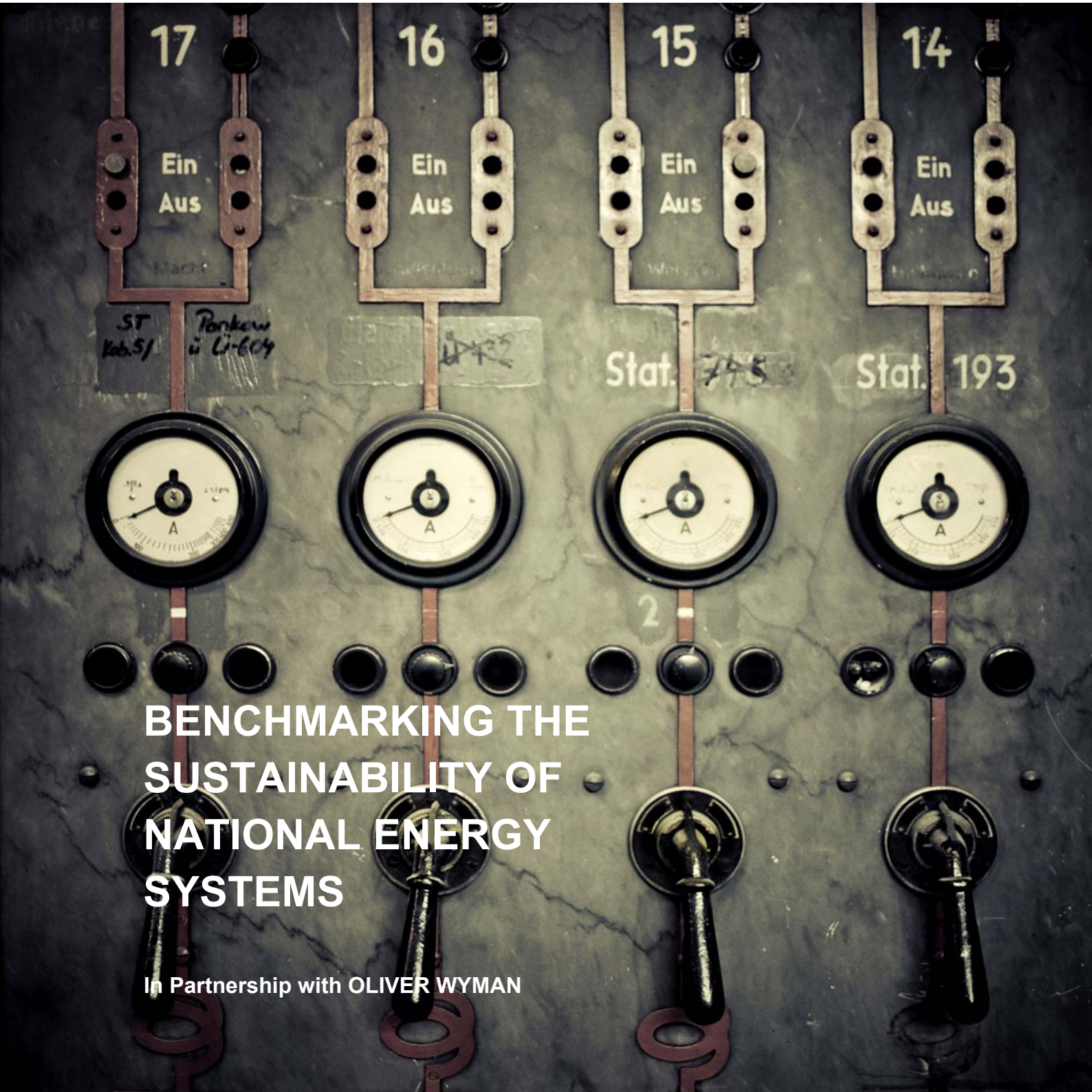
WORLD ENERGY COUNCIL

World Energy Trilemma Index | 2016



BENCHMARKING 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

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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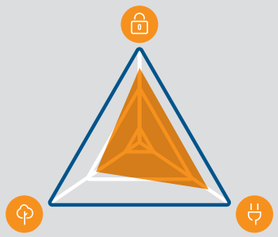
WORLD ENERGY TRILEMMA INDEX 2016: REGIONAL OVERVIEWS

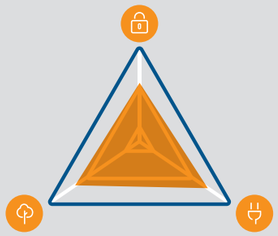
COUNTRY PERFORMANCE

Top 25%	25% – 50%	50% – 75%	Lower 25%	n/a

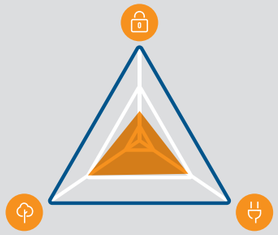
NORTH AMERICA

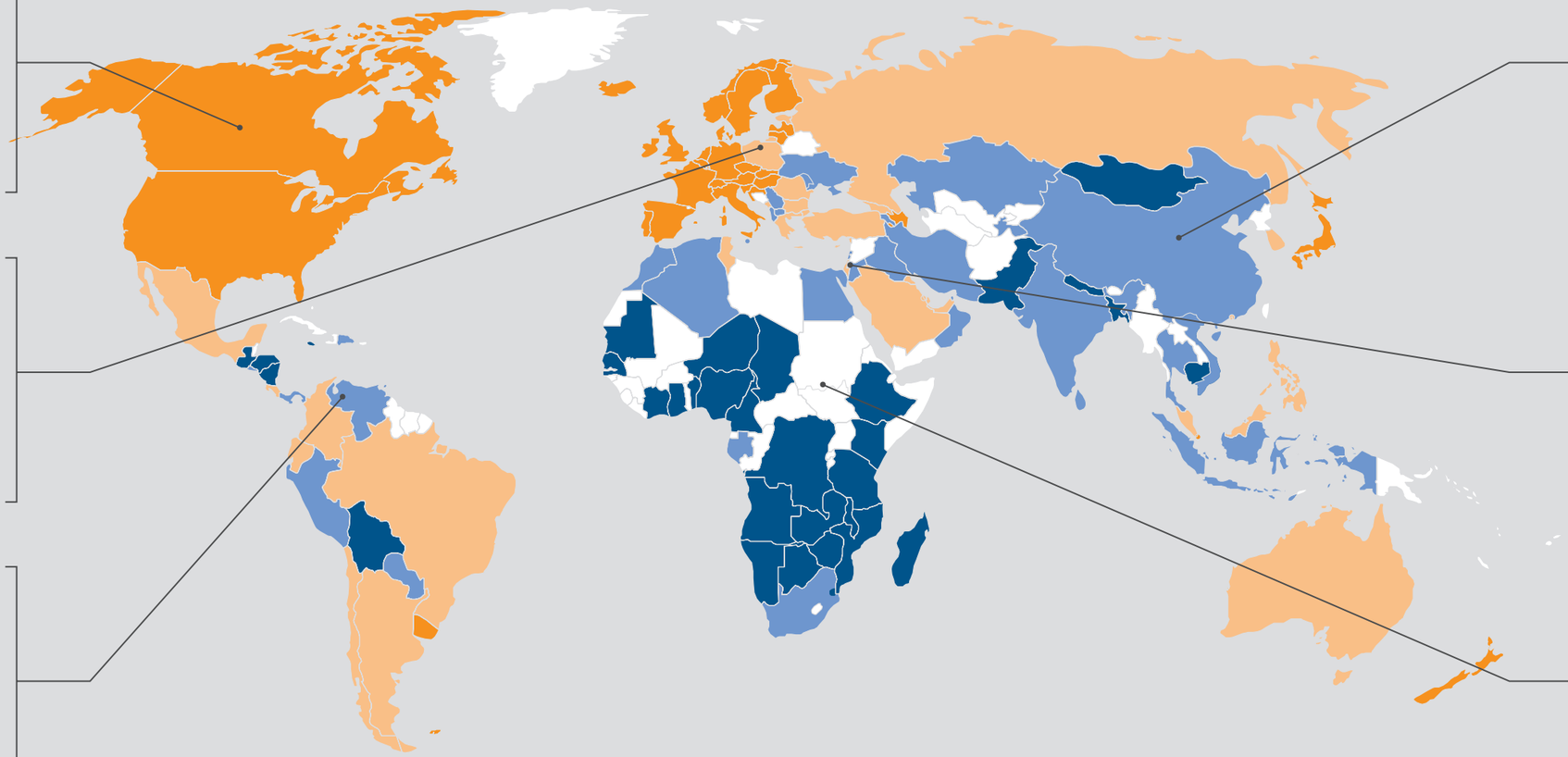


EUROPE

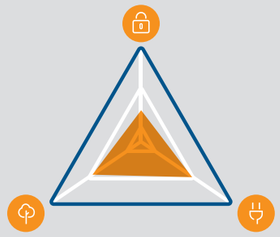


LATIN AMERICA AND CARIBBEAN

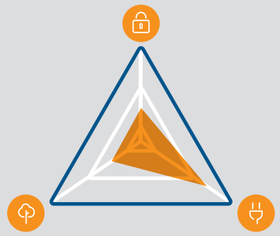




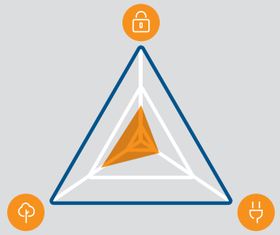
ASIA



MIDDLE EAST AND NORTH AFRICA



SUB-SAHARAN AFRICA



NORTH AMERICA
STRUGGLES WITH AGEING INFRASTRUCTURE AND EXTREME WEATHER

With 14% of total global greenhouse gas emissions stemming from North America, the region must improve environmental sustainability and update ageing energy infrastructure to strengthen resilience to emerging risks, including extreme weather events and cyber attacks.

Environmental sustainability is expected to improve significantly due to emission reduction measures such as the development of carbon capture, usage and storage technologies, and further diversification of the energy mix.

EUROPE
MANAGING THE ENERGY TRANSITION

Although European countries lead the 2016 Index, the region still faces the challenge of managing the energy security and affordability risks resulting from the energy transition.

To maintain a strong Trilemma performance, policymakers must focus on energy market design, regional markets, demand management, and designing an effective carbon price to successfully manage the challenging energy transition.

LATIN AMERICA AND THE CARIBBEAN
BUILDING RESILIENCE AND ENERGY EQUITY

The Latin America and Caribbean region must work on improving and maintaining its energy security by increasing the energy system's resilience to extreme weather events and improving energy equity.

Diversifying the energy supply with low-carbon sources such as solar and wind and increasing regional interconnection will be key to securing reliable supply. However, large-scale investments are required to finance the development of resilient energy infrastructure.

ASIA
DECREASING IMPORT DEPENDENCE IN THE FACE OF GROWING DEMAND

Asia faces the challenge of facilitating sustainable growth of its highly energy-intensive, emerging economies while managing increasing energy demand and growing energy import dependence.

Improvements on all three trilemma dimensions are possible by increasing the use of renewable energy sources, and by decreasing import dependence through reliable trade relationships and improved infrastructure.

MIDDLE EAST AND NORTH AFRICA
DIVERSIFYING AWAY FROM OIL AND GAS

The main challenges for the Middle East and North Africa (MENA) are high energy intensity, greenhouse gas emissions, and use of finite fossil fuel reserves. Combined with water scarcity concerns, these challenges, if not addressed, could threaten the region's energy security and environmental sustainability.

Many MENA countries are focused on improving energy efficiency and diversifying their economies and energy mixes through an increased use of solar and nuclear power. Significant changes to the region's trilemma performance are likely to show towards the 2020s and 2040s.

SUB-SAHARAN AFRICA
UNLOCKING RESOURCES AND RENEWABLES POTENTIAL

Sub-Saharan Africa is challenged by the world's lowest levels of energy access and commercial energy use, despite a rich endowment in resources and high renewables potential.

Stable and widely accessible energy supply could act as a catalyst for regional economic development. To unlock the region's resource potential and meet future energy demand, the region must attract investment, build institutional capacity and improve its grid and off-grid energy supply.

EXECUTIVE SUMMARY

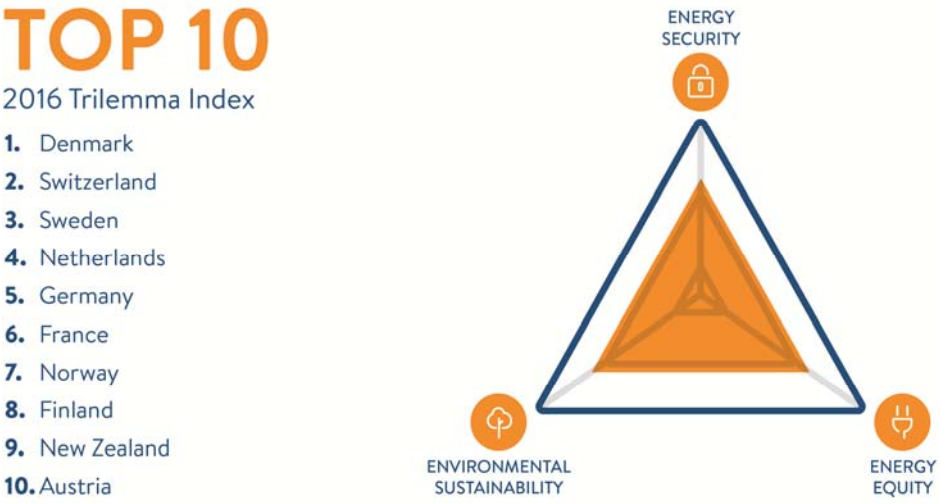
The World Energy Council's definition of energy sustainability is based on three core dimensions: energy security, energy equity, and environmental sustainability. The Energy Trilemma Index ranks countries' energy performance around the world and provides a framework to benchmark progress.

The 2016 Energy Trilemma Index reveals signs of progress on all dimensions of the energy trilemma. Thirteen of the 125 countries assessed achieve a triple-A score. 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 5% to 85% and 74% since 2000. Meanwhile, cleaner forms of energy are being used to support energy access and economic growth, with renewables making up 9.7% of total primary energy consumption 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 energy consumption, which is predicted to increase by up to 46% by 2060.

This year Denmark, Switzerland and Sweden top the Index, 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.

FIGURE 1: TOP 10 COUNTRIES IN THE ENERGY TRILEMMA INDEX 2016



Source: World Energy Council/Oliver Wyman, 2016

Introduction

ABOUT THE ANNUAL ENERGY TRILEMMA INDEX

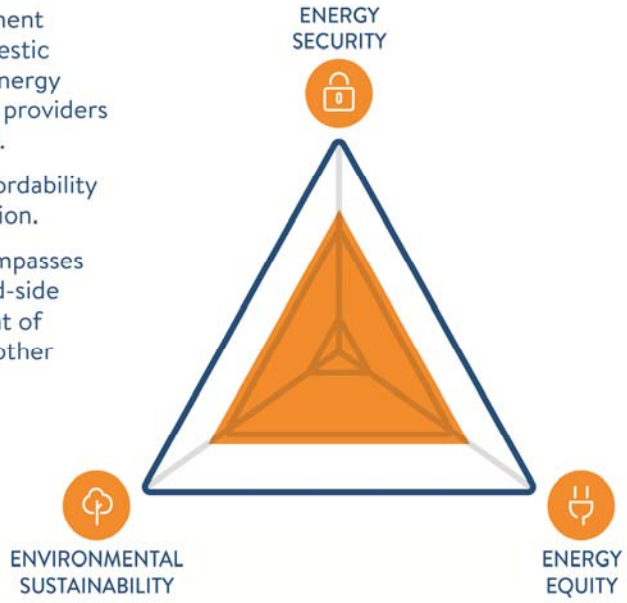
The World Energy Council's definition of energy sustainability is based on three core dimensions – energy security, energy equity, and environmental sustainability. Taken together, they constitute a 'trilemma', and achieving high performance on all three entails complex interwoven links between public and private actors, governments and regulators, economic and social factors, national resources, environmental concerns, and individual behaviours.

FIGURE 2: THE THREE DIMENSIONS OF THE ENERGY TRILEMMA

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

Energy equity: Accessibility and affordability of energy supply across the population.

Environmental sustainability: Encompasses achievement of supply- and demand-side energy efficiencies and development of energy supply from renewable and other low-carbon sources.



Source: World Energy Council/Oliver Wyman, 2016

The Energy Trilemma Index quantifies the energy trilemma and comparatively ranks 125 countries 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 triple-A 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 research, development and demonstration (RD&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.

Included in this Index report are:

- 2016 Energy Trilemma Index rankings and balance scores
- 2016 watch list
- Regional profiles by key geographies
- Energy Trilemma profiles for World Energy Council member countries[1]

As countries have unique resource endowments, 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 or economic peer group comparisons. For the deeper Index analysis, countries were organised in four economic groups:

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

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 and compare countries'

[1] The World Energy Trilemma Index report only features country profiles for the World Energy Council's member countries for which sufficient data is available.

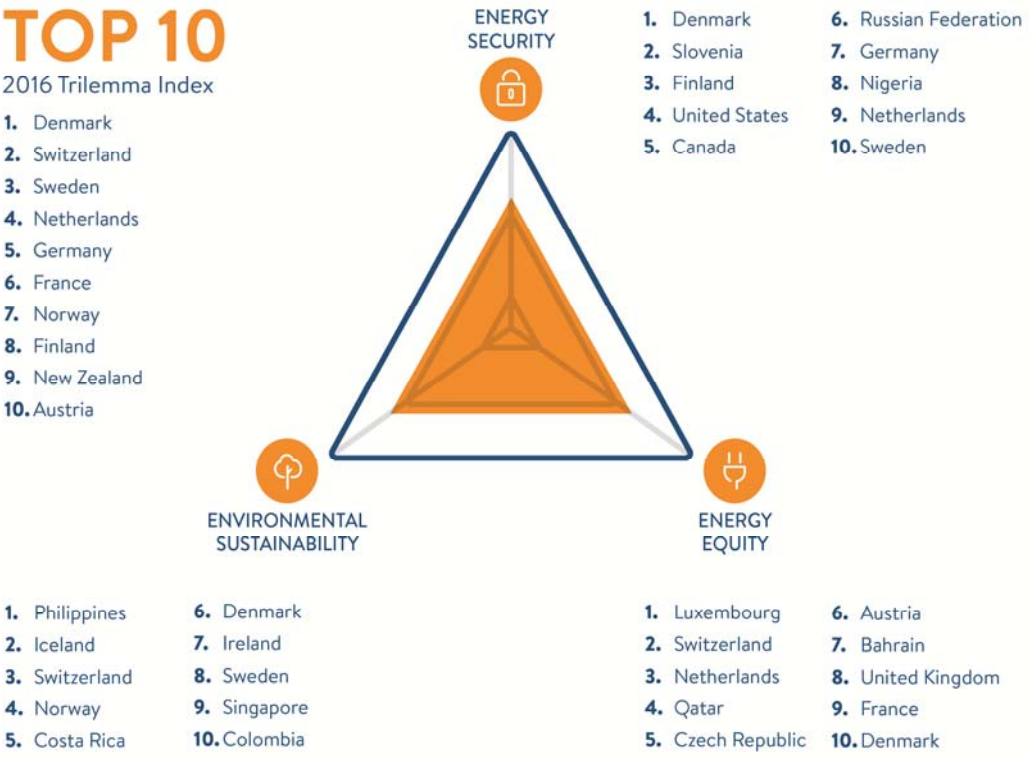
performance against other countries. The pathway calculator allows users to identify what it takes to improve the energy trilemma performance. The tool can be accessed at: www.worldenergy.org/data.

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 and business leaders to support investment decisions.

OVERVIEW OF THE 2016 ENERGY TRILEMMA INDEX RANKINGS AND BALANCE SCORE

This year's top 10 ranked countries are all European, except New Zealand, and are led by Denmark at rank 1. Eight of the top 10 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 among energy security, energy equity, and environmental sustainability. This is demonstrated, for example, through Europe's long-term, balanced energy policy, particularly the European Union's energy and climate policies to 2020, which have contributed to the region's success on the trilemma.

FIGURE 3: TOP 10 ENERGY TRILEMMA INDEX PERFORMERS OVERALL AND PER DIMENSION



Source: World Energy Council/Oliver Wyman, 2016

However, the complex trade-offs that are inherent in energy policymaking, 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 122nd in energy security and 103rd in environmental sustainability due to its small geographic area and resulting limitations on the availability and diversity of energy resources and generation capacity. Countries like Luxembourg will therefore have to redouble their efforts to find solutions tailored to address their specific situation and weaknesses, such as regional integration as a path to greater energy security, as 'typical solutions', which may apply to larger, resource-endowed countries, are unlikely to succeed here.

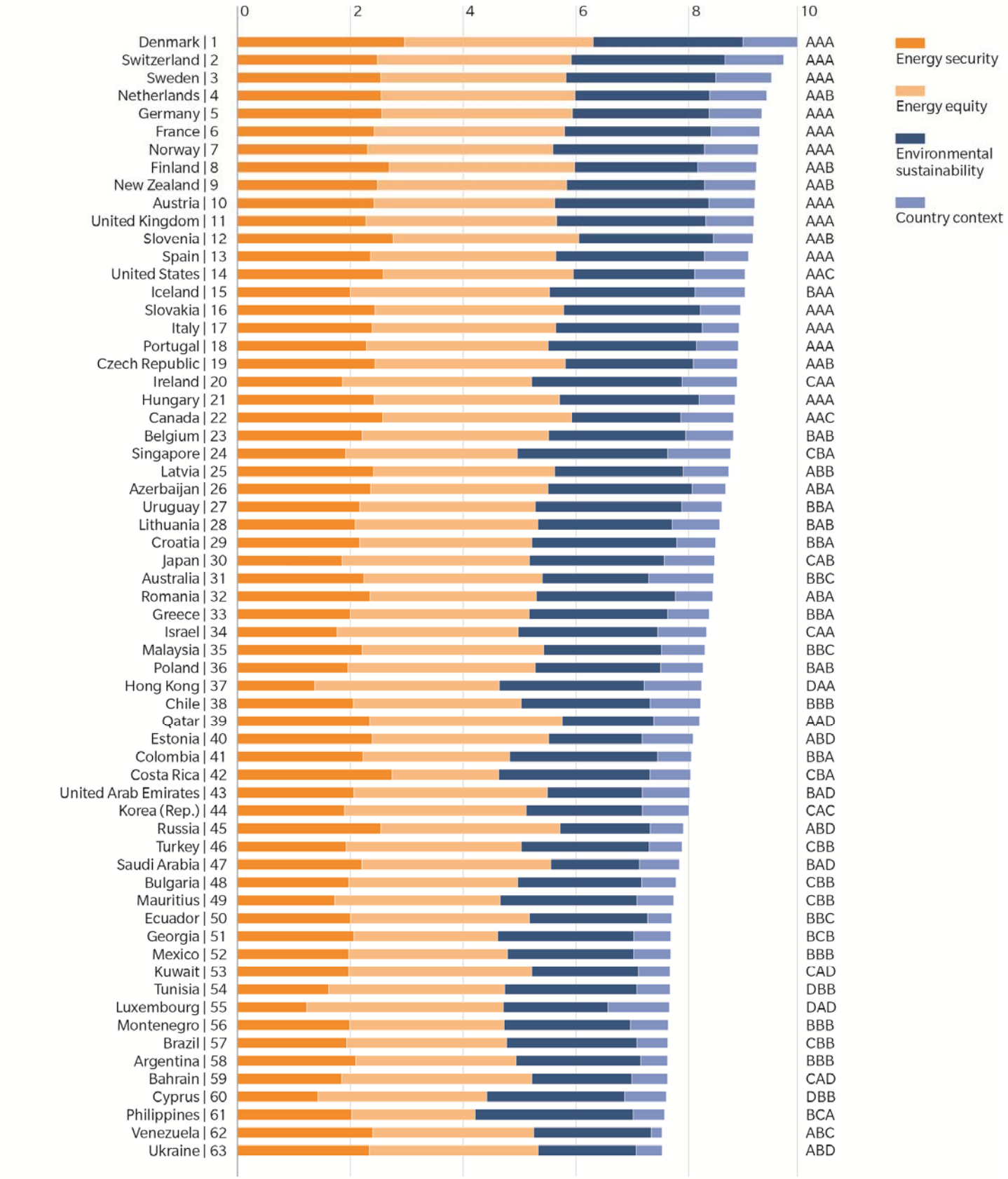
Conversely, the top-10 in environmental sustainability is dominated by states that are able to take advantage of their renewable energy potential such as the Philippines, Iceland and Colombia, which all have high geothermal or hydropower capacities. A significant challenge to these countries, however, is to avoid over-reliance on one single energy source, which could potentially hamper the resilience of the energy system and with that energy security. The top-10 in environmental sustainability moreover shows that resource availability is not the only pre-requisite to achieve top scores for environmental sustainability. Successfully harnessing the renewables potential also requires a sound institutional framework that facilitates research and coherent policymaking and implementation.

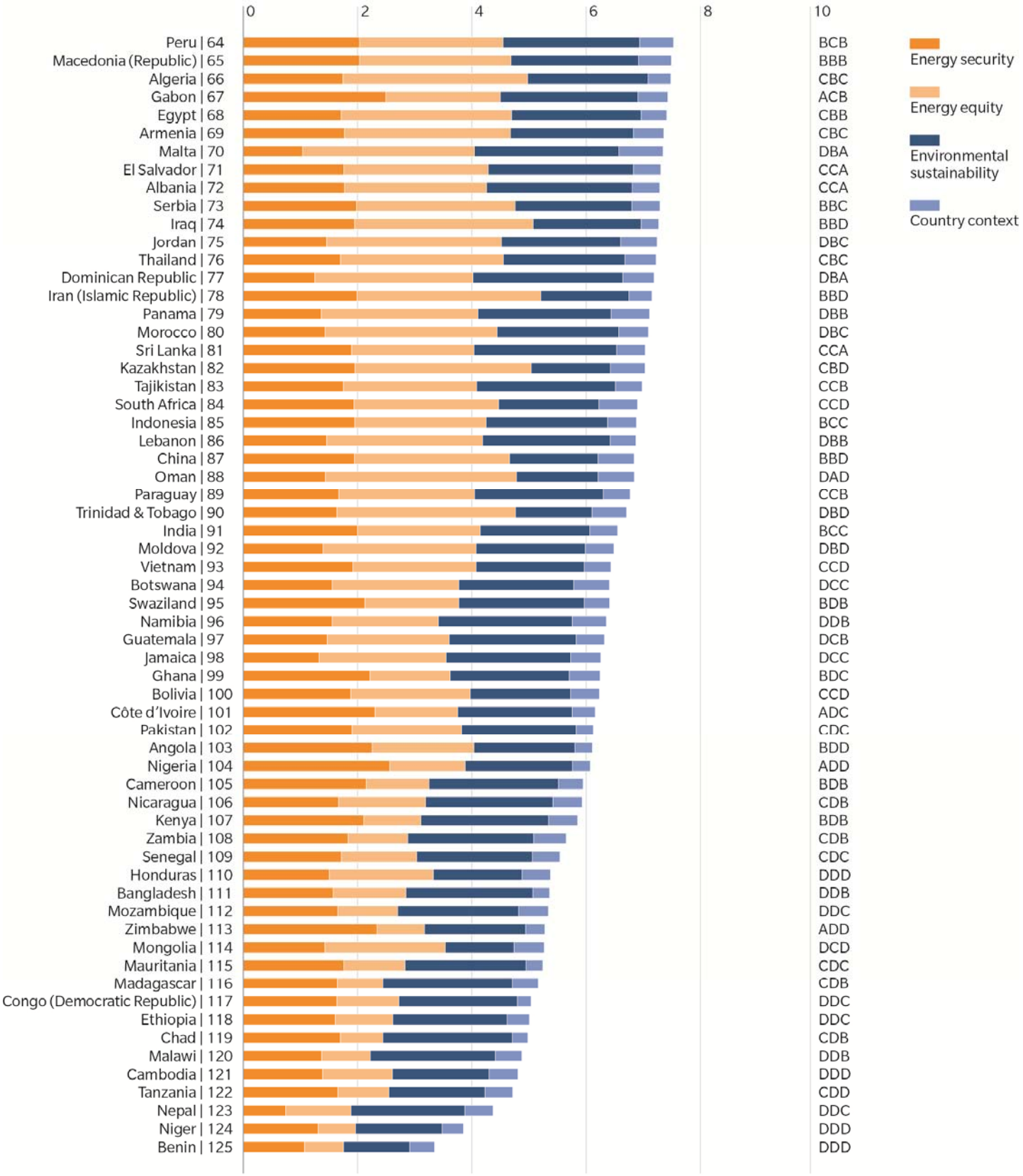
An analysis of selected key metrics used in this index shows that globally, there are signals that countries are building more sustainable energy systems by concurrently addressing energy security, energy equity and environmental sustainability challenges.

Among the countries included in the Index, access to electricity and clean cooking have both increased by 5% to 85% and 74% respectively since 2000. At the same time, global CO_2 intensity has been decreasing from 0.33 tCO_2/US$ in 2000 to 0.27 tCO_2/US$ in 2014. Together these figures 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 to support economic growth.

In addition, 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.

2016 ENERGY TRILEMMA INDEX AND BALANCE SCORES




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

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. Total primary energy consumption has been increasing from 2.2 quadrillion Btu in 2008 to 2.4 quadrillion Btu in 2012. Globally, efforts to increase resource productivity and manage energy demand growth will be key in ensuring a balanced energy trilemma going forward.

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.

TABLE 1: 2016 ENERGY TRILEMMA INDEX – POSITIVE WATCH LIST

Country	Rank	Score	Developments to watch
Chile	38	BBB	• Rapid growth of solar energy production • Planned infrastructure improvements
United Arab Emirates	43	BAD	• First nuclear power plant to come online in 2017 • Green growth strategy • Phasing out of gas and electricity subsidies
Ecuador	50	BBC	• Rapid expansion of hydroelectric power sector
Mexico	52	BBB	• Liberalisation of oil and gas markets • Transition to low-carbon economy
Philippines	61	BCA	• Energy Reform Plan to strengthen all three trilemma dimensions • Government is exploring the possibility of nuclear power generation
Bolivia	100	CCD	• Expansion of export capacity • Stepping up efforts to explore new gas resources and attract investment

Source: World Energy Council/Oliver Wyman, 2016

Positive watch list

The following countries remain on the Council's positive watch list (see Table 1):

- Even though the **United Arab Emirates (rank 43, BAD)** is well endowed with oil and natural gas reserves, the country is making major investments in low-carbon energy solutions. This includes the construction of the Barakah nuclear power plant, the first part of which is to come online in 2017.[2] The UAE's first green growth plan sets further targets for demand reduction, energy efficiency, and renewable energy, including the construction of a 1 GW solar park.[3] The elimination of subsidies for petrol and diesel from August 2015, as well as plans to further eliminate subsidies on electricity and gas are expected to rationalise fuel consumption, protect natural resources and the environment, and support state finances.[4] These developments have the potential to improve the UAE's performance in the energy security and environmental sustainability dimensions but may reduce energy equity scores.

- **Mexico (rank 52, BBB)** continues to pursue the liberalisation of its energy market, most recently publishing a plan to develop a fully competitive natural gas market by 2018.[5] New market rules further aim to promote energy efficiency and set a target of achieving 35% clean energy by 2024.[6] 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 improvement and expansion of the country's infrastructure is still needed.[7] However, the country's overall energy trilemma performance is expected to improve as the reforms continue to be implemented.

- The **Philippines (rank 61, BCA)** has recently introduced the Philippine Energy Reform Plan (PEP) 2012−2030, which commits the country to strengthening all three dimensions of the Energy Trilemma. Comprising over 30% of the energy mix, most of the country's renewable energy is currently generated through geothermal and hydropower, and investment in wind and solar energy could help to further increase the share of renewables in the energy mix and enhance energy security.[8] In further pursuit of this end, the country has most recently started exploring the option of generating nuclear power.[9]

[2] Emirates Nuclear Energy Corporation (ENEC): About Our Nuclear Plants (www.enec.gov.ae/)
[3] Beeantna: Building Inclusive Green Economies: The UAE approach, www.beeatna.ae
[4] Carpenter C and Khan S, 2015: U.A.E. Removes Fuel Subsidy as Oil Drop Hurts Arab Economies (Bloomberg, 22 July 2015); Kane F, 2016: UAE to Cut Remaining Energy Subsidies, Minister Says (The National, 23 January 2016)
[5] King and Spalding, 2016: Client Alert: Development of competitive natural gas market in Mexico
[6] Dezem V, 2016: Mexico Sets National target of 5% Renewable Energy by 2018 (Bloomberg, 31 March 2016)
[7] Clemente J, 2016: Mexico's Ever Growing Natural Gas Market (Forbes, 02 July 2016)
[8] Tan Hui Ann C, 2016: The Philippines' Renewable Energy Sector is Booming (and It Could Get Bigger) (CNBC, 09 August 2016)
[9] Cruz E, 2016: Philippines May Open Mothballed Marcos-era Nuclear Power Plant (Reuters, 30 August 2016); Republic of the Philippines Department of Energy, 2016: Philippines to Host Nuclear Energy Conference, www.doe.gov.ph

The following countries have been added to the Council's positive watch list in 2016 (see Table 1):

- **Chile (rank 38, BBB)** made headlines in June as its high supply of solar energy led to a drop in consumer prices to zero in certain areas on several occasions this year.[10] While this exemplifies Chile's role as the largest producer of renewable energy in South America, it also illustrates serious systemic difficulties, as continued oversupply will be detrimental to investment. The main challenge faced by Chile is thus to expand the capacity of its infrastructure and adapt to the intermittency of solar and wind power to keep up with its rapid growth in renewable energy production. In particular, the northern and southern electricity grids of the country need to be connected for a more effective distribution. A project to do just that is underway and expected to be completed by 2017. If successful, Chile's renewable energy expansion could strengthen all three trilemma dimensions in the country.

- **Ecuador (rank 50, BBC)** is undergoing a major shift towards renewable energy, with eight new hydroelectric power plants to come 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.

- Following the 2006 nationalisation of **Bolivia's (rank 100, CCD)** oil and gas sector, the country now plans to significantly increase its export capacity to become the 'Energy Heart of South America'.[11] To achieve this, Bolivia plans to triple its energy supply by 2020. This will entail the challenges of stepping up exploration efforts, improving supply infrastructure, and attracting new investment. Considering Bolivia's vast gas resources, this project could add significantly to the equity of access and energy security dimensions of the trilemma in Bolivia as well as the entire region.

[10] Dezem V and Quiroga J, 2016: Chile Has So much Solar Energy It's giving It Away For Free (Bloomberg, 02 June 2016)
[11] Wilson J, 2015: Bolivia Wants to Become the Energy Heart of South America (Financial Times, 26 October 2015)

TABLE 2: 2016 ENERGY TRILEMMA INDEX – NEGATIVE WATCH LIST

Country	Rank	Score	Developments to watch
Germany	5	AAA	• Continuing high cost of the energy transition • Reform in renewables support scheme
United Kingdom	11	AAA	• Energy security concerns and an uncertain regulatory regime impact investments in nuclear and gas sector • Political events create uncertainty around climate and energy policy
United States	14	AAC	• Ageing transmission infrastructure and impending coal-fired power plant retirements • Increased frequency of extreme weather events
Japan	30	CAB	• Continuation of high import dependence • Political, legal, and administrative barriers to diversification
Brazil	57	CBB	• Droughts affecting hydroelectricity generation • Sharp increase in energy prices
South Africa	84	CCD	• Continuing struggle with power shortages • Maintenance efforts by main utility creates difficulties for independently produced renewable energy to enter the market

Source: World Energy Council / Oliver Wyman, 2016

Negative watch list

The following countries remain on the negative watch list (see Table 2):

- While **Germany's (rank 5, AAA)** overall ranking has improved, it remains on the Council's negative watch list as it continues to be affected by the impacts of the plan to transition Germany's energy system, which includes goals of increasing power generation from renewable sources, a reduction of primary energy usage and CO_2 emissions, as well as the phase-out of nuclear power by 2022 (14% of the electricity generation mix in 2014).[12] However, a reform of the legislation for renewables support, to come into force in 2017, shifting from feed-in tariffs (FITs) to market-based support mechanisms, may impact the speed of this transition. Further, Germany's energy equity performance has seen a decline over the past years as energy services became more expensive due to renewable energy subsidies being

[12] Appunn K, 2016: Germany's Energy Consumption and Power Mix in Charts (Clean Energy Wire, 09 June 2016)

levied. Further changes in energy security and environmental sustainability are expected in future evaluations.

- The **United Kingdom (rank 11, AAA)** continues to face significant challenges in securing energy supply. Plans to close the UK's remaining coal plants are being put into question by the country's decision to leave the EU, as a potential exit from the single market could significantly increase the cost of its energy imports. The government recently agreed to the planned construction of a nuclear reactor at Hinkley Point after a prolonged debate on cost and energy security concerns. However, investment uncertainty remains due to planned changes to the regulation of foreign ownership of critical infrastructure. Moreover, the recent sharp decrease in FITs for wind and solar power may hinder investments in these sectors, impacting the country's goal to further diversify its energy supply and improve environmental sustainability. The newly established Department for Business, Energy and Industrial Strategy, which replaces the Department of Energy and Climate Change, may however provide more clarity for future energy investments.

- Despite an improvement in its overall ranking, the **United States (rank 14, AAC)** faces a key challenge in addressing its ageing energy transmission, storage, and distribution systems, as highlighted by the Department of Energy's Quadrennial Energy Review.[13] While there have been initiatives 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.[14] In addition, 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.[15] This poses challenges to the country's energy security over the coming years despite the expected increase in the country's energy exports. Moreover, the markedly different approaches to climate and energy policy of the two leading parties in the upcoming 2016 presidential election further add an element of political uncertainty to the sector.

- The government of **Japan (rank 30, CAB)** is pursuing a strategy of diversifying its energy supply, which, since the accident at Fukushima, has been comprised overwhelmingly of fossil fuels. The new strategy will include increasing the share of renewables to 13−14% and the share of nuclear energy to 10−11% of the national primary energy supply by 2030.[16] To this effect, three of the country's nuclear reactors are back online, while the resumption of energy production at other reactors has so far been delayed due to time-consuming examinations by the Nuclear Regulation Authority, political difficulties and legal challenges.[17]

[13] Conca J, 2015: It Really Is Our Aging infrastructure (Forbes, 21 May 2015)
[14] US Department of Energy, 2016: Energy Secretary Ernest Moniz Calls for Increased Investment to Enhance US Energy Emergency Response
[15] EIA, 2011: Age of Electric Power Generators Varies Widely, 16 June 2011
[16] Japanese Ministry of Economy, Trade and Industry, 2015: Long-term Energy Supply and Demand Outlook
[17] Stapczynski S, 2016: Japan Reactor Restart Signals Latest Step in Nuclear Rebirth

- The capacity of **South Africa's (rank 84, CCD)** energy system has improved over the past year due to increasing investment in infrastructure maintenance and fossil fuels, and the frequency of blackouts has decreased. However, the country still struggles to diversify its energy sources, with the majority of its electricity still being supplied by Eskom through fossil fuels.[18] 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. Unless these residual issues are addressed, South Africa's sustainability score is unlikely to improve.

