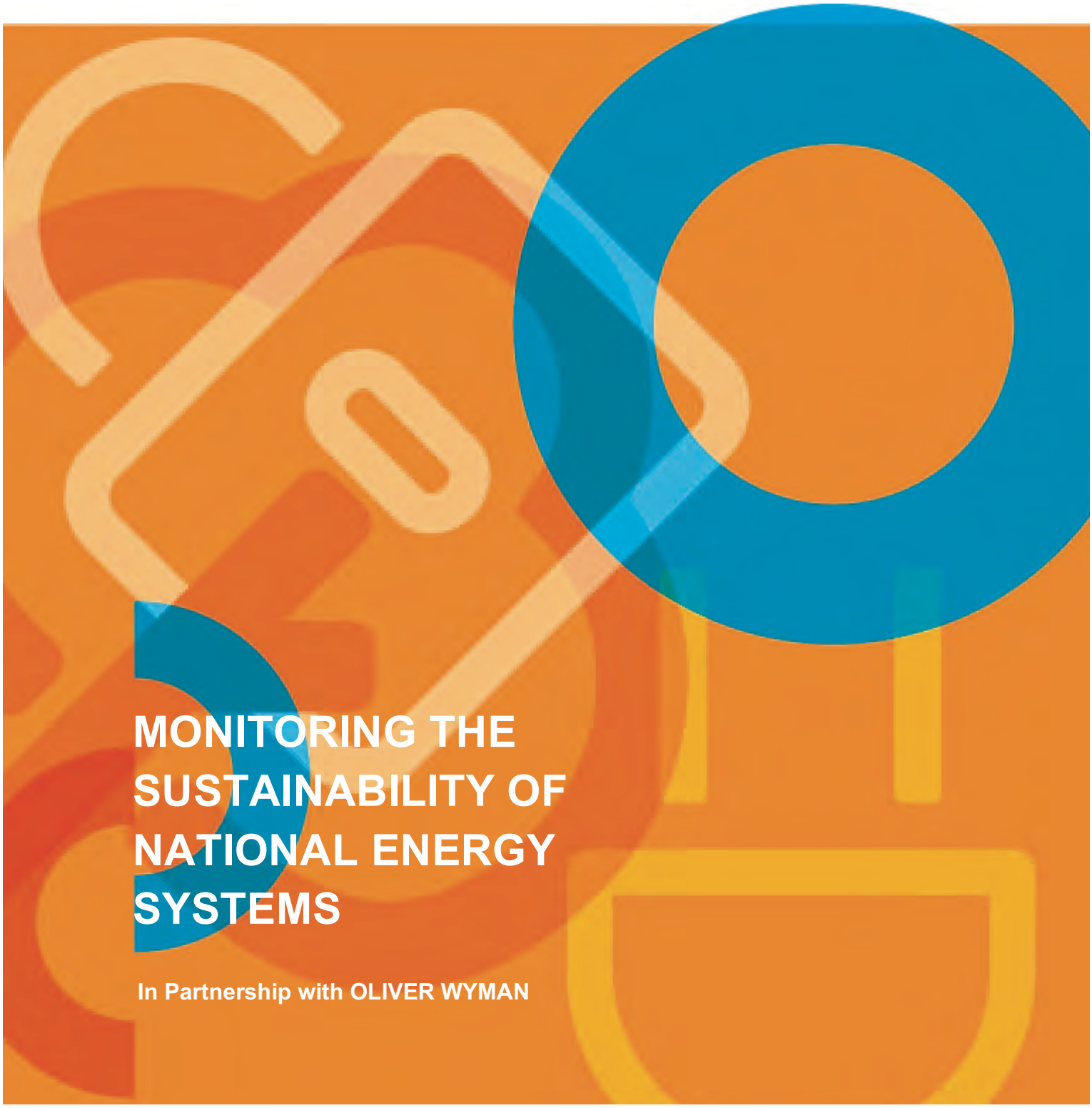
WORLD ENERGY COUNCIL

World Energy Trilemma Index | 2017



MONITORING THE SUSTAINABILITY OF NATIONAL ENERGY SYSTEMS

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** and **@WECouncil**

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ABOUT THE ENERGY TRILEMMA INDEX

The World Energy Council's definition of energy sustainability is based on three core dimensions: energy security, energy equity, and environmental sustainability. Balancing these three goals constitutes a 'trilemma' and is the basis for prosperity and competitiveness of individual countries.

The World Energy Trilemma Index, prepared annually by the World Energy Council in partnership with global consultancy Oliver Wyman, along with the Global Risk Centre 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 ability to balance the trade-offs between 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:
www.worldenergy.com/data.

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EXECUTIVE SUMMARY

MONITORING THE SUSTAINABILITY OF NATIONAL ENERGY SYSTEMS

The World Energy Council's definition of energy sustainability is based on three core dimensions: energy security, energy equity, and environmental sustainability. The Energy Trilemma Index rates countries' energy performance around the world and provides a framework to monitor progress.

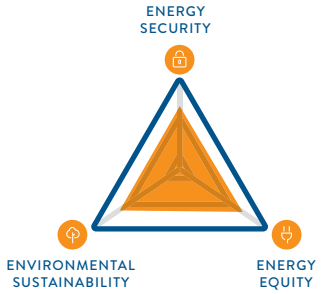
The 2017 Energy Trilemma Index reveals signs of progress on all dimensions of the Energy Trilemma. Efforts to increase resource productivity and manage energy demand growth will be key in ensuring a balanced Energy Trilemma.

Among the countries included in the Index, access to electricity and clean cooking have both increased by 7% to 87% and 75%, respectively since 2000. Meanwhile, lower carbon forms of energy are being used to support energy access and economic growth, with renewables making up 19.3% of final global energy consumption worldwide in 2015. A more diversified and low-carbon energy mix will help to improve energy security and environmental sustainability but its positive effects may be stifled by rising final energy consumption, which is predicted to increase by up to 46% by 2060[1].

Eight of the 125 countries assessed achieved a triple-A score, down from 13 in last year's index. This year Denmark, Sweden and Switzerland top the Index once more, with Denmark also achieving the highest score for energy security. While not in the top 10 overall, Luxembourg maintains its position for most equitable (affordable and accessible) and the Philippines is leading the way on the environmental sustainability dimension. In Latin America, Uruguay ranks the highest, while in the Middle-East, Israel outperforms its regional peers. In Sub-Saharan Africa, Mauritius performs best, and in Asia, New Zealand remains at the top of the regional leader board.

TRILEMMA INDEX 2017: TOP 10 COUNTRIES

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



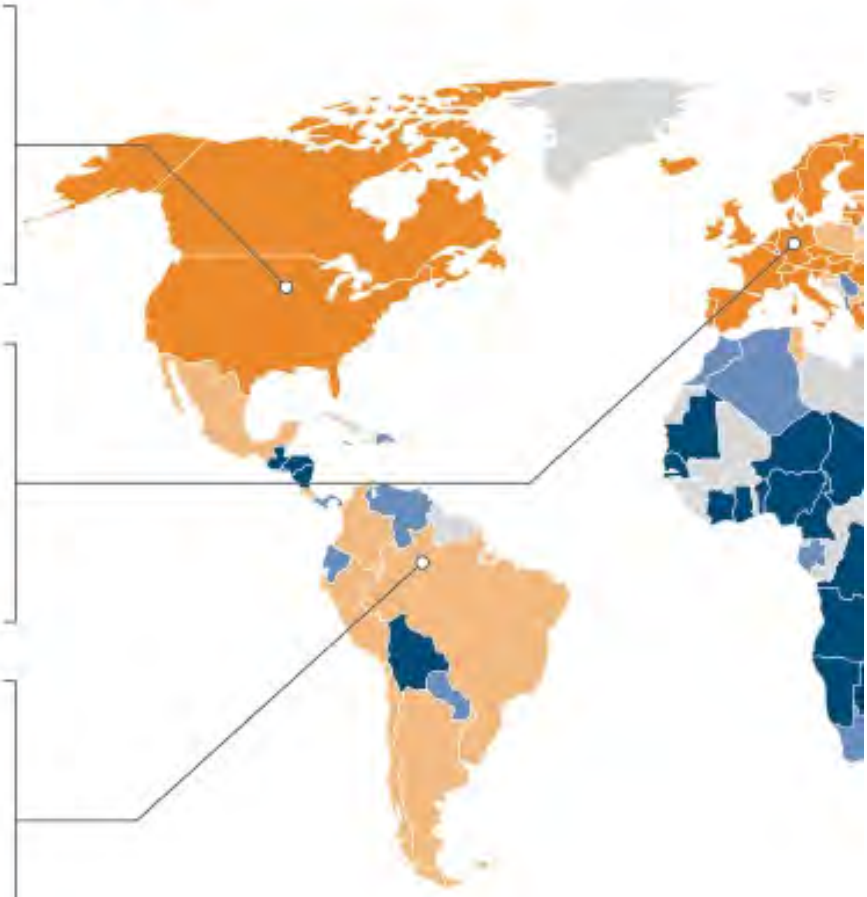
1 https://www.worldenergy.org/wp-content/uploads/2016/10/World-Energy-Scenarios-2016_Full-Report.pdf

WORLD ENERGY TRILEMMA INDEX 2017: REGIONAL OVERVIEWS

NORTH AMERICA

EUROPE

LATIN AMERICA AND CARIBBEAN



NORTH AMERICA

CONTINUED STRUGGLES WITH EXTREME WEATHER AND AGING INFRASTRUCTURE

North America remains the second highest performing geographic region on the Index, although aging infrastructure and extreme weather events continue to test the resilience of its energy systems. Additional uncertainty comes from the potential effects of a US withdrawal from the Paris Agreement. Despite this, the integration of distributed energy resources is providing opportunities for all three countries to improve their energy systems and help balance the Energy Trilemma.

EUROPE

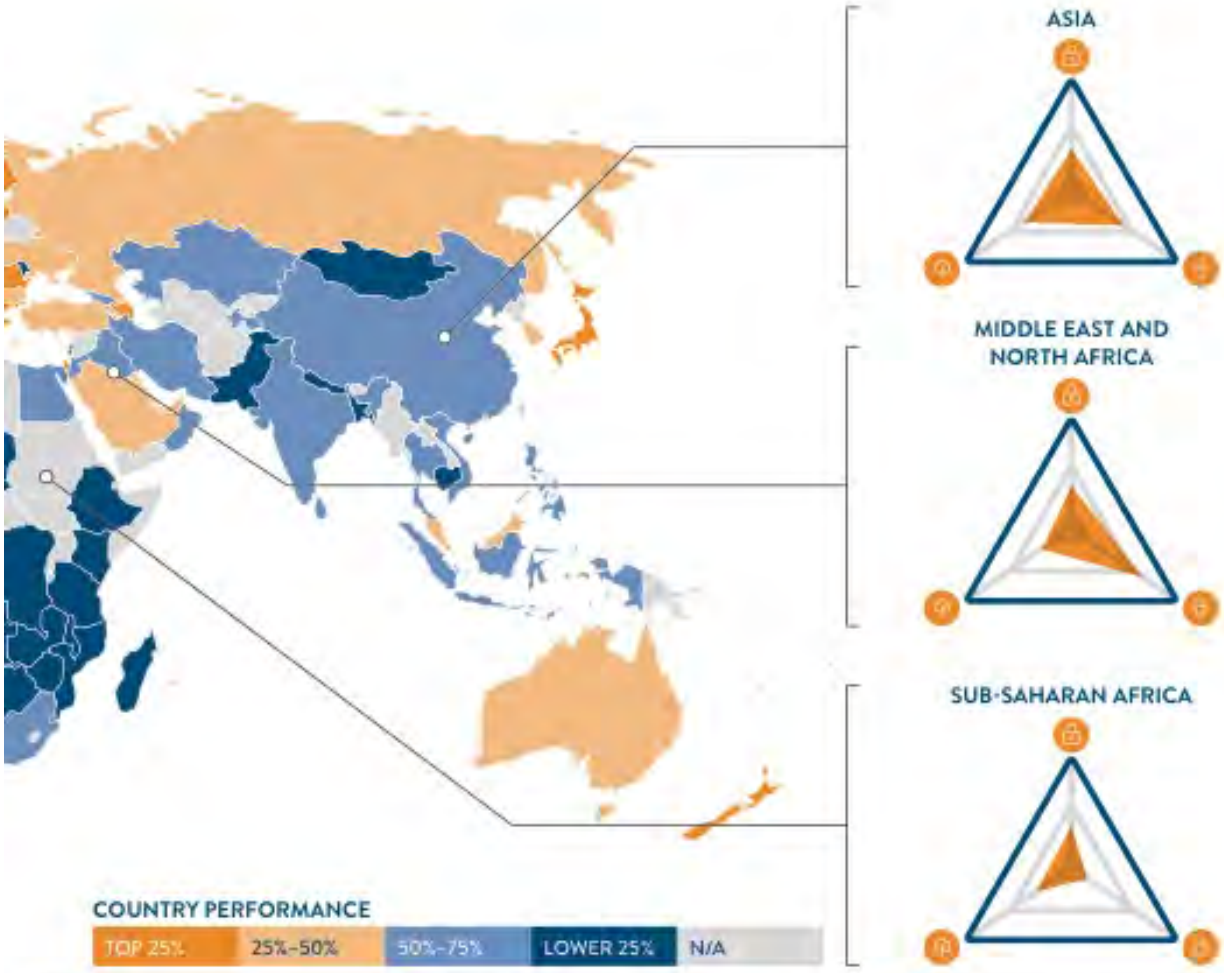
LEADING TRANSITION BUT NEED REGULATIONS TO EVOLVE TO REALISE DISTRIBUTED ENERGY RESOURCES POTENTIAL

Europe continues to dominate the Trilemma Index in 2017, with nine European countries occupying the top ten places globally and all countries placing inside the top 100. European countries need to guard against complacency and maintain their focus on balancing the competing dimensions of the Energy Trilemma. Key challenges remain with navigating the energy transition and ensuring that governance and regulations remain fit for purpose in a fast-evolving energy system.

LATIN AMERICA AND CARIBBEAN (LAC)

POSITIVE STEPS TOWARDS ENERGY RESILIENCE AND SUSTAINABILITY

The region faces many challenges that include extreme weather, poor diversification of energy sources, and societal issues such as widespread inequality. However there are positive signs to be seen with many countries setting ambitious goals for emissions, reductions and EV adoption. Greater interconnection between countries, large-scale investments in infrastructure, and regional co-operation are still needed in order to effectively balance the Energy Trilemma.



ASIA

RISING DEMAND FROM ECONOMIC GROWTH CREATING CHALLENGES

After 2040, the region will be the most important economic area in the world and it is because of this growth that Asia is facing the challenge of making progress on all three trilemma dimensions. The expected increase in the use of distributed generation and distributed energy resources can assist with meeting goals in energy security, energy equity, and environmental sustainability and reduce current reliance on energy imports.

MIDDLE EAST AND NORTH AFRICA

VAST POTENTIAL FOR DIVERSIFICATION

MENA retains strong scores in the energy access and affordability dimensions but faces significant challenges in energy security and environmental sustainability. Combined with growing water scarcity, the region's rising demands for electricity, water, and cooling, if not addressed, could threaten energy security and environmental sustainability. Going forward, distributed generation, especially solar and wind renewables, is expected to be increasingly deployed throughout the region to diversify energy sources, reduce GHG emissions, and improve energy access, especially in remote areas where off-grid electricity is less expensive than extending the existing power grid.

SUB-SAHARAN AFRICA

DISTRIBUTED ENERGY RESOURCES OFFERS POTENTIAL TO ADDRESS KEY ENERGY ACCESS CHALLENGE

Energy access remains a key challenge for the region, despite significant resources and renewables potential. With almost 65% of the total population lacking access to electricity in 2014, the region must attract investment, build institutional capacity, and improve its on-and-off-grid energy supply in order to unlock the region's resource potential and meet future energy demand. Global climate threats only add extra complexity to the successful management of the Energy Trilemma.

MONITORING THE SUSTAINABILITY OF NATIONAL ENERGY SYSTEMS

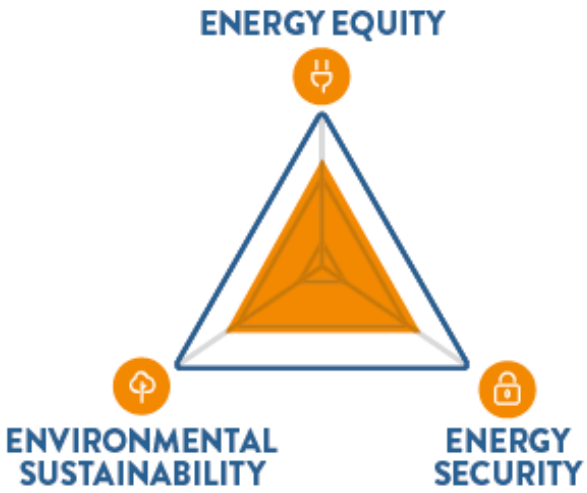
Introduction

INTRODUCTION: ABOUT THE ANNUAL ENERGY TRILEMMA INDEX

The World Energy Council's definition of energy sustainability is based on 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 behaviors.

As the global energy sector is being transformed by three reinforcing trends - decarbonisation, digitalisation and decentralisation – policymakers around the globe will come across new opportunities to make progress on the Energy Trilemma. At the same time, they will be required to sustain the advancements made on the trilemma over the past years by managing and actively integrating a greater diversity of market actors and technologies without fragmenting the energy system.

BOX 1: 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.

The Energy Trilemma Index quantifies the Energy Trilemma and comparatively ranks 125 countries[2] in terms of their ability to provide a secure, affordable, and environmentally sustainable energy system. In addition, countries are awarded a balance score that highlights how well the country manages the trade-offs between the three Energy Trilemma dimensions and identifies top performing countries with a 'AAA' score.

The Index rankings are based on a range of data sets that capture both energy performance and the context of that energy performance. Energy performance indicators consider supply and demand, the affordability of and access to energy, and the environmental impact of a country's energy production and use. 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.

Prepared annually by the World Energy Council in partnership with global consultancy Oliver Wyman, along with the Global Risk Centre of its parent Marsh & McLennan Companies since 2010, the Index methodology was updated and revised in 2016 to capture the changing energy landscape. The methodology maintains the focus on the three Energy Trilemma dimensions but is enhanced by three main changes. Firstly, the revised methodology broadens the scope of indicators covered to provide a more inclusive ranking of the energy sector with a greater focus on the diversity of energy supply. Secondly, the assessment of energy equity is enhanced by including measures for the quality of supply and affordability of a wider number of energy resources, including household electricity, natural gas and diesel costs. Finally, the revised Index includes a consideration of the resilience of a country's energy system, with indicators for energy storage and the ability of a country to prepare for and repair energy infrastructure following shocks (human factor).

Included in this Index report are:

- 2017 Energy Trilemma Index rankings and balance scores
- 2017 Watch list
- Regional profiles by key geographies
- Index rankings from three consecutive years (2015, 2016 and 2017)
- Energy Trilemma profiles for each of the 94 World Energy Council member countries included in the Index[3]
- Appendices including the revised Index rationale and 2016 methodology.

As countries have unique resources, policy goals and challenges, the absolute rank of a country may be less meaningful than its relative performance versus its peers. To support such analysis, the Index report provides data to generate regional, economic, or structure of the energy sector peer group comparisons. For the deeper Index analysis, countries were organised into four economic groups:

2 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 (Arab Republic), and Yemen.

3 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.

- 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.

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.

OVERVIEW OF THE 2017 ENERGY TRILEMMA RANKINGS

Figure 1 Top 10 Energy Trilemma Index performers overall and per dimension
Source: World Energy Council/Oliver Wyman, 2017

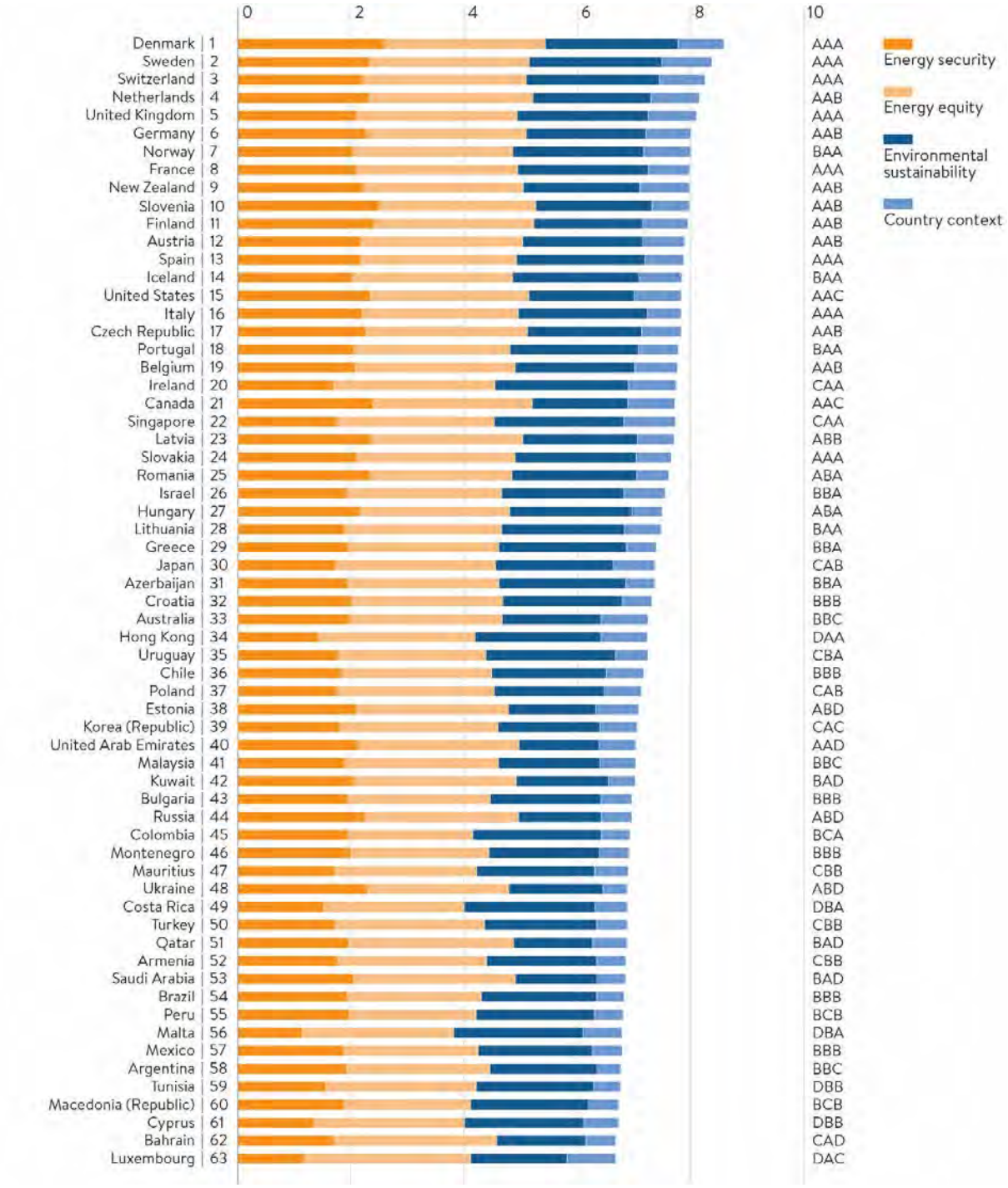
This year's top ten ranked countries are all European, except New Zealand, which continue to be led by Denmark at rank 1. Five of the top ten achieve a triple- A score. This reinforces that (a) countries must perform well across all trilemma dimensions to reach the top of the leader board and (b) it is possible to develop an energy system, in which policies work well together to balance the trade-offs between energy security, energy equity and environmental sustainability. But it also highlights, that it is important for policymakers to plan and manage the energy transition very carefully as there are many potential unintended consequences.

