

2020 EDITION



# INTERNATIONAL INDEX OF ENERGY SECURITY RISK<sup>®</sup>

Assessing Risk in a Global Energy Market

*Foreword by U.S. Assistant Secretary of State  
for Energy Resources Francis R. Fannon*

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GLOBAL  ENERGY INSTITUTE  
U.S. CHAMBER OF COMMERCE



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<b>A NOTE TO THE READER</b> .....	iii
<b>PREFACE</b> .....	iv
<b>FOREWORD</b> .....	v
<b>HIGHLIGHTS</b> .....	1
2018 Energy Security Rankings.....	1
Trends in Risk by Metric Category.....	6
Trends in Total Risks.....	16
Individual Metric Rankings.....	17
Note on Changes in GDP Measurement.....	23
<b>LARGE ENERGY USER GROUP ENERGY SECURITY PROFILES</b> .....	25
Australia.....	26
Brazil.....	28
Canada.....	30
China.....	32
Denmark.....	34
France.....	36
Germany.....	38
India.....	40
Indonesia.....	42
Italy.....	44
Japan.....	46
Mexico.....	48
Netherlands.....	50
New Zealand.....	52
Norway.....	54
Poland.....	56
Russian Federation.....	58
South Africa.....	60
South Korea.....	62
Spain.....	64
Thailand.....	66
Turkey.....	68
Ukraine.....	70
United Kingdom.....	72
United States.....	74
<b>APPENDIX 1. Methodology Used to Develop the International Index of Energy Security Risk</b> .....	76
<b>APPENDIX 2. International Energy Security Risk Index Scores (Tables by Country)</b> .....	86
<b>APPENDIX 3. Data Sources</b> .....	114



**T**his *International Index of Energy Security Risk* report, including the Foreword by Assistant Secretary of State for Energy Resources Francis R. Fannon, was completed well before the awful global health, economic, and energy impacts of the corona virus pandemic were fully felt. It describes energy security and energy market trends as they existed from 1980 to 2018. The big story in this year's edition is the rapid improvement in U.S. energy security over the course of the last 10 years to the point where America earned the highest energy security ranking of the 25 large energy consuming countries the report examines.

The report, especially the Foreword by Assistant Secretary Fannon, also points to emerging issues that could pose challenges to energy security going forward. No one could have guessed, however, the tremendous strain the response to a global pandemic would place on energy systems. Today energy production running well ahead of collapsing demand and prices as economies contract at an unprecedented rate. Indeed, since this edition went to press, Assistant Secretary Fannon and the Energy Resources bureau at the State Department were thrust into a high-profile U.S. effort—ultimately successful—to help bring an end the OPEC+ price war.

Even in a country as energy secure as the United States, a prolonged period of substantially lower demand coupled with over supply proved too much for some domestic producers to stay in business. How these new market dynamics shake out is yet to be determined, but it's pretty clear that what happens over the next few years as the global economy recovers will have a big impact on the energy security of the 25 large economies covered by the Global Energy Institute's *International Index*. Price volatility

alone is a large source of risk, and the collapsing energy prices we have seen thus far in 2020—and who knows, maybe even a sharp spike in prices if production falls and demand picks up later in the year of next year—will have a big impact on risks scores. So, too, could a consolidation of energy producers, especially if that means U.S. shale production doesn't recover, and a greater share of our energy supply coming from foreign sources. Our 2022 edition will pick up and report on these and other pandemic-related trends in the United States and other countries as they emerge during the next couple of years.

In the meantime, we should take comfort that the U.S. energy economy before the pandemic hit was in the best shape it has been in decades. In such an uncertain time where almost nothing can be taken for granted, Americans do not have to worry about counting on a reliable supply of energy. The U.S. energy industry will deliver as it always does. And with the proper policies in place and dynamic global engagement, it will meet the challenges of a global pandemic.

**“We’re number one! We’re number one!” Okay, we here at the Global Energy Institute pride ourselves on letting the facts speak for themselves without a lot of fanfare, so indulging in this kind of boosterism is admittedly a bit out of character. Still, it is hard to resist celebrating the remarkable turn of events in the U.S. energy markets over the last decade that led the United States to its first number one ranking in this 2020 edition of GEI’s Index of International Energy Security.**

When we first published the Index of U.S. Energy Security Risk and the International Index about ten years ago, there was not much to celebrate. High prices, declining domestic production, geopolitical challenges, and a stifling energy policy environment led to a less than ideal energy security posture. Fast forward to today, and the situation has changed completely. Indeed, it is hard to overestimate how profoundly the application of hydraulic fracturing, horizontal drilling, and advanced seismic imaging so rapidly improved our energy security by unlocking vast quantities of “unconventional” oil and natural gas—both of which are getting more conventional by the day. It is a story that could have unfolded only in the United States.

Since the beginning of the shale revolution, virtually every aspect of U.S. energy security has improved to one degree or another. We are producing more oil and natural gas than ever; energy prices, especially for natural gas, are historically low; abundant natural gas is providing feedstock to a revitalized industrial base; the energy economy is providing a huge boost to states across the country; emissions are declining thanks both to greater power generation from natural gas and from renewables backed up by natural gas; efficiency is improving; and our geopolitical influence is increasing. All this and more have made the United States, as measured by our Index, the most secure large energy user in the world. For reference the U.S. ranked number 11 in 2008.

Now is not the time for complacency, however, as history has shown an unpredictable or hostile policy and investment environment could derail the progress that has been made, increasing future energy security risks and making us more vulnerable in the process. Moreover, there are many new challenges on the horizon that could stymie or even reverse some of this improvement.

We are delighted, therefore, that the U.S. State Department’s Assistant Secretary of State for Energy resources, the Honorable Francis R. Fannon, has contributed a Foreword to this year’s edition laying out some of these challenges. As head of the primary office in the federal government dealing with national security and energy, Assistant Secretary Fannon is ideally positioned to identify these emerging issues—like the importance of market stability and the concentration of many critical earth elements used in many renewable and battery technologies—and explain how the U.S. government is approaching them. The Assistant Secretary lays out how smart diplomacy can help sustain the many energy advantages we have over the longer term and bring these advantages to other countries.

The International Index could not have been completed without the extraordinary efforts of many people. In particular, our thanks go to Daniel E. Klein, President of Twenty-First Strategies of Santa Fe, New Mexico, and his assistant, Christopher D. Russell, for their updating of the international database—a monumental task that requires sifting through huge amounts of data. Special thanks also go to GEI’s Kara Riba and the Chamber’s Laurie Frankel for their reviews of the manuscript. The entire production team here at the U.S. Chamber of Commerce is owed a huge debt of gratitude for designing and producing the publication under a tight deadline. Finally, special thanks go to the entire GEI team for creating what is still the most widely used energy security index that has changes the way we look at energy security.



**MARTY DURBIN**  
PRESIDENT  
GLOBAL ENERGY INSTITUTE  
U.S. CHAMBER OF COMMERCE

**We are living in a period of unprecedented energy transformations in both energy supply and demand patterns. These transformations present both great opportunities and real energy security risks, the subject of this edition.**

The United States' model of private sector-led energy development is a powerful example for the global energy sector. The Energy Information Administration projects that U.S. oil production will rise to 13.2 million barrels per day in 2020, allowing exports of some 3 million barrels per day of crude oil. It is a similarly positive story for natural gas. The United States began exporting natural gas in 2016 and, given private sector production growth, partnered with a concerted federal government effort to streamline the permitting of natural gas infrastructure, the United States is now among the world's top three exporters of liquefied natural gas. The U.S. renewable energy sector, led by U.S. technologies, has also made us one of the world's fastest growing recipients of renewable energy investment.

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**U.S. ENERGY ABUNDANCE OFFERS US OPPORTUNITIES TO CREATE A NEW ERA OF PARTNERSHIPS FOR ENERGY SECURITY AND GROWTH.**

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U.S. energy abundance offers us opportunities to create a new era of partnerships for energy security and growth. Our all energy sources and technologies approach ensures that countries can choose the energy mix best suited to achieve their economic and environmental goals. U.S. oil and gas exports, as well as exports of clean energy technologies, will strengthen these new commercial partnerships.

One need only look to the Indo-Pacific region, which will require trillions of dollars of investment in energy infrastructure to meet massive growth in energy

demand. Through the Enhancing Development and Growth through Energy program, Asia EDGE, the United States in partnership with regional organizations such as ASEAN and our allies and friends, is providing capacity building programs as well as technical cooperation and investment promotion efforts to ensure open and fair investment terms, open markets for energy trade, and international standard regulatory environments.

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**COUNTRIES AROUND THE WORLD MUST STILL DIVERSIFY THEIR ENERGY SOURCES, SUPPLIERS, AND ROUTES TO REDUCE VULNERABILITY TO SHOCKS AND POLITICAL MANIPULATION.**

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There remain real energy security risks, however. Countries around the world must still diversify their energy sources, suppliers, and routes to reduce vulnerability to shocks and political manipulation. In 2040, the world will require 31 percent more energy than we produce today. Yet malign actors are using market distorting tactics (including subsidies, intellectual property theft, and the threat of market closure) to dominate supply chains, and inhibit countries' sovereign rights to develop their own energy resources and determine their own energy supply mix, and wield energy supply as a political weapon.

U.S. government programs to level the playing field for international investment, including energy infrastructure investment, improve free market conditions for energy trade and interconnectivity

address this challenge. Even more importantly, U.S. industry transparency, fair labor practices, and innovation can mitigate these risks and help ensure the energy security of U.S. partners and friends to benefit the global economy.

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**HOWEVER, IF RESOURCE DEVELOPMENT IS MISMANAGED, HUMAN RIGHTS VIOLATIONS, DEBT, ECOLOGICAL DAMAGE AND CORRUPTION MAY INCREASE.**

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Another challenge is that as renewables comprise a greater proportion of the world's energy, demand for energy minerals, such as lithium, is expanding rapidly. The resulting race for new mines is a positive opportunity if it spurs new economic development in countries where it is needed most. However, if resource development is mismanaged, human rights violations, debt, ecological damage and corruption may increase. To address these pressing challenges, the State Department launched the Energy Resources Governance Initiative (ERGI) with founding partners Australia, Botswana, Canada, and Peru. ERGI focuses on three strategic objectives: (1) Engage resource-rich countries on responsible energy minerals governance (2) Support resilient supply chains and (3) Encourage international financial institutions to help meet the expected demand for responsible development of energy minerals.

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**THE UNITED STATES IS RANKED NUMBER ONE IN ENERGY SECURITY FOR THE FIRST TIME IN THE HISTORY OF THE GLOBAL ENERGY INSTITUTE'S INDEX OF INTERNATIONAL ENERGY SECURITY RISK.**

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It is significant that for the first time in the history of the Global Energy Institute's Index of International Energy Security Risk the United States is ranked number one in energy security. Thank you for this opportunity to contribute to this edition. The U.S. government will continue to work to assure that the dramatic shift in U.S. energy security over the last few years becomes a factor in reducing overall global energy security risk.



**FRANCIS R. FANNON**  
ASSISTANT SECRETARY  
BUREAU OF ENERGY RESOURCES  
U.S. DEPARTMENT OF STATE



**T**his 6<sup>th</sup> edition of the *International Index of Energy Security Risk* (International Index) provides an updated look at energy security risks across different countries from 1980 through 2018. The risk index scores are calculated for the United States and 24 other countries that make up the *International Index's* large energy user group. These countries are: Australia, Brazil, Canada, China, Denmark, France, Germany, India, Indonesia, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Poland, Russian Federation, South Africa, South Korea, Spain, Thailand, Turkey, Ukraine, and the United Kingdom.

The risk index scores for these countries also are measured in relation to an average reference index measuring risks for the Organization for Economic Co-operation and Development (OECD) member countries. The OECD average risk index is calibrated to a 1980 base year figure of 1,000 and is provided to serve as a single frame of reference for the 25 countries in the large energy user group.

Data revisions, necessary changes in methodology, changing databases, and other factors mean that each edition of the *International Index* should be seen as a stand-alone document. While general trends should not change all that much across editions, some specifics almost certainly will, making it unavoidably difficult to compare risk scores, rankings, and other data from one edition of the *International Index* to another.

The change in Gross Domestic Product (GDP) figures from real 2005 dollars (2005\$) to 2010\$ also has had an unavoidable impact on index scores. Readers should consult the Note on Changes in GDP Measurement later in the report for a discussion of some of the issues surrounding the World Bank GDP data that are used in the *International Index*, how they affect results, and how they have been addressed.

## 2018 ENERGY SECURITY RANKINGS

**Table 1 ranks the energy security scores of 25 large energy-consuming countries in 2018.** This is a risk index, so the highest (best) rank has the lowest risk score and the lowest (worst) rank has the highest risk score.

### TOP FIVE

**The United States for the first time had the best ranked energy security of the 25 countries**

**examined in 2018 (and 2017), overtaking Norway—which tumbled to number six—as the top ranked country.** Its 2018 total risk score of 727 was a record low and 30 points (4%) lower than the score for the next ranked country, New Zealand. New Zealand's score of 757 was enough for a second place finish. The United States and New Zealand were the only two countries with 2018 scores below 800. Since 2009, New Zealand has ranked either second or third. Rounding out the top five were Canada, Australia, and Denmark. In addition to these top five finishers, Norway and Russia registered 2018 scores below the OECD average score.

### BOTTOM FIVE

**Despite a 57% decline in risk score since 2000, Ukraine's 2018 score of 1,463 made it the least energy secure country in the 25-nation large energy user group.** Except from 2012 to 2014, Ukraine has been continuously in the 25<sup>th</sup> spot since 1992 (the first year we have data for Ukraine), with risks averaging 170% above the OECD average. A close 24<sup>th</sup> in 2018 was South Korea, whose risk score was just 10 points lower than Ukraine's. Whereas South Korea's economy is much more efficient than Ukraine's, it depends on imports for nearly all of its energy. As a result, it has been ranked 21 or higher since 1980 and from 2012 to 2014 was ranked 25<sup>th</sup>. Since the late 1990s, Thailand has consistently ranked in the bottom five, as economic growth put strains on energy systems, increasing demand and imports. For many of the same reasons, Turkey ranked in the bottom five (10<sup>th</sup> in 2018). Rounding out the worst performers at 22 was Japan, which has few energy resources and is dealing still with the repercussions of the Fukushima Daiichi incident.

TABLE 1

## Energy Security Risk Scores and Rankings for 25 Large Energy Using Countries: 2018

COUNTRY	RISK SCORE	LARGE ENERGY USER GROUP RANK
United States	727	1
New Zealand	757	2
Canada	802	3
Australia	805	4
Denmark	864	5
Norway	869	6
Russia	875	7
OECD	884	
China	912	8
Indonesia	932	9
United Kingdom	944	10
Mexico	966	11
Poland	967	12
Brazil	1,059	13
Germany	1,085	14
France	1,128	15
India	1,144	16
Netherlands	1,147	17
South Africa	1,156	18
Spain	1,189	19
Italy	1,240	20
Turkey	1,267	21
Japan	1,281	22
Thailand	1,396	23
South Korea	1,453	24
Ukraine	1,463	25

## UNITED STATES<sup>1</sup>

**Almost entirely because of the shale revolution, the United States moved up from a rank of 11 as recently as 2008 to number one in 2018 (Figure 1).**

The shale revolution continues to drive total U.S. energy risks downward, both absolutely—2018’s 727-point score was a record low—and measured relative to the OECD average. Since 2008, when the impacts of the shale revolution first started to be felt in earnest, the difference in the United States’ index score moved from 1% above the OECD average to 18% below in 2018. Over the same period, its rank rose from 11 to one.

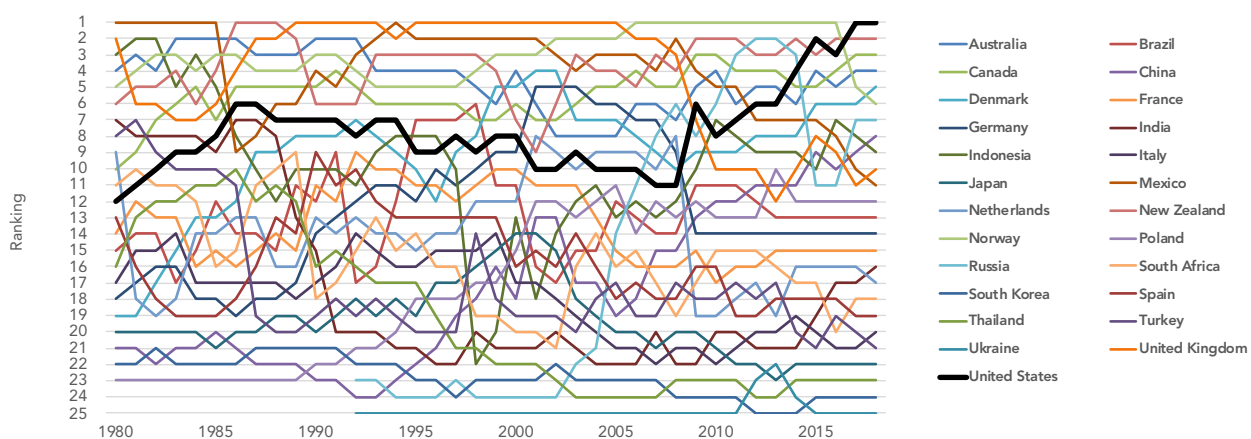
This vastly improved U.S. position relative to its peers is due primarily to the huge increase in unconventional oil and natural gas production from shale formations, the benefits of which have rippled through many metrics measuring imports, prices, and emissions. In particular, the United States logged large improvements in metrics measuring price volatility, security of petroleum imports, and fossil fuel import expenditures per unit of GDP in 2018.

Domestic crude oil production has increased rapidly and projections indicate continued growth for many years. From 2010 to 2018, crude oil production in the United States more than doubled to nearly 11.0 from 5.5 million barrels per day because of continuing development of shale plays, especially in the Permian Basin in West Texas and Southeast New Mexico. Largely as a result of the growing crude oil production, U.S. petroleum import risk fell 38% in 2018 to its lowest score in going back to 1970. It is expected that by 2020, the United States will become a net exporter of total petroleum (crude oil and refined products). Domestic natural gas production continues to roar ahead—it grew 43% from 2010 to 2018 to 30.4 trillion cubic feet—and is expected to continue climbing. The risks associated with the security of U.S. natural gas imports, therefore, will continue to remain zero for the foreseeable future. With the United States already a net natural gas exporter and set to become net oil exporter by 2020, the risk scores for the metrics measuring oil and gas import expenditures and oil and gas import expenditures as a share of GDP also will move to zero.

The United States is a much more efficient economy than it was in 2008 (about 17%), and its energy-related

**FIGURE 1**

### Historical Energy Security Rankings: 1980-2018



<sup>1</sup> It should be emphasized that the index data presented here and the index data presented in the Energy Institute’s *Index of U.S. Energy Security Risk* measure different things and are not strictly comparable, though the general trend is substantially the same. Moreover, the concern in this section is primarily with U.S. energy security risks in reference to those of the OECD average and other large energy users over time.

carbon dioxide emissions are considerably lower (about 14%), other factors that have contributed to its top position. Most of the reduction in emissions has come about from fuel switching in the power sector from coal to natural gas. Greater generation efficiency and renewable deployment also has contributed to lower emissions from electricity generation. The United States also scores well in those metrics measuring prices and volatility. U.S. energy prices to industry remain among the lowest among developed economies.

Of the 20 country-specific metrics, the U.S. ranked in the top five in seven of them (related to import and import energy expenditures risks and prices) and the bottom five in three of them (related to per capita energy use). Only Norway and Denmark had more individual metric scores in the top five than the United States (although Indonesia and the United Kingdom also had seven).

## MOVERS

**Improvements in 2018 versus 2017 were broad based.** All but four countries had lower risks scores in 2018 than in 2017, and the increases recorded for Brazil, Indonesia, Norway, and Turkey were inconsequential. The largest relative (percentage) improvement was recorded by Ukraine (8%). No other country improved by greater than 5%.

**Compared with 1980, the United States was one of 15 countries with a 2018 risk score lower than its initial 1980 score, from 1,071 (its highest risk score in the record) to 727, a drop of nearly one-third.** Poland (46%), Ukraine (42% from 1992), China (36%), Denmark (32%), and Russia (30% from 1992) are other countries that showed declines in total risk of 30% or more. While China's total risk score was quite a bit lower in 2018 than it was in 1980, other large emerging economies, not surprisingly, showed increasing owing to economic expansion and higher energy use, factors that can increase risks (e.g., India, Indonesia, Mexico, South Africa, Thailand, and Turkey). Italy, the Netherlands, Spain, and the United Kingdom had higher risks scores than in 1980 for a host of reasons, but mostly related to prices and imports.

## KEY DEVELOPMENTS

**Energy security risks for all countries in the large energy user group benefited from lower crude oil price volatility, which was more than enough to offset an increase in risks associated with the rising world price of crude oil (-665 vs. +165).** Because crude oil is priced in a global market, price volatility is a "shared" risk that applies equally to all countries. This means the 46% decline measured for this risk in 2018 benefited everyone. Volatility is measured in this *International Index* as a rolling three-year average. The low volatility score in 2018 reflected the dissipation of crude oil price collapse that occurred in 2015 (from more than \$110 per barrel to less than \$60 per barrel) as Saudi Arabia ramped up production in an effort to shut in U.S. production and garner greater global market share. Volatility can have profound effects on economies. Some amount of price volatility is inevitable, but large price swings over a short period of time create uncertainty about expectations of future prices and future production. It was expected that under a prolonged period of low oil prices, U.S. oil (and natural gas) production would be constrained. While production declined in 2016, consolidation in the industry and continual advances in production methods and technology soon pushed production higher, and it has been increasing ever since. Unlike the price plunge in 2015, the increase in price in 2018 was much easier for markets to handle.

**Generally, low energy prices and greater efficiency meant that energy expenditures in 2018 were lower for most countries.** The majority of countries also showed improvement in measures of energy end use and efficiency and carbon dioxide emissions. Scores in the two transportation metrics, however, were something of a mixed bag, with emerging economies in particular showing increased scores for transportation energy per capita. Not surprisingly, changes in import metric scores showed large variation among countries in the large energy user group.

**Global crude oil production surged 2.3% in 2018, about 1.9 million barrels per day (MMbbl/d) higher**

**than in 2017. An increase in U.S. output of 1.65 MMbbl/d (18%), largely from “unconventional” sources, was responsible for 86% of the surge.**

The United States became in 2018 the world’s largest producer of crude oil. It, Russia, and Saudi Arabia all produced more than 10 MMbbl/d in 2018 and together accounted for 39% of total global production. The next closest producer was Iraq at 4.6 MMbbl/d. Canada also chipped in with nearly 370,000 bbl/d of added production, though Mexican output declined by almost 7%, a continuation of a long-term trend. Saudi Arabia (290,000 bbl/d), Russia (180,000 bbl/d), and Iraq (160,000 bbl/d) were other countries that increased production by significant amounts. But the big story of 2018 was the growth in U.S. production.

**U.S. crude oil production has increased rapidly, and projections indicate continued growth for many years.** From 2010 to 2018, crude oil production in the United States more than doubled to nearly 11.0 MMbbl/d from 5.5 MMbbl/d because of continuing development of shale plays, especially in the Permian Basin in West Texas and Southeast New Mexico. Texas was responsible for nearly 60% (+3.2 MMbbl/d) of that jump. Large production increases also were observed in North Dakota (+960,000 bbl/d), New Mexico (+500,000 bbl/d), Colorado (+400,000 bbl/d), and Oklahoma (+365,000 bbl/d). Even greater production is expected from these regions. The U.S. Energy Information Administration’s (EIA) *Annual Energy Outlook 2019* (AEO2019) projects that by 2024, total U.S. crude oil production will exceed 14 MMbbl/d and stay above that level through 2040.

**Crude oil prices rose 28% in 2018, from about \$55 to \$71 per barrel.** The firming world price of crude oil in 2017 and 2018 after the big drop in price in 2015 and improved production efficiency helped spur the increased production of crude oil and natural gas. Output of both fuels fell in 2016 after the world price of crude oil tumbled 57% between 2014 and 2016. The rising crude oil price since has been comparatively modest and was not enough to send the crude oil volatility metric higher. At \$71 per barrel,

the price of crude oil in 2018 was about 56% higher than the 30-year baseline average price.