In 2016, Brazil was added to the Council's negative watch list:

- **Brazil (Rank 57, CBB)**, which produces over 70% of its total energy through hydroelectric power, has recently experienced a severe drought, lasting from 2014 until late 2015. This has negatively impacted many of the country's hydroelectric facilities.[19] Another concern is the sharp rise in energy prices by 50% in 2015, with further increases expected in the future. Policymakers have to find ways to render the country's energy sector more resilient to extreme weather events and pursue policies to guarantee energy security and equity of access.

AN ENERGY SECTOR IN TRANSITION: THE 2016 ENERGY TRILEMMA INDEX IN CONTEXT

Every country has opportunities to improve its energy performance, regardless of whether they are ranked first or last. However, the energy sector is at a transition point and improving energy performance will prove to be challenging. In addition, energy services must expand to meet rising global energy demand in many emerging economies and provide more than 1 billion people with needed access to modern energy services. Energy infrastructure needs to be expanded using low-carbon technologies while energy security and reliability must be maintained and strengthened in a context of increasing risks and resilience challenges posed by running legacy systems. At the same time new business models to tackle these challenges are becoming more prominent, which will require new approaches to market designs and regulation.

Energy industry and energy leaders have been implementing changes and making strides to meet these challenges. To meet energy and climate goals, governments must enact and continue to push the evolution of energy policies and financing solutions that support rapid transitions and expansion of energy infrastructure.

The *2016 World Energy Trilemma: Defining measures to accelerate the energy transition*, the companion report to this Index, identified five focus areas to drive progress on the

(Bloomberg, 11 August 2016); Harding R, 2016: Japan's Nuclear Restart Stymied by Courts (Financial Times, 06 April 2016)

[18] Cohen M and Burkhardt P, 2015: What is South Africa Doing to Tackle Its Electricity Crisis? (Bloomberg, 08 September 2015)

[19] Leahy J, 2015: São Paulo Drought Raises Fears of Brazil Energy Crisis (Financial Times, 11 February 2015)

energy trilemma and offers guidance in the complex task of translating the trilemma goals of energy security, energy equity and environmental sustainability into tangible actions.

The five focus areas are derived from a review of the findings of the past five trilemma reports and Trilemma Index trends over the same time period as well as a wide assessment of country energy strategies.

Five focus areas to accelerate the energy transition

Drawing on case studies and interviews with energy leaders, this 2016 report identifies five focus areas necessary to make progress on the energy trilemma:

1. TRANSFORMING ENERGY SUPPLY. Policymakers and decision makers must set clear and straightforward energy targets and build a broad consensus for the transition in energy supply and demand. This process must include new entrants to the energy sector and early engagement with affected communities. Taking an adaptive approach by launching pilot projects and regularly analysing policy effectiveness is crucial for the successful delivery and implementation of policies.

2. ADVANCING ENERGY ACCESS. Many emerging and developing economies continue to struggle to expand energy infrastructures to support advanced energy security, reliability and access. To increase private sector investments in infrastructure expansion and modernisation, countries are reforming regulatory frameworks to decrease the cost of doing business, and to increase competitiveness in the electricity market. In tandem, distributed generation through solar and wind renewables is bringing energy access to rural and remote communities that cannot currently be cost-effectively connected to the grid.

Solely expanding energy access infrastructure is not enough. Countries must look to a range of innovative mechanisms that enable affordable access for people to utilise the benefits of modern energy for income-generating activities. Innovative mechanisms include pay-as-you-go business models and mobile banking solutions to promote the take-up of renewable-powered energy services.

3. ADDRESSING AFFORDABILITY. Many countries with lower gross domestic products (GDPs) and low rankings on the energy equity dimension are struggling to ensure energy affordability while financing or creating the investment conditions to support energy infrastructure expansion. Over the short term, subsidies can be vital for lower-income consumers and for supporting social and economic programmes. Energy subsidies can be costly to deploy, are contentious to remove, and tend to decrease overall performance on the energy trilemma over the long term. The case studies in 2016 World Energy Trilemma report demonstrate how long-term subsidies can erode the profitability of utilities, stall improvements in energy infrastructure and stimulate inefficient energy use.

4. IMPROVING ENERGY EFFICIENCY AND MANAGING DEMAND. Energy efficiency and managing energy demand continue to be globally perceived as top action priorities with huge potential for improvement. As highlighted through the case studies in the companion report, cost savings alone are often insufficient to stimulate the adoption of energy efficiencies or behaviours.

Policymakers must align the interests of asset owners, users and regulators, and continue to implement a combination of energy efficiency standards, performance ratings, labelling programmes and incentives. They must also increase awareness across all industrial sectors, and encourage consumers to continue to focus on greater energy efficiency.

5. DECARBONISING THE ENERGY SECTOR. The groundbreaking conclusion of COP 21 added increasing momentum to the global transition to low-carbon energy. Dynamic and flexible renewable energy investment policies are the key to responding to evolving market dynamics and technological developments. Meeting COP 21 climate goals will require a clear path to a meaningful carbon price signal and changes beyond the energy sector and across the economy. Governments have a role in building the necessary consensus for change.

Recommendations

There are lessons emerging from innovative and tried-and-tested policies to overcome barriers and make progress on the energy trilemma:

Policy matters: Policy choices, and creating a regime to support a robust energy sector, are critical to lasting energy trilemma performance regardless of a country's resources or geographic location.

Time matters: Policies and investments intended to change energy supply and demand at a national level will take time and will likely be disruptive. Countries must act now to progress on the trilemma with secure, equitable and environmentally sustainable energy to support a thriving energy sector, a competitive economy and a healthy society.

Other recommendations include:

- Improved coordination and looking beyond the energy sector to meet climate change goals is critical.
- Policymakers should provide clarity to the market with succinct and aligned signals when devising policy strategies in order for investors to assess their commitments against long-term trends.
- Governments need to be strongly supportive of private sector investment in research, innovation and development.
- A change-management approach in communicating policies and setting expectations should be adopted to take into account technology changes and any setbacks that may occur in the future to avoid stakeholder backlash.
- Desired transitions in the energy sector must be accompanied and stimulated by transitions in regulatory frameworks. 'Energy 2.0' must be enabled by 'regulations 2.0'.

Regional profiles

REGIONAL 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 past the country level. A comparison of key metrics across geographical regions and GDP groups (see Table 3) illustrates this point.

TABLE 3: COMPARISON OF KEY METRICS ACROSS GEOGRAPHICAL REGIONS AND GDP GROUPS

Geographical region	GDP per capita, PPP US$	Instustrial sector (% of total GDP)	Population with access to electricity (%)	Access to clean cooking in rural areas (%)	Access to clean cooking in urban areas (%)	Household electricity prices (US$/kWh)	Diversity of international energy suppliers (HHI)	Energy intensity (koe per US$)	CO_2 intensity (kCO_2 per US$)	Rate of transmission and distribution losses (%)	GHG emission growth rate 2010 – 2014 (%)
Asia	21,313	31.1	88	46	75	0.11	2,284	0.09	0.29	10.7	3.9
Europe	32,390	25.4	100	75	85	0.22	2,499	0.09	0.28	8.9	0.0
Lat. Am. & Caribbean	13,203	31.7	92	54	85	0.12	3,678	0.08	0.24	14.5	3.4
Middle East & N. Africa	37,417	46.2	97	94	95	0.12	2,325	0.08	0.35	12.1	4.7
North America	39,141	27.8	100	84	95	0.20	4,223	0.10	0.35	10.2	0.3
Sub-Saharan Africa	5,628	26.2	37	16	50	0.08	3,794	0.15	0.18	16.2	3.8
GDP group											
Group I	54,608	31.9	98	88	88	0.24	2,078	0.08	0.26	6.4	1.1
Group II	22,818	32.0	97	76	87	0.18	2,998	0.08	0.32	10.7	1.8
Group III	10,999	31.1	89	47	83	0.11	3,117	0.09	0.29	13.1	3.2
Group IV	3,360	24.7	47	13	49	0.08	3,463	0.16	0.19	18.1	4.3
Global average	**22.937**	**30.1**	**84**	**57**	**78**	**0.18**	**2,920**	**0.10**	**0.27**	**11.9**	**2.5**

Source: World Energy Council/Oliver Wyman, 2016

As shown in the World Energy Trilemma reports, energy leaders have emphasised the need to examine opportunities to adopt regionally coordinated approaches to energy resources, infrastructure and regulation. However, the disparities between and within regions make this a difficult task.

This section presents regional energy trilemma balances and performances. In addition, with reference to the World Energy Council's Scenarios to 2060, it outlines the trilemma challenges and opportunities each region will face going forward.

The World Energy Scenarios identify three possible routes through a Grand Transition to 2060: Modern Jazz, Hard Rock and Unfinished Symphony.

The Grand Transition refers to the world's energy evolution through to 2060. While there are many uncertainties in this transition, there are a number of known, strong trends that will fundamentally change the world's energy system. Regardless of the selected energy scenario, the trends of the Grand Transition will lead to a world in 2060 with:

- a significantly lower population and slower global labour force growth
- a range of new energy technologies
- a greater appreciation of the planet's environmental boundaries
- a shift in economic and geopolitical power towards Asia.

There are three possible paths for the energy sector during this transition:

Modern Jazz: The world of 2060 has a diverse set of resilient and lower carbon energy systems. There is a complex, competitive and efficient market landscape that promotes the open access to information, innovation and the rapid deployment of new technologies.

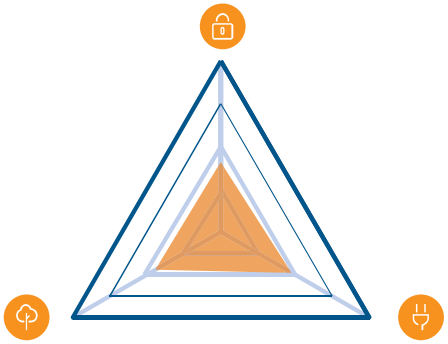
Unfinished Symphony: The world of 2060 has a global, integrated and resilient low carbon energy system. Global institutions and national governments support enabling technologies and there is unified action on security, environmental and economic issues.

Hard Rock: The world of 2060 has a set of diverse economic, energy and sustainability outcomes. National interests result in a fractured world with little collaboration between governments. Deployment of enabling technologies is limited based on availability of local resources and little attention is paid to climate change.

ASIA

Asia faces the challenge of facilitating sustainable growth of its highly energy-intensive, emerging economies while managing increasing energy demand and growing energy import dependence. Improvements on all three trilemma dimensions are possible by increasing the use of renewable energy sources, and decreasing import dependence through reliable trade relationships and improved infrastructure.

FIGURE 4: ASIA'S ENERGY TRILEMMA PROFILE



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

Source: World Energy Council / Oliver Wyman, 2016

Asia is the world's largest and most populous continent and energy demand is continuing to grow. 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).

Many countries in the region are in the lower half of the Index. Nonetheless, several countries have exhibited positive trends in their trilemma performance. The Philippines, for instance, has improved the diversity of its electricity generation, which now includes more than 15% of electricity generated from non-hydropower renewable energy sources. This achievement has allowed the country to decrease its dependence on fuel imports, improve electricity access and quality of electricity supply, as well as reduce emission intensity. However, possibly the most notable energy development of the region is occurring in Australia. The country now has several Liquefied Natural Gas (LNG) projects in operation and three more under construction.[20] With an expansion of LNG exports, the higher adoption of natural gas could be an important means of improving the region's energy trilemma profile.

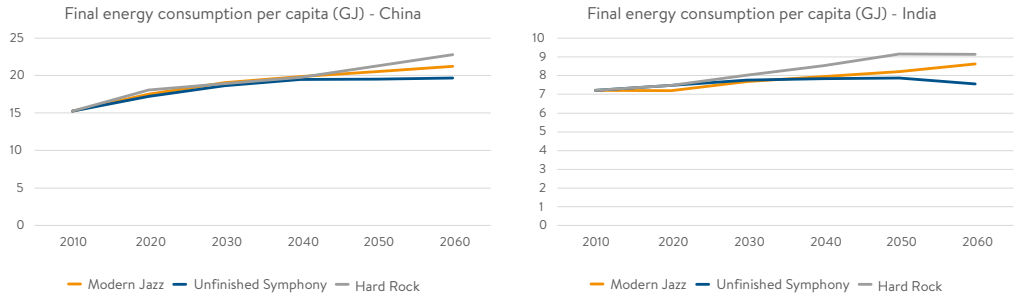
Between 2040 and 2050, Asia is projected to surpass North America and Europe combined in terms of GDP, population size, military, health, and education spending, and technological investment.[21] In line with these projections, fast-growing Asian economies are

[20] Appea, 2016: Australian LNG projects
[21] World Energy Council, 2016: World Energy Scenarios to 2060

currently in the midst of a highly energy-intensive stage of their economic development characterised by massive investments in infrastructure.

China and India in particular are expected to play significant roles in determining the future of the region's energy mix and sustainability; these two countries will be the primary driver behind demand growth to 2060 in the region (see Figure 5).

FIGURE 5: PRIMARY ENERGY CONSUMPTION (PER CAPITA) IN CHINA AND INDIA UP TP 2060



Source: World Energy Council, 2016: World Energy Scenarios to 2060

As these countries' economies continue to grow, it is especially important that they transition away from carbon-intensive energy sources and economic activities to ensure global climate targets are met. This may be challenging as the rapid growth in car ownership in China and India illustrates. In an effort to reduce GHG emissions, the Chinese government has invested heavily in electric vehicle subsidies (US$4.6bn) with a target of 5 million electric cars on the road by 2020. However, with current forecasts estimating that only 1.29 million electric cars will be sold by then, it is questionable whether this target will be met.[22] Meanwhile, India aims to have an all-electric car fleet by 2030, but will face limitations due to poor electricity infrastructure.[23]

Energy security is a key focus for the region and, according to the World Energy Scenarios, will remain so over the next 50 years. This focus has led to significant investments in and national pledges to use renewable energy sources in some Asian countries, which is expected to positively impact the diversity of energy supply in the region.

Due to low natural resource endowments, the East Asian region, including Korea, Japan, and China largely depends on imports to meet its current energy consumption needs. This significantly impacts East Asia's ability to secure its energy supply independently. The Republic of Korea, for example, relies almost entirely on crude oil imports and is the second largest importer of LNG after Japan. Japan is also the second largest coal importer and

[22] Automotive News, 2016: Skepticism Surrounds China EV Boom
[23] Green Car Reports, 2016: India's Ambitious Goal: All Electric Vehicles on Road by 2030

third largest net importer of crude oil and petroleum products in the world.[24] In 2013, China became the world's largest net importer of oil.[25]

Despite Asia's current struggle to balance the energy trilemma, it has the potential to improve on all three dimensions of the energy trilemma over the next 50 years. According to the 2016 World Energy Scenarios, energy intensity is expected to decrase between 25−76% by 2060 and CO_2 intensity could decrease between 73−93% by 2060 compared to 2014 levels (see Figure 6 and 7).[26] Moreover, diversity of primary energy supply will increase compared to 2014, providing a positive outlook on the energy security of the region. However, the region's energy security may be negatively impacted by the increasing dependence on energy imports. In order to minimise the vulnerability caused by increasing import dependence, the region should focus on building reliable trading relationships and developing its energy infrastructure.

FIGURE 6: CENTRAL ASIA'S PROJECTED ENERGY AND CO_2 INTENSITY

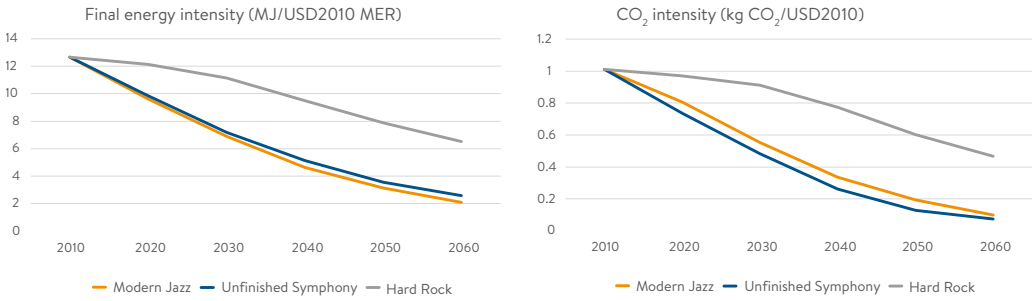
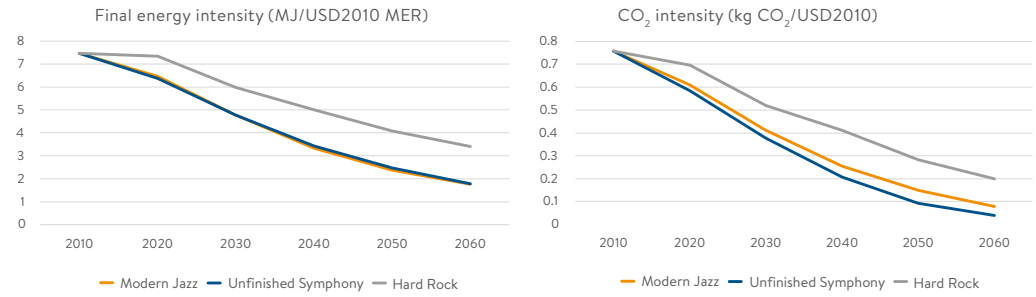


FIGURE 7: EAST ASIA'S PROJECTED ENERGY AND CO_2 INTENS



Source: World Energy Council, 2016: World Energy Scenarios to 2060

[24] U.S. Energy Information Administration, 2013: Japan is the Second Largest Net Importer of Fossil Fuels in the World
[25] U.S. Energy Information Administration
[26] World Energy Council, 2016: World Energy Scenarios to 2060

The region's future energy trilemma performance will depend on the path it takes. The Modern Jazz Scenario serves as a transition to a highly productive world, in which Asia is the economic and geopolitical centre. If Asia does not make concerted efforts to shift to renewable energy sources and address poverty and inequity, a declining performance on the environmental sustainability and energy equity dimensions of the energy trilemma may be inevitable; this would impact the region's ability to drive a balanced improvement on the energy trilemma.

FIGURE 8: CENTRAL ASIA'S PROJECTED DIVERSITY OF PRIMARY ENERGY SUPPLY

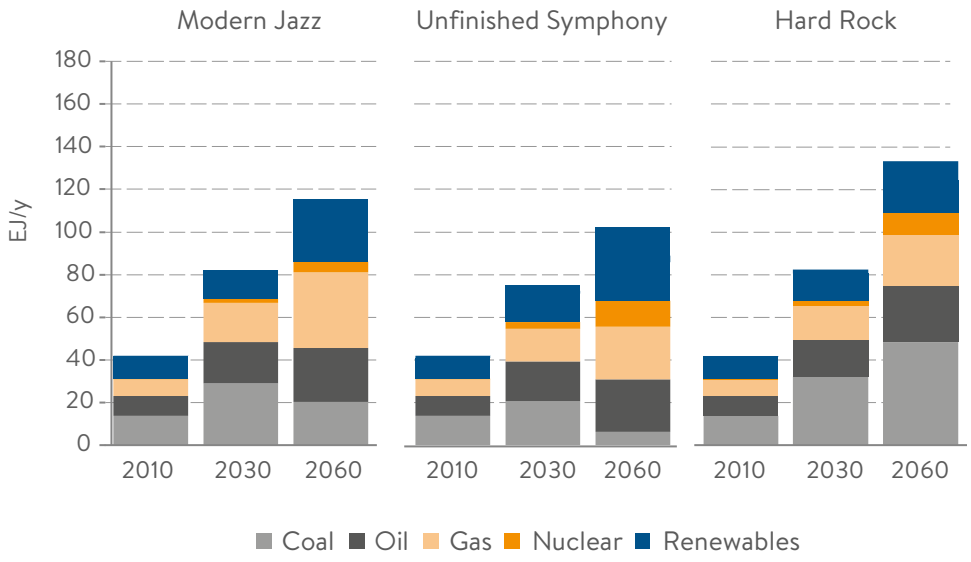
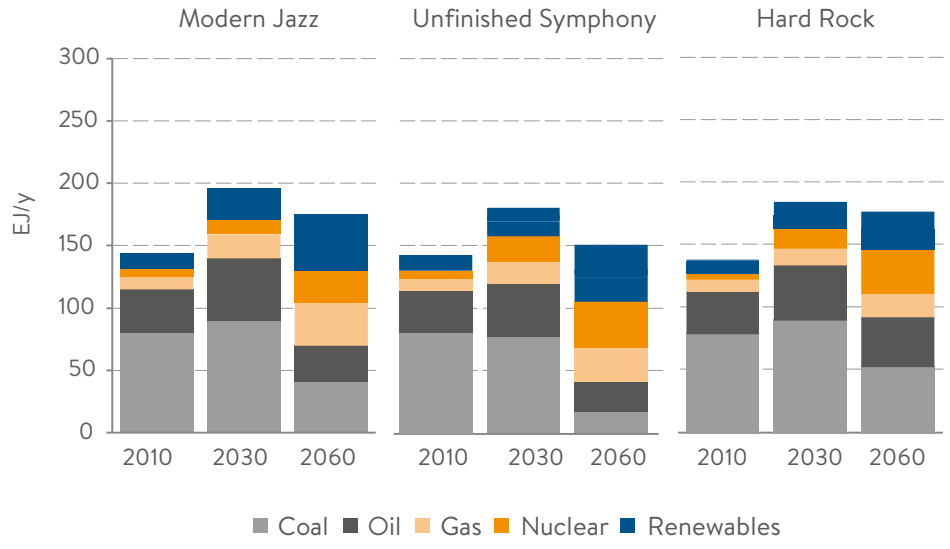


FIGURE 9: EAST ASIA'S PROJECTED DIVERSITY OF PRIMARY ENERGY SUPPLY

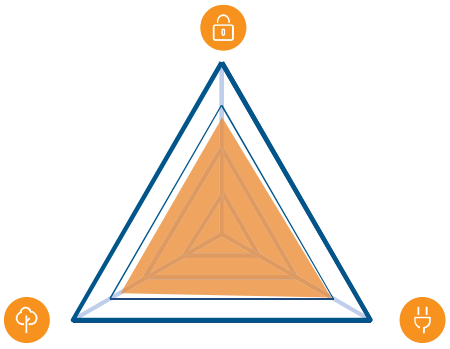


Source: World Energy Council, 2016: World Energy Scenarios to 2060

EUROPE

Although European countries lead the 2016 Index, the region still faces the challenge of managing the energy security and affordability risks resulting from the energy transition. To maintain a strong trilemma performance, policymakers must focus on energy market design, regional markets, demand management, and designing an effective carbon price to successfully manage the challenging energy transition.

FIGURE 10: EUROPE'S ENERGY TRILEMMA PROFILE



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	

Source: World Energy Council / Oliver Wyman, 2016

European countries lead the 2016 Index, claiming nine of the top 10 spots. The European Union's (EU) long-term climate and energy strategy, implemented through the '2020 Climate and Energy Package' is a key driver contributing towards the region's continued strong Index performance.[27] Analysis shows that the EU is broadly on track to meet the 20-20-20 goals.[28] Together with the region's strong Index performance this shows that the EU's policy making is contributing towards the region's success in the Index.

However, temporary external factors, including the global financial crisis of 2008/09 may have accelerated the progress on these energy sustainability goals in the short term due to the associated dip in energy demand and reduction in industrial activity. In order to secure the top ranks of the Index going forward, the region needs to continue working on the 20-20-20 goals. Additionally, the region should focus on energy security, while ensuring the long-term affordability of the energy system (at both the household and industrial levels).

Government policies aimed at achieving the 20-20-20 targets threaten the financial viability of the overall power sector, which will further financially impact both governments and consumers. This highlights the challenges that Europe faces in developing policies that promote balanced progress on the energy trilemma. Specifically, policies to achieve climate

[27] World Energy Trilemma 2016: Defining measures to accelerate the energy transition
[28] Eurostat, 2016: Europe 2020 indicators − climate change and energy

targets and increase the share of renewables have distorted electricity markets, causing decreased wholesale prices, and in turn have undermined investments in wholesale capacity. These occurrences render modern gas plants non-viable, while older, more polluting coal plants with lower marginal costs are able to operate profitably.

For example, Germany requires a total investment of US$58bn until 2033 to ensure the security of supply for conventional power generation and storage.[29] Under current conditions, the utilities' market share in power generation capacity is projected to decline by one-third, to less than 50% by 2033 as households and businesses invest directly in their own renewables-based power generation capacity. The German government will have to redesign the structure of its electricity market to compensate backup providers, keep conventional generation viable and encourage financing of larger-scale generation capacity during a period of energy transition. Along with this, the German government will need to focus on making gas power plants a more attractive investment option than CO_2-intensive coal power plants.

The UK also faces significant challenges in securing energy supply following the steady decline of domestic production of fossil fuels, the phase-out of nuclear power plants, and the introduction of European legislation that would force many coal plants to close. Ageing infrastructure, reduced investments in the wind and solar sectors, and tightened reserve capacity margins impose further strains on energy supply. The current uncertainty in future energy policy presented by the 'Brexit' referendum vote may stall necessary investments in updated energy infrastructure.

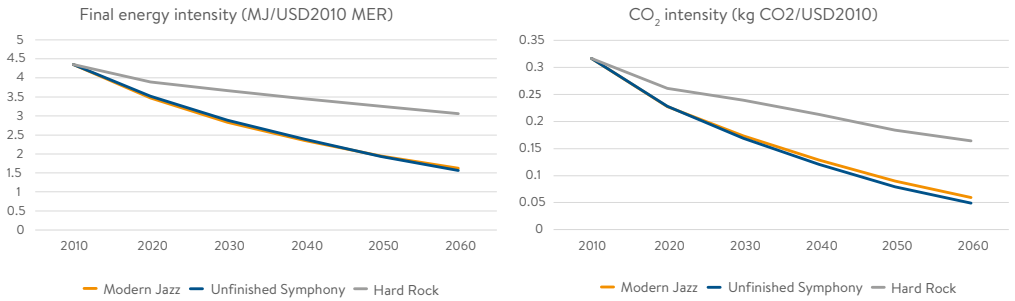
Eastern European countries face a different set of obstacles in addressing their future progress on the energy trilemma, particularly in energy security and environmental sustainability, including developing financial markets and a secure investment environment to encourage investment in the energy system to support economic growth.

Europe outperforms all regions with regards to energy access and the reliability of energy supply. However, high energy prices are a concern to many European countries. At governmental level, high expenditure is required to stimulate renewable energy growth. From 2012 to 2020, for example, an estimated €40.5bn will be spent in France to support the renewable power sector.[30] A significant portion of this investment will be borne at the consumer level.

To secure a high and balanced performance on the Energy Trilemma Index, meet the 20-20-20 targets, and the more ambitious energy targets set for 2030, European policymakers must enhance their existing climate and energy efforts. Specifically, they must place a greater focus on energy market design, regional energy markets, energy demand management, and the proper price setting for carbon.

[29] Oliver Wyman, 2014: Power Generation Disruption: Germany's Case for Change
[30] Deloitte, 2015: Energy Market Reform in Europe

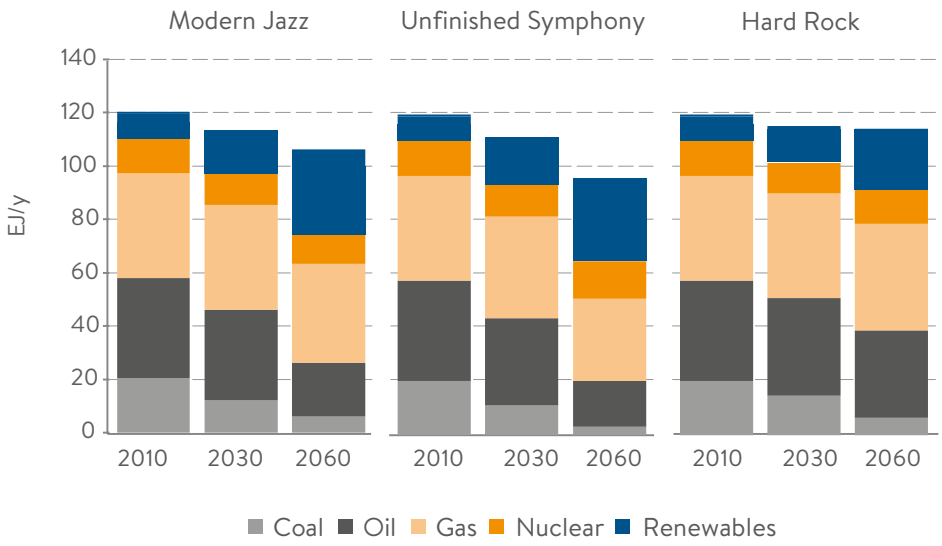
FIGURE 11: EUROPE'S PROJECTED ENERGY AND CO_2 INTENSITY



Source: World Energy Council, 2016: World Energy Scenarios to 2060

Despite the policy challenges ahead, all three World Energy Scenarios show promising trends to 2060 (see Figure 11): final energy intensity is predicted to decrease by 21–59% by 2060, while CO_2 intensity is expected to decrease by 41–83% by 2060, showing positive trends for Europe's performance on the environmental sustainability dimension of the energy trilemma in the long term. The region's performance on the energy security dimension is also predicted to fare well over the long term, with energy imports falling from their current 12% to 5–9.6% by 2060. At the same time, the diversity of primary energy supply is expected to increase (see Figure 12).

FIGURE 12: EUROPE'S PROJECTED DIVERSITY OF PRIMARY ENERGY SUPPLY

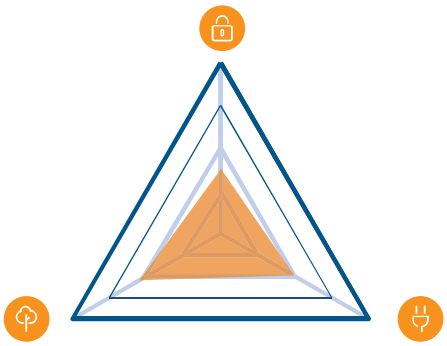


Source: World Energy Council, 2016: World Energy Scenarios to 2060

LATIN AMERICA AND THE CARIBBEAN

The Latin America and Caribbean (LAC) region must work on improving and maintaining its energy security by increasing the energy system's resilience to extreme weather events and improving energy equity. Diversifying the energy supply with low-carbon sources such as solar and wind and increasing regional interconnection will be key. However, large-scale investments are required to finance the development of resilient energy infrastructure.

FIGURE 13: LAC'S ENERGY TRILEMMA PROFILE



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		

Source: World Energy Council / Oliver Wyman, 2016

LAC is an energy-rich region with large oil and gas deposits and great natural endowments of exploitable renewable energy. The region is comprised of both net energy importers and exporters, including OPEC members Ecuador and Venezuela. The LAC region includes the majority of the world's hydro-powered countries such as Colombia, Uruguay, Costa Rica, Ecuador, Brazil, Peru and Paraguay. Many LAC countries with higher performance on the Index owe their success to leveraging strong hydropower capabilities. In Brazil and Colombia in particular, the extensive use of hydropower has led to low emissions and higher electrification rates.

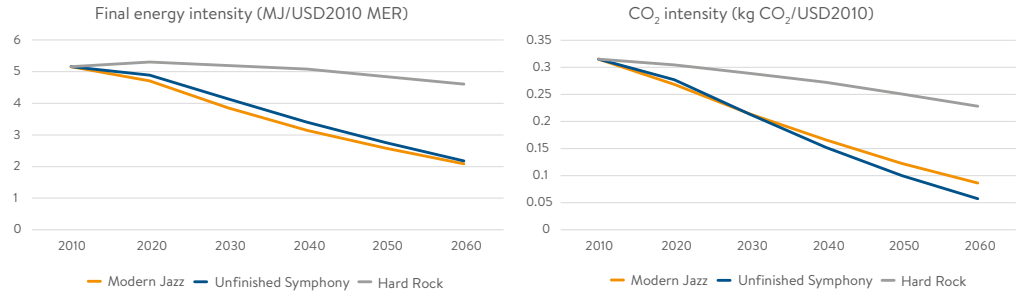
Environmental sustainability is LAC's strongest trilemma dimension, with the region as a whole accounting for only 9% of the world's GHG emissions. In the long term, the region's environmental performance is expected to improve even further, with CO_2 emission intensity expected to decrease by 26−81% by 2060 and the region's energy intensity decreasing by 10−59% by 2060.[31]

However, the region's strong reliance on hydropower is also a risk factor for energy security as it is highly susceptible to changing weather patterns. For example, in 2015 and early 2016, the region's hydropower output was significantly affected by El Niño related droughts.

[31] World Energy Council, 2016: World Energy Scenarios to 2060

The resulting power shortages led to spikes in energy prices and the need to use less efficient and more polluting short-term back-up energy sources to manage the power shortages. While El Niño effects are natural, recurring events, their frequency and severity are expected to increase over time, making the region more vulnerable to decreased hydroelectric power generation and energy shortages in the long term.[32]

FIGURE 14: LAC'S PROJECTED ENERGY AND CO_2 INTENSITY



Source: World Energy Council, 2016: World Energy Scenarios to 2060

The region's success in adapting to changing weather patterns and the water-energy nexus will impact its path to greater energy sustainability. For example, to address increased droughts, LAC countries must develop and implement substantial soft and hard resilience measures, including conventional, solar and wind power generation. Regional integration (e.g., the Central American Integrated System Project, which will connect Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama) is expected to play an increasingly important role in the region's ability to increase resilience.

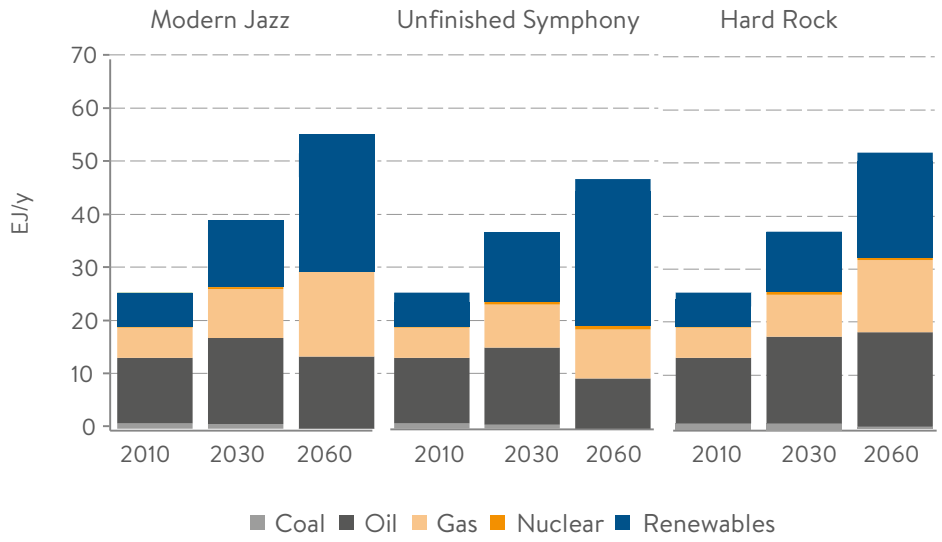
Another critical approach to mitigating the impacts of reduced hydropower resources is attracting investment. To be successful in this area, LAC countries will need to develop a secure investment profile, a task which will require overcoming several hurdles. In particular, hydropowered LAC countries will need to develop a strong pipeline of 'bankable projects' and increase investors' comfort with new renewables to strengthen the resilience of energy systems. For example, Argentina is particularly limited by a lack of investment in all energy sectors due to a persisting energy price freeze instituted by its government in response to the 2001 economic crisis, which has stunted the profitability of the energy sector. Although the country possesses large reserves of unconventional oil and natural gas, it is unable to exploit them due to its inability to attract the new investors necessary to do so. Countries that are not locked into fossil fuel heavy development paths, such as Nicaragua, also have problems attracting potential investments due to country risk ratings.

Looking to the future energy trilemma path, efforts to diversify the energy mix are promising to be successful in the long term, with the diversity of energy supply increasing by 2060.

[32] Yale environment 360, 2016: El Niño and Climate Change: Wild weather may get wilder; World Energy Council, 2015: World Energy Perspective: The road to resilience − Managing and financing extreme weather risks

A number of low-carbon, renewable energy sources such as biomass, which is expected to increase from 18% to 24−40% by 2060, will change the current composition of the primary energy mix and ensure greater resilience and energy security. At the same time, the share of oil will decrease from 47% today to 20−34% in 2060.[33]

FIGURE 15: LAC'S PROJECTED DIVERSITY OF PRIMARY ENERGY SUPPLY



Source: World Energy Council, 2016: World Energy Scenarios to 2060

While the share of net energy imports is expected to be near zero by 2060 for all scenarios, final energy consumption per capita is expected to increase by 53−85% by 2060. This indicates that the region will largely be energy self-sufficient by 2060, further contributing towards its energy security.

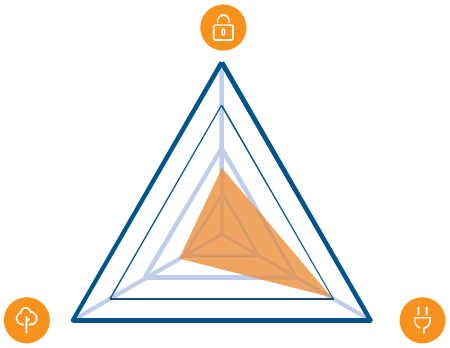
Historically, industrialising countries have substantially increased their impact on the environment as they strive to boost economic growth and access to modern energy services. As most of these LAC countries' economies are still developing, their challenge as they shift away from hydropower will be to meet a growing demand for electricity while maintaining a low environmental footprint. While urbanisation continues throughout the region, mitigating and adapting to the exacerbated impacts of extreme weather events in megacities, which are largely based around ports and require substantial energy infrastructure, will be a great challenge. At the same time, the region must address the resulting increases in smog, GHG, and CO_2 emissions to maintain the existing air quality. However, industrialisation, urbanisation and environmental sustainability are not mutually exclusive and lessons can be drawn from the experiences made by hydropowered countries, such as Brazil, Panama, Colombia or Ecuador.

[33] World Energy Council, 2016: World Energy Scenarios to 2060

MIDDLE EAST AND NORTH AFRICA

The main challenges for Middle East and North Africa (MENA) countries are high energy intensity, GHG emissions, and use of finite fossil fuel reserves. Combined with water scarcity concerns, these challenges, if not addressed, could threaten the region's energy security and environmental sustainability. Many MENA countries are focused on improving energy efficiency and diversifying their economies and energy mixes through an increased use of solar and nuclear power. Significant changes to the region's trilemma performance are however only likely to show towards the 2020s and 2040s.