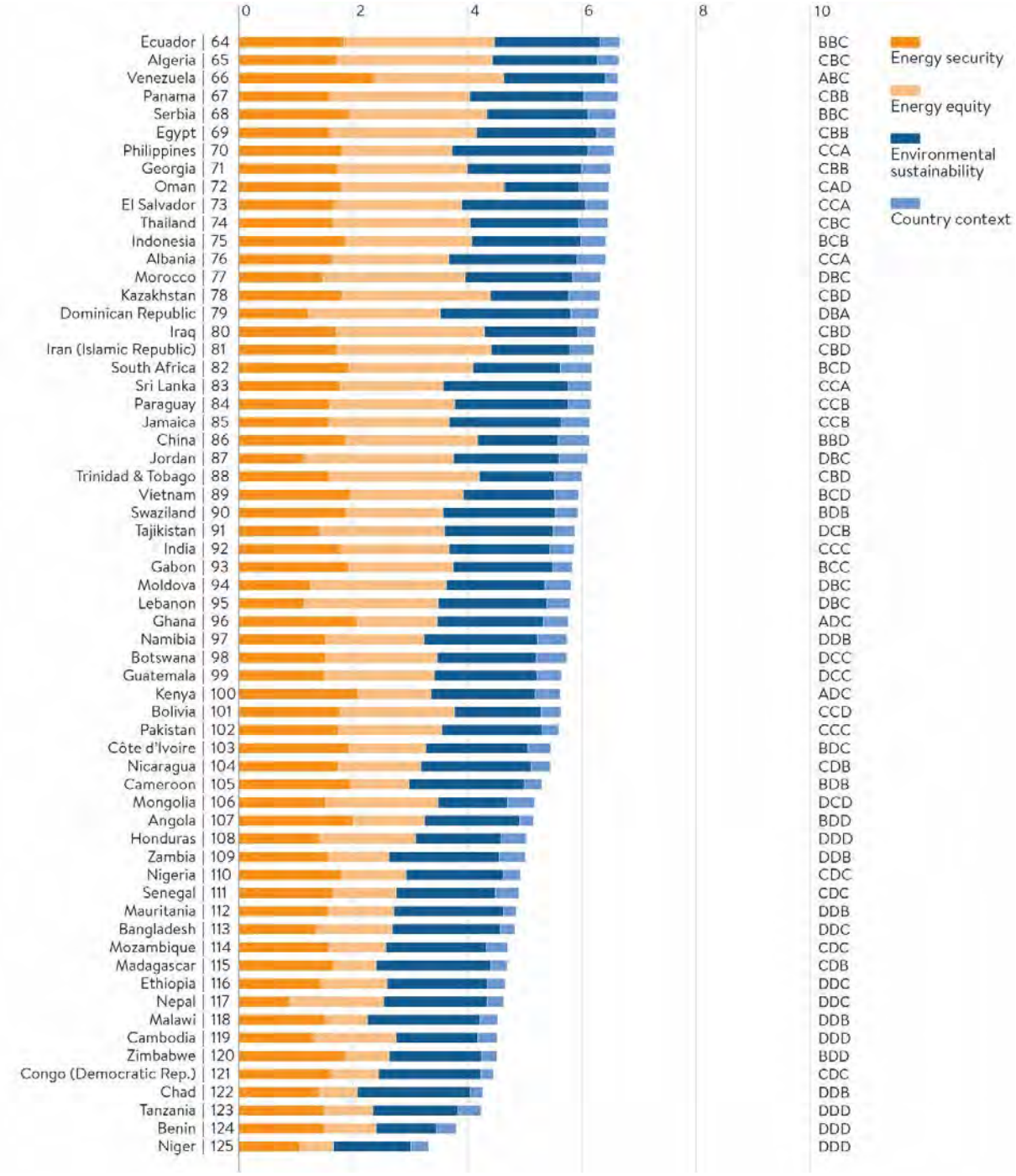
However, the complex trade-offs that are inherent in energy policy-making, as well as certain geographic limitations to achieving a trilemma balance, become evident when analysing countries that excel in one dimension but struggle to achieve a balance.

Luxembourg, for example, which receives the top score in energy equity, ranks 120th in energy security and 99th in environmental sustainability due to its small geographic area and resulting limitations in the availability and diversity of energy resources and generation capacity. Taking advantage of the transition trends, such as decentralisation, may provide countries such as Luxembourg with opportunities to improve both energy security and environmental sustainability. At the same time, the trend of empowered consumers may have unintended consequences, such as higher energy prices for some consumers and may lead to an overall drop of the country's energy equity performance.

Conversely, the top-ten in environmental sustainability is dominated by states that are able to take advantage of their renewable energy potential such as Iceland, the Philippines and Costa Rica, which all have high geothermal or hydropower capacities. A main challenge for these countries, however, is to avoid over-reliance on one single or weather dependent energy resources, which could potentially hamper the resilience of the energy system and with that energy security. The Philippines, for example, which receives the top score in environmental sustainability, ranks 63rd in energy security and 95th in energy equity. Taking advantage of the transition trends, such as decentralisation, may provide countries like the Philippines with opportunities to improve energy access rates while at the same time improving the country's energy equity performance. A well-managed integration of distributed energy resources (DER) and risks associated with the uptake of DER would at the same time reduce the risk of a drop in environmental sustainability.

Figure 2 shows the overall Index performance and balance score of the 125 countries assessed in 2017.





An analysis of selected key metrics used in this index shows that globally, there are signs that countries are building more sustainable energy systems by concurrently addressing energy security, energy equity and environmental sustainability challenges. Progress is most evident for indicators in the energy equity dimension.

Globally, the share of people with access to clean cooking, for example, has increased from 57% in 2000 to 64% in 2014, while the share of people with access to electricity has increased from 75% in 2000 to 82% in 2014.[4] At the same time, global CO2 intensity has been decreasing from 0.42 $tkCO_2$/USD in 2000 to 0.34 kCO_2/USD in 2015 and global energy intensity has been decreasing from 0.12 koe/USD in 2000 to 0.10

4 UN SE4All (2017), Global Tracking Framework

koe/USD in 2015.[5] Together these two trends point towards a global upward trend with regards to energy equity and environmental performance where access to energy is improving at the same time as cleaner forms of energy are being used per US dollars created. Well-planned and managed adoption of distributed energy resources can support further progress on the energy trilemma dimensions.

For example, the share of renewables in total primary energy consumption has increased from 6.8% in 2005 to 9.7% in 2015. In this regard, the index' regional profiles signal a positive trend towards greater diversification of energy sources, often through the exploitation of renewable energy generation potential. Oil-producing states, for example, are increasingly exploring or actively enhancing solar power generation to reduce their reliance on fossil fuels. Congruently, large developing states in Asia are working on decreasing their import dependence through an increase in renewable energy sources.

However, while a more diversified energy mix will help to improve energy security, its positive effects may be stifled by the global increase in energy consumption. Globally, efforts to increase resource productivity and manage energy demand growth will be key in ensuring a balanced energy trilemma going forward. Moreover, the increased use of distributed energy resources, especially distributed generation from renewables, may impact system reliability.

Placing countries on the Index watch list

The watch list seeks to identify countries that are likely to experience significant changes − positive or negative − in their trilemma Index performance in the near future. Due to constraints on the collection, processing, and dissemination of data, the goal of the watch list is to reflect developments in a country's energy sector that are currently ongoing but are not yet captured in the Index.

Positive Watch List

Country	Rank	Score	Developments to Watch
Japan	30	CAB	• Efforts to diversify energy sources away from fossil fuels • Reactivation of old nuclear facilities after 2011 shutdown • Integration of distributed renewable generation
Chile	36	BBB	• Rapid growth of solar energy production • Planned infrastructure improvements
United Arab Emirates	40	AAD	• First nuclear power plant to come online in 2017 • Green growth strategy • Phasing out of gas and electricity subsidies
Ecuador	64	BBC	• Rapid expansion of hydroelectric power sector
Mexico	57	BBB	• Liberalisation of oil and gas markets • Electricity sector reform • Transition to low-carbon economy

5 ENERDATA, World Energy Council (2017), Energy efficiency indicator database

Negative Watch List

Country	Rank	Score	Developments to Watch
Germany	6	AAA	• Continuing high cost of Energy Transition • Reform in renewables support scheme
United Kingdom	5	AAA	• Energy security concerns created by an uncertain regulatory regime impacting investments in nuclear and gas sector • Political events creating uncertainty around climate and energy policy
United States	15	AAC	• Ageing transmission infrastructure and impending coal-fired power plant retirements • Increased frequency of extreme weather events • Departure from Paris Climate Agreement creates new uncertainty
South Africa	82	BCD	• Continuing struggle with power shortages • Maintenance efforts by main utility is creating difficulties for independently produced renewable energy to enter the market

Positive Watch List

The following countries are on the Council's positive watch list:

- Despite being well-endowed with hydro-carbon reserves, the **United Arab Emirates (Rank 40, AAD)** is making substantial investments in low-carbon energy, including the construction of the Barakah nuclear power plant that will provide 25% of the country's electricity needs by 2020.[6] The UAE's first green growth plan further sets targets for demand reduction, energy-efficiency, and renewable energy, including the construction of a 1 GW solar park. The elimination of subsidies for petrol and diesel from August 2015, as well as plans to eliminate subsidies on electricity and gas are expected to rationalise fuel consumption, protect natural resources and the environment, and support state finances.[7] These developments have the potential to improve the UAE's performance across the security and sustainability dimensions but may reduce energy equity scores.

- **Mexico (Rank 57, BBB)** continues to make progress on the liberalisation of its energy market, most recently publishing a plan to develop a fully competitive natural gas market by 2018.[8] New market rules further aim to promote energy efficiency and a target of achieving 35% clean energy by 2024.[9] These two transitions, from a monopolistic structure to a competitive market scheme, and from a high-carbon to a low-carbon economy, are proving to be challenging, especially as

6 https://www.enec.gov.ae/discover/nuclear-energy-in-the-uae/

7 Carpenter C and Khan S, 2015: U.A.E. Removes Fuel Subsidy as Oil Drop Hurts Arab Economies

8 King and Spalding, 2016: Client Alert: Development of Competitive natural gas Market in Mexico (documents.jdsupra.com/09156197-c0e4-4a9a-b74b-36c44023579d.pdf)

9 Dezem V, 2016: Mexico Sets National target of 5% Renewable Energy by 2018 (31 March 2016) (www.bloomberg.com/news/articles/2015-03-31/mexico-sets-national-target-of-5-renewable-energy-by-2018)

improvement and expansion of the country's infrastructure is still required.[10] However, the country's overall energy trilemma performance is expected to improve gradually as the reforms are implemented.

- Having been on the Council's negative watch list in recent years and remaining at the same overall rank since 2014, the government of **Japan (Rank 30, CAB)** has been actively pursuing a strategy to diversify its energy supplies as part of its wider revised energy policy following the Fukushima accident and the Great East Japan Earthquake of 2011. The strategy aims to increase the share of renewables to 13-14% and the share of nuclear energy to 10-11% of the national primary energy supply by 2030.[11] The resumption of energy production at Japan's reactors has slowed due to time-consuming examinations by the Nuclear Regulation Authority. The country also amended its feed-in-tariff following criticism that the prices were set too high. Despite the difficulties in pursuing its policies, these developments may herald a positive trend in the country's energy policy.

- **Chile (Rank 36, BBB)** established its long-term plan to balance the energy trilemma with its Energy Policy 2050. While Chile is the largest producer of renewable energy in South America, it faces some systematic difficulties, with the main challenge being to expand its infrastructure capacity to adapt with the intermittency of solar and wind power. In particular, the northern and southern electricity grids of the country need to be better interconnected for a more effective distribution and work has already been underway to address this.

- **Ecuador (Rank 64, BBC)** is undergoing a major shift towards renewable energy, with eight new hydroelectric power plants coming online in the period 2015-2017. A total of 93% of the country's energy supply is currently coming from hydropower. This development, if accompanied by a supportive fossil fuel infrastructure and improvements to the supply network, has the potential to significantly strengthen Ecuador's performance across all dimensions of the Trilemma.

Negative Watch List

The following countries are on the negative watch list:

- While Germany's **(Rank 6, AAA)** overall ranking declined slightly, it remains on the Council's negative watch list given the challenges of the plan to transition Germany's energy system. The plan introduced in 2010 includes goals of increasing power generation from renewable sources, as well as a reduction of primary energy usage and CO_2 emissions. The 2011 decision to phase-out nuclear power by 2022 further challenges Germany's energy mix. Due to low wholesale prices and regulatory uncertainty, investment in necessary new conventional power plants has been challenged. A reform of the legislation for renewables support has shifted from feed-in tariffs (FITs) to a bidding process for green power, ensuring a more economical and affordable transition. Further changes in energy security and environmental sustainability are expected in future evaluations.

10 Clemente J, 2016: Mexico's Ever growing Natural Gas Market (Forbes, 02 July 2016) (www.forbes.com/sites/judeclemente/2016/07/02/mexicos-growing-natural-gas-market/#3f47d1dc5ddc)

11 Japanese Ministry of Economy, Trade and Industry, 2015: Long-term Energy Supply and Demand Outlook (www.meti.go.jp/english/press/2015/pdf/0716_01a.pdf)

- Despite, its improvement on this year's overall ranking, the **United Kingdom (Rank 5, AAA)** faces significant challenges with its energy policy following the country's decision to leave the EU. The potential exit from the single market could significantly increase its energy import costs with uncertainty affecting investment plans.

- Political uncertainty also affects the **United States (Rank 15, AAC)** following the decision to withdraw from the Paris Climate Change Agreement although its key challenges remain in addressing the country's ageing energy transmission, storage, and distribution systems, as highlighted by the Department of Energy's Quadrennial Energy Review.[12] While the Department of Energy has been stepping up efforts to diversify the country's energy supply and improve its emergency response measures in light of the increasing frequency of extreme weather events, more investment is needed to tackle this challenge. Moreover, the majority of coal-fired and nuclear power plants are at least 30 years old, and, with an average lifespan of just 40 years, will need to be replaced over the coming years. This poses challenges to the country's energy security in the immediate future despite the expected increase in the country's energy exports.

- **South Africa (Rank 84, BCD)** improved two places due to better energy security with lower demand growth and additional power coming from the Renewable Energy program launched in 2011, together with better operation of the existing generation fleet. More generally, the country's energy system has improved due to increasing investment in infrastructure maintenance and fossil fuels, meaning that the frequency of blackouts has decreased. However, the country still struggles to diversify its energy sources, with most of its electricity still being supplied by Eskom through fossil fuels.[13] Plans to build new nuclear reactors are on hold, and independent producers of renewable energy, while having made some advances over the past two years, still need to develop strong inroads into the country's supply. Until these issues are addressed, South Africa's sustainability score is unlikely to improve.

An Energy Sector in Transition: the 2017 Energy Trilemma Index in Context

All countries can improve their energy performance. The 2017 World Energy Trilemma report companion to this index tapped into the insights of global energy leaders to explore the implications of the expansion and integration of distributed energy resources; in particular distributed generation, into existing power and electricity systems. Distributed energy resources are becoming increasingly important to the global energy system, particularly in the context of the energy transition. Improved efficiency and falling technology costs are expected to further accelerate this trend, with distributed generation, particularly renewables, playing a key role.

As the decentralisation trend continues in many countries, four power system archetypes emerge. Each archetype represents a different combination of centralised and decentralised generation, including a centralised, two hybrids and a decentralised system. Recognising these emerging systems will be important in managing the complex transition from the infrastructure backbone of past to the grid of the future.

12 Conca J, 2015: It Really Is Our Aging infrastructure (Forbes, 21 May 2015) www.forbes.com/sites/jamesconca/2015/05/21/its-our-aging-energy-infrastructure-stupid/#74c870af7cd3)

13 Cohen M and Burkhardt P, 2015; What is South Africa Doing to tackle Its Electricity Crisis? (Bloomberg, 08 September 2015) (www.bloomberg.com/news/articles/2015-09-08/what-is-south-africa-doing-to-tackle-its-electricity-crisis-)

The interviews with energy leaders highlighted some key themes.

1. Countries that do not take the necessary steps to integrate distributed energy resources will face heightened energy security risks, potential infrastructure redundancies and investment challenges that will adversely affect their energy trilemma performance.
2. Decentralisation not only adds new resources to the system, but can also create new actors on energy markets, provided governments and regulators are prepared to allow access to them. Market entrants such as large energy 'prosumers', energy service aggregators, and rural energy entrepreneurs offer new sources of generation, supply and demand management. As countries transition to hybrid systems, the policies and regulatory frameworks governing who can participate in the energy markets and how, need to evolve.
3. Maintaining system reliability will become increasingly complex and new approaches to system management, supported by enhanced information technology systems, will be required to ensure energy security. However, this also creates the opportunity to improve system resilience through greater diversity of supply and generation, together with improved grid management.
4. Distributed generation technologies and standalone micro-grid and off-grid systems can provide electricity access at a faster rate and lower cost than conventional grid connections. This could allow developing economies to consider 'leap-frogging' some degree of centralised generation infrastructure to increase electricity access and meet global sustainable development goals.
5. Energy access and use is being opened up as consumers (especially companies) take control of how their energy needs are met and managed, enabled by growing options for distributed energy resources. If regulations and regulators empower them, consumers have the option to generate power for their own consumption and sell their excess electricity back into the grid, to leave the grid completely, or only use grid supply to supplement their own generation. They can choose electricity providers and utilise new energy management technologies to determine how to use energy. New technologies, such as blockchain or predictive analytics, will support this trend. Policymakers must evolve regulatory frameworks to integrate new opportunities arising from distributed energy resources and, potentially more proactive consumers, to respond to rising and rapidly evolving demands and options for energy use.

Implications for the energy sector

To achieve long-term energy goals and enable policy innovation, as well as reform, to play a part in navigating the Energy Trilemma, policymakers and regulators need urgently to focus on these emerging technologies. New opportunities can be created, but may be associated with the disruption of existing market frameworks, roles and responsibilities, leading to a reconsideration of the energy services provided and how the costs for energy services are recovered.

As countries transition from one archetype to another, the role of energy incumbents will change. This transition will need active management given the financial exposure of other economic sectors. Without coherent and predictable policy and regulatory frameworks in place, incumbents may refrain from making the necessary and new investments that may, in turn, affect system reliability and affordability. Energy incumbents need to work with regulators to develop effective and responsive tariff and pricing models to cover the cost for operating, upgrading and maintaining grids, as well as providing back-up capacity.

If consumers – residential, commercial and industrial – are enabled by regulators to exploit these new opportunities, regulators will also need to ensure equity for all consumers across the energy system. As distributed energy resources give consumers with financial capacity and empowered by suitable aggregation services the opportunity to manage energy cost and price volatility, it exposes those consumers without financial capacity to price increases.

Distributed energy resources could also offer scope to reduced carbon emissions and address localised pollution and some empowered consumers are already using them to meet their own environmental sustainability goals. Regulators will need to consider how their market frameworks can adapt to support suitably distributed energy resources while improving the environmental sustainability of their power systems.

Recommendations

Evolving technology and customer demands are two key drivers of a transition of the electricity system at an unprecedented pace. Policymakers should develop their own in-depth analysis of the potential opportunities and challenges that may arise in their own countries or regions from adopting distributed energy resources. Regulatory frameworks must evolve to integrate new opportunities to balance the Energy Trilemma effectively. The 2017 World Energy Trilemma research has identified three key focus areas for policymakers and industry leaders to consider in order to build a resilient energy system of tomorrow:

- **Enable a dynamic and resilient market framework with the agility to adapt with the transitioning system.** The market framework must be responsive and resilient to the future changes that will arise from new consumers and evolving customer needs and technological advances, as well as changing roles and responsibilities of market participants. Within this dynamic environment, regulators will need to enable adaptable funding mechanisms for rates and charges to support the necessary continued investment in the energy system.
- **Establishing robust technology-neutral regulations supported by agreed standards with all stakeholders will be key to building a more dynamic and resilient market framework that supports transitioning energy systems.** This includes standards for project development and financing to reduce cost and inefficiencies. Technical interoperability and service harmonisation, as well as standards to promote uptake and integration of distributed generation and distributed energy resources, are critical.
- **Allow and plan for aggregator services to empower consumers to be more proactive by ensuring that the market framework can adapt to their evolving and shifting needs.** Technology will provide new options to access and consume energy so the framework design will need to enable consumers to make those choices. This will require a different approach of considering what consumers may want and 'reverse engineering' a market framework to facilitate new market entrants while keeping the trilemma goals in balance.

The energy transition is an unstoppable phenomenon. There will be leaders, learners and laggards, and adapting to this new reality with innovative policy responses and new business models will require an enormous effort. The ability of companies and policymakers to respond rapidly, creatively and collaboratively will determine the pace and shape of the global transition and, in turn, affect the ability of societies across the world to navigate the energy trilemma of security, sustainability and equity successfully. Governments and regulators need to plan for the transitions and anticipate its likely impacts on energy systems and market actors.

2 Regional Energy Profiles

2. REGIONAL ENERGY PROFILES

The variability in performance seen across the three dimensions of the Trilemma Index shows the degree to which the energy challenges faced by each country are unique. However, the transnational nature of both energy markets and environmental sustainability issues necessitates a view that extends beyond individual countries to the regional level. This section presents regional Energy Trilemma balances and performances, and outlines the trilemma challenges and opportunities that countries in each region will face as they manoeuver through the 'grand transition'.

ASIA

Between 2040 and 2050, Asia will surpass North America and Europe combined in terms of GDP, population size, military spending, health, education, governance and technological investment. It is in this context that Asia is facing the challenge of facilitating sustainable growth and making progress on all three trilemma dimensions. The anticipated increasing use of distributed generation and distributed energy resources can assist with meeting energy goals in energy security, energy equity and environmental sustainability.

ASIAN COUNTRIES

Australia	Japan	Pakistan
Azerbaijan	Kazakhstan	Philippines
Bangladesh	Korea (Rep.)	Singapore
Cambodia	Malaysia	Sri Lanka
China	Mongolia	Tajikistan
Hong Kong, China	Nepal	Thailand
India	New Zealand	Vietnam
Indonesia		

The region includes a diverse array of economies, with less developed countries (Nepal and Pakistan), rapidly developing economies (China, India, Indonesia), and highly developed nations (Japan, the Republic of Korea, New Zealand). Asian countries vary enormously in their energy resources, as well as in their physical, social, cultural and economic backgrounds. Diverse challenges require each country to plot their own path forward.

Overall, the region is weak in all three energy trilemma dimensions and many countries in the region are currently in the lower half of the 2017 Energy Trilemma Index. There are increasing concerns for energy security across the region due to rapidly growing energy demand and import dependence. In 2011, China replaced the United States as the world largest energy consumer[14]. Meanwhile, India's energy demand will double by 2035 on the back of economic and population growth. As a result, most Asian countries' energy import dependence is increasing and among ASEAN, only Malaysia and Brunei Darussalam remain as net oil exporters[15]. The high energy import dependence, coupled with other factors such as weather-related disruptions pose increasing energy supply risks to this region. The strong energy demand also challenges environmental sustainability performance with Asia being the world's biggest greenhouse gas (GHG) emitter, accounting for around a third of global GHG emissions in 2014, more than the European Union and

14 World energy scenario

15 http://canaryusa.com/energy-games-asia-increasing-energy-demands-increasing-imports/

the United States combined[16]. In terms of energy equity, there are approximately 512 million people in the region lacking access to electricity, with the majority residing in rural areas[17]. Furthermore, Asia has the largest number of people that lack access to clean cooking, with nearly 50% of people in developing Asia still replying on biomass for cooking[18].

In response to rising energy demands, the region is moving fast and playing an increasingly important role in renewable energy development. For example, China leads the world in terms of wind and solar capacity, contributing to more than half of global energy savings since the 1990s[19]. As part of commitments made in the global Paris Climate agreement, China aims for its carbon emissions to peak by 2030[20]. On the other hand, given the region's rapid economic growth and urbanization, Asia is still home to the world's second largest population without electricity access. In order to solve the Energy Trilemma issue in Asia, the region needs to ensure that the ever-increasing energy demand is met while at the same time improving energy access and resilience.

Distributed generation holds significant potential for increasing energy security and access. Improving energy access is challenging in many countries, such as India and Nepal as well as island states such as Indonesia and the Philippines that have an uneven distribution of energy infrastructure. For these countries, the majority of the population without access to electricity resides in isolated communities and consists of low-income households. For example in Nepal, 97% of the urban population had access to electricity in 2012, compared with 71% in rural areas[21]. This is partly due to the scattered nature of the population in remote mountainous areas in Nepal, where grid expansion is extremely expensive and infeasible. Micro hydropower plants (MHPs) have become the major source of off-grid electricity in rural Nepal -by 2014, more than 1000 MHPs with a total generation capacity of 22 MW were providing off-grid electricity access to 20% of the population in Nepal[22]. In island countries like Indonesia, renewable energy microgrids are gradually replacing high cost diesel to produce power. In order to attract higher levels of private investment, the country recently issued the Accelerating Electrification in Rural Areas policy to grant 'Business Area' concession to investors to guarantee that the national grid will not impede on the company's service area.