Despite much greater U.S. crude oil production in the EIA forecast, greater global demand and declines in production elsewhere create conditions where crude oil prices will rise in the future. By 2035, EIA expects the global price of crude oil to breach \$100 per barrel. The expected increase in price, however, is much lower than the expected increase in forecasts from just a few years ago, when the per barrel price was forecast to exceed \$150 in a couple of decades. Although a significant contributor of future risk, the price of crude oil is not expected to be as big a contributor as it once was.

**Natural gas import risks remain very high for many countries, especially in Europe, Japan, and South Korea.** Large natural gas producers in the large energy user group like Australia, Canada, Russia, the United States, and a few others have a tremendous advantage over countries that rely on imports of this fuel. The addition of large and growing amounts of U.S. natural gas has made that fuel’s global market less risky than it would have been otherwise, but U.S. production has been matched by increases in production from countries with high risk profiles, such as Russia, Iran, Qatar, and Algeria. As a result, the amount of the world’s natural gas being produced in countries Freedom House labels as Not Free is around 61%, while the share being produced in countries labeled as Free is around 27%.

**While coal-related import risks are not weighted as much as oil and natural gas import risks, they have been rising steadily in many countries since around 2000.** This is especially the case for developing and emerging economies that are turning to coal as the primary fuel for electrification. Countries like China and India were once self-sufficient in coal but now require imports to satisfy domestic demand. Both countries have undertaken programs to increase mine output, which has had the effect of lowering coal import risks in the last few years. Many European countries also rely on coal imports to meet their

needs. Coal is being phased out in many European countries, which should decrease coal import risks but may increase other risks. The International Energy Agency's (IEA) *World Energy Outlook 2019* indicates that coal will still be the primary fuel for electricity generation for decades, so coal imports should continue to be a risk factor in many countries that rely on this fuel for power.

**Most developed countries saw their energy use intensity metrics and carbon dioxide emissions metrics improve in 2018 while emerging economies had more mixed results.** Petroleum intensity, in particular, was a source of growing risk in five of the nine emerging economies, but the long-term trend remains one of declining risk for this metric in these and other countries. Overall energy intensity can be improved through: (1) greater energy efficiency; and (2) relative shifts in economic activity from more to less energy-intensive activities (e.g., from industrial to service activities). Historical data suggest that as incomes rise, so do the resources available for investment in new, more efficient technologies, and there also is a shift to less energy-intensive economic activity. The result is that energy intensity tends to rise as countries develop before peaking and then declining.

Although developed countries in the large energy user group continue to see improvements—often very large improvements—in energy intensity, the economies in transition and the emerging economies often show increasing intensity as economic development takes hold. The three former communist countries—Poland, Russia, and Ukraine—and China, a communist country that has instituted market reforms, have shown the greatest improvement since 1980. This rapid improvement can be attributed largely to the emergence of market pressures in these countries that have led to greater efficiency and the closure of obsolete industrial facilities.

Declining emissions trends in 2018 were pretty much across the board, with nearly all countries showing lower risks in 2018 than in 2017.

**Although the range of risk scores among all countries in the large energy user group was quite large (from Spain's 505 to Norway's 1,417), nearly all countries had lower risk scores for electric capacity diversity in 2018.** The widespread adoption of renewable technologies in the power sectors explains some of the general decline in risk, as does the greater use of natural gas in the United States. Longer term trends tend to move slowly because of the large infrastructure requirements needed to change the fuel and technology mix of the power sector appreciably. It is not unusual to see emerging economies reduce the diversity of their power supply as they develop, especially if there is a dominant fuel resource available (e.g., India and Indonesia are both heavily reliant on coal).

The closure of nuclear plants in Japan following the Fukushima Daiichi incident also has affected its power generation diversity, as the closure of its nuclear plants essentially eliminated the use of nuclear technology in its generation mix while it increased the use of coal and gas capacity. If as expected nuclear plants are brought back on line, Japan's diversity score should improve. Germany, which has a fairly diverse power supply, could see its risks increase as it closes its nuclear plants by 2022.

## TRENDS IN RISK BY METRIC CATEGORY

This section looks at the risk trends by metric category for the 25 countries in the large energy user group. There are eight categories of metrics used in the *International Index*: Global Fuel; Fuel Imports; Energy Expenditure; Price and Market Volatility; Energy Use Intensity; Electric Power Sector; Transportation; and Environment. Each category is made up of between two and six metrics. The charts accompanying the discussions show trends in the total *weighted* scores for these metric groups—that is, the sum of the weighted individual index scores—for the emerging economies, economies in transition (EIT), Western European countries, and other advanced countries. All the charts for each metric group have the same scale to make them comparable. (See Appendix 1 for more information on these metrics categories and their weights.)

## GLOBAL FUELS

Unlike the other metric categories, Global Fuels is not country-specific. It applies to all countries equally. It combines measures of the reliability and diversity of crude oil, natural gas, and coal reserves and production.

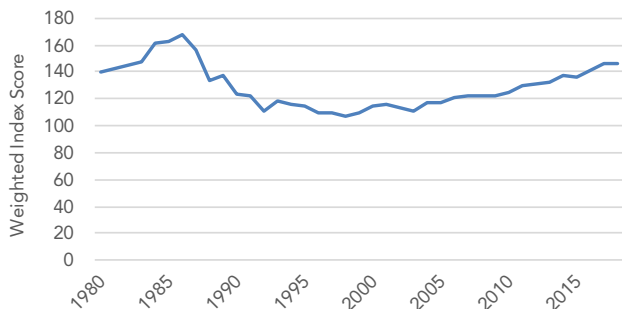
Figure 2 shows the trend in total Global Fuel supply risks since 1980. From the mid-1990s, total supply risks have been rising steadily, even as new-found supplies of unconventional U.S. crude oil and natural gas have come on the market in very large quantities. This is because production from countries with greater risk profiles has increased at a faster rate for these two fuels and coal.

This is apparent in Figures 3, 4, and 5, which plot the share of crude oil, natural gas, and coal production in countries ranked either Free, Partly Free, or Not Free by Freedom House. (Note how the crude oil and natural gas patterns are very similar as natural gas is produced in conjunction with crude oil in many parts of the world.) So while supply risks have been climbing, these risks would be much higher absent U.S. production of these fuels, especially crude oil and natural gas, production of which have been increasing rapidly (though U.S. coal production has been declining over the past decade).

It is also the case that the diversity of supplies of these fuels has been trending downward, another source of increased risk. Again, U.S. growing production of crude oil and natural gas has made this trend less severe than it may be otherwise.

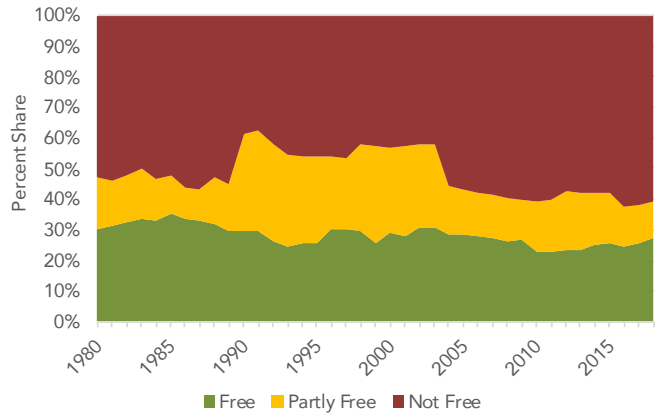
**FIGURE 2**

**Global Fuels Risk Scores: 1980-2018**

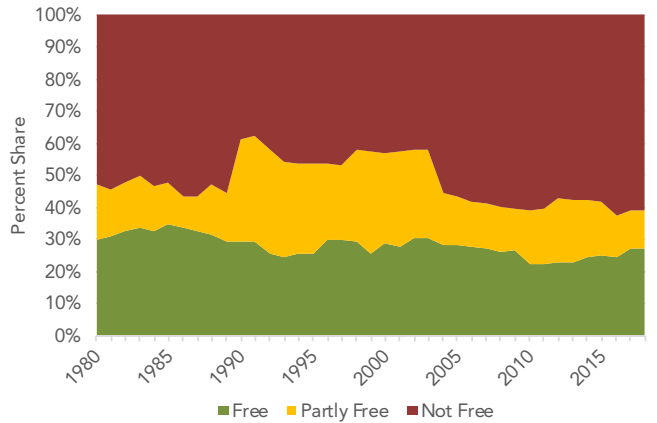


**FIGURES 3, 4, 5**

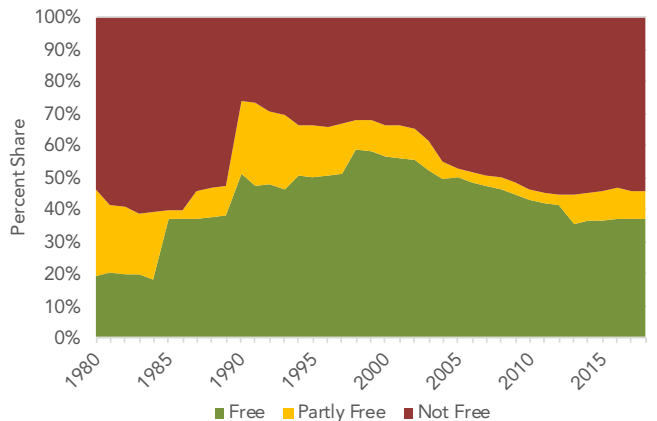
**Figure 3. Crude Oil Production in Free, Partly Free & Not Free Countries: 1980-2018**



**Figure 4. Natural Gas Production in Free, Partly Free & Not Free Countries: 1980-2018**



**Figure 5. Coal Production in Free, Partly Free & Not Free Countries: 1980-2018**



## FUEL IMPORTS

Import risks vary greatly and are influenced by many factors—the domestic resource base, the energy intensity of the economy, and the diversity and reliability of global fuels supplies, among others. Figures 6-9 show changes in total weighted fuel import exposure risks over time. The metrics in the Fuel Imports group include the petroleum, natural gas, coal, and total energy import metrics and the import expenditure intensity metric (i.e., as a share of GDP).

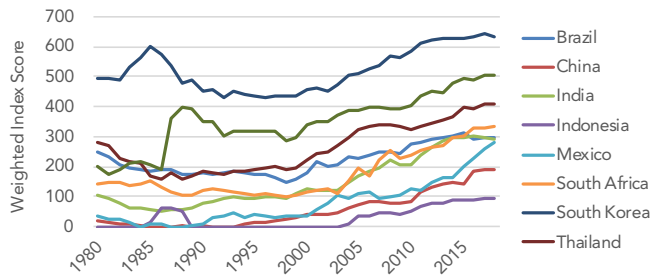
It is not surprising to see total import risks rising for emerging economies, a reflection of greater energy demand associated with rising levels of economic development and income. Most have seen increasing risks at least since 2010 and in some cases much earlier. Western European countries, with a couple

of notable exceptions (especially Norway), have high import risks comparable with those for the emerging economies. Although Europe is rich in coal, the North Sea remains the primary European source of crude oil and natural gas, and production from this area, already inadequate to meet demand for these products, is declining.

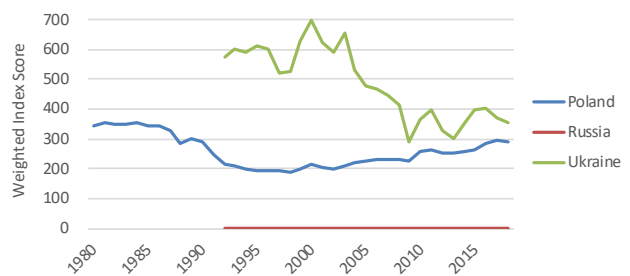
The lowest levels of import risk are in Russia, Canada, and the United States, the first two of which have registered zero risk for practically the entire period since 1980, while the United States is approaching zero. With virtually no energy resources to speak of, Japan has had consistently high fuel import risks that have worsened since the Fukushima Daiichi incident and the subsequent closure of Japan's nuclear power reactors, which propelled demand for imported coal and natural gas higher.

### FIGURES 6, 7, 8, 9

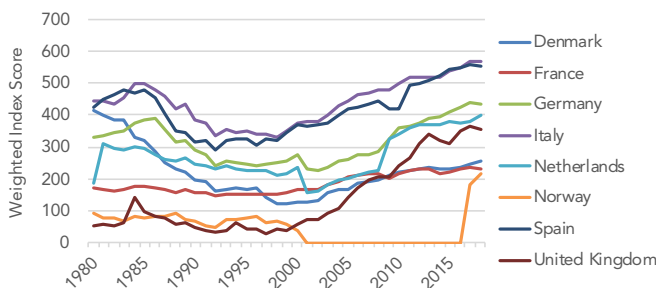
**Figure 6. Fuel Imports Risk Scores in Emerging Economies: 1980-2018**



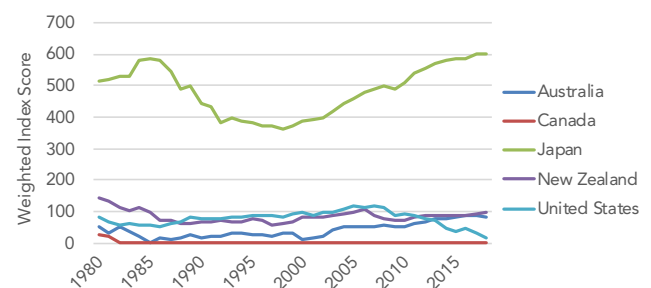
**Figure 7. Fuel Imports Risk Scores in EIT Countries: 1980-2018**



**Figure 8. Fuel Imports Risk Scores in Western European Countries: 1980-2018**



**Figure 9. Fuel Imports Risk Scores in Other Advanced Countries: 1980-2018**





## ENERGY EXPENDITURES

Many of the risks associated with Energy Expenditures are common risks that affect all countries nearly equally. Energy expenditure intensity, energy expenditures per capita, retail electricity prices, and crude oil prices make up the metrics in this group. The general pattern of risk for this metric category (Figures 10-13) is similar for all 25 countries in the large energy user group, reflecting the shared nature of crude oil prices (note the peak in risk around the time of the very high crude oil prices in 2011).

Many factors—fuel mix, efficiency, wealth, consumer choices, and government policy, among others— influence expenditure risks. Countries that have efficient economies tend to score slightly better than economies that are less efficient because they have to purchase

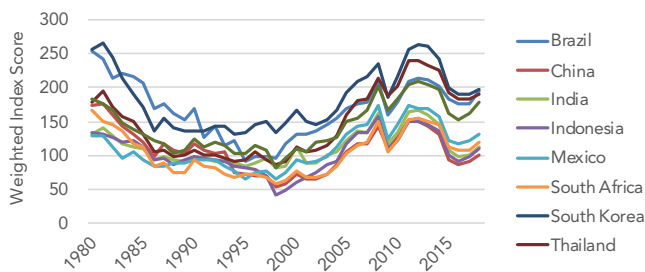
less energy. The choice of fuels matters, too. The use of more expensive technologies and fuels, such as natural gas (except in the United States), and renewables, can lead to increased expenditures compared with countries that use affordable coal, for example.

Many different factors affect expenditures per capita. In wealthy economies, even efficient ones, relatively high expenditures per capita reflect higher purchasing power, as in the United States. In Canada, high per capita expenditures are related to geography and a cold climate, while the Netherlands is a small country with relatively very large energy-intensive industrial and refining sectors.

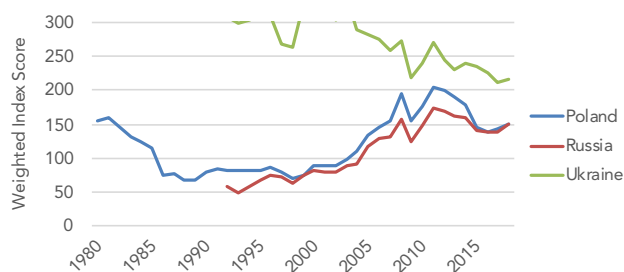
A big contributor to the Energy Expenditures category is average electricity rates. Average retail electricity prices generally are, with some notable exceptions,

### FIGURES 10, 11, 12, 13

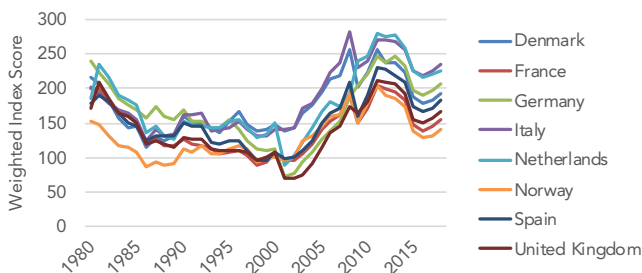
**FIGURE 10. Energy Expenditures Risk Scores in Emerging Economies: 1980-2018**



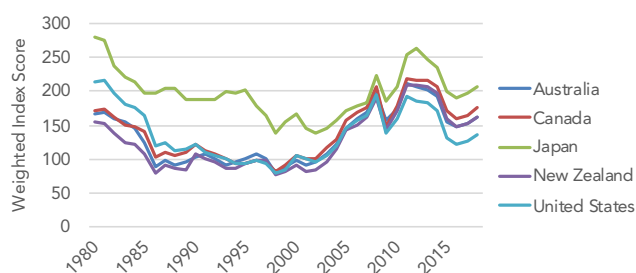
**Figure 11. Energy Expenditures Risk Scores in EIT Countries: 1980-2018**



**Figure 12. Energy Expenditures Risk Scores in Western European Countries: 1980-2018**



**Figure 13. Energy Expenditures Risk Scores in Other Advanced Countries: 1980-2018**



lowest in emerging and other advanced economies and highest in Western Europe. Seven of the eight Western European countries in the large energy user group are ranked in the bottom 10 for this metric (Norway, which relies heavily on hydropower, is at number 10 the exception). Electricity prices in much of Western Europe have increased sharply in recent years and are now among the highest in the world, creating competitive pressures on industry. Japan's rates also are relatively high but are in real terms lower than they were in much of the 1980s and 1990s.

Electricity rates in 2018 the United States were the lowest of any developed economy. Australia, Canada, and New Zealand are other countries that had comparatively low rates. Emerging economies also had low rates—South Africa's were ranked

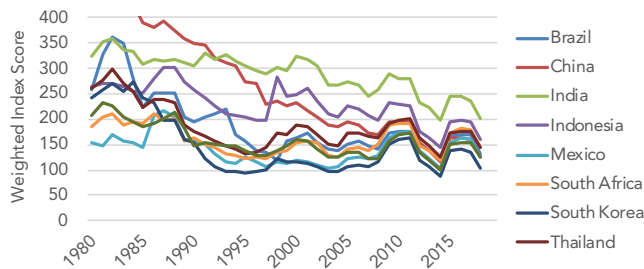
the lowest—with Brazil and Turkey being the only emerging economies with retail electricity prices in the bottom 10 in 2018. The use of affordable coal in emerging economies and the increasing use of low-priced natural gas for power production in North America has kept electricity prices comparatively low in these regions. Large-scale hydropower, especially in Canada and Norway, has contributed to lower electricity prices in those countries.

### PRICE AND MARKET VOLATILITY

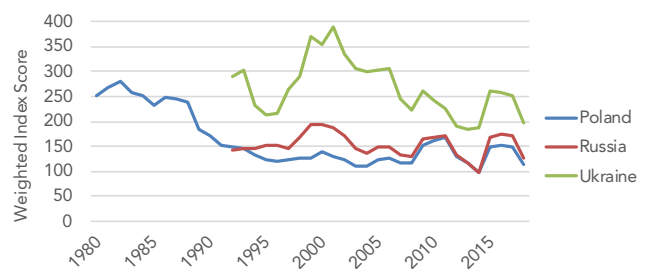
The weighted score of the Price and Market Volatility category has a significant influence on the total country-level energy security risk score. Over time, however, its impact has lessened, as has its variability among the countries in the large energy user group (Figures 14-17). This is explained in large

#### FIGURES 14, 15, 16, 17

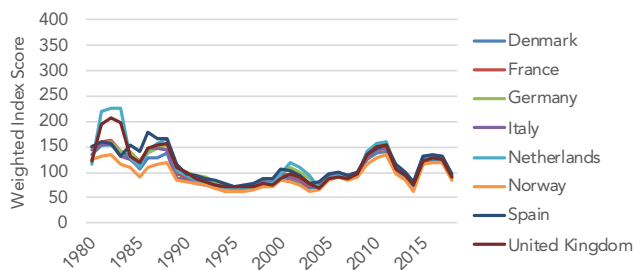
**Figure 14. Price & Market Volatility Risk Scores in Emerging Economies: 1980-2018**



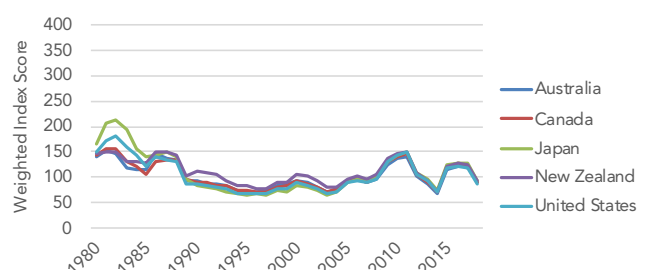
**Figure 15. Price & Market Volatility Risk Scores in EIT Countries: 1980-2018**



**Figure 16. Price & Market Volatility Risk Scores in Western European Countries: 1980-2018**



**Figure 17. Price & Market Volatility Risk Scores in Other Advanced Countries: 1980-2018**



part because three of the four risk metrics included in this category—crude oil price volatility, energy expenditure volatility, and world oil refinery usage—are universal risks affecting all countries equally.

The fourth metric, GDP per capita, is the only country-level metric in the group. GDP per capita was added as a metric because it provides an indication of the means countries have to address risks. Since 1980, the gap in the risk scores for this metric have narrowed significantly. The gains made by emerging economies have been notable—and driven by increased energy use. In 1980, the spread in risk scores for this metric was nearly 6,000 points. In 2018, the range had shrunk to about 2,850 points. We can expect that as these figures narrow further, this risk category will continue to show less and less variation in weighted score.

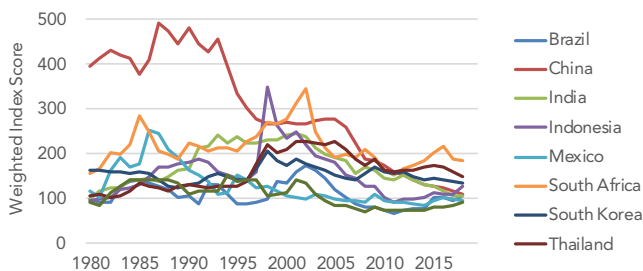
## ENERGY USE

The Energy Use of economies in the large energy user group has improved greatly since 1980, particularly in EIT and emerging economies, helping moderate increasing risks in other areas of energy security. The Energy Use category has three metrics: energy use per capita; energy intensity; and petroleum intensity.<sup>2</sup> Although the developed countries in the large energy user group continue to see declines in energy use intensity, the economies in transition and the emerging economies show greater variation.

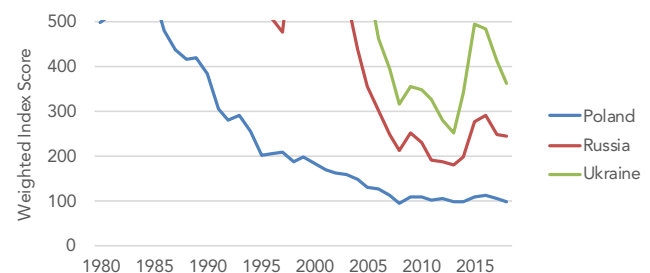
Figures 18-21 show the trends in the total weighted scores of the energy use intensity group metrics all scaled to a maximum risk score of 500 points to make them visually comparable. Note, too, that the two

### FIGURES 18, 19, 20, 21

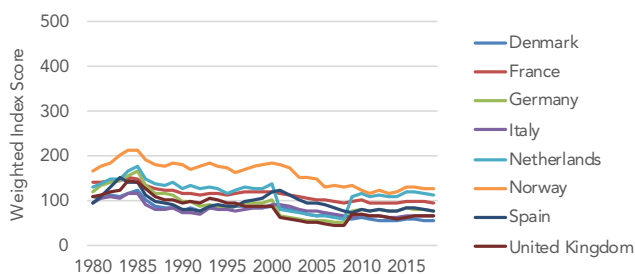
**Figure 18. Energy Use Intensity Risk Scores in Emerging Economies: 1980-2018**



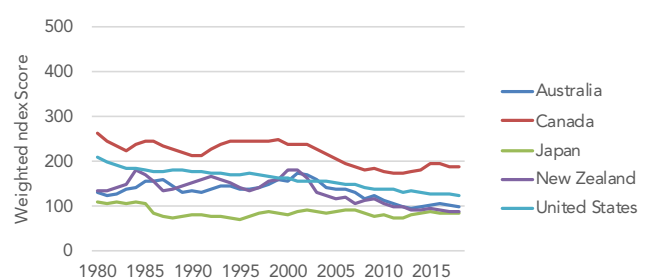
**Figure 19. Energy Use Intensity Risk Scores in EIT Countries: 1980-2018**



**Figure 20. Energy Use Intensity Risk Scores in Western European Countries: 1980-2018**



**Figure 21. Energy Use Intensity Risk Scores in Other Advanced Countries: 1980-2018**



<sup>2</sup> "Intensity" measures the amount of energy needed to produce a unit of GDP and can be improved both through greater energy efficiency and relative shifts in economic activity from more to less energy-intensive activities (e.g., from industrial to service activities).

intensity metrics are sensitive to the change in GDP figures from 2005\$ to 2010\$, as explained in the Note on Changes in GDP Measurement later in the report. The large gyrations in some of the trends shown in the following charts, especially before 2000, are in large part artifacts of this switch to 2010\$.