FIGURE 16: MENA'S ENERGY TRILEMMA PROFILE



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

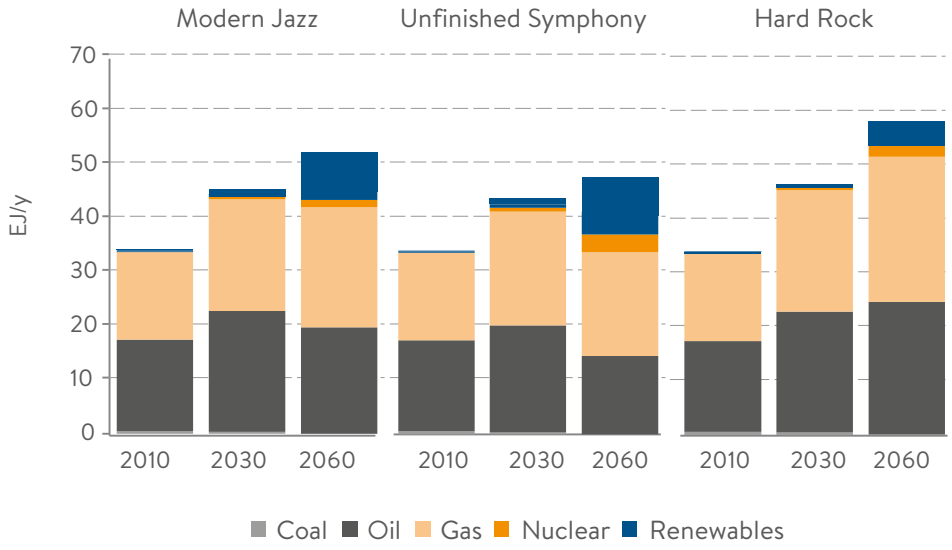
Source: World Energy Council / Oliver Wyman, 2016

The MENA region is central to the world's oil and gas agenda. The region has tremendous fossil fuel resources, with 54.9% of global oil and 50.3% of global gas.[34] As the Trilemma Index emphasises diversity and resilience as well as demand management in measuring energy security, MENA countries have a comparatively weaker energy security performance. To improve their energy security, many countries in the region are diversifying their energy mix and power generation, and are working on reducing final energy consumption. In the long term, the region is expected to increase the diversity of primary energy supply and reduce its final energy consumption per capita by 1−5%. However, these changes will only become visible towards the 2020s and 2040s.

In the short term however, the complex political and security landscape in some MENA countries is translating into reduced investments and supply disruptions, which are exacerbated by low oil prices; supply disruptions amount to almost three million barrels per day (Mb/d), with those disruptions concentrated in Libya (1.3 Mb/d) and Iran (860 Kb/d).[35]

[34] BP, 2016: Statistical Review of World Energy
[35] BP, 2015: BP Statistical Review of the World 2015 and Chatham House: Royal Institute of International Affairs, 2016: Middle East and North Africa Energy; Carnegie Endowment for

FIGURE 17: MENA'S PROJECTED DIVERSITY OF PRIMARY ENERGY SUPPLY



Source: World Energy Council, 2016: World Energy Scenarios to 2060

Many energy security concerns in less oil-rich countries relate to the Nile and the energy-water-food nexus. Egypt, for example, is dependent on the Nile for 97% of its water needs and experiences limited rainfalls, a trend that is set to continue. Coupled with population growth and the potential redistribution of the Nile's resources to other riparian nations,[36] Egypt's water overuse may lead to severe water scarcity in the future and impact plans for increased hydropower in the region. In fact, Egypt could run out of water by 2025, which highlights the energy-water-food nexus challenges the country and region are facing.[37]

Fossil-fuelled economies, such as Saudi Arabia and the UAE, are also facing energy security threats due to their high rate of energy consumption growth. However, many of these countries have recognised these risks and are making concerted efforts to mitigate their effects, including energy diversification. The UAE, for example, has set the goal to increase the low-carbon energy contribution of renewable energy and nuclear power to

International Peace, 2015: Middle East and North Africa Oil Producers are Facing a New Price Reality

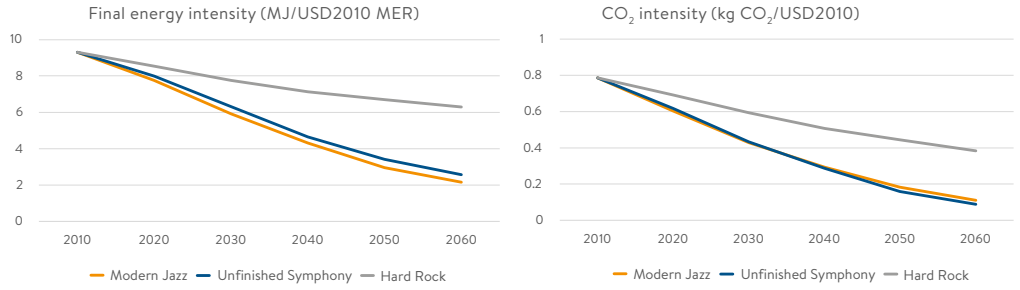
[36] Upstream riparian nations are experiencing high population growth, leading to additional strains on the Nile. Uganda and Ethiopia are undergoing especially high population growth levels, at 3.1% and 2.9% per annum respectively, which will intensify water needs due to rising consumption by industry, agriculture and households. Ethiopia is simultaneously experiencing strong economic growth, at 7.5% over the past three years, which is stimulating the development of infrastructure projects along the Nile. As other upstream nations experience economic growth, additional water infrastructure projects are expected to follow, which could lead to reduced flows for downstream riparian nations.

[37] Future Directions International, 2013: Conflict on the Nile: The future of transboundary water disputes over the world's longest river

24% of the overall energy mix by 2021.[38] The UAE plans to meet these targets using government-driven investment in large infrastructure projects, technical assistance and cooperation agreements with international energy agencies and governments, as well as economic support mechanisms including net metering and slab tariffs, to improve the competitiveness of solar energy and overall improved energy efficiency.

Saudi Arabia is pursuing energy reforms to address its energy security concerns. In December 2015, the country announced the first round of its energy reforms, which includes raising the price of gasoline with the goal of promoting energy efficiency and reducing the cost of subsidies. With fossil fuel subsidies amounting to over US$62bn, of which 75% are for oil, subsidy reductions are expected to cut costs by 12% following the energy reform. Prices will be increased by 60% for petrol, approximately 66% for gas and around 130% for ethane. The subsidy reforms are expected to generate US$30bn in savings per year by 2020.[39]

FIGURE 18: MENA'S PROJECTED ENERGY AND CO_2 INTENSITY



Source: World Energy Council, 2016: World Energy Scenarios to 2060

In 2012, the MENA region was responsible for approximately 7% of total global GHG emissions. This is relatively low, compared to other regions such as North America and Asia, which produced approximately 12% and 50% of global GHG emissions the same year. However, CO_2 emissions are projected to increase by 19% in the Council's Hard Rock scenario. Conversely, energy intensity and CO_2 intensity will decrease in all three of the World Energy Council's Scenarios to 2060 (Figure 18).

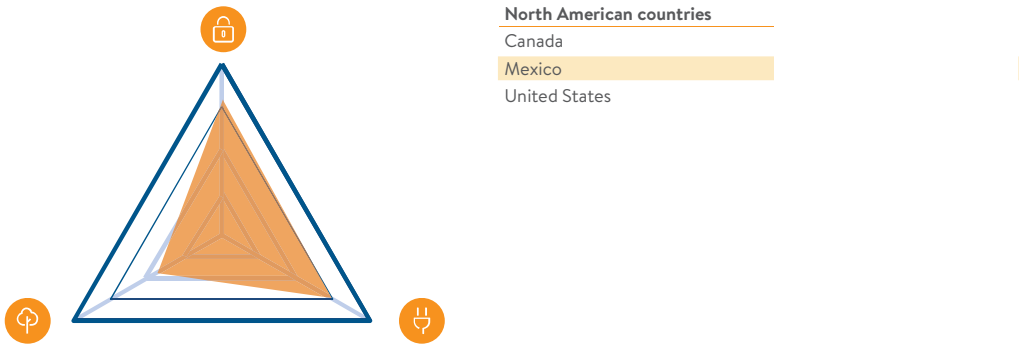
To prevent emission increases and secure development along a path similar to that of the Unfinished Symphony scenario, the MENA region must place an increased focus on improving both energy security and environmental sustainability levels. An expansion of existing efforts to improve energy efficiency and diversify the energy mix would provide a good foundation for such a shift. MENA countries could build on these developments by increasing transparency in market value of energy to improve demand management and energy-water-nexus issues.

[38] World Energy Council, 2016: World Energy Trilemma 2016: Defining measures to accelerate the energy transition
[39] ibid.

NORTH AMERICA

With 14% of total global GHG emissions stemming from North America, the region must improve environmental sustainability and update ageing energy infrastructure to strengthen resilience to emerging risks, including extreme weather events and cyber attacks. Environmental sustainability is expected to improve significantly due to emission reduction measures such as the development of carbon capture, usage and storage technologies, and further diversification of the energy mix.

FIGURE 19: NORTH AMERICA'S ENERGY TRILEMMA PROFILE



Source: World Energy Council / Oliver Wyman, 2016

North America, comprised of Canada, the United States (US) and Mexico, is the second strongest geographic region on the Index after Europe. Despite its strong performance, the region faces two main challenges: securing supply of energy over the long term and improving environmental sustainability.

North America is well endowed with fossil fuel resources, including oil, natural gas, and coal, and hydropower potential. Due to the region's natural resource endowment, energy security concerns are of a different nature than those of regions with limited energy resources. These include the need to diversify energy sources to increase energy security and the urgency of managing demand and increasing energy efficiency.

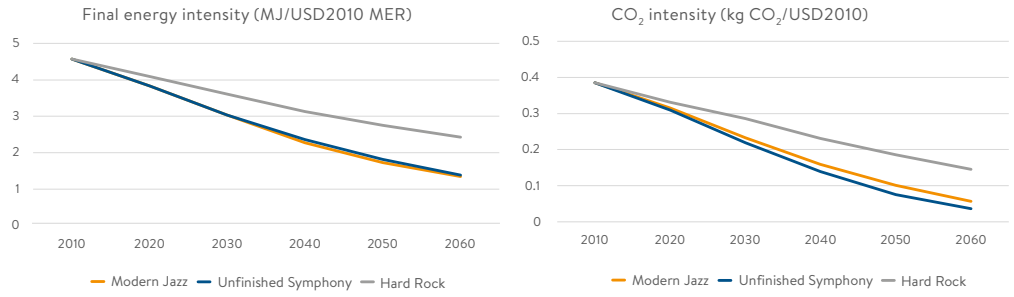
Reducing the carbon footprint, and mitigating the impacts of increasing GHG emissions, is especially important for North America due to emerging risks, including more extreme weather events. In 2012, North America accounted for 14% of total global GHG emissions,[40] which are expected to peak by 2030 and then fall back down to 2010 levels or even lower.

[40] World Resources Institute (WRI), 2014: CAIT 2.0 – WRI's Climate Data Explorer

Some progress has already been made in diversifying energy sources and decarbonizing electricity generation with greater shares of natural gas and renewables. The US has set 2020 emission targets as aggressive as those of several of the top 10 countries in the Index and has already made progress towards meeting these goals, driven by a reduction in coal-fired power generation and improvements in transport efficiency. In Canada, the Federal government is expected to publish a GHG reduction plan in autumn 2016 that may feature standardised and expanded emission disclosure requirements for the private sector. This plan will set a national price on carbon emissions. In addition, the four provinces that include 80% of the Canadian population have already established or are in the process of introducing a carbon price, which is typically either a tax or a cap-and-trade programme. Based on these experiences, Canadian officials believe that a carbon price is the most effective way to reduce emissions while simultaneously fostering necessary innovation, and this approach will be even more impactful if taken more uniformly.[41] While this path may work in Canada, certain national characteristics suggest that this will not be the case in the US. Most significantly, resistance by the US Congress and general regulatory uncertainty could stall, or permanently prevent the introduction of a national carbon price.

Looking forward, both the Modern Jazz and Unfinished Symphony scenarios project substantial decreases in North American CO_2 emissions by 2060, of approximately 55% and 75% respectively. However, if North America underinvests in energy systems and fails to collaborate with other countries, the Hard Rock scenario may unfold (31% decrease in CO_2 emissions by 2060).

FIGURE 20: NORTH AMERICA'S PROJECTED ENERGY AND CO_2 INTENSITY



Source: World Energy Council, 2016: World Energy Scenarios to 2060

Along with these challenges come potential opportunities for the region; in particular, a concerted effort to develop carbon capture, utilisation and storage (CCUS) technologies. This technology would allow the mitigation of GHG emissions from large-scale fossil-fuel usage in power generation, from fuel transformation, and also from industry. As all three North American economies rely heavily on energy production for energy exports and certain industries, the use of CCUS technologies, coupled with a focus on energy efficiency improvements, will likely prove effective in reducing GHG emissions from the energy sector.

[41] Bloomberg, 2016: Canada to Introduce National Carbon Price in 2016, Minister Says

A breakthrough in this area would enable the long-term utilisation of fossil fuels, thereby significantly improving these countries' trilemma performance.

Ageing infrastructure and resulting uncertainties with regards to the reliability of energy supply is a major concern for the US particularly. In this country, 51% of electricity generating capacity was built before 1980 and 74% of coal-fired plants are to come off-line in approximately 10 years.[42] Infrastructure is susceptible to damage caused by extreme weather events such as hurricanes, droughts, blizzards, and flooding, resulting in longer-lasting, more frequent failures and power interruptions, which makes investments in existing infrastructure and renewables alike especially important. Rising temperatures put a strain on the national water system, in turn threatening conventional power generation, which requires large volumes of water to operate. In addition, the large number of coal-fired power plants that are due to come off-line in the next decade further emphasises the importance of investments in new generation capacity and energy demand management requirements. The country's changing energy landscape as it moves from importer to exporter intensifies the need to address threats to national energy security. To secure US energy supply going forward, the US will have to invest to replace its energy infrastructure, diversify its energy mix and reduce its energy consumption.

The US adoption of a low-carbon energy system will involve increased decentralisation of energy infrastructure and a much higher percentage of non-hydro renewable energy. The expansion of wind and solar generating capacity is pushing the present supply infrastructure to the limits of its maximum performance capability. The system will thus need to achieve an adequate balance between generation and load. New York and California are currently the leaders in the US in developing a comprehensive strategy for distributed energy resource (DER) deployment and stimulating a change to the regulated investor-owned utility model and could provide good models for the rest of the country.

For its part, Mexico will likely experience both environmental sustainability and energy security improvements over the next 5-10 years, stemming from 2013−2014 constitutional reforms to increase energy sector electricity capacity. However, the country remains tasked with simultaneously managing the transition from a monopolistic structure to a competitive market scheme (following the 2014 allowance of full private sector participation in its energy markets) and from a high-carbon to a low-carbon economy.

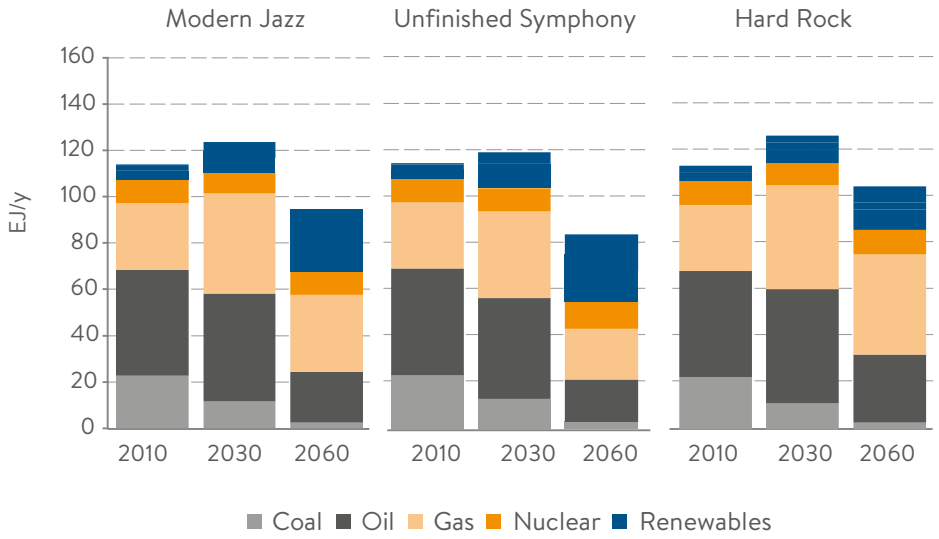
According to the 2016 World Energy Scenarios, the region's reliance on fossil fuels is projected to continue through 2060 but to a lesser extent, with fossil fuels making up 51% of primary energy by 2060.[43] As shown in Figure 21, this trend is also reflected in the region's overall diversity of primary energy supply. The US, for example, is placing a strong focus on renewables-based generation: by 2060, renewables produced in the US are expected to account for 17−36% of the country's total primary energy supply.[44] Mexico still

[42] World Energy Council, 2016: World Energy Trilemma
[43] World Energy Council, 2016: World Energy Scenarios
[44] ibid. The 17% refers to the Hard Rock Scenario while the 36% refers to the Unfinished Symphony Scenario.

obtains 82% of its electricity from burning fossil fuels, while Canada uses nuclear, hydropower and other renewables to meet 80% of its needs.[45]

Final energy consumption is expected to decrease by 2060 (depending on the scenario), which will help alleviate the stress on the energy system. Due to the region's natural resource endowment, import dependence is lower compared to other regions. In 2014, approximately 2% of primary energy supply was imported. This trend is expected to continue until 2060 with imports ranging between 0−6% until 2060.

FIGURE 21: NORTH AMERICA'S PROJECTED CHANGES IN DIVERSITY OF PRIMARY ENERGY SUPPLY



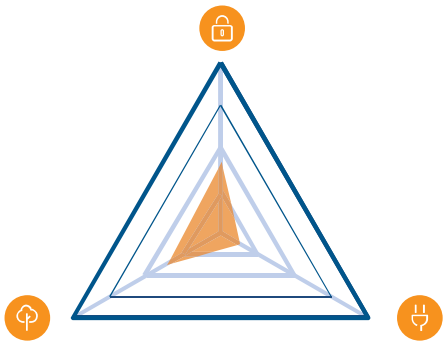
Source: World Energy Council, 2016: World Energy Scenarios to 2060

[45] EIA, 2013: International energy statistics

SUB-SAHARAN AFRICA

Sub-Saharan Africa is challenged by the world's lowest levels of energy access and commercial energy use, despite a rich endowment in resources and high renewables potential. Stable and widely accessible energy supply could act as a catalyst for regional economic development. 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.

FIGURE 22: SUB-SAHARAN AFRICA'S ENERGY TRILEMMA PROFILE



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

Source: World Energy Council / Oliver Wyman, 2016

Although the region is well endowed with natural resources, including fossil fuels, hydropower and renewables, most Sub-Saharan African countries perform poorly on all three dimensions of the energy trilemma. The region is home to 16% of the global population,[46] but at less than 700 kilograms of petrol equivalent per capita, compared to a North American average of 7,844 kg, it uses the lowest amount of commercial energy in the world.[47] Globally, Sub-Saharan Africa is the most electricity poor region in terms of both the total number of people served and the low percentage of its overall population with access to modern energy services.[48] Overall, the region performed poorly in the 2016 Trilemma Index, with a C in energy security, a D in energy equity, and a C in environmental sustainability.

Stable energy supply could act as a catalyst for regional economic development. Currently, the region accounts for just 2.5% of the world's total economic activity.[49] However, depending on its development path, Sub-Saharan Africa could contribute up to 11.9% of the world's total economic activity by 2060.[50] However, most countries in the region depend

[46] Discourse Media: Power Struggle, 2016: Sub-Saharan Africa access to energy research brief
[47] ibid.
[48] International Energy Agency, 2016: World Energy Outlook
[49] ibid.
[50] World Energy Council, 2016: World Energy Scenarios

on imports for more than 65% of their energy needs and as a result, the region spends more on oil imports (US$18bn) than it obtains in international aid ($15.6bn).[51]

Improving energy equity in the region (i.e., access to, quality and affordability of energy supply) will be challenging. For example, 50% of the Sub-Saharan African population lives in scattered rural and predominantly agrarian communities. Connecting these communities to the main grid would require immense infrastructure investments. An estimated US$11bn per annum must be invested to achieve 100% electricity access by 2030.[52] However, historically, annual investment levels have been about $2bn.[53]

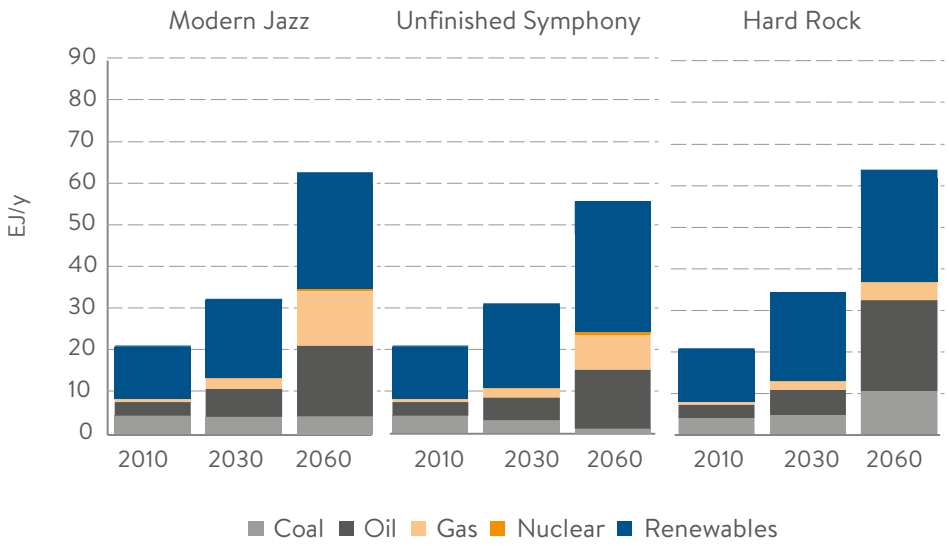
Off-grid technologies represent the most feasible solution to electrify rural areas, and pay-as-you-go models provide several advantages to customers with low or variable incomes.[54] Several Sub-Saharan African countries have already experienced success with this approach. M-KOPA Solar, which operates in Kenya, Uganda and Tanzania, and Off Grid Electric, in Tanzania and Rwanda, offer packages of small appliances, such as LED lights, a mobile phone charger and a radio, all of which are powered by a solar panel and a battery. Rather than paying for the electricity itself or purchasing more expensive kerosene to fuel older appliances, customers pay for the power equipment and new appliances in small instalments using mobile phone payment processing.[55]

At the same time, a number of large-scale renewable projects are in progress. These include Africa's first privately funded and developed geothermal plant, which will be built in Kenya; a 155 MW photovoltaic (PV) power plant, which is expected to increase Ghana's power capacity by 6% when it comes online in late 2016; the Congo's 40,000 MW Grand Inga Dam; and Ethiopia's 120 MW Ashegoda wind farm.[56]

Moreover, a number of untapped oil and gas reserves have been discovered in Cameroon, Ghana, Equatorial Guinea, the Congo (DR), Kenya, Tanzania, and Uganda, and could be exploited in the future. However, the process of converting these resources into energy for domestic populations may be challenging and effects will be limited to urban and peri-urban areas. For instance, in Nigeria, only 56% of the population has gained access to secure electricity despite the fact that the country holds the continent's largest known natural gas reserves.[57] This fact suggests that financing, institutional capacity and infrastructure deficits pose the greatest barriers to full access, rather than supply.

[51] EIA, 2013: International energy statistics
[52] Discourse Media: Power Struggle, 2016: Sub-Saharan Africa access to energy research brief
[53] ibid.
[54] World Energy Council, 2016: World Energy Trilemma 2016: Defining measures to accelerate the energy transition
[55] ibid.
[56] Banks J: Key Sub-Saharan Energy Trends and their Importance for the US (Africa Growth Initiative at Brookings)
[57] ibid.

FIGURE 23: SUB-SAHRAN AFRICA'S PROJECTED CHANGES IN DIVERSITY OF PRIMARY ENERGY SUPPLY



Source: World Energy Council, 2016: World Energy Scenarios to 2060

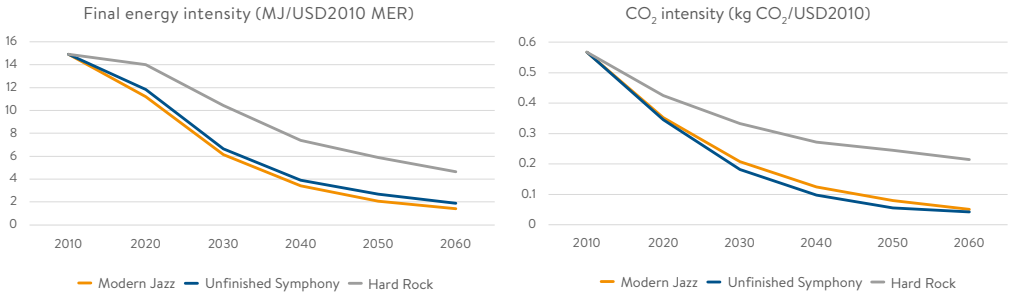
Managing energy demand is also a challenge for countries as they develop economically. South Africa, as one of the most developed countries in the region, still struggles with an unreliable supply of electricity, low capacity margins and the challenge of meeting growing energy demand. In response to insufficient electricity capacity during peak hours, South Africa's major power utility has devised various strategies to engage the public in voluntary demand reduction. The principal approach has been rotational load shedding to avoid national blackouts. Ghana has also implemented an efficiency programme to promote energy savings and with that security of supply. The Ghanaian programme is focused on household refrigerators, and involves minimum energy efficiency standards, consumer education, as well as outreach and rebate efforts.

Regional energy security in the long term is currently hard to predict. Projections suggest the region will manage the growth in energy demand, and the diversity of energy supply is predicted to improve. The region's import dependence is also expected to increase to a maximum of 12% by 2060.

Although the Sub-Saharan African region registers low emissions from the energy sector and relatively strong environmental sustainability, this trend is projected to change. Current environmental sustainability scores are a reflection of low energy consumption levels and lower social and economic development. However, economic growth is projected to increase significantly and energy demand in the region is predicted to more than double by 2050.

These developments are currently projected to increase CO_2 levels. According to the 2016 World Energy Scenarios, CO_2 emissions are expected to increase between 104% and 258% by 2060. At the same time, both CO_2 intensity and energy intensity are expected to decrease between 59−92% and 66−90% respectively by 2060 (see Figure 24).

FIGURE 24: SUB-SAHRAN AFRICA'S PROJECTED ENERGY AND CO_2 INTENSITY



Source: World Energy Council, 2016: World Energy Scenarios to 2060

Country profiles

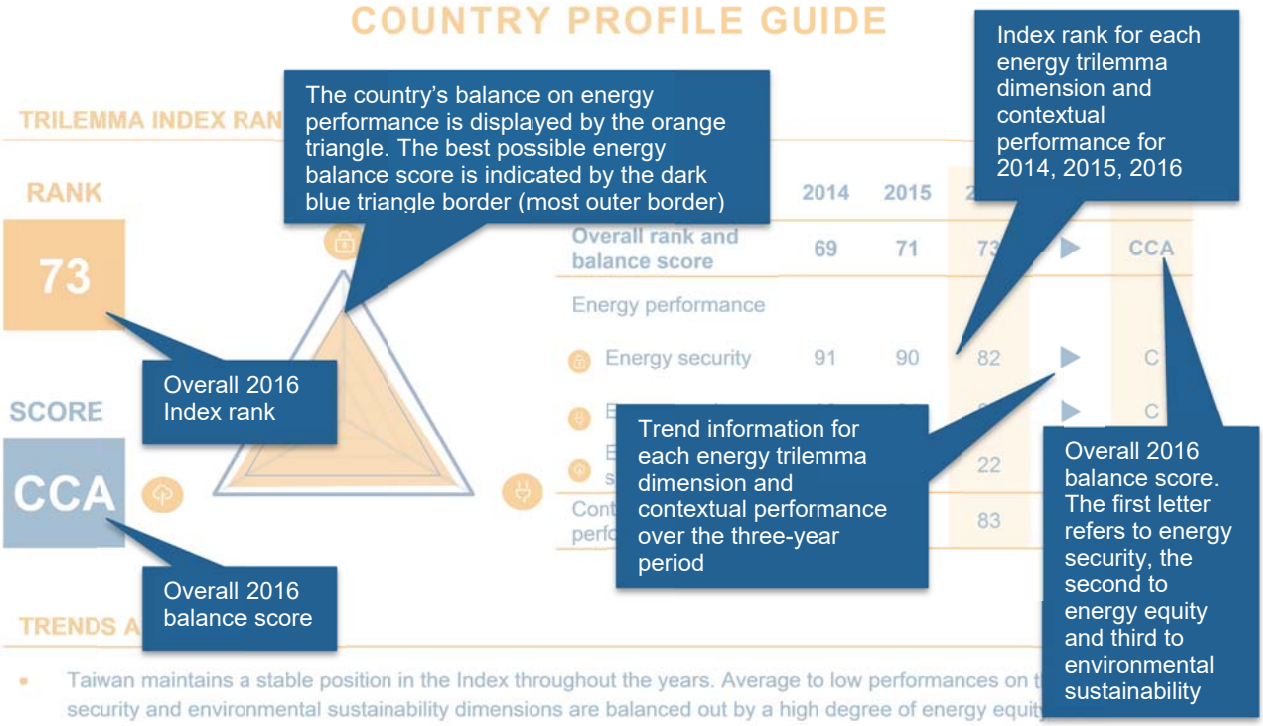
COUNTRY PROFILES

Country profiles provide the Index rankings overall and per dimension for each of the World Energy Council's member countries represented in the 2016 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 at: **www.worldenergy.org/data**.

COUNTRY PROFILE GUIDE



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 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 2000–2012 (%)	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 electricity generation	Diversity of energy supply and diversity of electricity generation: Contributors of energy sources to total primary energy supply and electricity generation, indicating current reliance on fossil fuels or other energy sources in the energy and electricity sector respectively (IEA, 2013)

ALGERIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

66

SCORE

CBC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**58**	**58**	**66**	▶	**CBC**
Energy performance					
Energy security	88	88	88	▶	C
Energy equity	34	36	37	▶	B
Environmental sustainability	55	70	80	▼	C
Contextual performance	108	103	108	▶	

TRENDS AND OUTLOOK

- Algeria drops 8 places in this year's Index, to rank 66. The country's balance score of CBC shows a good performance in energy equity, while energy security and environmental sustainability are weaker in comparison.
- 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

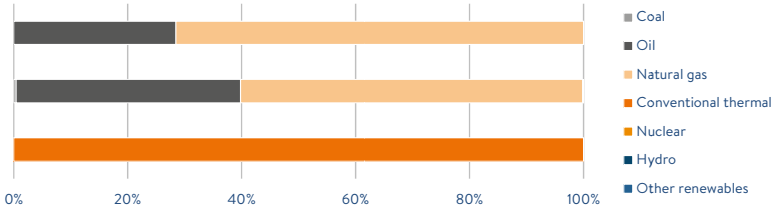
Industrial sector (% of GDP)	45.7	GDP per capita, PPP US$ (GDP Group)	14,687 (III)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	High (HHI = 1,200)
Population with access to electricity (%)	99	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	18.4
CO_2 intensity (kCO_2 per US$)	0.26	GHG emission growth rate 2000–2012 (%)	4.1

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

BBB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**61**	**61**	**58**	▶	**BBB**
Energy performance					
Energy security	57	51	48	▶	B
Energy equity	69	69	69	▶	B
Environmental sustainability	66	69	69	▶	B
Contextual performance	97	92	92	▶	

TRENDS AND OUTLOOK

- Argentina improves by 3 places, from rank 61 in 2015 to rank 58 in 2016. The country has a well-balanced energy trilemma profile, resulting in a balance score of BBB.
- If the current energy policy of low prices for producers and high subsidies to consumers continues, there is little chance to reverse the decline in production. Oil production declined by 30% since 1998, while natural gas production declined by 8% since 2006. As a consequence, Argentina, previously a net energy exporter in 2006 with a surplus of US$6bn, became a net energy importer in 2011 with a deficit of US$3bn.
- The oil company YPF, nationalised in 2012 (by expropriation of Repsol shares in Argentina's biggest oil company), is struggling to attract new investors, which are necessary to exploit the large reserves of unconventional oil and natural gas in Argentina and government programmes to incentivise investment have so far not been successful.
- The new government, elected in November 2015, aims to remedy this situation by phasing out subsidies to return to market-oriented prices for supply and incentivising investment through a focus on renewables and clearer regulations. The challenge for policymakers will be to implement these reforms to attract new investment while not compromising the trilemma's equity of access dimension.

KEY METRICS

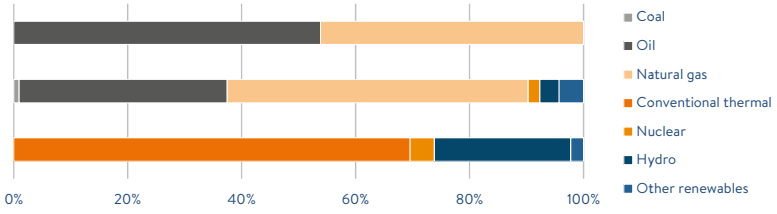
Industrial sector (% of GDP)	28.8	GDP per capita, PPP US$ (GDP Group)	N.A. (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,422)
Population with access to electricity (%)	88	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	14.9
CO_2 intensity (kCO_2 per US$)	0.22	GHG emission growth rate 2000–2012 (%)	2.5

ENERGY PROFILE

Fossil fuel reserves: 610 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ARMENIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

69

SCORE

CBC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**57**	**60**	**69**	▶	**CBC**
Energy performance					
Energy security	58	63	84	▼	C
Energy equity	61	61	65	▶	B
Environmental sustainability	83	82	78	▶	C
Contextual performance	58	65	70	▼	

TRENDS AND OUTLOOK

- Armenia drops 9 places, from rank 60 in 2015 to rank 69 in 2016. While exhibiting a good performance in the energy equity dimension, energy security and environmental sustainability scores are weaker in comparison, resulting in a balance score of CBC.
- The Armenian Public Services Regulatory Committee has 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 moreover 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

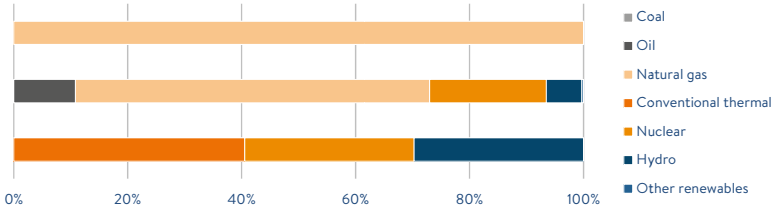
Industrial sector (% of GDP)	28.6	GDP per capita, PPP US$ (GDP Group)	8,394 (III)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	Low (HHI = 5,170)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 51
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	14.6
CO_2 intensity (kCO_2 per US$)	0.27	GHG emission growth rate 2000–2012 (%)	4.2

ENERGY PROFILE

Fossil fuel reserves: 15 Mtoe

Total primary energy supply composition

Diversity of electricity generation



AUSTRIA

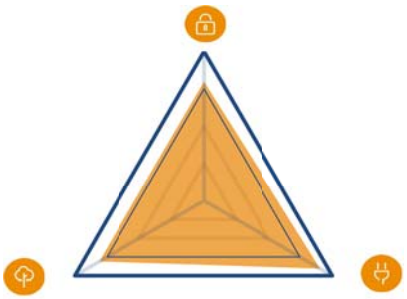
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

10

SCORE

AAA



	2014	2015	2016	Trend	Score
Overall rank and balance score	**8**	**11**	**10**	▶	**AAA**
Energy performance					
Energy security	20	26	20	▶	A
Energy equity	7	5	6	▶	A
Environmental sustainability	22	24	23	▶	A
Contextual performance	16	15	16	▶	

TRENDS AND OUTLOOK

- Austria improves by 1 place in this year's Index, making it into the top 10 list at rank 10. The country's energy policy is strong and well-balanced, resulting in a score of AAA.
- 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 more than doubled the production of renewable energy.
- Policy developments in Austria are in line with the EU's climate and energy goals for 2020 (the 20-20-20 targets). The country'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.
- Austria faces three major energy policy challenges according to the IEA: 1) the integration of security of supply, energy efficiency, sustainability and internal market dimensions; 2) the further reduction of Greenhouse Gas emissions; and 3) the integration of these two elements into an energy and climate strategy. To maintain or improve the country's ranking, Austrian policymakers will have to continue to build a strong, integrated energy policy.

KEY METRICS

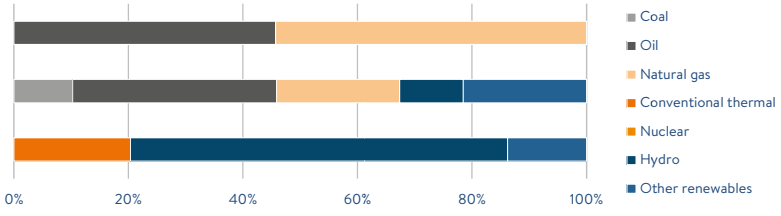
Industrial sector (% of GDP)	28.0	GDP per capita, PPP US$ (GDP Group)	47,824 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 1,261)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.26	Rate of transmission and distribution losses (%)	5.0
CO_2 intensity (kCO_2 per US$)	0.19	GHG emission growth rate 2000−2012 (%)	0.4

ENERGY PROFILE

Fossil fuel reserves: 15 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BAHRAIN

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

59

SCORE

CAD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**39**	**53**	**59**	▼	**CAD**
Energy performance					
Energy security	48	86	80	▶	C
Energy equity	8	9	7	▶	A
Environmental sustainability	95	101	104	▶	D
Contextual performance	41	47	58	▼	

TRENDS AND OUTLOOK

- Bahrain drops 6 places, to rank 59. The country exhibits a high degree of energy equity, but its overall energy policy is unbalanced due to relatively low scores in energy security and environmental sustainability, resulting in a balance score of CAD.
- In 2013 the cabinet approved the establishment of an 'Energy Think-tank' to address the issue of sustainable energy in Bahrain and is expected to address Bahrain's weak scores in environmental sustainability and energy security.
- The establishment of the 'Sustainable Energy Unit' is designed to make a significant contribution to energy conservation and more concrete commitment to the utilisation of renewable energy. This unit is currently working to develop 'Bahrain's National Energy Efficiency Action Plan (NEEAP) and to develop a National Renewable Energy Action Plan (NREAP).
- The unit is tasked with the preparation of proposals for energy efficiency levels, labelling requirements for appliances and proposals for the feed-in tariff (FIT) and financial support for renewable energy initiatives. The Unit's tasks have progressed very well during the past 18 months (January 2015–time of writing, 2016), and its role and responsibility is being elevated to the highest authority in the decision making process in the Government of Bahrain. It is hoped that the policy plans which are being finalised at this moment, are fostered and implemented by the Government at all levels. Part of the plan is the so-called 'KEEP – Kingdom of Bahrain Energy Efficiency Plan' which is being developed in collaboration with the World Bank to tackle energy inefficiencies (primarily electrical energy).