However, scaling up electricity access through rapid DG expansion can create other challenges. For example, in remote areas in China such as Qinghai and Tibet, local governments built microgrids for electricity access. However, the lithium-ion batteries used for storage led to high costs being incurred as the batteries required replacing every four to five years. To solve this problem, longer-life alternative-flow batteries are being introduced and gradually adopted in China and other Asian markets. By 2024, it is expected that the US energy storage market, the largest in the world, will be overtaken in size by China, Japan and India[23].

Highly developed countries such as Japan and Korea are turning towards the use of distributed generation and distributed energy resources to improve energy security and environmental sustainability. Japan is driving a transition from a centralized energy archetype system to a hybrid archetype system in partial response to the shock to the energy system resulting from the aftermath of the April 2011 earthquake and tsunami. In response to the plan of phasing out nuclear power as a result of the disaster, the government

16 World Economic Forum, 2016, As the World's biggest emitter, can Asia lead the charge against climate change?
17 IEA, 2016, World Energy Outlook 2016 – Electricity Access Database
18 http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/
19 World Economic Forum, 2016, As the World's biggest emitter, can Asia lead the charge against climate change?
20 http://www.abc.net.au/news/2017-03-02/china-coal-cuts-and-renewables-transform-climate-change-leader/8316660
21 World Bank data
22 The World Bank, 2015, Ensuring the sustainability of rural electrification in Nepal
23 Inframation News, 2017: Success Dragon outlines China solar Plus storage ambitious

has set a new energy policy to balance energy security, with coal-fired power contributing to 56% of the baseload. To achieve this goal, 43 coal-fired power projects are planned or under construction, resulting in 127 million tonnes of CO_2 being emitted every year[24]. While fossil-fueled generation continues to ensure more than half of the baseload, renewable generation is building up. By developing greater distributed generation, the goal is to develop a more reliable and disaster-resilient energy supply. Japan's progress into a hybrid system was further accelerated by the deregulation of its household electricity market in April 2016. The regulatory reform is expected to promote competition, enable prosumers, and drive customer adoption of distributed energy resources. Nonetheless, management of the transition could also be very challenging due to the cost implications that will arise from updating the ageing infrastructure in order to cope with the updated distributed energy system.

EUROPE

Europe continues to dominate the Trilemma Index in 2017, with nine European countries occupying the top ten places globally and all countries placed inside the top 100. But European countries need to guard against complacency and maintain focus on balancing the competing challenges of the Energy Trilemma. Key challenges remain with navigating the energy transition and ensuring that governance and regulations remain fit for purpose in a fast-evolving energy system.

EUROPEAN COUNTRIES

Albania	Greece	Poland
Armenia	Hungary	Portugal
Austria	Iceland	Romania
Belgium	Ireland	Russian Federation
Bulgaria	Italy	Serbia
Croatia	Latvia	Slovakia
Cyprus	Lithuania	Slovenia
Czech Republic	Luxembourg	Spain
Denmark	Macedonia (Rep.)	Sweden
Estonia	Malta	Switzerland
Finland	Moldova	Turkey
France	Montenegro	Ukraine
Georgia	Netherlands	United Kingdom
Germany	Norway	

Europe performs well in terms of the environmental sustainability dimension once again this year, with European countries claiming seven of the top ten spots. 20-20-20 targets set by the European Union in 2010, as well as the implications of the economic crisis, have helped to ensure that carbon and energy intensity have decreased, with the EU as a whole on track to meet the 20% target by 2020[25].

Nevertheless, long-term energy security remains a challenge. An over emphasis on climate change goals in the past has left EU member countries increasingly reliant on energy imports, with almost 73% of fossil fuels consumed in 2015 being imported compared with only 53% 25 years ago. Ongoing gas disputes between Russia and the EU have caused strain on countries particularly reliant on Russian gas in recent years[26], as in central and eastern Europe, however promises by the US to step up LNG supply provide a

24 http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/japan-nuclear-power.aspx

25 http://europa.eu/rapid/press-release_MEMO-17-163_en.htm

26 http://www.dw.com/en/europe-more-energy-efficient-but-still-import-dependent/a-37641114

credible alternative to Russia's influence in this regard. Tax and national regulation based competition amongst member states in order to protect national energy industries has only served to exacerbate security worries[27], with a fragmentation of energy policies across Europe remaining a key issue for the proposed Energy Union strategy to tackle in the future.

An average household retail electricity price annual increase of 3.2% between 2008 and 2015 has meant energy affordability has become an increasingly key issue for consumers in most European countries[28]. Taxes and levies used to support EU renewable energy and combined heat and power projects have steadily increased their share of the final electricity bill for households, with the average taxes and levies share increasing from 28% to 38% from 2008 to 2015. In Denmark, this figure was the highest amongst EU member states during the second half of 2016, with taxes and levies accounting for 67.8% of the final electricity price for household consumers.[29] However, as these revenues are used to finance energy efficiency and RES investments in Denmark, overall it reduces the net impact to the households' energy bills.

Although there are certainly Trilemma challenges present in Europe, there are also many examples where the effective integration of Distributed Energy Resources (DER) as well as Distributed Generation (DG) has turned these into opportunities.

There are examples of how micro-CHP installations, when integrated with the grid, can serve as back-up power to utilities and can help increase energy security, amongst other benefits. Projects run in both Germany and the Netherlands, including 'Powermatching City' in Groningen, found that the potential for micro-CHP to work as a Virtual Power Plant (VPP) had benefits for consumers as well as the electricity network and operators.[30] The result is a sustainable, resilient system that is sufficiently prepared for the future.[31]

Small-scale, distributed generation projects in Europe can also yield significant price savings to consumers in the community if conducted using appropriate stakeholder negotiation, financial and community support. For example, in Feldheim, Germany a combination of EU and Government subsidies, together with contributions from local residents and a local energy company, supported a construction of a parallel grid network for electricity and heating. Using wind turbines, solar PV, biogas and biomass plant, the grid works in parallel to the national grid to set energy prices independently.

Furthermore, digitalization projects involving demand response and sectoral coupling have delivered new efficiencies in European countries where they are well implemented. However, often such opportunities are hindered by missing or incomplete regulations.

Increasing interconnection capacity in Europe can also be effective in helping countries to manage their security of supply effectively. The proposed Midcat gas connection between France and Spain would help to reduce Europe's dependence on Russian gas, as well as help Spain to manage an overcapacity in renewable energy[32], providing benefits for security for all countries. Understandings between cross-national and government bodies – such as a Memorandum of Understanding signed between the European Commission and the Baltic Sea Region countries in 2015 supported by financing from the EU Connecting

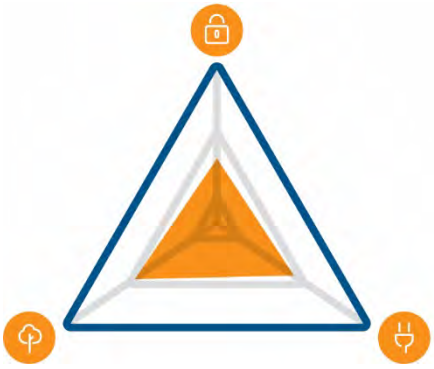
27 https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-er-energy-market-reform-in-europe.pdf
28 http://ec.europa.eu/energy/sites/ener/files/documents/com_2016_769.en_.pdf
29 http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_price_statistics
30 http://www.cogeneurope.eu/medialibrary/2015/05/19/d6648069/miro-CHP%20study_merged.pdf
31 https://www.dnvgl.com/technology-innovation/broader-view/electrifying-the-future/smart-energy-systems.html
32 https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_spain.pdf

Europe Facility (CEF) – has also helped to set political commitments that are able to better coordinate national energy policies more effectively, realizing improvements insecurity of supply and integration of renewable energies in the long-term.[33]

As a result of EU overall Greenhouse Gas (GHG) reduction targets of 40% by the year 2030, as well as specific emission reduction targets of 40% for all new cars sold by 2021[34], many European countries are increasingly looking at the use of Electric Vehicles (EVs) as one method of using distributed energy resources in order to reduce GHG emissions, and thereby improving their environmental sustainability Trilemma dimension[35]. Norway is a clear EV pacesetter with the highest per capita number of all-electric cars in the world, with EVs accounting for around 40% of newly registered passenger cars in the country in 2016. Norway's use of friendly transit policies and strong financial incentives has enabled EVs to compete with internal combustion (ICE) vehicles[36] but is likely to be difficult to replicate elsewhere.[37]

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. Ranging from an overall rank of 36 achieved by Chile, to 108 in Honduras, there has been a slight improvement in the region since last year, with ten out of 19 countries included in this year's Index showing overall improvement. Key challenges in the region are largely unchanged from the 2016 Index, with extreme weather phenomena, poor diversification of energy sources, inequality of wealth distribution, inadequate and inefficient methods of tax collection as well as a weak utilisation of interconnections and grid infrastructure, continuing to dominate energy reform agendas. However, there are positive signs to be seen, with many countries setting ambitious goals for reduced emissions, and targets for the number of EV vehicles. In order to balance the Energy Trilemma, the LAC region must continue to focus on making large scale investments in infrastructure, seek to diversify their energy mix further, and must encourage regional co-operation in order to unlock the long-term benefits that further integration of power systems between countries could provide.



LAC COUNTRIES

Argentina	Ecuador	Panama
Bolivia	El Salvador	Paraguay
Brazil	Guatemala	Peru
Chile	Honduras	Trinidad & Tobago
Colombia	Jamaica	Uruguay
Costa Rica	Nicaragua	Venezuela
Dominican Republic		

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 updates, 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

33 http://europa.eu/rapid/press-release_IP-15-5142_en.htm
34 https://ec.europa.eu/clima/policies/transport/vehicles/cars_en
35 https://ec.europa.eu/clima/policies/strategies/2030_en
36 World Energy Perspectives E-Mobility
37 https://www.ft.com/content/84e54440-3bc4-11e7-821a-6027b8a20f23

been made to promote general DG adoption in the region, and examples of distributed generation projects are present in many countries. For example, in 2010 Costa Rica launched a net metering pilot program to promote small-scale, distributed renewable energy. It also aimed to gather data on the impacts of small-scale renewable projects on the national grid in order to improve future energy planning[38]. Barbados also demonstrated how well-structured incentives can boost demand for renewable distributed generation and reduce utility-scale generation. In 2013 the country published an extensive tax incentive policy to encourage activities related to renewable energy, especially distributed generation. By 2015, the policy led to a 7% cut in generation from thermal plants and a subsequent increase in solar DG systems adoption, resulting in solar meeting almost 8% of the country's electricity needs[39].

Looking at the energy security dimension, with only four of the 19 countries included in this year's Index making it into the top 50 countries for energy security globally, and several countries lying outside of the top 100, energy security remains a key challenge for the region. A high reliance on hydropower means that the effects of changing weather patterns such as El Niño and La Niña, as well as extreme weather events in the region, remain a significant issue. Projected rises in electricity usage between 2.3 -2.7 times by 2060[40] mean that there is still a pressing need for large-scale infrastructure development, as well as regional integration. Nevertheless, there are signs of improvement to be seen. Twelve LAC countries improved their energy security ranking this year, with Brazil, Panama and Jamaica all rising by over 20 places. Examples such as the Central American Integrated System Project (SIEPAC), which aims to improve energy security through integrating regional power systems, show how the region is adapting to the challenge of energy resilience. By minimizing the risk of energy supply shortage through facilitating a multilateral agreement for a joint use of natural gas and hydropower reservoirs, Panama managed to recover from an energy crisis resulting from a prolonged drought in 2013 that reduced the levels of reservoirs at hydroelectric dams by importing electricity generated elsewhere in Central America and transmitted across the SIEPAC network[41].

As noted in the World Energy Council's 2017 Latin America & the Caribbean Energy Scenarios publication, LAC countries must seek to improve energy resilience to extreme weather events and look to diversify the energy mix with the use of decentralised and/or low-carbon generation sources[42]. Costa Rica's focus on diversifying energy generation through increasing investment in non-hydro renewables is one example. Although hydropower is Costa Rica's dominant energy source, accounting for 74% of electricity generation in 2016, the country has been investing heavily in wind farms, expanding its wind generating capacity from only 2.1% in 2009 to 10.5% of electricity generation in 2017[43]. In addition, Costa Rica generated 12.8% of the country's electricity with geothermal energy in 2016[44], and in 2013 ranked sixth in the world in terms of the percentage of electricity generated from geothermally generated sources[45]. The results are evident - in 2016 the country ran on 100% renewable electricity for more than 250 days, with renewable power suppling 98.1% of the national electricity demand, slightly down from the 98.8% in 2015. This is especially significant given the effects El Niño had on countries in the region in 2015, and considering that the country experienced low rainfall levels throughout 2016[46]. With such a diverse mix of renewable energy sources,

38 WorldWatch Institute, The way forward for renewable energy in central America, 2013

39 http://global-climatescope.org/en/region/lac/

40 https://www.worldenergy.org/wp-content/uploads/2017/03/LAC-Scenarios_summary-report_English_WEB_2017.05.25.pdf

41 http://www.iadb.org/en/news/webstories/2013-06-25/energy-integration-in-central-america,10494.html

42 https://www.worldenergy.org/wp-content/uploads/2017/03/LAC-Scenarios_full-report_English.pdf

43 http://www.ticotimes.net/2015/11/17/costa-rica-increases-wind-power-generation

44 https://www.weforum.org/agenda/2017/04/costa-rica-ran-entirely-on-renewable-energy-for-more-than-250-days-last-year/

45 http://www.worldwatch.org/system/files/CA_report_highres_english_2013.pdf - p.25

46 http://www.independent.co.uk/environment/costa-rica-renewable-energy-electricity-production-2016-climate-change-fossil-fuels-global-warming-a7505341.html

Costa Rica can take advantage of a greater availability of wind and biomass to guarantee sustainable renewable generation of energy - even during the dry season[47].

In 2014 the richest 10% of the population in Latin America owned 71% of the region's wealth, and this severe inequality continues to be reflected in Trilemma energy equity scores, with only one country in the LAC region placed in the top 50 countries globally in 2017. In addition, while the LAC region was the developing region that came closest to achieving 100% electricity access in 2014[48], there are nearly 30 million people in the region that are still without electricity access, most of whom are located in isolated rural areas with low population densities. Increasingly, rural electrification strategies and policies have recognized the important role that distributed generation in the form of off-grid renewables can play in addressing electricity access. For example, acknowledging that grid extension was not a viable solution in providing access to households located in the Amazon region, the Brazilian Electricity Regulatory Agency (ANEEL)issued a special project manual that included 85% of a capital subsidy allocated for renewable energy in order to support mini-grid installation. As a result, at least 15 small hydropower plants and one solar PV plant were operational in remote Amazon areas in 2010. In addition, for remote areas where the grid is not able to reach, such as regions in the Amazon basin, utilities are mandated to develop mini-grid systems in their service territories. Private players have been contracted to implement mini-grids under a Build-Own-Operate (BOO) arrangement, and many LAC countries use auctions to encourage uptake. The long-term nature of the contract helps developers to reduce project risk, attracting more investors and eventually leading to a price decline for renewables. Peru, for example, introduced the National PV household Electrification Programme in 2013, aiming to provide electricity to 500,000 households with solar PV. To achieve the goal, it held its first off-grid renewable energy auction in 2014 for a 15-year power supply concession using solar PV. The result was an increase in electricity access in the country from 72.5% in 2000[49] to 93% in 2014. As highlighted in this year's complementary Trilemma Report, Colombia is also looking to integrate distributed energy resources into the energy mix in order to help increase its electricity access rate from 96% to 100%, using a combination of off-grid, micro-grid and PV solar with storage. Achieving universal access will require a combination of decentralised and centralised approaches.

Although showing the most variability out of all Trilemma dimensions, with countries ranging from rank 7 to rank 122, environmental sustainability remains LAC's strongest Trilemma dimension, with Costa Rica and Uruguay exhibiting a particularly good performance at ranks 7 and 10 respectively. Although showing signs of decrease in recent years, the LAC region still derives a significant amount of electricity from hydropower, accounting for 54% of the overall electricity mix in 2014.[50]As a result, many countries in the LAC region with a high environmental sustainability dimension – such as Costa Rica and Uruguay - owe their success in part to leveraging these strong hydropower capabilities. In Brazil and Colombia in particular, the extensive use of hydropower has led to lower GHG emissions, as well as higher electrification rates.

It is important to note the potential role that EVs could play in lessening the region's pollution problem that is particularly evident in many cities. The transport sector in Latin America accounts for the largest and fastest-growing source of energy-related emissions[51], being responsible for more than one-third of CO_2 emissions in 2014, and some countries are starting to view EVs as a potential solution to this. In Colombia electrification of the transport fleet – including buses and taxes – has been identified as a top priority, with the city of Bogota hoping to substitute its entire bus fleet with hybrid and electric vehicles by 2024. In Chile,

47 http://www.ticotimes.net/2016/12/16/renewable-electricity-costa-rica

48 http://gtf.esmap.org/data/files/download-documents/eegp17-01_gtf_full_report_for_web_0516.pdf

49 http://www.irena.org/DocumentDownloads/Publications/IRENA_Market_Analysis_Latin_America_2016.pdf

50 https://www.worldenergy.org/wp-content/uploads/2017/03/LAC-Scenarios_summary-report_English_WEB_2017.05.25.pdf

51 http://www.thedialogue.org/wp-content/uploads/2015/10/Green-Transportation-The-Outlook-for-Electric-Vehicles-in-Latin-America.pdf

where the transport sector is expected to grow by 40% by 2020 under a business-as-usual scenario, electric vehicles have been recognised as one way of combatting the current air quality problem in cities, and officials aim to increase the amount of EVs to 70,000 by 2020. Given the region's access to large stores of hydro generation, if current barriers are reduced - including high upfront costs, a lack of charging infrastructure and grid reliability – increased uptake of EVs could be an excellent way of improving the region's environmental sustainability dimension. Other environmental sustainability results for the region also show promising signs – the LAC energy sector is the least carbon intensive in the developing world, and cumulative carbon emissions from 2014 to 2060 are projected to account for only 4.7-5.1% of the world's total emissions[52].

MIDDLE EAST AND NORTH AFRICA

The Middle East and North Africa (MENA) performs strongly in energy access and affordability dimensions but faces significant challenges with respect 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 growing demands for electricity, water, and cooling, are not addressed, the energy security and environmental sustainability dimensions could be threatened even further. Going forward, distributed generation powered by solar and wind renewables is expected to be deployed increasingly throughout the region in order to diversify energy sources, reduce GHG emissions, and improve energy access, particularly in remote areas where off-grid electricity is less expensive than extending the existing power grid.

MENA COUNTRIES

Algeria	Israel	Oman
Bahrain	Jordan	Qatar
Egypt	Kuwait	Saudi Arabia
Iran (Islamic Rep.)	Lebanon	Tunisia
Iraq	Morocco	United Arab Emirates

MENA countries have comparatively weaker energy security performance than other regions despite tremendous fossil fuel resources, with MENA accounting for 54.9% of global oil and 50.3% of global gas reserves. However, the region is challenged by energy demand management and low energy diversity. The region is expected to see energy consumption grow by 70% from 2009 to 2035, twice the global primary energy demand increase[53]. 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. Along with high fossil fuel use the Middle East has high energy-related greenhouse gas emissions and these are expected to increase by 47% from 2010 to 2035 – which is significantly higher than the global growth rate of 20%. As a result, most countries in the region score poorly in environmental sustainability dimension, with the exception of Egypt and Tunisia. Tunisia has focused on renewable development over the past five years, with wind power capacity increasing eightfold from 2008 to 2012. Compared with the marginal use of

52 https://www.worldenergy.org/wp-content/uploads/2017/03/LAC-Scenarios_full-report_English.pdf

53 http://library.fes.de/pdf-files/iez/08959.pdf

renewable energy in the region, Tunisia has been leading the way with a 14% renewable energy share in 2013[54].

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[55]. This is despite the region's vast potential for renewable energy - estimated at 45% of the total global potential for renewable energy. The region receives approximately 22% to 26% of all solar energy striking the earth, which is believed to be sufficient to meet the current global electricity needs[56]. With long sunshine hours and extensive land available for the construction of solar panels, the region has ideal conditions for the adoption of solar energy and distributed generation. As a result, many MENA countries are focused on improving energy efficiency, diversifying their energy mix through an increased use of solar and nuclear power, and examining how distributed generation (on-grid and off-grid) and distributed energy resources can help address Energy Trilemma challenges and meet energy goals. The region currently lags behind in the adoption of PV distributed generation and so the growth of distributed generation and distributed energy resources will require an evolution in regulatory frameworks – for example, allowing wheeling of power and net metering.

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 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 gigawatt-hours of electricity and reduced carbon dioxide emissions by over 536,000 tons in Dubai from 2009 to 2014[57].

Distributed generation is also being used to improve rural electrification. An estimated 20 million people in the MENA region lived without access to even a basic level of electricity in 2010[58], particulaly in rural areas without grid access. In this situation, off-grid renewables are an attractive option and Morocco's Global Rural Electrification Programme (PERG) is one example of a rural electrification programme that included solar and wind technologies. Under this programme, expensive, inefficient and polluting diesel generators are replaced by decentralized electrification systems based on mini-networks driven by wind and hydroelectric power or individual PV systems. Rural electrification rates hit 100% by 2012[59] with solar PV representing 10% of village electrification in the country.

Renewable energy is also being deployed to improve performance on the environmental sustainability dimension. Egypt has seen its environmental sustainability rank increase by 15 places in 2017 to top the region. This is in line with the country's ambitious plan of generating 20% of the national electricity from renewable sources by 2020[60]. To achieve this goal, the government has been gradually removing energy subsidies, and has launched a Feed-in Tariff schedule to allow for private investments in renewable energy

54 IRENA, MENA Renewables status report

55 https://www.iea.org/about/faqs/renewableenergy/

56 The Potential of Renewable Energy in MENA, IFC KNOWLEDGE SERIES IN MENA, Series 5 - see http://www.ifc.org/wps/wcm/connect/c6a15e8042cbdd4daa2bee384c61d9f7/Knowledg+issue+05+v6.pdf?MOD=AJPERES&The%20Potential%20of%20Renewable%20Energy%20in%20MENA

57 DEWA saves Dh752m through energy efficiency measures," Emirates 24/7, April 8, 2015 (http://www.emirates247.com/business/energy/dewa-saves-dh752m-through-energy-efficiency-measures-2015-04-08-1.586734)

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

59 Index data from world bank

60 https://www.iea.org/policiesandmeasures/pams/egypt/name-24583-en.php

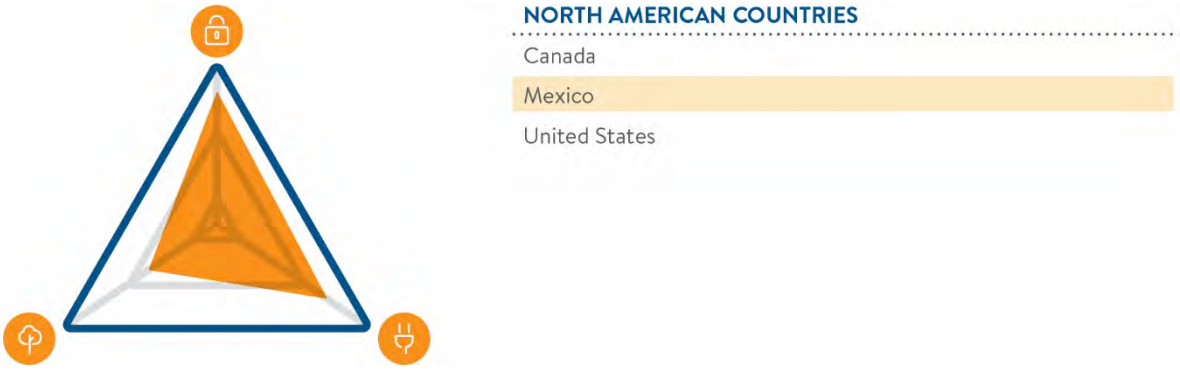
projects, and has a Feed-in Tariff in place for distributed generation PV rooftop systems. Due to Egypt's green initiatives in the past decade, the country has reduced its CO_2 per capita from 2.27 tonnes in 2012 to 1.95 tonnes in 2015[61].