Other than China, which has a much lower energy intensity today than it did in 1980, most of the emerging economies in our large energy user group had energy use intensities in 2018 comparable with those in 1980. This observation, however, masks tremendous improvement in many cases. It is characteristic for economies as they develop and industrialize to increase the amount of energy they use to create a unit of GDP, which puts upward pressure on energy security risks. As these economies continue to develop, energy intensity eventually peaks and then begins to improve steadily, often rapidly, as new technologies are introduced, service sectors grow, and competitive pressures increase efficiency. Energy use per capita, however, tends to increase along with economic growth. As the middle classes in these countries expand, people can afford and use more energy.

The economies in transition have remarkably high energy intensities, especially early in the period when they were not subject to market pressures—literally off the charts. Although there has been tremendous improvement in EIT economies since the breakup of the Soviet Union in the early 1990s, Russia and Ukraine still have a long way to go.

The weighted group scores for Western European countries have declined steadily since 1980 and today are bunched within a range between 50 and 150. Greater energy efficiency is a clear security advantage most Western European countries have had for decades vis-à-vis other countries in the large energy user group. Japan is another very efficient economy, a factor that has helped it offset high risks in other areas of energy security (e.g., high import levels). The other advanced economies also have made tremendous

improvement in intensity since 1980, but—with the exception of Japan—their energy use per capita scores are usually quite high, which explains their generally higher weighted scores for this metric group.

## ELECTRIC POWER SECTOR

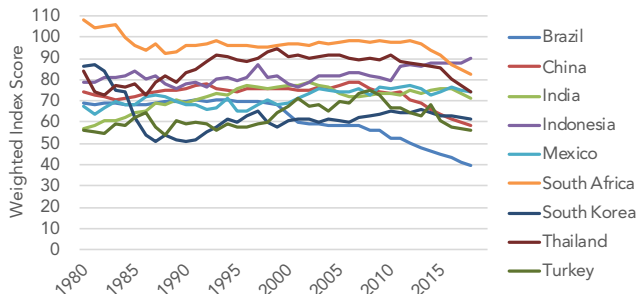
There is a great amount of variability for the Electric Power Sector metric category among the countries of the large energy user group. The two metrics that comprise this category are diversity—which combines measures of the diversity of generation capacity and the generation—and non-emitting generation. Figures 22-25 show the total weighted scores for this category, with a maximum score of 110 to make them comparable visually.

Canada, New Zealand, and Spain are examples of countries that scored very well in both metrics and thus had weighted scores of 40 or below for this category in 2018. Norway scores very well in the non-emitting metric but poorly in the diversity metric because it depends on hydropower for well more than 90% of its electricity. As a result, its total weighted score is somewhere in the middle of the pack. With a power sector heavily weighted towards coal, Poland, Indonesia, and South Africa did not score well in either metric and consequently had relatively high weighted risk scores (though these countries score pretty well in electricity rates).

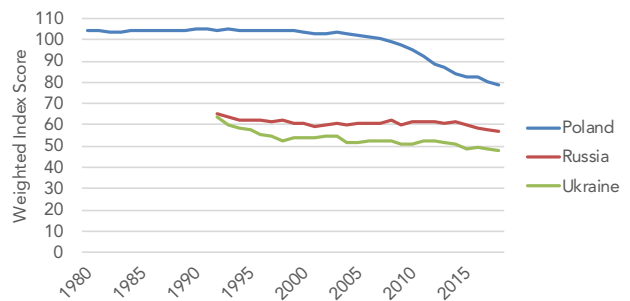
In the United States, the impact of the shale revolution is seen in the declining risk for this category beginning about 2005, when generation from plentiful and cheap natural gas increased greatly, enhancing generation diversity and lowering emissions, all without increasing electricity rates, a remarkable feat.

Meanwhile, the impact of the Fukushima Daiichi incident in Japan is clearly visible in the rising weighted risk score for this group after 2010. When its nuclear capacity was taken offline, both its diversity and non-emitting scores suffered.

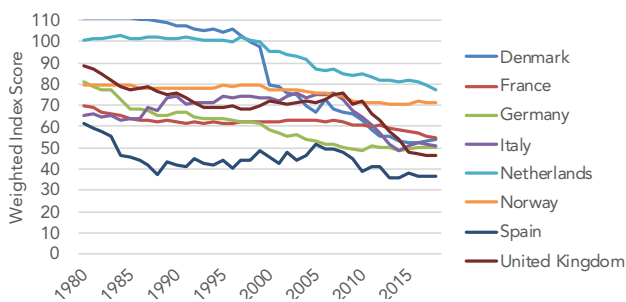
**Figure 22. Electric Power Sector Risk Scores in Emerging Economies: 1980-2018**



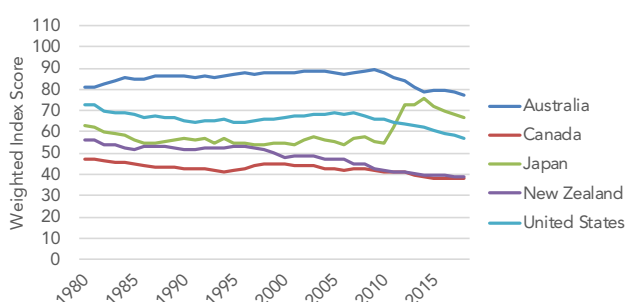
**Figure 23. Electric Power Sector Risk Scores in EIT Countries: 1980-2018**



**Figure 24. Electric Power Sector Risk Scores in Western European Countries: 1980-2018**



**Figure 25. Electric Power Sector Scores in Other Advanced Countries: 1980-2018**



## TRANSPORTATION SECTOR

There is a broad range of transportation-related risk scores among the countries in the large energy user group. In general, countries use more energy for transportation as they develop but use that energy more efficiently to produce a unit of GDP. Figures 26-29 present the weighted risk scores for the two Transportation metrics—energy use per capita and intensity—for the four country groupings. The charts have a maximum score of 150 for better visual comparison.

Although their risk scores are comparatively low, the emerging economies clearly show, without exception, generally rising transportation energy per capita, as do (at a slower rate) nearly all of EIT and other advanced countries except Japan, where per capita use has been declining since at least 2000. The emerging and EIT economies, especially, are experiencing rising energy use in their transportation sectors as rising middle class incomes allow more people to purchase personal transportation rather than rely on mass transportation.

While transportation energy intensity is improving in most countries in the large energy user groups, transportation energy use per capita is a rapidly growing source of risk in the emerging economies and EIT. Although it is not a growing source of risk in advanced economies, transportation energy use per capita is nonetheless considerably higher in developed economies than in emerging economies and EIT. Australia, Canada, and the United States have high levels of per capita energy use in the transportation sectors, a function of geography and population density in Australia and Canada and largely consumer preferences and affordable fuels costs in the United States. Countries in Western Europe since at least 2000 have been reducing their

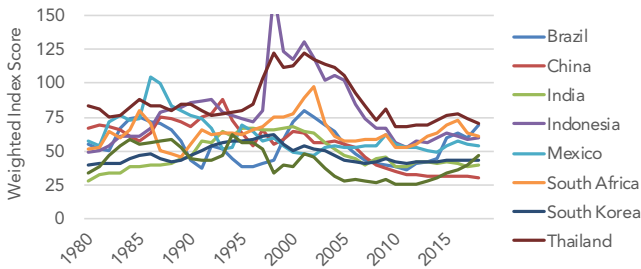
per capita transportation energy use as government policies, including efficiency standards and high taxes on motor fuels that cause people to use less energy than they would otherwise.

## ENVIRONMENTAL

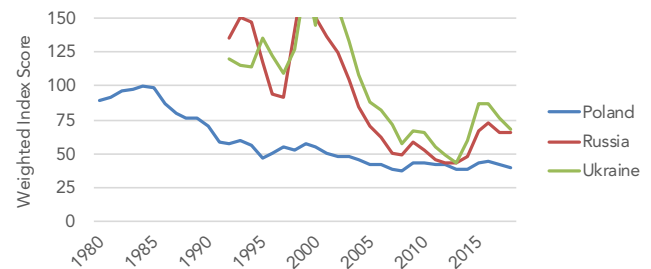
Many developed countries are seeing significant declines in risk associated with energy-related carbon dioxide emissions, but the trends in other countries are more mixed. Metrics in the Environmental risk category measure the *trend* in (not the amount of) total emissions, emissions per capita, and emissions intensity. There is wide variation in the overall emissions trends for countries in the large energy

### FIGURES 26, 27, 28, 29

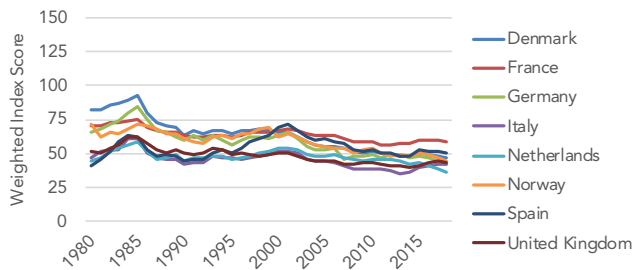
**Figure 26.** Transportation Sector Risk Scores in Emerging Economies: 1980-2018



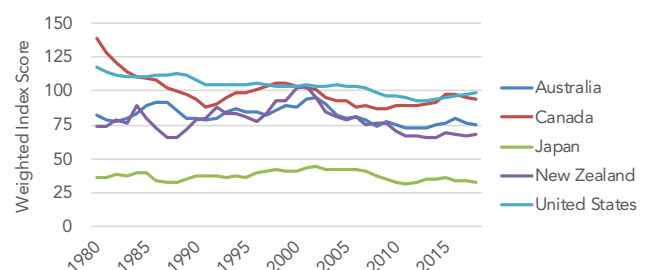
**Figure 27.** Transportation Sector Risk Scores in EIT Countries: 1980-2018



**Figure 28.** Transportation Sector Risk Scores in Western European Countries: 1980-2018



**Figure 29.** Transportation Sector Risk Scores in Other Advanced Countries: 1980-2018



user group, as seen in Figures 30-33, which show the weighted scores (up to 200) for this metric group since 1980. In broad terms, emissions risks have been rising in emerging economies and declining in EIT, Western European, and other advanced economies. Indeed, most of the growth in emissions in 2018 compared with 1980 has been from emerging economies.

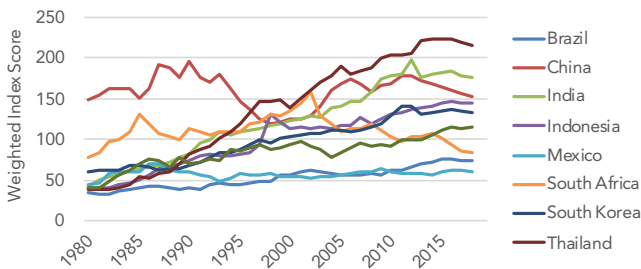
After the breakup of the Soviet Union, emissions in EIT countries fell sharply to at least 2000, after which the combined weighted Environmental risk scores stabilized in Poland and Russia but continued to decline in Ukraine. Western European countries and other advanced countries have seen their emissions peak and decline, lowering the contribution of this

metric group to overall energy security risk. There are many factors contributing to these reductions, including policies to encourage use of lower emitting technologies and fuels, greater energy efficiency, and in the United States from fuel switching from coal to natural gas.

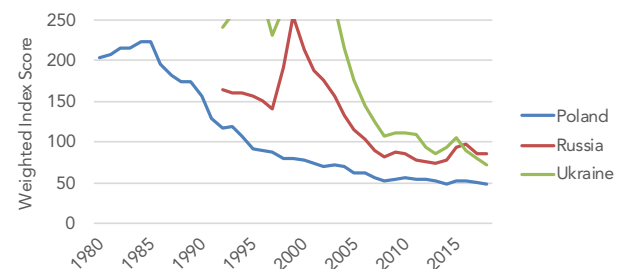
While emissions in many countries are trending down, fossil fuels will continue to be the primary global source of energy for decades to come, and coal will be the primary fuel for electrification. Fossil fuels currently provide about 85% of all global energy supply. The IEA's *2019 World Energy Outlook* forecasts that by 2040, fossil fuels will still provide two-thirds to three-quarters of the world's energy.

**FIGURES 30, 31, 32, 33**

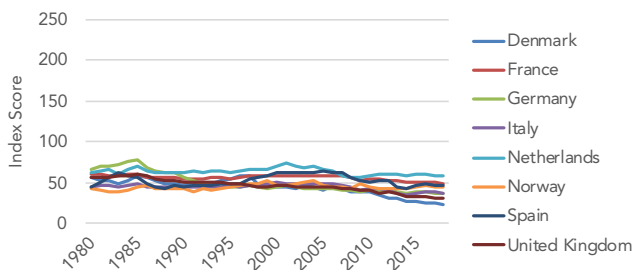
**Figure 30. Environmental Risk Scores in Emerging Economies: 1980-2018**



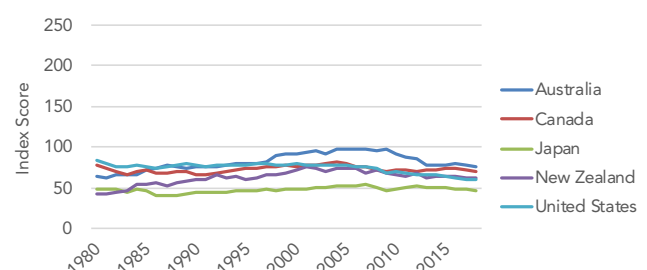
**Figure 31. Environmental Risk Scores in EIT Countries: 1980-2018**



**Figure 32. Environmental Risk Scores in Western European Countries: 1980-2018**



**Figure 33. Environmental Risk Scores in Other Advanced Countries: 1980-2018**



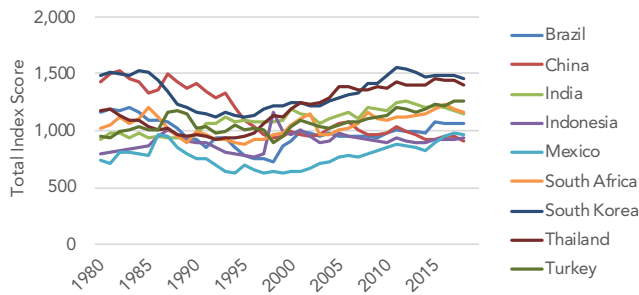
Developing and emerging countries are moving ahead rapidly with electrification of their economies, and it appears that, despite the Paris climate change deal agreed to at the end of 2015, coal will continue to play a central role in electrification even as its use in power generation in developed countries is expected to decline. China, India, and Southeast Asia account for the lion's share of total coal capacity under construction or planned. Combined with greater use of energy in transportation and industry, it is unlikely that the emissions trends in emerging economies will reverse themselves anytime soon.

## TRENDS IN TOTAL RISKS

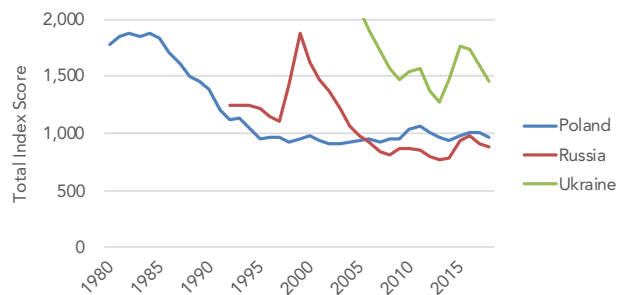
**Although energy security risk scores for the large energy user group countries show a variety of trends over the years, certain broad patterns emerge.** Risks for these countries by and large: decreased from the mid-1980s to the mid-1990s; increased from the early 2000s to about 2011; declined again from 2012 to 2014; rose from 2015 to 2017; and declined for almost all countries in 2018 (Figures 34-37). The high points in risks were in the early 1980s and in 2011, both periods of high and volatile energy prices and geopolitical discord in many

### FIGURES 34, 35, 36, 37

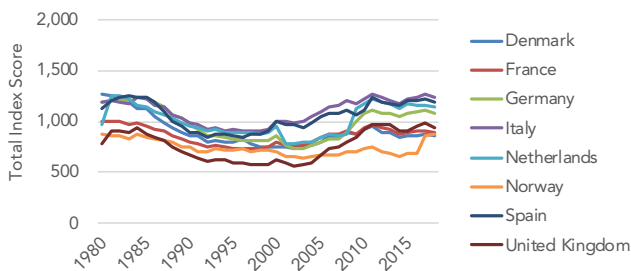
**Figure 34. Total Risk in Emerging Economies: 1980-2018**



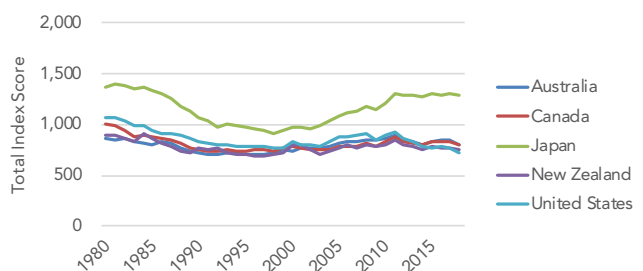
**Figure 35. Total Risk in EIT Countries: 1980-2018**



**Figure 36. Total Risk in Western European Countries: 1980-2018**



**Figure 37. Total Risk in Other Advanced Countries: 1980-2018**





energy producing regions. The overall decline in risk since 2011 has been driven primarily by a decline in the price volatility of crude oil.

Ongoing long-term improvements in Energy Use metrics, such as energy intensity, will continue to put downward pressure on risks in many developed countries and for some emerging economies. Moreover, upward pressure on the global price of crude oil has in recent years been lessened by greatly increased production in the United States from shale formations. If these and other trends can be maintained, and if the unconventional oil and gas revolution can be replicated in other countries, the steep drop in overall risk measured over the last couple of years could carry on well into the future.

**The decade of the 1990s was overall the best for energy security risks.** Of the 25 countries in the large energy user group, 14 (mostly economically advanced) had their best risk score somewhere between 1990 and 1999, evenly divided between developed and emerging economies. This is not surprising considering the large drop in oil-related risks during the late 1980s and 1990s, a period when the world price of oil plunged. Six other countries, all developed, had their lowest scores in 2002 or 2003. The best scores for Russia and Ukraine were in 2013, while those for China and the United States were in 2018.

**Rapid moves up or down the large energy group ranking are uncommon, but when a number of factors are aligned within a country, rapid movements occur and can be sustained over a long period.** Trends in country rankings tend to be driven by four types of factors: (1) global factors that affect all countries and are largely immune to policy responses; (2) country-specific factors, such as resource base, stage of economic development, population density, and climate; (3) technology innovation and adoption; and (4) energy policies. Figure 1 and Table 2 rank energy security risks over time.

Although large annual movements, either up or down, in the ranking list are uncommon, the interplay among many different factors, such as technology developments, political crises, natural disasters, policy changes, or combinations of these, can result in unusually large annual changes in rank among the large energy user group. Australia, Canada, Norway, South Korea, and Ukraine have shown the least variation in their risk ranking for the entire period since 1980 (or in the case of Ukraine, 1992). The risk ranking for Ukraine, for example, has stayed within the 22 to 25 range for the entire period since 1980, while Norway has moved between a range of one and six. In contrast, countries like China, Denmark, Indonesia, Russia, and South Africa have shown a great deal of variation in their rankings over the years.

## INDIVIDUAL METRIC RANKINGS

**No country scores well or poorly in every energy risk category. Countries that have very good total Index scores also can face sometimes significant energy security challenges.** Of the 29 metrics used in the *International Index*, nine are “universal” metrics that apply equally to every country (e.g., the price of crude oil) and 20 are “country-specific.” Scores for these 20 country-specific metrics for 2018 were ranked (Table 3). Even very highly ranked countries can and do score poorly on certain metrics, and vice versa. But, as expected, countries that score well tend to have more metrics in the top five than in the bottom five. On average, the top five ranked countries in 2018 had 5.8 metric scores in the top five compared with 3.2 scores in the bottom five. Countries ranked in the bottom five overall, however, had on average just 1.2 scores in the top five and 6.8 scores in the bottom five. For the 15 countries occupying the ranks in the middle, 4.5 scores were in the top five and 3.3 in the bottom five. The United States had seven metric scores in the top five and three in the bottom five.