KEY METRICS

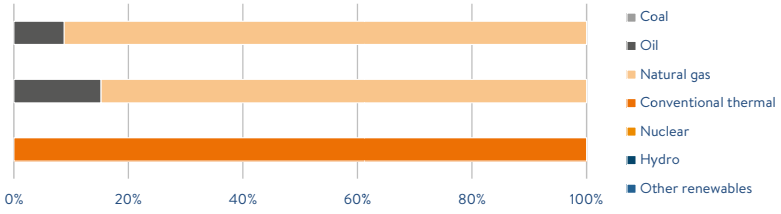
Industrial sector (% of GDP)	50.7	GDP per capita, PPP US$ (GDP Group)	46,946 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 8,872)
Population with access to electricity (%)	94	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.01	Rate of transmission and distribution losses (%)	5.2
CO_2 intensity (kCO_2 per US$)	0.63	GHG emission growth rate 2000−2012 (%)	4.4

ENERGY PROFILE

Fossil fuel reserves: 170 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BELGIUM

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

23

SCORE

BAB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**20**	**20**	**23**	▶	**BAB**
Energy performance					
Energy security	22	24	38	▶	B
Energy equity	14	10	14	▶	A
Environmental sustainability	39	41	37	▶	B
Contextual performance	26	26	24	▶	

TRENDS AND OUTLOOK

- Belgium drops 3 places, from rank 20 in 2015 to rank 23 in 2016. The country performs well across the board, with a particularly strong score in energy equity, for an overall score of BAB
- 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 of 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 capacity remuneration mechanisms.
- VAT on energy bills of final consumers was raised back to 21% (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 will have to be paid for by high-end consumer electricity prices. These choices will continue to weigh on Belgian electricity prices.

KEY METRICS

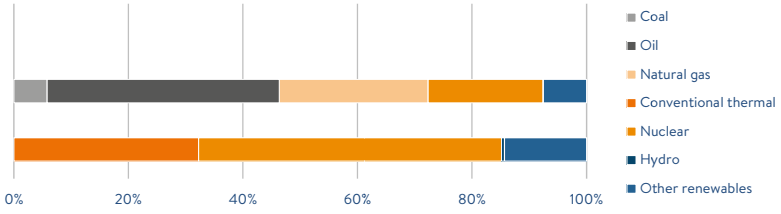
Industrial sector (% of GDP)	22.1	GDP per capita, PPP US$ (GDP Group)	43,992 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 3,310)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.27	Rate of transmission and distribution losses (%)	4.6
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000−2012 (%)	-1.1

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BOLIVIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

100

SCORE

CCD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**100**	**98**	**100**	▶	**CCD**
Energy performance					
Energy security	69	65	73	▶	C
Energy equity	97	97	97	▶	C
Environmental sustainability	108	106	107	▶	D
Contextual performance	96	102	110	▼	

TRENDS AND OUTLOOK

- Bolivia drops 2 places in this year's Index, to rank 100. The country still lags behind regarding environmental sustainability, resulting in a balance 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

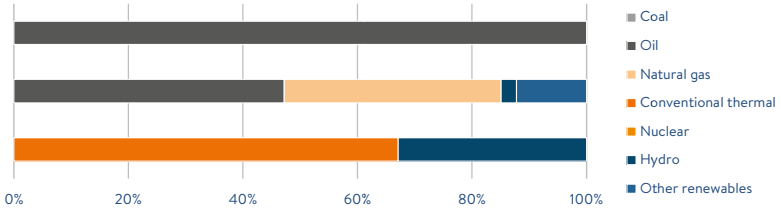
Industrial sector (% of GDP)	36.8	GDP per capita, PPP US$ (GDP Group)	6,881 (III)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	Medium (HHI = 1,556)
Population with access to electricity (%)	80	Access to clean cooking in urban | rural areas (%)	94 | 27
Household electricity prices (US$/kWh)	0.09	Rate of transmission and distribution losses (%)	9.6
CO_2 intensity (kCO_2 per US$)	0.31	GHG emission growth rate 2000−2012 (%)	7.7

ENERGY PROFILE

Fossil fuel reserves: 22 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BOTSWANA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

94

SCORE

DCC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**96**	**96**	**94**	▶	**DCC**
Energy performance					
Energy security	107	106	105	▶	D
Energy equity	88	92	90	▶	C
Environmental sustainability	93	93	92	▶	C
Contextual performance	46	46	45	▶	

TRENDS AND OUTLOOK

- Botswana improves 2 places, to rank 94. It receives relatively low scores across the board, with energy security being particularly weak, 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. Indeed, 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 great 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

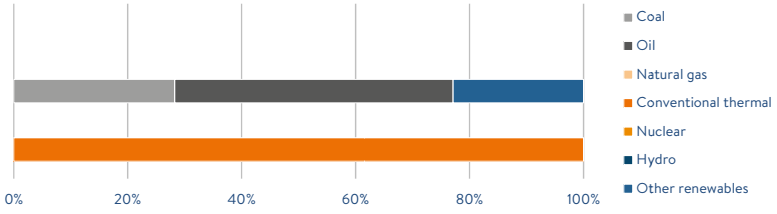
Industrial sector (% of GDP)	39.2	GDP per capita, PPP US$ (GDP Group)	15,807 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Low (HHI = 8,732)
Population with access to electricity (%)	43	Access to clean cooking in urban | rural areas (%)	90 | 38
Household electricity prices (US$/kWh)	0.07	Rate of transmission and distribution losses (%)	6.9
CO_2 intensity (kCO_2 per US$)	0.26	GHG emission growth rate 2000–2012 (%)	1.2

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



BRAZIL

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

57

SCORE

CBB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**54**	**55**	**57**	▶	**CBB**
Energy performance					
Energy security	85	73	68	▶	C
Energy equity	62	67	70	▶	B
Environmental sustainability	40	43	46	▶	B
Contextual performance	65	67	75	▶	

TRENDS AND OUTLOOK

- Brazil drops 2 places, from rank 55 in 2015 to rank 57 in 2016. The country's energy policy is balanced overall, with energy security being the country's weakest trilemma dimension, resulting in a balance score of CBB.
- In 2015, Brazil experienced a 50% rise in electricity prices due to losses incurred by the government following a plan to reduce power bills by 20% in 2012. While there was a drop in prices in the international market, domestic gasoline and diesel oil prices rose by 12.4% and 13.0% respectively. Regarding the energy security dimension, Brazil reduced its dependence on foreign energy to 7.1% in 2015, down from 12.7% in 2014. This was achieved largely by increases in crude oil and natural gas production, combined with a 7.2% decline in consumption demand for petroleum products. This decline in consumption also contributed to a decrease in emissions of 4.6%. In spite of the 2014–2016 drought, which had a negative impact on the country's hydroelectric power generation, the share of renewables in the domestic energy supply rose from 39.4% to 41.2%.
- Going forward the challenge for Brazilian policymakers will be to remove barriers to investment, improve the resilience of the country's infrastructure to extreme weather events, and find ways to improve energy equity, which is threatened by the steep increase in consumer prices. The impact of the recent adverse political and economic environment on the Brazilian energy sector will be attenuated. The production of oil and natural gas is increasing and the power sector supply capacity is expected to increase via the exploitation of renewable sources, such as wind, solar, biomass and hydro. Accordingly, it is possible for Brazil to improve its ranking in energy security and environmental sustainability dimensions in the coming years, even with the return of demand growth.

KEY METRICS

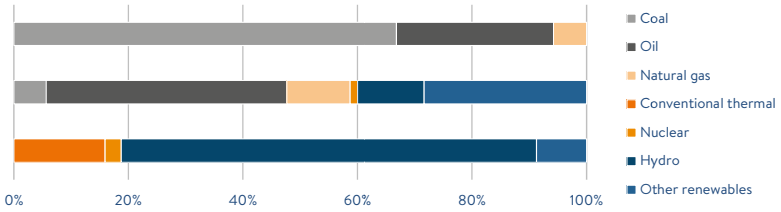
Industrial sector (% of GDP)	23.4	GDP per capita, PPP US$ (GDP Group)	15,359 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	High (HHI = 992)
Population with access to electricity (%)	99	Access to clean cooking in urban | rural areas (%)	95 | 64
Household electricity prices (US$/kWh)	0.11	Rate of transmission and distribution losses (%)	15.1
CO_2 intensity (kCO_2 per US$)	0.19	GHG emission growth rate 2000–2012 (%)	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

48

SCORE

CBB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**56**	**49**	**48**	▶	**CBB**
Energy performance					
Energy security	59	52	67	▶	C
Energy equity	60	59	55	▶	B
Environmental sustainability	81	71	67	▶	B
Contextual performance	52	50	49	▶	

TRENDS AND OUTLOOK

- Bulgaria improves by 1 rank in this year's Index, to 48. The country's energy policy is balanced, with energy equity and environmental sustainability being Bulgaria's strongest trilemma dimensions, resulting in a balance score of CBB.
- 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

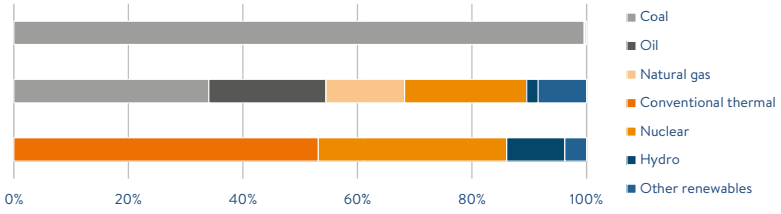
Industrial sector (% of GDP)	27.2	GDP per capita, PPP US$ (GDP Group)	17,512 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Low (HHI = 4,685)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	N.A. | N.A.
Household electricity prices (US$/kWh)	0.12	Rate of transmission and distribution losses (%)	12.0
CO_2 intensity (kCO_2 per US$)	0.47	GHG emission growth rate 2000−2012 (%)	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

	2014	2015	2016	Trend	Score
Overall rank and balance score	**103**	**105**	**105**	▶	**BDB**
Energy performance					
Energy security	29	33	43	▶	B
Energy equity	111	113	112	▶	D
Environmental sustainability	47	48	51	▶	B
Contextual performance	109	110	112	▶	

TRENDS AND OUTLOOK

- Cameroon maintains its position at rank 105. The country's trilemma performance is imbalanced, with the energy equity dimension lagging behind the other two, resulting in a balance score of BDB.
- Significant energy issues affecting Cameroon are (a) the intermittence and (b) supply of energy to the population. Disruption of energy supply is currently significant as it is largely dependent on rainfall. Consequently, in dry periods supply can significantly decrease.
- Cameroon's Energy Sector Development 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 last five years and figures provide positive signs for the investment needed to achieve 'energy emergence'.

KEY METRICS

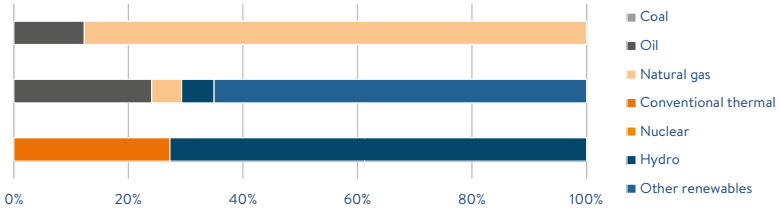
Industrial sector (% of GDP)	30.1	GDP per capita, PPP US$ (GDP Group)	3,123 (IV)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	Low (HHI = 4,228)
Population with access to electricity (%)	54	Access to clean cooking in urban | rural areas (%)	41 | 5
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	14.4
CO_2 intensity (kCO_2 per US$)	0.11	GHG emission growth rate 2000–2012 (%)	1.0

ENERGY PROFILE

Fossil fuel reserves: 147 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CANADA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

22

SCORE

AAC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**15**	**18**	**22**	▶	**AAC**
Energy performance					
Energy security	4	4	5	▶	A
Energy equity	5	14	11	▶	A
Environmental sustainability	100	97	96	▶	C
Contextual performance	15	14	14	▶	

TRENDS AND OUTLOOK

- Canada, at rank 22 maintains its strong scores on energy security, where it ranks 5th, and energy equity, where it ranks 11th, but still lags behind on environmental sustainability.
- 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. Further, 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

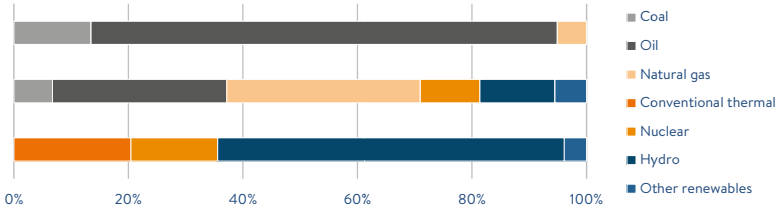
Industrial sector (% of GDP)	28.6	GDP per capita, PPP US$ (GDP Group)	44,310 (I)
Energy intensity (koe per US$)	0.13	Diversity of international energy suppliers	Low (HHI = 4,629)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.17	Rate of transmission and distribution losses (%)	9.7
CO_2 intensity (kCO_2 per US$)	0.43	GHG emission growth rate 2000−2012 (%)	0.2

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

119

SCORE

CDB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**120**	**119**	**119**	▶	**CDB**
Energy performance					
Energy security	89	91	93	▶	C
Energy equity	125	123	123	▶	D
Environmental sustainability	52	54	52	▶	B
Contextual performance	125	124	124	▶	

TRENDS AND OUTLOOK

- Chad maintains its position at rank 119. The country receives a particularly low score in the energy equity dimension, with a balance score of CDB.
- Consumption of electricity and petroleum products accounts for only 10% of national consumption. Wood and charcoal provide 90% of the energy consumed in Chad, while natural gas consumption is very limited as fewer than 11,000 households are equipped with gas heaters. Most of energy production and consumption occurs in the capital. Output of electricity was 103 GWh in 2008, from thermal sources only. High costs and scarcity of electricity hamper Chad's economic development.
- The country is highly dependent on oil imports from Nigeria, Cameroon and other neighbouring countries. STEE, the utility responsible for electricity production and distribution, does not have the capacity to meet the country's ever-growing electric energy demand. Therefore, the country is in the process of implementing a national energy policy, with considerations given to renewable energy due to its great solar potential.
- The Sustainable Energy Fund for Africa (SEFA) has approved in 2015 a US$780,000 preparation grant for the development of a first phase 40 MW of Starsol solar PV plant near N'Djamena in Chad as the first Independent Power Producer (IPP) scheme to be connected to the national grid.

KEY METRICS

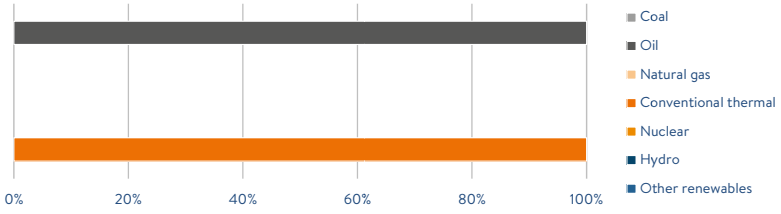
Industrial sector (% of GDP)	15.1	GDP per capita, PPP US$ (GDP Group)	2,171 (IV)
Energy intensity (koe per US$)	0.04	Diversity of international energy suppliers	Low (HHI = 7,910)
Population with access to electricity (%)	4	Access to clean cooking in urban | rural areas (%)	27 | 6
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	12.2
CO_2 intensity (kCO_2 per US$)	0.02	GHG emission growth rate 2000–2012 (%)	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

38

SCORE

BBB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**35**	**35**	**38**	▶	**BBB**
Energy performance					
Energy security	42	42	44	▶	B
Energy equity	68	66	66	▶	B
Environmental sustainability	46	51	48	▶	B
Contextual performance	22	20	23	▶	

TRENDS AND OUTLOOK

- Chile drops 3 places, from rank 35 in 2015 to rank 38 in 2016. The country performs well across all trilemma dimensions, with a balance score of BBB.
- Chile currently imports 60% of its total primary energy, exposing it to international commodity price volatility as well political and market related risks. The greatest challenges are perceived to be: securing fuel supply; developing local resources, in particular renewables; developing a regulatory framework for the gas sector; promoting energy efficiency; reducing biomass cooking and heating; promoting regional integration through gas and electricity interconnectors; advancing e-mobility and smart cities; and accounting for additional capacity delivered by upcoming tenders for electricity production.
- The 2014 Agenda de Energía sets the following targets: 1) 30% reduction of marginal costs of electricity in 4 years; 2) 25% price cuts of tenders for households as well as small and medium enterprises that produce electricity; 3) renewables to constitute 45% of capacity installed by 2025; 4) energy efficiency improvements to achieve a 20% savings target by 2025; 5) development of a framework to hedge exposure to fuel price volatility; 6) reform of state-owned ENAP to have a greater participation in new electricity generation; and 7) development of a comprehensive and inclusive energy policy.

KEY METRICS

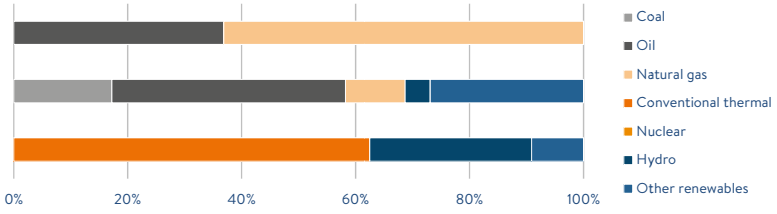
Industrial sector (% of GDP)	35.1	GDP per capita, PPP US$ (GDP Group)	22,316 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Medium (HHI = 2,231)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 53
Household electricity prices (US$/kWh)	0.09	Rate of transmission and distribution losses (%)	7.0
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2000–2012 (%)	3.6

ENERGY PROFILE

Fossil fuel reserves: 54 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CHINA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

87

SCORE

BBD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**87**	**87**	**87**	▶	**BBD**
Energy performance					
Energy security	83	70	62	▶	B
Energy equity	77	77	77	▶	B
Environmental sustainability	119	116	117	▶	D
Contextual performance	62	63	62	▶	

TRENDS AND OUTLOOK

- China maintains its position at rank 87. The country performs well in the energy security and energy equity dimensions, with its environmental sustainability score remaining relatively low, 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%. Energy intensity and carbon intensity reduced to 18% and 21% respectively, and the share of non-fossil energy increased to 15%.
- 2016 is 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. Related plans and policies, which will promote more sustainable development in the coming five years, will be announced soon.

KEY METRICS

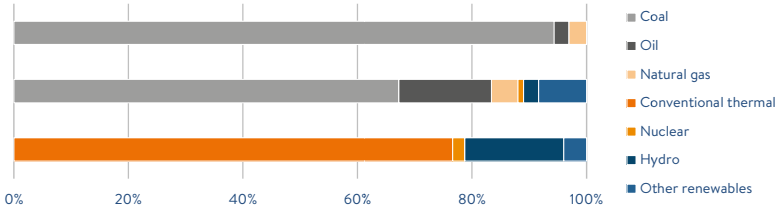
Industrial sector (% of GDP)	42.7	GDP per capita, PPP US$ (GDP Group)	14,239 (III)
Energy intensity (koe per US$)	0.13	Diversity of international energy suppliers	High (HHI = 572)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	70 | 19
Household electricity prices (US$/kWh)	0.08	Rate of transmission and distribution losses (%)	6.2
CO_2 intensity (kCO_2 per US$)	0.60	GHG emission growth rate 2000−2012 (%)	8.4

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

41

SCORE

BBA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**47**	**43**	**41**	▶	**BBA**
Energy performance					
Energy security	46	35	36	▶	B
Energy equity	79	81	80	▶	B
Environmental sustainability	7	8	10	▶	A
Contextual performance	68	66	68	▶	

TRENDS AND OUTLOOK

- Colombia improves by 2 places in this year's Index, to rank 41. The country performs well across all trilemma dimensions, with environmental sustainability, where it ranks 10th globally, being a particular strength. This results in a balance score of BBA.
- 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

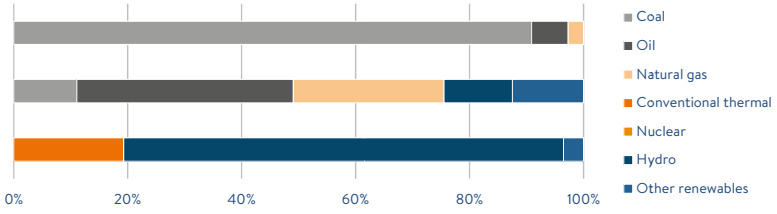
Industrial sector (% of GDP)	36.0	GDP per capita, PPP US$ (GDP Group)	13,801 (III)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Low (HHI = 7,767)
Population with access to electricity (%)	97	Access to clean cooking in urban | rural areas (%)	95 | 49
Household electricity prices (US$/kWh)	0.14	Rate of transmission and distribution losses (%)	12.3
CO_2 intensity (kCO_2 per US$)	0.13	GHG emission growth rate 2000–2012 (%)	1.7

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

117

SCORE

DDC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**115**	**116**	**117**	▶	**DDC**
Energy performance					
Energy security	95	94	98	▶	D
Energy equity	114	112	113	▶	D
Environmental sustainability	84	86	85	▶	C
Contextual performance	123	122	122	▶	

TRENDS AND OUTLOOK

- The Democratic Republic of the Congo (DRC) ranks 117th in this year's Index. Receiving low scores across all trilemma dimensions, energy equity is particularly weak, with a balance score of DDC.
- The DRC meets its energy needs mostly through biomass and hydropower. The country currently exploits only 2% of its hydroelectric resources from the Congo River, which is estimated to have the potential to supply 100 GW of power, the highest in Africa. Current hydro installed capacity is 2,420 MW, of which only 1,281 MW is operational. The World Bank and the African Development Bank are supporting the country to develop an additional 4,800 MW at the Inga 3 site.
- Despite such rich hydroelectric potential and 2009 reforms, the DRC has one of the lowest rates of electrification in the world, amounting in 2013 to 1% in rural areas and 19% in urban areas. This is due to a limited length of high voltage transmission lines (only 4,600 km).
- All these conditions have favoured the development of small and independent power producers and distributors, through which the country has been liberalising the sector, promoting private investment in generation and distribution.

KEY METRICS

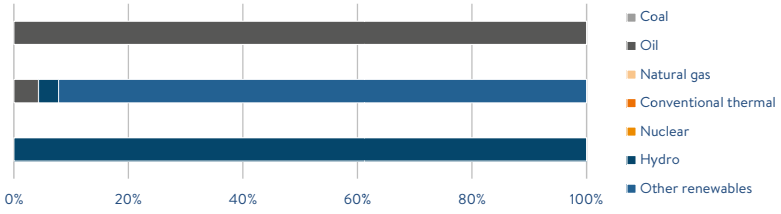
Industrial sector (% of GDP)	33.2	GDP per capita, PPP US$ (GDP Group)	783 (IV)
Energy intensity (koe per US$)	0.43	Diversity of international energy suppliers	Medium (HHI = 2,174)
Population with access to electricity (%)	15	Access to clean cooking in urban | rural areas (%)	14 | 5
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	N.A.
CO_2 intensity (kCO_2 per US$)	0.12	GHG emission growth rate 2000–2012 (%)	3.1

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

101

SCORE

ADC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**105**	**104**	**101**	▶	**ADC**
Energy performance					
Energy security	18	19	30	▶	A
Energy equity	107	106	105	▶	D
Environmental sustainability	99	95	94	▶	C
Contextual performance	116	113	102	▶	

TRENDS AND OUTLOOK

- Côte d'Ivoire improves by 3 places, from rank 104 in 2015 to rank 101 in 2016. The country has a strong performance in energy security, but energy equity remains its weakest trilemma dimension, resulting in a balance score of ADC.
- 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.
- The government agreed in 2012 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

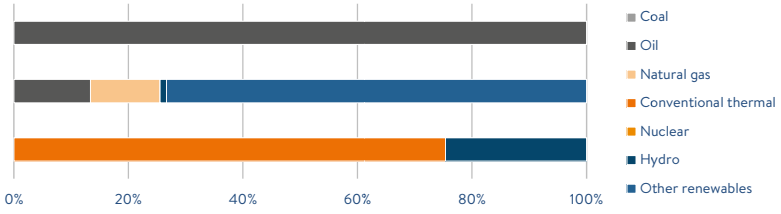
Industrial sector (% of GDP)	21.1	GDP per capita, PPP US$ (GDP Group)	3,496 (IV)
Energy intensity (koe per US$)	0.12	Diversity of international energy suppliers	Low (HHI = 6,872)
Population with access to electricity (%)	59	Access to clean cooking in urban | rural areas (%)	35 | 5
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	20.7
CO_2 intensity (kCO_2 per US$)	0.14	GHG emission growth rate 2000–2012 (%)	3.4

ENERGY PROFILE

Fossil fuel reserves: 14 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CROATIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

29

SCORE

BBA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**31**	**29**	**29**	▶	**BBA**
Energy performance					
Energy security	47	43	41	▶	B
Energy equity	44	44	43	▶	B
Environmental sustainability	34	28	26	▶	A
Contextual performance	49	44	54	▶	

TRENDS AND OUTLOOK

- Croatia maintains its position at rank 29. The country's trilemma performance is well balanced, with environmental sustainability receiving a particularly high score, resulting in a letter grade of BBA.
- 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

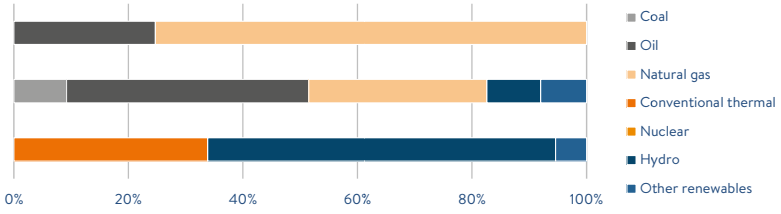
Industrial sector (% of GDP)	28.8	GDP per capita, PPP US$ (GDP Group)	21,880 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 1,393)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 82
Household electricity prices (US$/kWh)	0.18	Rate of transmission and distribution losses (%)	11.2
CO_2 intensity (kCO_2 per US$)	0.22	GHG emission growth rate 2000−2012 (%)	-0.2

ENERGY PROFILE

Fossil fuel reserves: 28 Mtoe

Total primary energy supply composition

Diversity of electricity generation



CYPRUS

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

60

SCORE

DBB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**76**	**64**	**60**	▲	**DBB**
Energy performance					
Energy security	115	116	112	▶	D
Energy equity	67	58	58	▶	B
Environmental sustainability	41	38	32	▶	B
Contextual performance	60	43	38	▲	

TRENDS AND OUTLOOK

- Cyprus improves by 4 places in this year's Index, to rank 60. While it performs well in terms of energy equity and environmental sustainability, it ranks low in the energy security dimension, resulting in a balance score of DBB.
- The major energy issue in Cyprus is to develop the natural gas offshore field in the Cyprus Exclusive Economic Zone (EEZ). The Aphrodite project, the first runner, began preparations for the development and production stage, following the announcement of its commerciality in 2015. The block is estimated to contain over 125 billion cubic metres of gas. Exploration of four other blocks is being conducted by ENI/KOGAS and Total.
- As of July 2016, eight energy companies have made expressions of interest for the exploration licencing rights in three offshore blocks. The development of the gas field will bring new opportunities to the Cyprus energy sector and national financial stability. On the other hand, marketing the gas could prove a challenge in the future because of competition from neighbouring projects in Israel and Egypt which have made the largest offshore natural gas discoveries in the Mediterranean.
- The electrical interconnection with Greece and Israel will be the next major challenge in the Cypriot energy sector. The Israel and Greece interconnections are due to be completed in 2019 and 2020 respectively. The project will effectively contribute to the 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. It is therefore expected that the country's energy security and environmental performance will improve in the coming years.

KEY METRICS

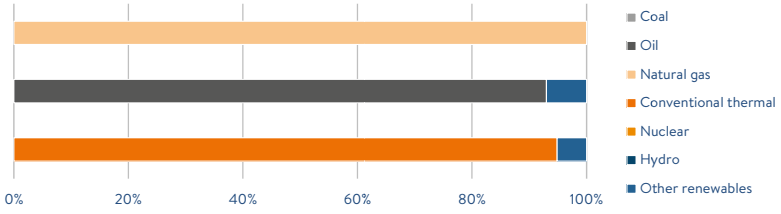
Industrial sector (% of GDP)	10.6	GDP per capita, PPP US$ (GDP Group)	30,734 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 2,321)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	N.A. | N.A.
Household electricity prices (US$/kWh)	0.31	Rate of transmission and distribution losses (%)	4.5
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2000–2012 (%)	0.3

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

19

SCORE

AAB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**23**	**21**	**19**	▶	**AAB**
Energy performance					
Energy security	17	14	14	▶	A
Energy equity	13	8	5	▶	A
Environmental sustainability	63	62	54	▶	B
Contextual performance	32	30	29	▶	

TRENDS AND OUTLOOK

- The Czech Republic improves by 2 places, to rank 19. The country's trilemma performance is well balanced, with a particularly high score in energy equity, where it ranks 5th worldwide. This results in a balance score 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; 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 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

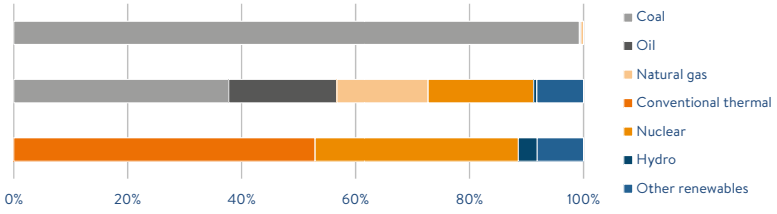
Industrial sector (% of GDP)	38.0	GDP per capita, PPP US$ (GDP Group)	32,167 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Medium (HHI = 2,312)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.17	Rate of transmission and distribution losses (%)	6.5
CO_2 intensity (kCO_2 per US$)	0.37	GHG emission growth rate 2000–2012 (%)	-1.1

ENERGY PROFILE

Fossil fuel reserves: 739 Mtoe

Total primary energy supply composition

Diversity of electricity generation



DENMARK

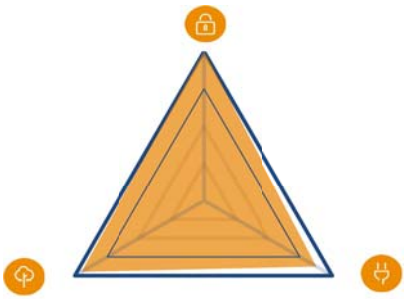
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

1

SCORE

AAA



	2014	2015	2016	Trend	Score
Overall rank and balance score	**1**	**1**	**1**	▶	**AAA**
Energy performance					
Energy security	1	1	1	▶	A
Energy equity	15	13	10	▶	A
Environmental sustainability	6	5	6	▶	A
Contextual performance	11	12	11	▶	

TRENDS AND OUTLOOK

- Denmark tops the Index this year, ranking 1st not only overall, but also on the energy security dimension. Its trilemma performance is excellently balanced, resulting in a letter grade of AAA.
- In March 2012 a new Energy Agreement was reached in Denmark. The Agreement contains a wide range of ambitious initiatives. This should bring Denmark closer to reaching the target of 100% renewable energy in the energy and transport sectors by 2050 by committing to large investments up to 2020 in energy efficiency, renewable energy and the overall energy system. Targets to reach by 2020 include approximately 50% of electricity consumption supplied by wind power, and more than 35% of final energy consumption supplied from renewable energy sources.
- To overcome the challenges and reach its ambitious targets of becoming independent of fossil fuels and reducing CO_2 emissions, Danish policymakers are focusing on the implications of: being fossil fuel free for the transport sector; the future role of the Danish natural gas grid; and the introduction of huge amounts of fluctuating renewable energy in the electricity grid.

KEY METRICS

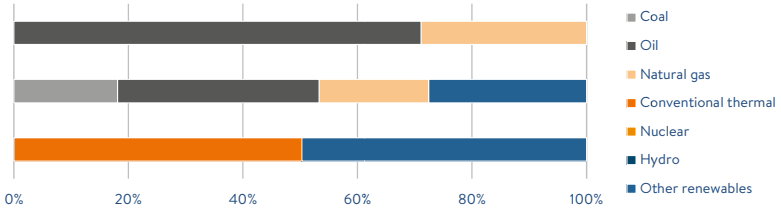
Industrial sector (% of GDP)	22.5	GDP per capita, PPP US$ (GDP Group)	46,635 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 1,597)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	N.A. | N.A.
Household electricity prices (US$/kWh)	0.40	Rate of transmission and distribution losses (%)	5.6
CO_2 intensity (kCO_2 per US$)	0.18	GHG emission growth rate 2000−2012 (%)	-2.8

ENERGY PROFILE

Fossil fuel reserves: 104 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ECUADOR

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

50

SCORE

BBC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**51**	**50**	**50**	▶	**BBC**
Energy performance					
Energy security	51	49	50	▶	B
Energy equity	47	49	46	▶	B
Environmental sustainability	70	72	79	▶	C
Contextual performance	98	96	101	▶	

TRENDS AND OUTLOOK

- Ecuador maintains its place from last year at rank 50. Its trilemma performance is well balanced overall, with the environmental sustainability dimension lagging slightly behind the other two, 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

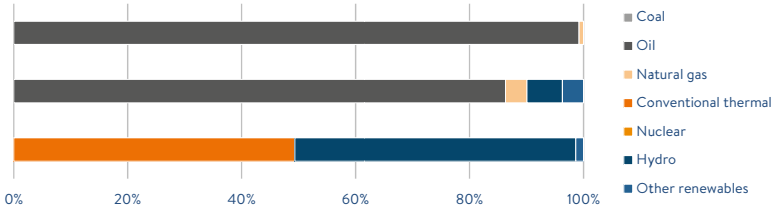
Industrial sector (% of GDP)	39.1	GDP per capita, PPP US$ (GDP Group)	11,388 (III)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 4,260)
Population with access to electricity (%)	97	Access to clean cooking in urban | rural areas (%)	95 | 87
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	12.4
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2000−2012 (%)	4.4

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

68

SCORE

CBB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**64**	**72**	**68**	▶	**CBB**
Energy performance					
Energy security	94	93	90	▶	C
Energy equity	58	65	60	▶	B
Environmental sustainability	44	44	49	▶	B
Contextual performance	106	109	113	▶	

TRENDS AND OUTLOOK

- Egypt improves by 4 places, to rank 68. The country receives a good score in the energy equity and environmental sustainability dimensions, but lags behind regarding energy security, scoring 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 going through, challenges related to energy security need to be overcome. These challenges 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

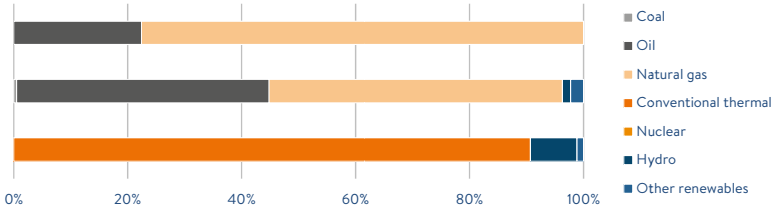
Industrial sector (% of GDP)	39.9	GDP per capita, PPP US$ (GDP Group)	10,891 (III)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	High (HHI = 1,215)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	13.1
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000–2012 (%)	5.8

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

40

SCORE

ABD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**48**	**44**	**40**	▶	**ABD**
Energy performance					
Energy security	39	27	22	▲	A
Energy equity	54	53	50	▶	B
Environmental sustainability	107	107	111	▶	D
Contextual performance	20	18	20	▶	

TRENDS AND OUTLOOK

- Estonia improves by 4 places in this year's Index, to rank 40. While it receives good scores in energy security and energy equity, its poor score in the environmental sustainability dimension results in an imbalanced trilemma performance, with a score 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. To remedy this, the government is now introducing a 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 find 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

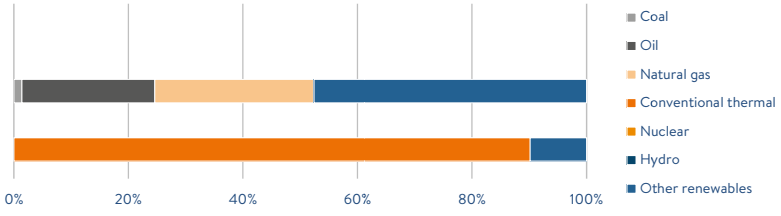
Industrial sector (% of GDP)	28.1	GDP per capita, PPP US$ (GDP Group)	28,095 (II)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	Low (HHI = 3,302)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 69
Household electricity prices (US$/kWh)	0.18	Rate of transmission and distribution losses (%)	10.2
CO_2 intensity (kCO_2 per US$)	0.74	GHG emission growth rate 2000–2012 (%)	1.0

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ETHIOPIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

118

SCORE

DDC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**121**	**120**	**118**	▶	**DDC**
Energy performance					
Energy security	111	107	102	▶	D
Energy equity	117	118	117	▶	D
Environmental sustainability	91	87	90	▶	C
Contextual performance	112	114	111	▶	

TRENDS AND OUTLOOK

- Ethiopia improves by 2 places, from rank 120 in 2015 to rank 118 in 2016. While attaining low scores on the whole, environmental sustainability is the country's strongest trilemma dimension, resulting in a balance score of DDC.
- Ethiopia's GDP growth of about 11% for the last 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

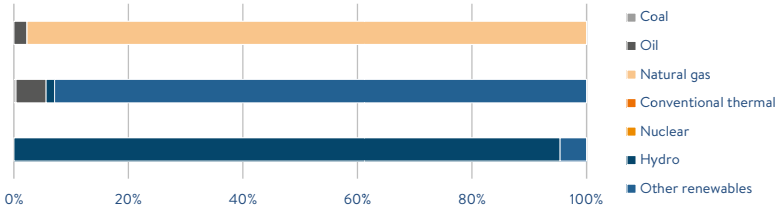
Industrial sector (% of GDP)	14.7	GDP per capita, PPP US$ (GDP Group)	1,626 (IV)
Energy intensity (koe per US$)	0.32	Diversity of international energy suppliers	Low (HHI = 3,971)
Population with access to electricity (%)	23	Access to clean cooking in urban | rural areas (%)	27 | 5
Household electricity prices (US$/kWh)	0.03	Rate of transmission and distribution losses (%)	21.4
CO_2 intensity (kCO_2 per US$)	0.08	GHG emission growth rate 2000–2012 (%)	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

8

SCORE

AAB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**5**	**3**	**8**	▶	**AAB**
Energy performance					
Energy security	2	2	3	▶	A
Energy equity	24	21	24	▶	A
Environmental sustainability	78	74	71	▶	B
Contextual performance	3	2	2	▶	

TRENDS AND OUTLOOK

- Finland drops 5 places in this year's Index, to rank 8. Finland's energy trilemma is well balanced, and it places 3rd globally in the energy security dimension, resulting in a letter grade of AAB.
- 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 completely phase out energy production from coal and to halve oil imports by 2030. Imports of hard coal have already decreased in 2015, which could have a positive effect on the trilemma's energy security dimension. Further, 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

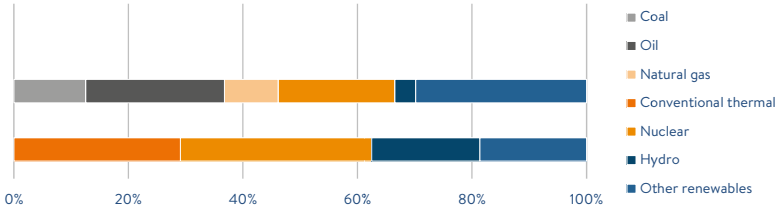
Industrial sector (% of GDP)	26.5	GDP per capita, PPP US$ (GDP Group)	40,601 (I)
Energy intensity (koe per US$)	0.13	Diversity of international energy suppliers	Low (HHI = 3,692)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.20	Rate of transmission and distribution losses (%)	3.0
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2000–2012 (%)	-1.0

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



FRANCE

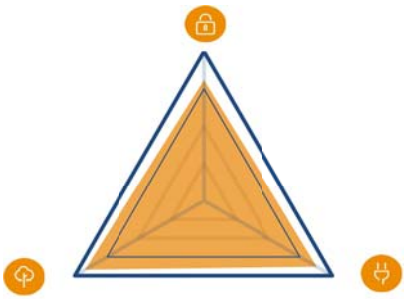
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

6

SCORE

AAA



	2014	2015	2016	Trend	Score
Overall rank and balance score	**10**	**9**	**6**	▶	**AAA**
Energy performance					
Energy security	24	21	16	▶	A
Energy equity	10	12	9	▶	A
Environmental sustainability	11	13	11	▶	A
Contextual performance	21	22	19	▶	

TRENDS AND OUTLOOK

- France improves by 3 places to rank 6. The country balances the trilemma excellently and places in the top 10 globally in the energy equity dimension, resulting in a balance 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 about 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 to cut 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

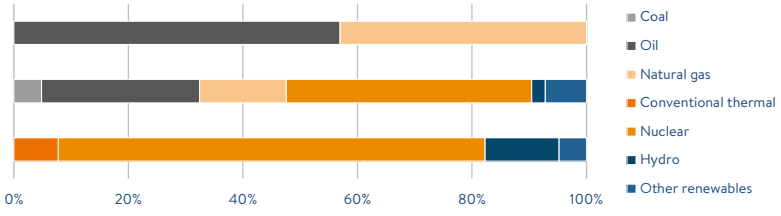
Industrial sector (% of GDP)	19.4	GDP per capita, PPP US$ (GDP Group)	39,678 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 728)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.23	Rate of transmission and distribution losses (%)	7.6
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2000−2012 (%)	-1.2

ENERGY PROFILE

Fossil fuel reserves: 19 Mtoe

Total primary energy supply composition

Diversity of electricity generation



GERMANY

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

5

SCORE

AAA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**4**	**5**	**5**	▶	**AAA**
Energy performance					
Energy security	6	6	7	▶	A
Energy equity	20	22	15	▶	A
Environmental sustainability	24	29	31	▶	A
Contextual performance	14	16	15	▶	

TRENDS AND OUTLOOK

- Germany maintains its 2015 position, at rank 5. The country's energy trilemma is excellently balanced, and it places 7th globally regarding energy security, for an overall balance score of AAA.
- The most recent policy development in Germany, initiated before 2010, is the German Energy Transition, targeting sustainability and focusing 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. Eight out of 17 facilities were closed immediately, one was closed in 2015, and the remaining eight nuclear power plants will be phased out gradually over the next seven 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 increased share of renewables, the Renewable Energy Law (EEG) guarantees a fixed price, independent of demand and supply for renewable power plants. The law is disabling market mechanisms, allowing the sector to rely on subsidies rather than encouraging competition for innovative, efficient and inexpensive technologies. Subsidies for renewable energy and investments in grid infrastructure to integrate the increasing amounts of volatile renewable energy into the system have led and will continue to lead to higher electricity prices. Policymakers must set the right framework towards a free and efficient European electricity market to limit the burden.

