the electricity Code which provides for the regulation of the energy sector and the exemption of renewable energy equipment. This is likely to improve the uptake of new renewable infrastructure.
- Recent national data reports a lower rate of electricity access at 12%, and a higher rate of transmission and distribution losses at 23%.

KEY METRICS

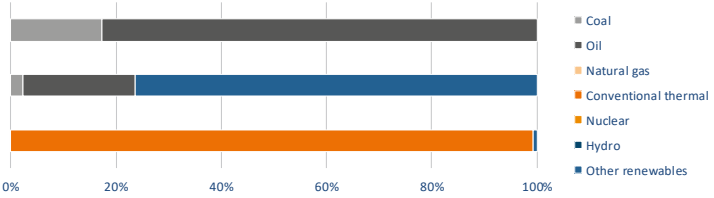
Industrial sector (% of GDP)	21.94	GDP per capita, PPP US$ (GDP Group)	986 (IV)
Energy intensity (koe per US$)	0.17	Diversity of international energy suppliers	Medium (HHI = 1,729)
Population with access to electricity (%)	16	Access to clean cooking (%)	2
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	16.53
CO_2 intensity (kCO_2 per US$)	0.13	GHG emission growth rate 2010 – 2014 (%)	5.24

ENERGY PROFILE

Fossil fuel reserves: 24 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NIGERIA

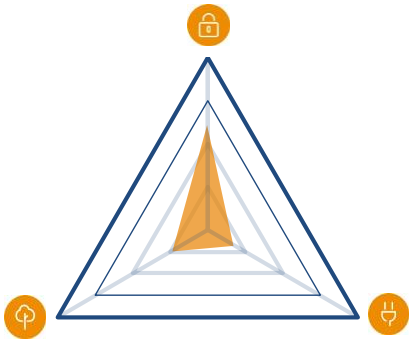
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

106

SCORE

BDD



	2016	2017	2018	Trend	Score
Overall rank and balance score	**104**	**110**	**106**	▶	**BDD**
Energy performance					
Energy security	8	67	49	▶	B
Energy equity	108	113	109	▶	D
Environmental sustainability	101	98	98	▶	D
Contextual performance	117	114	118	▶	

TRENDS AND OUTLOOK

- Nigeria rises by 4 places in this year's Index to rank 106. Energy equity remains its weakest dimension, whilst energy security sees a noticeable rise, resulting in an overall balance score of BDD.
- The key priority challenge for Nigeria is to diversify energy sources especially from renewable energy (solar and wind) that has huge potential. According to the Ministry of Power, Works and Housing of Nigeria, the country depends on gas-fired power plants for over 80% of its electricity while hydropower generates about 14%.
- However, the gas supply is frequently disrupted by militants due to political issues. This situation drives the country to find other energy sources, i.e. renewable energy, particularly solar and wind energy. In July 2016, the federal government signed the power purchase agreement with 12 firms for the construction of solar power plants. These are expected to give the country 975 MW of electricity capacity and bring the benefits of enhancement of energy security.
- The second challenge refers to the energy equity aspect of the Trilemma. Nigeria has one of the lowest shares of electrification, however is showing signs of progress, climbing from 48% of people having access in 2010 to 58% in 2014. Therefore, developing a new transmission and distribution network and improving existing lines will continue to feature as priorities for the country's energy agenda.

KEY METRICS

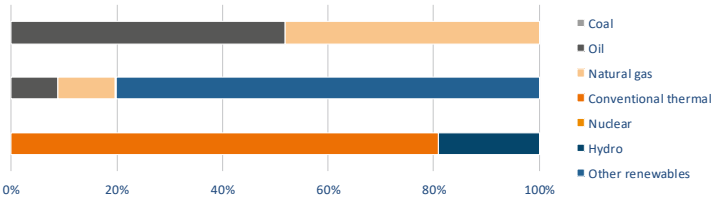
Industrial sector (% of GDP)	20.38	GDP per capita, PPP US$ (GDP Group)	5,861 (IV)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Medium (HHI = 2,164)
Population with access to electricity (%)	59	Access to clean cooking (%)	5
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	16.58
CO_2 intensity (kCO_2 per US$)	0.04	GHG emission growth rate 2010 – 2014 (%)	1.25

ENERGY PROFILE

Fossil fuel reserves: 9,736 Mtoe

Total primary energy supply composition

Diversity of electricity generation



PAKISTAN

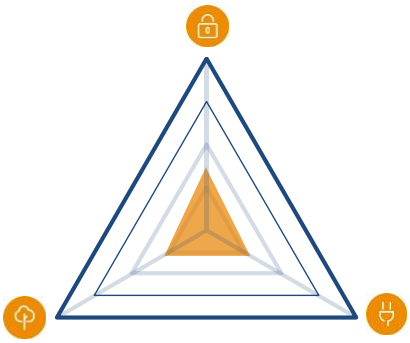
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

103

SCORE

CCC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**102**	**102**	**103**	▶	**CCC**
Energy performance					
Energy security	76	78	84	▶	C
Energy equity	99	98	98	▶	C
Environmental sustainability	93	90	94	▶	C
Contextual performance	120	118	111	▶	

TRENDS AND OUTLOOK

- Pakistan drops by 1 this year at rank 103. Receiving relatively low scores across all dimensions, the country has a balance score of CCC.
- Pakistan's energy sector is faced with a triple challenge posed by a large supply–demand gap, an ageing and inefficient power transmission system, and expensive thermal power generation. To remedy this situation, in 2013, the government launched the National Power Plan (NPP). A key aspect of the NPP is to step up efforts to exploit the country's potential for renewable energy generation.
- In addition, projects are being developed under the auspices of the China–Pakistan Economic Corridor (CPEC) to achieve a higher share of renewables. One of the projects, the Quaid-e-Azam Solar Park, started operating in 2015 and plans exist to expand its capacity to 1,000 MW. This would make it the world's largest solar power plant. Other projects include several wind farms and hydroelectric power plants such as the Suki Kinari project currently under construction in the North East of the country.
- Pakistan will also have to make sure that the country's transmission infrastructure can keep up with the rapid development of renewable energy capacity to ensure the reliable supply of energy.

KEY METRICS

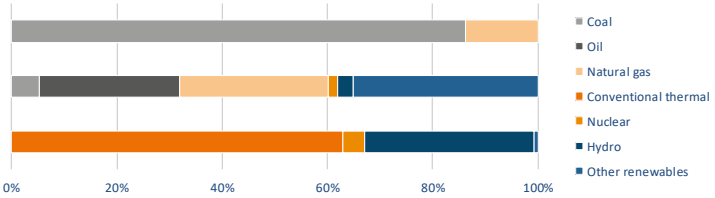
Industrial sector (% of GDP)	19.96	GDP per capita, PPP US$ (GDP Group)	5,235 (IV)
Energy intensity (koe per US$)	0.10	Diversity of international energy suppliers	Low (HHI = 3,339)
Population with access to electricity (%)	99	Access to clean cooking (%)	43
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	17.42
CO_2 intensity (kCO_2 per US$)	0.20	GHG emission growth rate 2010 – 2014 (%)	2.85

ENERGY PROFILE

Fossil fuel reserves: 2,487 Mtoe

Total primary energy supply composition

Diversity of electricity generation



PANAMA

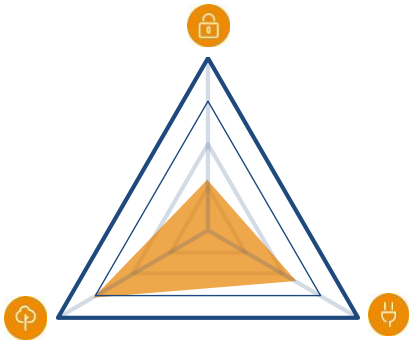
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

61

SCORE

CBA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**79**	**67**	**61**	▶	**CBA**
Energy performance					
Energy security	118	94	92	▶	C
Energy equity	76	69	69	▶	B
Environmental sustainability	47	51	28	▶	A
Contextual performance	39	39	43	▶	

TRENDS AND OUTLOOK

- Panama improves by 6 places this year to rank 61. A new baseline for environmental sustainability recognises Panama's strengths in this dimension. Energy security remains a challenge for Panama, resulting in a CBA score.
- Vulnerabilities in Panama's electricity system, caused by investment complications in infrastructure in recent years, have led to blackouts and overloads that have affected not just Panama, but other countries connected directly to the SIEPAC grid. In response to this, the state-owned transmission company is planning to construct and extend several transmission lines. Discussions are still ongoing regarding a proposed Panama-Colombia Interconnection Line.
- Several encouraging developments are being made in power generation. Electrification efforts include the use of renewable energy solutions in remote locations and the city of Panama's installation of eight lines of electric transport. Panama has recently sought to diversify its hydro-dominated energy matrix; after the installation of a wind park and photovoltaic plants that together make up 10% of total installed capacity, the 381 MW Aes Colon combined-cycle power plant was inaugurated this summer. It is doubled with an LNG import terminal, partly for local use and partly for regional distribution.
- The National Energy Plan for 2015-2050, enforced by Panama's Secretary of Energy, aims to produce at least 67% of Panama's energy requirements for the domestic market using conventional and non-conventional renewable energy sources. Its implementation requires further discussion.

KEY METRICS

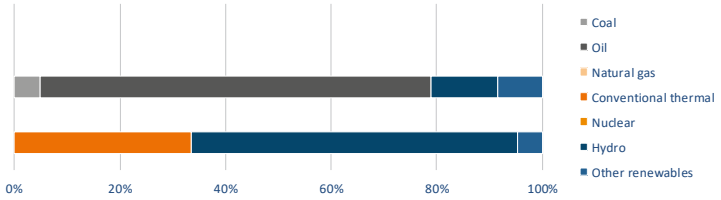
Industrial sector (% of GDP)	27.74	GDP per capita, PPP US$ (GDP Group)	23,009 (II)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Low (HHI = 2,510)
Population with access to electricity (%)	93	Access to clean cooking (%)	89
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	14.11
CO_2 intensity (kCO_2 per US$)	0.14	GHG emission growth rate 2010 – 2014 (%)	6.02

ENERGY PROFILE

Fossil fuel reserves: N/A

Total primary energy supply composition

Diversity of electricity generation



PARAGUAY

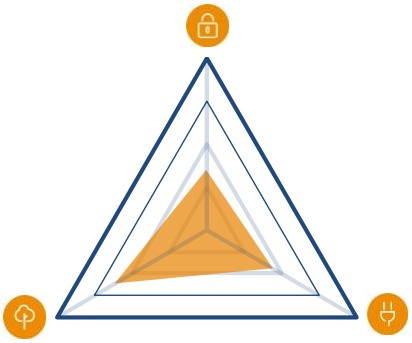
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

87

SCORE

CCB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**89**	**84**	**87**	▶	**CCB**
Energy performance					
Energy security	96	95	88	▶	C
Energy equity	86	85	88	▶	C
Environmental sustainability	57	52	48	▶	B
Contextual performance	96	96	94	▶	

TRENDS AND OUTLOOK

- Paraguay drops by 3 places this year to rank 87. Whilst scoring well in Environmental Sustainability, Energy Security and Energy Equity remain its weakest dimensions, resulting in a balance score of CCB.
- Nearly 99% of Paraguay's energy demand is met by hydropower. Therefore, there is little to no incentive for Paraguay to develop a policy framework promoting the use of renewables.
- The only clean energy policy incentive in Paraguay is a biofuel mandate for gasoline and diesel. The mandate states that diesel sold commercially in the country must contain 5% biodiesel and gasoline must contain between 18% and 24% ethanol. It is hoped that the policy will introduce more diversification of supply and less reliance on hydropower in the future.
- The abundant supply of energy results in low energy costs for the retail and commercial consumer, and is a good basis for social and economic development in the future.