TABLE 2

## Energy Security Rankings for Large Energy User Group: 1980-2018

COUNTRY	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Australia	4	2	2	4	4	8	4	4	5	4	4
Brazil	15	12	12	7	11	12	11	13	13	13	13
Canada	10	7	5	6	6	5	3	5	4	3	3
China	21	20	23	22	18	19	12	9	10	9	8
Denmark	19	13	8	10	5	7	9	6	6	6	5
France	14	15	11	11	10	15	17	15	15	15	15
Germany	18	18	14	12	9	6	14	14	14	14	14
India	7	9	15	21	21	22	20	19	17	17	16
Indonesia	3	5	10	8	13	13	7	10	7	8	9
Italy	17	17	17	16	17	21	22	20	21	21	20
Japan	20	21	20	19	14	20	21	22	22	22	22
Mexico	1	1	4	2	2	3	5	7	8	10	11
Netherlands	9	14	13	15	12	9	19	16	16	16	17
New Zealand	6	4	6	3	7	4	2	3	2	2	2
Norway	5	3	3	5	3	2	1	1	1	5	6
Poland	23	23	22	18	15	11	13	12	12	12	12
Russia	–	–	–	24	24	14	6	11	11	7	7
South Africa	11	16	18	14	20	16	15	17	20	18	18
South Korea	22	22	21	23	23	23	24	24	24	24	24
Spain	13	19	9	13	16	18	16	18	18	19	19
Thailand	16	11	16	17	22	24	23	23	23	23	23
Turkey	8	10	19	20	19	17	18	21	19	20	21
Ukraine	–	–	–	25	25	25	25	25	25	25	25
United Kingdom	2	6	1	1	1	1	10	8	9	11	10
United States	12	8	7	9	8	10	8	2	3	1	1

TABLE 3

## Energy Security Metric Rankings for Large Energy User Group: 2018

Fuel Import Metrics				
Petroleum Import Exposure	Natural Gas Import Exposure	Coal Import Exposure	Total Energy Import Exposure	Fossil Fuel Import Expenditures per GDP
1. (tied) Canada	1. (tied) Australia	1. (tied) Australia	1. (tied) Canada	1. (tied) Canada
1. (tied) Mexico	1. (tied) Canada	1. (tied) Canada	1. (tied) Russia	1. (tied) Russia
1. (tied) Norway	1. (tied) Denmark	1. (tied) Indonesia	3. Norway	3. Norway
1. (tied) Russia	1. (tied) Indonesia	1. (tied) New Zealand	4. United States	4. Denmark
5. United States	1. (tied) Norway	1. (tied) Russia	5. Denmark	5. United States
6. Brazil	1. (tied) Russia	1. (tied) South Africa	6. Brazil	6. United Kingdom
7. Denmark	7. United States	1. (tied) United States	7. Indonesia	7. Australia
8. United Kingdom	8. New Zealand	8. Poland	8. China	8. Brazil
9. Indonesia	9. Netherlands	9. China	9. Australia	9. Mexico
10. China	10. Brazil	10. India	10. Mexico	10. New Zealand
11. Australia	11. Thailand	11. Ukraine	11. New Zealand	11. China
12. Thailand	12. Ukraine	12. Mexico	12. Ukraine	12. France
13. India	13. China	13. Germany	13. South Africa	13. Germany
14. New Zealand	14. United Kingdom	14. Turkey	14. United Kingdom	14. Italy
15. Ukraine	15. India	15. Thailand	15. Poland	15. Indonesia
16. Italy	16. Mexico	16. Spain	16. France	16. Netherlands
17. Turkey	17. Poland	17. Brazil	17. India	17. Poland
18. Poland	18. South Africa	18. United Kingdom	18. Netherlands	18. Spain
19. Netherlands	19. Italy	19. Norway	19. Thailand	19. Japan
20. Germany	20. Germany	20. South Korea	20. Germany	20. India
21. France	21. Japan	21. Japan	21. Spain	21. Turkey
22. South Africa	22. South Korea	22. Denmark	22. Italy	22. South Korea
23. Spain	23. Turkey	22. France	23. Turkey	23. South Africa
24. Japan	24. Spain	22. Italy	24. Japan	24. Thailand
25. South Korea	25. France	22. Netherlands	25. South Korea	25. Ukraine

TABLE 3

(CONTINUED)

## Energy Security Metric Rankings for Large Energy User Group: 2018

Energy Expenditure Metrics			Price & Market Volatility Metrics	
Energy Expenditure Intensity	Energy Expenditures Per Capita	Retail Electricity Prices	Energy Expenditure Volatility	GDP Per Capita
1. Norway	1. India	1. South Africa	1. Norway	1. Norway
2. United States	2. Indonesia	2. India	2. United Kingdom	2. United States
3. Denmark	3. China	3. China	3. France	3. Denmark
4. France	4. South Africa	4. Russia	4. United States	4. Australia
5. United Kingdom	5. Mexico	5. Indonesia	5. Turkey	5. Netherlands
6. China	6. Ukraine	6. South Korea	6. Germany	6. Germany
7. Germany	7. Poland	7. United States	7. Italy	7. Canada
8. Australia	8. Turkey	8. Thailand	8. Indonesia	8. United Kingdom
9. New Zealand	9. Brazil	9. Canada	9. Denmark	9. New Zealand
10. Spain	10. Thailand	10. Norway	10. China	10. France
11. Indonesia	11. Russia	11. Mexico	11. Canada	11. Japan
12. Mexico	12. Spain	12. Australia	12. New Zealand	12. Italy
13. Poland	13. France	13. New Zealand	13. Spain	13. South Korea
14. Italy	14. United Kingdom	14. Ukraine	14. Japan	14. Spain
15. Canada	15. Italy	15. Poland	15. Australia	15. Poland
16. Japan	16. New Zealand	16. Brazil	16. Mexico	16. Russia
17. India	17. United States	17. France	17. Poland	17. China
18. South Africa	18. Germany	18. Turkey	18. Netherlands	18. Mexico
19. Netherlands	19. Denmark	19. Netherlands	19. India	19. Turkey
20. Turkey	20. Norway	20. United Kingdom	20. South Africa	20. Brazil
21. Russia	21. Australia	21. Japan	21. Brazil	21. Thailand
22. South Korea	22. Japan	22. Spain	22. Russia	22. South Africa
23. Brazil	23. Canada	23. Denmark	23. South Korea	23. Indonesia
24. Thailand	24. South Korea	24. Germany	24. Thailand	24. Ukraine
25. Ukraine	25. Netherlands	25. Italy	25. Ukraine	25. India

TABLE 3

(CONTINUED)

## Energy Security Metric Rankings for Large Energy User Group: 2018

Energy Use Intensity Metrics			Electric Power Sector Metrics	
Energy Consumption Per Capita	Energy Intensity	Petroleum Intensity	Electricity Capacity Diversity	Non Carbon Generation
1. India	1. Denmark	1. Denmark	1. Spain	1. Norway
2. Indonesia	2. United Kingdom	2. Norway	2. United Kingdom	2. France
3. Brazil	3. Italy	3. United Kingdom	3. Canada	3. Brazil
4. Mexico	4. Germany	4. Germany	4. Italy	4. New Zealand
5. Turkey	5. France	5. Italy	5. Germany	5. Canada
6. Thailand	6. Australia	6. France	6. New Zealand	6. Denmark
7. China	7. Japan	7. New Zealand	7. France	7. Ukraine
8. South Africa	8. Spain	8. Australia	8. Turkey	8. Spain
9. Ukraine	9. New Zealand	9. United States	9. Brazil	9. United Kingdom
10. Poland	10. Norway	10. Poland	10. Ukraine	10. Germany
11. Italy	11. Netherlands	11. Japan	11. China	11. Russia
12. Spain	12. United States	12. Spain	12. United States	12. Italy
13. United Kingdom	13. Mexico	13. China	13. Russia	13. United States
14. Denmark	14. Brazil	14. Turkey	14. South Korea	14. South Korea
15. Japan	15. Poland	15. Netherlands	15. Japan	15. China
16. France	16. Turkey	16. Canada	16. Denmark	16. Turkey
17. Germany	17. South Korea	17. South Korea	17. India	17. Japan
18. New Zealand	18. India	18. Mexico	18. Mexico	18. South Africa
19. Russia	19. China	19. India	19. Thailand	19. India
20. South Korea	20. Canada	20. Indonesia	20. Netherlands	20. Thailand
21. Australia	21. Indonesia	21. Brazil	21. Australia	21. Mexico
22. Netherlands	22. Thailand	22. South Africa	22. Poland	22. Australia
23. United States	23. South Africa	23. Ukraine	23. South Africa	23. Poland
24. Norway	24. Russia	24. Russia	24. Indonesia	24. Netherlands
25. Canada	25. Ukraine	25. Thailand	25. Norway	25. Indonesia

TABLE 3

(CONTINUED)

## Energy Security Metric Rankings for Large Energy User Group: 2018

Transportation Sector Metrics		Environmental Metrics		
Transport Energy Per Capita	Transport Energy Intensity	CO <sub>2</sub> Emissions	CO <sub>2</sub> Per Capita	CO <sub>2</sub> GDP Intensity
1. India	1. Norway	1. Denmark	1. India	1. Denmark
2. Ukraine	2. Netherlands	2. Germany	2. Indonesia	2. Norway
3. Indonesia	3. Japan	3. France	3. Brazil	3. France
4. China	4. Denmark	4. United Kingdom	4. Ukraine	4. United Kingdom
5. South Africa	5. Germany	5. Poland	5. Mexico	5. Italy
6. Turkey	6. United Kingdom	6. Italy	6. Turkey	6. New Zealand
7. Mexico	7. France	7. United States	7. Thailand	7. Germany
8. Poland	8. Italy	8. Russia	8. France	8. Spain
9. Thailand	9. South Korea	8. Ukraine	9. Denmark	9. Japan
10. Brazil	10. China	10. Netherlands	10. Italy	10. United States
11. Russia	11. Spain	11. Japan	11. Spain	11. Netherlands
12. Japan	12. Australia	12. Norway	12. China	12. Australia
13. South Korea	13. Poland	13. Spain	13. South Africa	13. Brazil
14. Italy	14. New Zealand	14. Canada	14. United Kingdom	14. Canada
15. Netherlands	15. United States	15. South Africa	15. Poland	15. Mexico
16. Spain	16. Turkey	16. Mexico	16. New Zealand	16. South Korea
17. United Kingdom	17. Canada	17. Australia	17. Norway	17. Turkey
18. France	18. India	18. New Zealand	18. Japan	18. Poland
19. Germany	19. Mexico	19. Brazil	19. Germany	19. Indonesia
20. Denmark	20. Russia	20. Turkey	20. Russia	20. Thailand
21. Norway	21. South Africa	21. South Korea	21. South Korea	21. China
22. New Zealand	22. Indonesia	22. China	22. Netherlands	22. India
23. Australia	23. Brazil	23. Indonesia	23. Australia	23. South Africa
24. Canada	24. Thailand	24. India	24. United States	24. Russia
25. United States	25. Ukraine	25. Thailand	25. Canada	25. Ukraine

## NOTE ON CHANGES IN GDP MEASUREMENT

The *International Index* was the first systematic attempt to measure energy security risks across time and across countries. With 29 metrics covering a range of activities, and with data sources of uneven completeness, this effect has been an evolving one, adapting our approach as new data and insights warrant.

With this year's *Index*, we have begun using a different, and we believe more appropriate, measure of GDP. A country's GDP is an important component in seven of the 29 metrics used in the *International Index*:

11. Fossil Fuel Import Expenditures/GDP
12. Energy Expenditure Intensity
19. GDP per Capita
21. Energy Intensity
22. Petroleum Intensity
26. Transport Energy Intensity
29. Carbon Dioxide Emissions Intensity

At the weightings we give these seven metrics, they collectively account for about 25% to 30% of the overall index value, varying across countries and over time. GDP is used as the denominator for these seven metrics. With other factors held equal, a higher GDP therefore will reduce risk and a lower GDP will increase risk.

While it may seem straightforward, measuring and comparing GDPs across time and countries is actually a complex undertaking. Estimates of a country's GDP in any given year (itself a difficult calculation) is typically made in a country's local currency units (LCU), in nominal terms for that year. When comparing across countries, the desire is to: (1) convert those local currency units into a standardized currency—in this case, U.S. dollars; and (2) convert those nominal values into real values using a GDP deflator factor to account for inflation over time.

The GDP data for the *International Index* comes from the World Bank. The World Bank presents several GDP datasets, such as in current LCUs, constant (real) LCUs, current U.S. dollars, and constant U.S. dollars. In the dataset used in all previous editions of the *Index*, GDP was expressed in constant 2005\$, and this served as a consistent dataset not requiring additional transformations.

In the World Bank dataset used for this report, a country's GDP is expressed in constant 2010\$. These figures, however, do not reflect fluctuations in exchange rates but, instead, use the same 2010 exchange rates for every year going back to 1980. Since exchange rates vary—sometimes wildly—over time, this particular World Bank dataset gives an accurate depiction of a country's GDP relative to the U.S. GDP only for 2010. Estimates for other years will be higher or lower depending on exchange rate fluctuations.

This limitation in the World Bank dataset poses problems for the *Index*. Many of the GDP-related metrics have an economic component to them expressed either as expenditures or physical volumes of energy consumption. And since many of these commodities, especially petroleum, are denominated in U.S. dollars on the world market, the numerator reflects exchange rate changes over time. Accordingly, having a denominator (GDP) that does not reflect these same exchange-rate effects can lead to a distorted value for the metric.

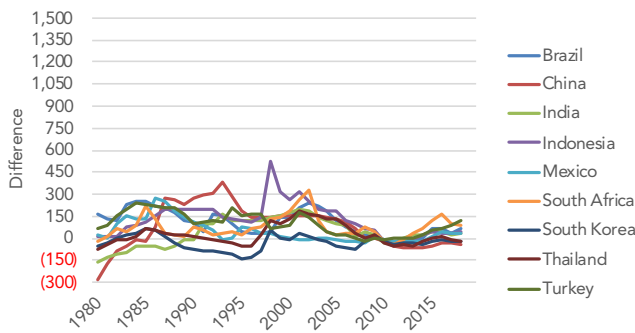
To account for this, this year's edition of the *International Index* uses a GDP dataset that reflects year-to-year exchange rates as well as inflation over time. To achieve this, we use the World Bank's GDP series (current U.S. dollars) and adjust these figures using the appropriate U.S. GDP deflator to produce a GDP series in real 2010\$ that reflects the then-prevailing exchange rates.

In general, this change in GDP methodology affects a country's total index score by fewer than 150 points and usually far less. Major exceptions to this are Indonesia, Poland, Russia, and Ukraine, whose scores and rankings are more volatile, especially in the late 1990s and early 2000s, under the new revised GDP methodology owing to bigger variability in year-to-year exchange rates. Moreover, in years where the

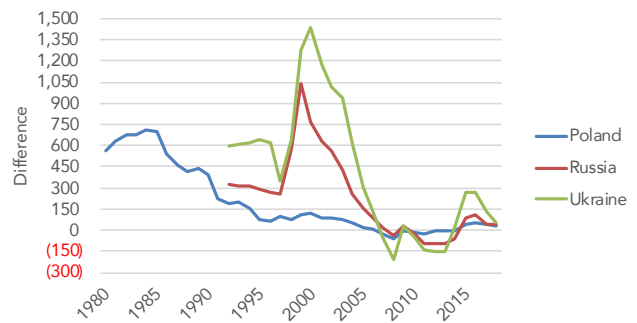
U.S. dollar is relatively weak, other countries' GDP (in US\$) and metric values will look comparatively strong and vice versa. Figures 38-41 chart the differences in total risk scores using: (1) GDP in 2010\$ and prevailing change rates (the method used in this report); and (2) GDP in 2010\$. The effects also can be seen, especially for these four countries, in the large energy user group profiles that follow.

**FIGURES 38, 39, 40, 41**

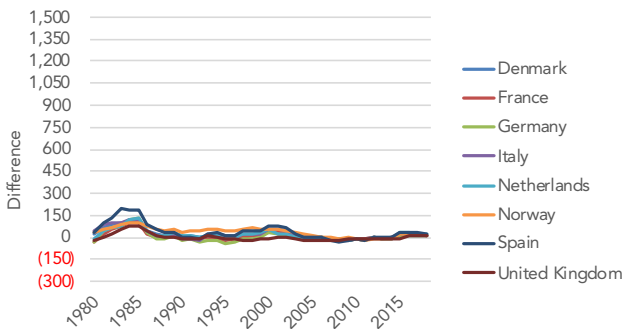
**Figure 38.** Difference in Risk Score from Change in GDP in Emerging Economies: 1980-2018



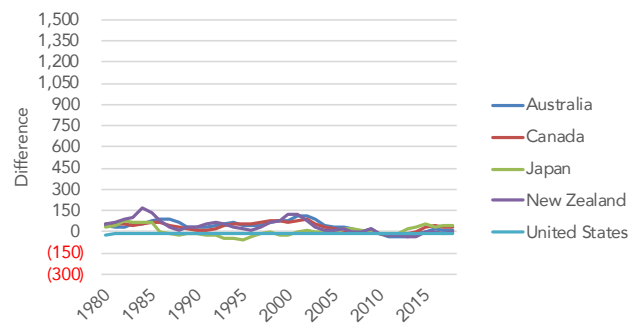
**Figure 39.** Difference in Risk Score from Change in GDP in EIT Countries: 1980-2018



**Figure 40.** Difference in Risk Score from Change in GDP in Western European Countries: 1980-2018



**Figure 41.** Difference in Risk Score from Change in GDP in Other Advanced Countries: 1980-2018





# LARGE ENERGY USER GROUP ENERGY SECURITY PROFILES

The summaries in this section provide brief snapshots of the energy security risks for each country in the large energy user group, including a description of how its scores compare with the OECD average and those factors that have had the greatest impact, both positively and negatively, on their energy security. The countries are listed in alphabetical order.

The information in each country profile is as follows:

1. A table summarizing world ranking in energy production, energy consumption, and power generation and whether the country is a net importer or exporter of oil, natural gas, and coal.
2. A table showing current- and previous-year total risk scores and those years with the historically highest and lowest risk scores, both absolutely and relative to the OECD baseline average. (More detailed data on the energy security risk scores for each country are presented in Appendix 3.)
3. A pie chart showing the current estimated energy demand mix.
4. A pie chart showing the current estimated power generation energy mix.
5. A line chart showing the country's energy security risk trend and the OECD average trend since 1980.
6. A line chart showing the country's risk trend relative to the OECD average (measured as percent variance) since 1980. This provides an indication of progress or deterioration in energy security risks compared with an international baseline
7. A line chart showing trends in the country's risk ranking since 1980.
8. Two area charts showing the weighted contribution of the eight metric groups since 1980. One shows the absolute contribution of each metric group to the total risk score and the other shows the relative contribution, as a percent, of each metric group to the total risk score.
9. A table showing by metric grouping how the country's risk scores fare against the comparable OECD averages in five-year increments, plus the most recent year of data. Cells highlighted in green indicate risk scores at least 10% lower (better) than the comparable OECD scores, while cells highlighted in red indicate country risk scores at least 10% higher (worse) than the comparable OECD scores. Cells with no highlighting indicate risk scores within 10% either way of the comparable OECD average. These tables provide an indication of how the country's metric groups have performed over time vis-à-vis the OECD average, with those cells in green performing considerably better and those in red performing considerably worse.

As a word of caution, because the data for many countries are not as robust or detailed as U.S. data, readers should place less emphasis on precise values or changes in metrics from one year to the next and more emphasis on broader trends within and across countries.

Concerning the United States, it should be emphasized that the index data presented here and in the Energy Institute's Index of U.S. Energy Security Risk, of necessity, measure different things and are not strictly comparable, though the general trends are substantially the same. The emphasis here is on how U.S. energy security risks over time relate to those of the "average" OECD country and other large energy users.

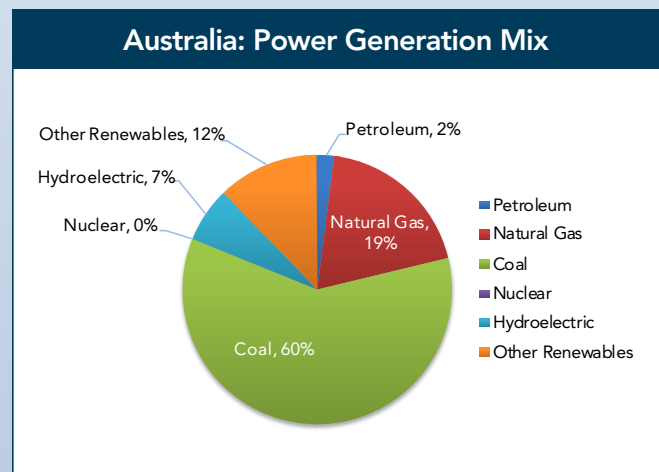
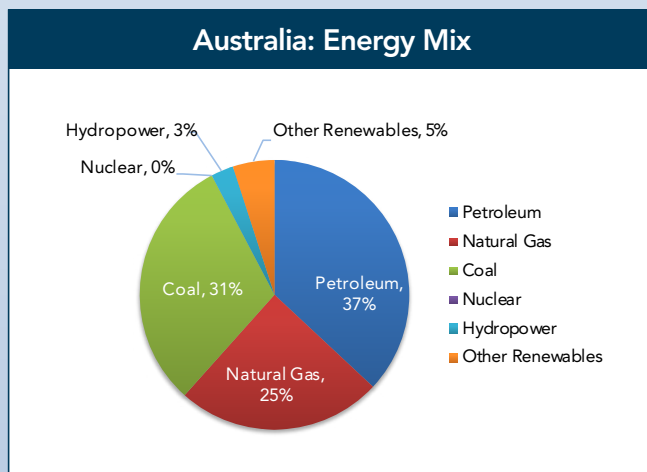


# AUSTRALIA

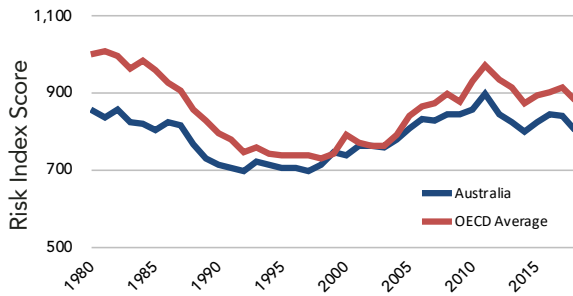


Australia: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	32
Natural Gas	8
Coal	4
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	21
Natural Gas	18
Coal	12
Total Energy	18
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	14
Nuclear	NA
Hydropower	40
Other Renewables	15
Total Generation	21
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Exporter
Coal	Exporter

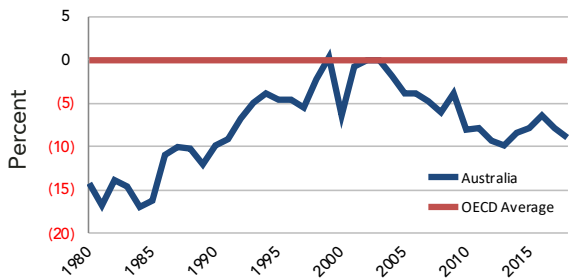
Australia: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	805
2018 Large Energy User Group Rank	4
Score in Previous Year	842
Rank in Previous Year	4
Score in 1980	858
Average Score: 1980-2018	790
Best Energy Security Risk Score	698 (1992)
Worst Energy Security Risk Score	897 (2011)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	-8%
Best Relative Score	-17% (1984)
Worst Relative Score	0% (1999)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	3
Number in Bottom Five	6



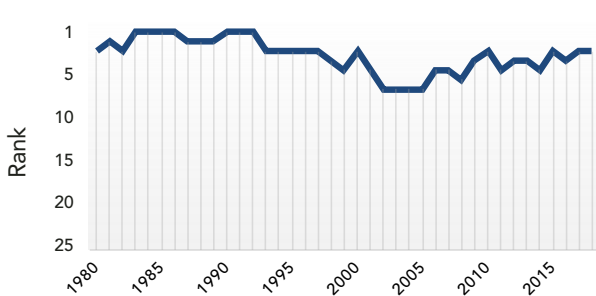
### Australia vs. OECD: Risk Index Scores



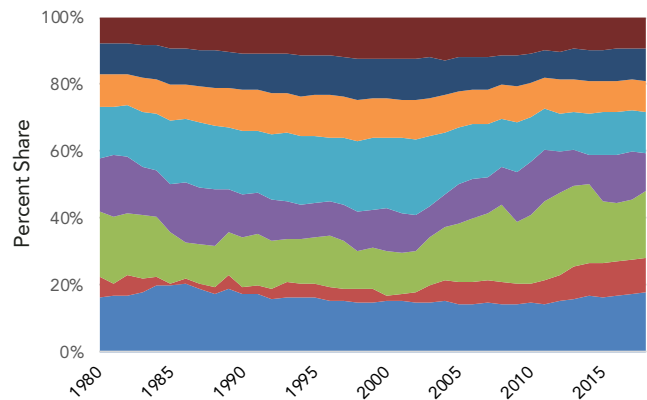
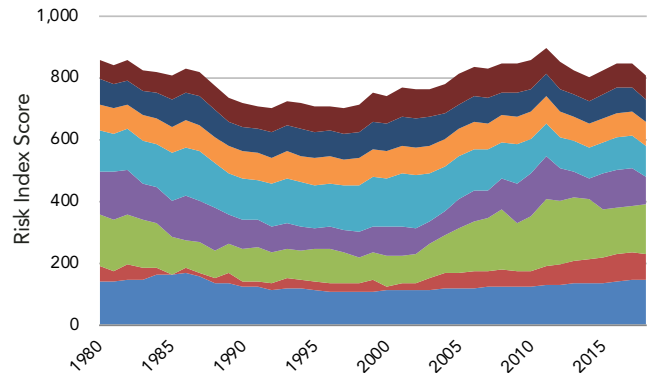
### Australia: Risk Variance from OECD



### Australia: Risk Ranking



### Australia: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Australia vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells  $\geq 10\%$  Above OECD; Green Cells  $\leq 10\%$  Below OECD; White Cells  $< 10\%$  to  $< -10\%$  of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-69	-99	-89	-81	-94	-75	-77	-63	-62	-63	-65
Energy Expenditure Metrics	-17	-17	-18	-7	-7	4	2	4	7	5	4
Price & Market Volatility Metrics	-7	-6	4	0	2	1	-3	-5	-3	-2	-3
Energy Use Intensity Metrics	-6	3	15	23	29	35	11	2	9	5	4
Electric Power Sector Metrics	15	33	39	42	41	39	46	38	41	41	41
Transportation Sector Metrics	17	20	28	37	32	27	29	29	34	29	27
Environmental Metrics	8	21	37	44	54	65	70	52	57	55	54
<b>Total Weighted Index</b>	<b>-14</b>	<b>-16</b>	<b>-10</b>	<b>-5</b>	<b>-6</b>	<b>-4</b>	<b>-8</b>	<b>-8</b>	<b>-6</b>	<b>-8</b>	<b>-9</b>