KEY METRICS

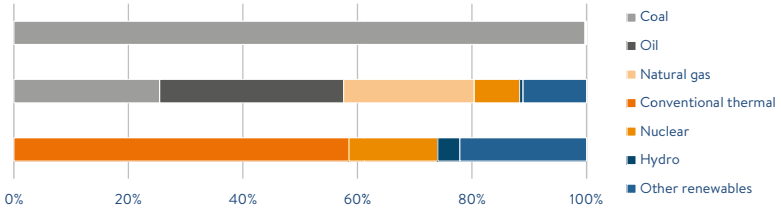
Industrial sector (% of GDP)	30.3	GDP per capita, PPP US$ (GDP Group)	47,268 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,387)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.40	Rate of transmission and distribution losses (%)	3.7
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000–2012 (%)	-0.8

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

99

SCORE

BDC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**95**	**97**	**99**	▶	**BDC**
Energy performance					
Energy security	32	36	35	▶	B
Energy equity	104	105	106	▶	D
Environmental sustainability	75	78	81	▶	C
Contextual performance	80	83	91	▶	

TRENDS AND OUTLOOK

- Ghana drops 2 places in this year's Index, from rank 97 in 2015 to rank 99 in 2016. While the country achieves good results in the energy security dimension, it lags behind regarding energy equity, resulting in a balance score of BDC.
- In order to improve energy security, energy equity and environmental sustainability Ghana needs to address a number of related challenges, such as: 1) the lack of a credible, sustained and focused energy policy; 2) the inability to execute policies; 3) governmental interference; and 4) ineffective regulatory authorities.
- Recent policy developments include: the enactment of Electricity Regulations, 2008 (L.I 1937), which is intended to provide for the planning, expansion, safety criteria, reliability and cost-effectiveness of the Interconnected Transmission System, and to regulate the wholesale electricity market; the enactment of the Renewable Energy Act, 2011 (Act 832) to improve the development, management and utilisation of renewable energy sources for production of heat and power in an efficient and environmentally-sustainable manner; 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

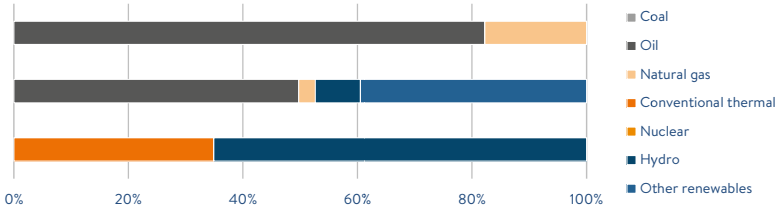
Industrial sector (% of GDP)	27.7	GDP per capita, PPP US$ (GDP Group)	4,201 (IV)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Low (HHI = 3,991)
Population with access to electricity (%)	61	Access to clean cooking in urban | rural areas (%)	28 | 5
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	23.6
CO_2 intensity (kCO_2 per US$)	0.16	GHG emission growth rate 2000−2012 (%)	7.4

ENERGY PROFILE

Fossil fuel reserves: 109 Mtoe

Total primary energy supply composition

Diversity of electricity generation



GREECE

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

33

SCORE

BBA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**37**	**37**	**33**	▶	**BBA**
Energy performance					
Energy security	84	77	56	▲	B
Energy equity	45	46	44	▶	B
Environmental sustainability	21	23	19	▶	A
Contextual performance	55	48	46	▶	

TRENDS AND OUTLOOK

- Greece improves by 4 places, to rank 33. The country's energy trilemma performance is well balanced overall, resulting in a letter grade of BBA.
- Greece has put in place a number of policy instruments to meet the ever-increasing electricity demand, favouring the market uptake of renewable energy sources. The aim is also to attempt to reduce the share of coal in electricity generation, 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

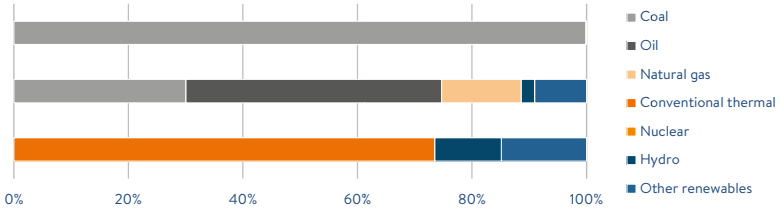
Industrial sector (% of GDP)	15.8	GDP per capita, PPP US$ (GDP Group)	26,680 (II)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	Medium (HHI = 1,696)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.24	Rate of transmission and distribution losses (%)	6.9
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2000−2012 (%)	-1.1

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

37

SCORE

DAA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**38**	**40**	**37**	▶	**DAA**
Energy performance					
Energy security	120	121	117	▶	D
Energy equity	26	29	31	▶	A
Environmental sustainability	20	20	20	▶	A
Contextual performance	9	8	7	▶	

TRENDS AND OUTLOOK

- Hong Kong improves by 3 places in this year's Index, to rank 37. The country receives excellent scores in the energy equity and environmental sustainability dimensions, but lags behind regarding energy security, resulting in a balance score of DAA.
- The economy has scarce indigenous energy sources and about 25% of electricity is imported. To secure 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 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 around the year 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

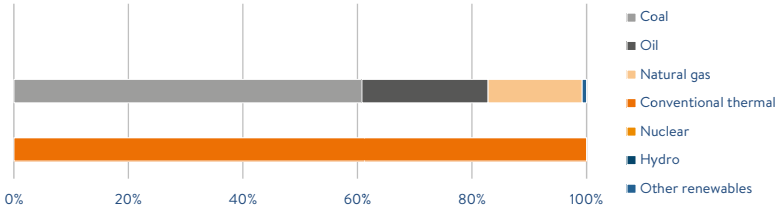
Industrial sector (% of GDP)	7.3	GDP per capita, PPP US$ (GDP Group)	56,719 (I)
Energy intensity (koe per US$)	0.03	Diversity of international energy suppliers	Medium (HHI = 1,961)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	N.A. | N.A.
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	11.6
CO_2 intensity (kCO_2 per US$)	0.14	GHG emission growth rate 2000–2012 (%)	N.A.

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ICELAND

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

15

SCORE

BAA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**13**	**12**	**15**	▶	**BAA**
Energy performance					
Energy security	54	54	57	▶	B
Energy equity	17	17	19	▶	A
Environmental sustainability	1	2	2	▶	A
Contextual performance	17	17	17	▶	

TRENDS AND OUTLOOK

- Iceland drops 3 places, to rank 15. Iceland performs well across the board, with environmental sustainability being a particular strength. This results 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

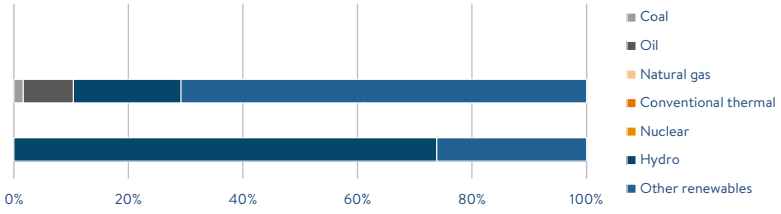
Industrial sector (% of GDP)	23.6	GDP per capita, PPP US$ (GDP Group)	46,547 (I)
Energy intensity (koe per US$)	0.22	Diversity of international energy suppliers	Low (HHI = 2,671)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	2.1
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2000−2012 (%)	-1.4

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



INDIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

91

SCORE

BCC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**90**	**92**	**91**	▶	**BCC**
Energy performance					
Energy security	50	60	51	▶	B
Energy equity	95	93	93	▶	C
Environmental sustainability	98	96	97	▶	C
Contextual performance	101	105	100	▶	

TRENDS AND OUTLOOK

- India improves by 1 place in the 2016 Index to rank 91. The country receives a balance score of B for energy security and receives lower scores in the energy equity and environmental sustainability dimensions, resulting in an overall balance score of BCC.
- India's Intended Nationally Determined Contributions (INDCs) include; reduction of emission intensity of GDP by 33−35 % by 2030 from 2005 levels; about 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_{2e} through additional forest cover by 2030.
- Recent policy developments and impacts include: 1) phased implementation of 175 GW RE power capacity by 2022; 2) UDAY to turn around DISCOMS; 3) DDUGJY scheme for rural electrification; 4) EPAR for limiting emissions from coal-fired stations; 5) leapfrogging to latest emission standards in road transport sector; 6) help for boosting of domestic oil and gas exploration and production sector; 7) tighter LPG subsidy beneficiary targeting via DBT; 8) improved availability of coal through transparent coal block auction; 9) second cycle of PAT for industrial energy efficiency notified with wider scope; 10) DSM through large-scale replacement by LEDs; 11) smart cities.
- Key challenges include: 1) DISCOM reforms yielding expected results; 2) growth in manufacturing through Make-in India; 3) expanding energy access; 4) integrating large RE capacity.

KEY METRICS

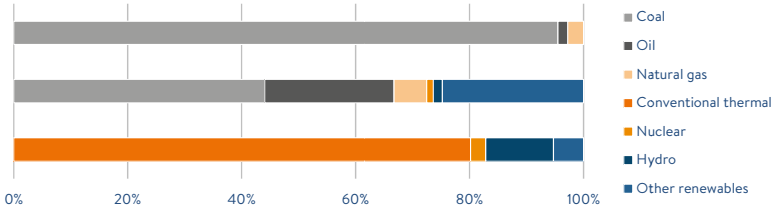
Industrial sector (% of GDP)	30.1	GDP per capita, PPP US$ (GDP Group)	6,089 (III)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	High (HHI = 779)
Population with access to electricity (%)	75	Access to clean cooking in urban | rural areas (%)	77 | 14
Household electricity prices (US$/kWh)	0.08	Rate of transmission and distribution losses (%)	19.7
CO_2 intensity (kCO_2 per US$)	0.32	GHG emission growth rate 2000−2012 (%)	6.1

ENERGY PROFILE

Fossil fuel reserves: 44,262 Mtoe

Total primary energy supply composition

Diversity of electricity generation



IRAN (ISLAMIC REPUBLIC)

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

78

SCORE

BBD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**79**	**80**	**78**	▶	**BBD**
Energy performance					
Energy security	75	81	58	▶	B
Energy equity	33	37	40	▶	B
Environmental sustainability	116	118	119	▶	D
Contextual performance	107	107	105	▶	

TRENDS AND OUTLOOK

- Iran improves by 2 places in this year's Index, to rank 78. The country performs well in the energy security and energy equity dimensions, but lags behind regarding environmental sustainability, resulting in a balance score of BBD.
- Home of the world's fourth largest proved crude oil reserves and second largest natural gas reserves, Iran's energy sector has not managed to develop, due to international sanctions. After sanctions were lifted in early 2016, Iran's oil exports have tripled compared to figures from late 2015, now exceeding 2 million barrels per day.
- Further, Iran has managed to attract significant foreign investment and more efficient technologies for energy generation and transformation are now being employed. This includes a contract with Turkey to build 5,000 MW of advanced combined-cycle power plants with about 60% efficiency, to be completed within the next three years.
- The country is also taking steps to address the trilemma's environmental sustainability dimension, with plans to install 5 GW of both solar panels and wind turbines by 2021. These could help to render Iran's renewable energy infrastructure more resilient to extreme weather events: recurring droughts have significant negative effects on the country's hydroelectric power plants. Due to droughts in early 2016, hydropower plants are only able to operate at around 15% capacity.

KEY METRICS

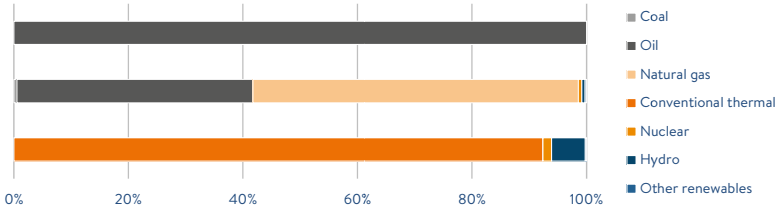
Industrial sector (% of GDP)	38.2	GDP per capita, PPP US$ (GDP Group)	17,366 (II)
Energy intensity (koe per US$)	0.15	Diversity of international energy suppliers	High (HHI = 866)
Population with access to electricity (%)	98	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	13.7
CO_2 intensity (kCO_2 per US$)	0.53	GHG emission growth rate 2000–2012 (%)	4.7

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

74

SCORE

BBD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**68**	**69**	**74**	▶	**BBD**
Energy performance					
Energy security	68	59	64	▶	B
Energy equity	52	54	53	▶	B
Environmental sustainability	92	92	100	▶	D
Contextual performance	118	118	118	▶	

TRENDS AND OUTLOOK

- In this year's Index, Iraq drops 5 places, to rank 74. The country receives good scores regarding energy security and energy equity, with environmental sustainability being Iraq's lowest scoring trilemma dimension. This results in a balance score of BBD.
- The Iraqi energy sector is still completely owned by the public sector. The energy sector 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) render 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

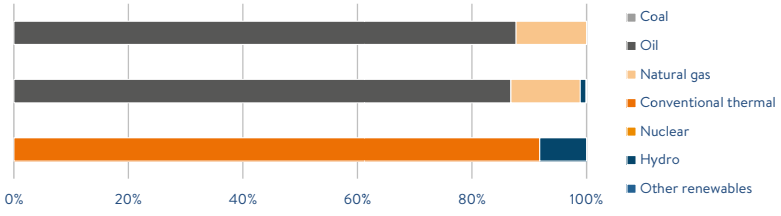
Industrial sector (% of GDP)	63.8	GDP per capita, PPP US$ (GDP Group)	14,895 (II)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Low (HHI = 4,669)
Population with access to electricity (%)	98	Access to clean cooking in urban | rural areas (%)	95 | 91
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	26.7
CO_2 intensity (kCO_2 per US$)	0.29	GHG emission growth rate 2000−2012 (%)	3.2

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

	2014	2015	2016	Trend	Score
Overall rank and balance score	**17**	**19**	**20**	▶	**CAA**
Energy performance					
Energy security	70	75	77	▶	C
Energy equity	18	16	16	▶	A
Environmental sustainability	9	10	7	▶	A
Contextual performance	10	11	10	▶	

TRENDS AND OUTLOOK

- Ireland ranks 20th in this year's Index. The country performs well regarding energy equity and environmental sustainability, placing 7th globally in the latter. This 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% in 2014. 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

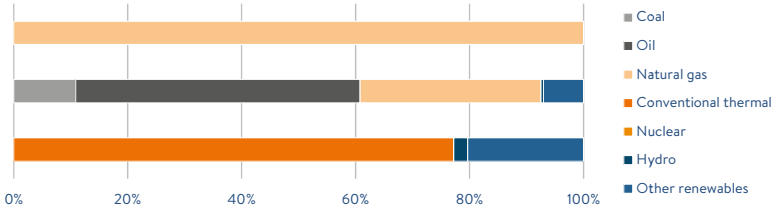
Industrial sector (% of GDP)	25.6	GDP per capita, PPP US$ (GDP Group)	54,654 (I)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Low (HHI = 4,440)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.34	Rate of transmission and distribution losses (%)	7.6
CO_2 intensity (kCO_2 per US$)	0.18	GHG emission growth rate 2000−2012 (%)	-1.3

ENERGY PROFILE

Fossil fuel reserves: 8 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ISRAEL

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

34

SCORE

CAA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**30**	**34**	**34**	▶	**CAA**
Energy performance					
Energy security	79	85	85	▶	C
Energy equity	39	35	36	▶	A
Environmental sustainability	36	37	29	▶	A
Contextual performance	23	24	22	▶	

TRENDS AND OUTLOOK

- Israel maintains its place in this year's ranking, at 34. The country performs well in the energy equity and environmental sustainability dimensions, receiving its lowest score in energy security. This results in a balance score of CAA.
- 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

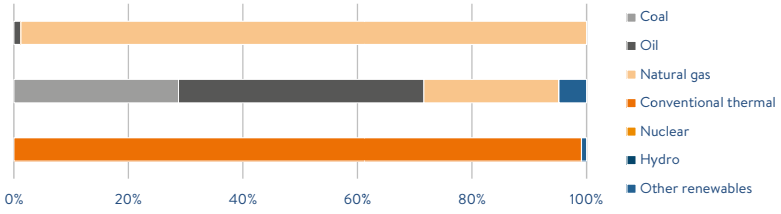
Industrial sector (% of GDP)	31.4	GDP per capita, PPP US$ (GDP Group)	35,432 (I)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Low (HHI = 3,383)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	4.6
CO_2 intensity (kCO_2 per US$)	0.27	GHG emission growth rate 2000−2012 (%)	2.7

ENERGY PROFILE

Fossil fuel reserves: 165 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ITALY

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

17

SCORE

AAA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**24**	**23**	**17**	▶	**AAA**
Energy performance					
Energy security	25	23	19	▶	A
Energy equity	32	33	32	▶	A
Environmental sustainability	19	19	14	▶	A
Contextual performance	39	40	40	▶	

TRENDS AND OUTLOOK

- Italy improves by 6 places in this year's Index, to rank 17, earning a perfect score across the board (overall balance score of AAA).
- Italy has one of the most efficient thermoelectric generation systems in Europe and the energy mix for power generation is dominated by natural gas and renewable energy (gas 48%, renewable 28%, coal 15%, oil 3%, other 7%). Energy efficiency improved in the residential, commercial and transport sectors, with impressive achievements in the reduction of GHG emissions and water pollution between 2005 and 2013.
- Recent policy developments include: an extension of the incentives scheme for PV installations, energy efficiency, seismic retrofitting of buildings, building renovations and energy storage systems; Conto Energia, a mechanism supporting the production of energy from solar PV and solar thermal plants in buildings and businesses; Conto Termico 2.0, which encourages measures to increase energy efficiency and the production of thermal energy from renewable sources; a 20-year plan for funding non-solar renewable energy such as wind, geothermal, biomass and thermodynamic. These measures aim to lower the burden of incentives on energy bills, increase the share of renewables in thermal uses, and improve efficiency.
- Increased interconnection of the Italian natural gas market with EU markets is expected to increase Italian energy security, also lowering natural gas prices in the wholesale market. The government has also restored the minimum limit of 12 miles from the coast for off-shore oil and gas drilling activities.

KEY METRICS

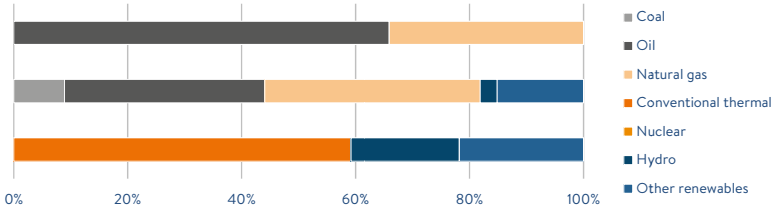
Industrial sector (% of GDP)	23.5	GDP per capita, PPP US$ (GDP Group)	35,896 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 886)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.31	Rate of transmission and distribution losses (%)	6.7
CO_2 intensity (kCO_2 per US$)	0.19	GHG emission growth rate 2000–2012 (%)	-1.1

ENERGY PROFILE

Fossil fuel reserves: 124 Mtoe

Total primary energy supply composition

Diversity of electricity generation



JAPAN

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

30

SCORE

CAB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**28**	**30**	**30**	▶	**CAB**
Energy performance					
Energy security	61	83	78	▶	C
Energy equity	38	23	23	▶	A
Environmental sustainability	37	40	41	▶	B
Contextual performance	19	21	21	▶	

TRENDS AND OUTLOOK

- In this year's Index, Japan maintains its place at rank 30. The country performs well in the energy equity and environmental sustainability dimensions, but lags behind in terms of energy security, resulting in a balance score of CAB.
- The government has amended the five-year-old feed-in tariff (FIT) system, with changes to be introduced in April 2017. One of the criticisms of the current FIT system is that purchasing prices were set high. To address this criticism, the new FIT system introduces a bidding system for the purchasing price from large-scale PVs such as mega-solar farms.
- The Nuclear Regulation Authority (NRA) approved the safety measures of Sendai, Takahama and Ikata nuclear power plants based on new safety standards. While Ikata nuclear plant unit 3 (890 MW) started its operation in August 2016, Takahama nuclear plants (2 units, 870 MW each) were operational in early 2016, but have been temporarily shut down.
- Although some challenges might be encountered in restarting the remaining nuclear plants, many of these plants are expected to restart in the long run and Japan's energy security score will improve. Additionally, the plant owners are expecting a lifetime extension of nuclear plants from 40 years to at most 60 years.

KEY METRICS

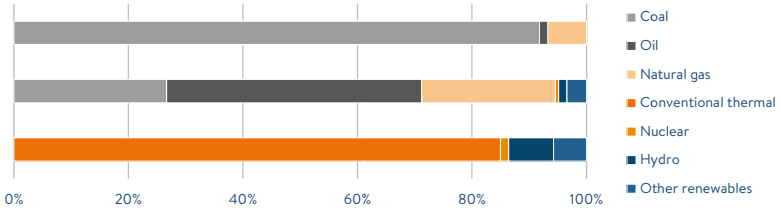
Industrial sector (% of GDP)	26.2	GDP per capita, PPP US$ (GDP Group)	37,322 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,015)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.11	Rate of transmission and distribution losses (%)	4.8
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2000–2012 (%)	0.4

ENERGY PROFILE

Fossil fuel reserves: 264 Mtoe

Total primary energy supply composition

Diversity of electricity generation



JORDAN

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

75

SCORE

DBC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**62**	**67**	**75**	▼	**DBC**
Energy performance					
Energy security	93	100	106	▼	D
Energy equity	48	50	52	▶	B
Environmental sustainability	76	83	82	▶	C
Contextual performance	71	68	72	▶	

TRENDS AND OUTLOOK

- Jordan drops 8 places, from rank 67 in 2015 to rank 75 in 2016. Energy equity is the country's strongest trilemma dimension, while energy security is its weakest, resulting in a balance score of DBC.
- The major current challenges for the country are an extremely high dependence on imports with over 95% of its energy demand annually being imported. These imports impose a heavy cost burden, representing about 20% of the GDP in 2014. The Arab Spring leaves the country in constant instability of supply of oil and natural gas. Energy demand is projected to continue to grow between 5–7% annually with the flow of refugees, national population growth, and expansion of development projects. The country's current and future top priorities are to achieve a diversification of energy sources by introducing alternative energy, exploiting domestic reserves, and switching from import of Piped Natural Gas (PNG) to Liquefied Natural Gas (LNG).
- The country has been attempting to increase the share of nuclear, solar and wind power to 16% of the total energy mix by 2020 compared to 2% in 2013, signing a $10bn deal for construction of 2,000 MW nuclear power reactors with Russian state-owned company Rosatom in March 2015. The oil shale reserve has been developed by the Jordan Oil Shale Company and Shell with the expectation that shales will contribute 14% to the nation's energy mix in 2020. A new LNG terminal opened in July 2015 to replace the import of oil and unstable PNG. This will also contribute to reducing CO_2 emissions as well as increasing energy security.

KEY METRICS

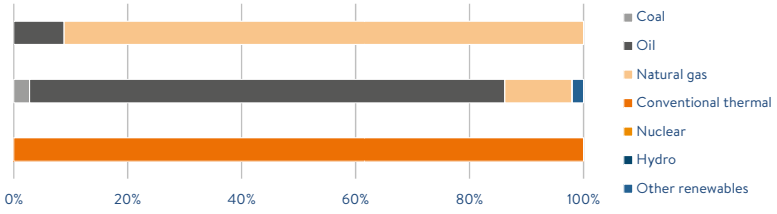
Industrial sector (% of GDP)	29.8	GDP per capita, PPP US$ (GDP Group)	10,880 (III)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 2,854)
Population with access to electricity (%)	99	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	14.5
CO_2 intensity (kCO_2 per US$)	0.37	GHG emission growth rate 2000–2012 (%)	3.8

ENERGY PROFILE

Fossil fuel reserves: 6 Mtoe

Total primary energy supply composition

Diversity of electricity generation



KAZAKHSTAN

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

82

SCORE

CBD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**75**	**84**	**82**	▶	**CBD**
Energy performance					
Energy security	37	72	65	▶	C
Energy equity	53	52	54	▶	B
Environmental sustainability	121	123	122	▶	D
Contextual performance	56	60	50	▶	

TRENDS AND OUTLOOK

- Kazakhstan improves by 2 places in this year's Index, to rank 82. The country receives good scores regarding energy security and energy equity, but performs poorly in the environmental sustainability dimension, for a balance score of CBD.
- Recent policy developments in Kazakhstan include: strengthening state institutions responsible for energy efficiency in production, extraction and consumption of energy; clear and comprehensive energy saving programmes to reduce the energy intensity of industry (a 25% reduction by 2020 compared to 2008); the adoption of policies to support the development and inclusion of available renewable energy sources (RES) into the energy mix (renewable and alternative sources by 2050 should provide 50% of the country's electricity); and plans and programmes to facilitate the modernisation of existing power generation, power grids and oil refining installations. The diversification of the generation portfolio will be enhanced by Kazakhstan's Transition to a Green Economy, approved by the Order of the President of Kazakhstan in 2013.
- Policymakers will continue existing successful practices to maintain a favourable investment climate, which allows improvements to the country's trilemma balance, and attracts investment into the exploration and production of energy resources for export to world markets. There is a need to further develop power generating facilities by introducing cutting-edge technologies that will not only ensure domestic supply, but also enable the country to offer significant amounts of electricity to markets in neighbouring countries.

KEY METRICS

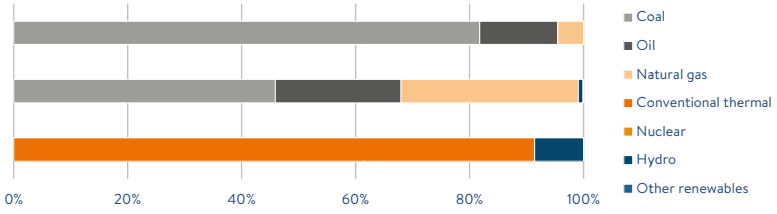
Industrial sector (% of GDP)	36.0	GDP per capita, PPP US$ (GDP Group)	25,877 (II)
Energy intensity (koe per US$)	0.12	Diversity of international energy suppliers	Low (HHI = 5,555)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 77
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	8.0
CO_2 intensity (kCO_2 per US$)	0.69	GHG emission growth rate 2000–2012 (%)	6.0

ENERGY PROFILE

Fossil fuel reserves: 28,663 Mtoe

Total primary energy supply composition

Diversity of electricity generation



KENYA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

107

SCORE

BDB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**107**	**107**	**107**	▶	**BDB**
Energy performance					
Energy security	31	37	47	▼	B
Energy equity	118	117	118	▶	D
Environmental sustainability	56	55	58	▶	B
Contextual performance	94	93	89	▶	

TRENDS AND OUTLOOK

- Kenya maintains its place in this year's index, at rank 107. The country performs well in the energy security and environmental sustainability dimensions, but receives a balance score of D in energy equity, for an overall letter grade of BDB.
- Kenya's energy sector faces a number of challenges: growing demand, inadequate power supply capacity, a low connectivity rate, a weak transmission and distribution network, and lack of investments from the private sector. The country's high dependence on hydropower also exposes the energy sector to emerging risks, such as extreme weather events.
- Recent developments to boost electricity generation include the commissioning of: 1) the Olkaria IV power plant, the world's largest single-turbine geothermal power plant, which will add 140 MW to the grid; 2) the largest wind energy project in the region to deliver 15% of supply; and 3) 1 GW of world-class solar projects to be built by SkyPower over the next five years.
- In its long-term development strategy 'Vision 2030', energy was identified as one of the critical foundations and enablers of the socio-economic transformation envisioned for the country. To this effect a number of policies and regulations have been developed: the 2015 Energy Bill to consolidate all laws relating to energy, the National Energy and Petroleum Policy 2015 to support the administration of all the proposed laws and the Petroleum Exploration, Development and Production Local Content Regulations 2014 Act for local content provisions to name a few.

KEY METRICS

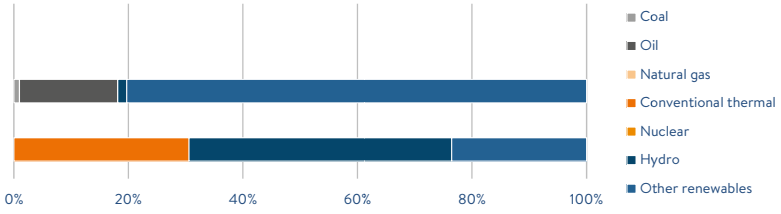
Industrial sector (% of GDP)	19.4	GDP per capita, PPP US$ (GDP Group)	3,083 (IV)
Energy intensity (koe per US$)	0.12	Diversity of international energy suppliers	Low (HHI = 2,994)
Population with access to electricity (%)	19	Access to clean cooking in urban | rural areas (%)	61 | 5
Household electricity prices (US$/kWh)	0.11	Rate of transmission and distribution losses (%)	15.6
CO_2 intensity (kCO_2 per US$)	0.10	GHG emission growth rate 2000−2012 (%)	2.4

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



KOREA (REPUBLIC)

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

44

SCORE

CAC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**43**	**46**	**44**	▶	**CAC**
Energy performance					
Energy security	72	76	72	▶	C
Energy equity	30	38	35	▶	A
Environmental sustainability	87	89	88	▶	C
Contextual performance	28	29	28	▶	

TRENDS AND OUTLOOK

- In this year's Index, Korea (Rep.) ranks 44th. Energy equity is the country's strongest trilemma dimension, while it receives a letter grade of C in both energy security and environmental sustainability, for a balance score of CAC.
- Energy security remains a major challenge with a very low stability of resource supplies and an energy import dependency of around 97%.
- Recent policy measures to enhance energy security include: expanding cooperation with resource-rich countries; strengthening the competitiveness of energy developing companies; and establishing the Overseas Resource Development Fund to fund energy development projects in addition to giving government loans and guarantees. Environmental sustainability policy measures include: the expansion of renewable energy with targets until 2030 and the strong support of RD&D. Nuclear energy plays an essential role in the country's energy system in terms of energy security, economics, climate change and load demand.
- Policymakers need to continue focusing on: 1) the enhancement of overseas energy development; 2) the development of renewable energy; and 3) the expansion of the nuclear power sector, with consideration given to safety issues, waste disposal, and increasing public acceptance by providing objective information and being transparent.

KEY METRICS

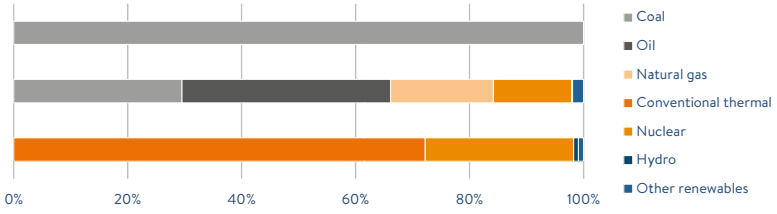
Industrial sector (% of GDP)	38.2	GDP per capita, PPP US$ (GDP Group)	34,549 (I)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	High (HHI = 926)
Population with access to electricity (%)	93	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.24	Rate of transmission and distribution losses (%)	3.5
CO_2 intensity (kCO_2 per US$)	0.36	GHG emission growth rate 2000–2012 (%)	2.8

ENERGY PROFILE

Fossil fuel reserves: 88 Mtoe

Total primary energy supply composition

Diversity of electricity generation



KUWAIT

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

53

SCORE

CAD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**59**	**56**	**53**	▶	**CAD**
Energy performance					
Energy security	81	74	75	▶	C
Energy equity	19	24	21	▶	A
Environmental sustainability	96	98	99	▶	D
Contextual performance	79	78	76	▶	

TRENDS AND OUTLOOK

- Kuwait improves by 3 places, from rank 56 in 2015 to rank 53 in 2016. Energy equity is by far the country's strongest trilemma dimension, with Kuwait receiving its lowest letter grade for its environmental sustainability performance, resulting in a balance score of CAD.
- In light of the rapidly increasing power demand over the past decade, the government unveiled an extensive development plan for the electric grid. Since 2007, 5 GW of capacity have been commissioned, through combined-cycle gas-fired plants and several smaller expansions to oil-fired facilities. By 2020 the installed capacity is planned to increase to 25 GW, with a reserve margin of more than 10%. By increasing the share of natural gas in its primary energy consumption from 34% in 2009 to 42% in 2012, the country has moreover been looking for solutions to meet its electricity demand at peak times.
- Although most of this planned capacity will be fuelled by natural gas or oil, 5% of the electricity is planned to come from renewables by 2020 and to increase to 15% by 2030, mainly deploying solar and wind technology. However, the regulated oil sector has delayed further exploration and production. Project Kuwait attempts to incentivise foreign investment to bring production capacity to 4 million barrels per day by 2020, as well as to diversify its oil-heavy economy through natural gas production.

KEY METRICS

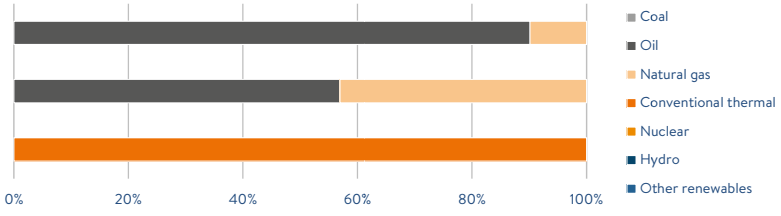
Industrial sector (% of GDP)	64.3	GDP per capita, PPP US$ (GDP Group)	71,312 (I)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Medium (HHI = 2,344)
Population with access to electricity (%)	94	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	13.3
CO_2 intensity (kCO_2 per US$)	0.36	GHG emission growth rate 2000–2012 (%)	3.5

ENERGY PROFILE

Fossil fuel reserves: 15,510 Mtoe

Total primary energy supply composition

Diversity of electricity generation



LATVIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

25

SCORE

ABB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**26**	**24**	**25**	▶	**ABB**
Energy performance					
Energy security	16	15	18	▶	A
Energy equity	43	41	38	▶	B
Environmental sustainability	53	49	56	▶	B
Contextual performance	24	23	26	▶	

TRENDS AND OUTLOOK

- In this year's Index, Latvia drops 1 place to rank 25. The country's trilemma performance is overall balanced, with energy security being its strongest dimension. This results in a balance score of ABB.
- In 2012 the Latvian government agreed on the Latvian Energy Long Term Strategy 2030 – Competitive Energy for Society. Since then, the country has made significant progress on this plan. Interconnection in the area has increased, especially due to connections between Sweden and Lithuania as well as Poland and Lithuania, which has led to a decrease in energy prices.
- A planned connection from Latvia to Estonia, to be completed by 2020, is further expected to improve the security and equity dimensions of the trilemma. A diversification of gas imports, mainly due to a new LNG terminal in Lithuania, is likely to further add to this. The country has also made progress in the renewables sector, with the ongoing renovation of its hydroelectric power plants, as well as building capacity in wind energy.
- The main challenge for Latvia will be to further grow its renewable energy sector, as well as designing an effective feed-in tariff scheme to support this growth.