KEY METRICS

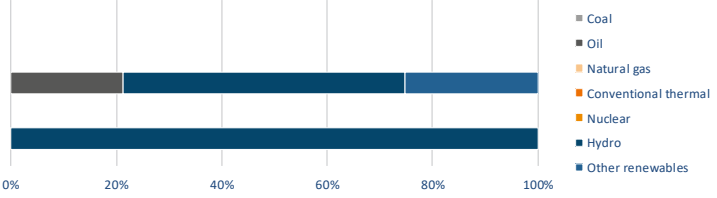
Industrial sector (% of GDP)	29.61	GDP per capita, PPP US$ (GDP Group)	9,567 (III)
Energy intensity (koe per US$)	0.10	Diversity of international energy suppliers	Low (HHI = 2,769)
Population with access to electricity (%)	98	Access to clean cooking (%)	66
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	27.1
CO_2 intensity (kCO_2 per US$)	0.11	GHG emission growth rate 2010 – 2014 (%)	3.21

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



PERU

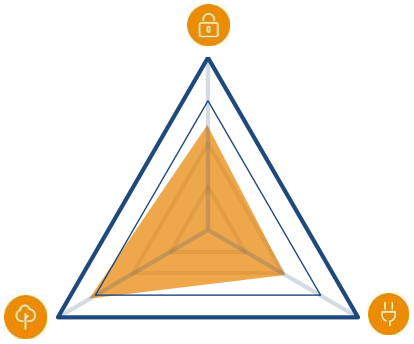
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

51

SCORE

BBA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**64**	**55**	**51**	▶	**BBA**
Energy performance					
Energy security	54	38	50	▲	B
Energy equity	84	80	78	▶	B
Environmental sustainability	38	39	23	▶	A
Contextual performance	60	67	67	▶	

TRENDS AND OUTLOOK

- Peru improves by 4 places this year to rank 51. Achieving good results in energy security and environmental sustainability dimensions and improving in energy equity, resulting in a balance score of BBA.
- The setback in energy security is almost exclusively due to a decrease in oil supply that might be an exceptional event or the start of a worrying trend. Oil supply, and energy security as a whole, should be kept under close watch.
- Peru's National Energy Policy 2010–2040 was approved at the end of 2010, with the goal to encourage and protect private investment in the sector; and to minimise the social and environmental impacts by promoting the development of energy markets, encouraging efficiency and the development of renewable energies at the local, regional, and national level.
- Schemes to support these goals are already in place and include: a law, passed in April 2012, to promote energy security in hydrocarbons; a scheme to promote the modernisation of oil refineries; a universal energy access plan for the 2013–2022 period, implemented in May 2013, with clearly defined targets for different sub-components; and auctions and calls for tenders to secure the implementation of hydro projects. Additional fiscal incentives are in place for small-scale hydro, solar, wind, biomass, and geothermal.

KEY METRICS

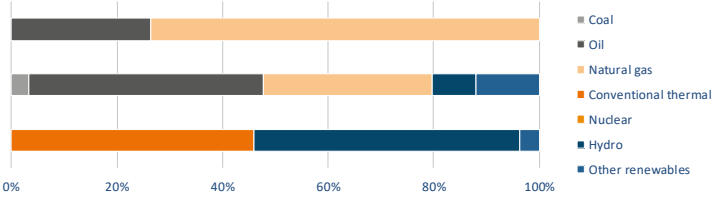
Industrial sector (% of GDP)	32.83	GDP per capita, PPP US$ (GDP Group)	13,019 (III)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Low (HHI = 3,051)
Population with access to electricity (%)	95	Access to clean cooking (%)	75
Household electricity prices (US$/kWh)	0.16	Rate of transmission and distribution losses (%)	11.24
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2010 – 2014 (%)	4.51

ENERGY PROFILE

Fossil fuel reserves: 536 Mtoe

Total primary energy supply composition

Diversity of electricity generation



POLAND

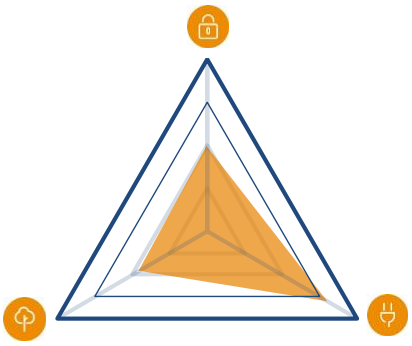
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

41

SCORE

CAC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**36**	**37**	**41**	▶	**CAC**
Energy performance					
Energy security	60	73	69	▶	C
Energy equity	28	30	25	▶	A
Environmental sustainability	64	60	76	▶	C
Contextual performance	36	35	34	▶	

TRENDS AND OUTLOOK

- Poland drops 4 places this year, to rank 41. Performing very well in energy equity, a drop in environmental sustainability results in a balance score of CAC.
- Recent energy policy developments include the improvement of competitiveness through market liberalization, cooperation with the Clean Coal Technology Centre to develop technology and improvements to the legal framework for domestic fuel exploration.
- By 2030, Poland's power sector TFEC is expected to feature 19.2% renewable energy. The bulk of the increase will be wind power; potentially even up to 10 GW of offshore wind power could be connected to the grid by 2030. Hydropower shall remain the second biggest source of renewable energy, dropping from 3.5% of the TFEC to 2% due to other capacities increasing. The remainder is set to come from solid and gaseous biomass and biogas, with photovoltaics as a fast-growing source of energy.
- The future developments of Poland's energy landscape include the planning of a pipeline through Denmark that would connect Poland to Norwegian gas fields, increasing Polish energy security and connexion to the European energy markets. Besides, Poland has identified the following action priorities: Further diversification of the energy sources. Increased security of primary fuel supply through application of clean coal technologies. Continued efforts to improve energy efficiency and air quality. Development of the environmental network infrastructure through the improvement of use of E70 Inland Water Way and an increase in hydropower potential.

KEY METRICS

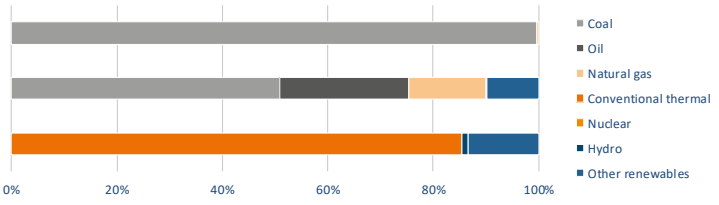
Industrial sector (% of GDP)	34.12	GDP per capita, PPP US$ (GDP Group)	27,383 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 3,815)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.16	Rate of transmission and distribution losses (%)	7.07
CO_2 intensity (kCO_2 per US$)	0.36	GHG emission growth rate 2010 – 2014 (%)	-0.31

ENERGY PROFILE

Fossil fuel reserves: 18,128 Mtoe

Total primary energy supply composition

Diversity of electricity generation



PORTUGAL

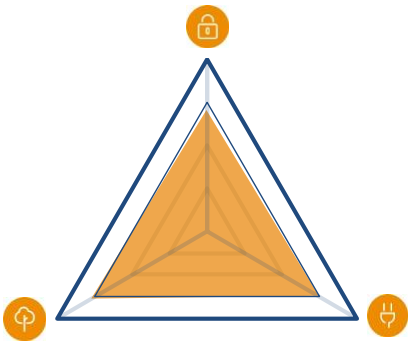
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

22

SCORE

BAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**18**	**18**	**22**	▶	**BAA**
Energy performance					
Energy security	31	30	33	▶	B
Energy equity	33	34	36	▶	A
Environmental sustainability	12	17	26	▶	A
Contextual performance	32	24	25	▶	

TRENDS AND OUTLOOK

- Portugal drops by 4 place to 22 in this year's Index. A well-balanced energy trilemma profile results in a score of BBA, with environmental sustainability being a particular strength.
- Electricity decarbonization is being strongly pursued, with renewable capacity, by the end of 2016, amounting to13.388MW (63% of total installed capacity), of which 13.676 MW hydro, 5.313 MW wind, 467 MW PV, 742 MW Bio and 29 MW geothermal. The development of the electric interconnections remains central to the Portuguese energy policy, aiming to reach full integration with European energy market, a condition to fully develop its renewable generation potential. Portugal strived to promote measures at EU level for a reasonable electric grids' interconnection capacity, now included in EU Regulation as a minimum target of 15% interconnection capacity between neighbour countries, to be supported by implementation measures. Cooperation in course between Portugal, Spain and France is a major driver for reaching that interconnection capacity objective, namely by a Gulf of Biscay interconnector project.
- The studies for an electric interconnection with Morocco are in progress. After the conclusion of a viability study, a Joint Declaration has been signed between both governments which tasks the Transmission System Operators (TSOs) of Portugal and Morocco to prepare a preliminary design and to propose a financial model for the project.
- Renewable electricity is now entering the competitive market, as each existing plant is attaining the limit for the Feed-in-tariff (FIT) regime and, also, as renewable plants licensed after the end of the FIT regime are entering operation and selling electricity in the free market.

KEY METRICS

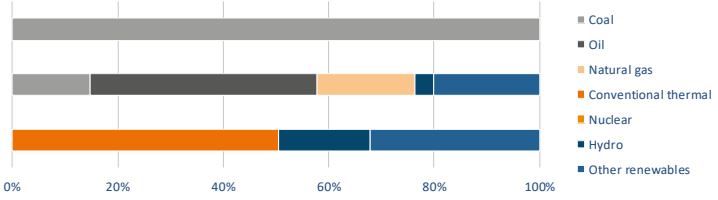
Industrial sector (% of GDP)	22.25	GDP per capita, PPP US$ (GDP Group)	30,659 (II)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	High (HHI = 1,171)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.26	Rate of transmission and distribution losses (%)	9.74
CO_2 intensity (kCO_2 per US$)	0.21	GHG emission growth rate 2010 – 2014 (%)	-2.23

ENERGY PROFILE

Fossil fuel reserves:

Total primary energy supply composition

Diversity of electricity generation



ROMANIA

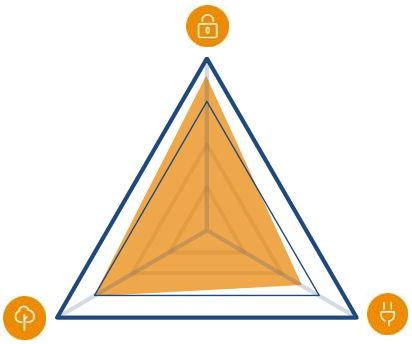
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

23

SCORE

ABA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**32**	**25**	**23**	▶	**ABA**
Energy performance					
Energy security	24	7	6	▶	A
Energy equity	63	64	63	▶	B
Environmental sustainability	28	23	31	▶	A
Contextual performance	53	44	46	▶	

TRENDS AND OUTLOOK

- An improvement of 2 places sees Romania rank 23 in this year's Index. Once again, the country scores well across the board, with energy security being particularly strong at 6th globally. This results in a balance score of ABA.
- The Romanian Parliament has adopted amendments in the Energy Law, meant to allow prosumers to penetrate the electricity market. From now on, small electricity consumers will have the opportunity to install their own renewable energy facilities and sell the energy surplus on the market.
- In Romania the energy security trend is expected to be positive in the years to come, mainly due to the exploitation of the new gas deposits in Romania's continental shelf in the Black Sea and also to the commissioning of the Bulgaria, Romania, Hungary and Austria (BRUA) gas pipeline.
- Romania has adopted the special offshore gas exploration and operation law, according to which at least 50% of Romania's Black Sea offshore gas will have to be transacted on the local market (Romania), which will result in a steady improvement in energy security.
- In terms of the environmental impact, Romania will propose its first integrated plan for climate change, such as to meet the Energy Union Governance requirements. The plan will also take into account achieving the new goals of the "Clean Energy for all Europeans" package on energy efficiency and renewable energy sources. Indeed, there are now some uncertainties on the appropriate instruments to promote renewables because of the changes in the green certificate allocation rules. However, based on the Integrated Plan, new schemes for promoting renewables and high efficiency cogeneration will be considered.