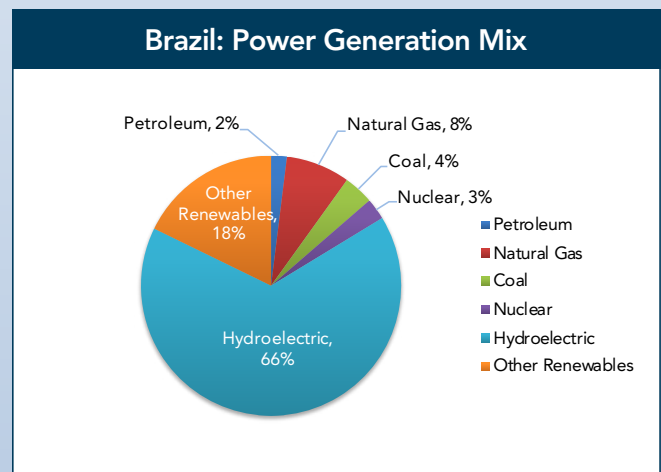
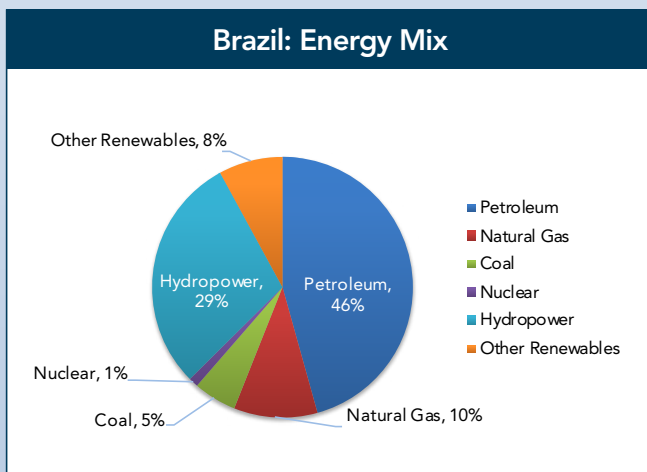


# BRAZIL

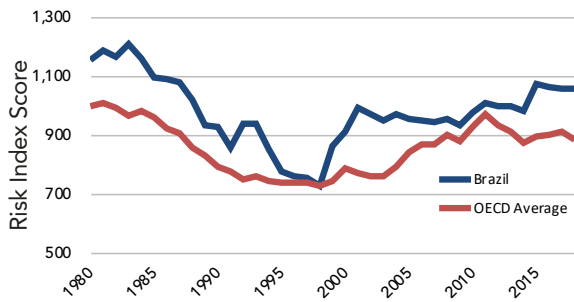


Brazil: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	10
Natural Gas	28
Coal	35
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	7
Natural Gas	25
Coal	22
Total Energy	10
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	28
Nuclear	21
Hydropower	2
Other Renewables	5
Total Generation	6
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

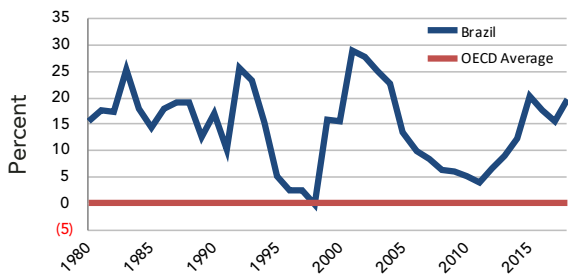
Brazil: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	1,059
2018 Large Energy User Group Rank	13
Score in Previous Year	1,058
Rank in Previous Year	13
Score in 1980	1,156
Average Score: 1980-2018	983
Best Energy Security Risk Score	729 (1998)
Worst Energy Security Risk Score	1,210 (1983)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	15%
Best Relative Score	0% (1998)
Worst Relative Score	29% (2001)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	3
Number in Bottom Five	4



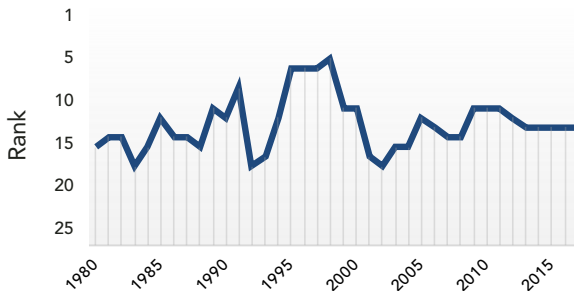
### Brazil vs. OECD: Risk Index Scores



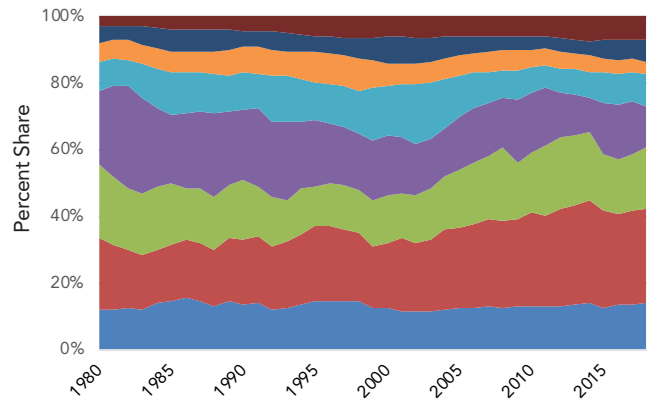
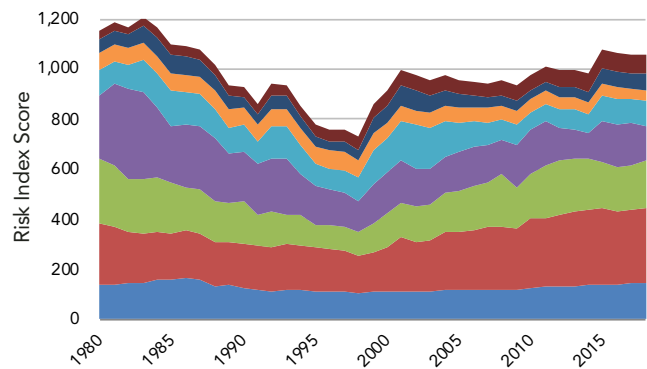
### Brazil: Risk Variance from OECD



### Brazil: Risk Ranking



### Brazil: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Brazil vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	46	3	17	13	5	12	28	41	26	26	28
Energy Expenditure Metrics	27	38	34	-15	24	20	4	24	27	22	26
Price & Market Volatility Metrics	70	82	114	116	76	66	22	34	34	36	44
Energy Use Intensity Metrics	-29	-6	-10	-21	11	14	-28	2	4	-4	9
Electric Power Sector Metrics	-2	8	12	14	2	-7	-14	-22	-23	-25	-28
Transportation Sector Metrics	-21	1	-32	-38	8	-14	-35	0	6	2	17
Environmental Metrics	-41	-32	-25	-18	-3	-3	13	47	49	47	51
<b>Total Weighted Index</b>	<b>16</b>	<b>14</b>	<b>17</b>	<b>5</b>	<b>15</b>	<b>13</b>	<b>5</b>	<b>20</b>	<b>18</b>	<b>16</b>	<b>20</b>

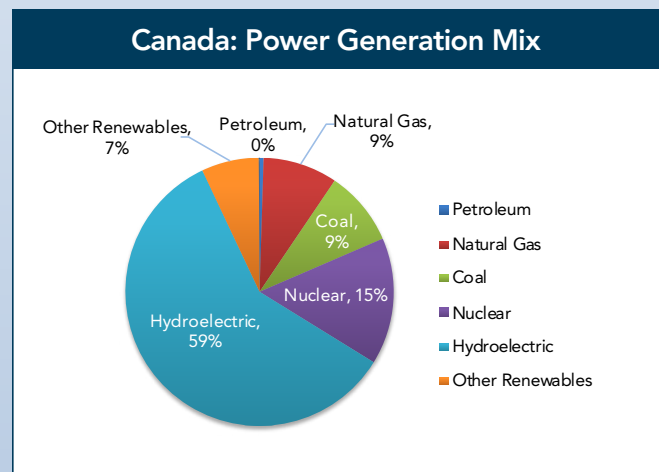
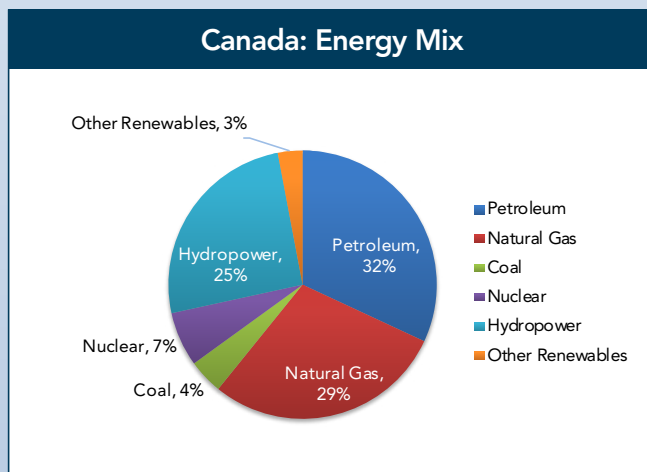


# CANADA

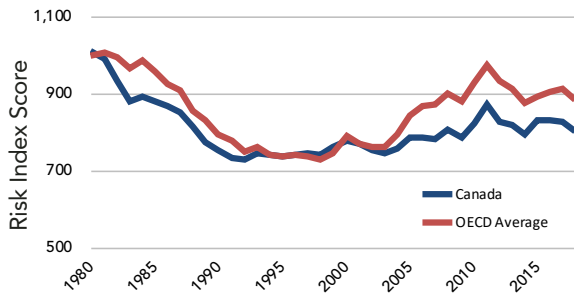


Canada: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	4
Natural Gas	5
Coal	12
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	11
Natural Gas	5
Coal	19
Total Energy	6
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	23
Nuclear	6
Hydropower	3
Other Renewables	10
Total Generation	7
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Exporter
Natural Gas	Exporter
Coal	Exporter

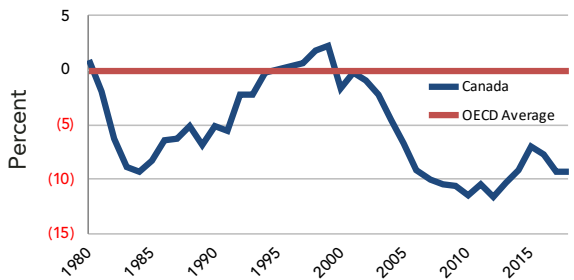
Canada: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	802
2018 Large Energy User Group Rank	3
Score in Previous Year	830
Rank in Previous Year	3
Score in 1980	1,009
Average Score: 1980-2018	809
Best Energy Security Risk Score	732 (1992)
Worst Energy Security Risk Score	1,009 (1980)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	-5%
Best Relative Score	-12% (2012)
Worst Relative Score	2% (1999)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	7
Number in Bottom Five	4



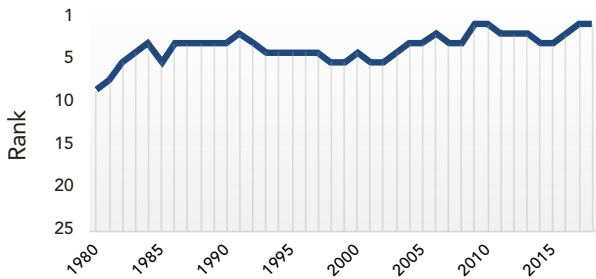
### Canada vs. OECD: Risk Index Scores



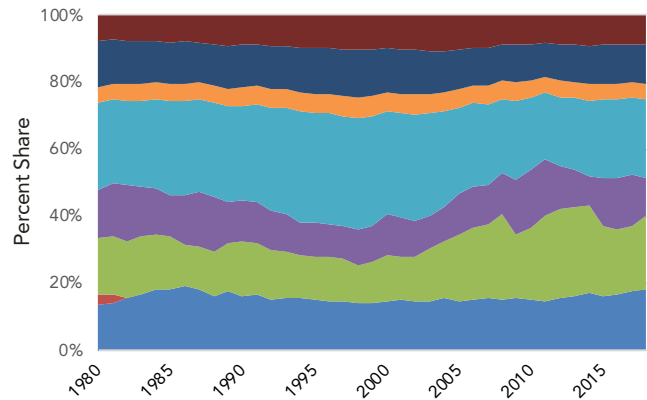
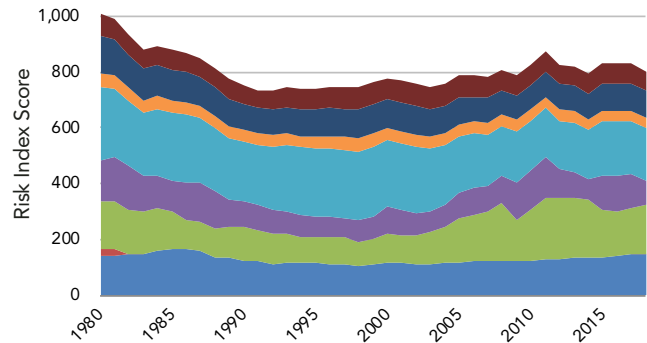
### Canada: Risk Variance from OECD



### Canada: Risk Ranking



### Canada: Risk Scores by Metric Group and Share of Total Risk by Metric Group

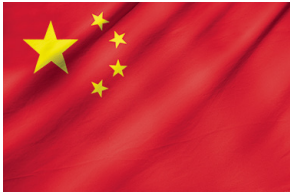


- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Canada vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-84	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100
Energy Expenditure Metrics	-15	-6	-3	-13	0	11	4	16	15	13	13
Price & Market Volatility Metrics	-3	-13	0	2	1	2	0	-1	0	1	-1
Energy Use Intensity Metrics	88	65	82	116	98	97	75	95	99	94	96
Electric Power Sector Metrics	-32	-29	-31	-32	-28	-32	-32	-34	-33	-32	-31
Transportation Sector Metrics	98	47	49	61	56	47	53	64	64	60	59
Environmental Metrics	29	18	22	33	31	36	32	44	46	44	44
<b>Total Weighted Index</b>	<b>1</b>	<b>-8</b>	<b>-5</b>	<b>0</b>	<b>-2</b>	<b>-7</b>	<b>-11</b>	<b>-7</b>	<b>-8</b>	<b>-9</b>	<b>-9</b>

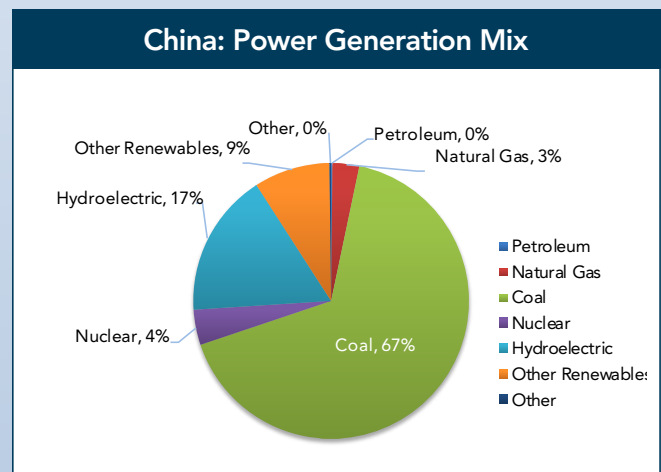
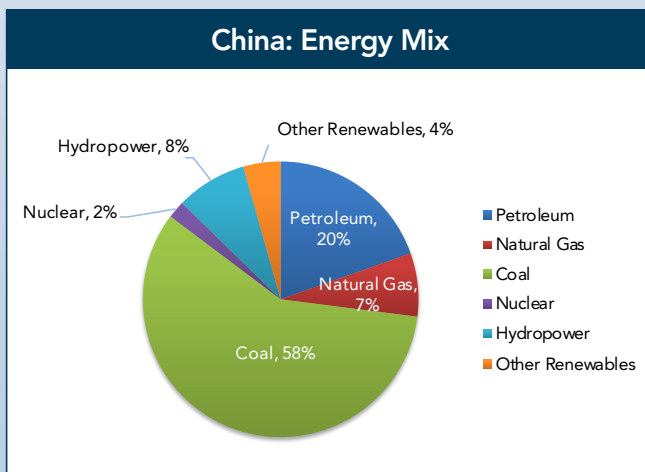


# CHINA



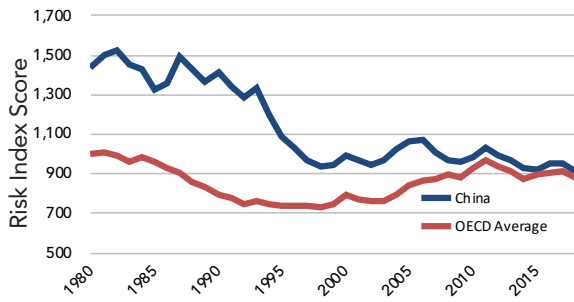
China: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	7
Natural Gas	6
Coal	1
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	2
Natural Gas	3
Coal	1
Total Energy	1
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	1
Nuclear	3
Hydropower	1
Other Renewables	1
Total Generation	1
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

China: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	912
2018 Large Energy User Group Rank	8
Score in Previous Year	956
Rank in Previous Year	8
Score in 1980	1,436
Average Score: 1980-2018	1,141
Best Energy Security Risk Score	912 (2018)
Worst Energy Security Risk Score	1,522 (1982)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	34%
Best Relative Score	3% (2015)
Worst Relative Score	78% (1990)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	3
Number in Bottom Five	2

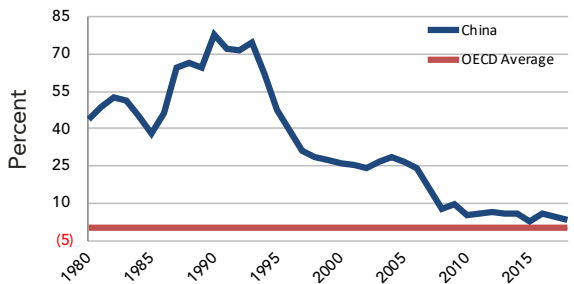




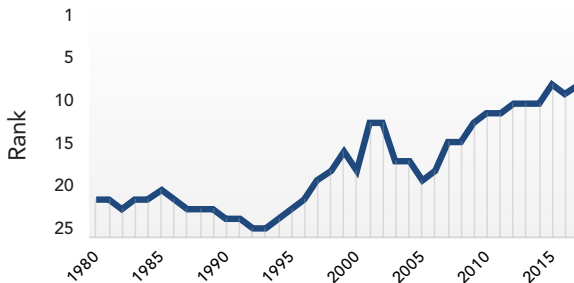
### China vs. OECD: Risk Index Scores



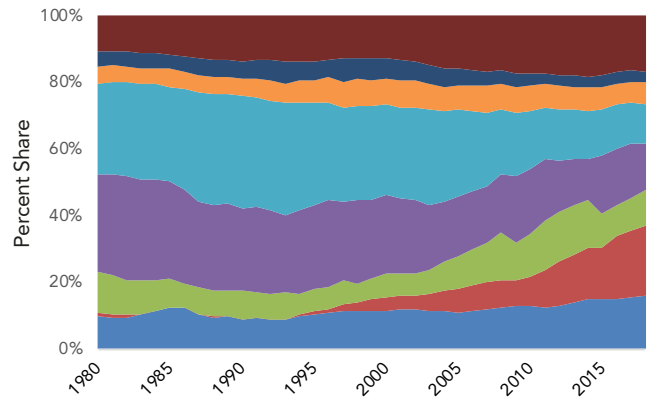
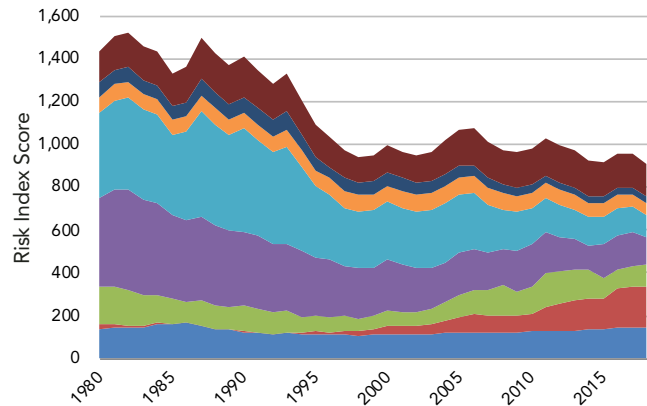
### China: Risk Variance from OECD



### China: Risk Ranking



### China: Risk Scores by Metric Group and Share of Total Risk by Metric Group

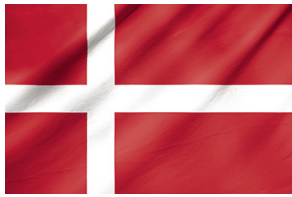


- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### China vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-89	-100	-98	-92	-76	-64	-61	-36	-20	-19	-18
Energy Expenditure Metrics	-13	-20	-7	-34	-32	-25	-26	-36	-38	-37	-35
Price & Market Volatility Metrics	180	217	282	280	150	113	37	31	29	28	35
Energy Use Intensity Metrics	181	152	310	197	125	166	71	27	27	21	13
Electric Power Sector Metrics	6	13	21	22	22	22	21	10	9	8	7
Transportation Sector Metrics	-4	-23	9	2	-3	-13	-39	-48	-46	-48	-50
Environmental Metrics	148	150	254	166	112	187	210	218	217	214	211
<b>Total Weighted Index</b>	<b>44</b>	<b>38</b>	<b>78</b>	<b>47</b>	<b>26</b>	<b>27</b>	<b>5</b>	<b>3</b>	<b>6</b>	<b>4</b>	<b>3</b>

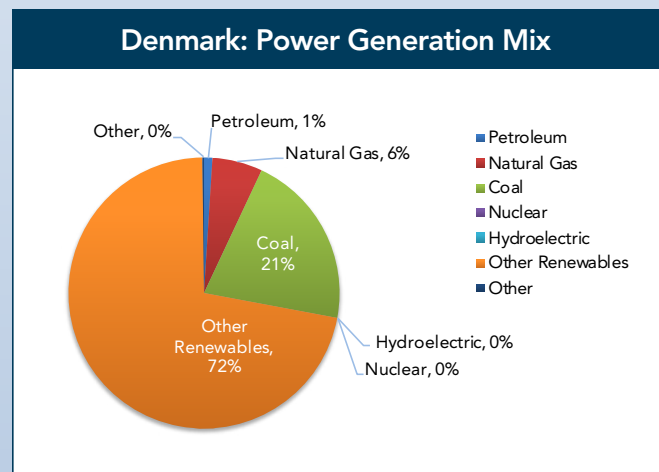
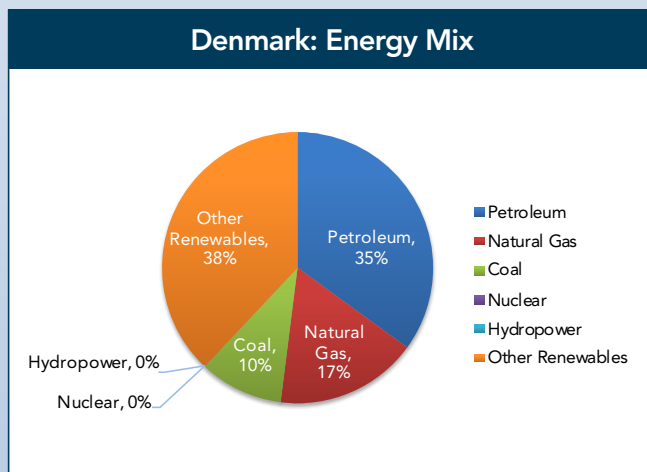


# DENMARK

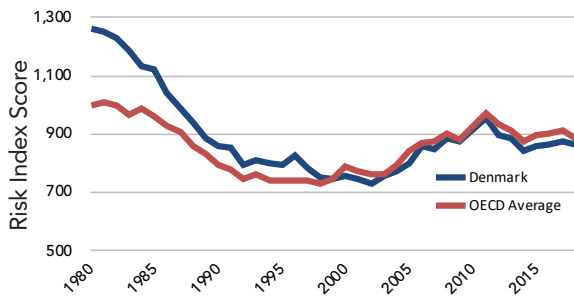


Denmark: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	41
Natural Gas	50
Coal	NA
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	71
Natural Gas	67
Coal	49
Total Energy	67
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	78
Nuclear	NA
Hydropower	135
Other Renewables	18
Total Generation	66
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Exporter
Coal	Importer