KEY METRICS

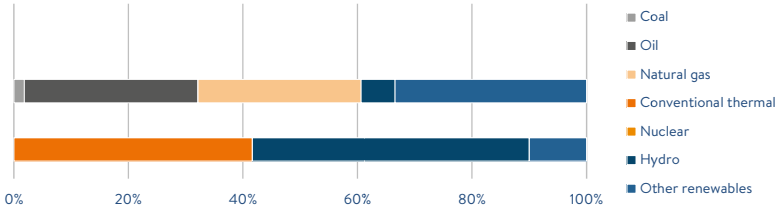
Industrial sector (% of GDP)	23.4	GDP per capita, PPP US$ (GDP Group)	24,286 (II)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	Low (HHI = 2,539)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 78
Household electricity prices (US$/kWh)	0.17	Rate of transmission and distribution losses (%)	8.2
CO_2 intensity (kCO_2 per US$)	0.19	GHG emission growth rate 2000–2012 (%)	0.3

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



LEBANON

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

86

SCORE

DBB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**84**	**86**	**86**	▶	**DBB**
Energy performance					
Energy security	108	112	113	▶	D
Energy equity	75	76	74	▶	B
Environmental sustainability	58	58	61	▶	B
Contextual performance	93	99	95	▶	

TRENDS AND OUTLOOK

- Lebanon maintains its place in this year's ranking, at rank 86. The country performs well in the energy equity and environmental sustainability dimensions, but lags behind regarding energy security, for a balance score of DBB.
- In 2010, the government approved a strategy for the rehabilitation of the power sector, including the development of energy efficiency and renewable energy to address the country's energy security concerns.
- The national target is for 12% of total electricity production to come from renewable energy by 2020. A recent move towards developing larger solar power plants, such as the Beirut River Solar Snake project, is a promising sign of the country's progress on its renewables targets.
- With regards to energy efficiency targets, progress is slowing down. The National Energy Efficiency Action Plan, adopted in 2011, expired in 2015 and no successor plan has been formulated to ensure continuing energy efficiency gains.
- A key challenge to successful implementation will be to update the legislative framework that governs the power sector. Policymakers should focus on creating an enabling legislative framework for the development of renewable energy and energy efficiency, which has the potential to improve both the trilemma's environmental sustainability and security dimensions.

KEY METRICS

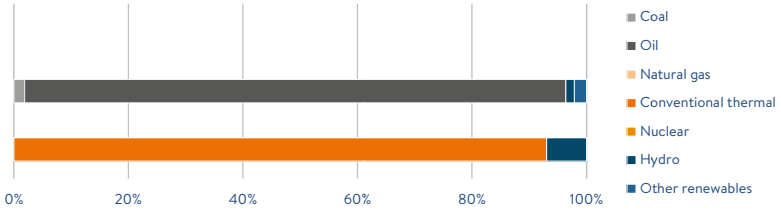
Industrial sector (% of GDP)	24.8	GDP per capita, PPP US$ (GDP Group)	13,938 (III)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	High (HHI = 1,091)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	9.6
CO_2 intensity (kCO_2 per US$)	0.33	GHG emission growth rate 2000–2012 (%)	3.7

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



LITHUANIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

28

SCORE

BAB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**29**	**28**	**28**	▶	**BAB**
Energy performance					
Energy security	40	25	46	▶	B
Energy equity	36	34	34	▶	A
Environmental sustainability	72	67	40	▲	B
Contextual performance	34	32	34	▶	

TRENDS AND OUTLOOK

- Lithuania ranks the same as last year, at 28. Energy equity is the country's strongest trilemma dimension and it receives a letter grade of B in both energy security and environmental sustainability, for a balance score of BAB.
- Lithuania remains among the few European countries where electricity consumption grows steadily every year and this trend will continue in the next 10 years according to Litgrid. One of the country's energy challenges is to reduce its energy dependence on a single supplier to secure reliable and reasonably priced energy. Its key actions are to develop a regional electricity interconnection and to construct an LNG terminal and LNG Hub.
- In light of historic disruption of gas supply from Russia to the isolated energy countries, not only Lithuania but also Latvia and Estonia, the next important policy challenge will be to strengthen regional energy integration.
- Lithuania has already opened up power links with Poland and Sweden in December 2015. The establishment of an LNG terminal in December 2014 is another effort to enhance its independence from a monopoly exporter. The country saw a drop of 63% in the share of total gas imports that came from Russia in the first quarter of 2016, which indicates that the country's energy security performance is likely to increase given the improvement of its energy import ratio, all else being equal.

KEY METRICS

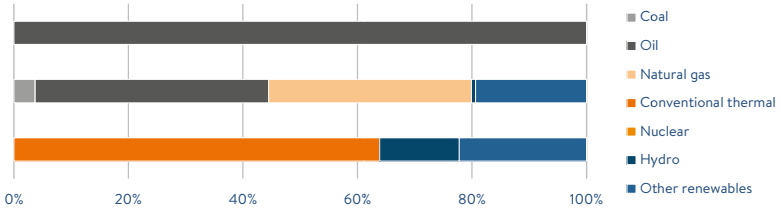
Industrial sector (% of GDP)	30.5	GDP per capita, PPP US$ (GDP Group)	27,730 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 6,272)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	N.A. | N.A.
Household electricity prices (US$/kWh)	0.18	Rate of transmission and distribution losses (%)	7.5
CO_2 intensity (kCO_2 per US$)	0.20	GHG emission growth rate 2000−2012 (%)	1.6

ENERGY PROFILE

Fossil fuel reserves: 1 Mtoe

Total primary energy supply composition

Diversity of electricity generation



LUXEMBOURG

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

55

SCORE

DAD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**60**	**57**	**55**	▶	**DAD**
Energy performance					
Energy security	118	120	122	▶	D
Energy equity	1	1	1	▶	A
Environmental sustainability	111	108	103	▶	D
Contextual performance	6	3	5	▶	

TRENDS AND OUTLOOK

- Luxembourg places 55th in this year's Index. While it achieves the best score globally regarding energy equity, the limitations of its geographical size have negative consequences for its scores in energy security and environmental sustainability, resulting in a balance score of DAD.
- A major challenge that Luxembourg faces is its dependence on energy imports (96.8% in 2010). Due to the country's limited resource endowment, there is little potential for Luxembourg to develop domestic energy sources. Instead, the country needs to focus on promoting regional interconnection, diversifying its energy sources and suppliers and improving its energy efficiency and intensity to promote its energy security.
- The wider deployment of renewables is a major challenge for Luxembourg, with renewables accounting for 2.9% of the energy mix in 2010. However, the 2020 target is at 11% and despite its support mechanisms, which include feed-in tariffs, investment incentives and tax deductions, the country is unlikely to meet the target given current progress.
- Energy and carbon intensity in Luxembourg's economy is the lowest among EU-15 countries. However, for the industry and transportation sectors energy intensity is the highest among all EU-15 countries with low diesel price one of the contributing factors.

KEY METRICS

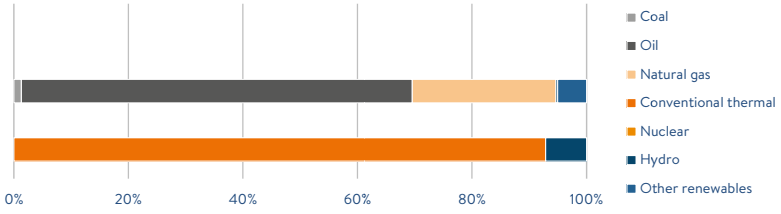
Industrial sector (% of GDP)	11.9	GDP per capita, PPP US$ (GDP Group)	101,926 (I)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Low (HHI = 3,876)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.23	Rate of transmission and distribution losses (%)	1.9
CO_2 intensity (kCO_2 per US$)	0.23	GHG emission growth rate 2000–2012 (%)	2.3

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



MALAYSIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

35

SCORE

BBC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**41**	**38**	**35**	▶	**BBC**
Energy performance					
Energy security	64	55	37	▲	B
Energy equity	37	40	41	▶	B
Environmental sustainability	69	75	83	▼	C
Contextual performance	35	33	33	▶	

TRENDS AND OUTLOOK

- Malaysia improves by 3 places, to rank 35. Its trilemma performance is overall balanced, scoring slightly lower in the environmental sustainability dimension, for an overall letter grade of BBC.
- According to the eleventh Malaysia Plan (2016–2020), rural electrification and renewable energy development will be key aims for the Malaysian energy sector. The share of households with access to electricity has increased to approximately 98% in 2015. In order to complete the electrification of the entire country by 2020, construction of new generation plants with 7.6 GW of total capacity and a number of grid interconnection projects will be implemented. New power plants will contribute to not only the improvement of energy equity but also enhance energy security and sustainability through replacing older, inefficient plants.
- The country is also seeking to improve its generation mix, which will reduce its high dependency on oil and gas. The potential of several alternative sources is being examined by the government; in particular biomass, biogas, geothermal and wind are expected to be at the heart of government policy. The target share of renewable sources in total generation capacity is 7.8% in Peninsular Malaysia and Sabah by 2020. Under this aim, the first geothermal plant is currently under construction and will start operation in 2018. In addition, the country will complete its national wind mapping by 2016 to explore its feasibility as a reliable source of energy.

KEY METRICS

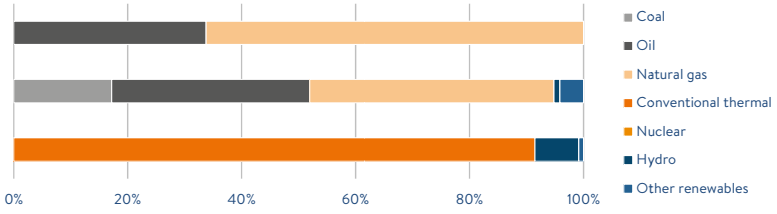
Industrial sector (% of GDP)	40.0	GDP per capita, PPP US$ (GDP Group)	26,891 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,411)
Population with access to electricity (%)	99	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	4.2
CO_2 intensity (kCO_2 per US$)	0.36	GHG emission growth rate 2000–2012 (%)	4.4

ENERGY PROFILE

Fossil fuel reserves: 1,395 Mtoe

Total primary energy supply composition

Diversity of electricity generation



MEXICO

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

52

SCORE

BBB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**52**	**59**	**52**	▶	**BBB**
Energy performance					
Energy security	66	62	59	▶	B
Energy equity	64	72	71	▶	B
Environmental sustainability	51	57	55	▶	B
Contextual performance	51	56	55	▶	

TRENDS AND OUTLOOK

- Mexico improves by 7 places in this year's Index, from rank 59 in 2015 to rank 52 in 2016. The country performs well across the board, receiving a balance score of BBB.
- The Mexican energy sector is facing a dual challenge: a) the transition from a monopolistic structure to a competitive market scheme, following the market liberalisation in 2013; and b) the transition from a high-carbon to a low-carbon economy.
- Mexico is the second country, after the UK, which has enacted a law that frames the actions to be taken with regards to climate change (2012 General Law on Climate Change, LGCC), both from an emission mitigation point of view as well as measures of adaptation. Mexico's Intended Nationally Determined Contributions for COP'21 include a 25% reduction in GHG emissions by 2030 (compared to a business-as-usual projection), with 35% of electricity generation to come from clean energies by 2024 and an aspirational goal of a 50% reduction in GHG emissions by 2050.
- The greatest challenges policymakers need to focus on to meet the targets are: 1) the continuation of a renewable energy programme and the re-initiation of a nuclear programme; 2) continued increase of production of both oil and natural gas on and offshore as well as the development of shale gas resources; and 3) improved energy efficiency and energy conservation including cogeneration in order to reduce Mexico's energy intensity.

KEY METRICS

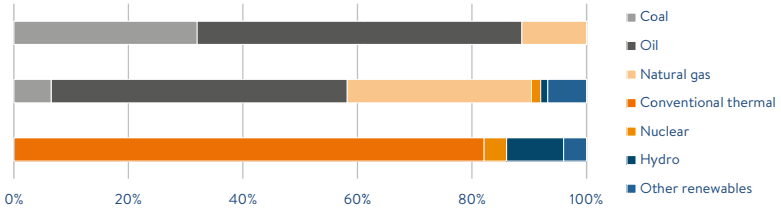
Industrial sector (% of GDP)	34.4	GDP per capita, PPP US$ (GDP Group)	17,277 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Low (HHI = 6,511)
Population with access to electricity (%)	99	Access to clean cooking in urban | rural areas (%)	95 | 61
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	14.8
CO_2 intensity (kCO_2 per US$)	0.27	GHG emission growth rate 2000−2012 (%)	1.7

ENERGY PROFILE

Fossil fuel reserves: 2,638 Mtoe

Total primary energy supply composition

Diversity of electricity generation



MONGOLIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

114

SCORE

DCD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**111**	**111**	**114**	▶	**DCD**
Energy performance					
Energy security	116	115	114	▶	D
Energy equity	96	95	95	▶	C
Environmental sustainability	122	123	124	▶	D
Contextual performance	64	69	65	▶	

TRENDS AND OUTLOOK

- Mongolia drops 3 places to rank 114. The country receives low scores across the board, scoring a letter grade of D in both energy security and environmental sustainability. This results in a balance score of DCD.
- An important challenge for the Mongolian energy sector is to develop a national integrated energy system. Currently four separate electricity grids are in operation. Therefore, the country is planning to connect these grids and expand the distribution system under the Programme on Mongolian Integrated Power System (2007–2040).
- Modernisation and increasing electric production capacity are priorities for the country. According to the Asian Development Bank, the share of electricity which is being imported from Russia to manage peak demand has been increasing over the past years. Due to ageing power plants it is essential to reduce losses by improving existing plants and operational management and to develop new plants to secure a reliable energy supply.
- Lastly, the government is aiming to increase the share of renewables in the national energy mix to 20% by 2020. The government is strengthening its international cooperation and working with international companies to develop the country's renewables potential, which has been estimated by the Mongolian National Renewable Energy centre to be approximately 2,600 GW.

KEY METRICS

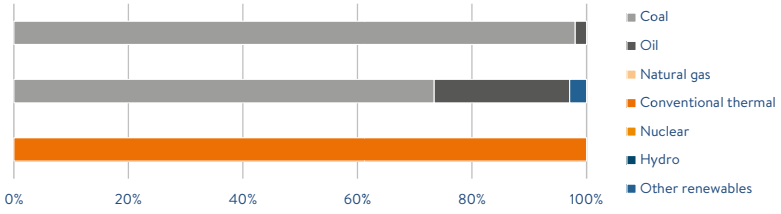
Industrial sector (% of GDP)	37.2	GDP per capita, PPP US$ (GDP Group)	12,189 (III)
Energy intensity (koe per US$)	0.14	Diversity of international energy suppliers	Low (HHI = 6,621)
Population with access to electricity (%)	86	Access to clean cooking in urban | rural areas (%)	43 | 5
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	12.8
CO_2 intensity (kCO_2 per US$)	0.74	GHG emission growth rate 2000–2012 (%)	4.5

ENERGY PROFILE

Fossil fuel reserves: 1,793 Mtoe

Total primary energy supply composition

Diversity of electricity generation



MOROCCO

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

80

SCORE

DBC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**78**	**78**	**80**	▶	**DBC**
Energy performance					
Energy security	113	118	111	▶	D
Energy equity	57	57	59	▶	B
Environmental sustainability	67	76	75	▶	C
Contextual performance	82	81	81	▶	

TRENDS AND OUTLOOK

- Morocco ranks 80th in this year's Index. The country's strongest trilemma dimension is energy equity, but it receives a letter grade of D regarding energy security, for a balance score of DBC.
- Morocco has taken a strong initiative to develop renewable energy since 2008 in order to deal with high levels of energy imports and to reduce its dependency on fossil fuels. The country set a target to establish 6 GW of renewable energy from solar, wind and hydropower, which will lead to 42% of installed power capacity in 2020 compared to 13% in 2015.
- According to the Climate Investment Funds, the first phase of the NOOR project, a group of 5 solar plans which was opened in 2016, can play a vital role to improve energy security and sustainability by producing enough energy to power over one million homes by 2018 and reducing emissions by an estimated 760,000 tons of CO_2 per year. At the same time, the country is focusing on promoting energy efficiency. The goal for energy efficiency is to achieve a 20% improvement by 2030.
- Renewable energy and energy efficiency will keep its position as the heart of the national energy strategy in the country as US$11bn is projected to be invested in solar and wind over the next five years in Morocco.

KEY METRICS

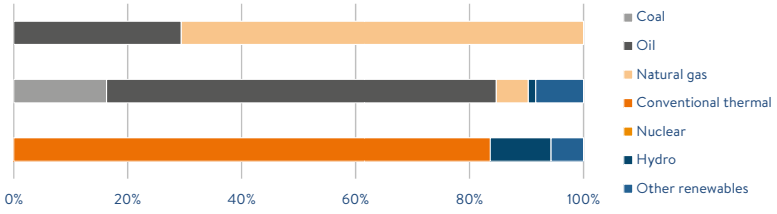
Industrial sector (% of GDP)	29.3	GDP per capita, PPP US$ (GDP Group)	7,821 (III)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,047)
Population with access to electricity (%)	99	Access to clean cooking in urban | rural areas (%)	95 | 87
Household electricity prices (US$/kWh)	0.12	Rate of transmission and distribution losses (%)	13.7
CO_2 intensity (kCO_2 per US$)	0.25	GHG emission growth rate 2000–2012 (%)	5.1

ENERGY PROFILE

Fossil fuel reserves: 2 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NAMIBIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

965

SCORE

DDB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**102**	**100**	**96**	▶	**DDB**
Energy performance					
Energy security	114	113	103	▶	D
Energy equity	100	100	100	▶	D
Environmental sustainability	54	52	45	▶	B
Contextual performance	61	57	59	▶	

TRENDS AND OUTLOOK

- Namibia improves by 4 places in this year's index, from rank 100 in 2015 to rank 96 in 2016. The country's strongest trilemma dimension is environmental sustainability while both energy security and energy equity receive a letter grade of D. this results in a balance score of DDB.
- Namibia struggles to meet local demand. In addition to its own installed capacity the country relies on imports from neighbouring countries such as Zimbabwe, Zambia, Mozambique and South Africa. However, the country plans to tackle these difficulties, particularly through the expansion of its renewable energy sector. To this effect the country has recently developed a framework to include Independent Power Producers (IPPs) in the energy supply, and the national regulator, the Electricity Control Board (ECB), has already issued 14 IPP licences. These developments have the potential to improve the country's energy trilemma performance across all dimensions.
- Formulating an integrated long-term energy strategy remains a key challenge for the country. The National Integrated Resource Plan and the Renewable Energy Policy, as well as the transformation of the ECB into the Namibia Energy Regulatory Authority (NERA) with an expanded regulatory remit are positive recent developments. However, these policies are still formed under the aegis of the 1998 White Paper on Energy Policy, which needs to be updated to arrive at a strong and coherent energy policy and thus to improve the country's ranking.

KEY METRICS

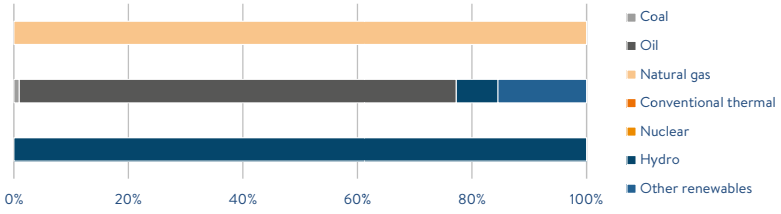
Industrial sector (% of GDP)	31.8	GDP per capita, PPP US$ (GDP Group)	10,414 (III)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 2,522)
Population with access to electricity (%)	44	Access to clean cooking in urban | rural areas (%)	83 | 14
Household electricity prices (US$/kWh)	0.11	Rate of transmission and distribution losses (%)	12.6
CO_2 intensity (kCO_2 per US$)	0.18	GHG emission growth rate 2000−2012 (%)	4.5

ENERGY PROFILE

Fossil fuel reserves: 53 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NEPAL

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

123

SCORE

DDC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**123**	**123**	**123**	▶	**DDC**
Energy performance					
Energy security	125	125	125	▶	D
Energy equity	112	111	111	▶	D
Environmental sustainability	85	85	86	▶	C
Contextual performance	114	116	115	▶	

TRENDS AND OUTLOOK

- Nepal ranks 123rd in this year's Index, maintaining its 2015 rank. The country's energy security and energy equity scores are particularly low, resulting in an overall letter grade of DDC.
- The key energy challenges for Nepal are to improve access to modern energy in rural communities and to increase electricity supply to provide reliable energy services to the population.
- Nepal has one of the lowest levels of electrification among South Asian countries and the rural population is highly dependent on traditional biofuel for heating and cooking. At the same time, energy demand is expected to increase at over 8% per year until 2027 according to the Nepal Electricity Authority (NEA).
- To provide reliable and sustainable energy, a 'Rural Energy Development Programme' was launched in 1996 supported by the United Nations Development Programme (UNDP). The National Rural and Renewable Energy Programme (2012–2017) is building on the Rural Energy Development Programme by building small hydropower and solar heating systems. The programme is expected to bring benefits of economic, environmental and social development to the country.

KEY METRICS

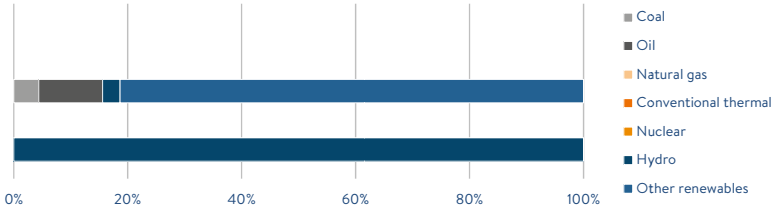
Industrial sector (% of GDP)	15.6	GDP per capita, PPP US$ (GDP Group)	2,458 (IV)
Energy intensity (koe per US$)	0.18	Diversity of international energy suppliers	Low (HHI = 9,432)
Population with access to electricity (%)	76	Access to clean cooking in urban | rural areas (%)	67 | 10
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	24.4
CO_2 intensity (kCO_2 per US$)	0.10	GHG emission growth rate 2000–2012 (%)	2.7

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NETHERLANDS

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

4

SCORE

AAB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**7**	**8**	**4**	▶	**AAB**
Energy performance					
Energy security	15	20	9	▶	A
Energy equity	3	4	3	▶	A
Environmental sustainability	42	42	42	▶	B
Contextual performance	8	5	6	▶	

TRENDS AND OUTLOOK

- In this year's Index, the Netherlands improve by 4 places to rank 4. The country performs strongly across the board, making it into the top 10 not just overall, but also with regard to energy security and energy equity. This results in a balance score of AAB.
- The Netherlands is well-positioned in the Index but still faces a number of challenges. These include: the public debate around installation of additional onshore wind capacity; high expectations of biomass and green gas in the face of challenging markets; ensuring solar surges and geothermal meet expectations given the low starting base; and a feed-in tariff scheme that is not sufficient to reach targets. Furthermore, energy efficiency progress is fairly slow.
- Key energy policy developments are: the green deals; energy innovation top sector approach designed to strengthen market steering, market involvement and market resources for energy; and the SDE+ (stimulation of sustainable/renewable energy) feed-in scheme that is fully operational and funded (over €1.5bn per annum).
- A key trend is the strong decentralisation of power generation. Policymakers have to create the framework to stimulate or facilitate this development including the upgrade of the existing network such as smart grids. Finally, the Netherlands is expected to strengthen its position as a gas country, with an increased focus on the role of gas as a balancing fuel in a system that is moving towards sustainability.

KEY METRICS

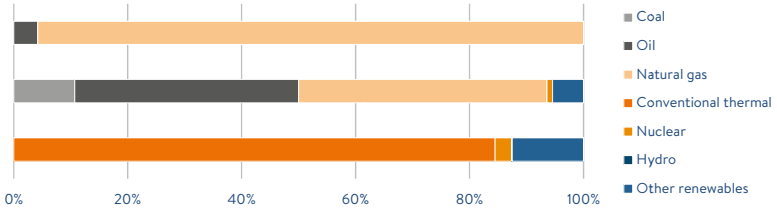
Industrial sector (% of GDP)	21.2	GDP per capita, PPP US$ (GDP Group)	48,459 (I)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 924)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.23	Rate of transmission and distribution losses (%)	3.9
CO_2 intensity (kCO_2 per US$)	0.25	GHG emission growth rate 2000–2012 (%)	0.1

ENERGY PROFILE

Fossil fuel reserves: 715 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NEW ZEALAND

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

9

SCORE

AAB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**11**	**7**	**9**	▶	**AAB**
Energy performance					
Energy security	19	16	13	▶	A
Energy equity	29	18	20	▶	A
Environmental sustainability	38	36	36	▶	B
Contextual performance	4	4	8	▶	

TRENDS AND OUTLOOK

- New Zealand places 9th in this year's Index. In this year's index, New Zealand ranks 9th. With its stable market-based framework and strong economic growth the country balances the trade-offs between energy security, energy equity and environmental sustainability well, resulting in a balance score of AAB.
- The New Zealand Energy Strategy (NZES) and Energy Efficiency and Conservation Strategy sets out the government's overarching energy policy framework. Its four priorities (diverse resource development, environmental responsibility, efficient use of energy, and secure and affordable energy) help shape New Zealand's trilemma performance.
- Retirements of thermal generation has seen New Zealand's already high proportion of renewable electricity increase to 81% in 2015. Recent policy initiatives have focussed on leveraging this advantage, with government consulting on energy sector wide targets for increasing the proportion of renewable energy in the economy and implementing targets and support measures for electric and low emissions vehicles to 2021.
- Trends to watch are: 1) the speed of electric vehicle uptake in light of government and business action; 2) the implications of the energy-sector wide targets on investment and energy intensity trends; 3) growing demand-side involvement in the electricity market, and the implications of the more rapid adoption of new technologies on demand, future competition, network regulation, and prices.

KEY METRICS

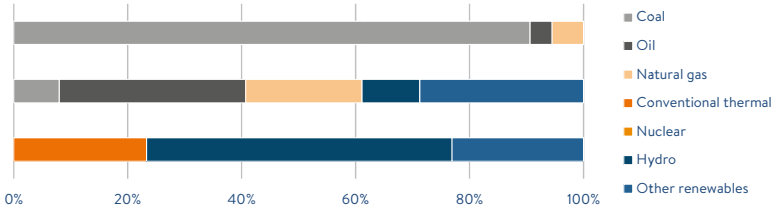
Industrial sector (% of GDP)	24.6	GDP per capita, PPP US$ (GDP Group)	36,982 (I)
Energy intensity (koe per US$)	0.10	Diversity of international energy suppliers	High (HHI = 1,024)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.13	Rate of transmission and distribution losses (%)	6.6
CO_2 intensity (kCO_2 per US$)	0.27	GHG emission growth rate 2000−2012 (%)	0.4

ENERGY PROFILE

Fossil fuel reserves: 440 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NIGER

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

124

SCORE

DDD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**124**	**124**	**124**	▶	**DDD**
Energy performance					
Energy security	119	117	119	▶	D
Energy equity	124	125	125	▶	D
Environmental sustainability	120	120	120	▶	D
Contextual performance	111	112	114	▶	

TRENDS AND OUTLOOK

- Niger places second to last in this year's Index, at rank 124, and receives the lowest score globally regarding energy equity. This results in an overall balance score of DDD.
- Despite the richness of Niger's resources, energy is still a challenge for the authorities. This is mainly a result of low economic productivity and investment, and also the limited access that the majority of the country has to energy.
- Niger has significant natural energy resources such as biomass, uranium, mineral coal, natural gas, hydro and solar. It is estimated that 90% of Niger's population accesses energy through the use of biomass, and 70% of energy supply comes from biomass. The second largest contributor is oil at 17%.
- National law and the liberalisation of the energy market result in Niger being an attractive investment opportunity, but infrastructure for delivering energy remains a key barrier.
- With regards to the renewable energy sector, there is still lack of sufficient legislation to attract incoming investment, specifically competitiveness, transparency and security of the market.

KEY METRICS

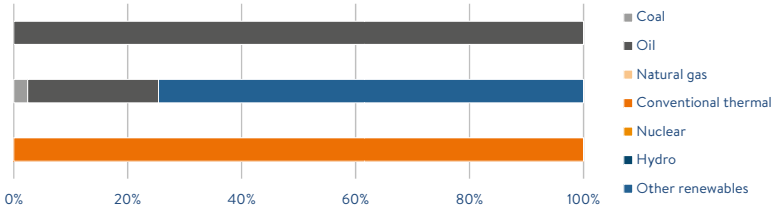
Industrial sector (% of GDP)	19.5	GDP per capita, PPP US$ (GDP Group)	954 (IV)
Energy intensity (koe per US$)	0.17	Diversity of international energy suppliers	Medium (HHI = 2,031)
Population with access to electricity (%)	9	Access to clean cooking in urban | rural areas (%)	6 | 5
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	15.0
CO_2 intensity (kCO_2 per US$)	0.13	GHG emission growth rate 2000–2012 (%)	N.A.

ENERGY PROFILE

Fossil fuel reserves: 20 Mtoe

Total primary energy supply composition

Diversity of electricity generation



NIGERIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

104

SCORE

ADD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**98**	**101**	**104**	▶	**ADD**
Energy performance					
Energy security	5	5	8	▶	A
Energy equity	106	107	108	▶	D
Environmental sustainability	97	102	101	▶	D
Contextual performance	117	117	117	▶	

TRENDS AND OUTLOOK

- Nigeria drops 3 places in this year's Index, to rank 104. While the country performs strongly in the energy security dimension, placing 8th globally, it receives a letter grade of D in the other two dimensions, for a balance score of ADD.
- The key priority challenge for Nigeria is to diversify energy sources. According to the Ministry of Power, Works and Housing of Nigeria, the country depends on gas-fired power plants for over 80% of its electricity while hydropower generates about 14%.
- However, the gas supply is frequently disrupted by militants. This situation drives the country to find other energy sources, i.e. renewable energy. In July 2016, the federal government signed the power purchase agreement with 12 firms for the construction of solar power plants. These are expected to give the country 975 MW of electricity capacity and bring the benefits of enhancement of energy security.
- The second challenge refers to the energy equity aspect of the Trilemma. Nigeria has one of the lowest shares of electrification. Only 48% of the population currently has access to electricity. Therefore, developing a new transmission and distribution network and improving existing lines will come into the priority list of the country's energy agenda.

KEY METRICS

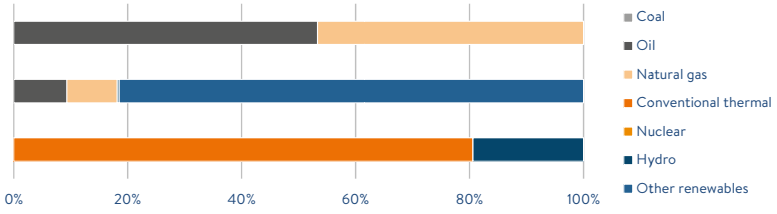
Industrial sector (% of GDP)	24.2	GDP per capita, PPP US$ (GDP Group)	5,992 (IV)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	High (HHI = 1,190)
Population with access to electricity (%)	48	Access to clean cooking in urban | rural areas (%)	54 | 10
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	15.8
CO_2 intensity (kCO_2 per US$)	0.04	GHG emission growth rate 2000–2012 (%)	2.0

ENERGY PROFILE

Fossil fuel reserves: 9,384 Mtoe

Total primary energy supply composition

Diversity of electricity generation



PAKISTAN

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

102

SCORE

CDC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**104**	**102**	**102**	▶	**CDC**
Energy performance					
Energy security	74	69	76	▶	C
Energy equity	99	99	99	▶	D
Environmental sustainability	94	94	93	▶	C
Contextual performance	120	119	120	▶	

TRENDS AND OUTLOOK

- Pakistan ranks 102nd in this year's Index. The country receives low scores across the board, resulting in a balance score of CDC.
- Pakistan's energy sector is faced with a triple challenge posed by a large supply–demand gap, an ageing and inefficient power transmission system, and expensive thermal power generation. To remedy this situation, the government in 2013 launched the National Power Plan (NPP). A key aspect of the NPP is to step up efforts to exploit the country's potential for renewable energy generation.
- In addition, projects are being developed under the auspices of the China–Pakistan Economic Corridor (CPEC) to achieve a higher share of renewables. One of the projects, the Quaid-e-Azam Solar Park, started operating in 2015 and plans exist to expand its capacity to 1,000 MW. This would make it the world's largest solar power plant. Other projects include several wind farms and hydroelectric power plants such as the Suki Kinari project currently under construction in the North East of the country.
- Pakistan will also have to make sure that the country's transmission infrastructure can keep up with this rapid development of renewable energy capacity to ensure the reliable supply of energy.

KEY METRICS

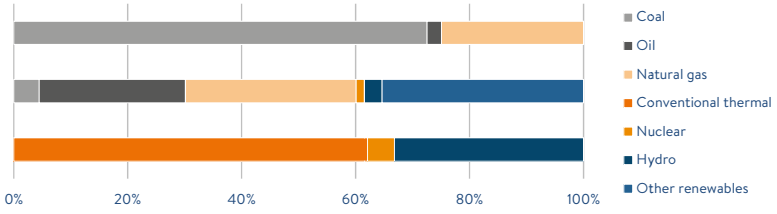
Industrial sector (% of GDP)	20.9	GDP per capita, PPP US$ (GDP Group)	5,042 (IV)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Low (HHI = 2,647)
Population with access to electricity (%)	91	Access to clean cooking in urban | rural areas (%)	71 | 11
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	16.6
CO_2 intensity (kCO_2 per US$)	0.19	GHG emission growth rate 2000–2012 (%)	3.1

ENERGY PROFILE

Fossil fuel reserves: 1,990 Mtoe

Total primary energy supply composition

Diversity of electricity generation



PARAGUAY

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

89

SCORE

CCB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**91**	**89**	**89**	▶	**CCB**
Energy performance					
Energy security	99	97	96	▶	C
Energy equity	87	86	86	▶	C
Environmental sustainability	77	59	57	▶	B
Contextual performance	102	100	96	▶	

TRENDS AND OUTLOOK

- Paraguay maintains its place at rank 89. The country's strongest trilemma dimension is environmental sustainability, where it receives a letter grade of B, but it scores lower regarding energy security and energy equity, for a balance score of CCB.
- Nearly 99% of Paraguay's energy demand is met by hydropower. Therefore, there is little to no incentive for Paraguay to develop a policy framework promoting the use of renewables.
- The only clean energy policy incentive in Paraguay is a biofuel mandate for gasoline and diesel. The mandate states that diesel sold commercially in the country must contain 5% biodiesel and gasoline must contain between 18% and 24% ethanol. It is hoped that the policy will introduce more diversification of supply and less reliance on hydropower in the future.
- The abundant supply of energy results in low energy costs for the retail and commercial consumer, and is a good basis for social and economic development in the future.

KEY METRICS

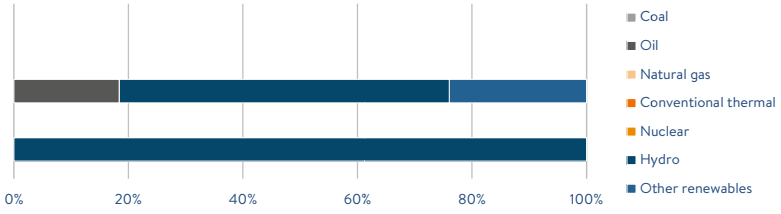
Industrial sector (% of GDP)	28.8	GDP per capita, PPP US$ (GDP Group)	9,184 (III)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Low (HHI = 2,554)
Population with access to electricity (%)	97	Access to clean cooking in urban | rural areas (%)	68 | 20
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	27.1
CO_2 intensity (kCO_2 per US$)	0.10	GHG emission growth rate 2000–2012 (%)	3.6

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



PERU

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

64

SCORE

BCB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**63**	**63**	**64**	▶	**BCB**
Energy performance					
Energy security	65	61	54	▶	B
Energy equity	83	85	84	▶	C
Environmental sustainability	32	32	38	▶	B
Contextual performance	57	62	60	▶	

TRENDS AND OUTLOOK

- Peru drops 1 place to rank 64 in this year's Index. The country performs well regarding environmental sustainability, with energy equity being its weakest trilemma dimension, for a balance score of BCB.
- Peru's National Energy Policy 2010–2040 was approved at the end of 2010 with the goal to encourage and protect private investment in the sector; and to minimise the social and environmental impacts by promoting the development of energy markets, encouraging efficiency and the development of renewable energies at the local, regional, and national level.
- Schemes to support these goals are already in place and include: a law, passed in April 2012, to promote energy security in hydrocarbons; a scheme to promote the modernisation of oil refineries; a universal energy access plan for the 2013–2022 period, implemented in May 2013, with clearly defined targets for different sub-components; and auctions and calls for tenders to secure the implementation of hydro projects. Additional fiscal incentives are in place for small-scale hydro, solar, wind, biomass, and geothermal.

KEY METRICS

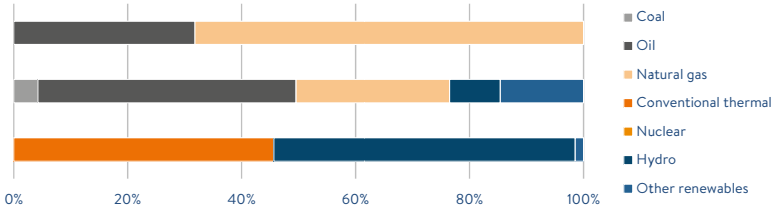
Industrial sector (% of GDP)	36.8	GDP per capita, PPP US$ (GDP Group)	12,402 (III)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Low (HHI = 3,055)
Population with access to electricity (%)	85	Access to clean cooking in urban | rural areas (%)	92 | 25
Household electricity prices (US$/kWh)	0.16	Rate of transmission and distribution losses (%)	11.2
CO_2 intensity (kCO_2 per US$)	0.15	GHG emission growth rate 2000–2012 (%)	4.9

ENERGY PROFILE

Fossil fuel reserves: 536 Mtoe

Total primary energy supply composition

Diversity of electricity generation



PHILIPPINES

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

61

SCORE

BCA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**67**	**62**	**61**	▶	**BCA**
Energy performance					
Energy security	60	56	52	▶	B
Energy equity	91	90	92	▶	C
Environmental sustainability	2	1	1	▶	A
Contextual performance	75	71	69	▶	

TRENDS AND OUTLOOK

- The Philippines drops 1 place to rank 61. The country performs excellently in the environmental sustainability dimension, placing 1st worldwide, but lags behind regarding energy equity, resulting in a balance score of BCA.
- The Philippines suffers from a shortage of power supply, often resulting in rotating brownouts lasting an average of 2–3 hours daily. Though the power shortage is a systemic problem to be resolved through the collaboration of all stakeholders, the Department of Energy has outlined some short-term solutions to address the brownouts: 1) the Interruptible Load Programme; 2) a boost in supply through the commissioning and rehabilitation of plants; 3) an increase in capacity from renewables, primarily solar, wind and biomass.
- There is a need for investments in power generation. Recently an increased feed-in tariff allocation for solar power projects has been introduced, which is expected to increase the investments in solar energy projects in the long-run. Most projects that are currently in the pipeline are coal-fired as coal project developers are currently favoured by a premium given to the peso-per-kilowatt hour cost of electricity. Additionally, natural gas projects via LNG regasification opportunities are currently discussed such as LNG terminals to import LNG from the Middle East/Europe/Australia with an anticipated capacity of 2–4 million tons of gas per year.