There are other initiatives across the region to increase distributed generation. For example, net metering and power wheeling schemes have supported the expansion of small distributed generation PV in Jordan, and Kuwait has plans to roll out a program for multi-home rooftop PV across the country.

However, there are barriers that create significant challenges for the MENA economies when considering adopting renewable energy and distributed generation more generally. Firstly, most MENA countries subsidize 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 MENA countries are also challenging renewable energy and distributed generation development in the region.

NORTH AMERICA

North America is the second highest performing geographic region on the Index after Europe, although aging infrastructure and extreme weather events continue to test the resilience of its energy systems. Additional uncertainty comes from the potential effects of a US withdrawal from the Paris Agreement. Despite this, the integration of distributed energy resources is providing opportunities for all three countries to improve their energy systems and help balance the Energy Trilemma.



North America, comprised of Canada, the United States (US) and Mexico, is the second highest performing geographic region on the Index after Europe. 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.

61 Enerdata

North America is well endowed with fossil fuel resources, including oil, natural gas, and coal, and also has significant hydropower potential. Due to the region's natural resource endowment, energy security concerns are related to diversifying energy sources, updating aging energy infrastructure and increasing resilience to extreme weather events. Increased severity of extreme weather events are testing the reliability of North American energy infrastructure and posing challenges to future operations. For example, the period from 2013-2016 saw four of the top five hottest years on record[62], and as temperatures continue to rise, air conditioning driven electricity demand will grow, while at the same time high temperatures reduce the efficiency of aging transmission lines.

The region also needs to improve performance on the environmental sustainability dimension. Reducing the carbon footprint and mitigating the impacts of GHG emissions is especially important for North America due to the region's status as a top emitter of GHG. In 2013, North America accounted for approximately16% of total global GHG emissions[63], making it the second-highest emitting region behind Asia.
Distributed energy resources, especially distributed generation, provide opportunities for all three countries to address energy security and environmental sustainability challenges. Aging generational infrastructure across the region further emphasizes the importance of investments in new generation capacity and energy demand management. Canada, Mexico, and the US all face the challenge of updating aging energy infrastructure to accommodate new technologies and resources, services and service providers. The infrastructure deficit in the U.S. is pegged at $USD3.6 trillion[64]; in Canada, it is C$570 billion[65]. Smart grids and DER will be important components in modernizing the aging system, easing the integration of distributed resources, while potentially reducing demand from traditional generating sources and offering opportunities to increase energy efficiency. Canada, for example, is investing half a billion dollars (Canadian) of public funds in smart grid projects.

North America's transition from the current energy generation paradigm to one with a higher proportion of distributed energy resources, especially renewable distributed generation, raises questions on how to manage and structure the energy system to ensure supply and demand. For example, reliability of the electric system can be impacted by the addition of DER when the resources are not controllable or viewable by the system operator. The intermittency and seasonality of some forms of distributed generation, especially solar and wind, add to the challenge.

There has been significant increase in distributed generation units in the US; these are mainly single solutions (in particular solar panels) both connected and not connected to the distribution grid. In the US, New York and California are currently leaders in developing a comprehensive strategy for the deployment of DER and stimulating a change to the regulated investor-owned utility model. New York has initiated a number of distributed generation programs and pilot distributed generation projects with a focus on improving resilience in case of extreme weather by increasing consumers' self-sufficiency. By contrast, California, has been pursuing distributed generation with a focus on improving environmental sustainability. The state currently has 5600MW of installed capacity from distributed generation[66], and the main utility operator has proposed allowing any distributed generation system with at least 0.5KW of capacity to connect to the grid, with operator control only required for systems with over 10KW of capacity[67].

62 NOAA National Centers for Environmental Information, State of the Climate: Global Climate Report for Annual 2016, published online January 2017, retrieved on August 22, 2017 from https://www.ncdc.noaa.gov/sotc/global/201613

63 http://data.worldbank.org/indicator/EN.ATM.CO2E.KT

64 https://www.infrastructurereportcard.org/solutions/investment/

65 https://www.theglobeandmail.com/report-on-business/rob-commentary/a-national-infrastructure-bank-will-ensure-canadas-long-term-prosperity/article35237546/

66 http://www.californiadgstats.ca.gov/

Looking forward, regulatory uncertainty remains a key challenge for the US energy sector with the government's recent decision to withdraw from the Paris Climate Agreement[68]. However, despite the uncertain regulatory climate around sustainable energy, commitment among Americans remains high to support the development of additional solar and wind, and the positive trend seen in recent years may continue.

Canada is one of the top five energy producers in the world and is a net exporter of electricity to the US. Sixty-one percent of Canada's power needs are met by hydroelectricity. The country had an installed DG capacity of about 5GW as of 2014[69]. With a large country and relatively small population, using a locally-placed, sustainable method of generation can increase the reliability and availability of power, diversify the electricity portfolio while increasing overall environmental sustainability. Distributed generation systems can be especially helpful in rural areas, where long transmission lines from central power generation sources are highly susceptible to failure and reduce efficiency of production. In addition, local renewable powered distributed generation can help rural communities that may currently rely on diesel powered plants.

Mexico is a signee of the Paris climate accord and pledged to reduce energy consumption by 22% over 2010 levels, leading to efforts to improve performance in the environmental sustainability dimension. For example, in 2016, Mexico City introduced new building regulations designed to increase the energy efficiency of their buildings, and it is estimated that efficiency measures will reduce building energy usage by up to 20 percent[70].

Mexico is expected to experience an explosion of renewable energy, with laws in place requiring 35% of energy generation to come from clean sources, up from 25% today[71]. Most of the advances are expected with solar power, as wind power is developing slowly in Mexico, with only 3 GW of installed power in 2015[72]. Looking at solar energy, the Secretariat of Energy estimates solar electricity generation capacity to increase by 3.5 GW between 2016 and 2018. Solar resources are the main components of distributed systems in Mexico, making up 97% of new installations in 2015. Distributed generation is especially important for providing reliable energy for remote communities in Mexico, and contributing to the country's achievement of the country's Paris agreement goals.

Mexico's energy secretary (SENER) has taken a number of steps to support the increase of solar DG. For example, new guidelines for the interconnection of small solar system to the national electricity grid were introduced in 2017 to make it easier and more attractive for residential and commercial consumers to invest in solar energy. The government also increased the electricity price by 25% for high consumption users toincentivise the adoption of distribution generation further. By 2016, Mexico reached 220 MW of distributed rooftop solar generation capacity, and this number is forecasted to double in 2017 and eventually reach the government's goal of 500,000 domestic rooftop solar systems interconnected to the grid[73].

67 https://www.greentechmedia.com/articles/read/californias-plan-to-turn-distributed-energy-resources-into-grid-market-play

68 https://www.nytimes.com/2017/06/01/climate/trump-paris-climate-agreement.html?mcubz=0

69 Hiscock, Jennifer, Smart Grid in Canada 2014, report # 2015-018 RP-ANU 411-SGPLAN, Natural Resources Canada, March 2015 .

70 http://www.wrirosscities.org/news/mexico-city-prioritizes-building-efficiency-new-regulations

71 Secretariat of Energy, Mexico: Renewable Energies Outlook 2016-2030

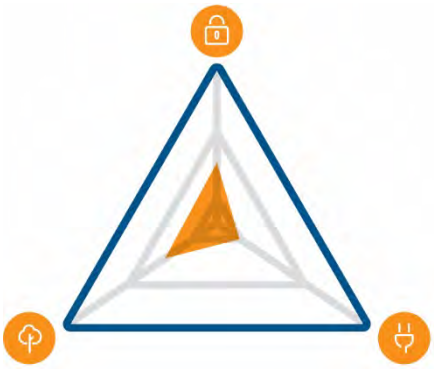
72 Mexico Energy Outlook, International Energy Agency

73 http://www.theyucatantimes.com/2017/04/mexico-cuts-red-tape-relating-to-small-solar-energy-system-installations/

https://www.nrel.gov/docs/fy17osti/66026.pdf

SUB-SAHARAN AFRICA

Eighteen out of the 25 countries included in this year's Index for the Sub-Saharan region are placed outside the top 100 overall, with only Mauritius being placed in the top 50 due to a strong performance in environmental sustainability. Energy access remains a key challenge for the region, despite significant resources and renewables potential. To unlock the region's resource potential and meet future energy demand, the region must attract investment, build institutional capacity and improve its on-grid and off-grid energy supply.



SUB-SAHARAN AFRICAN COUNTRIES

Angola	Ghana	Niger
Benin	Kenya	Nigeria
Botswana	Madagascar	Senegal
Cameroon	Malawi	South Africa
Chad	Mauritania	Swaziland
Congo (Dem. Rep.)	Mauritius	Tanzania
Côte d'Ivoire	Mozambique	Zambia
Ethiopia	Namibia	Zimbabwe
Gabon		

The region is well endowed with natural resources including fossil fuels, hydropower and renewables, and Sub-Saharan Africa has 16% of the global population. However, it uses the lowest amount of commercial energy in the world, using less than 700 kilograms of oil equivalent per capita - compared with a North American average of 7,844 kg. In addition, Africa is particularly 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 its high poverty level and limited adaptation capabilities, areas of scarce water and rain-fed agricultural production are particularly at risk[74]. For example, in 2016 the effects of an especially strong El Niño and higher than average temperatures left over 20 million people in East Africa food insecure, with 10 million people requiring food aid in Ethiopia alone[75]. By contrast, in 2012 Nigeria suffered unprecedented levels of flooding, displacing 1.3 million people from their homes.[76]

With 21 out of 25 countries in the region lying outside the top 100, energy equity remains the region's worst performing dimension. The region has the world's largest number of people living without access to electricity, accounting for almost 65% of the total population in 2014, or around 632 million people.[77] Furthermore, electricity demand in the region grew by around 45% from 2000 to 2012, with Nigeria and South Africa the largest consumers and being responsible for more than 40% of total demand[78]. It is predicted that the electricity demand will continue to increase at an average rate of 2% a year until 2040[79] due to a strong rate of economic expansion, population growth, urbanization and industrialization in the region. However, with limited generation capacities and installed power grids, the supply of electricity is lagging behind demand growth, resulting in a complex and persistent electricity gap in most Sub-Saharan Africa countries. In addition, in some cases even the presence of a grid connection does not guarantee electricity access, or that people will even use it. For example, Nigeria has a grid connection rate of 96%, but only 18% of connections work properly around 50% of the time[80], and 41% of Nigerian businesses opt to generate their own electricity in addition to

74 https://africacheck.org/factsheets/factsheet-why-africa-is-vulnerable-to-climate-change/

75 https://docs.unocha.org/sites/dms/Documents/El%20Nino%20Monthly%20Overview%209%20March%2016.pdf

76 https://www.irinnews.org/feature/2017/05/03/flood-ridden-nigeria-farmers-need-more-help-adapting-climate-change

77 IEA, 2014

78 IEA, 2014

79 IEA, 2014

80 http://theconversation.com/what-lies-behind-africas-lack-of-access-and-unreliable-power-supplies-56521

the national grid due to an unreliable power supply. This self-produced, typically diesel-generated, electricity can cost in excess of twice that of electricity from the grid, meaning that a lack of electricity access has significant effects on energy equity trilemma performance when considering the direct impact it has on electricity prices. Nevertheless, this does indicate the region's strong demand for electricity and willingness to pay. Addressing these challenges will involve realizing efficiencies across the power network using appropriate means, improving network capacity and quality of supply, and also investing in automation and smart mini-grid projects in order to close the electricity gap.

In areas that are far from the existing grid, or where the grid is not reliable enough for customer needs, hybrid micro-grids using both renewable sources and fossil fuels are often being used to improve the reliability of supply. For instance, in Tanzania, mini-grids have boosted the rural electricity access rate from 3% in 2012 to 11% in 2014. By the beginning of 2016, Tanzania's mainland had more than 109 mini-grids with a total installed capacity of 158 MW[81]. In order to attract more private capital, Tanzania's Rural Electrification Agency developed a framework to regularly call for proposals from the private sector to encourage mini-grid development. Establishing the commercial viability of these proposed solutions is also crucial to attracting the significant concessional and commercial finance necessary to have a real impact on energy access and economic growth but also depends on a consistent legal and regulatory framework.

On the other hand, in areas with significant concentrations of population, on-grid supply is likely to remain as the most cost-effective solution, with DG technology being used as an effective back up when the central connection fails. In urban Kenya, for example, a higher population density and widespread coverage by the national grid tend to favour an on-grid supply. The country added 1.3 million households to its electricity grid by 2016, raising the percentage of connected Kenyans to 55% from just 27% in 2013[82.] To take advantage of the region's abundant renewable resources, countries need to determine the role of centralized and decentralized grids in increasing people's access and improving energy use. In 2014 only 18% of those in rural areas had access to electricity where grid connection is generally difficult to access and costly to expand[83]. Under these circumstances, distributed generation supported by distributed energy resources - provided costs for storage are affordable - can offer a promising opportunity to provide electricity to rural areas in a sustainable and efficient way.

Nearly 70% of current power generation in Africa is from fossil fuels[84], but recently volatile fossil fuel prices and unreliable supply have hindered the generation capacity in most importing countries in the region, as well as some exporting countries, e.g. Nigeria. In addition, coal-fired plants pose a high risk of pollution. With 16 out of 25 countries achieving either a 'C' or 'D' rank in the Trilemma, one method of addressing these problems and improving the environmental sustainability dimension is through a switch away from carbon-intensive technology towards the use if a greater proportion of renewable resources. However, the prevalence of fossil fuel subsidies in the region is inhibiting uptake of renewable resources in many Sub-Saharan Africa countries, with an estimated $21 billion incurred annually for fuel subsidies, the majority of which is spent in North Africa, Angola and Nigeria[85]. However, recent studies are increasingly highlighting the viability of renewable projects as a feasible option in some areas. Solar and wind resources are increasingly gaining prominence and a recent report issued in 2017 by Berkeley Laboratory concluded that wind and solar could be economically and environmentally competitive options compared with hydropower and fossil fuels for some areas in South and East Africa[86].

81 http://www.business-sweden.se/contentassets/99a903a7d7474da398e4e40568f66a59/energy-east-africa---exploring-private-investment-in-power-generation.pdf

82 https://qz.com/882938/kenya-is-rolling-out-its-national-electricity-program-in-half-the-time-it-took-america/

83 https://data.worldbank.org/indicator/EG.ELC.ACCS.RU.ZS?locations=ZG

84 Cartwright, 2015. http://newclimateeconomy.report/2015/wp-content/uploads/sites/3/2015/09/NCE-APP-final.pdf

85 Africa Progress Panel, 2015

86 http://newscenter.lbl.gov/2017/03/27/economic-case-wind-solar-energy-africa/

Country Profiles

COUNTRY PROFILES

Country profiles provides the Index rankings overall and per dimension for each of the World Energy Council's member country represented in the 2017 Trilemma Index as well as their balance score. The Trilemma graph on each country profile illustrates the balance score, which highlights the trade-offs between the three competing 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 years. 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.

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 Centre 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 (CIA World Fact Book, 2014)
GDP per capita, PPP US$ (GDP Group	Gross domestic product (World Bank 2015) and Index GDP group
Energy intensity (koe per US$)	Measures how much energy is used to create one unit of GDP (Enerdata & World Energy Council, 2014)
Diversity of international energy suppliers	Indicates to what extent the country is dependent on energy trading partners. Diversity of international energy suppliers calculated through the Herfindahl-Hirschman Index (HHI), (UNCTAD, 2014).
Population with access to electricity (%)	Share of population with access to electricity (SE4All, 2012)
Access to clean cooking in urban | rural areas (%)	% of households that have access to non-solid fuels in urban and rural areas (SE4All, 2012)
Household electricity prices (US$/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, 2014)
CO_2 intensity (kCO_2 per US$)	Measures CO_2 from fuel combustion to generate one unit of GDP in PPP (Enerdata and World Energy Council , 2014)
GHG emission growth rate 2010 – 2014 (%)	Greenhouse gas emission growth rate from the energy sector between 2000 and 2012, (WRI/CAIT, 2012)
Fossil fuel reserves	Resource endowment (World Energy Council, 2016: World Energy Resources). For additional energy resources, for example, unconventional or renewable energy sources, visit www.worldenergy.org/data/resources
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, 2013)
Diversity of electricity generation	

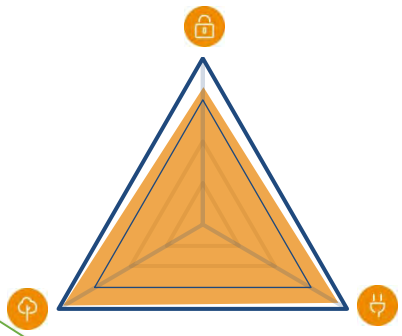
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

3

SCORE

AAA



	2015		2017	Tr	
Overall rank and balance score	**2**		**3**	▶	**AAA**
Energy performance					
Energy security	12	12	16	▶	A
Energy equity	3	2	4	▶	A
Environmental sustainability	3	3	3	▶	A
Contextual performance	7	3	13	▶	

Index rank for each energy trilemma dimension and contextual performance for 2015, 2016, 2017

Overall 2017 balance score. The first letter refers to energy security, the second to energy equity and third to environmental sustainability

Overall 2017 balance score

Trend for each energy trilemma dimension and contextual performance over the three-year period.

TRENDS AND OUTLOOK

- Switzerland drops by 1 place to rank 3 in this year's Index. Excellent scores in both energy equity and environmental sustainability, where it is ranked 4th and 3rd respectively, result in a well-balanced energy trilemma profile of AAA.

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

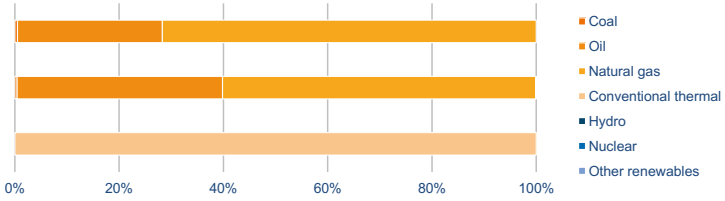
KEY METRICS

Industrial sector (% of GDP)	45.7	GDP per capita, PPP US$ (GDP Group)	14,687 (III)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	High (HHI = 1,200)
Population with access to electricity (%)	98	Access to clean cooking in urban | rural areas (%)	100 | 100
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	18.4
CO_2 intensity ($tCO_{2\,/\,USD}$)	2.96	GHG emission growth rate 2010 – 2014 (%)	4.1

ENERGY PROFILE

Fossil fuel reserves: 5,399 Mtoe

Diversity of total primary energy supply Diversity of electricity generation



ALGERIA

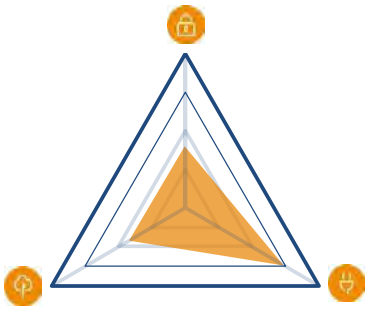
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

65

SCORE

CBC



	2015	2016	2017	Trend	Score
Overall rank and balance score	**58**	**66**	**65**	▶	**CBC**
Energy performance					
Energy security	88	88	81	▶	C
Energy equity	36	37	37	▶	B
Environmental sustainability	70	80	79	▶	C
Contextual performance	103	108	101	▶	

TRENDS AND OUTLOOK

- Algeria improves by 1 place in this year's Index, to rank 65. Algeria performs well in energy equity, but lags behind in energy security and environmental sustainability, resulting in a balance score of CBC.
- Algeria has continuously developed its economy and improved its energy system. Energy policies have been implemented to intensify oil and gas exploration efforts to increase reserves, to promote renewable energy and energy efficiency and increase the share of renewables in electricity generation to 40% by 2030.
- Policymakers should continue to focus on: 1) increasing the proportion of renewable energy in electricity generation; 2) the development of energy efficiency because there is great potential for improvement; 3) the development of a renewable energy industry that is economically sustainable; and 4) the development and support of research and development (R&D) and training to increase the transfer of knowledge and technology.

KEY METRICS

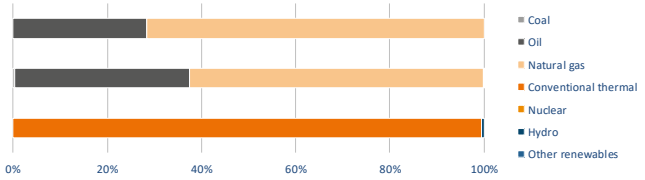
Industrial sector (% of GDP)	38.9	GDP per capita, PPP US$ (GDP Group)	15,075 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,175)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	16.3
CO_2 intensity (kCO_2 per US$)	0.27	GHG emission growth rate 2000 – 2013 (%)	3.8

ENERGY PROFILE

Fossil fuel reserves: 5,397 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ARGENTINA

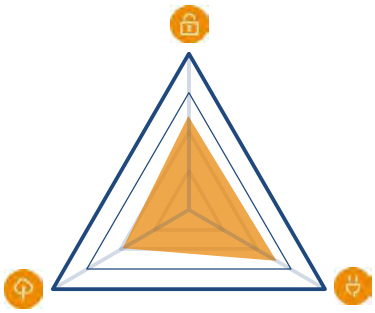
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

58

SCORE

BBC



	2015	2016	2017	Trend	Score
Overall rank and balance score	**61**	**58**	**58**	▶	**BBC**
Energy performance					
Energy security	51	48	52	▶	B
Energy equity	69	69	61	▶	B
Environmental sustainability	69	69	72	▶	C
Contextual performance	92	92	92	▶	

TRENDS AND OUTLOOK

- Argentina maintains its rank this year at 58. The country performs well in all trilemma dimensions, with environmental sustainability being the country's weakest dimension, resulting in a balance score of BBC.
- The Government, in power since December 2015, is trying to reverse the deep energy crisis that the former had created. Among the measures taken are: 1) Gradual reduction of subsidies for gas and electricity demand; 2) Renegotiation of the distribution and transmission tariffs that have been frozen since 2002; 3) Price increases for non-conventional gas (USD 7,5 MMBTU), to be gradually reduced over 3 years; 4) International bids for renewable energy projects that have resulted in more than 2000 MW offered; 5) Bids for new thermal capacity.
- The state-controlled oil company YPF has an aggressive programme in shale gas areas, entering into contracts with private international companies including Chevron, Shell, Exxon, Statoil and Petronas. However, the country's oil production continues to fall (6% per year) and gas production remains stable. Local costs of production are still too high and therefore there is a need to subsidise prices to producers. With subsidies to shale gas representing 30% of all energy subsidies, the Government is making big efforts to reduce these costs. The country continues to be a net importer of energy (approx. 15%), but importation costs have been reduced drastically, especially for LNG imports.

KEY METRICS

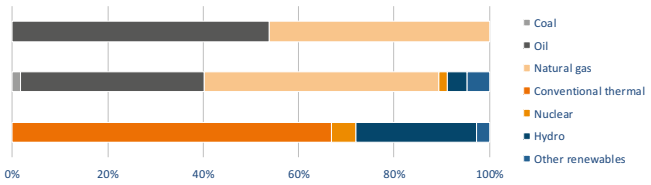
Industrial sector (% of GDP)	28.1	GDP per capita, PPP US$ (GDP Group)	19,934 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,338)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 99
Household electricity prices (US$/kWh)	0.01	Rate of transmission and distribution losses (%)	17.7
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000 – 2013 (%)	2.0

ENERGY PROFILE

Fossil fuel reserves: 610 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ARMENIA

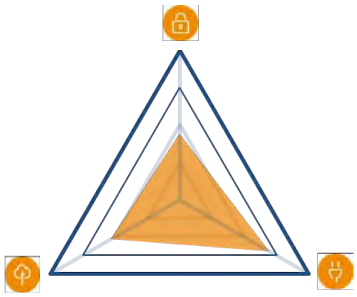
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

52

SCORE

CBB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**60**	**69**	**52**	▶	**CBB**
Energy performance					
Energy security	63	84	72	▶	C
Energy equity	61	65	53	▶	B
Environmental sustainability	82	78	63	▲	B
Contextual performance	65	70	59	▶	

TRENDS AND OUTLOOK

- Armenia improves by 17 places this year, from rank 69 in 2016 to rank 52 in 2017. An improvement across all trilemma dimensions results in a balanced profile of CBB, with energy security being the country's weakest dimension.
- The Armenian Public Services Regulatory Committee introduced a new, more sophisticated set of tariffs effective as of 1 August 2016, following an unsuccessful tariff scheme that was initiated in 2015. The new tariffs aim to help the national utility to generate the finances needed to guarantee the security of supply. Going forward, policy makers will have to monitor the new tariff's influence on the affordability of energy to avoid adverse impacts on the energy equity dimension of the energy trilemma, which is currently the strongest of the three dimensions.
- The country is also working on building capacity in the renewables sector. The 'Scaling Up Renewable Energy Program for Armenia', published in April 2014, sets a target of 21% and 26% of renewable energy in total power generation by 2020 and 2025, respectively. Small hydropower plants and other renewable energy sources now account for 11.4% of Armenia's energy production, with a further 18.6% coming from two large hydroelectric power plants (World Bank, 2016). If solar and wind options are further explored, this policy has the potential to contribute to improving the environmental sustainability dimension of the trilemma in Armenia.