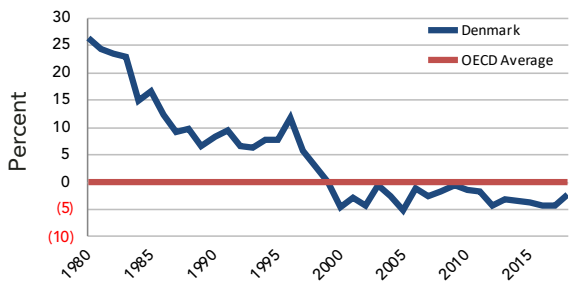
Denmark: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	864
2018 Large Energy User Group Rank	5
Score in Previous Year	876
Rank in Previous Year	5
Score in 1980	1,263
Average Score: 1980-2018	899
Best Energy Security Risk Score	731 (2002)
Worst Energy Security Risk Score	1,263 (1980)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	5%
Best Relative Score	-5% (2005)
Worst Relative Score	26% (1980)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	10
Number in Bottom Five	2



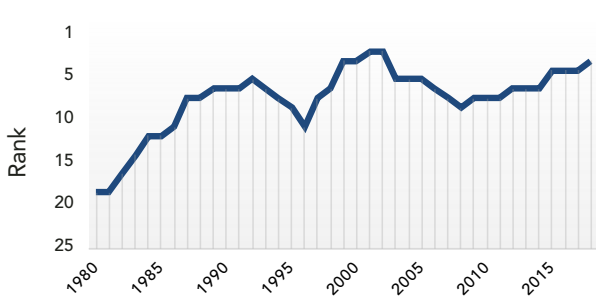
### Denmark vs. OECD: Risk Index Scores



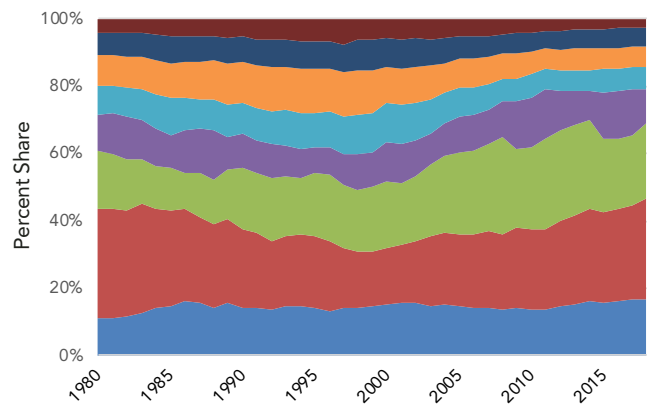
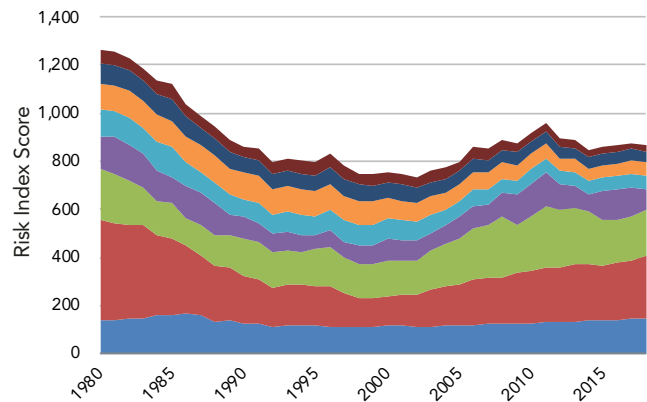
### Denmark: Risk Variance from OECD



### Denmark: Risk Ranking



### Denmark: Risk Scores by Metric Group and Share of Total Risk by Metric Group

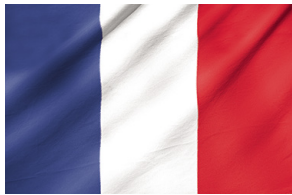


- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Denmark vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	143	79	27	9	-25	-17	1	5	2	3	11
Energy Expenditure Metrics	9	-2	25	40	39	39	29	27	29	27	24
Price & Market Volatility Metrics	-9	-12	-4	-15	-4	-4	-4	-3	-3	-3	-5
Energy Use Intensity Metrics	-22	-17	-35	-29	-28	-35	-38	-41	-41	-42	-42
Electric Power Sector Metrics	58	74	72	70	28	6	4	-9	-7	-4	-1
Transportation Sector Metrics	17	25	1	5	-1	-13	-13	-16	-18	-19	-21
Environmental Metrics	-7	-3	-17	-2	-26	-31	-29	-49	-51	-51	-51
<b>Total Weighted Index</b>	<b>26</b>	<b>17</b>	<b>8</b>	<b>8</b>	<b>-5</b>	<b>-5</b>	<b>-1</b>	<b>-4</b>	<b>-4</b>	<b>-4</b>	<b>-2</b>

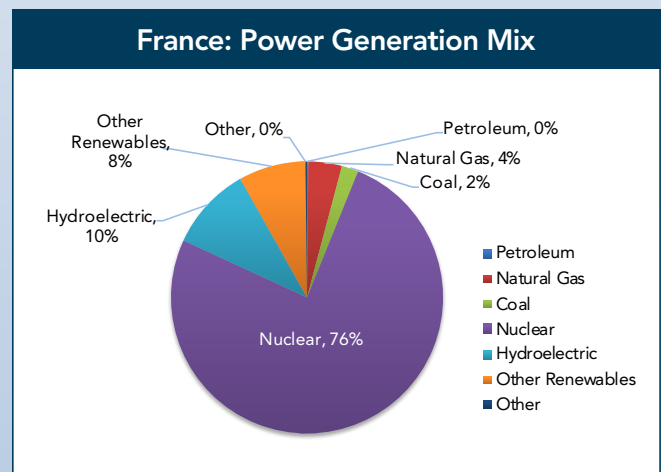
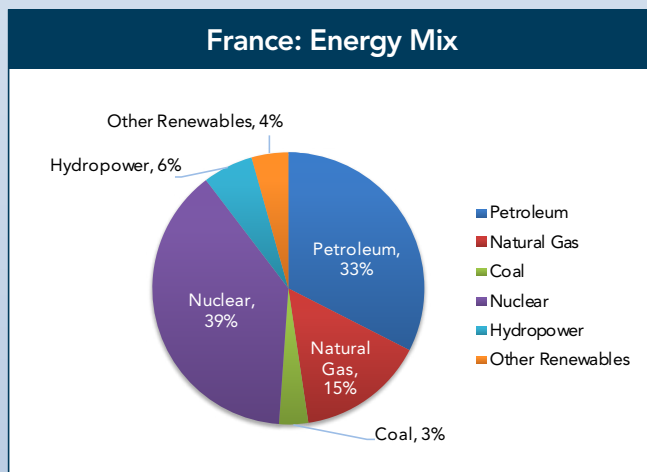


# FRANCE

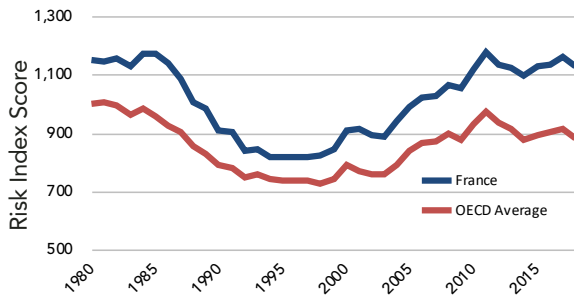


France: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	69
Natural Gas	90
Coal	NA
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	14
Natural Gas	19
Coal	30
Total Energy	12
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	43
Nuclear	2
Hydropower	13
Other Renewables	11
Total Generation	9
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

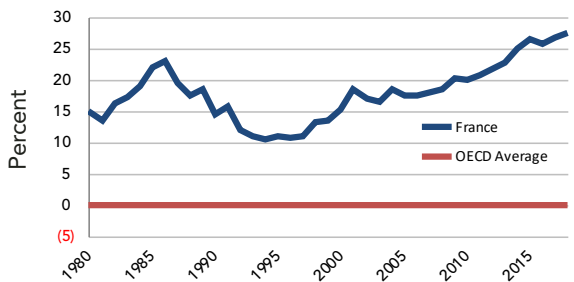
France: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	1,128
2018 Large Energy User Group Rank	15
Score in Previous Year	1,160
Rank in Previous Year	15
Score in 1980	1,152
Average Score: 1980-2018	1,014
Best Energy Security Risk Score	821 (1995)
Worst Energy Security Risk Score	1,177 (2011)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	18%
Best Relative Score	11% (1994)
Worst Relative Score	28% (2018)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	6
Number in Bottom Five	3



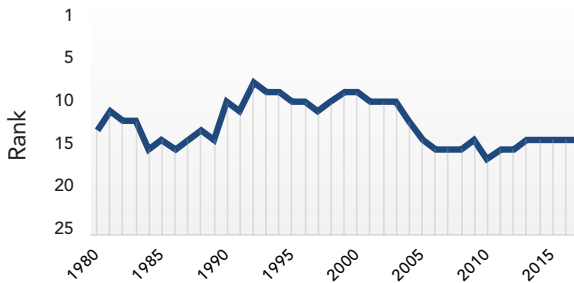
### France vs. OECD: Risk Index Scores



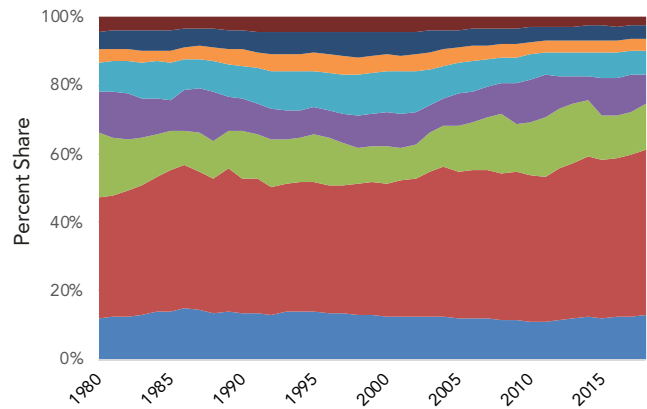
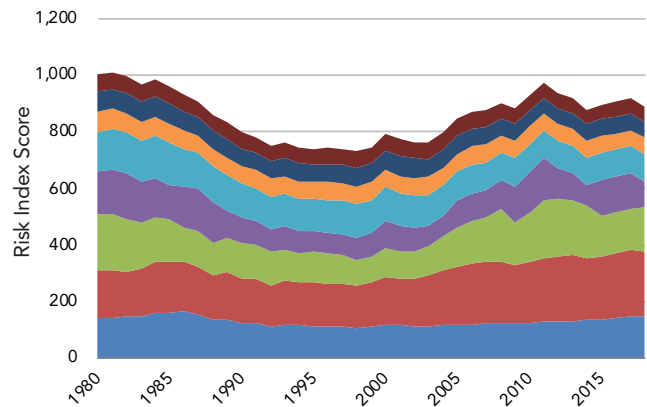
### France: Risk Variance from OECD



### France: Risk Ranking



### France: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### France vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	140	173	129	102	110	109	120	137	129	131	134
Energy Expenditure Metrics	9	-7	1	6	-8	-6	-2	0	1	1	0
Price & Market Volatility Metrics	-8	-13	-6	-11	0	0	0	2	1	1	-1
Energy Use Intensity Metrics	-30	-15	-26	-22	-10	-13	-20	-15	-15	-15	-16
Electric Power Sector Metrics	-39	-40	-31	-30	-30	-29	-32	-31	-32	-31	-31
Transportation Sector Metrics	-14	-5	-17	-15	-6	-17	-18	-18	-20	-22	-25
Environmental Metrics	-22	-28	-39	-40	-37	-40	-42	-45	-44	-44	-44
<b>Total Weighted Index</b>	<b>15</b>	<b>22</b>	<b>15</b>	<b>11</b>	<b>15</b>	<b>18</b>	<b>20</b>	<b>27</b>	<b>26</b>	<b>27</b>	<b>28</b>

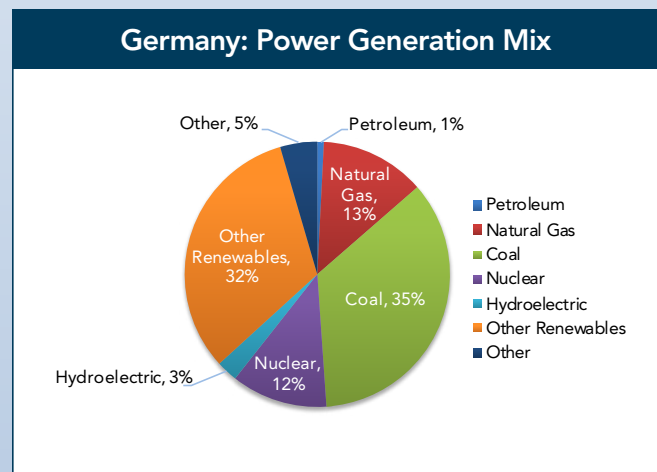
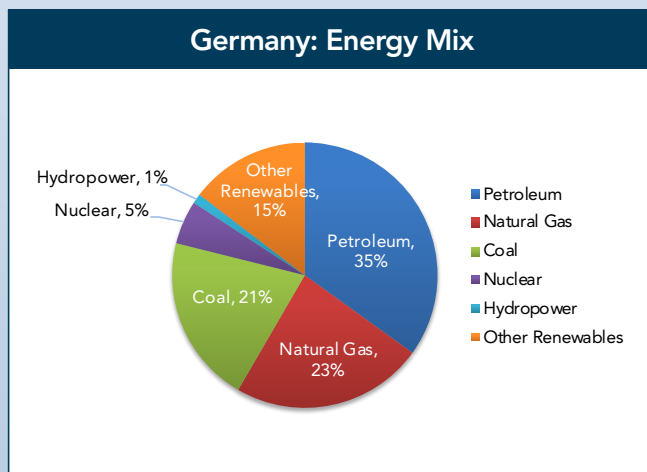


# GERMANY

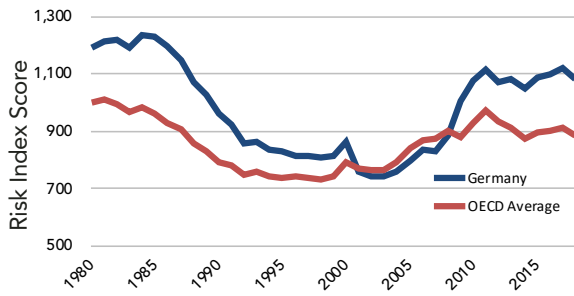


Germany: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	57
Natural Gas	48
Coal	11
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	21
Natural Gas	18
Coal	12
Total Energy	18
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	14
Nuclear	NA
Hydropower	40
Other Renewables	15
Total Generation	21
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Exporter
Coal	Exporter

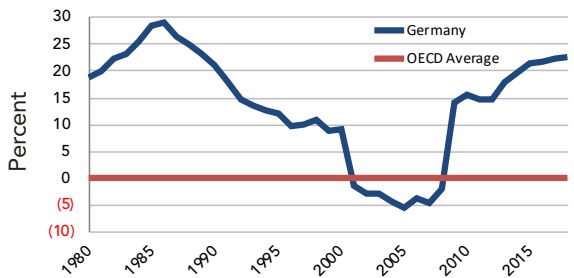
Germany: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	805
2018 Large Energy User Group Rank	4
Score in Previous Year	842
Rank in Previous Year	4
Score in 1980	858
Average Score: 1980-2018	790
Best Energy Security Risk Score	698 (1992)
Worst Energy Security Risk Score	897 (2011)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	-8%
Best Relative Score	-17% (1984)
Worst Relative Score	0% (1999)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	3
Number in Bottom Five	6



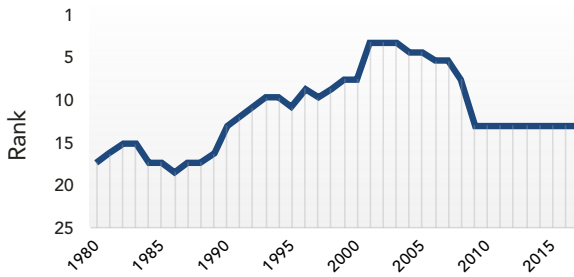
### Germany vs. OECD: Risk Index Scores



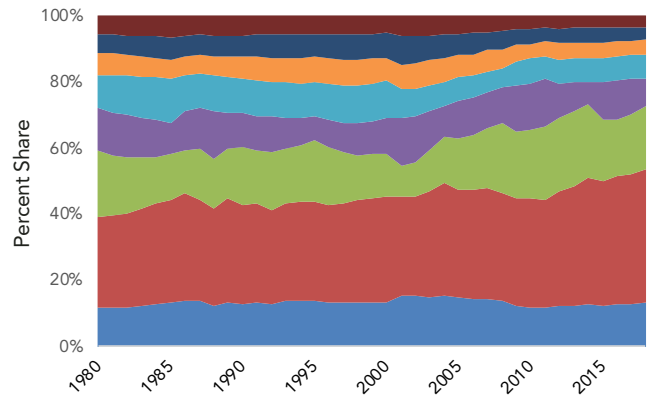
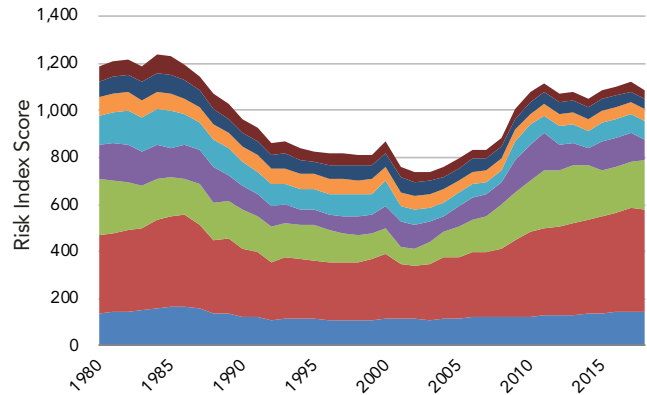
### Germany: Risk Variance from OECD



### Germany: Risk Ranking



### Germany: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Germany vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	93	117	85	61	63	27	64	86	84	86	87
Energy Expenditure Metrics	20	13	33	42	5	-10	29	34	37	36	33
Price & Market Volatility Metrics	0	-3	9	-11	1	-3	6	0	0	-1	-2
Energy Use Intensity Metrics	-15	11	-16	-25	-15	-46	-19	-17	-18	-18	-19
Electric Power Sector Metrics	16	7	8	4	-6	-16	-19	-15	-11	-10	-8
Transportation Sector Metrics	-7	13	-5	-9	-5	-17	-16	-18	-22	-26	-29
Environmental Metrics	10	28	1	-20	-24	-27	-26	-25	-24	-25	-25
<b>Total Weighted Index</b>	<b>19</b>	<b>28</b>	<b>21</b>	<b>12</b>	<b>9</b>	<b>-5</b>	<b>16</b>	<b>21</b>	<b>22</b>	<b>22</b>	<b>23</b>

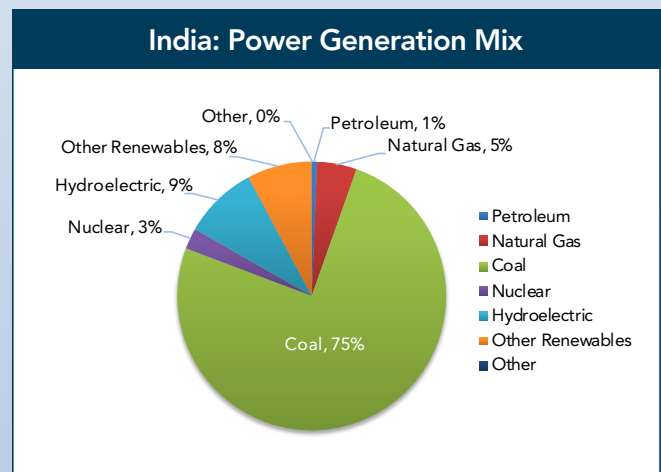
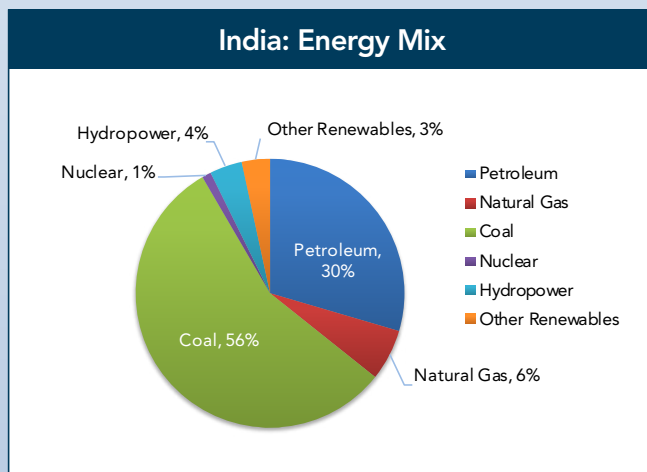


# INDIA



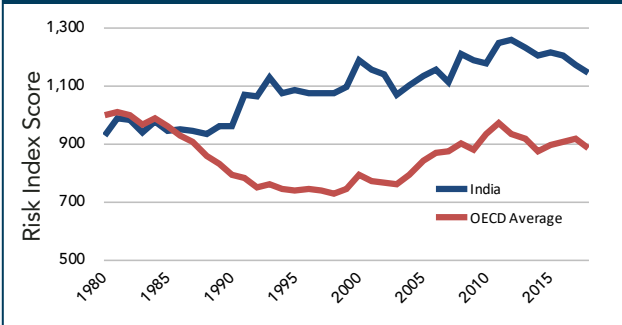
India: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	24
Natural Gas	24
Coal	3
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	3
Natural Gas	14
Coal	2
Total Energy	4
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	3
Nuclear	13
Hydropower	7
Other Renewables	4
Total Generation	3
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

India: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	1,144
2018 Large Energy User Group Rank	16
Score in Previous Year	1,170
Rank in Previous Year	16
Score in 1980	928
Average Score: 1980-2018	1,090
Best Energy Security Risk Score	928 (1980)
Worst Energy Security Risk Score	1,259 (2012)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	29%
Best Relative Score	-7% (1980)
Worst Relative Score	50% (2000)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	5
Number in Bottom Five	3

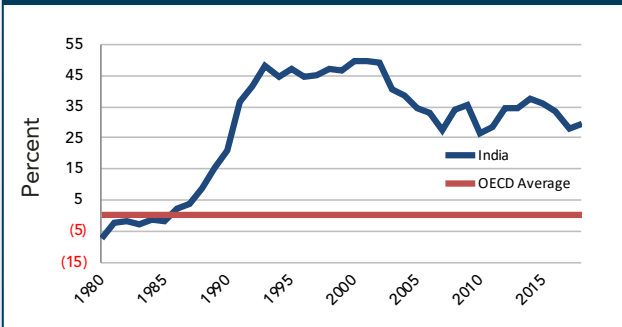




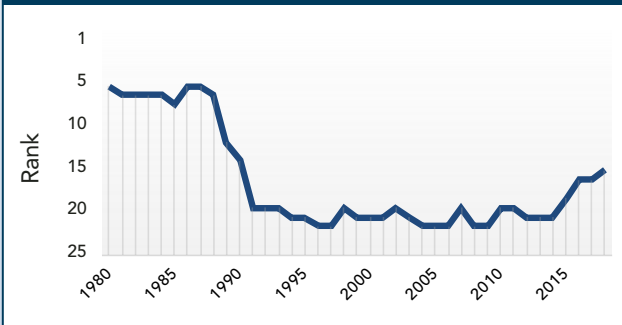
### India vs. OECD: Risk Index Scores



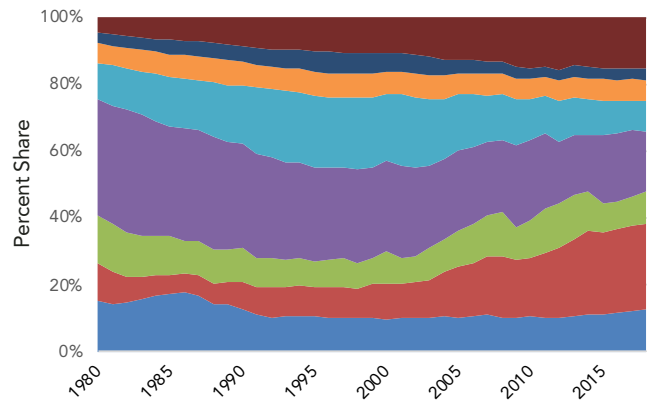
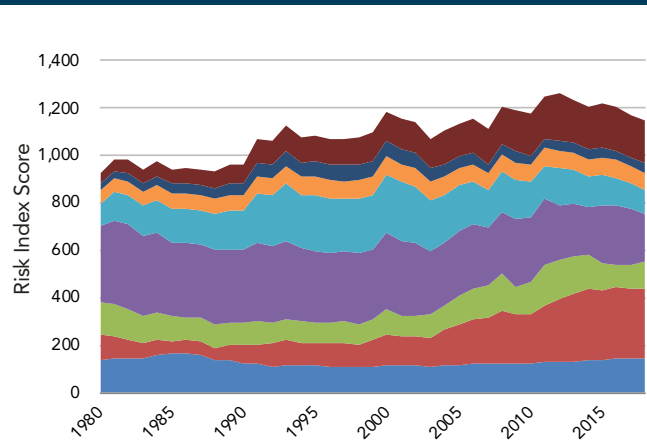
### India: Risk Variance from OECD