KEY METRICS

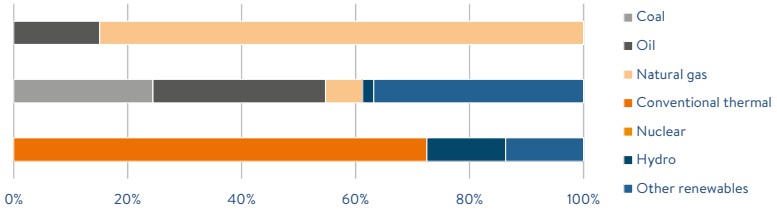
Industrial sector (% of GDP)	31.4	GDP per capita, PPP US$ (GDP Group)	7,359 (III)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	High (HHI = 1,253)
Population with access to electricity (%)	83	Access to clean cooking in urban | rural areas (%)	76 | 34
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	10.3
CO_2 intensity (kCO_2 per US$)	0.16	GHG emission growth rate 2000–2012 (%)	1.5

ENERGY PROFILE

Fossil fuel reserves: 99 Mtoe

Total primary energy supply composition

Diversity of electricity generation



POLAND

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

36

SCORE

BAB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**33**	**32**	**36**	▶	**BAB**
Energy performance					
Energy security	53	47	60	▶	B
Energy equity	31	30	28	▶	A
Environmental sustainability	73	68	64	▶	B
Contextual performance	36	34	36	▶	

TRENDS AND OUTLOOK

- Poland drops 4 places, to rank 36. The country's trilemma performance is overall balanced, with energy equity being a particular strength. This results in a balance score of BAB.
- Recent energy policy developments include the diversification of the energy mix through additional nuclear plants; incentives to diversify gas supply and development of renewables; reducing energy intensity and increasing energy efficiency; increasing the competitiveness of fuels and energy by liberalisation of the markets; improving the legal framework for exploration works for domestic primary energy fuels; and limiting the energy sector impact on the environment by the development of clean coal technologies.
- Expected future trends affecting Poland's energy sustainability and issues for policymakers to focus on are: 1) development of the country's energy network infrastructure; 2) further diversification of energy sources; 3) modernisation of the electricity generation sector; 4) increase security of primary fuel supply through investments in more efficient coal mining exploitation and exploration for conventional and unconventional gas; 5) increase transport biofuels production and use; 6) continued efforts to improve energy efficiency and energy savings; 7) transition to a low-carbon economy, while enabling an improvement of lifestyles over the next 20 years, by deploying low-emission technologies to achieve lower emissions growth.

KEY METRICS

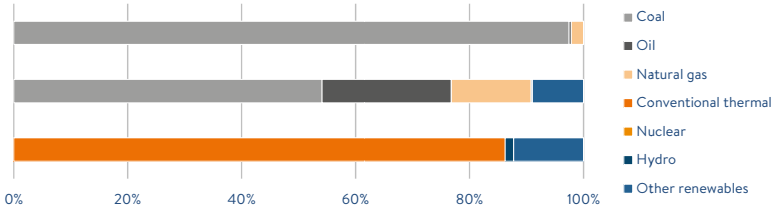
Industrial sector (% of GDP)	32.6	GDP per capita, PPP US$ (GDP Group)	26,135 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 5,502)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.19	Rate of transmission and distribution losses (%)	7.0
CO_2 intensity (kCO_2 per US$)	0.38	GHG emission growth rate 2000–2012 (%)	0.0

ENERGY PROFILE

Fossil fuel reserves: 3,912 Mtoe

Total primary energy supply composition

Diversity of electricity generation



PORTUGAL

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

18

SCORE

AAA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**16**	**17**	**18**	▶	**AAA**
Energy performance					
Energy security	27	39	31	▶	A
Energy equity	27	31	33	▶	A
Environmental sustainability	12	11	12	▶	A
Contextual performance	29	27	32	▶	

TRENDS AND OUTLOOK

- Portugal ranks 18th in this year's Index. The country balances the trilemma very well, with environmental sustainability being its strongest dimension. This results in a balance score of AAA.
- Portugal's aim to reinforce the electricity interconnection capacity between the Iberian Peninsula and Central Europe gained momentum with the Madrid Declaration (4 March 2015). The initiative seeks to promote market integration and the supply to Europe of excess renewable electricity generated in this southwestern region. Gas interconnections were also considered in the Madrid Declaration, signed by the three leaders of Spain, Portugal and France (project MIDCAT), to integrate the Iberian gas market with France and Central Europe, fostering competition and increasing European supply security by taking advantage of the high capacity of LNG terminals in the Iberian peninsula. Security of energy supply is also being pursued by promoting renewable energy sources, but also by promoting energy efficiency and diversifying imports, with the Portuguese government considering a submarine cable connection with Morocco.
- Greater access to energy services for low-income households was facilitated by the Portuguese government in 2015 by increasing tariff reductions and broadening the eligibility criteria. The government also implemented a Green Taxation Reform and called for civil society participation and support for a Green Growth Commitment, which aims to reduce emissions and promote the efficient use of resources.

KEY METRICS

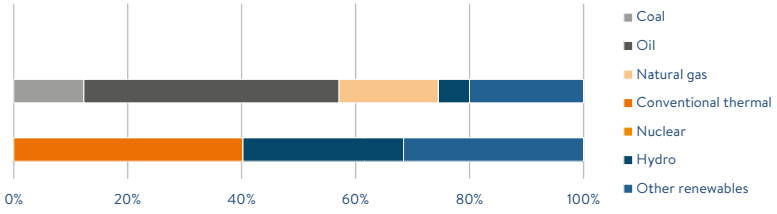
Industrial sector (% of GDP)	21.5	GDP per capita, PPP US$ (GDP Group)	29,214 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 981)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.30	Rate of transmission and distribution losses (%)	10.4
CO_2 intensity (kCO_2 per US$)	0.20	GHG emission growth rate 2000–2012 (%)	-2.2

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



QATAR

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

39

SCORE

AAD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**34**	**39**	**39**	▶	**AAD**
Energy performance					
Energy security	35	40	25	▶	A
Energy equity	2	2	4	▶	A
Environmental sustainability	113	112	115	▶	D
Contextual performance	25	28	30	▶	

TRENDS AND OUTLOOK

- Qatar maintains its place at rank 39. The country performs very well regarding energy security and energy equity. But receives a letter grade of D in the environmental sustainability dimension, resulting in a balance score of AAD.
- The Qatar National Vision 2030 defines the long-term outcomes for the country and provides a framework within which national strategies and implementation plans can be developed. Expanding competitive industries derived from hydrocarbon industries, building a knowledge-based economy characterised by relying on research, development and innovation, and excellence in entrepreneurship are three key elements identified to achieve the set goals.
- Recent energy policy developments include the objectives to: 1) reduce electricity usage by 20% and water consumption by 35% within five years; and 2) enhance the management of economic, environmental and social impacts within the energy and industry sector. Multinational companies in Qatar are encouraged to put forward their five-year sustainable development strategies with well-defined performance targets with higher levels of innovation. However, policymakers need to continue developing an integrated set of measures to attract domestic, regional and foreign investment to establish and support the government's goal to diversify the economy.

KEY METRICS

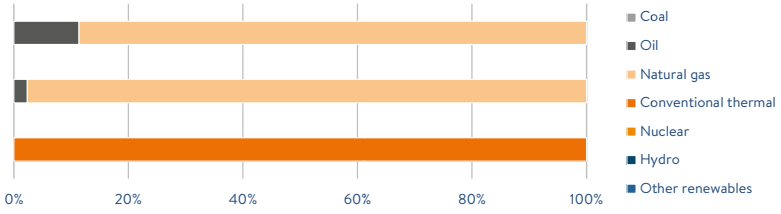
Industrial sector (% of GDP)	67.9	GDP per capita, PPP US$ (GDP Group)	143,788 (I)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	High (HHI = 1,115)
Population with access to electricity (%)	94	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	6.7
CO_2 intensity (kCO_2 per US$)	0.30	GHG emission growth rate 2000−2012 (%)	10.9

ENERGY PROFILE

Fossil fuel reserves: 23,721 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ROMANIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

32

SCORE

ABA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**40**	**31**	**32**	▶	**ABA**
Energy performance					
Energy security	23	17	24	▶	A
Energy equity	63	63	63	▶	B
Environmental sustainability	43	39	28	▲	A
Contextual performance	67	58	53	▲	

TRENDS AND OUTLOOK

- Romania ranks 32nd in this year's Index. The country scores well across the board, resulting in a balance score of ABA.
- Romania's renewable energy sector, which is mainly comprised of wind energy, in June 2016 reached a capacity of 4690 MW. Further, the country has already reached and exceeded its EU-mandated target of a 24% share of renewables in gross final energy consumption. However, the future of further investments in renewable energy is uncertain due to recent changes to the country's green certificate scheme and the fact that a feed-in tariff system for small renewable energy producers, having been passed into law in 2015, has still not been effectively implemented.
- Although plans to construct a submarine cable connection with Turkey have been abandoned, the integration of the power markets of the Czech Republic, Slovakia, Hungary and Romania, along with the already high share of renewable energy, is expected to maintain Romania's strong energy security score.
- Going forward, Romanian policymakers will have to find ways to design more effective and coherent systems to support the further development of renewable energy, as well as focus on the maintenance and improvement of the existing energy supply and transmission structure, which will need large investments to raise the country's energy equity score.

KEY METRICS

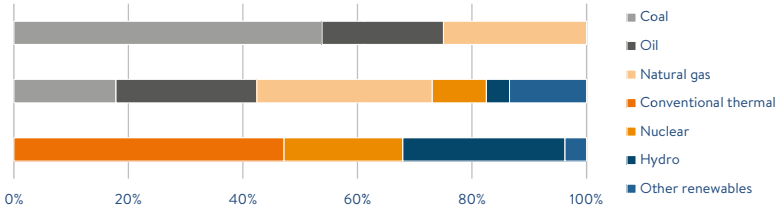
Industrial sector (% of GDP)	27.3	GDP per capita, PPP US$ (GDP Group)	21,403 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 3,132)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 63
Household electricity prices (US$/kWh)	0.17	Rate of transmission and distribution losses (%)	13.4
CO_2 intensity (kCO_2 per US$)	0.28	GHG emission growth rate 2000−2012 (%)	-0.9

ENERGY PROFILE

Fossil fuel reserves: 377 Mtoe

Total primary energy supply composition

Diversity of electricity generation



RUSSIAN FEDERATION

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

45

SCORE

ABD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**50**	**48**	**45**	▶	**ABD**
Energy performance					
Energy security	11	8	6	▶	A
Energy equity	46	42	42	▶	B
Environmental sustainability	117	117	116	▶	D
Contextual performance	53	51	48	▶	

TRENDS AND OUTLOOK

- In this year's Index, Russia improves by 3 places, to rank 45. The country performs well in energy security, where it ranks 6th globally, and energy equity, but receives a letter grade of D in environmental sustainability, resulting in a balance score of ABD.
- Russia is endowed with natural resources, and exports natural gas and oil to countries in Eastern and Western Europe, Turkey, Japan as well as other Asian countries. The high dependence of the economy on energy exports and the vulnerability to the fluctuations in energy prices, the development of shale gas in other regions of the world, and to Europe's efforts to decrease dependence on Russian gas imports following disputes with key transit countries such as Ukraine, led to the development of new transportation routes and plans to tap new gas markets in the east ('Pivot to the East'). However, competition with other gas suppliers as well as economic turmoil in China is raising concerns over the profitability of these plans. With nine new nuclear reactors currently under construction, and another 31 units planned to be completed by 2030, Russia is working to further improve its security of supply while reducing its dependence on fossil fuels.
- Energy efficiency is a key issue for Russia. To this end, the government, in 2014, published an updated version of the State Program on Energy Efficiency and Energy Development, which envisages a 40% decrease in energy intensity of the economy by 2020. Another key part of this strategy is the further development of renewables, which, by 2020, are to account for 2.5% of electricity generation, excluding large hydroelectric power plants.

KEY METRICS

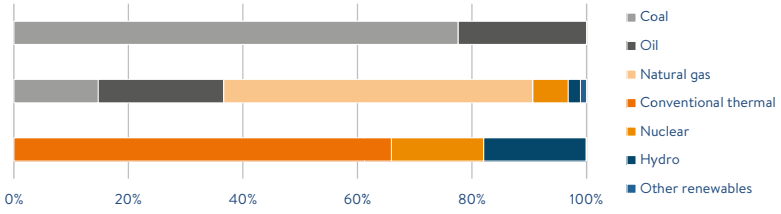
Industrial sector (% of GDP)	35.8	GDP per capita, PPP US$ (GDP Group)	24,451 (II)
Energy intensity (koe per US$)	0.16	Diversity of international energy suppliers	Medium (HHI = 1,519)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 92
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	11.0
CO_2 intensity (kCO_2 per US$)	0.72	GHG emission growth rate 2000–2012 (%)	1.1

ENERGY PROFILE

Fossil fuel reserves: 62,602 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SAUDI ARABIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

47

SCORE

BAD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**44**	**47**	**47**	▶	**BAD**
Energy performance					
Energy security	33	41	39	▶	B
Energy equity	11	11	12	▶	A
Environmental sustainability	109	110	112	▶	D
Contextual performance	47	54	51	▶	

TRENDS AND OUTLOOK

- Saudi Arabia maintains its place at rank 47. The country performs particularly well in the energy equity dimension, but receives a letter grade of D in environmental sustainability, resulting in a balance score of BAD.
- The Saudi energy sector is fully dependent on oil and gas for electricity generation and transportation. In order to diversify its energy supply, the government in April 2016 launched its long-term development roadmap, 'Saudi Arabia's Vision 2030', which sets a goal of building 9.5 GW of renewable energy generation capacity by 2030.
- In June 2016, the country published the National Transformation Program 2020, which specifies more detailed short-term targets for the country. This includes a goal of generating 4% of energy supply through renewable energy by 2020, which is to be met chiefly through solar energy. This has been rendered more attractive by the recent drop in prices for solar PV technology. The National Transformation Program also calls for full compliance with security standards for the introduction of nuclear power generation.
- Saudi Arabian policymakers must now focus on realising these ambitious goals and attracting the necessary investment, while also continuing to improve energy efficiency in the country. Although fossil fuels will continue to make up the vast majority of Saudi Arabia's energy supply, successful implementation could improve the country's environmental sustainability as well as energy security scores in future rankings.

KEY METRICS

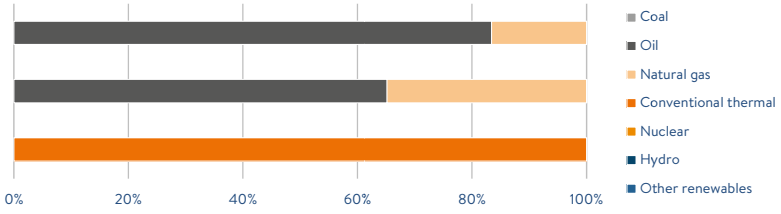
Industrial sector (% of GDP)	56.9	GDP per capita, PPP US$ (GDP Group)	53,430 (I)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Medium (HHI = 1,713)
Population with access to electricity (%)	94	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	9.7
CO_2 intensity (kCO_2 per US$)	0.36	GHG emission growth rate 2000–2012 (%)	6.1

ENERGY PROFILE

Fossil fuel reserves: 43,894 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SENEGAL

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

109

SCORE

CDC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**109**	**109**	**109**	▶	**CDC**
Energy performance					
Energy security	86	82	92	▶	C
Energy equity	108	108	107	▶	D
Environmental sustainability	88	88	91	▶	C
Contextual performance	105	101	99	▶	

TRENDS AND OUTLOOK

- Senegal ranks 109th in this year's Index. Energy equity is the country's weakest trilemma dimension (score D) with an overall balance score of CDC.
- Senegal's energy sector is currently faced with a number of challenges, including ageing infrastructure that is not being properly maintained nor planned to be replaced. Water issues are also at the top of the agenda, as droughts have a strong impact on households, especially those located in rural areas.
- The 2012 Energy Strategy for Senegal sets out a sustainable development plan for the country's energy sector, Targets include achieving a 50% rural electrification rate by 2017 and a 20% renewables share of the electricity generation mix by 2017. To support the deployment of renewables, Senegal has joined the 'Scaling Solar' initiative in early 2016 to develop up to 200 MW of solar power.
- The Senegalese government has also signed up to the World Bank's Electricity Sector Support Project, running from 2012 to 2020. The aim of the Senegal Electricity Sector Support Project is to reduce the national utility company's technical and commercial losses and to improve the reliability of electricity supply in certain areas of the country, mainly in Greater Dakar. While improving the reliability of electricity supply will help to improve the country's energy equity, improving access to electricity in rural areas will be required to achieve significant energy equity gains.

KEY METRICS

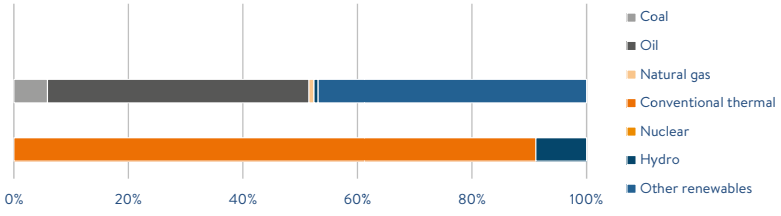
Industrial sector (% of GDP)	23.5	GDP per capita, PPP US$ (GDP Group)	2,431 (IV)
Energy intensity (koe per US$)	0.10	Diversity of international energy suppliers	Medium (HHI = 1,618)
Population with access to electricity (%)	57	Access to clean cooking in urban | rural areas (%)	86 | 17
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	15.6
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000–2012 (%)	4.0

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SERBIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

73

SCORE

BBC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**73**	**68**	**73**	▶	**BBC**
Energy performance					
Energy security	52	46	61	▶	B
Energy equity	74	73	73	▶	B
Environmental sustainability	90	90	89	▶	C
Contextual performance	92	89	84	▶	

TRENDS AND OUTLOOK

- Serbia drops 5 places to rank 73. The country has a balanced trilemma performance overall, but lags slightly behind in the environmental sustainability dimension, resulting in a balance score of BBC.
- Considerable investments have been made in the energy sector to meet environmental goals. Several wind farms are ready for construction to meet the target of 500 MW, set by the National Action Plan, which calls for 27% of gross final energy consumption in 2020 to be from renewables.
- The new Energy Sector Development Strategy to 2030 (ESDS) has been adopted in line with the EU policy, enforced by the Energy Community Treaty and action plans to implement energy efficiency and renewables. The existing feed-in tariff (FIT) scheme has been modified for solar power plants. These developments will have a positive impact on the energy security and environmental sustainability dimension. At the same time, construction of a new coal fired power generation unit has started. Existing units are being refurbished, with the intention that they will remain in operation until after the year 2023, which is likely to improve the country's energy security.
- Policymakers need to focus on: 1) adopting the program for the implementation of the ESDS until 2023; 2) meeting the obligation from the Energy Community Treaty to implement flue gas desulphurisation in all existing power plants that will remain in operation after 2023; 3) meeting the 27% target of renewables, including a 10% target for biofuels in the transport sector; and 4) enforcing the incentives for energy efficiency through the new budget fund.

KEY METRICS

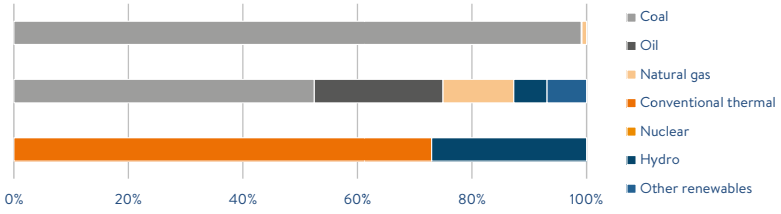
Industrial sector (% of GDP)	29.8	GDP per capita, PPP US$ (GDP Group)	13,482 (III)
Energy intensity (koe per US$)	0.10	Diversity of international energy suppliers	Low (HHI = 3,983)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	89 | 41
Household electricity prices (US$/kWh)	0.08	Rate of transmission and distribution losses (%)	15.9
CO_2 intensity (kCO_2 per US$)	0.50	GHG emission growth rate 2000−2012 (%)	0.6

ENERGY PROFILE

Fossil fuel reserves: 9,404 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SINGAPORE

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

24

SCORE

CBA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**25**	**25**	**24**	▶	**CBA**
Energy performance					
Energy security	73	80	70	▶	C
Energy equity	56	56	56	▶	B
Environmental sustainability	10	7	9	▶	A
Contextual performance	1	1	1	▶	

TRENDS AND OUTLOOK

- Singapore improves by 1 place to rank 24. The country performs very well in terms of environmental sustainability, but receives a letter grade of C in the energy security dimension, for a letter grade of CBA.
- The country has been investing intensively in R&D projects, in particular gas and smart grid areas. The R&D innovation in gas industry is one of the important issues for Singapore. Natural gas is a major source of electricity generation, accounting for nearly 95%, thus securing reliable supplies of natural gas is a high priority for the government, as is improving the resilience and efficiency of gas infrastructure (such as the distribution network and LNG terminals). To facilitate gas technology innovation, S$27m grants have been awarded to 13 R&D projects in these areas in May 2016.
- Smart grids are the other key part of the new energy industry in Singapore. The smart grid and data analytics projects were launched in August 2016, and these are expected to be completed by 2021. The projects can allow the country to enhance energy supply stability and sustainability by monitoring electricity disruptions and facilitating the use of renewable energy.

KEY METRICS

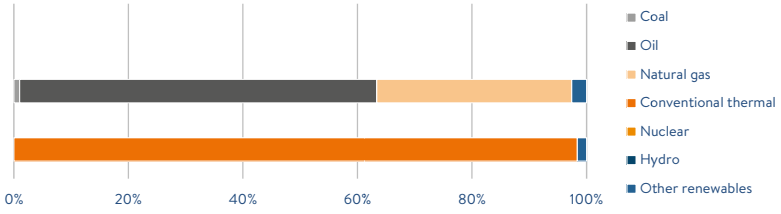
Industrial sector (% of GDP)	24.9	GDP per capita, PPP US$ (GDP Group)	85,209 (I)
Energy intensity (koe per US$)	0.03	Diversity of international energy suppliers	High (HHI = 638)
Population with access to electricity (%)	73	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	0.5
CO_2 intensity (kCO_2 per US$)	0.14	GHG emission growth rate 2000–2012 (%)	1.1

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SLOVAKIA

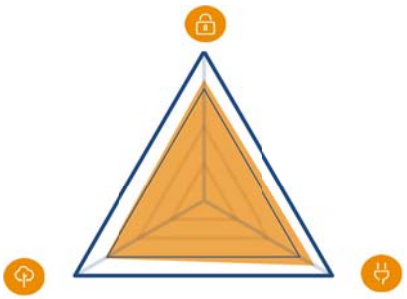
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

16

SCORE

AAA



	2014	2015	2016	Trend	Score
Overall rank and balance score	**18**	**14**	**16**	▶	**AAA**
Energy performance					
Energy security	12	9	15	▶	A
Energy equity	21	20	18	▶	A
Environmental sustainability	35	33	30	▶	A
Contextual performance	38	38	37	▶	

TRENDS AND OUTLOOK

- Slovakia ranks 16th in this year's Index. The country balances the trilemma very well, receiving an overall balance score of AAA.
- Recent policy developments are mainly driven by EU energy and climate targets and implementation of EU policy and regulation continues, including market liberalisation and promotion of environmentally-friendly energy technologies. The removal of cross subsidies is challenging as it conflicts with the support of the availability of cheap energy for low-income households and for the manufacturing sector.
- Policymakers need to focus on dealing with the challenge for the distribution system as a result of decentralised production and e-mobility. Increasing energy efficiency in all sectors of the economy remains a challenge and requires structural changes in the economy to move from heavy industry to sophisticated production, but also measures to reduce energy consumption of buildings. The role of nuclear energy needs to be discussed because the technology allows an increase of electricity generation without increasing carbon emissions. Furthermore, policymakers need to focus on decreasing the dependence on natural gas and oil imports.

KEY METRICS

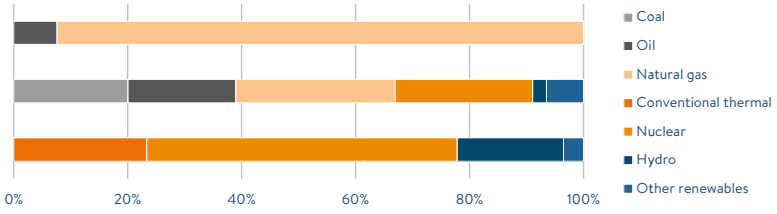
Industrial sector (% of GDP)	33.6	GDP per capita, PPP US$ (GDP Group)	28,877 (II)
Energy intensity (koe per US$)	0.08	Diversity of international energy suppliers	Low (HHI = 2,610)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.20	Rate of transmission and distribution losses (%)	3.4
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000–2012 (%)	-1.4

ENERGY PROFILE

Fossil fuel reserves: 13 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SLOVENIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

12

SCORE

AAB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**12**	**13**	**12**	▶	**AAB**
Energy performance					
Energy security	3	3	2	▶	A
Energy equity	23	26	25	▶	A
Environmental sustainability	50	47	44	▶	B
Contextual performance	33	35	35	▶	

TRENDS AND OUTLOOK

- Slovenia improves by 1 place, to rank 12 in this year's Index. Energy security is the country's strongest trilemma dimension (rank 2) while environmental sustainability is the country's weakest trilemma dimension (rank 44), resulting in an overall balance score of AAB.
- The Energy Act increases competition in the electricity market, especially in the gas market, and stimulates investment in renewables and in energy efficiency. The National Energy Concept which sets energy related environmental goals, is still in public discussion and should be adopted by 2018.
- Construction of a series of hydroelectric power plants on the Sava River is in progress, which will increase the share of renewables in the energy mix. The construction of electricity and gas interconnections with Hungary are in progress, which will benefit the regional energy market. Multiple technologically advanced smart grid projects are in realisation as well, including the SINCRO.GRID project, initiated by a Slovenian transmission operator with a Croatian operator.
- To improve Slovenia's environmental performance additional financial investments are needed for energy efficiency measures, particularly in the energy consumption of buildings (thermal insulation, window replacement and replacement of obsolete heating systems) and in supporting schemes for the use of renewable energy sources for energy supply of buildings. National environmental legislation and permit granting are crucial obstacles for investments in the energy sector and in renewable energy sources.

KEY METRICS

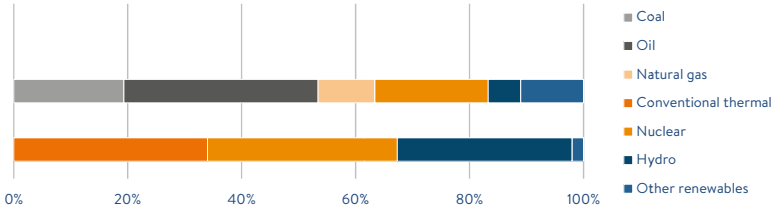
Industrial sector (% of GDP)	33.1	GDP per capita, PPP US$ (GDP Group)	31,122 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Medium (HHI = 1,548)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.22	Rate of transmission and distribution losses (%)	6.3
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000–2012 (%)	0.3

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SOUTH AFRICA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

84

SCORE

CCD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**81**	**81**	**84**	▶	**CCD**
Energy performance					
Energy security	76	68	66	▶	C
Energy equity	78	80	82	▶	C
Environmental sustainability	106	105	105	▶	D
Contextual performance	45	49	47	▶	

TRENDS AND OUTLOOK

- In this year's Index, South Africa ranks 84th, down from rank 81 in 2015. Over the past three years, energy security has been the country's strongest trilemma dimension (rank 66 across all countries). The country receives an overall balance score of CCD.
- Energy security may be improved due to the recent initiative that has allowed independent power producers (IPPs) into the electricity sector using renewable technologies. Of the 6,376 MW planned, 2,220 MW is already operational, with the balance coming online over 2017 and 2018.
- Environmental sustainability continues to be South Africa's weakest trilemma dimension as a result of coal-based electricity generation. Although the contribution from renewable energy sources is increasing, it is still small (<14%). Coal-based generation of electricity will continue to dominate even as renewable energy programmes are completed.
- Due to infrastructure expansions and increased network maintenance efforts, blackouts reduced significantly and 83% of the country now has access to energy, which is likely to improve energy equity in the coming years.
- Given that South Africa has no indigenous natural gas supplies and the need to address the environmental sustainability dimension, policymakers and businesses are exploring possibilities of establishing a natural gas infrastructure based on imported LNG, initially for power generation. It is anticipated that participation in the development and use of the significant natural gas resources in the region may assist in this initiative.

KEY METRICS

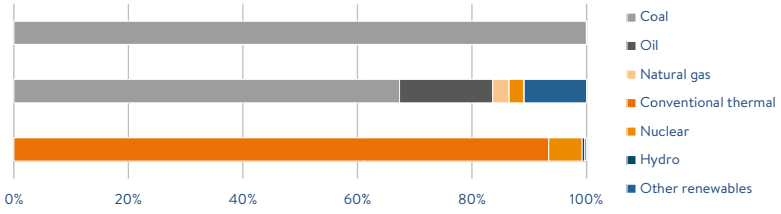
Industrial sector (% of GDP)	29.5	GDP per capita, PPP US$ (GDP Group)	13,165 (III)
Energy intensity (koe per US$)	0.12	Diversity of international energy suppliers	Medium (HHI = 1,508)
Population with access to electricity (%)	83	Access to clean cooking in urban | rural areas (%)	94 | 63
Household electricity prices (US$/kWh)	0.09	Rate of transmission and distribution losses (%)	9.2
CO_2 intensity (kCO_2 per US$)	0.72	GHG emission growth rate 2000–2012 (%)	2.1

ENERGY PROFILE

Fossil fuel reserves: 21,039 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SPAIN

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

13

SCORE

AAA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**14**	**16**	**13**	▶	**AAA**
Energy performance					
Energy security	21	22	26	▶	A
Energy equity	25	28	30	▶	A
Environmental sustainability	17	15	17	▶	A
Contextual performance	30	31	31	▶	

TRENDS AND OUTLOOK

- Spain improves by 3 places in this year's Index, from rank 16 in 2015 to rank 13 in 2016. The country manages the trade-offs among energy security, energy equity and environmental sustainability well, with a balance score of AAA.
- The electricity market reform (2013) aims to eliminate the tariff deficit and reinforce the energy system's economic and financial sustainability. In 2015, for a second consecutive year, a surplus in the electricity tariff has been generated, accumulating a total of more than €800m (provisional data).
- Spain has set a target of 20% of renewable energy in gross final energy consumption in 2020. In 2015 the share of renewables in final energy consumption reached 17.43%, on track to achieve the proposed objective by 2020. However, regional interconnection may pose an obstacle towards the further growth of renewables. While the current level of electricity interconnections with Europe has progressed significantly in 2015, with a new interconnection between Spain and France (the first since 1982), increasing the installed capacity by up to 5%, this value is still well below the EU target of 10%. Gas interconnection has also increased (2 billion cubic metres flowed from Spain to France), but the total level still needs to be improved.
- With the potential operation of the Iberian gas trading being discussed, the use of gas across Europe is further promoted. These are relevant steps towards enhancing security of supply in Europe, especially taking into account Spain's excellent gas infrastructure.

KEY METRICS

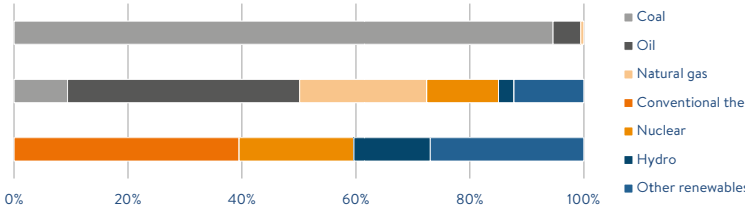
Industrial sector (% of GDP)	22.4	GDP per capita, PPP US$ (GDP Group)	34,527 (I)
Energy intensity (koe per US$)	0.06	Diversity of international energy suppliers	High (HHI = 721)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.31	Rate of transmission and distribution losses (%)	9.9
CO_2 intensity (kCO_2 per US$)	0.19	GHG emission growth rate 2000–2012 (%)	-0.6

ENERGY PROFILE

Fossil fuel reserves: 391 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SRI LANKA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

81

SCORE

CCA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**85**	**83**	**81**	▶	**CCA**
Energy performance					
Energy security	82	84	74	▶	C
Energy equity	93	96	96	▶	C
Environmental sustainability	27	21	24	▶	A
Contextual performance	85	88	85	▶	

TRENDS AND OUTLOOK

- Sri Lanka improves by 2 places, to rank 81. Environmental sustainability is the country's strongest trilemma dimension, but it receives a letter grade of C in both energy security and energy equity, resulting in a balance score of CCA.
- Avoiding the expected energy shortage will be an urgent and important challenge for the country. Recently, the country faced nationwide power failures in November 2015 and February and March 2016, due to a severe drought and a resultant drop in hydropower generation. Moreover, according to the Public Utilities Commission's analysis, Sri Lanka could face energy and capacity shortages in 2018–2019 and beyond under drought conditions even with panned plant additions.
- Despite this situation, the project for 100% electrification will gain momentum in the near future. In July 2016, the Asian Development Bank (ADB) has approved a loan of US$115m and US$3.8m in grants to help some areas, particularly small islands, to enjoy reliable electricity supply and allow the country to improve access to energy. The project includes the construction of hybrid renewable energy mini-grids, upgrades to the medium-voltage network, and 2,300 km of low-voltage line expansions, and is expected to be complete by 2021.

KEY METRICS

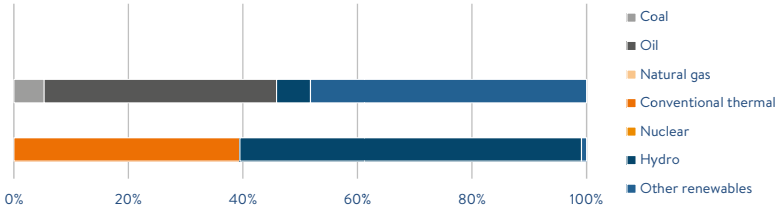
Industrial sector (% of GDP)	30.1	GDP per capita, PPP US$ (GDP Group)	11,739 (III)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Medium (HHI = 2,081)
Population with access to electricity (%)	85	Access to clean cooking in urban | rural areas (%)	66 | 15
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	10.2
CO_2 intensity (kCO_2 per US$)	0.09	GHG emission growth rate 2000–2012 (%)	3.4

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SWAZILAND

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

95

SCORE

BDB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**92**	**95**	**95**	▶	**BDB**
Energy performance					
Energy security	41	48	45	▶	B
Energy equity	103	103	103	▶	D
Environmental sustainability	62	66	70	▼	B
Contextual performance	90	90	98	▶	

TRENDS AND OUTLOOK

- Swaziland places 95th in this year's Index. The country performs well in the energy security and environmental sustainability dimensions, but lags behind in terms of energy equity, resulting in a balance score of BDB.
- Coal will continue to play an important role in the energy mix of Swaziland. The country has vast reserves and is considering building a 300 MW coal fired thermal power station using clean coal technologies, which is expected to supply the country and allow export to the Southern African Power Pool. However, companies are investing in cogeneration to replace coal. These efforts are expected to improve the country's energy independence by reducing the heavy reliance on imported energy. In addition, the development of a renewable energy strategy for both power (off- and on-grid) and fuel (biofuels), an independent power producer policy, and feed-in tariffs are underway.
- In addition, the country is looking to increase its strategic fuel reserves, enhance bulk purchasing (better prices), explore the possibility of setting up a petroleum products refinery, and tap into the natural gas market in Mozambique.
- Policymakers need to: 1) support the deployment of renewables; and 2) increase the budget for the energy sector to enable economic development and poverty reduction, through increased rural electrification, energy access, research and development, development of skills, and capacity building.

KEY METRICS

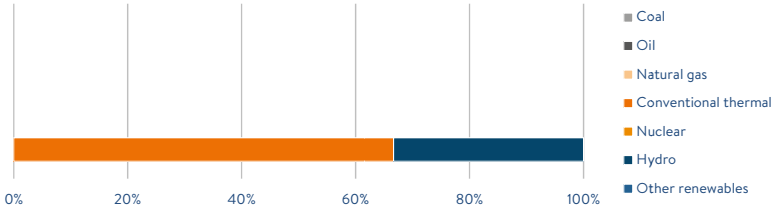
Industrial sector (% of GDP)	44.1	GDP per capita, PPP US$ (GDP Group)	8,427 (III)
Energy intensity (koe per US$)	0.13	Diversity of international energy suppliers	Low (HHI = 9,609)
Population with access to electricity (%)	35	Access to clean cooking in urban | rural areas (%)	87 | 25
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	13.0
CO_2 intensity (kCO_2 per US$)	0.14	GHG emission growth rate 2000–2012 (%)	N.A.

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SWEDEN

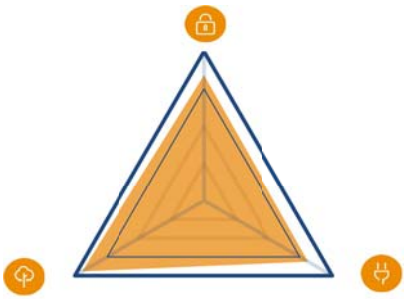
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

3

SCORE

AAA



	2014	2015	2016	Trend	Score
Overall rank and balance score	3	4	3	▶	AAA
Energy performance					
Energy security	10	13	10	▶	A
Energy equity	28	32	27	▶	A
Environmental sustainability	14	9	8	▶	A
Contextual performance	2	10	4	▶	

TRENDS AND OUTLOOK

- Sweden maintains its position of 3rd place in this year's Index. The country manages to balance the trade-offs between energy security, energy equity and environmental sustainability well with a balance score of AAA. In order to maintain a high Index ranking, a key issue for Sweden is to make the transport sector sustainable.
- Currently, the transport sector (except trains, metro and trams) relies on fossil fuels. Special policies and financial support to incentivise the purchase of electric cars are in place, but results are not yet meeting expectations. The EU target to increase the share of biofuels used in transport to 10% by 2020 will be exceeded, as the share has already reached 24% according to a Swedish Energy Agency report. This is mostly due to a rapid increase in the blending of HVO-biodiesel and other biofuels in gasoline and diesel, and an increased number of cars running on biogas.
- Policymakers need to focus on finding a solution to replace the existing 10 nuclear reactors that will be taken out of operation to meet future electricity demand. The first reactors are expected to close between 2017 and 2020. Vattenfall has taken a policy decision to close the two smallest reactors in Ringhals, and Uniper (formerly E.ON) is expected to close the two smallest reactors in Oskarshamn before 2018. While the application to build new reactors has not been formally withdrawn, Vattenfall has currently stopped any further work on the application. In addition to finding measures to meet the EU CO_2 reduction and RES targets, energy efficiency needs to be a top priority.