KEY METRICS

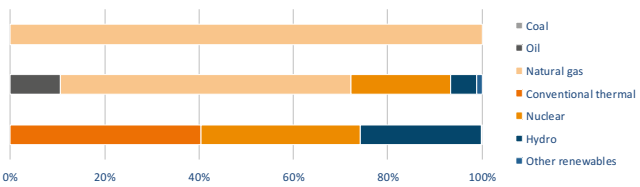
Industrial sector (% of GDP)	28.8	GDP per capita, PPP US$ (GDP Group)	8,818 (III)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Low (HHI = 5,717)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	95 | 91
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	13.2
CO_2 intensity (kCO_2 per US$)	0.23	GHG emission growth rate 2000 – 2013 (%)	3.6

ENERGY PROFILE

Fossil fuel reserves: 15 Mtoe

Total primary energy supply composition

Diversity of electricity generation



AUSTRIA

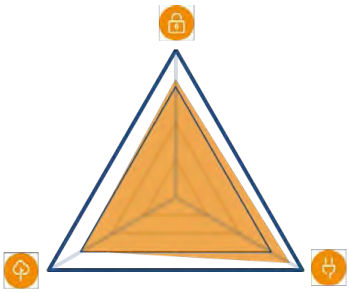
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

12

SCORE

AAB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**11**	**10**	**12**	▶	**AAB**
Energy performance					
Energy security	26	20	18	▶	A
Energy equity	5	6	8	▶	A
Environmental sustainability	24	23	30	▶	B
Contextual performance	15	16	22	▶	

TRENDS AND OUTLOOK

- Austria drops by 2 places this year to rank 12. A strong performance across the board, especially for energy equity, where it ranks 8th globally, results in a well-rounded trilemma profile of AAB.
- Austria's energy security ranking reflects its increasing energy self-sufficiency, which is also one of the country's main long-term goals, as well as the progress made since 1980 in the renewable energy sector, where Austria has nearly tripled the production of renewable energy.
- Austria's energy policy rests on three pillars – security of supply, energy efficiency and renewable energy sources. The country's decarbonisation drive has strengthened as the economy and renewable energy use have continued to grow, while fossil fuel use has decreased. Notably, Austria has quadrupled public funding for energy research, development and demonstration over the past 10 years (2005 to 2015). Research into energy efficiency, smart grids, storage and renewables define the priorities for publicly financed energy research.
- Policy developments in Austria and targets for 2020 are compatible and in line with EU policy, including 1) increasing the share of energy consumption produced from renewable resources to 34% by 2020; 2) 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 the EU-ETS and 3) 20% improvement in energy efficiency by 2020. In addition, Austria's Sustainability Strategy lists 20 goals to increase quality of life overall, strengthen economic growth, support sustainable goods and services, and optimise the transport system.

KEY METRICS

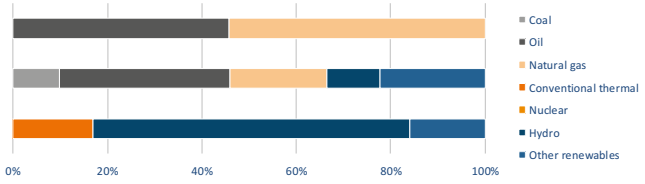
Industrial sector (% of GDP)	28.3	GDP per capita, PPP US$ (GDP Group)	50,078 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 1,420)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	0.22	Rate of transmission and distribution losses (%)	5.0
CO_2 intensity (kCO_2 per US$)	0.20	GHG emission growth rate 2000 – 2013 (%)	0.3

ENERGY PROFILE

Fossil fuel reserves: 15 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BAHRAIN

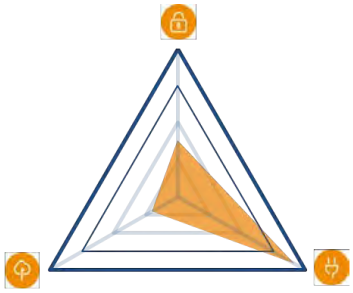
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

62

SCORE

CAD



	2015	2016	2017	Trend	Score
Overall rank and balance score	**53**	**59**	**62**	▶	**CAD**
Energy performance					
Energy security	86	80	84	▶	C
Energy equity	9	7	5	▶	A
Environmental sustainability	101	104	107	▶	D
Contextual performance	47	58	54	▶	

TRENDS AND OUTLOOK

- Bahrain has a rank of 62 in this year's Index. Whilst performing particularly strongly on energy equity, where it ranks 5th globally, energy security and environmental sustainability remain relatively low. This results in a balance score of CAD.
- 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).

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KEY METRICS

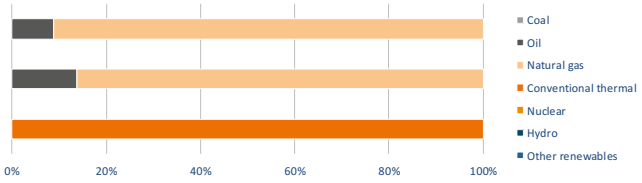
Industrial sector (% of GDP)	40.3	GDP per capita, PPP US$ (GDP Group)	46,586 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 8,742)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	4.0
CO_2 intensity (kCO_2 per US$)	0.59	GHG emission growth rate 2000 – 2013 (%)	3.9

ENERGY PROFILE

Fossil fuel reserves: 170 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BELGIUM

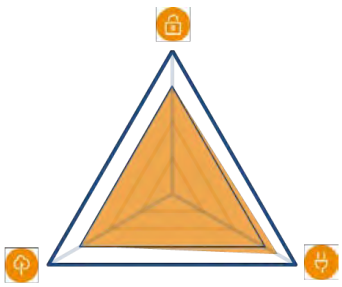
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

19

SCORE

AAB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**20**	**23**	**19**	▶	**AAB**
Energy performance					
Energy security	24	38	27	▶	A
Energy equity	10	14	20	▶	A
Environmental sustainability	41	37	31	▲	B
Contextual performance	26	24	19	▶	

TRENDS AND OUTLOOK

- Belgium improves by 4 places this year to rank 19. The country performs well across the board, with a particularly strong score in energy security and equity, giving an overall score of AAB.
- Belgium's supply is secure, as a liquid oil market and a well-diversified contractual gas portfolio (with 18 entrance points for natural gas pipelines and LNG) facilitate its reliance on oil and gas imports.
- Low average wholesale prices in north-west Europe, a pushback on thermal generation due to the injection of low marginal cost renewables, a continuing low level of demand, low global coal prices, and low prices for CO_2 certificates in the EU Emissions Trading System (EU ETS), and the technical issues on two major nuclear power plants, all impact negatively on the economic profitability of the Belgian electricity market. To tackle these issues, the government is allocating strategic reserves and possibly implementing capacity remuneration mechanisms.
- VAT on energy bills of final consumers was increased back to 21% in 2015 (after being lowered by previous governments to 14%, partly to keep inflation low and mask the high levies for renewable support). The very fast growth of solar PV and wind in the Belgian system is expected to be paid for by high end-consumer electricity prices. These choices will continue to weigh on Belgian electricity prices.

KEY METRICS

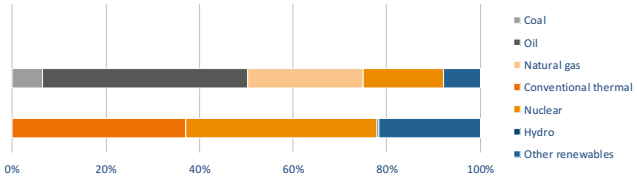
Industrial sector (% of GDP)	22.2	GDP per capita, PPP US$ (GDP Group)	46,383 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 2,930)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	0.26	Rate of transmission and distribution losses (%)	4.5
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000 – 2013 (%)	-1.9

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BOLIVIA

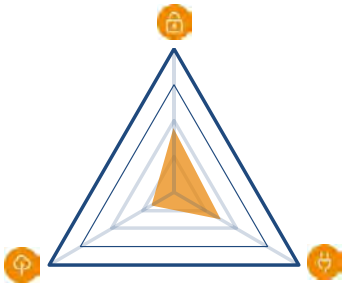
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

101

SCORE

CCD



	2015	2016	2017	Trend	Score
Overall rank and balance score	**98**	**100**	**101**	▶	**CCD**
Energy performance					
Energy security	65	73	71	▶	C
Energy equity	97	97	90	▶	C
Environmental sustainability	106	107	110	▶	D
Contextual performance	102	110	106	▶	

TRENDS AND OUTLOOK

- Bolivia drops 1 place in this year's Index to rank 101. 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 importer as production fails to keep pace with consumption. There is good potential for renewable energy, especially from by-products of sugar cane and wood industries, and hydroelectric, which has not yet been fully exploited.
- Recent developments focus on the oil and gas sector, aiming to replenish oil reserves and maintain natural gas exports to Brazil and Argentina, through an Investment Act, complemented by a Law of Incentives for the oil sector, a new hydrocarbons law and a law on prior consultation.
- 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; 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

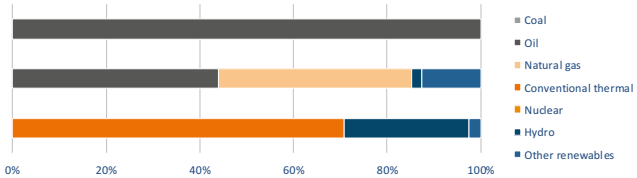
Industrial sector (% of GDP)	32.6	GDP per capita, PPP US$ (GDP Group)	7,236 (III)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	Medium (HHI = 1,969)
Population with access to electricity (%)	90	Access to clean cooking in rural | urban areas (%)	39 | 95
Household electricity prices (US$/kWh)	0.10	Rate of transmission and distribution losses (%)	9.4
CO_2 intensity (kCO_2 per US$)	0.30	GHG emission growth rate 2000 – 2013 (%)	7.3

ENERGY PROFILE

Fossil fuel reserves: 22 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BOTSWANA

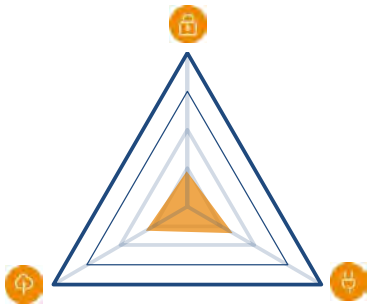
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

98

SCORE

DCC



	2015	2016	2017	Trend	Score
Overall rank and balance score	**96**	**94**	**98**	▶	**DCC**
Energy performance					
Energy security	106	105	103	▶	D
Energy equity	92	90	93	▶	C
Environmental sustainability	93	92	94	▶	C
Contextual performance	46	45	49	▶	

TRENDS AND OUTLOOK

- Botswana drops 4 places this year to rank 98 overall. The country performs poorly on energy security, resulting in a balance score of DCC.
- Botswana's power sector relies on coal for 60% of electricity generation. The power system – comprising only the Morupule A 132 MW coal-fired power plant – is run by the vertically integrated government-owned utility, Botswana Power Corporation. However, back-up power plants are necessary to meet the country's peak demand. Botswana relies on an independent power producer running power plants consuming approximately 17,000 litres of diesel/hour, and the country is highly dependent on electricity and diesel imports to meet its peak demand.
- The government has only recently recognised the need to further its strategy for increasing the role of renewables in the energy mix. In particular, Botswana is endowed with ample solar energy potential.
- In 2015, the government asked for assistance from the World Bank for a renewable energy strategy to harness the significant solar potential of the country. In June 2015, the government announced it would release a tender for two 50 MW solar PV plants. Renewable energy currently accounts for less than 2% of the country's generation mix.

KEY METRICS

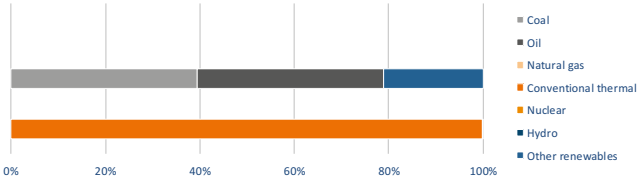
Industrial sector (% of GDP)	33.2	GDP per capita, PPP US$ (GDP Group)	16,735 (II)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	Low (HHI = 7,977)
Population with access to electricity (%)	56	Access to clean cooking in rural | urban areas (%)	39 | 77
Household electricity prices (US$/kWh)	0.07	Rate of transmission and distribution losses (%)	6.8
CO_2 intensity (kCO_2 per US$)	0.23	GHG emission growth rate 2000 – 2013 (%)	2.2

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BRAZIL

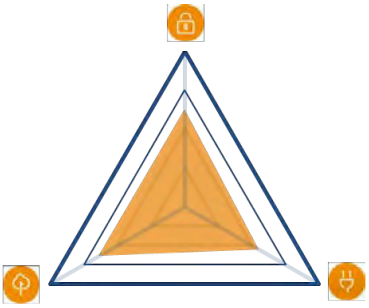
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

54

SCORE

BBB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**55**	**57**	**54**	▶	**BBB**
Energy performance					
Energy security	73	68	46	▲	B
Energy equity	67	70	74	▶	B
Environmental sustainability	43	46	47	▶	B
Contextual performance	67	75	74	▶	

TRENDS AND OUTLOOK

- With an improvement of 3 places in this year's Index, Brazil rises to rank 54. An improvement in energy security results in a well-rounded trilemma profile of BBB.
- An increased diversification of energy sources, as well as a continued reduction in external energy dependency both contributed to Brazil's rise in energy security in 2017. With the expected increases in domestic production of oil and natural gas and generation capacity for hydroelectric, biomass, wind and solar, this trend is projected to continue.
- To attract more private investment into the sector, in 2016 Brazil launched a multibillion-dollar plan to auction off oil, power rights and infrastructure concessions. In August 2017, the privatisation of the mostly state-owned utility company Eletrobras was announced. It is expected that this will have a positive impact on electricity prices in the long term. Greater participation from private investors may contribute to improved efficiency and reduced costs, but reliability and accessibility improvements will require firm action from the power sector regulator.
- Electricity prices largely followed the inflation rate in 2016, with consumer gasoline and diesel prices increasing by 21.3% and 16.8% respectively. The 2016 announcement of a new pricing formula for petrol and diesel sales based on international market prices by Petrobras was an encouraging signal to consumers. The new model reviews prices at least once a month and includes a more transparent decision-making process.
- Brazil has a large share of renewables and bioenergy in the energy mix, with renewable sources accounting for 81.7% in the Domestic Electric Energy Supply (DEES) in 2016 – up 6.2% compared to 2015. The ratio between CO_2 emissions from energy use and total energy demand also dropped from 1.55 tCO_2/tep in 2015 to 1.48 tCO_2/tep in 2016. Taking into account the growth potential, as well as the trends in increasing capacity of electricity generation, Brazil's environmental sustainability dimension is expected to improve in the coming years.

KEY METRICS

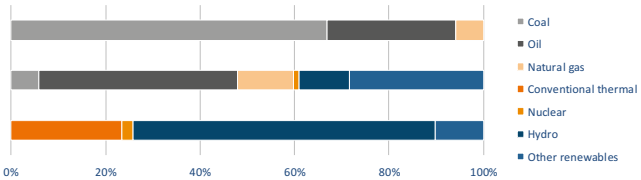
Industrial sector (% of GDP)	22.3	GDP per capita, PPP US$ (GDP Group)	15,128 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 902)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	66 | 99
Household electricity prices (US$/kWh)	0.14	Rate of transmission and distribution losses (%)	15.6
CO_2 intensity (kCO_2 per US$)	0.17	GHG emission growth rate 2000 – 2013 (%)	3.4

ENERGY PROFILE

Fossil fuel reserves: 6,913 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BULGARIA

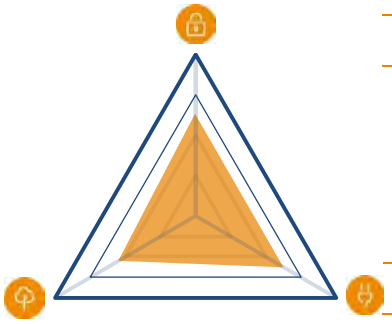
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

43

SCORE

BBB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**49**	**48**	**43**	▶	**BBB**
Energy performance					
Energy security	52	67	45	▶	B
Energy equity	59	55	62	▶	B
Environmental sustainability	71	67	62	▲	B
Contextual performance	50	49	48	▶	

TRENDS AND OUTLOOK

- Bulgaria improves by 5 places to rank 43. An improvement in energy security results in a well-balanced score of BBB.
- 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

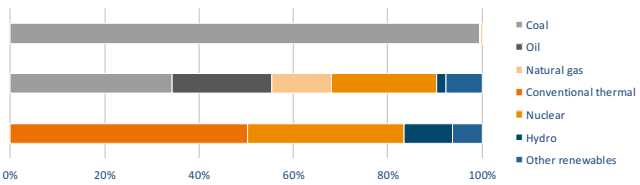
Industrial sector (% of GDP)	27.9	GDP per capita, PPP US$ (GDP Group)	19,199 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Low (HHI = 4,930)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 84
Household electricity prices (US$/kWh)	0.11	Rate of transmission and distribution losses (%)	12.2
CO_2 intensity (kCO_2 per US$)	0.47	GHG emission growth rate 2000 – 2013 (%)	-0.5

ENERGY PROFILE

Fossil fuel reserves: 1,657 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CAMEROON

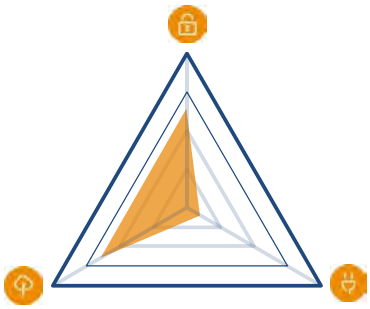
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

105

SCORE

BDB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**105**	**105**	**105**	▶	**BDB**
Energy performance					
Energy security	33	43	41	▶	B
Energy equity	113	112	116	▶	D
Environmental sustainability	48	51	46	▶	B
Contextual performance	110	112	115	▶	

TRENDS AND OUTLOOK

- Cameroon maintains its position at rank 105 for another consecutive year. Whilst the country performs well on energy security and environmental sustainability, it lags behind on energy equity, resulting in an imbalanced trilemma profile of BDB.
- Significant energy issues affecting Cameroon are: 1) the intermittence and 2) 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 Plan aims to achieve a 75% electrification rate by 2030. These plans are supported by the Cameroon Clean Development Mechanism project to convert biogas into electricity. Cameroon has additionally implemented policies such as the 'energy emergence' initiative, which is due to be completed in 2035. Moving away from over-reliance on hydropower and diversifying the energy mix will assist in reducing energy supply intermittency.
- However, the government will need to ensure significant investment takes place. It is 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 and greater mix. Cameroon has experienced a slow but steady increase in GDP and economic growth in the past five years giving positive signs for the investment needed to achieve 'energy emergence'.

KEY METRICS

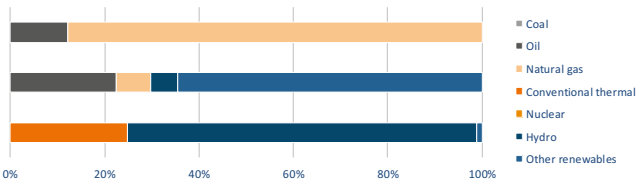
Industrial sector (% of GDP)	28.5	GDP per capita, PPP US$ (GDP Group)	3,286 (IV)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	Low (HHI = 3,778)
Population with access to electricity (%)	57	Access to clean cooking in rural | urban areas (%)	4 | 38
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	11.0
CO_2 intensity (kCO_2 per US$)	0.10	GHG emission growth rate 2000 – 2013 (%)	1.2

ENERGY PROFILE

Fossil fuel reserves: 147 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CANADA

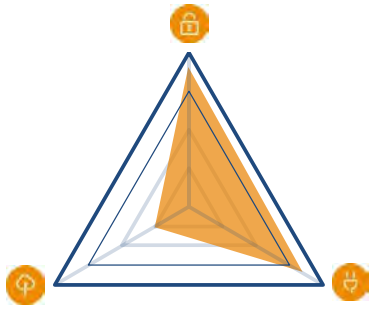
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

21

SCORE

AAC



	2015	2016	2017	Trend	Score
Overall rank and balance score	**18**	**22**	**21**	▶	**AAC**
Energy performance					
Energy security	4	5	4	▶	A
Energy equity	14	11	22	▶	A
Environmental sustainability	97	96	100	▶	C
Contextual performance	14	14	11	▶	

TRENDS AND OUTLOOK

- Canada improves by 1 place this year to rank 21. The country performs strongly on energy security and energy equity dimensions, but lags behind when it comes to environmental sustainability. This results in an imbalanced trilemma grade of AAC.
- Many world-leading efforts in carbon policy have been implemented by Canada's provincial governments, which have the primary authority over energy and environmental matters. 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, and investments in advanced technology such as the world's first fully integrated project to capture, use and permanently store CO_2 from a coal-fired power plant. In addition, transformations towards green electricity generation are now underway in several provinces. These developments should support the continuing improvement in Canada's future rankings.
- 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 inclusive and comprehensive review process for energy infrastructure projects to access new export markets, taking account of the many diverse interests involved; and, 3) ensuring wider engagement and the sharing of benefits from resource development projects, most notably with Canada's aboriginal population on whose traditional lands most major energy projects will be located.

KEY METRICS

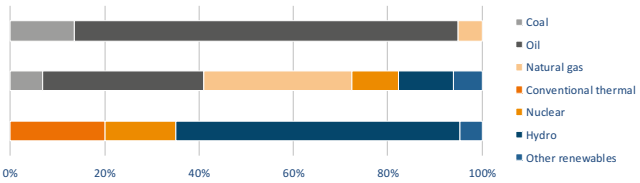
Industrial sector (% of GDP)	27.7	GDP per capita, PPP US$ (GDP Group)	44,025 (I)
Energy intensity (koe per US$)	0.13	Diversity of international energy suppliers	Low (HHI = 4,974)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	0.16	Rate of transmission and distribution losses (%)	9.8
CO_2 intensity (kCO_2 per US$)	0.40	GHG emission growth rate 2000 – 2013 (%)	0.4

ENERGY PROFILE

Fossil fuel reserves: 34,086 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CHAD

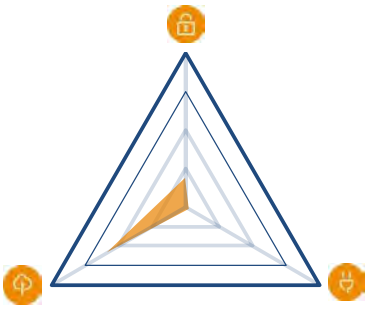
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

122

SCORE

DDB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**119**	**119**	**122**	▶	**DDB**
Energy performance					
Energy security	91	93	113	▶	D
Energy equity	123	123	124	▶	D
Environmental sustainability	54	52	56	▶	B
Contextual performance	124	124	124	▶	

TRENDS AND OUTLOOK

- Chad drops 3 places this year to rank 122. Although performing relatively well in environmental sustainability, the country still lags behind on energy security and energy equity, resulting in a balance grade of DDB.
- 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. The majority 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 the country's significant solar potential.
- In 2015, the Sustainable Energy Fund for Africa (SEFA) approved 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

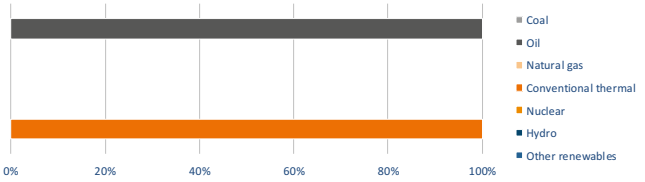
Industrial sector (% of GDP)	14.2	GDP per capita, PPP US$ (GDP Group)	1,991 (IV)
Energy intensity (koe per US$)	0.04	Diversity of international energy suppliers	Low (HHI = 8,704)
Population with access to electricity (%)	8	Access to clean cooking in rural | urban areas (%)	2 | 13
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	12.2
CO_2 intensity (kCO_2 per US$)	0.01	GHG emission growth rate 2000 – 2013 (%)	N.A.