### India: Risk Ranking



### India: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### India vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-37	-69	-51	-39	-25	-17	-6	35	31	24	26
Energy Expenditure Metrics	-35	-27	-22	-22	5	-13	-22	-27	-30	-31	-28
Price & Market Volatility Metrics	115	151	231	322	248	198	95	100	93	88	119
Energy Use Intensity Metrics	-29	-5	41	112	99	84	43	28	20	7	9
Electric Power Sector Metrics	-18	1	11	24	24	17	22	32	33	31	30
Transportation Sector Metrics	-60	-48	-27	8	2	-26	-34	-29	-30	-35	-32
Environmental Metrics	-28	6	48	98	110	139	225	256	263	257	259
<b>Total Weighted Index</b>	<b>-7</b>	<b>-2</b>	<b>21</b>	<b>47</b>	<b>50</b>	<b>35</b>	<b>26</b>	<b>36</b>	<b>33</b>	<b>28</b>	<b>29</b>

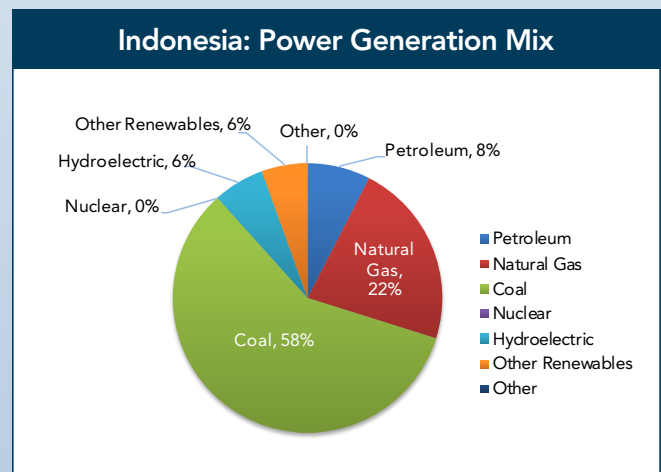
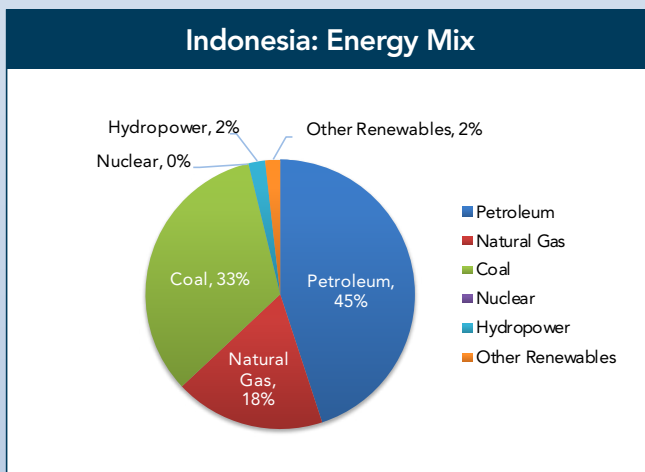


# INDONESIA

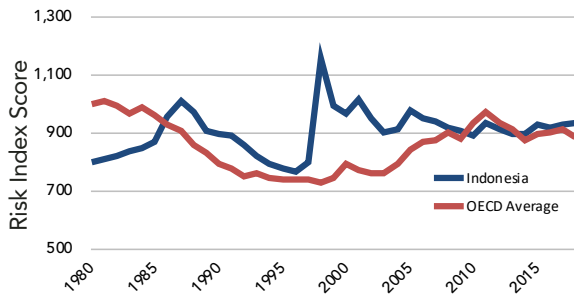


Indonesia: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	25
Natural Gas	13
Coal	6
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	12
Natural Gas	21
Coal	10
Total Energy	13
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	11
Nuclear	NA
Hydropower	26
Other Renewables	30
Total Generation	19
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Exporter
Coal	Exporter

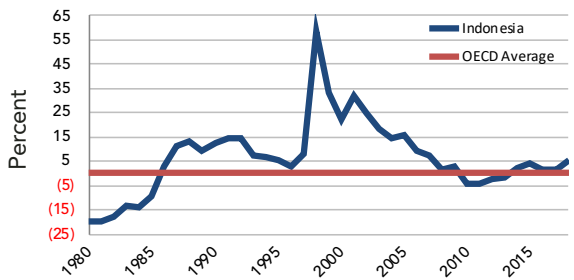
Indonesia: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	932
2018 Large Energy User Group Rank	9
Score in Previous Year	930
Rank in Previous Year	9
Score in 1980	799
Average Score: 1980-2018	904
Best Energy Security Risk Score	764 (1996)
Worst Energy Security Risk Score	1,159 (1998)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	7%
Best Relative Score	-20% (1980)
Worst Relative Score	59% (1998)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	7
Number in Bottom Five	6



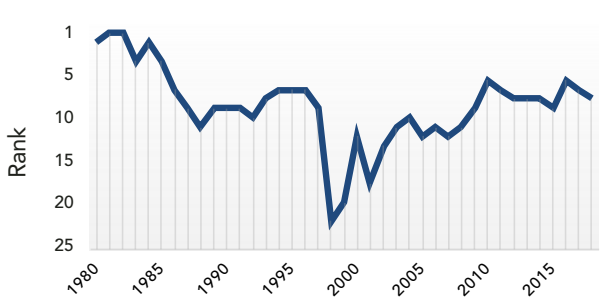
### Indonesia vs. OECD: Risk Index Scores



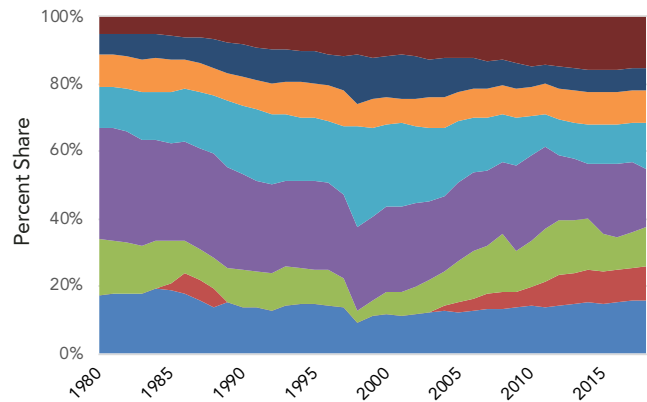
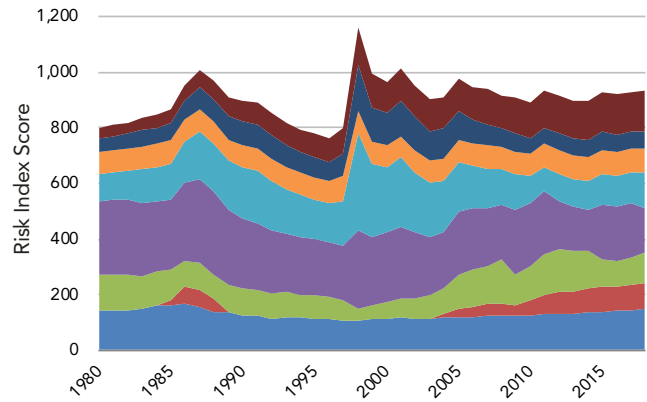
### Indonesia: Risk Variance from OECD



### Indonesia: Risk Ranking



### Indonesia: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Indonesia vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-100	-91	-100	-100	-100	-84	-76	-59	-62	-61	-59
Energy Expenditure Metrics	-33	-24	-23	-25	-44	-16	-29	-32	-34	-33	-30
Price & Market Volatility Metrics	76	104	180	182	166	148	59	58	54	54	74
Energy Use Intensity Metrics	-32	-12	55	29	94	74	0	12	11	14	31
Electric Power Sector Metrics	13	32	26	29	26	29	31	52	55	58	64
Transportation Sector Metrics	-30	-19	36	20	78	62	-5	8	3	-1	2
Environmental Metrics	-33	-17	36	47	91	100	140	183	189	189	194
<b>Total Weighted Index</b>	<b>-20</b>	<b>-10</b>	<b>13</b>	<b>5</b>	<b>22</b>	<b>16</b>	<b>-4</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>5</b>

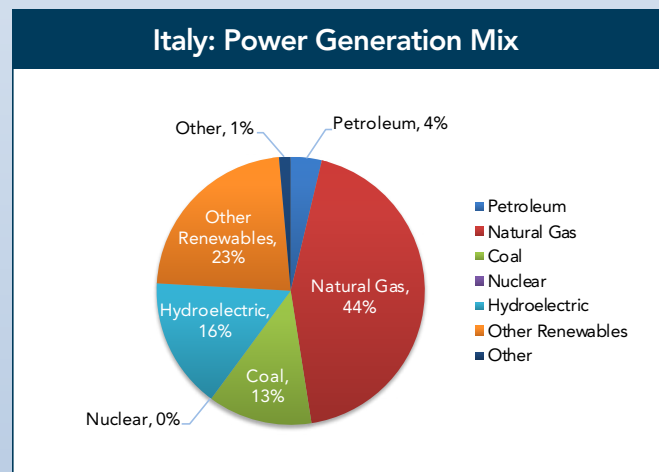
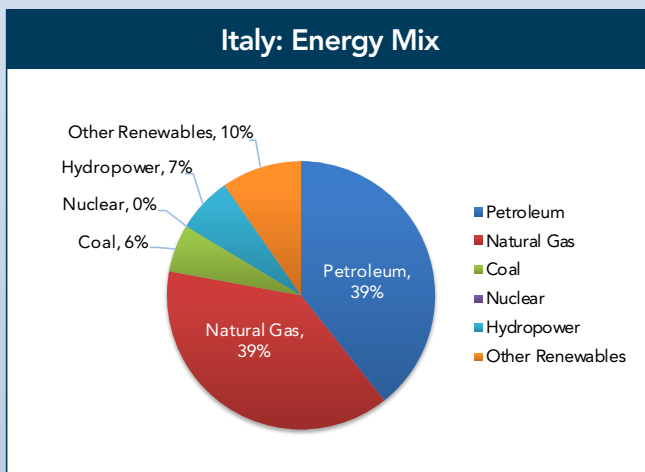


**ITALY**

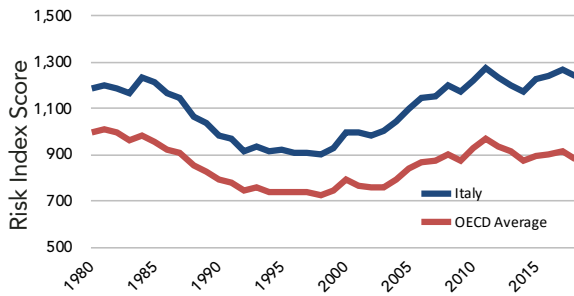


Italy: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	43
Natural Gas	51
Coal	47
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	18
Natural Gas	12
Coal	25
Total Energy	16
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	17
Nuclear	NA
Hydropower	8
Other Renewables	19
Total Generation	17
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

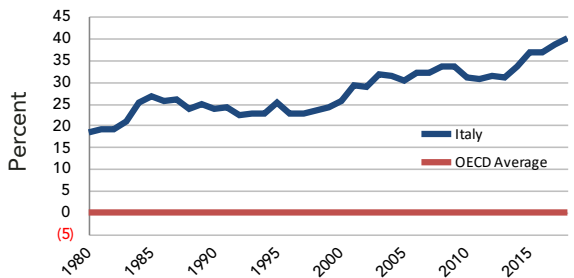
Italy: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	1,240
2018 Large Energy User Group Rank	20
Score in Previous Year	1,270
Rank in Previous Year	20
Score in 1980	1,184
Average Score: 1980-2018	1,098
Best Energy Security Risk Score	902 (1998)
Worst Energy Security Risk Score	1,274 (2011)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	28%
Best Relative Score	18% (1980)
Worst Relative Score	40% (2018)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	4
Number in Bottom Five	3



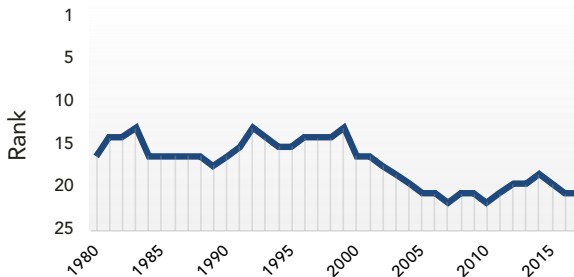
### Italy vs. OECD: Risk Index Scores



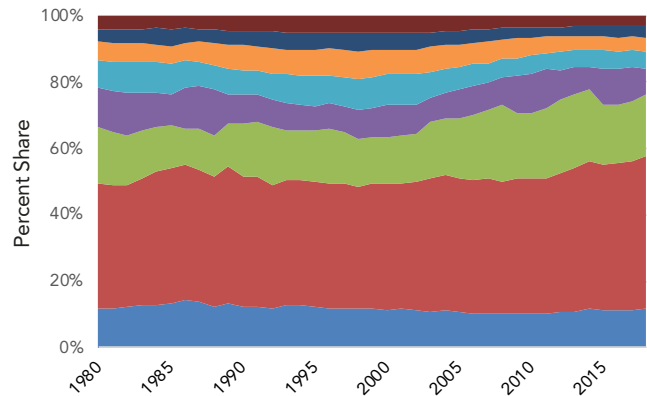
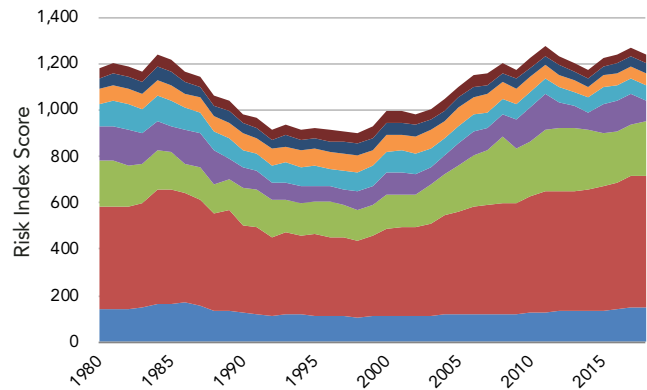
### Italy: Risk Variance from OECD



### Italy: Risk Ranking



### Italy: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Italy vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	161	181	146	127	122	117	130	144	137	141	144
Energy Expenditure Metrics	1	4	28	32	33	43	39	52	56	55	52
Price & Market Volatility Metrics	-3	-10	-7	-6	4	4	1	6	5	4	3
Energy Use Intensity Metrics	-32	-22	-38	-27	-24	-27	-32	-31	-31	-31	-31
Electric Power Sector Metrics	-7	0	19	21	18	18	7	-11	-7	-7	-7
Transportation Sector Metrics	-33	-19	-33	-23	-23	-30	-33	-32	-31	-30	-29
Environmental Metrics	-26	-21	-20	-15	-16	-17	-21	-28	-25	-24	-24
<b>Total Weighted Index</b>	<b>18</b>	<b>27</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>31</b>	<b>31</b>	<b>37</b>	<b>37</b>	<b>39</b>	<b>40</b>

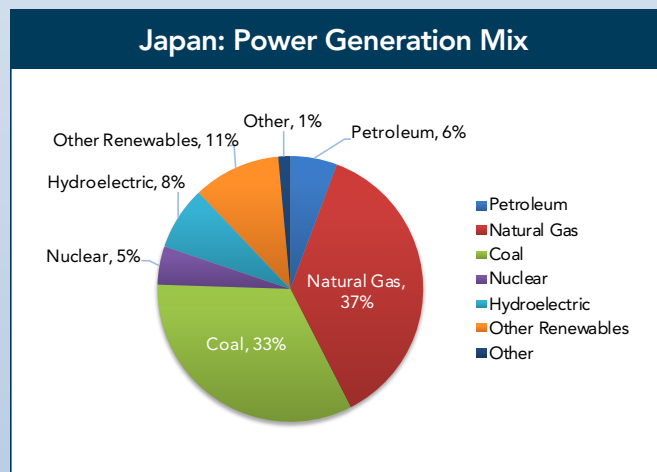
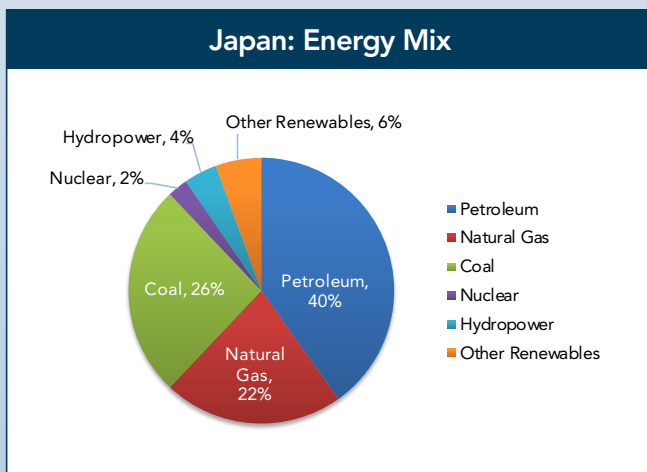


# JAPAN

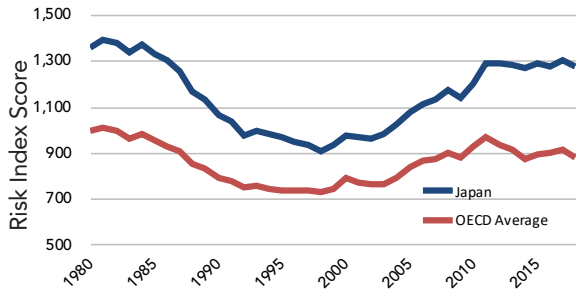


Japan: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	78
Natural Gas	56
Coal	42
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	5
Natural Gas	6
Coal	5
Total Energy	5
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	4
Nuclear	12
Hydropower	9
Other Renewables	6
Total Generation	21
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Exporter
Coal	Exporter

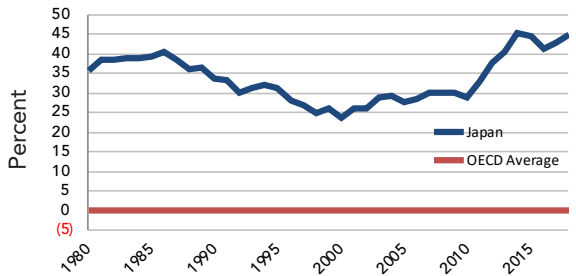
Japan: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	1,281
2018 Large Energy User Group Rank	22
Score in Previous Year	1,307
Rank in Previous Year	22
Score in 1980	1,357
Average Score: 1980-2018	1,151
Best Energy Security Risk Score	912 (1998)
Worst Energy Security Risk Score	1,395 (1981)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	34%
Best Relative Score	24% (2000)
Worst Relative Score	45% (2014)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	2
Number in Bottom Five	6



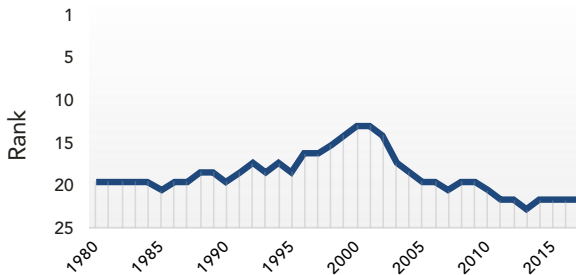
### Japan vs. OECD: Risk Index Scores



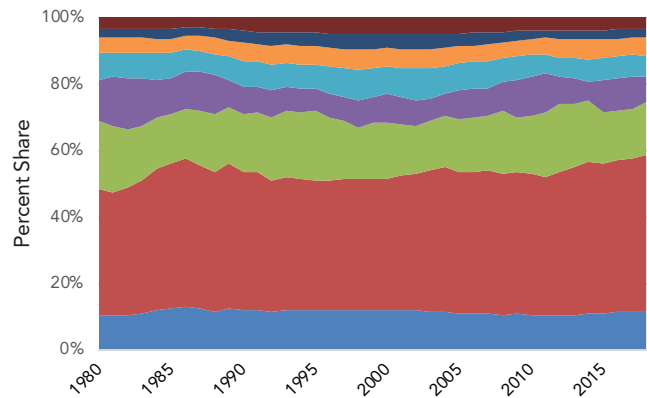
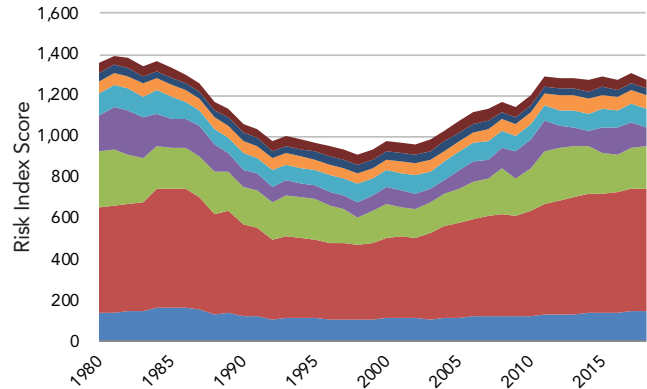
### Japan: Risk Variance from OECD



### Japan: Risk Ranking



### Japan: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Japan vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	202	230	186	148	130	124	134	166	153	155	158
Energy Expenditure Metrics	39	33	47	86	56	23	20	35	36	35	34
Price & Market Volatility Metrics	11	15	-6	-8	-10	-2	1	1	1	2	2
Energy Use Intensity Metrics	-22	-29	-30	-36	-32	-14	-21	-11	-16	-13	-11
Electric Power Sector Metrics	-10	-12	-8	-11	-13	-12	-10	25	23	23	23
Transportation Sector Metrics	-47	-47	-40	-40	-39	-33	-44	-39	-43	-43	-44
Environmental Metrics	-19	-21	-17	-17	-18	-10	-11	-2	-5	-4	-3
<b>Total Weighted Index</b>	<b>36</b>	<b>39</b>	<b>34</b>	<b>31</b>	<b>24</b>	<b>28</b>	<b>29</b>	<b>44</b>	<b>41</b>	<b>43</b>	<b>45</b>



# MEXICO



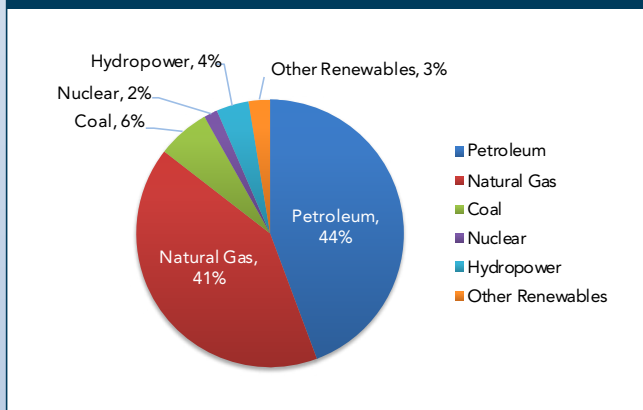
## Mexico: Energy at a Glance

Production:	World Rank
Petroleum	12
Natural Gas	29
Coal	21
Consumption:	World Rank
Petroleum	13
Natural Gas	10
Coal	23
Total Energy	15
Power Generation:	World Rank
Conventional Fossil	10
Nuclear	20
Hydropower	23
Other Renewables	19
Total Generation	15
Net Importer/Exporter of:	Status in 2018
Petroleum	Exporter
Natural Gas	Importer
Coal	Importer