KEY METRICS

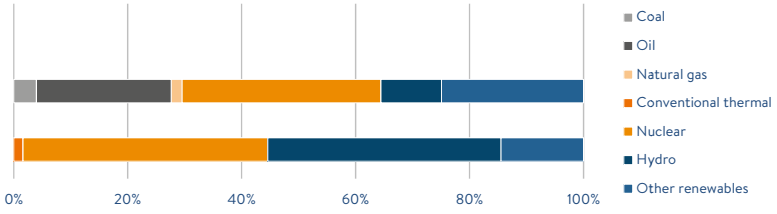
Industrial sector (% of GDP)	26.0	GDP per capita, PPP US$ (GDP Group)	46,420 (I)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Medium (HHI = 1,561)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.25	Rate of transmission and distribution losses (%)	7.2
CO_2 intensity (kCO_2 per US$)	0.10	GHG emission growth rate 2000−2012 (%)	-2.3

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



SWITZERLAND

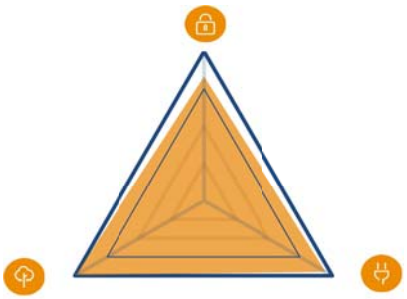
TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

2

SCORE

AAA



	2014	2015	2016	Trend	Score
Overall rank and balance score	**2**	**2**	**2**	▶	**AAA**
Energy performance					
Energy security	9	12	12	▶	A
Energy equity	4	3	2	▶	A
Environmental sustainability	3	3	3	▶	A
Contextual performance	13	7	3	▲	

TRENDS AND OUTLOOK

- Switzerland places 2nd in this year's Index. The country's trilemma performance is excellent, and it ranks 2nd globally in energy equity and 3rd in environmental sustainability, resulting in a balance score of AAA.
- Switzerland's leading position in the index reflects the country's past energy and energy-related policy decisions. Recent policy decisions however are likely to have a strong impact on the country's energy sustainability balance.
- Recent energy policy developments include the decision to refrain from building new nuclear power plants, which will be included in the new energy strategy that is under development and expected to be implemented fully by 2050. The measures and next steps to phase out nuclear are not yet known and will be a matter of political discussions in the next few months (a public referendum is probable). To achieve the transition to a low-carbon energy system in the long term, in the mid-term Switzerland is likely to become more dependent on gas-fired electricity generation.
- Policymakers need to focus on: 1) construction of new electricity grids; 2) completing the liberalisation of the electricity market; and 3) coming to a bilateral agreement with the EU in order to participate in the European internal energy market and the EU-ETS. Furthermore, there is the need to be ambitious and increase the renovation rate of buildings as part of the transition to a low-carbon energy system.

KEY METRICS

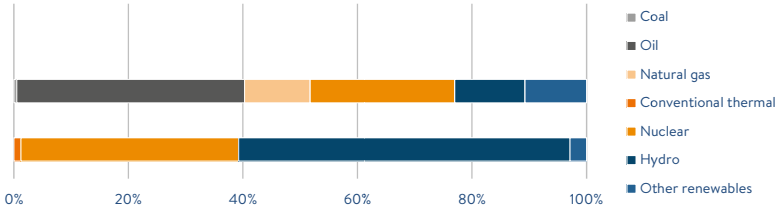
Industrial sector (% of GDP)	26.3	GDP per capita, PPP US$ (GDP Group)	60,535 (I)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	Medium (HHI = 1,667)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.17	Rate of transmission and distribution losses (%)	7.4
CO_2 intensity (kCO_2 per US$)	0.10	GHG emission growth rate 2000−2012 (%)	-0.3

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



TANZANIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

122

SCORE

CDD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**119**	**121**	**122**	▶	**CDD**
Energy performance					
Energy security	67	64	83	▶	C
Energy equity	122	122	121	▶	D
Environmental sustainability	110	113	114	▶	D
Contextual performance	89	94	94	▶	

TRENDS AND OUTLOOK

- Tanzania drops 1 place to rank 122. The country receives low scores across the board, with its strongest dimension being energy security. Its overall balance score is CDD.
- Tanzania faces a shortage of energy services. Power generation capacities are still insufficient, transmission and distribution networks are inadequate, and there is a huge lack of investment, human capital and technology. The government is implementing a number of projects under Big Results Now (BRN) to increase power generation, access to electricity and to bring reliable power to citizens, to drive economic growth and social development. The government is engaging in the development of the country's solar energy capacity, pursuing off-grid or micro-grid options, for example, thought the 'One Million Solar Homes' initiative, as well as larger-scale projects such as a planned 55 MW solar park in Dodoma.
- Targets set by the government include: 1) increasing electricity access to 50% by 2025 and reaching 75% by 2033; 2) increasing electricity generation up to 3,000 MW in 2018 and 10,000 MW by 2025; and 3) reducing transmission and distribution losses to 12% by 2018. The government has also developed a number of initiatives, such as the Petroleum Policy, the PPP Act and participation in the Southern African Power Pool, to create an attractive environment for private investors and increase competitiveness and transparency in the energy sector.

KEY METRICS

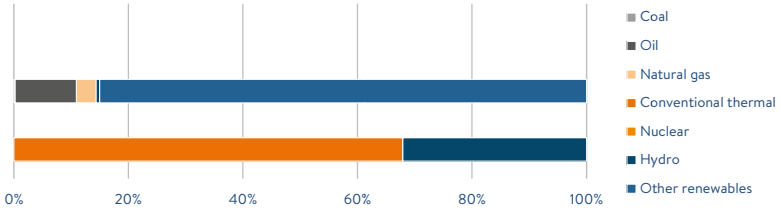
Industrial sector (% of GDP)	25.0	GDP per capita, PPP US$ (GDP Group)	2,667 (IV)
Energy intensity (koe per US$)	0.16	Diversity of international energy suppliers	Low (HHI = 3,722)
Population with access to electricity (%)	15	Access to clean cooking in urban | rural areas (%)	16 | 5
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	20.2
CO_2 intensity (kCO_2 per US$)	0.08	GHG emission growth rate 2000−2012 (%)	5.9

ENERGY PROFILE

Fossil fuel reserves: 101 Mtoe

Total primary energy supply composition

Diversity of electricity generation



THAILAND

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

76

SCORE

CBC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**80**	**76**	**76**	▶	**CBC**
Energy performance					
Energy security	103	96	94	▶	C
Energy equity	70	68	67	▶	B
Environmental sustainability	74	77	76	▶	C
Contextual performance	72	72	71	▶	

TRENDS AND OUTLOOK

- Thailand maintains its place at rank 76 in this year's Index. Energy equity is the country's strongest trilemma dimension, and it receives a letter grade of C in both energy security and environmental sustainability resulting in a balance score of CBC.
- Increasing energy production to enhance energy security and reduce reliance on energy imports is a key challenge for Thailand. To address this challenge, the government aims to advance the exploration and production of energy resources at domestic and international levels; explore the joint development of energy resources with neighbouring economies; develop a more diversified energy mix; and encourage electricity production from renewable and other alternative energy sources. In addition, the government aims to increase competition and investment in the energy industry by creating a business-friendly, transparent environment through the Investor Relation Office, which will be responsible for investment procedures and processes in the energy industry.
- The government has developed policies to encourage the production and use of alternative energy, in particular biofuels, biomass, solid waste and animal manure. These measures are expected to enhance energy security, reduce pollution and support farmers by encouraging the production and use of renewable energy at the community level.

KEY METRICS

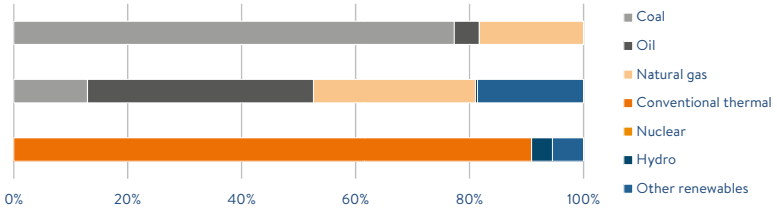
Industrial sector (% of GDP)	36.8	GDP per capita, PPP US$ (GDP Group)	16,305 (II)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	High (HHI = 1,103)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	90 | 57
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	6.1
CO_2 intensity (kCO_2 per US$)	0.32	GHG emission growth rate 2000–2012 (%)	4.6

ENERGY PROFILE

Fossil fuel reserves: 1,118 Mtoe

Total primary energy supply composition

Diversity of electricity generation



TRINIDAD & TOBAGO

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

90

SCORE

DBD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**89**	**90**	**90**	▶	**DBD**
Energy performance					
Energy security	101	102	99	▶	D
Energy equity	49	48	48	▶	B
Environmental sustainability	124	124	123	▶	D
Contextual performance	63	61	64	▶	

TRENDS AND OUTLOOK

- Trinidad and Tobago maintains its place at rank 90. Energy equity is the country's strongest trilemma dimension (rank 48 across all countries), while environmental sustainability is the country's weakest trilemma dimension (rank 123 across all countries) and energy security is also low, resulting in a balance score of DBD.
- Trinidad and Tobago's electricity rates are among the lowest in the Caribbean region at approximately US$0.04 to US$0.06 per kWh, well below the regional average of US$0.33 per kWh, contributing towards the country's energy equity performance. Trinidad and Tobago has significant oil and natural gas reserves and is a net exporter of these fuels. The country is the world's 6th largest exporter of LNG. Liquid fuels subsidies are removed on a step-by-step basis. There have been two price increases since 2015 in order to bring prices in-line with the international market, in an effort to decrease the fiscal burden on the government.
- The government has set a renewable energy goal of 135 MW (10% of 2016 peak capacity) by 2021. There is a strong recognition for the need to increase energy security through promotion of energy efficiency and energy conservation in the production and utilisation of energy sources. Key issues the government will continue to address include: 1) increasing current production levels while reducing the rate of depletion of energy sources; 2) diversifying energy sources to include renewable energy and contributing to global efforts to address climate change and global warming; and 3) maximising the benefits that accrue to the citizens from the exploitation of energy resources.

KEY METRICS

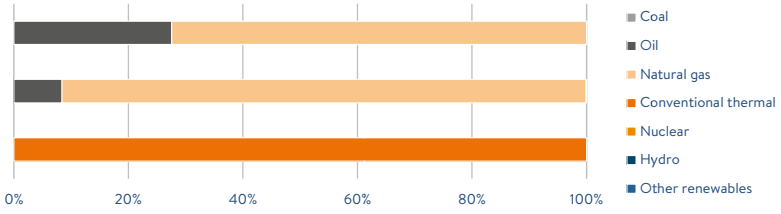
Industrial sector (% of GDP)	56.5	GDP per capita, PPP US$ (GDP Group)	32,597 (II)
Energy intensity (koe per US$)	0.11	Diversity of international energy suppliers	High (HHI = 1,481)
Population with access to electricity (%)	99	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US cents $/kWh)	0.06	Rate of transmission and distribution losses (%)	2.6
CO_2 intensity (kCO_2 per US$)	1.05	GHG emission growth rate 2000−2012 (%)	4.9

ENERGY PROFILE

Fossil fuel reserves: 410 Mtoe

Total primary energy supply composition

Diversity of electricity generation



TUNISIA

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

54

SCORE

DBB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**49**	**54**	**54**	▶	**DBB**
Energy performance					
Energy security	96	101	101	▶	D
Energy equity	41	45	49	▼	B
Environmental sustainability	29	35	43	▼	B
Contextual performance	69	80	80	▶	

TRENDS AND OUTLOOK

- Tunisia ranks 54th in this year's Index. Energy equity and environmental sustainability are the country's strongest trilemma dimensions, but it lags behind in terms of energy security, resulting in a balance score of DBB.
- Over the past few years, Tunisia has made continued efforts to sustain its economic development and improve the energy sustainability balance. To achieve the latter, policies have been implemented to manage the exploration and production of hydrocarbons that will allow Tunisia to accelerate its economic development and to establish its position on the world market. Furthermore, programmes for the promotion of energy efficiency, renewable energy and energy substitution have been initiated.
- Key issues policymakers need to focus on are: 1) increasing the share of renewable energy in electricity generation (including wind, solar and a new concentrated solar power (CSP) scheme) and households (solar water heat, micro generation); and 2) extending the natural gas network in the south and central part of the country.

KEY METRICS

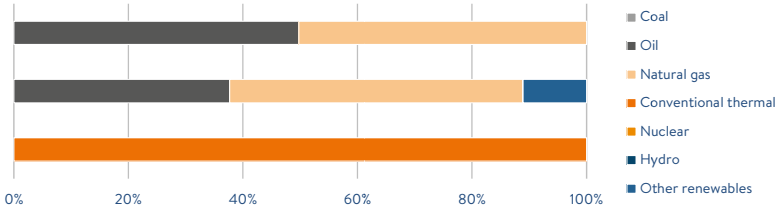
Industrial sector (% of GDP)	29.3	GDP per capita, PPP US$ (GDP Group)	11,397 (III)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,396)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	15.4
CO_2 intensity (kCO_2 per US$)	0.24	GHG emission growth rate 2000–2012 (%)	2.0

ENERGY PROFILE

Fossil fuel reserves: 111 Mtoe

Total primary energy supply composition

Diversity of electricity generation



TURKEY

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

46

SCORE

CBB

	2014	2015	2016	Trend	Score
Overall rank and balance score	**46**	**45**	**46**	▶	**CBB**
Energy performance					
Energy security	71	67	69	▶	C
Energy equity	50	43	45	▶	B
Environmental sustainability	59	56	53	▶	B
Contextual performance	50	53	57	▶	

TRENDS AND OUTLOOK

- Turkey places 46th in this year's Index. The country receives a letter grade of B in both the energy equity and environmental sustainability dimensions, with a slightly lower score in energy security. This results in an overall score of CBB.
- Turkey has to accommodate a fast-growing demand for energy, and enormous investment volumes are required to meet this growth. Furthermore, only 25% of energy consumption is met by domestic resources, thus energy dependence is of great concern.
- Several initiatives are underway to improve energy security in the country: 1) Turkey is currently constructing a nuclear reactor at Akkuyu, with a further one planned in Sinop. When completed, both reactors are expected to make up a 10% share of total electricity supply; 2) construction on the Trans-Anatolian Natural Gas Pipeline (TANAP) began on 17 March 2015, with the project expected to be completed in 2018. TANAP, the last section of the Southern Gas Corridor, has the potential to significantly contribute to the diversity and thus security of Turkey's gas imports; 3) Turkey is working on growing its renewables sector, which includes expanding its existing hydroelectric power capacity, and stepping up efforts in geothermal and solar energy production. Taken together, these developments are likely to help the country improve its ranking in future reports.

KEY METRICS

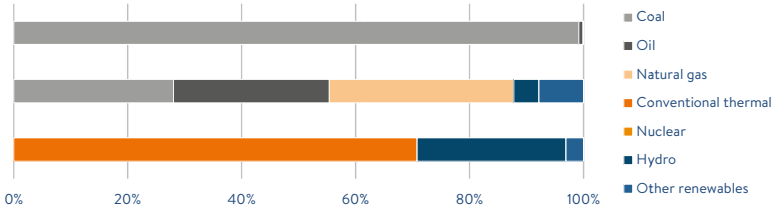
Industrial sector (% of GDP)	27.1	GDP per capita, PPP US$ (GDP Group)	19,618 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	High (HHI = 1,199)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.13	Rate of transmission and distribution losses (%)	15.2
CO_2 intensity (kCO_2 per US$)	0.30	GHG emission growth rate 2000–2012 (%)	3.6

ENERGY PROFILE

Fossil fuel reserves: 6,123 Mtoe

Total primary energy supply composition

Diversity of electricity generation



UKRAINE

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

63

SCORE

ABD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**65**	**65**	**63**	▶	**ABD**
Energy performance					
Energy security	26	28	28	▶	A
Energy equity	59	60	61	▶	B
Environmental sustainability	112	111	108	▶	D
Contextual performance	99	95	97	▶	

TRENDS AND OUTLOOK

- Ukraine improves 2 places to rank 63. The country performs well in terms of energy security, with environmental sustainability being the country's weakest trilemma dimension. It receives a balance score of ABD.
- Ukraine's energy sector faces great challenges, from a high dependence on expensive fossil fuel imports such as oil and gas, to inefficient infrastructure and markets. Recent energy policy developments to address those challenges include the decision to replace Russian gas with Ukrainian coal, increase oil and gas production (for example, from the Black Sea shelf) and develop nuclear power capacity.
- Furthermore, there is a need to strengthen energy efficiency policies, make full use of the country's renewable energy potential such as biogas and municipal waste for heat and power generation, and lower gas consumption in the district heating sector to ensure heat supply and lower energy bills.

KEY METRICS

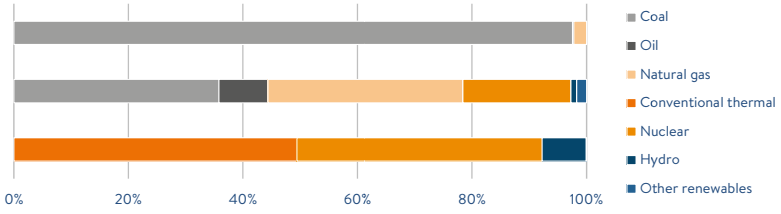
Industrial sector (% of GDP)	25.4	GDP per capita, PPP US$ (GDP Group)	7,916 (III)
Energy intensity (koe per US$)	0.19	Diversity of international energy suppliers	Low (HHI = 2,578)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 89
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	12.3
CO_2 intensity (kCO_2 per US$)	0.73	GHG emission growth rate 2000−2012 (%)	-0.3

ENERGY PROFILE

Fossil fuel reserves: 24,231 Mtoe

Total primary energy supply composition

Diversity of electricity generation



UNITED ARAB EMIRATES

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

43

SCORE

BAD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**45**	**42**	**43**	▶	**BAD**
Energy performance					
Energy security	45	34	42	▶	B
Energy equity	22	19	22	▶	A
Environmental sustainability	114	114	113	▶	D
Contextual performance	27	25	25	▶	

TRENDS AND OUTLOOK

- The United Arab Emirates ranks 43rd in this year's Index. While the country performs well in both the energy security and energy equity dimensions, it receives a letter grade of D in environmental sustainability. This results in a balance score of BAD.
- The UAE relies significantly on conventional hydrocarbon resources for electricity and transport. However, there are opportunities for renewable energy and energy efficiency solutions. For example, the UAE has launched initiatives such as Vision 2021, Dubai Plan 2021, or Abu Dhabi Vision 2030, which include the establishment of renewable energy (7% and 5% generation capacity in Abu Dhabi and Dubai respectively by 2030) and energy efficiency targets (30% demand reduction target by 2030 in Dubai). The UAE is also working on a comprehensive energy policy plan to coordinate all federal initiatives.
- Diversification of the energy mix, energy efficiency and conservation as well as a deep understanding of the water-energy nexus in a water-scarce environment, are all issues policymakers need to focus on in the coming years. The leading oil producer in the UAE has scrapped subsidies on petrol and diesel from August 2015 to support state finances, rationalise fuel consumption and protect natural resources and the environment.

KEY METRICS

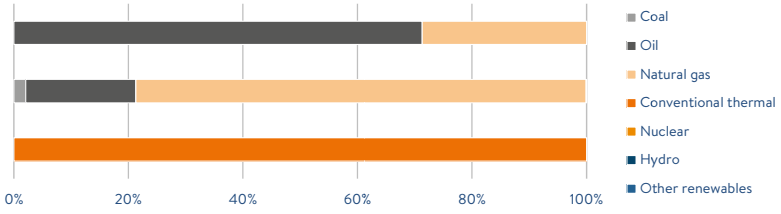
Industrial sector (% of GDP)	56.1	GDP per capita, PPP US$ (GDP Group)	70,238 (I)
Energy intensity (koe per US$)	0.10	Diversity of international energy suppliers	Medium (HHI = 1,628)
Population with access to electricity (%)	94	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	7.7
CO_2 intensity (kCO_2 per US$)	0.35	GHG emission growth rate 2000−2012 (%)	5.8

ENERGY PROFILE

Fossil fuel reserves: 18,197 Mtoe

Total primary energy supply composition

Diversity of electricity generation



UNITED KINGDOM

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

11

SCORE

AAA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**9**	**10**	**11**	▶	**AAA**
Energy performance					
Energy security	34	38	32	▶	A
Energy equity	12	7	8	▶	A
Environmental sustainability	16	16	15	▶	A
Contextual performance	12	13	13	▶	

TRENDS AND OUTLOOK

- In this year's Index the United Kingdom ranks 11th. The country manages to balance the trade-offs between energy security, energy equity and environmental sustainability well with a balance score of AAA.
- Challenges in securing energy supply, however, remain. Overall domestic production of fossil fuels continues to decline, and the plans to expand production of unconventional oil and gas still have to overcome technical challenges and gain public support. In the power sector, an ageing nuclear plant is being decommissioned, while planned new nuclear was approved by the new government in mid-2016. In addition, the planned closure of all coal plants under UK legislation by 2025 (as well as existing EU regulation driving closure at present) is resulting in a decline in electricity generation from coal and was at a record low in the first quarter of 2016. Electricity generation from renewables is showing steady increase year on year, but does not match the decline in generation from conventional sources.
- Regarding energy affordability, policy changes continue to impact. In June 2016, the UK Competition and Markets Authority published its final review into the supply and acquisition of energy in the UK and, while acknowledging that the sector has made significant progress in reducing emissions and ensuring security of supply, concerns were raised in relation to energy affordability. Proposed regulatory changes in light of the report are yet to come into effect. In addition, the consequences of the UK's decision to leave the EU and subsequent changes in government leadership and restructuring of government departments are yet to be realised.

KEY METRICS

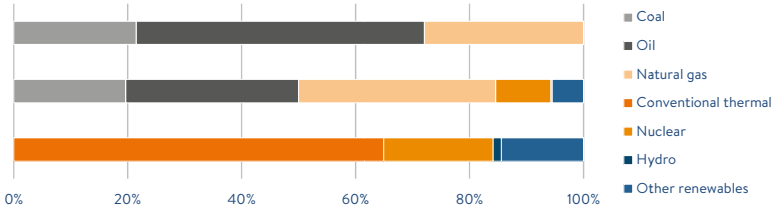
Industrial sector (% of GDP)	21.0	GDP per capita, PPP US$ (GDP Group)	41,325 (I)
Energy intensity (koe per US$)	0.05	Diversity of international energy suppliers	High (HHI = 1,260)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.27	Rate of transmission and distribution losses (%)	8.2
CO_2 intensity (kCO_2 per US$)	0.18	GHG emission growth rate 2000−2012 (%)	-1.4

ENERGY PROFILE

Fossil fuel reserves: 740 Mtoe

Total primary energy supply composition

Diversity of electricity generation



UNITED STATES

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

14

SCORE

AAC

	2014	2015	2016	Trend	Score
Overall rank and balance score	**19**	**22**	**14**	▶	**AAC**
Energy performance					
Energy security	14	11	4	▶	A
Energy equity	6	15	13	▶	A
Environmental sustainability	82	80	73	▶	C
Contextual performance	18	19	18	▶	

TRENDS AND OUTLOOK

- The United States improves by 8 places to rank 14. The country's strongest trilemma dimensions are energy security, where it ranks 4th globally, and energy equity. This results in a balance score of AAC.
- Due to advances in horizontal drilling and hydraulic fracturing, shale gas production has become economically viable in recent years. The Energy Information Administration (EIA) estimates that the country has more than 1,744 trn cubic feet (tcf) of technically recoverable natural gas, including 211 tcf of proved reserves (the discovered, economically recoverable fraction of the original gas-in-place). Production of shale gas is expected to increase from a 2007 US total of 1.4 tcf to 4.8 tcf in 2020. The significant increases in domestic oil and gas production will greatly reduce oil imports over the next 10 years, and lead to increased exports of refined products and possibly natural gas.
- Important energy policy developments in the United States that will impact on the country's balance in the three dimensions of energy sustainability include: 1) the Environmental Protection Agency (EPA) regulations on coal leading to the projected closure of more than 200 coal plants in the next few years, accounting for more than 10% of the US's current energy production; 2) possible regulations on unconventional gas production; and 3) the extension (or not) of the wind production tax credit, which can cut the cost of developing a wind project by nearly a third.

KEY METRICS

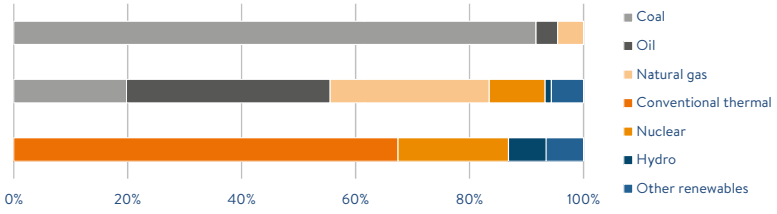
Industrial sector (% of GDP)	20.5	GDP per capita, PPP US$ (GDP Group)	55,837 (I)
Energy intensity (koe per US$)	0.09	Diversity of international energy suppliers	Medium (HHI = 1,528)
Population with access to electricity (%)	100	Access to clean cooking in urban | rural areas (%)	95 | 95
Household electricity prices (US$/kWh)	0.22	Rate of transmission and distribution losses (%)	6.2
CO_2 intensity (kCO_2 per US$)	0.35	GHG emission growth rate 2000−2012 (%)	-1.0

ENERGY PROFILE

Fossil fuel reserves: 180,609 Mtoe

Total primary energy supply composition

Diversity of electricity generation



URUGUAY

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

27

SCORE

BBA

	2014	2015	2016	Trend	Score
Overall rank and balance score	**27**	**27**	**27**	▶	**BBA**
Energy performance					
Energy security	38	29	40	▶	B
Energy equity	55	51	51	▶	B
Environmental sustainability	18	14	16	▶	A
Contextual performance	44	45	44	▶	

TRENDS AND OUTLOOK

- Uruguay maintains its place at rank 27 in this year's Index. The country balances the trilemma well, with environmental sustainability being a particular strength, for a balance score of BBA.
- The country has no proven oil, natural gas or coal reserves but a high availability of renewable energy sources. By carefully choosing renewable energy sources and technologies such as hydropower, wind energy, biomass cogeneration, and biofuels, it was possible, without subsidies, to reach a 57% share of renewable energy in the 2015 energy mix (up from 37% in 2005). At the end of 2015, Uruguay had 26 wind farms (857 MW installed capacity) of which 19 were installed in the last two years. This represents a 15% share of wind energy in the electricity generation mix. In addition, during 2015, the country increased the use of biomass waste as an energy source by 30%. This, among other measures, contributes towards the country's strong energy trilemma performance.
- The country is evaluating the construction of a regasification LNG plant and 70% of the Uruguayan offshore area is being explored for natural gas and oil. Between 2010 and 2015 US$7bn has been invested in the energy sector (15% of annual GDP). As a result of this process, during the last two years, Uruguay has moved from being an energy importer to being an energy exporter. Moreover, since 2015 Uruguay did not have to import electricity.

KEY METRICS

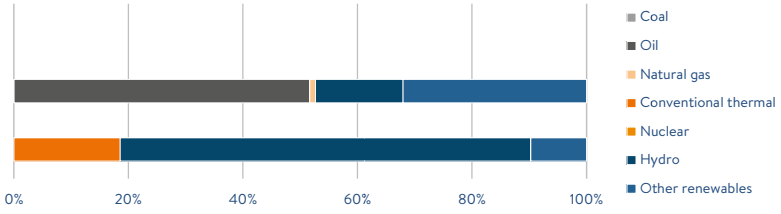
Industrial sector (% of GDP)	27.9	GDP per capita, PPP US$ (GDP Group)	21,201 (II)
Energy intensity (koe per US$)	0.07	Diversity of international energy suppliers	Medium (HHI = 1,990)
Population with access to electricity (%)	99	Access to clean cooking in urban | rural areas (%)	95 | 87
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	11.0
CO_2 intensity (kCO_2 per US$)	0.11	GHG emission growth rate 2000–2012 (%)	4.2

ENERGY PROFILE

Fossil fuel reserves: 0 Mtoe

Total primary energy supply composition

Diversity of electricity generation



ZIMBABWE

TRILEMMA INDEX RANKINGS AND BALANCE SCORE

RANK

113

SCORE

ADD

	2014	2015	2016	Trend	Score
Overall rank and balance score	**116**	**118**	**113**	▶	**ADD**
Energy performance					
Energy security	49	50	27	▶	A
Energy equity	121	120	120	▶	D
Environmental sustainability	102	109	109	▶	D
Contextual performance	115	115	116	▶	

TRENDS AND OUTLOOK

- Zimbabwe improves by 5 places in this year's Index, to rank 113. While the country performs very well in terms of energy security, it receives a letter grade of D in both energy equity and environmental sustainability. This results in a balance score of ADD.
- Over the past few years Zimbabwe has made continued efforts to improve its energy security, energy access and environmental footprint. The installation of a 100 MW project and increased energy imports have resulted in improved energy security and reliability, with tangible impacts for consumers. Since December 2015 there has not been any load shedding in Zimbabwe. Energy equity is addressed through the rural energy master plan, which is being implemented. Moreover, after signing the Paris Agreement, the government has committed to reducing the country's carbon footprint by 33% by 2020. This has already seen a marked shift of power projects to hydro and solar, which is expected to improve the country's environmental sustainability in the future. In addition, the use of biofuels is further promoted, with an increase in the blending ratio from 15% today to 20% by 2018.
- Additional policy developments include: establishment of an independent energy regulator; amendment of the Electricity Act to promote energy efficiency in the public utility; promotion of public-private partnerships to spur development in the petroleum and power sector and the adoption of a long-term, government-driven renewable energy technologies programme.

KEY METRICS

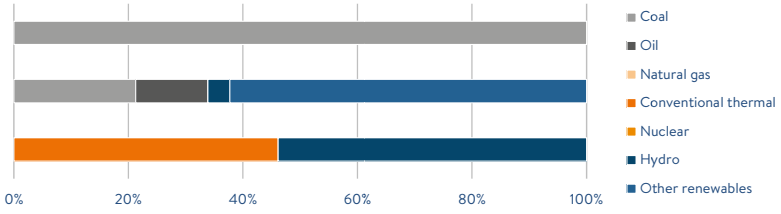
Industrial sector (% of GDP)	29.4	GDP per capita, PPP US$ (GDP Group)	1,794 (IV)
Energy intensity (koe per US$)	0.45	Diversity of international energy suppliers	Medium (HHI = 1,804)
Population with access to electricity (%)	37	Access to clean cooking in urban | rural areas (%)	84 | 6
Household electricity prices (US$/kWh)	N.A.	Rate of transmission and distribution losses (%)	24.4
CO_2 intensity (kCO_2 per US$)	0.58	GHG emission growth rate 2000−2012 (%)	-2.3

ENERGY PROFILE

Fossil fuel reserves: 350 Mtoe

Total primary energy supply composition

Diversity of electricity generation



APPENDIX: INDEX METHODOLOGY OVERVIEW

INTRODUCTION

The Energy Trilemma Index assesses 125 countries' performance across three dimensions of energy sustainability − energy security, energy equity, and environmental sustainability − within a country context. The Index's quantification provides two results: a country's overall ranking and a country's balance score.

The Index ranking, displayed as a number, summarises a country's overall energy trilemma performance and shows its comparative positioning among 93 Council member countries and an additional 32 countries.[58] The balance score, displayed as three letters (e.g., AAD), demonstrates how well a country is meeting the energy trilemma challenge – balancing the three dimensions – with 'A' being the best and 'D' the worst grade.

Together, the Index ranking, balance scores and trend information provide insights into the key areas that countries can address to further develop a balanced energy profile and minimise the risks of an unsustainable imbalance.

BACKGROUND TO THE 2016 METHODOLOGY CHANGE

The Energy Trilemma Index was first introduced in 2009 and ranked almost 90 countries. In 2013 the Index was expanded to cover additional countries where data could be captured and the 'balance score' was introduced to highlight how well countries manage the trade-offs between the three energy trilemma dimensions.

In response to the changing energy landscape, the World Energy Council, in partnership with global management consultancy Oliver Wyman, conducted a review of the Energy Trilemma Index methodology in 2016. The revised index methodology reflects global energy sector insights captured through six years of trilemma research, leverages improved data sets and addresses pressing issues that impact energy sector dynamics.

The 2016 methodology has a broader scope to provide a more inclusive representation of the energy sector; enables a forward-looking view of energy performance by capturing the resilience of a country's energy system and aims to reduce a potential bias to wealthier countries.

The comprehensive index methodology including the full list of data references is available from the World Energy Council London Secretariat upon request (info@worldenergy.org).

[58] The World Energy Trilemma Index report only features country profiles for World Energy Council's member countries for which sufficient data is available. Results for all 125 countries can be viewed at www.worldenergy.org/data.

INDEX STRUCTURE

To measure a country's overall performance, the Index looks at indicators in four areas: energy security, energy equity, environmental sustainability and country context. For each area multiple, granular indicator categories capture key aspects of performance. For example, energy security is evaluated by looking at security of supply and energy delivery and energy infrastructure resilience. Indicator categories are composed of a set of indicators. In total there are 35 indicators, which are made up from 71 data points (see Table 4).

TABLE 4: INDEX STRUCTURE AND WEIGHTING

Dimension	Weight	Indicator category	Weight	Indicator	Weight
Energy security	30%	Security of supply and energy delivery	15%	Diversity of primary energy supply	5.0%
				Energy consumption in relation to GDP growth	5.0%
				Import dependence	5.0%
		Resilience	15%	Diversity of electricity generation	5.0%
				Energy storage	5.0%
				Preparedness (human factor)	5.0%
Energy equity	30%	Access	10%	Access to electricity	5.0%
				Access to clean cooking	5.0%
		Quality of supply	10%	Quality of electricity supply	5.0%
				Quality of supply in urban vs. rural areas	5.0%
		Affordability and competitiveness	10%	Electricity prices	3.3%
				Gasoline and diesel prices	3.3%
				Natural gas prices	3.3%
Environmental sustainability	30%	Energy resource productivity	10%	Final energy intensity	5.0%
				Efficiency of power generation and T&D	5.0%
		GHG emissions	10%	GHG emission trend	5.0%
				Change in forest area	5.0%
		CO_2 emissions	10%	CO_2 intensity	3.3%
				CO_2 emission per capita	3.3%
				CO_2 from electricity generation	3.3%
Country context	10%	Coherent and predictable policy framework	2%	Macroeconomic environment	0.5%
				Effectiveness of government	0.5%
				Political stability	0.5%
				Perception of corruption	0.5%
		Stable regulatory environment	2%	Transparency of policy making	0.7%
				Rule of law	0.7%
				Regulatory quality	0.7%
		Initiatives that enable RD&D and innovation	2%	Intellectual property protection	0.5%
				FDI & technology transfer	0.5%
				Capacity for innovation	0.5%
				Number of patents issued by residents	0.5%
		Investability	2%	Foreign direct investment net inflows	1.0%
				Ease of doing business	1.0%
		Air pollution, land and water impact	2%	Wastewater treatment	1.0%
				Air pollution	1.0%

Source: World Energy Council/Oliver Wyman, 2016

Dimensions, indicator categories and indicators are assigned respective weights in the Energy Trilemma Index to signify their relative importance, while balancing scientific robustness and simplicity (for ease of understanding).

- **Trilemma dimensions:** A major, overarching proposition of the Trilemma Index is that the three core trilemma dimensions are equally important. Each receives an equal weight of 30% in the Index.

- **Indicator categories:** They provide an overview of energy challenges and opportunities facing each country in the index. Indicator categories are weighted equally to the dimension that they belong to.

- **Individual indicators:** Each indicator is assumed to contribute equally to the indicator category that they belong to; all indicators within an indicator category receive equal weight.

On the basis of this weighting methodology, there are a similar number of indicators across the core trilemma dimensions, such that indicators receive a comparable weight as a reflection of their presumed importance. Slight differences among indicator weightings are due to the lack of additional data sets or their failure in meeting the indicator selection criteria.

INDICATOR SELECTION CRITERIA

The selection and inclusion of indicators in the index is guided by a set of pragmatic principles:

- **Robustness:** Indicators are to be taken from reputable sources with the most current information available. If data for an individual country is missing for the most recent year, available data from previous years (maximum two years back) can be considered instead. Where appropriate the average indicator value of a group of countries sharing similar characteristics with the country with missing data is used to substitute for the missing information. Such characteristics may include GDP group, region, and/or other profiles.

- **Contextual sensitivity:** Indicators capture different country situations (for example, wealth, size) and where appropriate indicators are normalised by GDP (PPP), GDP (PPP) per capita or other relevant metrics such as electricity consumption.

- **Relevance:** Indicators are chosen or developed to provide insight into country situations in the context of the Index goals.

- **Distinctiveness:** Each indicator focuses on a different aspect of the issue being explored, unless reinforcement is required.

- **Coverage:** Individual indicators are required to provide data for 50% of countries included in the Index. Only countries with data available for at least 75% of all indicators and 50% per indicator group are included in the Index calculation.[59]

- **Comparability:** Data to calculate an indicator is derived from as single and common a unique source as possible, to ensure comparability between countries.

[59] Indicators for electricity and gas prices currently experience <50% coverage. In the first year of implementation, a couple of theoretically critical indicators may fall short of the coverage criterion due to the lack of robust data covering a broad set of in-scope countries. As these indicators are theoretically important for a relevant and meaningful Trilemma Index, the World Energy Council is reluctant to exclude these indicators solely on the grounds of low data coverage. As such, the World Energy Council will strive to collect additional data from member countries to complement existing sources and ensure that we can meet the coverage criterion in future years.

However, in cases where data accuracy or coverage can be greatly improved, exceptions can be made if the data sources produce comparable results.

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

CALCULATION OF THE INDEX RESULTS AND THE BALANCE SCORE

After data for each indicator is collected and verified, and scores have been calculated for each indicator, the indicator-level results are standardised using the z-score and then re-scaled to a range between 0−100. This is to ensure cross-indicator, cross-category and cross-dimension comparability. With that, indicators can be combined into dimension score, based on the weights assigned to each indicator.

The balance score grade (A to D) for each dimension score is assigned based on the mean and standard deviation of each dimension. This approach ensures that the distribution of grades stay true to that of the underlying scores.

- **Grade A:** Countries with a dimension score >0.75 standard deviation above the mean dimension score across all in-scope countries
- **Grade B:** Countries with a dimension score of the mean value to 0.75 standard deviation above the mean across countries
- **Grade C:** Countries with a dimension score of -0.75 standard deviation below the mean to the mean dimension score across countries
- **Grade D:** Countries with a dimension score ≤-0.75 standard deviation below the mean dimension score across countries.

CALCULATION OF TRENDS

Trends have been calculated taking into account rank changes between years and the mean standard deviation of a country's result across all years which is evaluated against the mean standard deviation of all countries per trilemma dimension.

- **Upward trend:** Countries that improve by 3 or more ranks from 2014 to 2015 and by 3 or more ranks from 2015 to 2016, if their standard deviation is larger than the mean standard deviation across all countries.
- **Downward trend:** Countries that fall by 3 or more ranks from 2014 to 2015 and by 3 or more ranks from 2015 to 2016, if the standard deviation of their score is larger than the mean standard deviation across all countries.

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