ENERGY PROFILE

Fossil fuel reserves: 216 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CHILE

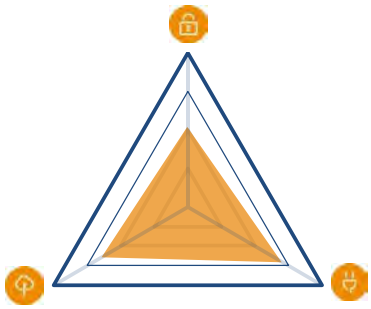
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

36

SCORE

BBB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**35**	**38**	**36**	▶	**BBB**
Energy performance					
Energy security	42	44	62	▶	B
Energy equity	66	66	49	▶	B
Environmental sustainability	51	48	44	▶	B
Contextual performance	20	23	32	▶	

TRENDS AND OUTLOOK

- Chile improves by 2 places this year to rank 36. The country performs well across all trilemma dimensions, resulting in a balanced grade of BBB.
- Chile currently imports 60% of its total primary energy, exposing it to the international volatility of commodity prices, as well as political and market risks. The greatest challenges are perceived as: the development of local resources, in particular medium and small-scale renewable energies; developing a regulatory framework for the electricity distribution sector; developing the regulatory framework for energy efficiency; promoting regional integration through gas and electricity interconnectors; promoting electric mobility and smart cities; and accommodating for the additional capacity provided by the next tenders for the production of electricity.
- Chile's Energy Policy 2050 establishes the following objectives by 2050: 1) Electricity outages to not exceed 1 hour/year in any locality of Chile, except in cases of force majeure; 2) GHG emissions relating to Chile's energy sector are consistent with the thresholds defined by international guidelines and with the corresponding national emissions reduction goal; 3) Universal and equitable access to modern, reliable and affordable energy services for the entire population; 4) Regional and territorial planning and land-use instruments are in line with the guidelines of the Energy Policy; 5) Aim to be one of the top three OECD countries with the lowest average residential and industrial electricity prices; 6) 70% of electricity generated in Chile comes from renewable sources; 7) Growth of energy consumption is decoupled from GDP growth; 8) 100% of new buildings meet OECD standards for construction, and are fitted with intelligent management systems; 9) 100% of the major categories of appliances and equipment sold in Chile are energy efficient; 10) Ensure knowledge surrounding energy efficiency is diffused to all levels of society.

KEY METRICS

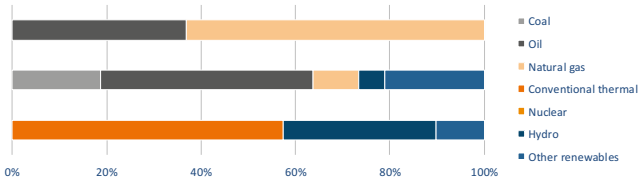
Industrial sector (% of GDP)	32.4	GDP per capita, PPP US$ (GDP Group)	23,960 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 2,512)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	55 | 98
Household electricity prices (US$/kWh)	0.07	Rate of transmission and distribution losses (%)	6.7
CO_2 intensity (kCO_2 per US$)	0.26	GHG emission growth rate 2000 – 2013 (%)	3.7

ENERGY PROFILE

Fossil fuel reserves: 54 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CHINA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

86

SCORE

BBD

	2015	2016	2017	Trend	Score
Overall rank and balance score	**87**	**87**	**86**	▶	**BBD**
Energy performance					
Energy security	70	62	58	▲	B
Energy equity	77	77	76	▶	B
Environmental sustainability	116	117	117	▶	D
Contextual performance	63	62	47	▶	

TRENDS AND OUTLOOK

- China improves 1 rank this year to 86. China performs relatively well in energy security and energy equity, but still lags behind on environmental sustainability, resulting in a balance score of BBD.
- China is still in the process of rapid industrialisation and urbanisation, and balancing the economic/social development and the related energy/environment issues is a challenge for China, to which the Chinese government is paying much attention. China's 12th five-year plan set mandatory targets on energy efficiency, non-fossil share, environment protection and low carbon during 2010−2015. In this period China's GDP grew by 7.8% on average, with an annual primary energy consumption and carbon emission growth of 3.6% and 2.7%, respectively. Energy intensity and carbon intensity reduced to 18% and 21%, respectively, and the share of non-fossil energy increased to 15%.
- 2016 was the first year of China's 13th five-year plan. China has proposed the strategy of green development and set ambitious mandatory targets for 2015−2020, including reducing energy intensity by 15%, reducing carbon intensity by 18%, increasing the share of non-fossil to 15%, and an air quality target which aims for I and II degree level air in 335 cities on 80% of days. In the meantime, China pledges to enhance legislation and introduce market-based reforms, including launching the nationwide carbon trading market in 2017. Related plans and policies, which will promote more sustainable development in the coming five years, will be announced soon.

KEY METRICS

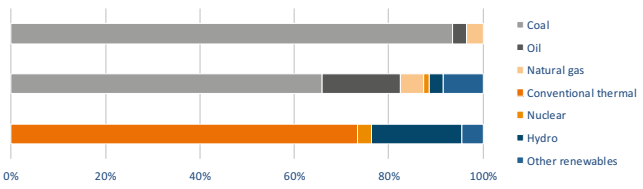
Industrial sector (% of GDP)	40.9	GDP per capita, PPP US$ (GDP Group)	15,535 (II)
Energy intensity (koe per US$)	0.12	Diversity of international energy suppliers	High (HHI = 531)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	17 | 91
Household electricity prices (US$/kWh)	0.09	Rate of transmission and distribution losses (%)	5.8
CO_2 intensity (kCO_2 per US$)	0.54	GHG emission growth rate 2000 – 2013 (%)	8.5

ENERGY PROFILE

Fossil fuel reserves: 85,363 Mtoe

Total primary energy supply composition

Diversity of electricity generation



COLOMBIA

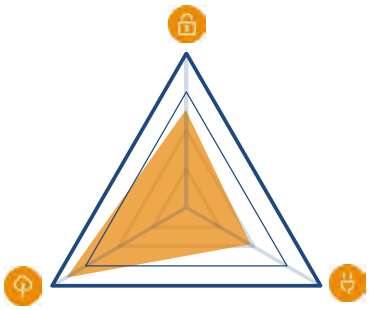
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

45

SCORE

BCA



	2015	2016	2017	Trend	Score
Overall rank and balance score	**43**	**41**	**45**	▶	**BCA**
Energy performance					
Energy security	35	36	43	▶	B
Energy equity	81	80	84	▶	C
Environmental sustainability	8	10	16	▶	A
Contextual performance	66	68	66	▶	

TRENDS AND OUTLOOK

- Colombia drops 4 places in this year's Index to rank 45. Good performance in both energy security and environmental sustainability dimensions, combined with a relatively low score in energy equity, results in an overall trilemma grade of BCA.
- Colombia, although in a relatively high position in the Index, still faces major challenges such as: expanding coverage of energy services, and finding solutions based on non-conventional energies; improving quality and reliability of energy services; diversification of the energy mix; and sustaining positive economic development without increasing CO_2 emissions.
- Main areas policymakers are focusing on are: 1) ensuring the continued development of the mining and energy sector as one of the main drivers of economic growth and social development; 2) promoting energy efficiency on energy demand and supply side, and consolidating a culture for sustainable use of natural resources; 3) strengthening the participation of different stakeholders in the development phases of the industry; 4) increasing exploration of natural gas; 5) developing and implementing efficient mass transport systems; 6) ensuring the expansion of electricity generation capacity; and 7) strengthening guarantees and investment opportunities in the country, and boosting investment in science and technology in the energy sector.

KEY METRICS

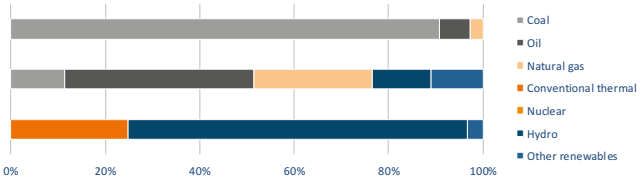
Industrial sector (% of GDP)	33.4	GDP per capita, PPP US$ (GDP Group)	14,158 (III)
Energy intensity (koe per US$)	0.04	Diversity of international energy suppliers	Low (HHI = 7,236)
Population with access to electricity (%)	98	Access to clean cooking in rural | urban areas (%)	50 | 98
Household electricity prices (US$/kWh)	0.18	Rate of transmission and distribution losses (%)	11.3
CO_2 intensity (kCO_2 per US$)	0.13	GHG emission growth rate 2000 – 2013 (%)	2.0

ENERGY PROFILE

Fossil fuel reserves: 5,178 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CONGO (DEMOCRATIC REPUBLIC)

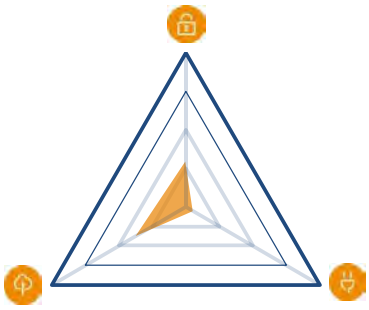
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

121

SCORE

CDC



	2015	2016	2017	Trend	Score
Overall rank and balance score	**116**	**117**	**121**	▶	**CDC**
Energy performance					
Energy security	94	98	91	▶	C
Energy equity	112	113	120	▶	D
Environmental sustainability	86	85	82	▶	C
Contextual performance	122	122	125	▶	

TRENDS AND OUTLOOK

- The Democratic Republic of the Congo (DRC) drops 4 places this year to rank 121. An improvement in energy security results in a grade change from D to C from 2016-2017; however, energy equity still remains low, resulting in an overall balance score of CDC.
- 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

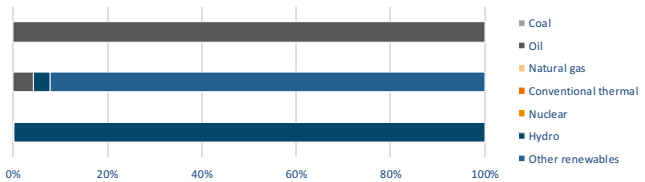
Industrial sector (% of GDP)	35.2	GDP per capita, PPP US$ (GDP Group)	801 (IV)
Energy intensity (koe per US$)	0.44	Diversity of international energy suppliers	Medium (HHI = 1,835)
Population with access to electricity (%)	14	Access to clean cooking in rural | urban areas (%)	2 | 11
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	N.A.
CO_2 intensity (kCO_2 per US$)	0.05	GHG emission growth rate 2000 – 2013 (%)	3.8

ENERGY PROFILE

Fossil fuel reserves: 24 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CÔTE D'IVOIRE

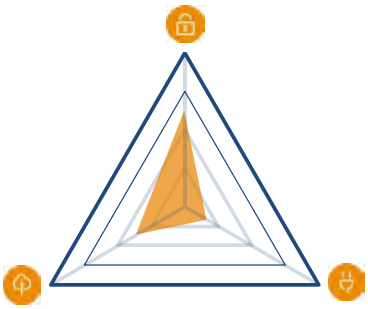
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

103

SCORE

BDC



	2015	2016	2017	Trend	Score
Overall rank and balance score	**104**	**101**	**103**	▶	**BDC**
Energy performance					
Energy security	19	30	48	▶	B
Energy equity	106	105	107	▶	D
Environmental sustainability	95	94	86	▶	C
Contextual performance	113	102	98	▲	

TRENDS AND OUTLOOK

- Côte d'Ivoire ranks 103 in this year's Index, dropping 2 places from 2016. Whilst achieving good results in energy security, the country lags behind in both energy equity and environmental sustainability, 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 develop these energy sources has been hampered by internal conflict. Combined with a lack of investment in energy and infrastructure, this has resulted in low energy access and a poorly diversified energy mix.
- Although there is extensive grid supply, the prohibitive cost of accessing the grid presents a barrier to access the electricity. As a result, there is a large disparity between the number of people who live in a grid-connected locality and the households that are actually connected.
- In 2012, the government agreed on an energy sector plan that prioritises investment in fossil-fuelled power generation and transport infrastructure, and commits the country to 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

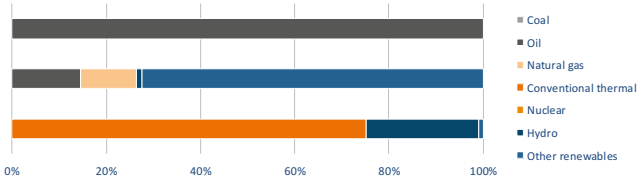
Industrial sector (% of GDP)	31.8	GDP per capita, PPP US$ (GDP Group)	3,720 (IV)
Energy intensity (koe per US$)	0.12	Diversity of international energy suppliers	Low (HHI = 7,363)
Population with access to electricity (%)	62	Access to clean cooking in rural | urban areas (%)	2 | 35
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	17.0
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2000 – 2013 (%)	3.7

ENERGY PROFILE

Fossil fuel reserves: 14 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CROATIA

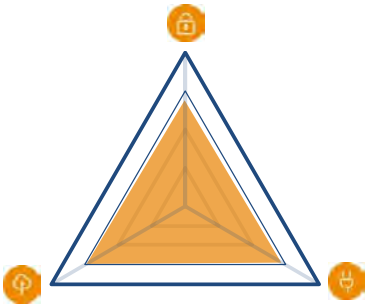
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

32

SCORE

BBB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**29**	**29**	**32**	▶	**BBB**
Energy performance					
Energy security	43	41	35	▶	B
Energy equity	44	43	43	▶	B
Environmental sustainability	28	26	33	▶	B
Contextual performance	44	54	51	▶	

TRENDS AND OUTLOOK

- A drop of 3 places this year sees Croatia rank 32 in this year's Index. A well-balanced trilemma profile across the board results in a trilemma grade of BBB.
- In 2013 the government adopted a National Action Plan (NAP), revising the 2020 target for renewable energy sources (RES) in line with market changes and the decline in energy consumption. Already in 2012, the share of RES in gross final consumption amounted to 16.8%. The country is seeking to introduce more flexible and diversified sources of gas by developing strategic gas infrastructure to ensure stability of supply. Among the most notable projects are the Ionian Adriatic Pipeline (IAP) and the LNG terminal on Krk island.
- Energy efficiency is playing a key role in the overall strategy of the country. With the 2009 Energy Strategy, the National Energy Efficiency Programme, and the First National Energy Efficiency Action Plan, the country set the target of reducing final energy consumption in 2016 by 19.77 PJ (petajoule), and in 2020 by 22.76 PJ, with a view to boosting security of energy supply, competitiveness of the energy sector and sustainable development.
- Furthermore, attention has increasingly shifted towards energy efficiency by deploying highly efficient central heating systems and thermal energy generation in cogeneration plants.

KEY METRICS

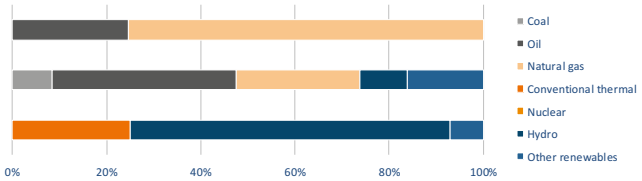
Industrial sector (% of GDP)	26.6	GDP per capita, PPP US$ (GDP Group)	23,596 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	High (HHI = 1,113)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	81 | 100
Household electricity prices (US$/kWh)	0.16	Rate of transmission and distribution losses (%)	10.6
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000 – 2013 (%)	-0.8

ENERGY PROFILE

Fossil fuel reserves: 28 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CYPRUS

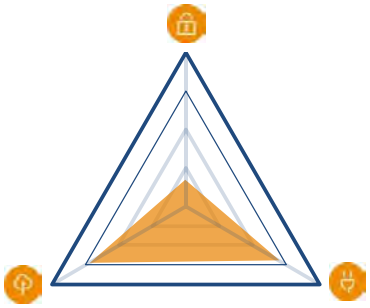
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

61

SCORE

DBB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**64**	**60**	**61**	▶	**DBB**
Energy performance					
Energy security	116	112	116	▶	D
Energy equity	58	58	51	▶	B
Environmental sustainability	38	32	35	▶	B
Contextual performance	43	38	37	▶	

TRENDS AND OUTLOOK

- Dropping 1 place in this year's ranking, Cyprus sees its rank change to 61. Whilst it exhibits a good performance 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 will bring new opportunities to the hydrocarbons sector of Cyprus and financial growth. Exploration activity, by the licensees of previous rounds will continue, while the first exploration well will be concluded by October 2017.
- 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. 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

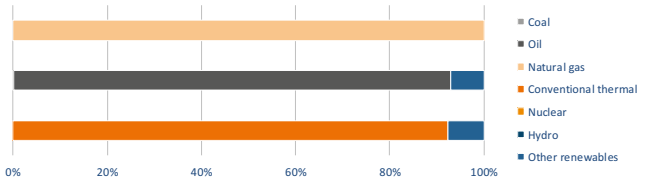
Industrial sector (% of GDP)	10.6	GDP per capita, PPP US$ (GDP Group)	32,580 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 2,121)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	0.20	Rate of transmission and distribution losses (%)	4.0
CO_2 intensity (kCO_2 per US$)	0.30	GHG emission growth rate 2000 – 2013 (%)	-0.9

ENERGY PROFILE

Fossil fuel reserves: 121 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CZECH REPUBLIC

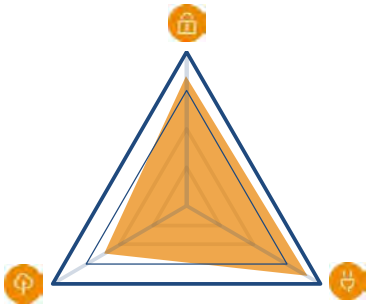
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

17

SCORE

AAB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**21**	**19**	**17**	▶	**AAB**
Energy performance					
Energy security	14	14	14	▶	A
Energy equity	8	5	7	▶	A
Environmental sustainability	62	54	49	▲	B
Contextual performance	30	29	26	▶	

TRENDS AND OUTLOOK

- A consecutive yearly improvement of 2 places from 2014, where it sat at rank 23, means the Czech Republic ranks 17 in this year's Index. Energy equity is a particular highlight, where the country ranks 7th globally. This results in a well-balanced profile of AAB.
- In 2015 the Czech government issued several energy policies: 1) the update of the State Energy Concept of the Czech Republic (SEK); 2) the National Action Plan for Smart Grids; 3) the National Action Plan for Energy Efficiency; and 4) the National Plan on Nuclear Energy Development.
- The national energy policy is based on: construction of new nuclear power generation units on the existing sites of nuclear power plants; a gradual transition from mostly extracted lignite deposits towards natural gas and renewable energy sources for electricity and heat production, with domestic coal remaining a stable segment of the country's energy mix (decreasing from 45% today to less than 20% in the coming decades); medium-term stabilising of combined heat and power (CHP), provision of coal/fuels for central heating; increasing efficiency in energy production and making considerable efficiencies in the use of all kinds of energy; and reconstruction and development of network infrastructure (electricity, gas) to ensure system integration of decentralised production, operational reliability, as well as ancillary and transit services.

KEY METRICS

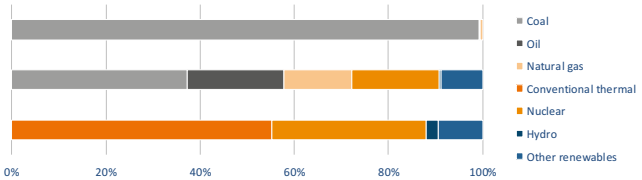
Industrial sector (% of GDP)	37.8	GDP per capita, PPP US$ (GDP Group)	34,711 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Medium (HHI = 2,096)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	0.15	Rate of transmission and distribution losses (%)	6.4
CO_2 intensity (kCO_2 per US$)	0.35	GHG emission growth rate 2000 – 2013 (%)	-1.5

ENERGY PROFILE

Fossil fuel reserves: 739 Mtoe

Total primary energy supply composition

Diversity of electricity generation



DENMARK

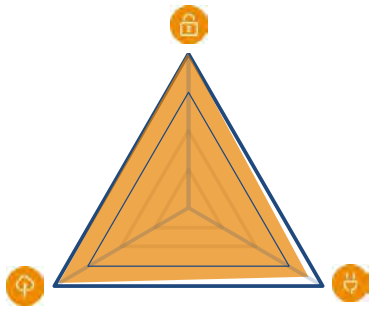
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

1

SCORE

AAA



	2015	2016	2017	Trend	Score
Overall rank and balance score	**1**	**1**	**1**	▶	**AAA**
Energy performance					
Energy security	1	1	1	▶	A
Energy equity	13	10	12	▶	A
Environmental sustainability	5	6	4	▶	A
Contextual performance	12	11	15	▶	

TRENDS AND OUTLOOK

- Denmark maintains its position in the top 10 this year at number 1. The country 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 large amounts of fluctuating renewable energy in the electricity grid.

KEY METRICS

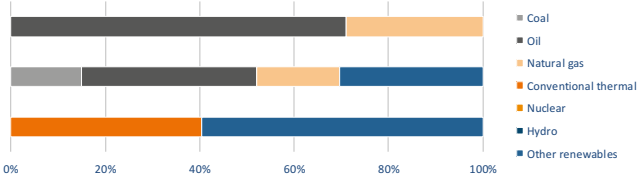
Industrial sector (% of GDP)	22.9	GDP per capita, PPP US$ (GDP Group)	49,696 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 1,642)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	0.34	Rate of transmission and distribution losses (%)	5.9
CO_2 intensity (kCO_2 per US$)	0.16	GHG emission growth rate 2000 – 2013 (%)	-2.2

ENERGY PROFILE

Fossil fuel reserves: 104 Mtoe

Total primary energy supply composition

Diversity of electricity generation



DOMINICAN REPUBLIC

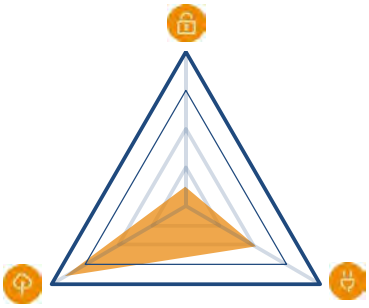
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

79

SCORE

DBA



	2015	2016	2017	Trend	Score
Overall rank and balance score	**79**	**77**	**79**	▶	**DBA**
Energy performance					
Energy security	123	121	119	▶	D
Energy equity	75	75	77	▶	B
Environmental sustainability	12	13	14	▶	A
Contextual performance	70	67	73	▶	

TRENDS AND OUTLOOK

- Dropping by 2 places this year, Dominican Republic ranks 79 in this year's Index. While scoring excellently for environmental sustainability, its energy security dimension is particularly low, resulting in an imbalanced trilemma profile of DBA.
- Dominican Republic relied on fossil fuel imports for 86% of electricity generation in 2015, and so the government is seeking to diversify its supply and increase domestic fossil fuel production in the region in order to improve energy security. Law 57-07 sets a target for a 25% share of renewables in the power generation mix by 2025 and, as of 2017 eight renewable energy projects were under construction with a total capacity of 361.2 MW, with projects expected to be finalised and operational in 2018. 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 country currently has serious problems with its electricity network, with theft of electricity, low rates of payment collection and distribution losses leading to blackouts and power outages. In response to this, in 2015 the European Commission initiated the Corporación Dominican de Empresas Eléctricas Estatales (CDEEE) Electricity Distribution Loss Reduction Project, under the control of the CDEEE, the holding company responsible for all the state-owned Dominican power companies, which aims to reduce losses and limit dependence of the power sector on the Government's financial support. In addition, the recent resumption of discussions regarding the proposed electricity sector pact – known as Pacto Eléctrico – that intends to increase the competiveness of the country and improve Dominicans' standard of living, is an encouraging sign for Dominican Republic's trilemma performance in the future.