KEY METRICS

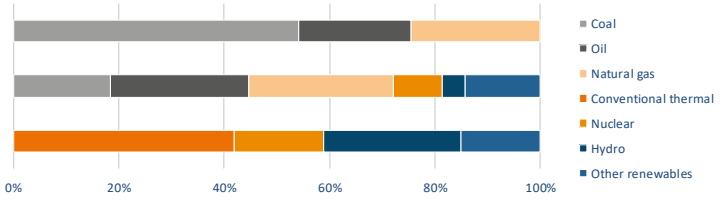
Industrial sector (% of GDP)	33.68	GDP per capita, PPP US$ (GDP Group)	23,027 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Medium (HHI = 2,436)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	86
Household electricity prices (US$/kWh)	0.14	Rate of transmission and distribution losses (%)	13.4
CO_2 intensity (kCO_2 per US$)	0.25	GHG emission growth rate 2010 – 2014 (%)	-1.63

ENERGY PROFILE

Fossil fuel reserves: 376 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SAUDI ARABIA

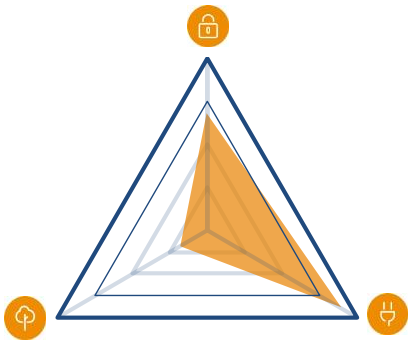
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

47

SCORE

BAD



	2016	2017	2018	Trend	Score
Overall rank and balance score	47	53	47	▶	BAD
Energy performance					
Energy security	39	31	36	▶	B
Energy equity	12	11	10	▶	A
Environmental sustainability	112	114	111	▶	D
Contextual performance	51	71	69	▶	

TRENDS AND OUTLOOK

- Saudi Arabia improves by 6 places this year to rank 47. Performing strongly in energy equity, where it ranks 10th globally, its weakest dimension is environmental sustainability. A good score in energy security completes the profile to give a balance score of BAD.
- The Saudi energy sector is fully dependent on oil and gas for electricity generation and transportation. In order to diversify its energy supply, in April 2016, the government launched its long-term development roadmap, 'Saudi Arabia's Vision 2030', which sets a goal of building 9.5 GW of renewable energy generation capacity by 2030.
- In June 2016, the country published the National Transformation Program 2020, which specifies more detailed short-term targets for the country. This includes a goal of generating 4% of energy supply through renewable energy by 2020, which is to be met chiefly through solar and wind energy. The National Transformation Program also calls for full compliance with security standards for the introduction of nuclear power generation.
- Saudi Arabia's Renewable Energy Project Development Office (REPDO) has been reviewing bids for new renewable projects. In February 2018, REPDO announced that the Saudi energy group ACWA is the final winner of a 300 MW solar PV project with an levelized cost of electricity (LCOE) of USD 0.0236 per kWh. The solar plant will be built with a 30% quota of locally manufactured PV components. In July 2018, REPDO started reviewing bids on a 400 MW wind power project and has received some competitive bids.
- In July 2018, a team of experts from the International Atomic Energy Agency (IAEA) have reviewed the development of infrastructure for the Saudi nuclear power programme as part of Phase 2 of IAEA's Milestones Approach. This marks the readiness of a country to invite bids or negotiate contracts for its first nuclear power plant.

KEY METRICS

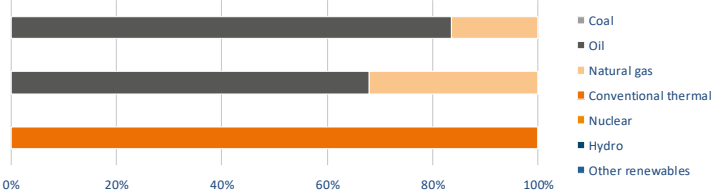
Industrial sector (% of GDP)	45.27	GDP per capita, PPP US$ (GDP Group)	54,417 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 1,438)
Population with access to electricity (%)	100	Access to clean cooking (%)	96
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	7.11
CO_2 intensity (kCO_2 per US$)	0.4	GHG emission growth rate 2010 – 2014 (%)	5.95

ENERGY PROFILE

Fossil fuel reserves: 43,799 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SENEGAL

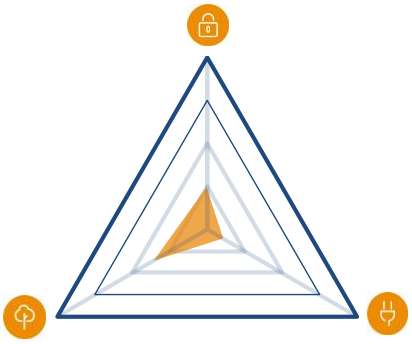
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

113

SCORE

DDC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**109**	**111**	**113**	▶	**DDC**
Energy performance					
Energy security	92	88	95	▶	D
Energy equity	107	114	116	▶	D
Environmental sustainability	91	96	89	▶	C
Contextual performance	99	91	91	▶	

TRENDS AND OUTLOOK

- Senegal drops 2 places to rank 113 in this year's Index. With relatively low scores across the board, especially regarding energy equity and energy security. Thus, Senegal receives an overall balance score of DDC, the same score as last year.
- The energy sector is currently facing a number of challenges, including ageing power infrastructure that is not being properly maintained, nor planned to be replaced in appropriate timeframe, thus creating power supply gap. Water issues are also at the top of the country's agenda, as droughts have a strong impact on households living standards, especially those located in populated urban and peri-urban areas.
- Energy security improvements reflect the fact that the Senegalese government has signed up to the World Bank's Electricity Sector Support Project '*Scaling Solar Initiative*' in 2016, to increase substantial development of solar power by 2020. The aim of this initiative is to reduce the national electricity company's technical and commercial losses and to improve the reliability of the electricity supply in certain areas of the country, mainly in Greater Dakar. This will also help to improve the country's energy equity, by enhancing access in rural and remote areas.
- Senegal's positive trend in the ranking for the sustainability dimension can be enhanced by options on further renewable energy development, including two solar projects coming on line in 2018 (with a joint capacity of 60MW) and a IPP wind farm project of 151.8 MW, provided these will be substantial enough to offset the impact of increased fossil fuels use in power generation (oil and coal), increased use of old second hand imported vehicles, inefficient road transport fleet.

KEY METRICS

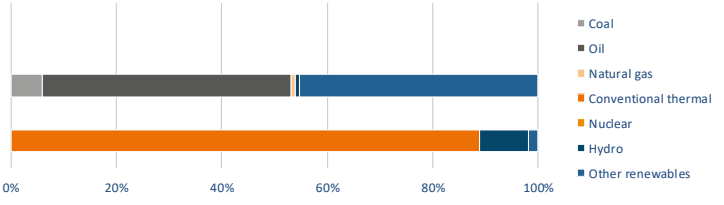
Industrial sector (% of GDP)	23.36	GDP per capita, PPP US$ (GDP Group)	2,566 (IV)
Energy intensity (koe per US$)	0.1	Diversity of international energy suppliers	Medium (HHI = 1,714)
Population with access to electricity (%)	65	Access to clean cooking (%)	32
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	12.96
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2010 – 2014 (%)	4.04

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SERBIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

73

SCORE

BBD

	2016	2017	2018	Trend	Score
Overall rank and balance score	**73**	**68**	**73**	▶	**BBD**
Energy performance					
Energy security	61	51	60	▶	B
Energy equity	73	70	68	▶	B
Environmental sustainability	89	88	96	▶	D
Contextual performance	84	72	72	▶	

TRENDS AND OUTLOOK

- Serbia has dropped 5 places to rank 73 in this year's Index. With good scores received for both energy security and energy equity dimensions, it lags behind slightly in environmental sustainability, resulting in a letter grade BBD.
- Considerable investments have been made in the energy sector to meet environmental goals. Several wind farms are ready for construction to meet the target of 500 MW, set by the National Action Plan, which calls for 27% of gross final energy consumption in 2020 to be from renewables. This is expected to improve the country's energy security. •
- The new Energy Sector Development Strategy to 2030 (ESDS) has been adopted in line with the EU policy, enforced by the Energy Community Treaty and action plans to implement energy efficiency and renewable energy solutions. The existing feed-in tariff (FIT) scheme has been modified for solar power plants. These developments will have a positive impact on the energy security and environmental sustainability dimension. At the same time, construction of a new coal-fired power generation unit has started. Existing units are also being refurbished, with the intention that they will remain in operation beyond 2023, while those that do not meet environmental regulations will be shut down. •
- Policymakers need to focus on: 1) adopting the program for the implementation of the ESDS until 2023; 2) meeting the obligation from the Energy Community Treaty to implement flue gas desulphurisation in all existing power plants that will remain in operation after 2023; 3) meeting the 27% target of renewables, including a 10% target for biofuels in the transport sector; and 4) enforcing the incentives for energy efficiency through the new budget fund.

KEY METRICS

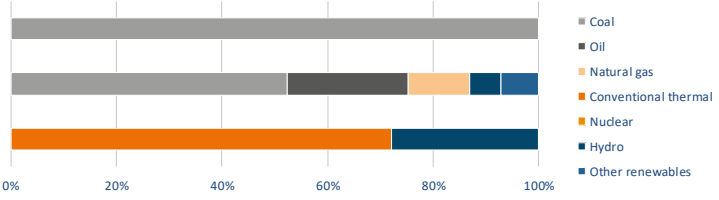
Industrial sector (% of GDP)	31.36	GDP per capita, PPP US$ (GDP Group)	14,515 (II)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	Low (HHI = 2,599)
Population with access to electricity (%)	100	Access to clean cooking (%)	76
Household electricity prices (US$/kWh)	0.07	Rate of transmission and distribution losses (%)	15.39
CO_2 intensity (kCO_2 per US$)	0.58	GHG emission growth rate 2010 – 2014 (%)	-1.07

ENERGY PROFILE

Fossil fuel reserves: 5,260 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SINGAPORE

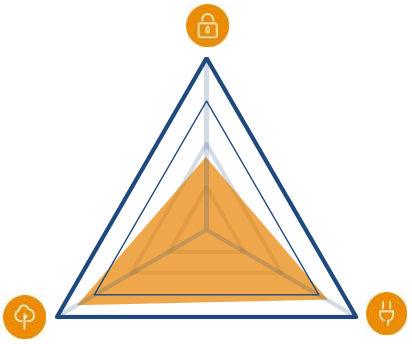
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

19

SCORE

CAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**24**	**22**	**19**	▶	**CAA**
Energy performance					
Energy security	70	74	81	▶	C
Energy equity	56	28	22	▶	A
Environmental sustainability	9	11	9	▶	A
Contextual performance	1	1	2	▶	

TRENDS AND OUTLOOK

- An improvement of 3 places sees Singapore rise to rank 19 in this year's Index. Performing strongly in Environmental Sustainability, where it ranks 9th globally, as well as 2nd for contextual performance, Energy Security remains weak. This results in a letter grade of CAA.
- The country has been investing heavily in R&D projects, particularly in the electricity grid infrastructure. The country has recently launched a Grid 2.0 initiative, that would consolidate the country's gas, solar and thermal energy into a single intelligent network. The government is committing about S$1 billion from the National Research Foundation into this initiative to address Singapore's future energy challenges.
- Smart grids are the other key part of the new energy industry in Singapore. The smart grid and data analytics projects were launched in August 2016, and these are expected to be completed by 2021. The projects can allow the country to enhance energy supply stability and sustainability by monitoring electricity disruptions and facilitating the use of renewable energy.

KEY METRICS

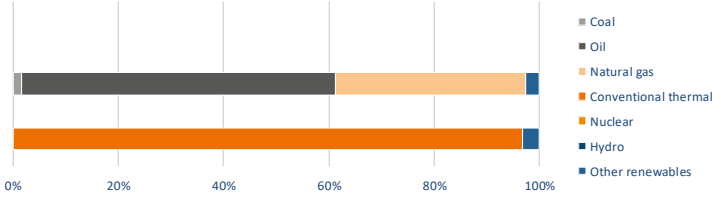
Industrial sector (% of GDP)	26.17	GDP per capita, PPP US$ (GDP Group)	87,833 (I)
Energy intensity (koe per US$)	0.03	Diversity of international energy suppliers	High (HHI = 669)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	1.69
CO_2 intensity (kCO_2 per US$)	0.13	GHG emission growth rate 2010 – 2014 (%)	0.62

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SLOVAKIA

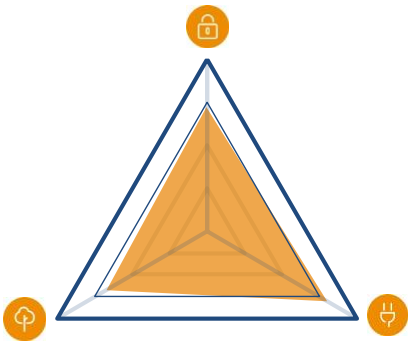
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

26

SCORE

BAB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**16**	**24**	**26**	▶	**BAB**
Energy performance					
Energy security	15	23	29	▶	B
Energy equity	18	25	24	▶	A
Environmental sustainability	30	29	38	▶	B
Contextual performance	37	36	37	▶	

TRENDS AND OUTLOOK

- Slovakia drops by 2 places this year to rank 26. Showing good performance across all trilemma dimensions, Slovakia balances the trilemma very well, resulting in an overall balance score of BAB.
- Recent policy developments are mainly driven by EU energy and climate targets and implementation of EU policy and regulation continues, including market liberalisation and promotion of environmentally-friendly energy technologies. The removal of cross subsidies is challenging as it conflicts with the support of the availability of cheap energy for low-income households and for the manufacturing sector. The development of renewable energy sources stalled in the last few years due to the growing impact on the electricity prices, but a new support mechanism is now being implemented. A new law also supports Energy Performance Services in buildings and promotes the deployment of smart grids and e-mobility.
- Increasing energy efficiency in all sectors of the economy remains a challenge and requires structural changes in the economy to move from heavy industry to sophisticated production, but also measures to reduce energy consumption of buildings. Completion of two nuclear reactors is far behind schedule and over budget, but preparation works for a new reactor are slowly continuing. Policymakers need to focus on decreasing the dependence on natural gas and oil imports with strategic projects of new gas pipelines to Poland and Hungary.

KEY METRICS

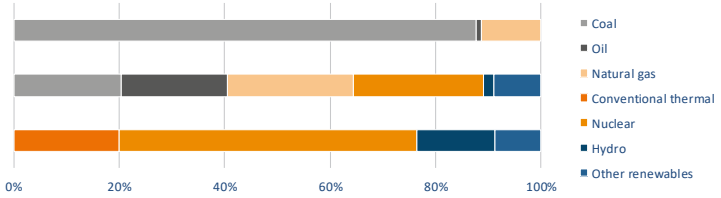
Industrial sector (% of GDP)	34.82	GDP per capita, PPP US$ (GDP Group)	30,460 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 3,252)
Population with access to electricity (%)	100	Access to clean cooking (%)	97
Household electricity prices (US$/kWh)	0.17	Rate of transmission and distribution losses (%)	2.55
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2010 – 2014 (%)	-1.72

ENERGY PROFILE

Fossil fuel reserves: 107 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SLOVENIA

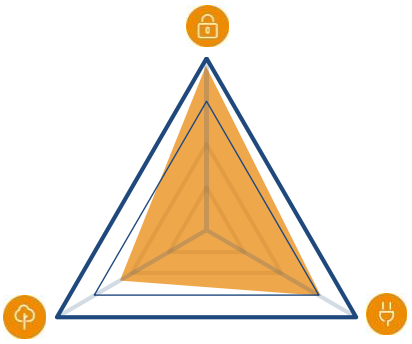
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

6

SCORE

AAB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**12**	**10**	**6**	▶	**AAB**
Energy performance					
Energy security	2	2	2	▶	A
Energy equity	25	31	33	▶	A
Environmental sustainability	44	43	58	▶	B
Contextual performance	35	31	29	▶	

TRENDS AND OUTLOOK

- Slovenia has risen by 4 places in this year's index to 6. A strong performance in energy security, where it ranks 2nd globally, is matched by an excellent performance in energy equity. Overall Slovenia balances the energy trilemma very well, receiving a balance score of AAB.
- The energy legislation increases competition and stimulates energy investments. These boosts advanced energy projects including energy innovations in households and industry. Energy projects of sustainable mobility, smart communities and net metering for prosumers (50% of distribution network users were equipped with smart meters) are in full swing.
- Energy entrepreneurship has become important part of national economic growth. This includes regional smart grid projects governed by the Slovenian transmission operator. The construction of electric and gas interconnections with Hungary are in progress to strength a market coupling and price convergence regionally. Considerable capacities of renewables as well as of hydropower are under the construction (the Sava River).
- The National Energy Concept based on national energy climate goals was consulted, but due to the government resign not adopted by the National Assembly. The main concerns and focus for the upcoming government will be on the future energy mix, decarbonisation and de-fossilization of the economy related with binding national goals and financing.
- National environmental legislation and permit granting are still crucial obstacles for investments in the energy sector.

KEY METRICS

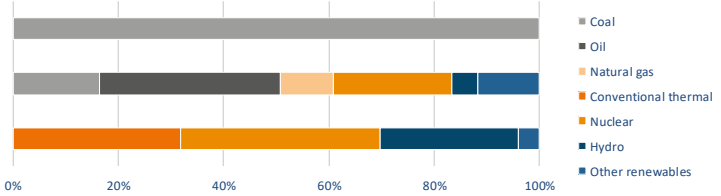
Industrial sector (% of GDP)	32.75	GDP per capita, PPP US$ (GDP Group)	32,723 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	High (HHI = 1,282)
Population with access to electricity (%)	100	Access to clean cooking (%)	96
Household electricity prices (US$/kWh)	0.18	Rate of transmission and distribution losses (%)	6.14
CO_2 intensity (kCO_2 per US$)	0.26	GHG emission growth rate 2010 – 2014 (%)	-0.69

ENERGY PROFILE

Fossil fuel reserves: 259 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SOUTH AFRICA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

85

SCORE

BCD

	2016	2017	2018	Trend	Score
Overall rank and balance score	**84**	**82**	**85**	▶	**BCD**
Energy performance					
Energy security	66	47	37	▶	B
Energy equity	82	87	85	▶	C
Environmental sustainability	105	109	118	▶	D
Contextual performance	47	46	48	▶	

TRENDS AND OUTLOOK

- South Africa moves down in the ranking by 3 places to rank 85 in this year's Trilemma. While South Africa's combined sustainability score shows a gradually improving trend, the country's rank has dropped this year due to the relative improved performance of other countries and an adjusted emissions baseline. Stable and improving performance in equity and security contribute to an overall balance score of BCD.
- Energy security has continued to improve as seen in the Energy security score. This improvement is due to more projects from the Renewable Energy programme coming on line; the National Utility maintaining its improved operation of its coal fired fleet and the growth demand has not been as strong as anticipated due to the slow-down in the economy. In fact, the National Utility now has excess power relative to the local demand it is serving, so it is exporting power to the region.
- Given the large amount of power still generated from coal, Environmental sustainability continues to be South Africa's weakest trilemma dimension. The contribution from renewable energy sources is increasing, but it still remains small (<15%).Coal-based generation of electricity will continue to dominate even as renewable energy programmes are completed.
- For future power generation, South Africa continues to explore ways to reduce its dependence on coal-based electricity generation in order to meet commitments made following the Paris agreement. Since the country does not have any established indigenous natural gas supply, the possibility of establishing a natural gas infrastructure based on imported LNG is being considered and additional nuclear generating capacity is also being examined.

KEY METRICS

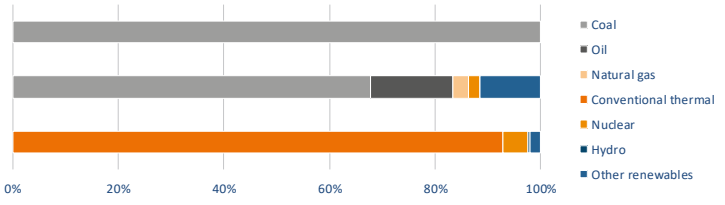
Industrial sector (% of GDP)	29.15	GDP per capita, PPP US$ (GDP Group)	13,197 (III)
Energy intensity (koe per US$)	0.12	Diversity of international energy suppliers	High (HHI = 1,344)
Population with access to electricity (%)	84	Access to clean cooking (%)	85
Household electricity prices (US$/kWh)	0.09	Rate of transmission and distribution losses (%)	9.05
CO_2 intensity (kCO_2 per US$)	0.72	GHG emission growth rate 2010 – 2014 (%)	3.39

ENERGY PROFILE

Fossil fuel reserves: 6,925 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SPAIN

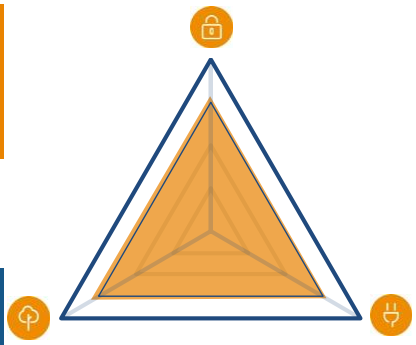
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

16

SCORE

AAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**13**	**13**	**16**	▶	**AAA**
Energy performance					
Energy security	26	20	21	▶	A
Energy equity	30	33	32	▶	A
Environmental sustainability	17	15	22	▶	A
Contextual performance	31	27	30	▶	

TRENDS AND OUTLOOK

- Spain moves down slightly in this year's ranking to position 16. The sustainability rank drops slightly this year due to the relative performance of other countries, however Spain's combined score in this dimension shows a stable and improving trend. Being able to manage the energy trilemma excellently, Spain once again exhibits a balanced score of AAA.
- Spain has set a target of a 20% share of renewable energy in gross final energy consumption by 2020. 17% was achieved in 2016 and the target is expected to be met. In 2017, renewables' share in electricity generation decreased to 34% (40% in 2016) mainly due to dry weather impact on hydroelectric generation. Nuclear energy capacity has been reduced due to the shutdown of Garoña Nuclear Plant in 2017. As a result, GHG emissions rose 4% but remain 23% lower than in 2005.
- Regional integration may pose an obstacle to the further growth of renewables and security of supply. In electricity there is an EU target of 10% by 2020. At the beginning of 2018 Europe decided to subsidise various electricity and gas interconnections projects, including an electric interconnection between Spain and France through Vizcaya's Gulf and the public participation phase of a gas interconnection; the latter project has received other funds for previous phases.
- The new government has the intention of presenting a Climate Change and Energy Transition Act and the Integrated National Energy and Climate Change Plan by the end of 2018, with the objective of facilitating compliance with international and European commitments. The other objective of the new government in the energy sector is to take advantage of the opportunities of the green economy and to assure a just and fair energy transition.

KEY METRICS

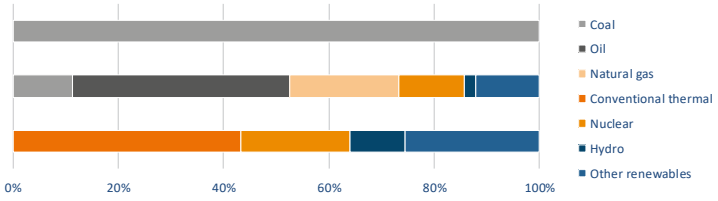
Industrial sector (% of GDP)	23.64	GDP per capita, PPP US$ (GDP Group)	36,305 (I)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	High (HHI = 629)
Population with access to electricity (%)	100	Access to clean cooking	100
Household electricity prices (US$/kWh)	0.24	Rate of transmission and distribution losses (%)	10.15
CO2 intensity (kCO2 per US$)	0.19	GHG emission growth rate 2010 – 2014 (%)	-1.37

ENERGY PROFILE

Fossil fuel reserves: 831 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SRI LANKA

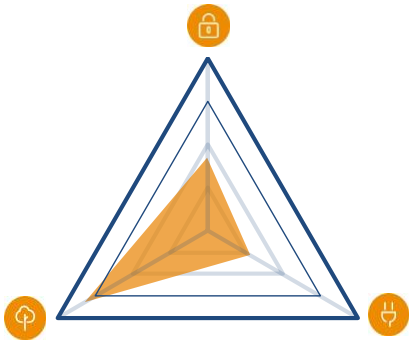
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

89

SCORE

CCA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**81**	**83**	**89**	▶	**CCA**
Energy performance					
Energy security	74	69	80	▶	C
Energy equity	96	99	99	▶	C
Environmental sustainability	24	24	18	▶	A
Contextual performance	85	93	99	▶	

TRENDS AND OUTLOOK

- Dropping 6 places, Sri Lanka ranks 89 in this year's Trilemma. A strong performance in environmental sustainability results in a letter grade A; however, energy security and equity remain relatively low. This results in an imbalanced energy trilemma profile of CCA.
- Avoiding the expected energy shortage will be an urgent and important challenge for the country. According to the Long Term Generation Expansion Plan 2018-2037, prepared by the Ceylon Electricity Board, adequate plant additions of proper mix is envisioned to mitigate medium term and long term capacity and energy requirements of the country even during drought conditions.
- In July 2016, the Asian Development Bank (ADB) approved a loan of US$115m and US$3.8m in grants to improve the reliability and quality of electricity supply. This includes electrification of remote islands with renewable hybrid energy systems. The country currently has an electrification rate of around 99.3%, the only South Asian nation to have near 100% grid connectivity. In 2017, ADB approved a loan of US$200m to develop country's first 100 MW wind park and a US$ 50m loan to help fund rooftop solar power generation systems in Sri Lanka, to increase the share of renewable energy sources in the country's energy mix.