KEY METRICS

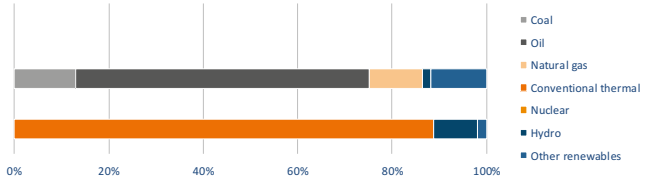
Industrial sector (% of GDP)	27.3	GDP per capita, PPP US$ (GDP Group)	15,209 (II)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Low (HHI = 2,928)
Population with access to electricity (%)	98	Access to clean cooking in rural | urban areas (%)	77 | 96
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	12.3
CO_2 intensity (kCO_2 per US$)	0.18	GHG emission growth rate 2000 – 2013 (%)	1.7

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ECUADOR

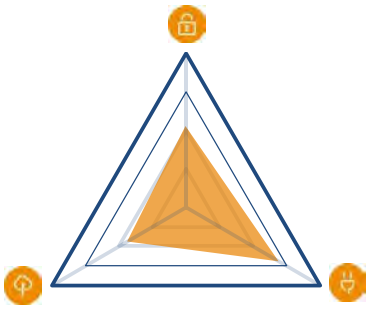
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

64

SCORE

BBC



	2015	2016	2017	Trend	Score
Overall rank and balance score	**50**	**50**	**64**	▶	**BBC**
Energy performance					
Energy security	49	50	61	▶	B
Energy equity	49	46	54	▶	B
Environmental sustainability	72	79	77	▶	C
Contextual performance	96	101	108	▶	

TRENDS AND OUTLOOK

- Ecuador drops 14 places this year to rank 64. Receiving relatively good scores in both energy security and energy equity dimensions, Ecuador still lags behind a little in environmental sustainability, resulting in a balance score of BBC.
- The Ecuadorian government has been pushing several initiatives to create a more sustainable energy sector. The Ecuadorian National Strategic Planning (National Plan for Good Living), sets the following goals: increase of the share of renewable energy in the electricity generation mix; reduce oil-derived imports; change the current profile of oil exports to higher value-added products; increase of effectiveness and efficiency of the transport sector; reduce losses of generation and distribution; and an overall increase in energy efficiency.
- For this purpose, the government is currently developing several projects, which include: 1) the construction of eight high-capacity hydroelectric power plants; 2) projects to promote the installation of renewable power plants; 3) the change from gas-based cooking to efficient induction-based cooker appliances; and 4) the construction of a large oil refinery.
- The ambitious policies developed by the government will ensure the sustainability of the Ecuadorian energy sector by promoting improvement on each of the three energy trilemma dimensions.

KEY METRICS

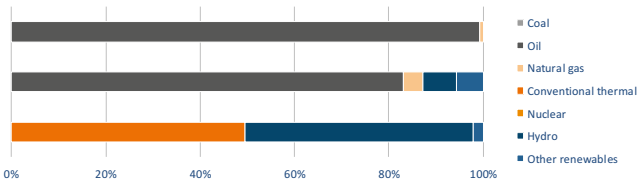
Industrial sector (% of GDP)	34.1	GDP per capita, PPP US$ (GDP Group)	11,286 (III)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 3,744)
Population with access to electricity (%)	99	Access to clean cooking in rural | urban areas (%)	85 | 100
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	12.8
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000 – 2013 (%)	4.6

ENERGY PROFILE

Fossil fuel reserves: 1,184 Mtoe

Total primary energy supply composition

Diversity of electricity generation



EGYPT

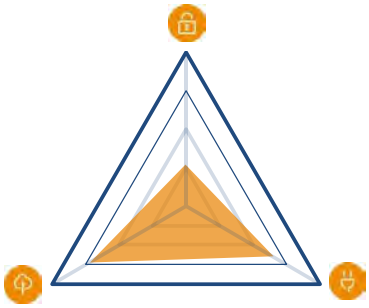
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

69

SCORE

CBB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**72**	**68**	**69**	▶	**CBB**
Energy performance					
Energy security	93	90	93	▶	C
Energy equity	65	60	60	▶	B
Environmental sustainability	44	49	34	▶	B
Contextual performance	109	113	103	▶	

TRENDS AND OUTLOOK

- Egypt drops 1 place this year to rank 69. Scoring well in both the energy equity and environmental sustainability dimensions, but still lagging behind when it comes to energy security, Egypt receives a balance grade of CBB.
- As the most populous country in North Africa, Egypt is keen to improve its energy sustainability. Therefore, energy has become one of the most important topics in recent years. Due to the political transition the country is experiencing, challenges related to energy security need to be overcome. These include an insufficient electricity capacity to meet the demand and no reserve capacities, low energy efficiency, especially in the industrial sector, and the slow progress of new and renewable energy projects due to the incremental cost gap between fossil fuel and renewable technologies.
- Policymakers are addressing the following energy developments: 1) expansion of new power capacities at the least costly location; 2) diversification of power generation by expanding wind farms, and introducing solar PV and solar thermal generation to benefit from one of the best solar belt locations in the world; 3) improvement of the energy tariff structure to encourage energy saving measures; 4) encouragement of the private sector to invest in the development of energy infrastructure including renewable energy projects using build, own, operate (BOO) schemes; and 5) extension of the regional interconnection power grid capacity between Egypt and Arab, Africa and Europe.

KEY METRICS

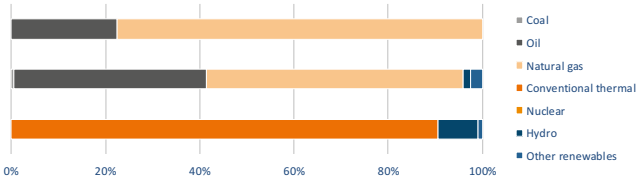
Industrial sector (% of GDP)	36.2	GDP per capita, PPP US$ (GDP Group)	11,132 (III)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	High (HHI = 624)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	11.6
CO_2 intensity (kCO_2 per US$)	0.21	GHG emission growth rate 2000 – 2013 (%)	4.4

ENERGY PROFILE

Fossil fuel reserves: 2,040 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ESTONIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

38

SCORE

ABD

	2015	2016	2017	Trend	Score
Overall rank and balance score	**44**	**40**	**38**	▶	**ABD**
Energy performance					
Energy security	27	22	22	▶	A
Energy equity	53	50	42	▶	B
Environmental sustainability	107	111	108	▶	D
Contextual performance	18	20	18	▶	

TRENDS AND OUTLOOK

- Estonia improves by 2 places this year, to rank 38. Poor performance in environmental sustainability, combined with good results in energy security and equity, result in an imbalanced trilemma grade of ABD.
- 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. However, the current low oil prices put pressure on Estonian shale oil producers, and investments in new production capacity have been put on hold, which may result in a negative impact on energy security. Further 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 is now planning to introduce an auction-based market premium model to support new renewable energy projects, while existing projects will benefit from the old feed-in tariffs until 2020.
- Policymakers should focus on successfully implementing these tariff reforms and finding other ways to increase 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

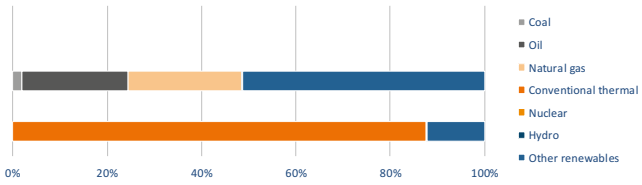
Industrial sector (% of GDP)	27.4	GDP per capita, PPP US$ (GDP Group)	29,365 (II)
Energy intensity (koe per US$)	0.10	Diversity of international energy suppliers	Low (HHI = 3,609)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	70 | 96
Household electricity prices (US$/kWh)	0.15	Rate of transmission and distribution losses (%)	8.6
CO_2 intensity (kCO_2 per US$)	0.65	GHG emission growth rate 2000 – 2013 (%)	2.1

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ETHIOPIA

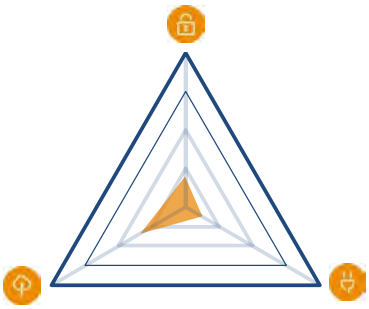
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

116

SCORE

DDC



	2015	2016	2017	Trend	Score
Overall rank and balance score	**120**	**118**	**116**	▶	**DDC**
Energy performance					
Energy security	107	102	110	▶	D
Energy equity	118	117	111	▶	D
Environmental sustainability	87	90	91	▶	C
Contextual performance	114	111	110	▶	

TRENDS AND OUTLOOK

- Ethiopia improves by 2 places once again this year, improving from rank 118 in 2016 to rank 116 in 2017. 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

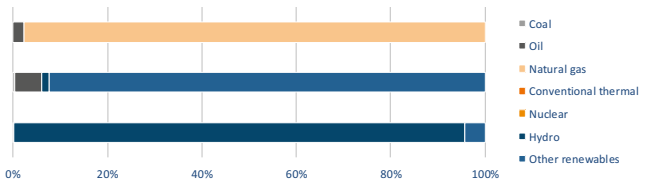
Industrial sector (% of GDP)	17.7	GDP per capita, PPP US$ (GDP Group)	1,735 (IV)
Energy intensity (koe per US$)	0.30	Diversity of international energy suppliers	Low (HHI = 4,332)
Population with access to electricity (%)	27	Access to clean cooking in rural | urban areas (%)	2 | 3
Household electricity prices (US$/kWh)	0.03	Rate of transmission and distribution losses (%)	21.4
CO_2 intensity (kCO_2 per US$)	0.07	GHG emission growth rate 2000 – 2013 (%)	4.2

ENERGY PROFILE

Fossil fuel reserves: 22 Mtoe

Total primary energy supply composition

Diversity of electricity generation



FINLAND

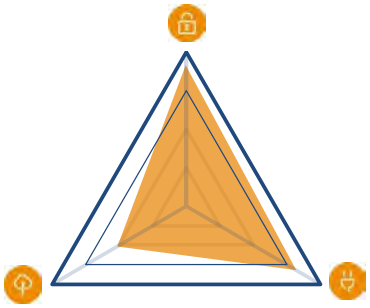
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

11

SCORE

AAB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**3**	**8**	**11**	▶	**AAB**
Energy performance					
Energy security	2	3	3	▶	A
Energy equity	21	24	27	▶	A
Environmental sustainability	74	71	67	▶	B
Contextual performance	2	2	12	▶	

TRENDS AND OUTLOOK

- Finland moves out of the top 10 this year, dropping by 3 places to rank 11. Excellent performance on energy security, where it ranks 3rd globally, along with good performance in energy equity and environmental sustainability, result in a balance grade of AAB. Environmental sustainability remains its weakest dimension.
- While a majority of the country's conventional thermal power generation is made up of highly efficient combined heat and power production, Finland's environmental sustainability score still needs to be improved. To this effect, the government has recently stepped up its efforts in the renewables sector, making €80m available to support biofuel and new energy technology projects. This is part of a long-term plan to phase out energy production from coal and to halve oil imports by 2030. Imports of hard coal already decreased in 2015, which could have a positive effect on the trilemma's energy security dimension. In addition, the country has already met its 38% 2020 renewables target under the EU's Renewable Energy Directive, with the country's domestic strategy calling for a further increase of the renewables share to 50% by 2030.
- Finnish policymakers must now ensure that these promising reforms are implemented in an effective way. If successful, the country's ranking is expected to improve in future reports.

KEY METRICS

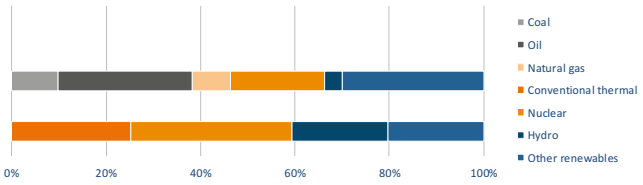
Industrial sector (% of GDP)	26.9	GDP per capita, PPP US$ (GDP Group)	43,053 (I)
Energy intensity (koe per US$)	0.13	Diversity of international energy suppliers	Low (HHI = 3,622)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	0.18	Rate of transmission and distribution losses (%)	3.0
CO_2 intensity (kCO_2 per US$)	0.25	GHG emission growth rate 2000 – 2013 (%)	-0.9

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



FORMER YUGOSLAV REPUBLIC OF MACEDONIA (FYROM)

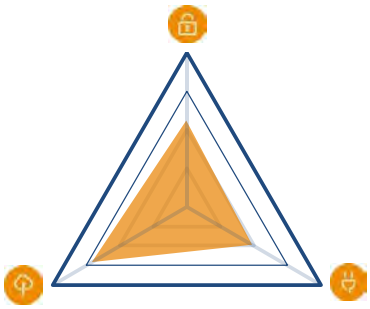
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

60

SCORE

BCB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**70**	**65**	**60**	▲	**BCB**
Energy performance					
Energy security	66	53	56	▶	B
Energy equity	78	79	81	▶	C
Environmental sustainability	63	60	37	▶	B
Contextual performance	64	61	57	▶	

TRENDS AND OUTLOOK

- FYROM moves up 5 places in this year's Index to rank 60. Whilst exhibiting a good performance in the environmental sustainability and energy security dimensions, energy equity scores remain low, resulting in a balance score of BCB.
- Electricity is produced in the country via two thermal plants with a capacity of 800 MW, as well as several large and small hydro power plants with a total capacity of 650 MW. Total annual production of electricity in 2016 satisfied around 82% of domestic electricity needs, providing about 70% of the country's electricity needs. The government is investigating building a 150 MW coal power plant in the eastern part of the country, as well as building new gas fired power plants. The country is in the process of gradually liberalising the electricity market, with the current period of 2016-2020 seeing an additional 158 legal entities joining the previous 271 companies.
- FYROM is currently in the process of constructing an internal gas distribution network, with a total of 204 km of pipeline costing over €150 million to be built over a four year period. The section from Klecovce to Stip was completed in 2016, with construction of Stip-Negotino and Negotino-Bitola pipelines still under development. The gas capacity into FYROM is via one pipeline and is owned by Russia, and the government has expressed interest in building natural gas interconnections with Greece and Bulgaria in an effort to diversify its supply through connections to the Trans-Adriatic Pipeline (TAP) or by building liquefied natural gas (LNG) terminals in Greece.
- In 2007 and 2008 the Energy Regulatory Commission (ERC) adopted a series of rulebooks regarding the use of feed-in tariffs for purchase of electricity from different renewable energy sources, however large-scale use of renewables has not yet occurred in FYROM. Nevertheless, the government is encouraging investment in renewables, including large and small-scale hydro, and is investigating extending concessions for constructing small-scale hydro along parts of the Vardar River.

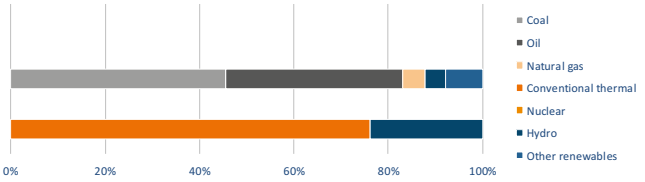
Industrial sector (% of GDP)	26.6	GDP per capita, PPP US$ (GDP Group)	15,121 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 2,527)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	43 | 83
Household electricity prices (US$/kWh)	0.08	Rate of transmission and distribution losses (%)	12.5
CO_2 intensity (kCO_2 per US$)	0.31	GHG emission growth rate 2000 – 2013 (%)	-0.6

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



FRANCE

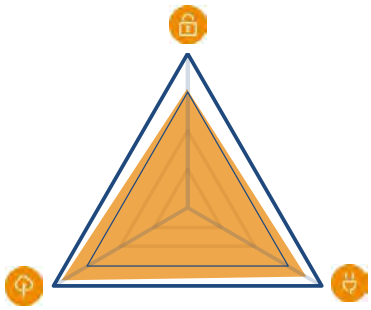
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

8

SCORE

AAA



	2015	2016	2017	Trend	Score
Overall rank and balance score	**9**	**6**	**8**	▶	**AAA**
Energy performance					
Energy security	21	16	25	▶	A
Energy equity	12	9	13	▶	A
Environmental sustainability	13	11	6	▶	A
Contextual performance	22	19	21	▶	

TRENDS AND OUTLOOK

- France remains in the top 10 this year, ranking 8 overall. An excellent prioritisation of trilemma dimensions – where it performs particularly well in environmental sustainability - results in a very well-balanced score of AAA.
- France has very little domestic oil and natural gas production and relies heavily on imports. To reduce import dependency, France has pursued a vigorous policy of nuclear power development since the mid-1970s, and now has by far the largest nuclear generating capacity of any country in Europe, and is second only to the United States worldwide. Nuclear power constitutes approximately 79% of total electricity generation.
- Recent energy policies include measures and targets to improve energy efficiency, boost renewable power and tackle climate change. The government recently passed a new energy transition law with the aim of cutting France's reliance on nuclear energy in favour of renewables. The legislation includes the commitment to increase the target price of carbon to €56 per ton in 2020 and €100 per ton in 2030.The government has also revised social tariffs for electricity and gas to counteract the increase in energy prices.
- Key challenges for France come with the implementation phase of its policies and efforts must go towards meeting the targets set. The coexistence of regulated tariffs and market prices for electricity could also cause friction for producers.

KEY METRICS

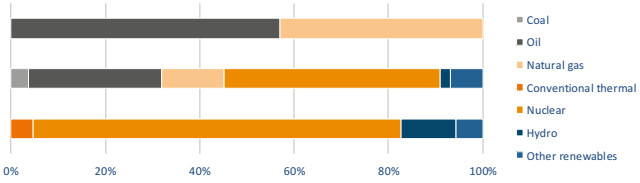
Industrial sector (% of GDP)	19.5	GDP per capita, PPP US$ (GDP Group)	41,466 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 747)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	0.20	Rate of transmission and distribution losses (%)	7.7
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2000 – 2013 (%)	-1.5

ENERGY PROFILE

Fossil fuel reserves: 19 Mtoe

Total primary energy supply composition

Diversity of electricity generation



GERMANY

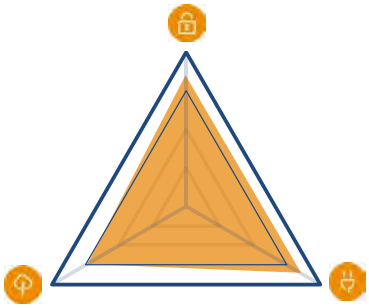
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

6

SCORE

AAB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**5**	**5**	**6**	▶	**AAB**
Energy performance					
Energy security	6	7	12	▶	A
Energy equity	22	15	17	▶	A
Environmental sustainability	29	31	32	▶	B
Contextual performance	16	15	16	▶	

TRENDS AND OUTLOOK

- Dropping by 1 place, Germany maintains a place in the top 10 at number 6. The country balances the trilemma dimensions very well, giving an overall balance score of AAB.
- The German Energy Transition, initiated before 2010, targets sustainability and focuses on a strong increase in power generation from renewable sources, a reduction of primary energy usage and CO_2 emissions. The 2011 decision to phase out nuclear by 2022 constitutes a challenge to Germany's energy mix. Nine out of 17 facilities have been shut down to date and the remaining eight nuclear power plants will be phased out gradually over the next five years. Due to low wholesale prices and regulatory uncertainty, investors are reluctant to invest in new conventional power plants, which will still be needed to secure energy demand.
- For an increased share of renewables, the Renewable Energy Law (EEG) guarantees a fixed price, independent of demand and supply for renewable power plants. In 2016 the decision to transform the electricity market in Germany from a feed-in-tariff based system towards a bidding process for green power producers represented an important change, aiming at a more economical and affordable transition. The government also enacted a new law on market design to further develop the energy-only market instead of implementing a capacity market. Nevertheless, tools such as a grid and capacity reserve were installed to ensure security of supply. Renewable energies and their integration into the existing system will represent the major challenge in energy politics for the new government elected in September 2017. Policymakers must set the right framework towards a free and efficient European electricity market to limit the burden.

KEY METRICS

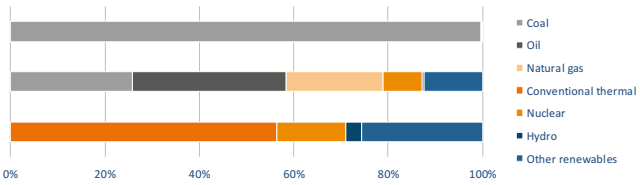
Industrial sector (% of GDP)	30.5	GDP per capita, PPP US$ (GDP Group)	48,730 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,364)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	0.33	Rate of transmission and distribution losses (%)	4.6
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000 – 2013 (%)	-0.7

ENERGY PROFILE

Fossil fuel reserves: 28,355 Mtoe

Total primary energy supply composition

Diversity of electricity generation



GHANA

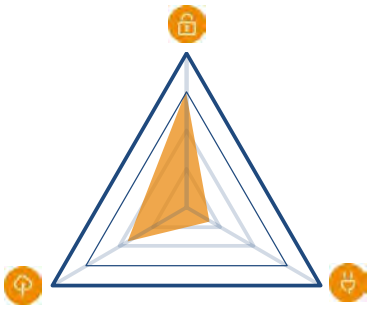
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

96

SCORE

ADC



	2015	2016	2017	Trend	Score
Overall rank and balance score	**97**	**99**	**96**	▶	**ADC**
Energy performance					
Energy security	36	35	28	▶	A
Energy equity	105	106	106	▶	D
Environmental sustainability	78	81	76	▶	C
Contextual performance	83	91	82	▶	

TRENDS AND OUTLOOK

- Ghana improves by 3 spots this year, rising from rank 99 in 2016 to rank 96 in 2017. Whilst performing excellently in energy security, environmental sustainability and energy equity in particular remain weak. This results in an overall balance score of ADC.
- In order to improve energy security, energy equity and environmental sustainability Ghana needs to address a number of related challenges, including: 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; 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

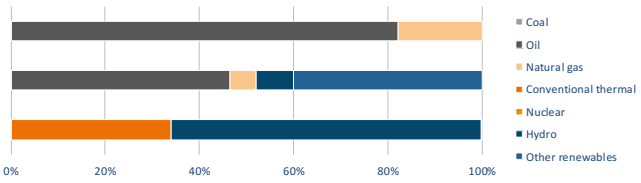
Industrial sector (% of GDP)	27.6	GDP per capita, PPP US$ (GDP Group)	4,294 (IV)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Low (HHI = 2,715)
Population with access to electricity (%)	78	Access to clean cooking in rural | urban areas (%)	4 | 29
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	23.6
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2000 – 2013 (%)	7.3

ENERGY PROFILE

Fossil fuel reserves: 109 Mtoe

Total primary energy supply composition

Diversity of electricity generation



GREECE

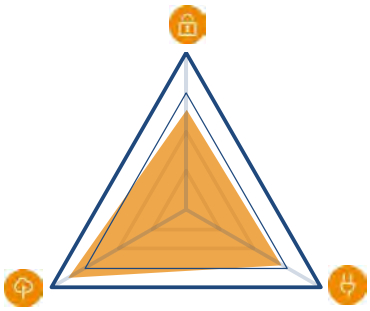
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

29

SCORE

BBA



	2015	2016	2017	Trend	Score
Overall rank and balance score	**37**	**33**	**29**	▲	**BBA**
Energy performance					
Energy security	77	56	42	▲	B
Energy equity	46	44	48	▶	B
Environmental sustainability	23	19	18	▶	A
Contextual performance	48	46	53	▶	

TRENDS AND OUTLOOK

- Greece continues its trend of rising 4 places each year, where it ranked 37 in 2015, to rank 29 overall in 2017. The country continues to balance the energy trilemma well, with noticeable improvement seen in the energy security dimension, resulting in a 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, which currently accounts for 40% of power generation. If successful, such plans can help to improve the country's energy security and environmental sustainability trilemma performance.
- A new 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. Only 7 MW of new PV was installed in the first half of 2015. To revive the stalled 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).
- The Government is obstructing the liberalisation of the energy market, maintaining control of the national electricity company − the Public Power Corporation (PPC), owner of the national transmission system operator.

KEY METRICS

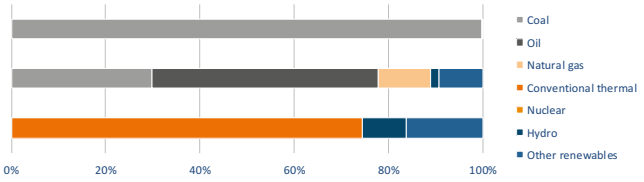
Industrial sector (% of GDP)	15.7	GDP per capita, PPP US$ (GDP Group)	26,783 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 1,633)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	0.21	Rate of transmission and distribution losses (%)	7.5
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2000 – 2013 (%)	-1.9

ENERGY PROFILE

Fossil fuel reserves: 2,109 Mtoe

Total primary energy supply composition

Diversity of electricity generation



HONG KONG

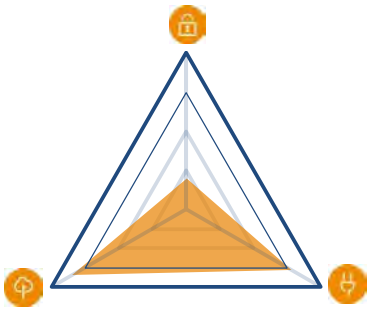
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

34

SCORE

DAA



	2015	2016	2017	Trend	Score
Overall rank and balance score	**40**	**37**	**34**	▶	**DAA**
Energy performance					
Energy security	121	117	111	▲	D
Energy equity	29	31	32	▶	A
Environmental sustainability	20	20	22	▶	A
Contextual performance	8	7	10	▶	

TRENDS AND OUTLOOK

- Hong Kong improves by 3 places in this year's Index, where it ranked 37 in 2016, to rank 34 in 2017. Whilst receiving excellent scores in both energy equity and environmental sustainability dimensions, it performs poorly in energy security, resulting in an imbalanced trilemma score of DAA.
- The economy has scarce indigenous energy sources and approximately 25% of electricity is imported. To secure a clean and reliable electricity supply, Hong Kong signed a Memorandum of Understanding (MOU) on energy cooperation with mainland China in August 2008, guaranteeing supply of nuclear energy and an enhanced supply of natural gas. The successful completion and commissioning of the Hong Kong Branch Line of the Second West−East Natural Gas Pipeline has helped ensure a stable and secure supply of natural gas from the mainland for power generation. The government has put in place a contingency plan for oil in the event of disruption. A code of practice has also been put in place that requires major oil companies to maintain a minimum of 30 days' supply of gas oil and naphtha.
- In the 1990s, natural gas for electricity generation was introduced for diversity of supply. Moreover, with the introduction of LPG vehicles in 2000, LPG has been used as a fuel for more than 20,000 taxis and light buses.
- With the 2013 Clean Air Plan for Hong Kong, the Government has implemented a series of measures to improve air quality.

KEY METRICS

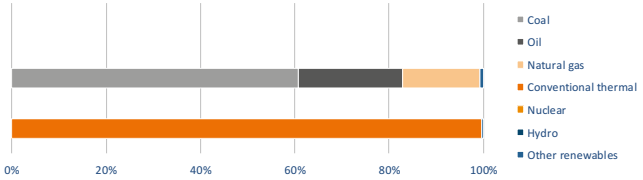
Industrial sector (% of GDP)	7.3	GDP per capita, PPP US$ (GDP Group)	58,553 (I)
Energy intensity (koe per US$)	0.03	Diversity of international energy suppliers	Low (HHI = 2,530)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	N.A. | N.A.
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	9.4
CO_2 intensity (kCO_2 per US$)	0.13	GHG emission growth rate 2000 – 2013 (%)	N.A.

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



HUNGARY

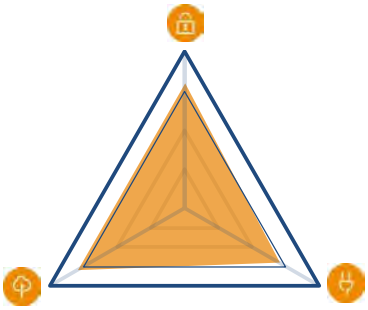
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

27

SCORE

ABA



	2015	2016	2017	Trend	Score
Overall rank and balance score	**15**	**21**	**27**	▶	**ABA**
Energy performance					
Energy security	10	17	19	▶	A
Energy equity	27	26	50	▶	B
Environmental sustainability	25	25	27	▶	A
Contextual performance	37	43	50	▶	

TRENDS AND OUTLOOK

- Hungary drops 6 places this year to rank 27. Hungary balances the trade-offs of the energy trilemma well, although lags behind slightly in energy equity, resulting in a balance score of ABA.
- Published in 2012, the Hungarian government has developed a National Energy Strategy to 2030 focusing on reducing the country's energy dependency by: 1) improving energy-efficiency measures throughout the supply and consumption chain; 2) increasing the share of low-carbon electricity generation; 3) maintaining existing nuclear capacity; 4) construction of international connections and closer integration with the Central European electricity and gas networks; and 5) renewing the government's energy institutions.
- Hungary regularly outperforms its targets for shares of renewable energy as set out under EU guidelines, with biomass for the use of heat and power being a main driver. Solar power increased from 1 GWh in 2010 to 186 GWh in 2015; however, an amendment to the energy law in 2016 stunts penetration of wind by banning the construction of turbines within a 12 km radius of populated areas. Nuclear power provides the majority of Hungary's electricity, and in March 2017 the European Commission cleared investment for an agreement that was reached with the Russian Federation to build two nuclear reactors of 1,200 MW. The reactors are expected to be operational in 2025 and 2026.
- Key areas policymakers continue to focus on are: 1) energy efficiency, through renovation of existing building stock to reduce energy consumption for heating and cooling; 2) electricity market regulation, through inclusion of capacity payment mechanisms, to cover long-term marginal costs of power plants as [wholesale] electricity prices fall.

KEY METRICS

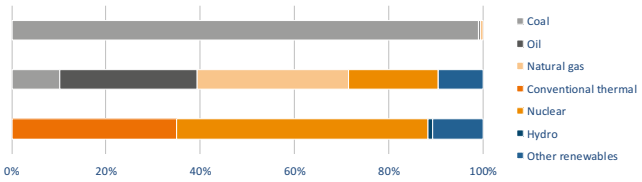
Industrial sector (% of GDP)	31.9	GDP per capita, PPP US$ (GDP Group)	26,681 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Medium (HHI = 2,195)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 84
Household electricity prices (US$/kWh)	0.14	Rate of transmission and distribution losses (%)	9.0
CO_2 intensity (kCO_2 per US$)	0.23	GHG emission growth rate 2000 – 2013 (%)	-2.3

ENERGY PROFILE

Fossil fuel reserves: 21,169 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ICELAND

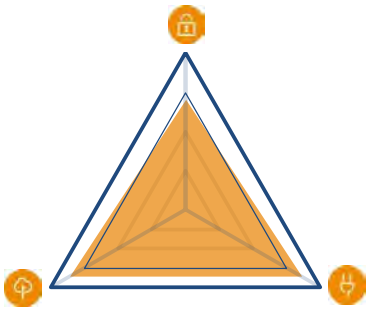
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

14

SCORE

BAA



	2015	2016	2017	Trend	Score
Overall rank and balance score	**12**	**15**	**14**	▶	**BAA**
Energy performance					
Energy security	54	57	33	▶	B
Energy equity	17	19	16	▶	A
Environmental sustainability	2	2	21	▶	A
Contextual performance	17	17	17	▶	

TRENDS AND OUTLOOK

- Iceland improves by 1 place this year to rank 14 overall. Iceland exhibits a good performance across all trilemma dimensions, resulting in a balance score of BAA.
- With a big share of renewables, Iceland currently does not have a spot market for electricity. Prices are negotiated via a power purchase agreement (PPA). State-owned Landsvirkjun is by far the largest energy company in Iceland, providing approximately 75% of all the electricity produced in Iceland (12.6 GWh annually). Landsvirkjun is responsible for more than 96% of all hydro generation, and 11% of the total geothermal output. 80% of electricity Landsvirkjun generates is sold to energy intensive industries via long-term contracts. The remaining 20% is bought by public utilities and the Icelandic Transmission System Operator (TSO).
- According to the National Renewable Energy Action Plan for 2020 (NREAP), electricity generation from geothermal power plants is expected to increase by 12% from 5.24 TWh in 2014 to 5.8 TWh in 2020, which corresponds to about 80 MW installed electrical capacity. Recently, the possibility emerged of exporting electricity − via HVDC submarine cables − to mainland Europe.

KEY METRICS

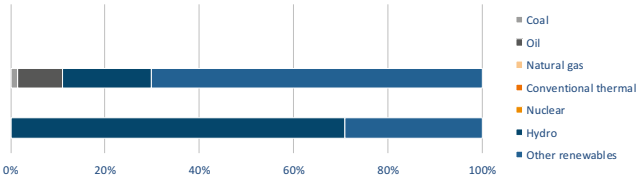
Industrial sector (% of GDP)	22.7	GDP per capita, PPP US$ (GDP Group)	51,399 (I)
Energy intensity (koe per US$)	0.22	Diversity of international energy suppliers	Medium (HHI = 2,437)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	2.8
CO_2 intensity (kCO_2 per US$)	0.16	GHG emission growth rate 2000 – 2013 (%)	-0.5

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



INDIA

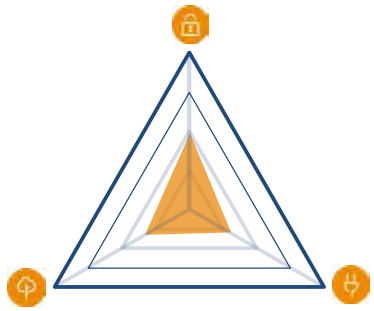
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

92

SCORE

CCC



	2015	2016	2017	Trend	Score
Overall rank and balance score	**92**	**91**	**92**	▶	**CCC**
Energy performance					
Energy security	60	51	66	▶	C
Energy equity	93	93	96	▶	C
Environmental sustainability	96	97	92	▶	C
Contextual performance	105	100	86	▲	

TRENDS AND OUTLOOK

- With a drop of 1 place this year, India ranks 92 overall. The country performs equally on all dimensions resulting in a balance score of CCC.
- India's Intended Nationally Determined Contributions (INDCs) include; reduction of emission intensity of GDP by 33−35 % by 2030 from 2005 levels; approximately 40% cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030, with the help of technology transfer and low-cost international finance from the Green Climate Fund (GCF); creation of additional carbon sink of 2.5-3 billion tonnes of CO_2 through additional forest cover by 2030.
- Recent policy directions and impacts include: 1) goal to reduce crude oil import dependence by 10% by 2022 via increasing domestic production through unified E&P policy under HELP, new fuel efficiency standards effective from April 2017, promotion of EVs (all new cars to be electric by 2030), and new biofuel policy; 2) raise the share of gas in the energy mix to 15% by 2022; 3) increase RE power capacity to 175 GW by 2022 and 275 GW by 2027; 4) new hydro policy; 5) interventions under UDAY improving DISCOMS; 6) on track for 100% village electrification by 2018; 7) EPAR compliance being implemented; 8) gradual phasing out of subsidies for kerosene with targeted subsidy via DBT; 9) second cycle of PAT for industrial energy efficiency and SEEP for super-efficient appliances; 10) DSM through large-scale replacement by LEDs; 11) smart cities.
- Key challenges include: 1) integrating large RE capacity 2) Regulations and policies keeping pace with technology; 3) improving operational performance of DISCOMS; 4) growth in manufacturing through Make-in India; 5) clean energy for all.

KEY METRICS

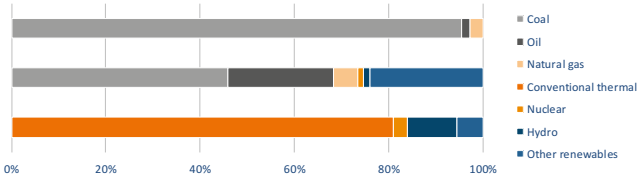
Industrial sector (% of GDP)	29.6	GDP per capita, PPP US$ (GDP Group)	6,572 (III)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 782)
Population with access to electricity (%)	79	Access to clean cooking in rural | urban areas (%)	12 | 87
Household electricity prices (US$/kWh)	0.08	Rate of transmission and distribution losses (%)	19.9
CO_2 intensity (kCO_2 per US$)	0.30	GHG emission growth rate 2000 – 2013 (%)	5.2

ENERGY PROFILE

Fossil fuel reserves: 44,262 Mtoe

Total primary energy supply composition

Diversity of electricity generation



INDONESIA

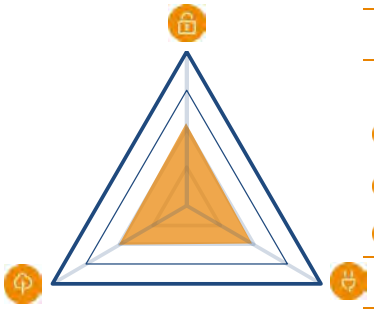
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

75

SCORE

BCB



	2015	2016	2017	Trend	Score
Overall rank and balance score	**82**	**85**	**75**	▶	**BCB**
Energy performance					
Energy security	57	63	59	▶	B
Energy equity	87	88	82	▶	C
Environmental sustainability	81	77	68	▲	B
Contextual performance	77	77	83	▶	

TRENDS AND OUTLOOK

- Indonesia improves by 10 places this year to rank 75. It performs well for both energy security and environmental sustainability, but lags behind slightly when it comes to energy equity, resulting in a balance score of BCB.
- 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 to support social and economic development. The total subsidies in Indonesia were estimated at US$ 27.7 billion in 2014, or around 3% GDP, which is almost 6% of the total global subsidies in the same year.
- The National Energy Presidential Decree No. 5, 2006 on National Energy Policy that guides Indonesia's long-term energy goals was revised in October 2014 setting new targets, including a mix of oil (25%), gas (22%), coal (30%) and new and renewable energy (23%) by 2025. Indonesia is also currently in the third stage of its 20-year National Long-Term Development Plan that lasts from 2005-2025. Targets for this include a renewable energy share of 23% in total primary energy supply by 2025, and at least a 31% share by 2050. A draft National Electricity General Plan (RUKN) for 2015-2034 also includes a renewable electricity capacity target of 45 GW by 2025, with hydropower expecting to have the largest share at 21 GW, followed by geothermal, solar PV, bioenergy, ocean and wind.
- Key issues policymakers need to continue to focus on include: 1) removing energy subsidies; 2) intensifying the efforts to increase the use of new and renewable energy through research and development, pilot projects, providing incentives, capacity building; 3) embed low-carbon and carbon-free technologies in the long-term energy plan; 4) increase energy efficiency on supply and demand sides; and 5) attract more investments to the energy sector.

KEY METRICS

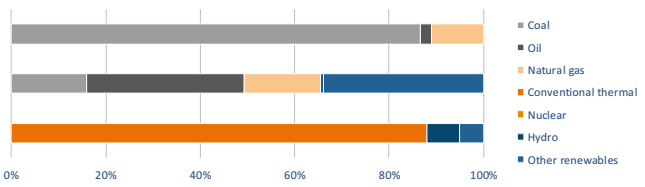
Industrial sector (% of GDP)	40.	GDP per capita, PPP US$ (GDP Group)	11,612 (III)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	Medium (HHI = 1,814)
Population with access to electricity (%)	97	Access to clean cooking in rural | urban areas (%)	29 | 88
Household electricity prices (US$/kWh)	0.11	Rate of transmission and distribution losses (%)	9.8
CO_2 intensity (kCO_2 per US$)	0.19	GHG emission growth rate 2000 – 2013 (%)	2.8

ENERGY PROFILE

Fossil fuel reserves: 22,536 Mtoe

Total primary energy supply composition

Diversity of electricity generation



IRAN (ISLAMIC REPUBLIC)

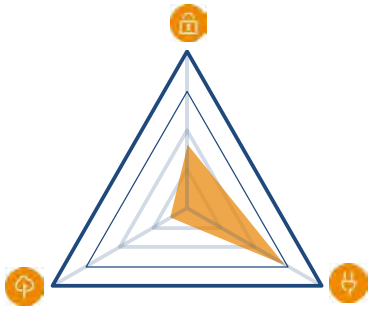
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

81

SCORE

CBD



	2015	2016	2017	Trend	Score
Overall rank and balance score	**80**	**78**	**81**	▶	**CBD**
Energy performance					
Energy security	81	58	79	▶	C
Energy equity	37	40	40	▶	B
Environmental sustainability	118	119	119	▶	D
Contextual performance	107	105	90	▶	

TRENDS AND OUTLOOK

- Iran drops by 3 places this year to rank 81. A good score for energy equity is offset by poor performance in energy security and environmental sustainability, resulting in a balance score of CBD.
- Home of the world's fourth largest proven 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, and now exceed 2 million barrels per day.
- In addition, 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 approximately 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

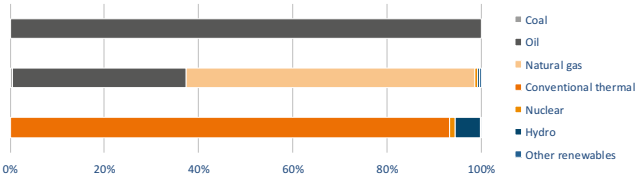
Industrial sector (% of GDP)	24.5	GDP per capita, PPP US$ (GDP Group)	17,366 (II)
Energy intensity (koe per US$)	0.14	Diversity of international energy suppliers	High (HHI = 1,336)
Population with access to electricity (%)	99	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	11.2
CO_2 intensity (kCO_2 per US$)	0.52	GHG emission growth rate 2000 – 2013 (%)	4.3

ENERGY PROFILE

Fossil fuel reserves: 21,433 Mtoe

Total primary energy supply composition

Diversity of electricity generation



IRAQ

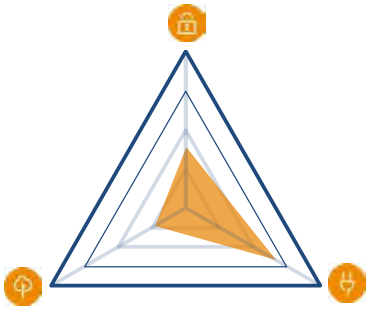
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

80

SCORE

CBD



	2015	2016	2017	Trend	Score
Overall rank and balance score	**69**	**74**	**80**	▶	**CBD**
Energy performance					
Energy security	59	64	83	▶	C
Energy equity	54	53	58	▶	B
Environmental sustainability	92	100	103	▶	D
Contextual performance	118	118	111	▶	

TRENDS AND OUTLOOK

- Iraq drops 6 places this year to rank 80. A drop in energy security results in a letter grade of C, whilst environmental sustainability remains the weakest scoring dimension, resulting in a balance score of CBD.
- The Iraqi energy sector is still completely owned by the public sector, and is nearly totally dependent on oil and gas revenues for electricity generation, transportation and distribution. The sector is still facing the challenge of the highly expensive and destructive war against ISIS terrorists, and also the very low oil prices, and hence very limited government revenues. Moreover, the continued disputes with the Kurdistan Regional Government (KRG) reduce oil/gas production and export and hence annual federal revenues are not clearly defined.
- Other minor challenges include rising energy demand internally and also improvement of environment protection legislations. Iraq is tackling these challenges through diversification of economic resources, and through better exploitation of gas and gas-linked industry. In addition, it is intended that a good portion of the revenues will be invested in the non-energy economy, including industry, agriculture, trade, transport and education.
- Improvement of energy efficiency has priority in the recently updated renewable and energy strategy. The national target is for renewable energy to exceed 5% of total electricity production by 2030.

KEY METRICS

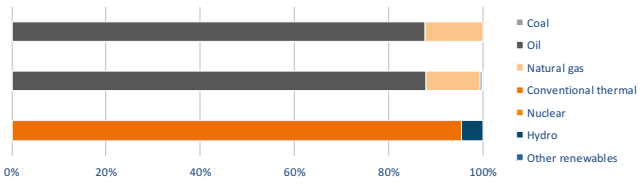
Industrial sector (% of GDP)	63.8	GDP per capita, PPP US$ (GDP Group)	17,353 (II)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Low (HHI = 4,052)
Population with access to electricity (%)	99	Access to clean cooking in rural | urban areas (%)	95 | 100
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	43.8
CO_2 intensity (kCO_2 per US$)	0.31	GHG emission growth rate 2000 – 2013 (%)	3.7

ENERGY PROFILE

Fossil fuel reserves: 22,014 Mtoe

Total primary energy supply composition

Diversity of electricity generation



IRELAND

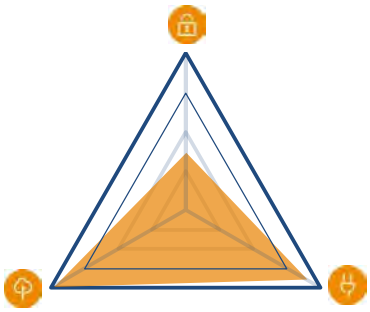
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

20

SCORE

CAA



	2015	2016	2017	Trend	Score
Overall rank and balance score	**19**	**20**	**20**	▶	**CAA**
Energy performance					
Energy security	75	77	85	▶	C
Energy equity	16	16	10	▶	A
Environmental sustainability	10	7	2	▶	A
Contextual performance	11	10	6	▶	

TRENDS AND OUTLOOK

- Ireland maintains its position at rank 20 this year, where it performs particularly well in environmental sustainability, being placed 2nd globally. An excellent score for energy equity, combined with a somewhat weak score in energy security results in a balance score of CAA.
- In 2014, Ireland imported 85% of its energy needs. At the same time, total primary energy use in Ireland fell by 0.5%. Fossil fuels accounted for 90% of all energy used in Ireland, with oil remaining as the dominant fuel source (47%), followed by gas (28%), coal (9%), renewable energy (8%) and peat (6%), with the balance (2%) 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.
- 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

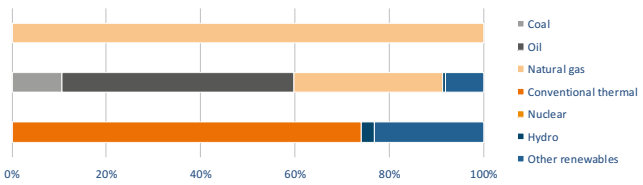
Industrial sector (% of GDP)	41.7	GDP per capita, PPP US$ (GDP Group)	68,883 (I)
Energy intensity (koe per US$)	0.04	Diversity of international energy suppliers	Low (HHI = 4,314)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	0.27	Rate of transmission and distribution losses (%)	7.4
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2000 – 2013 (%)	-1.5

ENERGY PROFILE

Fossil fuel reserves: 8 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ISRAEL

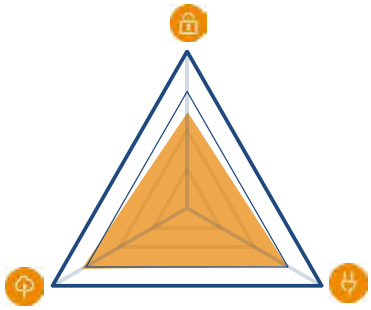
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

26

SCORE

BBA



	2015	2016	2017	Trend	Score
Overall rank and balance score	**34**	**34**	**26**	▶	**BBA**
Energy performance					
Energy security	85	85	49	▶	B
Energy equity	35	36	36	▶	B
Environmental sustainability	37	29	28	▶	A
Contextual performance	24	22	23	▶	

TRENDS AND OUTLOOK

- Israel improves its position by 8 places this year, rising to 26. An improvement in energy security results in a well-rounded trilemma profile of BBA, with Israel performing particularly well regarding environmental sustainability.
- The discovery of offshore natural gas reserves and underground oil shale, and the subsequent beginning of exploration will change the country's energy landscape, as Israel relies heavily on fossil fuel imports to meet its growing energy needs. As a country that has been largely dependent on imports to meet its needs, these reserves are critical to the country's energy security.
- Recent policy developments 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)	37,901 (I)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	High (HHI = 1,110)
Population with access to electricity (%)	100	Access to clean cooking in rural | urban areas (%)	100 | 100
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	3.2
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2000 – 2013 (%)	1.8

ENERGY PROFILE

Fossil fuel reserves: 165 Mtoe

Total primary energy supply composition

Diversity of electricity generation