KEY METRICS

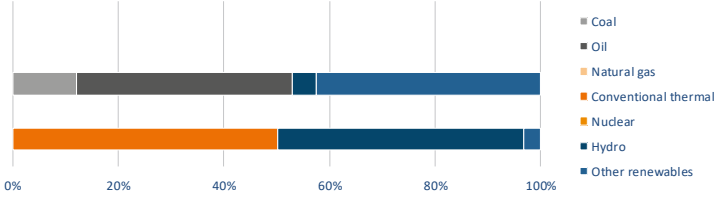
Industrial sector (% of GDP)	29.45	GDP per capita, PPP US$ (GDP Group)	12,313 (III)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	Medium (HHI = 2,013)
Population with access to electricity (%)	96	Access to clean cooking (%)	26
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	11.25
CO_2 intensity (kCO_2 per US$)	N.A	GHG emission growth rate 2010 – 2014 (%)	3.20

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SWAZILAND (ESWATINI)

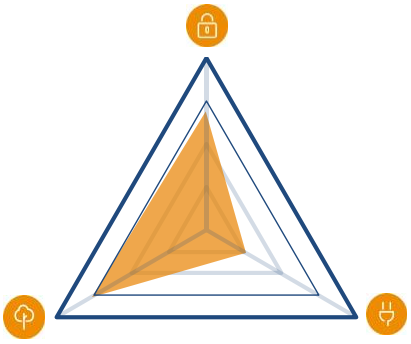
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

84

SCORE

BCA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**95**	**90**	**84**	▶	**BCA**
Energy performance					
Energy security	45	54	35	▶	B
Energy equity	103	102	100	▶	C
Environmental sustainability	70	58	27	▶	A
Contextual performance	98	97	98	▶	

TRENDS AND OUTLOOK

- Swaziland, continues to climb up the ranks of the Trilemma, ascending 6 places to rank 84 this year. A new baseline for the sustainability dimension demonstrates Swaziland's low carbon intensity and good performance in this aspect. Whilst energy security is also strong, energy equity remains the weakest dimension for Swaziland, resulting in a balance score of BCA.
- Coal will continue to play an important role in the energy mix of Swaziland. The country has vast reserves and is assessing the feasibility of building a 300 MW coal-fired thermal power station using clean coal technologies, which is expected to supply the country as well as the region through export to the Southern African Power Pool. However, companies are investing in cogeneration, particularly the sugar and forestry sectors. These efforts are expected to reduce the heavy reliance on imported energy while also observing issues of price and environmental sustainability. In addition, the country is looking to increase its strategic fuel reserves, enhance bulk purchasing (better prices), explore the possibility of setting up a petroleum products refinery, and tap into the natural gas market in Mozambique.
- The country has finalised an Independent Power Producer Policy Energy Policy and the Energy Masterplan to provide guidance on the development and assessment of energy supply scenarios to meet domestic future energy demand, and outlines sector-specific development pathways through to 2034. The development of a Short-term Generation Plan and Power Procurement toolkit and Energy Efficiency Policy are underway. Latest national figures for electricity access suggest 78% of the population is covered.
- Policymakers need to: 1) support the deployment of renewables; and 2) increase the budget for the energy sector to enable economic development and poverty reduction, through increased rural electrification, energy access, research and development, development of skills, and capacity building.

KEY METRICS

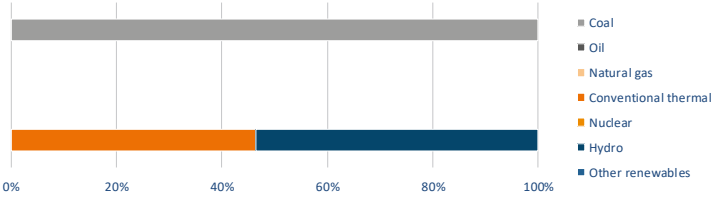
Industrial sector (% of GDP)	37.91	GDP per capita, PPP US$ (GDP Group)	8,330 (III)
Energy intensity (ktoe per US$)	0.1	Diversity of international energy suppliers	Low (HHI = 9,704)
Population with access to electricity (%)	66	Access to clean cooking (%)	49
Household electricity prices (US$/kWh)	0.11	Rate of transmission and distribution losses (%)	13.04
CO_2 intensity (kCO_2 per US$)	0.11	GHG emission growth rate 2010 – 2014 (%)	0.25

ENERGY PROFILE

Fossil fuel reserves: 100 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SWEDEN

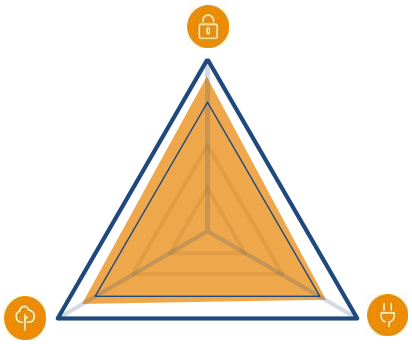
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

3

SCORE

AAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**3**	**2**	**3**	▶	**AAA**
Energy performance					
Energy security	10	9	4	▶	A
Energy equity	27	21	27	▶	A
Environmental sustainability	8	5	16	▶	A
Contextual performance	4	2	4	▶	

TRENDS AND OUTLOOK

- Sweden have dropped by 1 place to rank 3 in this year's Index but still have an impressive performance. The country continues to manage the energy trilemma excellently, with improvement seen in energy security, resulting in a balance score of AAA.
- Currently, the transport sector (except trains, metro and trams) relies on fossil fuels. Special policies and financial support to incentivise the purchase of electric cars are in place, but results are not yet meeting expectations. The EU target to increase the share of biofuels used in transport to 10% by 2020 will be exceeded, with the share having already reached 31% in 2016. This is primarily due to a rapid increase in the blending of HVO-biodiesel and other biofuels in gasoline and diesel, and an increased number of cars running on biogas.
- Policymakers need to focus on finding a solution to replace the existing ten nuclear reactors that will be taken out of operation to meet future electricity demand. The first reactors are expected to close between 2017 and 2020. Vattenfall has taken a policy decision to close the two smallest reactors in Ringhals, and Uniper (formerly E.ON) has already closed the two smallest reactors in Oskarshamn in 2017. While the application to build new reactors has not been formally withdrawn, Vattenfall has currently stopped any further work on the application. In addition to finding measures to meet the EU CO2 reduction and RES targets, energy efficiency needs to be a top priority.

KEY METRICS

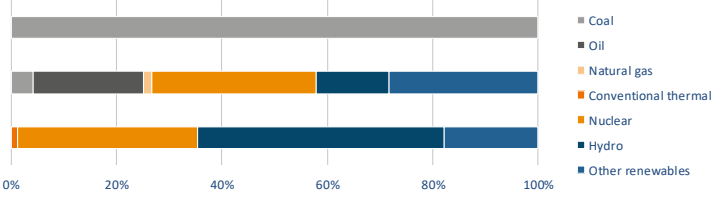
Industrial sector (% of GDP)	26.28	GDP per capita, PPP US$ (GDP Group)	48,905 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 1,290)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.21	Rate of transmission and distribution losses (%)	5.5
CO_2 intensity (kCO_2 per US$)	0.10ne	GHG emission growth rate 2010 – 2014 (%)	-2.38

ENERGY PROFILE

Fossil fuel reserves: 1 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SWITZERLAND

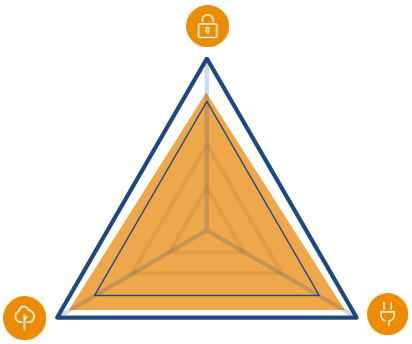
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

2

SCORE

AAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	**2**	**3**	**2**	▶	**AAA**
Energy performance					
Energy security	12	16	17	▶	A
Energy equity	2	4	6	▶	A
Environmental sustainability	3	3	4	▶	A
Contextual performance	3	13	1	▶	

TRENDS AND OUTLOOK

- Switzerland improves by 1 place to rank 2nd in this year's Index. Excellent scores in both Energy Equity and Environmental Sustainability, where it is ranked 6th and 4th respectively, result in a well-balanced energy trilemma profile of AAA.
- Switzerland's leading position in the Index reflects the country's past energy and energy-related policy decisions. Recent policy decisions however are likely to have an impact on the country's generation mix and thereby on its energy sustainability balance.
- Recent energy policy developments include the decision to refrain from building new nuclear power plants, to reduce energy consumption, increase energy efficiency and to promote renewable energies. In a popular vote in May 2017 the Swiss people approved these initial measures. The entire energy strategy is expected to be implemented fully by 2050. The measures and next steps to phase out nuclear are not yet known and will be a matter of political discussions in the next years (a public referendum is probable). To achieve the transition to a low-carbon energy system in the long term, in the mid-term Switzerland is likely to become more dependent on electricity imports.
- Policymakers need to focus on: 1) construction of new electricity grids; 2) completing the liberalisation of the electricity market; 3) securing energy supply after the phase-out of nuclear power plants and 4) coming to a bilateral agreement with the EU in order to participate in the European internal energy market and the EU-ETS. Furthermore, there is the need to promote new heating systems in buildings and more efficient and cleaner technologies in vehicles as part of the transition to a low-carbon energy system.

KEY METRICS

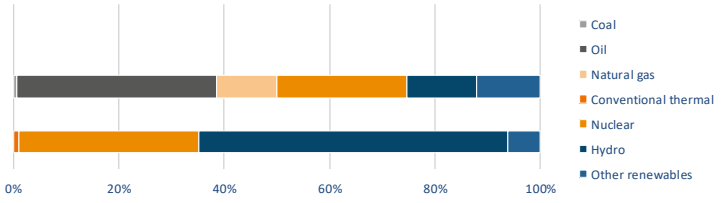
Industrial sector (% of GDP)	25.52	GDP per capita, PPP US$ (GDP Group)	63,889 (I)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Medium (HHI = 2,406)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.20	Rate of transmission and distribution losses (%)	7.56
CO_2 intensity (kCO_2 per US$)	0.1	GHG emission growth rate 2010 – 2014 (%)	-0.82

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



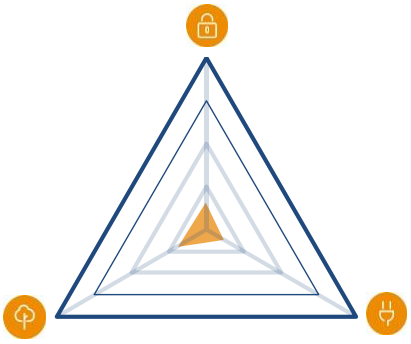
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

121

SCORE

DDD



	2016	2017	2018	Trend	Score
Overall rank and balance score	**122**	**123**	**121**	▶	**DDD**
Energy performance					
Energy security	83	107	118	▼	D
Energy equity	121	119	113	▶	D
Environmental sustainability	114	112	110	▶	D
Contextual performance	94	94	95	▶	

TRENDS AND OUTLOOK

- Tanzania improves by 2 places, rising into rank 121 in this year's Index. An improvement in Energy Equity and Environmental Sustainability is offset by a drop in Energy Security, resulting in an overall balance score of DDD.
- Tanzania has underdeveloped modern energy services. Currently, power generation capacities are sufficient, transmission and distribution networks are improving due to ongoing rural electrification program, and there is significant investment in new energy infrastructure (400kV line, Kinyerezi – II (240MW), Rufiji Hydropower (2100 MW) and others), improving human capital and technology. The government is implementing a number of projects under new era of President Dr. John Joseph Pombe Magufuli to increase power generation, access to electricity and to bring reliable power to citizens, to drive economic growth and social development. The government is engaging in the development of the country's modern energy and power generation capacity.
- Targets set by the government include: 1) increasing electricity access to 50% by 2025 and reaching 75% by 2033; 2) increasing electricity generation up to 5,000 MW in 2020 and 10,000 MW by 2025; and 3) reducing transmission and distribution losses to 10% by 2020. The government has also developed a number of initiatives, such as the Energy Policy of 2015, the PPP Act of 2010, and participation in the Southern African Power Pool, to create an attractive environment for private investors and increase competitiveness and transparency in the energy sector.

KEY METRICS

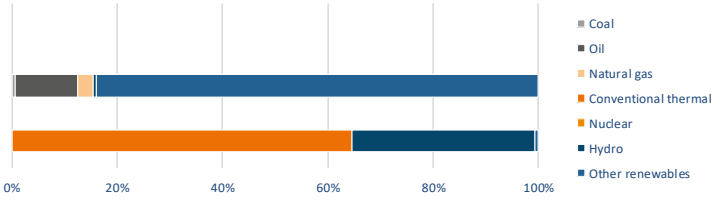
Industrial sector (% of GDP)	26.06	GDP per capita, PPP US$ (GDP Group)	2,786 (IV)
Energy intensity (koe per US$)	0.19	Diversity of international energy suppliers	Low (HHI = 3,959)
Population with access to electricity (%)	32	Access to clean cooking (%)	2
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	17.49
CO_2 intensity (kCO_2 per US$)	0.1	GHG emission growth rate 2010 – 2014 (%)	5.71

ENERGY PROFILE

Fossil fuel reserves: 0Mtoe

Total primary energy supply composition

Diversity of electricity generation



THAILAND

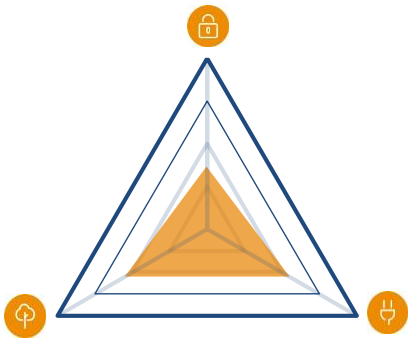
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

75

SCORE

CBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	76	74	75	▶	CBB
Energy performance					
Energy security	94	89	86	▶	C
Energy equity	67	71	75	▶	B
Environmental sustainability	76	73	62	▶	B
Contextual performance	71	62	60	▶	

TRENDS AND OUTLOOK

- Thailand drops by 1 place to rank 75 in this year's Index. A good performance in the Energy Equity and Environmental Sustainability dimensions is offset by relatively low score in Energy Security dimension, resulting in a balance score of CBB.
- Increasing energy production to enhance energy security and reduce reliance on energy imports is a key challenge for Thailand. To address this challenge, the government aims to advance the exploration and production of energy resources at domestic and international levels; explore the joint development of energy resources with neighbouring economies; develop a more diversified energy mix; and encourage electricity production from renewable and other alternative energy sources. In addition, the government aims to increase competition and investment in the energy industry by creating a business-friendly, transparent environment through the Investor Relation Office, which will be responsible for investment procedures and processes in the energy industry.
- The government has developed policies to encourage the production and use of alternative energy, in particular biofuels, biomass, solid waste and animal manure. These measures are expected to enhance energy security, reduce pollution and support farmers by encouraging the production and use of renewable energy at the community level.

KEY METRICS

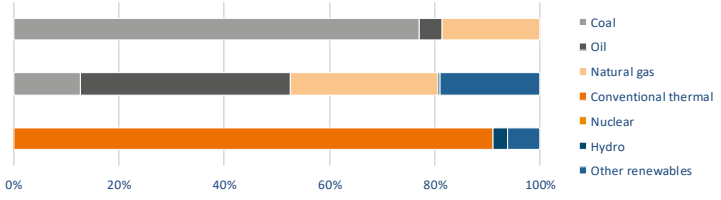
Industrial sector (% of GDP)	36.39	GDP per capita, PPP US$ (GDP Group)	16,913 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 1,225)
Population with access to electricity (%)	100	Access to clean cooking (%)	74
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	5.91
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2010 – 2014 (%)	3.67

ENERGY PROFILE

Fossil fuel reserves: 966 Mtoe

Total primary energy supply composition

Diversity of electricity generation



TRINIDAD & TOBAGO

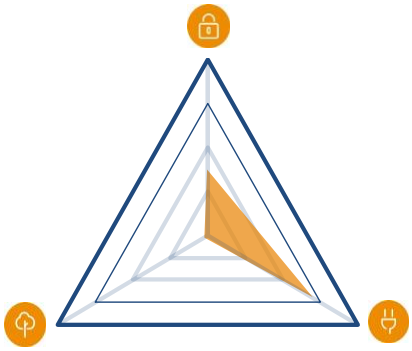
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

90

SCORE

CBD



	2016	2017	2018	Trend	Score
Overall rank and balance score	**90**	**88**	**90**	▶	**CBD**
Energy performance					
Energy security	99	92	83	▶	C
Energy equity	48	55	48	▶	B
Environmental sustainability	123	122	124	▶	D
Contextual performance	64	75	78	▶	

TRENDS AND OUTLOOK

- A drop of 2 places sees Trinidad and Tobago rank 90 in this year's Index. Whilst scoring low on Environmental Sustainability, it performs well in terms of Energy Equity, receiving a balance score of CBD overall.
- Trinidad and Tobago (T&T) continues to experience nominal to positive economic growth and show signs of recovery in the energy sector. The country maintains significant oil and natural gas reserves and is home to one of the largest natural gas liquefaction facilities in the Western Hemisphere. T&T is currently the 9th largest exporter of LNG with 10.8MT and 3.7% market share.
- T&T maintains the lowest electricity rates in the Caribbean region with an average cost of US$0.04 to $US0.06 per kWh. The Regulated Industries Commission (RIC) is reviewing these rates in T&T, with the view of bringing them in line with the average rates for the region.
- A new rate of 12.5% for both offshore and onshore oil and gas production is expected to provide attractive conditions for investment. There is also a commitment to the removal of the fuel subsidy with the aim of the promoting efficiency in the use of resources As such, over the past 18 months, the price of liquid fuels for consumption within T&T has increased on two occasions and the rates are currently aligned with present market prices.
- T&T is committed to a 15% reduction in CO2 equivalent under the Paris Climate Change Agreement, by encouraging energy security through the promotion of energy efficiency and energy conservation in the utilization of electricity.

KEY METRICS

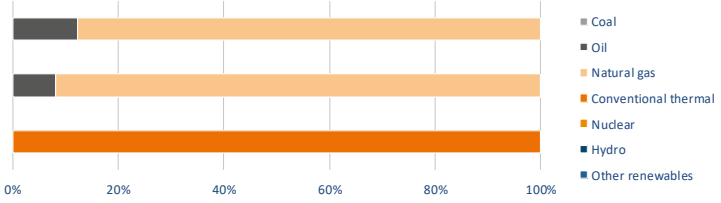
Industrial sector (% of GDP)	40.44	GDP per capita, PPP US$ (GDP Group)	32,855 (II)
Energy intensity (koe per US$)	0.12	Diversity of international energy suppliers	Low (HHI = 3,275)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.05	Rate of transmission and distribution losses (%)	2.39
CO_2 intensity (kCO_2 per US$)	N.A	GHG emission growth rate 2010 – 2014 (%)	3.86

ENERGY PROFILE

Fossil fuel reserves: 267 Mtoe, (234 Mtoe gas)

Total primary energy supply composition

Diversity of electricity generation (100% conventional thermal - gas)



TUNISIA

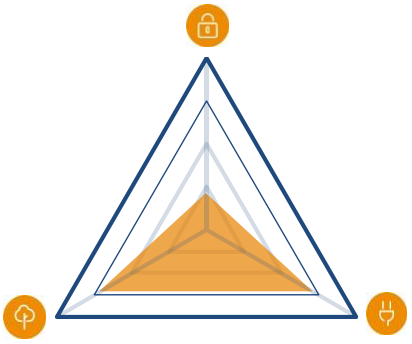
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

66

SCORE

DBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**54**	**59**	**66**	▶	**DBB**
Energy performance					
Energy security	101	100	107	▶	D
Energy equity	49	47	45	▶	B
Environmental sustainability	43	41	34	▶	B
Contextual performance	80	78	77	▶	

TRENDS AND OUTLOOK

- Tunisia ranks in 66th place in this year's Trilemma. Energy security is Tunisia's most challenging dimension; however, this is offset by good scores in energy equity and environmental sustainability. A new baseline in the sustainability dimension reflects the stronger performance of Tunisia. The resulting balance score is DBB.
- Policies have been implemented in Tunisia to manage the exploration and production of hydrocarbons that will allow Tunisia to improve its energy security, advance economic development and establish its position on the world market. Currently, about 40% if electricity comes from natural gas.
- Tunisia has made valuable progress in efforts to sustain its economic development and improve the energy sustainability balance through the promotion of energy efficiency, renewable and alternative energy. The economy is growing, with latest national figures reporting industrial sector growth to 34%. Although access to electricity is widespread, some pockets of the population have lower quality or intermittent electricity. In 2010, Tunisian GHG emissions form energy generation were at around 27 MtCO2e. Policies have been implemented to address this scale of emissions. Renewable electricity generation represents about 2.4% generated by wind energy, and a small proportion of hydro generation.
- Key issues policymakers need to focus on are: 1) increasing the share of renewable energy in electricity generation (including wind, solar (especially PV) and household micro generation (solar water heat, electricity); and 2) extending the natural gas network in the south, north east and central parts of the country.

KEY METRICS

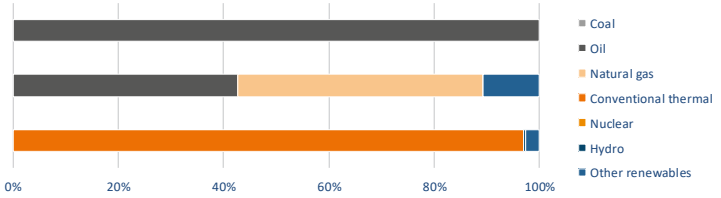
Industrial sector (% of GDP)	28.2	GDP per capita, PPP US$ (GDP Group)	11,596 (III)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 1,790)
Population with access to electricity (%)	100	Access to clean cooking (%)	99
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	15.73
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2010 – 2014 (%)	2.43

ENERGY PROFILE

Fossil fuel reserves: 55 Mtoe

Total primary energy supply composition

Diversity of electricity generation



TURKEY

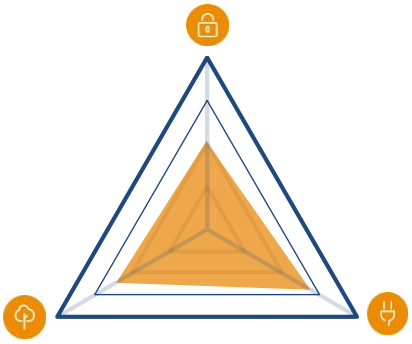
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

44

SCORE

BBB



	2016	2017	2018	Trend	Score
Overall rank and balance score	**46**	**50**	**44**	▶	**BBB**
Energy performance					
Energy security	69	82	67	▶	B
Energy equity	45	52	54	▶	B
Environmental sustainability	53	55	49	▶	B
Contextual performance	57	52	53	▶	

TRENDS AND OUTLOOK

- Turkey climbs 6 places to rank 44 this year. Good scores are achieved in the energy equity and environmental sustainability dimensions. The energy security score has improved relative to other countries and as part of the measure of supply diversity. The improved balance score is BBB.
- Turkey must accommodate a fast-growing demand for energy. Enormous investment volumes are required to meet the country's continuing growth. Currently, 27% of primary energy consumption and 50% of power generation – a record high – is met by domestic resources. In addition, 33% of overall power generated in Turkey is from renewable resources.
- Numerous initiatives are underway to improve energy security in the country: 1) Two competitive tenders of 1000 MW for each of solar and onshore wind was completed in 2017. Turkey has announced a first of its kind tender to be held 2018 for offshore wind, targeting 1200 MW of installed capacity; 2) An additional 8222 MW of capacity was added in 2017, almost 70% of which is from renewable resources, mainly solar and wind. Tender allocations of 3000 MW wind capacity were completed in 2017 by the National Transmission System Operator; 3) An estimated 300 MW of new geothermal power capacity came online in 2017. This puts Turkey in 2nd place in terms of net additional installed capacity in 2017; 4) Turkey has firm plans for adding nuclear power to its energy mix. Construction license of the Mersin Akkuyu nuclear power plant is granted by the regulator and is scheduled to become operational by 2023. A new agency has been established in Turkey to regulate the nuclear energy sector; 5) The most important part of Southern Gas Corridor, the Trans-Anatolian Natural Gas Pipeline (TANAP), has become operational in June 2018. Export to Europe is expected in 2020 once the construction of the Trans Adriatic Pipeline (TAP) is completed; 6) TurkStream Natural Gas Pipeline is expected to become operational by the end of 2019.

KEY METRICS

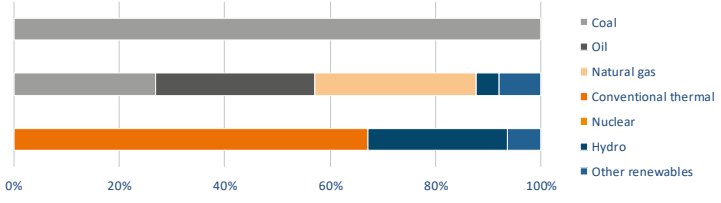
Industrial sector (% of GDP)	31.67	GDP per capita, PPP US$ (GDP Group)	25,247 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 1,302)
Population with access to electricity (%)	100	Access to clean cooking (%)	96
Household electricity prices (US$/kWh)	0.15	Rate of transmission and distribution losses (%)	13.76
CO_2 intensity (kCO_2 per US$)	0.30	GHG emission growth rate 2010 – 2014 (%)	3.16

ENERGY PROFILE

Fossil fuel reserves: 7,947 Mtoe

Total primary energy supply composition

Diversity of electricity generation



UNITED ARAB EMIRATES

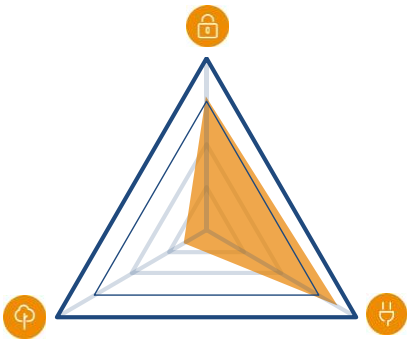
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

36

SCORE

AAD



	2016	2017	2018	Trend	Score
Overall rank and balance score	**43**	**40**	**36**	▶	**AAD**
Energy performance					
Energy security	42	21	24	▶	A
Energy equity	22	14	12	▶	A
Environmental sustainability	113	116	116	▶	D
Contextual performance	25	29	28	▶	

TRENDS AND OUTLOOK

- The United Arab Emirates continues to ascend the Trilemma ranking, climbing four places to position 36 this year. Strong performances in both energy security and energy equity dimensions are in contrast to a particularly low score in environmental sustainability, resulting in an imbalanced trilemma profile of AAD.
- The UAE relies significantly on conventional hydrocarbon resources for electricity and transport. However, there are opportunities for renewable energy and energy efficiency solutions. For example, the UAE has launched initiatives such as National Agenda Vision 2021, Dubai Plan 2021, and Abu Dhabi Vision 2030, which include the establishment of renewable energy (7% and 5% generation capacity in Abu Dhabi and Dubai, respectively by 2030), and energy efficiency targets (30% demand reduction target by 2030 in Dubai). The UAE is also working on a comprehensive energy policy plan to coordinate all federal initiatives.
- The UAE has officially launched its long-term National Energy Strategy 2050 in January 2017. The strategy aims to achieve 50% clean energy capacity by 2050 as well as a 40% reduction in electricity and water consumption. The clean energy target aims for deployment of 44 GW of renewable energy capacity, which includes centralized and decentralized solar power plants
- The UAE is receptive to the transition to a more electrified transport sector with the total number of charging stations in the emirate of Dubai set to double by end of 2018. The UAE government accelerator platform conducted a stakeholder dialogue to incentivise EV in the country. The Dubai government later launched an incentive package, which includes free charging until 2019, parking fee exemptions as well as rebate in the toll fees within the emirate.

KEY METRICS

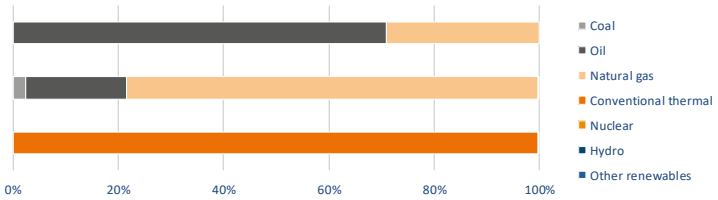
Industrial sector (% of GDP)	55.28	GDP per capita, PPP US$ (GDP Group)	72,400 (I)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	High (HHI = 1,299)
Population with access to electricity (%)	100	Access to clean cooking (%)	98
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	7.66
CO_2 intensity (kCO_2 per US$)	0.43	GHG emission growth rate 2010 – 2014 (%)	5.51

ENERGY PROFILE

Fossil fuel reserves: 18,321 Mtoe

Total primary energy supply composition

Diversity of electricity generation



UNITED KINGDOM

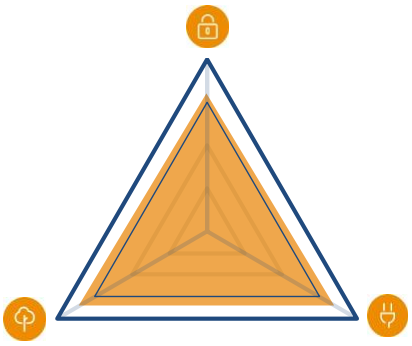
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

5

SCORE

AAA



	2016	2017	2018	Trend	Score
Overall rank and balance score	11	5	5	▶	AAA
Energy performance					
Energy security	32	26	18	▶	A
Energy equity	8	15	19	▶	A
Environmental sustainability	15	9	14	▶	A
Contextual performance	13	7	9	▶	

TRENDS AND OUTLOOK

- The United Kingdom maintains its position in the top 10 global ranking at number 5. Excellent performance in all trilemma dimensions results in a very well balanced profile of AAA. The UK continues to balance the trilemma effectively with a reliable energy system derived from a mix of energy sources.
- Decarbonisation of the energy supply continues apace, led by the continued decline in coal, which now accounts for just 5% of UK energy supply (declining from more than 20% of the mix just five years ago). Although fossil fuels still make up 80% of the UK's primary energy – this is the lowest-ever share historically – the UK is anticipated to meet easily its third legally binding carbon budget for the period 2018-2023.
- Renewables capacity continues to rise, buoyed by increases in supply from onshore and off-shore wind – with 41GW of supply coming from renewable sources in 2017 – an overall increase of 14%. Renewable energy sources now make up 30% of the overall UK energy mix and, together with nuclear, low carbon sources of energy topped 50% for the first time in 2017.
- However, with BREXIT (the UK's departure from the European Union on 29th March 2019) looming large on the horizon, and many aspects of the UK's future relationship with respect to energy and the European Union yet to be worked out. Uncertainty is the key factor and is anticipated to have an impact on the energy security and energy affordability axes for 2019.

KEY METRICS

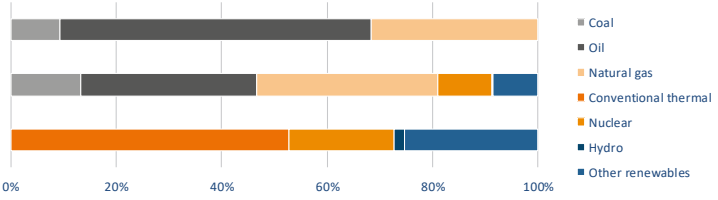
Industrial sector (% of GDP)	19.41	GDP per capita, PPP US$ (GDP Group)	42,656 (I)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Medium (HHI = 1,721)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.22	Rate of transmission and distribution losses (%)	7.95
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2010 – 2014 (%)	-1.96

ENERGY PROFILE

Fossil fuel reserves: 523 Mtoe

Total primary energy supply composition

Diversity of electricity generation



UNITED STATES

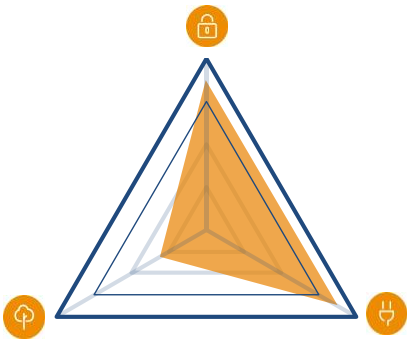
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

14

SCORE

AAC



	2016	2017	2018	Trend	Score
Overall rank and balance score	**14**	**15**	**14**	▶	**AAC**
Energy performance					
Energy security	4	8	7	▶	A
Energy equity	13	24	14	▶	A
Environmental sustainability	73	75	93	▶	C
Contextual performance	18	14	14	▶	

TRENDS AND OUTLOOK

- The United States rise 1 place this year to rank 14 in the Trilemma. Strong performances in both energy equity and energy security, where it ranks 7th globally, are offset by a lower ranking for environmental sustainability. However, the scores in this dimension show a steady and gradual increase for the United States, and the change in rank is attributed to the relative performance of other countries. This results in an imbalanced score of AAC.

- After a slowdown of the American shale gas production in 2016, higher oil prices and continuous improvements to productivity have sent the industry soaring once again. The Energy Information Administration (EIA) estimates that the country has more than 2,462 trillion cubic feet (tcf) of technically recoverable natural gas, including 341 tcf of proven reserves. The significant increases in domestic oil and gas production will greatly reduce oil imports over the next 10 years, and lead to increased exports of refined products and possibly natural gas. Those effects are not visible in this year's Trilemma, but the outlook is clear: improved energy security is sure to follow, while environmental sustainability might suffer.

- Despite federal policy in favour of a coal production regrowth, many states are moving towards more renewable and nuclear energy, pledging for high levels of clean energy and reductions in greenhouse gases emissions. The resulting geographical contrasts could prove challenging for the harmonisation of the national electricity grid.

KEY METRICS

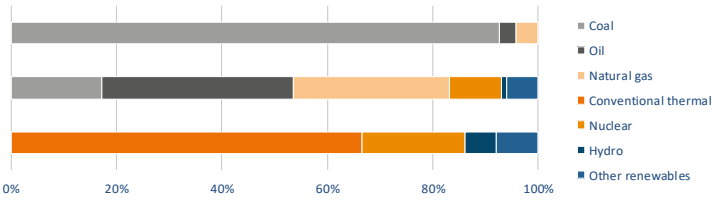
Industrial sector (% of GDP)	20.03	GDP per capita, PPP US$ (GDP Group)	57,638 (I)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Medium (HHI = 1,545)
Population with access to electricity (%)	100	Access to clean cooking (%)	100
Household electricity prices (US$/kWh)	0.13	Rate of transmission and distribution losses (%)	6.16
CO_2 intensity (kCO_2 per US$)	0.33	GHG emission growth rate 2010 – 2014 (%)	-0.6

ENERGY PROFILE

Fossil fuel reserves: 189,497 Mtoe

Total primary energy supply composition

Diversity of electricity generation



URUGUAY

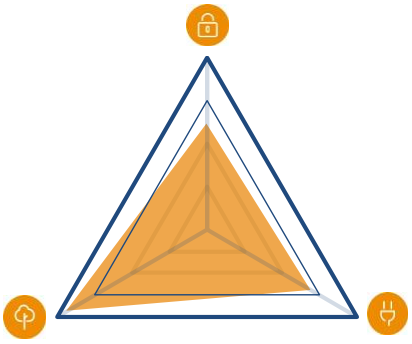
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

28

SCORE

BBA



	2016	2017	2018	Trend	Score
Overall rank and balance score	27	35	28	▶	BBA
Energy performance					
Energy security	40	70	48	▶	B
Energy equity	51	57	53	▶	B
Environmental sustainability	16	10	3	▶	A
Contextual performance	44	43	49	▶	

TRENDS AND OUTLOOK

- Uruguay reclaims several points in the Trilemma ranking, placing at 28 this year. Energy security and equity dimensions both show strong performance. Uruguay is one of the top countries in the environmental sustainability ranking, which is recognised by a new baseline for this dimension. This results in a balance score of CBA.
- The country has no proven oil, natural gas or coal reserves, but a high availability of renewable energy sources. By carefully choosing renewable energy sources and technologies such as hydropower, wind energy, biomass cogeneration, and biofuels, it was possible, without subsidies, to reach a 57% share of renewable energy in the 2015 energy mix (up from 37% in 2005). At the end of 2017, Uruguay had 41 wind farms (1500 MW installed capacity), of which 15 were installed in the past two years. This represents a 26% share of wind energy in the electricity generation mix. The most recent national data shows hydro power at 52% and other renewables at 46% of the electricity mix.
- 70% of the Uruguayan offshore area is being explored for natural gas and oil. Between 2010 and 2015 US$7bn has been invested in the energy sector (15% of annual GDP). As a result of this process, during the past two years, Uruguay has moved from being an energy importer to being an energy exporter. Moreover, since 2015 Uruguay did not have to import electricity.
- Total investment in the Electricity Sector in Uruguay between 2005 and 2017 has been US$ 4.768 bn. 87% of this was in Renewable Energy; 30% came from public investment and 70% from private. This result is 2,920 MW new capacity added to the electrical system, with an average power of 1,200 MW and a peak power of 1,900 MW.

KEY METRICS

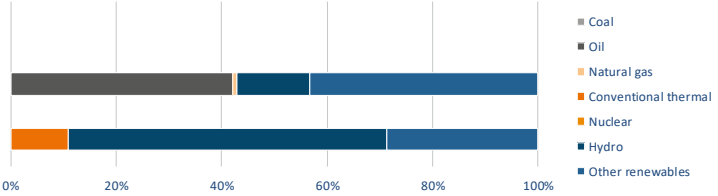
Industrial sector (% of GDP)	28.89	GDP per capita, PPP US$ (GDP Group)	21,620 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 1,819)
Population with access to electricity (%)	100	Access to clean cooking (%)	98
Household electricity prices (US$/kWh)	N.A	Rate of transmission and distribution losses (%)	12.38
CO_2 intensity (kCO_2 per US$)	0.10	GHG emission growth rate 2010 – 2014 (%)	1.60

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



FREQUENTLY ASKED QUESTIONS

TRILEMMA CONTEXT

The Energy Trilemma Index aims to support an informed dialogue about improving energy policy with Trilemma scores needing to be considered in the context of all three dimensions. Energy policy is complex: while modelling can provide insight, it requires some simplifying assumptions that can also produce anomalies from methodology issues that stem from a global indicator relying upon comparable data. Methodological anomalies exist for each Trilemma dimensions:

- Energy Security focuses on domestic resources not on quality of supply;
- Energy Equity does not differentiate between low prices from fuel subsidies or competitive markets;
- Environmental Sustainability highlights lower energy users per capita that may not represent the most sustainable energy policies.

The Council is evolving the Trilemma methodology to address these issues and help to ensure that the Trilemma remains relevant and useful for all users.

What is the World Energy Trilemma Index?

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

The World Energy Trilemma Index looks at indicators of energy performance across the three dimensions as well as the country's context.

Energy Security measures the ability to meet current and future energy demand.

Energy Equity measures the ability to provide access to reliable and affordable energy for domestic and commercial use.

Environmental Sustainability measures the ability to mitigate natural resource depletion and environmental degradation.

Country Context focuses on elements that enable countries to effectively develop and implement energy policy and achieve energy goals. This component examines factors such as the capacity to support a coherent and predictable policy framework, a stable regulatory environment, and overall attractiveness of the country to investors.

The Energy Trilemma Index is prepared annually by the World Energy Council in partnership with

global consultancy Oliver Wyman, along with the Global Risk Center of its parent Marsh & McLennan Companies since 2010.

What is the goal of the Index?

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 thus informs policy makers, energy leaders, and the investment and financial sector.

What is the scope of the Index?

The Index includes 130 countries, 90 of which have World Energy Council Member Committees. However, in 2018, rankings have only been produced for 125 countries due to data limitations. Countries that are tracked but not ranked are: Chinese Taipei, Libya, Barbados, Syria (Arab Republic) and Yemen.

The Index aggregates 72 datasets into 35 indicators to create a snapshot energy profile for each country.

What time period does the 2018 Index capture?

The 2018 Index generally reflects data from 2014-2017, although selected datasets may date from earlier if more recent data is not available. Recent world events that could affect the Index's outcomes may therefore not be fully captured (e.g., geopolitical unrest in the Middle East).

To address this limitation, the World Energy Trilemma Index Report identifies a 'watch list' that seeks to identify countries that are likely to experience significant changes – positive or negative – in their trilemma Index performance in the near future. The goal of the watch list is to reflect developments in a country's energy sector that are currently ongoing but not yet captured in the data that is available.

How are the Index results presented?

Countries are provided with an overall Index ranking (1-125), as well as rankings for each dimension of Energy Security, Energy Equity and Environmental Sustainability. The top performing country is awarded a #1 ranking, while the lowest ranking country is assigned # 125.

In addition, each country is also given a 'balance score' that allocates a 'letter grade' to a country's ranking in each dimension and countries are provided with a three-letter score. The scores are calculated by splitting the normalised results in each dimension into four groups (A, B, C, D). High performance across all three dimensions is awarded 'AAA'. Letter scores such as BBC, CCD, highlight the balance or imbalance across a country's energy performance. An imbalance in energy performance suggests current or future challenge in the country's energy policy. 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.

Index results and analysis are also complemented by regional overviews as well as individual country profiles of World Energy Council Member Committee countries only. The country profiles provide trends in energy trilemma performance as well as performance on specific indicators assessed in the overall Index.

Where can I find the full results?

The results are published once a year. Results can be downloaded for free from the Council's webpage. Index data is available at: https://www.worldenergy.org/data/.

The full report with country rankings and profiles is available at: https://www.worldenergy.org/publications/

A. INDEX RANKINGS & POLICIES

What does the Index tell us about the country's energy performance and policy?

The Index shows how well each country is performing on the Energy Trilemma and in effect, captures the aggregate effect of energy policies applied over time. Because the Index shows aggregate policy effects, it does not identify the effectiveness of a particular policy; each policy interacts with a unique set of policies specific to that country over different periods. Nonetheless, the Index broadly measures the aggregate outcome of country policies, such as the level of country CO2 emissions or the overall use of electricity per capita relative to other countries.

What will affect a country's ranking in the Index?

The Index is weighted in favour of energy performance versus contextual performance. Therefore, changes in energy performance will have a greater effect on a country's ranking than contextual dimensions.

A country's overall position in the Index is affected by the degree of balance between the three energy performance dimensions. Given the equal weighting of these dimensions, countries that exhibit broadly similar and relatively higher scores in these will typically rank higher on the Index and have a higher letter grade.

Few countries manage to perform well across all three energy dimensions. Currently, many countries achieve stronger performance in two dimensions, suggesting trade-offs between energy dimensions. For example, some energy exporting countries may lead in social equity (highly affordable and accessible energy) and also in energy security (high energy exports), but obtain lower scores in environmental impact mitigation (due to intense energy use). A trade-off between strong affordability and low energy intensity becomes evident as low prices limit incentives to reduce energy consumption and to engage in energy efficiency programs.

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 in the context of the relative performance of all the countries. To move up in the Index ranking requires a country to improve its performance relative to peer countries. Thus, if a country's energy performance remains stable but those of other countries improve, a country will by default decrease in the rankings.

For example, a country's ranking on the indicator 'Diversity of electricity production' will depend on how its diversity (e.g., hydroelectric, nuclear, wind, conventional thermal) ranks against other countries. Alternatively, 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.

What policies will affect a country's position on the Index?

The Index aggregates many different data points and it is thus often difficult to pinpoint how any single policy affects a country's performance against a particular indicator or in an overall dimension. For example, 'GHG emissions' could change due to multiple policies implemented over time aimed at reducing GHG and CO2 emissions. Technological factors within specific industries (e.g., changes in automotive technology) can also have an impact, and are not directly measured by the Index.

Those factors noted, countries which 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.

B. INDEX METHODOLOGY

How are indicators selected for the Index?

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

It was also critical that the indicators could be consistently and readily derived from reputable sources and cover a high proportion of Member Committee countries; some potential indicators were excluded from the Index due to low country coverage. Indicator data sources include the International Energy Agency, the U.S. Energy Information Administration, the World Bank, the International Monetary Fund, the World Economic Forum, and others.

Data selection criteria included:

- Country coverage / data availability and timeliness;
- Comparability of data: indicator data is derived from as unique and comprehensive source as possible
- Relevance: Indicators are chosen or developed to provide insight into country situations;
- Distinctiveness and balance: Each indicator focuses on a different aspect of the issue being explored;
- Contextual sensitivity: Indicators capture different country situations (e.g., wealth, size);
- Robustness: Indicators are captured from reputable sources with the most current information available;
- Balance: Indicators within each dimension (and dimensions across the Index) exhibit coverage of different issues.

What is the 2018 Index based on?

Each country's overall Index ranking is based on underlying indicators across 13 categories in 4 dimensions – some of which are supported by multiple datasets. For example, "Affordability and competitiveness" is measured using three indicators, each of which is supported by multiple datasets. Figure 29 provides an overview of underlying indicators and weighting regimes.

Figure 29: 2018 Energy Trilemma index structure and weighting

Dimension	%	Indicator category	%	Indicator	%
Energy security 	30%	1 Security of supply and energy delivery	15%	a Diversity of primary energy supply	5.0%
				b Energy consumption in relation to GDP growth	5.0%
				c Import dependence	5.0%
		2 Resilience	15%	a Diversity of electricity generation	5.0%
				b Energy storage	5.0%
				c Preparedness (human factor)	5.0%
Energy equity 	30%	1 Access	10%	a Access to electricity	5.0%
				b Access to clean cooking	5.0%
		2 Quality of supply	10%	a Quality of electricity supply	5.0%
				b Quality of supply in urban vs. rural areas	5.0%
		3 Affordability and competitiveness	10%	a Electricity prices	3.3%
				b Gasoline and diesel prices	3.3%
				c Natural gas prices	3.3%
Environmental sustainability 	30%	1 Energy resource productivity	10%	a Final energy intensity	5.0%
				b Efficiency of power generation and T&D	5.0%
		2 GHG emissions	10%	a GHG emission trend	5.0%
				b Change in forest area	5.0%
		3 CO2 emissions	10%	a CO2 intensity	3.3%
				b CO2 emission per capita	3.3%
				c CO2 from electricity generation	3.3%
Country context	10%	1 Coherent and predictable policy framework	2.0%	a Macroeconomic environment	0.5%
				b Effectiveness of government	0.5%
				c Political stability	0.5%
				d Perception of corruption	0.5%
		2 Stable regulatory environment	2.0%	a Transparency of policy making	0.7%
				b Rule of law	0.7%
				c Regulatory quality	0.7%
		3 Initiatives that enable RD&D and innovation	2.0%	a Intellectual property protection	0.5%
				b FDI & technology transfer	0.5%
				c Capacity for innovation	0.5%
				d Number of patents issued by residents	0.5%
		4 Investability	2.0%	a Foreign direct investment net inflows	1.0%
				b Ease of doing business	1.0%
		5 Air pollution, land and water impact	2.0%	a Wastewater treatment	1.0%
				b Air pollution	1.0%

Are more details on the methodology available?

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 available at: www.worldenergy.org.

Why are grades assigned using actual distribution?

Assigning grades using the actual distribution is more representative of the data. It presents the absolute difference between the countries' performance in the different dimensions and avoids artificially dividing countries into different categories with a fixed number of countries within each category (e.g. AAA ranking), as would occur with an even distribution approach.

Why are gate criteria used?

Gate criteria were introduced to address heavily skewed data, such as access to energy – there are a large number of countries that have a 100% access rate. A gate criterion helps group similar countries (e.g., those with a 100% access rate) and thereby prevents the skewed data from excessively influencing outcomes.

Which (sub)-indicators are subject to a gate criterion?

The following indicators and sub-indicators are subject to a gate criterion:

1. Diversity of primary energy supply;
2. Import dependence;
3. Energy storage (oil stocks and infrastructure);
4. Access to electricity;
5. Access to clean cooking;
6. Number of patents issued by residents.

Please refer to the full Index Methodology document for a detailed explanation of the gate criteria and the rationale behind the gate criteria for each of the sub-indicators.

Why is missing data replaced by the group mean?

The group mean is more representative of the specific countries in terms of economic development, social situation, etc. This representativeness renders missing values less likely to distort country outcomes.

The groups are established based (jointly) on economic groups and geographic region

- GDP Group I: GDP per capita greater than USD 33,500;
- GDP Group II: GDP per capita between USD14,300 and USD 33,500;
- GDP Group III: GDP per capita between USD 6,000 and USD 14,300;
- GDP Group IV: GDP per capita lower than USD 6,000.

The indicator mean is the average of a specific indicator across all countries. For example, the indicator mean would average CO2 emissions data between the United States and South Sudan, which have very different figures.

Using group means ensures that, for example, CO2 emissions data would be averaged between South Sudan and countries with a similar GDP and geographic location, which could be more reflective of the economy and energy profile of South Sudan.

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 particular policy.
- The Index uses nearly 100 data sets. In a number of instances data for specific countries is not available (i.e. the dataset has missing data), in which case missing data is replaced by the group mean.

What questions/ discussion are revealed by the Index?

The Index prompts an analysis of statistical groupings of countries to better understand why some are performing better than others. The grouping of countries is sometimes obvious, but other times requires additional analysis to understand. This leads to further dialogue:

- What is the country's perspective/priority on the 'right balance' on the energy trilemma?
- How does the country want to achieve its energy trilemma goals?
- What is the role of government policies (national, regional, local) in supporting these energy goals?
- What policies are appropriate to drive energy goals (e.g., raising fuel taxes to encourage energy efficiency or encouraging greater use of electric cars?). How do these policies need to evolve over time?
- What are the situational and/or contextual barriers the country faces in terms of energy performance, and how might these barriers be overcome?
- How do situational and contextual barriers differ across countries in different stages of their development? How can emerging countries combine social and economic development with balancing the energy trilemma?

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