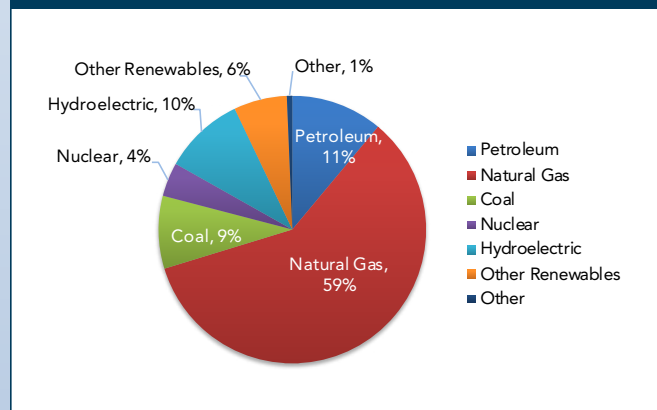
## Mexico: Energy Security Risk Summary

Risk Scores:	
2018 Energy Security Risk Score	966
2018 Large Energy User Group Rank	11
Score in Previous Year	975
Rank in Previous Year	11
Score in 1980	742
Average Score: 1980-2018	778
Best Energy Security Risk Score	626 (1994)
Worst Energy Security Risk Score	975 (2017)
Risk Scores Relative to OECD Average:	
Average Annual Difference 1980-2018	-9%
Best Relative Score	-30% (1981)
Worst Relative Score	9% (2018)
Country-Specific Metric Ranking—2018:	
Number in Top Five	4
Number in Bottom Five	1

## Mexico: Energy Mix

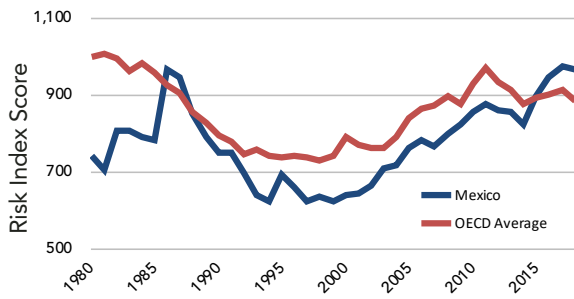


## Mexico: Power Generation Mix

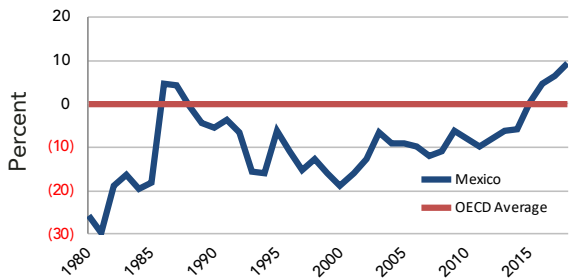




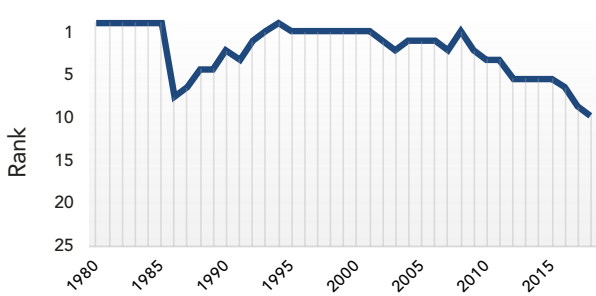
### Mexico vs. OECD: Risk Index Scores



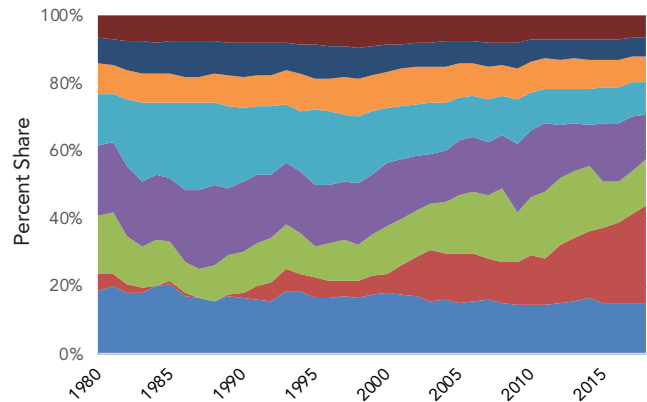
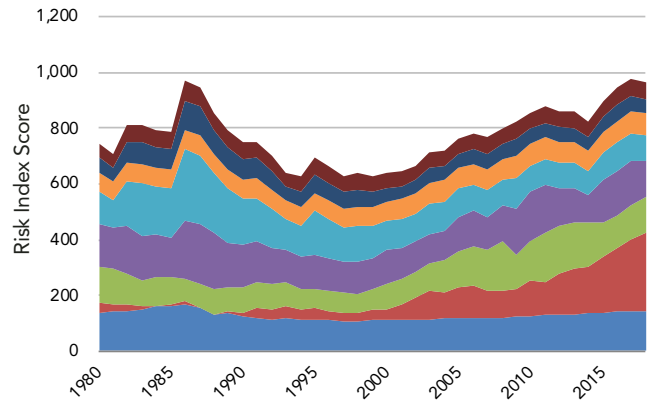
### Mexico: Risk Variance from OECD



### Mexico: Risk Ranking



### Mexico: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Mexico vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-79	-96	-93	-72	-79	-46	-42	-8	-2	9	20
Energy Expenditure Metrics	-36	-37	-27	-40	-13	-6	-16	-17	-15	-16	-15
Price & Market Volatility Metrics	2	17	70	76	27	34	21	25	28	27	36
Energy Use Intensity Metrics	-18	17	40	37	-12	-3	-4	-4	5	1	0
Electric Power Sector Metrics	-4	7	9	7	11	17	26	29	34	35	36
Transportation Sector Metrics	-18	0	22	12	-26	-17	-6	-9	-3	-7	-9
Environmental Metrics	-25	-2	8	5	-7	-5	10	17	25	23	23
<b>Total Weighted Index</b>	<b>-26</b>	<b>-18</b>	<b>-5</b>	<b>-6</b>	<b>-19</b>	<b>-9</b>	<b>-8</b>	<b>1</b>	<b>5</b>	<b>7</b>	<b>9</b>

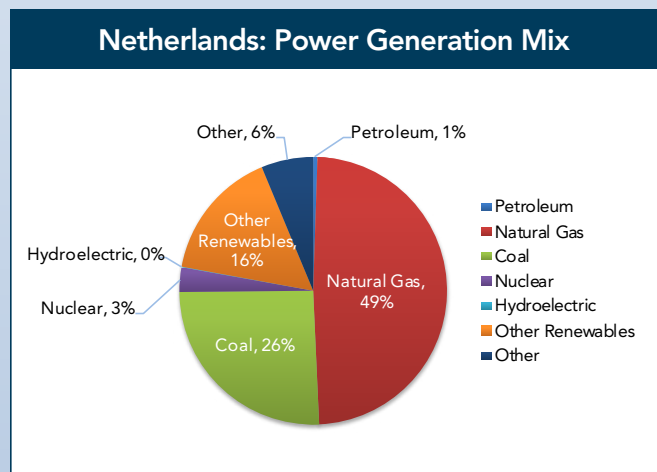
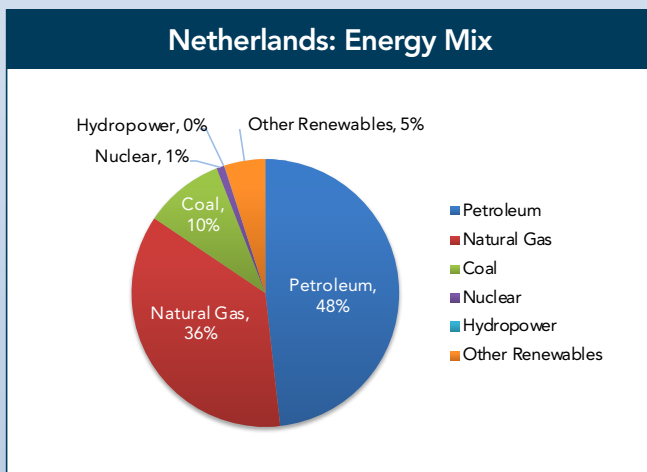


# NETHERLANDS

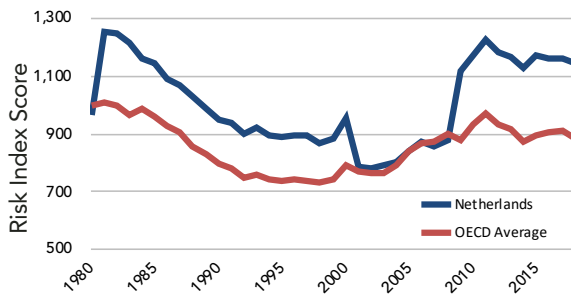


Netherlands: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	62
Natural Gas	22
Coal	NA
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	24
Natural Gas	24
Coal	26
Total Energy	28
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	29
Nuclear	NA
Hydropower	137
Other Renewables	21
Total Generation	35
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

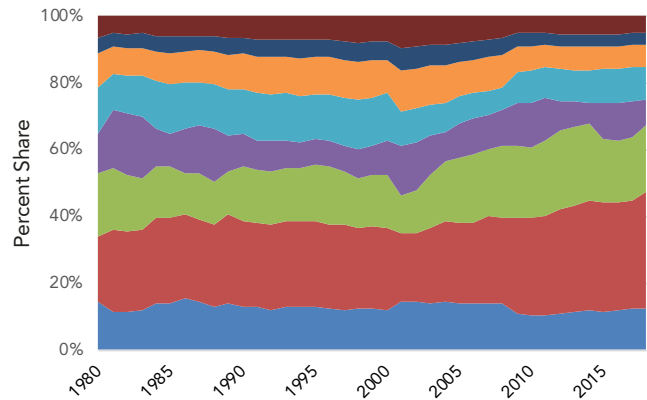
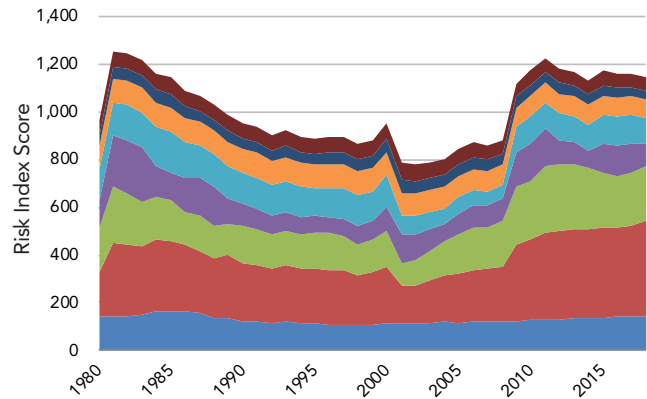
Netherlands: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	1,147
2018 Large Energy User Group Rank	17
Score in Previous Year	1,163
Rank in Previous Year	17
Score in 1980	968
Average Score: 1980-2018	1,012
Best Energy Security Risk Score	782 (2002)
Worst Energy Security Risk Score	1,253 (1981)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	18%
Best Relative Score	-3% (1980)
Worst Relative Score	31% (2015)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	2
Number in Bottom Five	5



### Netherlands vs. OECD: Risk Index Scores

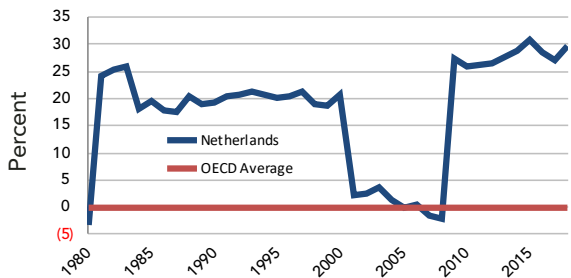


### Netherlands: Risk Scores by Metric Group and Share of Total Risk by Metric Group

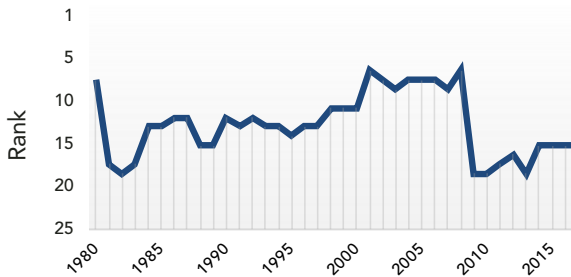


- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Netherlands: Risk Variance from OECD



### Netherlands: Risk Ranking



### Netherlands vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	11	66	57	48	40	-1	56	73	63	60	72
Energy Expenditure Metrics	-8	19	20	41	41	19	44	53	55	52	46
Price & Market Volatility Metrics	-22	-11	2	-5	5	-4	9	2	2	1	0
Energy Use Intensity Metrics	-6	18	9	5	14	-35	14	20	20	19	16
Electric Power Sector Metrics	44	59	63	64	54	38	40	41	43	42	42
Transportation Sector Metrics	-37	-22	-30	-26	-19	-24	-22	-27	-31	-34	-38
Environmental Metrics	4	16	13	11	19	11	8	18	19	19	18
<b>Total Weighted Index</b>	<b>-3</b>	<b>20</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>0</b>	<b>26</b>	<b>31</b>	<b>29</b>	<b>27</b>	<b>30</b>

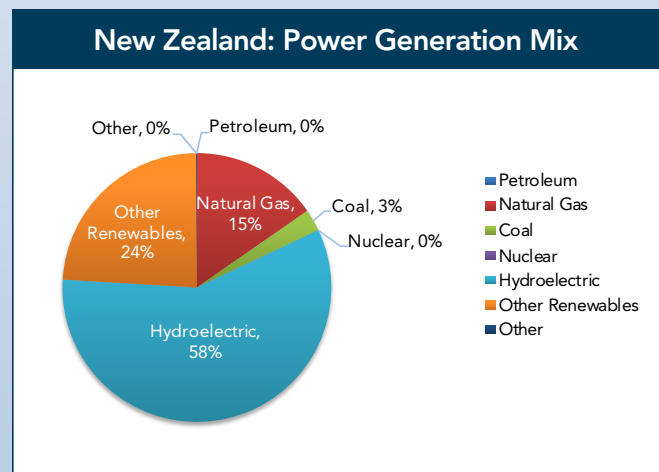
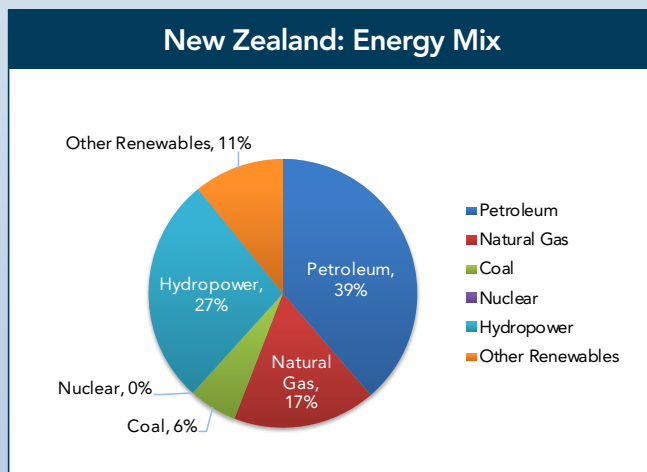


# NEW ZEALAND

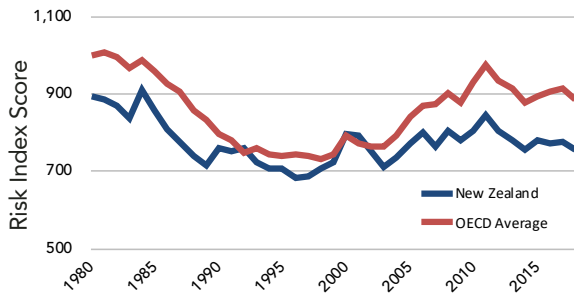


New Zealand: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	61
Natural Gas	52
Coal	30
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	72
Natural Gas	54
Coal	58
Total Energy	66
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	85
Nuclear	NA
Hydropower	21
Other Renewables	29
Total Generation	59
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Exporter

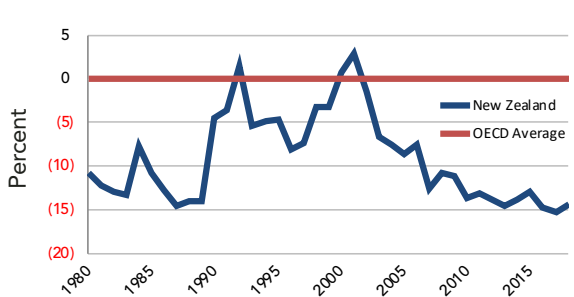
New Zealand: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	757
2018 Large Energy User Group Rank	2
Score in Previous Year	774
Rank in Previous Year	2
Score in 1980	892
Average Score: 1980-2018	776
Best Energy Security Risk Score	682 (1996)
Worst Energy Security Risk Score	909 (1984)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	-9%
Best Relative Score	-15% (2017)
Worst Relative Score	3% (2001)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	2
Number in Bottom Five	1



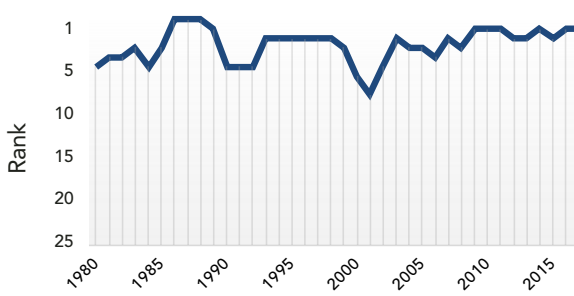
### New Zealand vs. OECD: Risk Index Scores



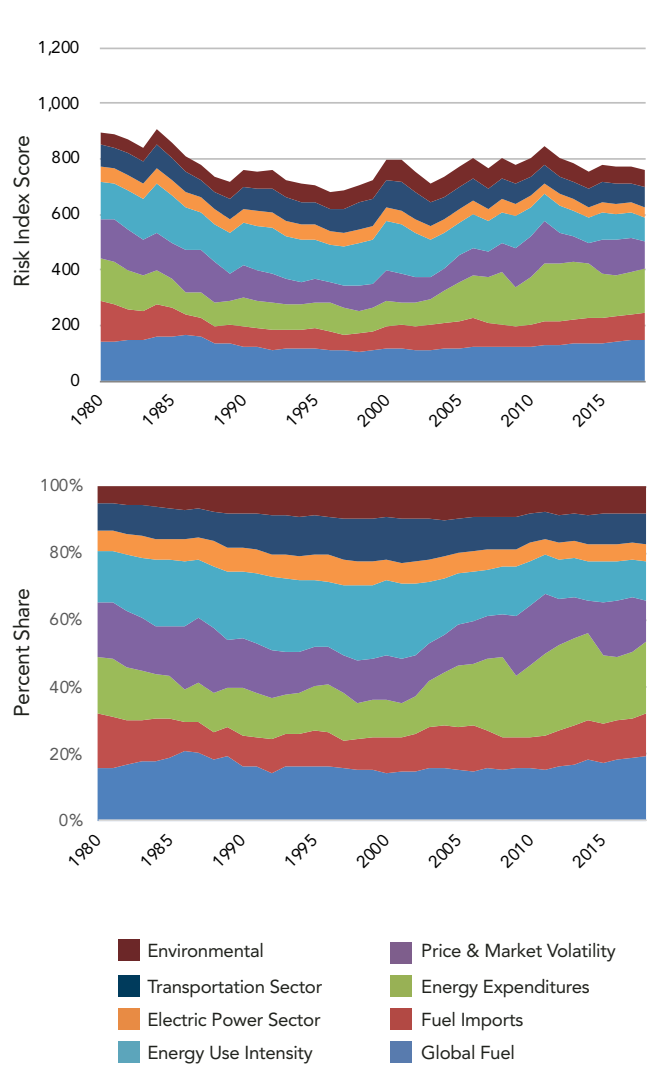
### New Zealand: Risk Variance from OECD



### New Zealand: Risk Ranking



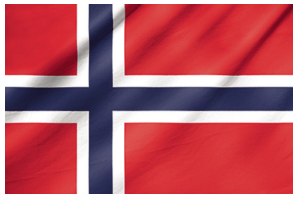
### New Zealand: Risk Scores by Metric Group and Share of Total Risk by Metric Group



### New Zealand vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-15	-44	-55	-50	-50	-52	-66	-59	-61	-61	-58
Energy Expenditure Metrics	-23	-27	-15	-14	-15	1	0	8	6	5	5
Price & Market Volatility Metrics	-3	4	24	16	14	5	3	0	0	1	1
Energy Use Intensity Metrics	-4	14	30	26	48	13	6	-3	-6	-8	-7
Electric Power Sector Metrics	-20	-18	-16	-13	-23	-25	-31	-31	-30	-30	-29
Transportation Sector Metrics	6	8	25	31	54	24	20	17	15	13	15
Environmental Metrics	-27	-9	11	10	23	25	21	26	25	25	25
<b>Total Weighted Index</b>	<b>-11</b>	<b>-11</b>	<b>-4</b>	<b>-5</b>	<b>1</b>	<b>-9</b>	<b>-14</b>	<b>-13</b>	<b>-15</b>	<b>-15</b>	<b>-14</b>

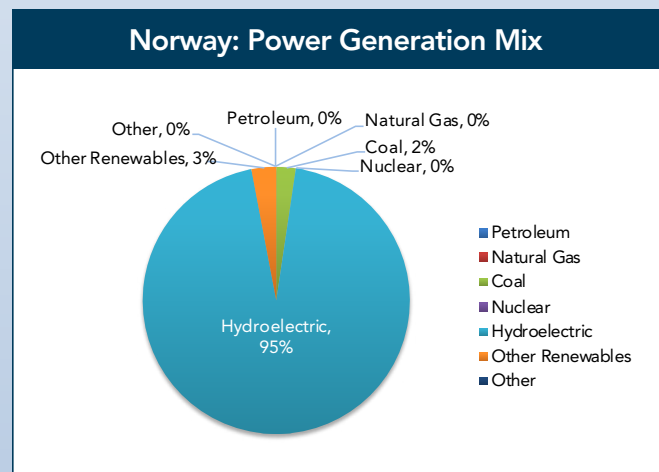
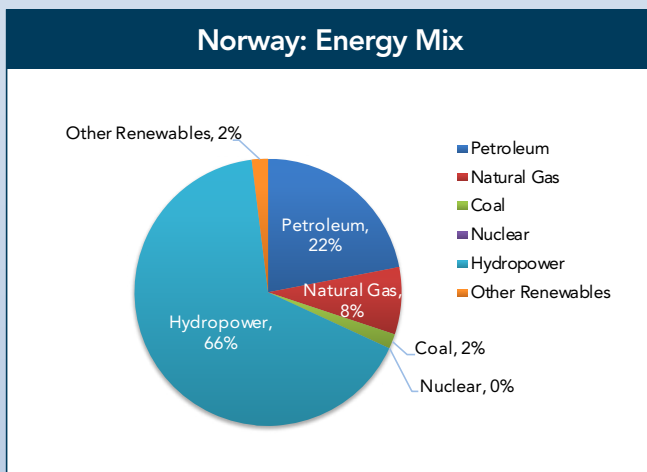


# NORWAY

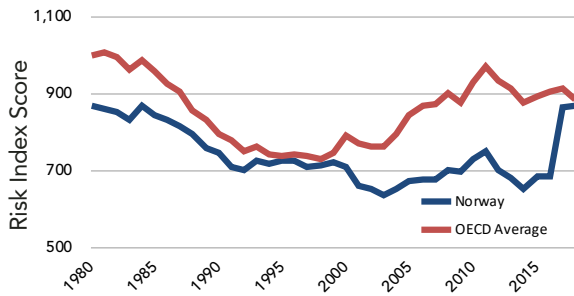


Norway: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	14
Natural Gas	7
Coal	65
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	58
Natural Gas	60
Coal	74
Total Energy	44
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	13
Nuclear	NA
Hydropower	6
Other Renewables	49
Total Generation	31
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Exporter
Natural Gas	Exporter
Coal	Importer

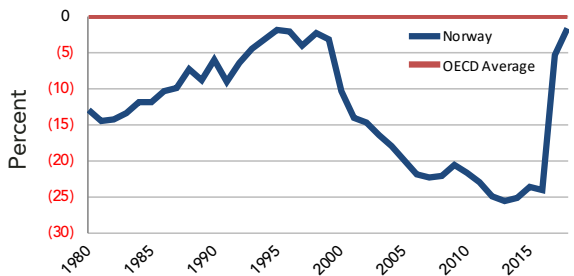
Norway: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	869
2018 Large Energy User Group Rank	6
Score in Previous Year	866
Rank in Previous Year	6
Score in 1980	870
Average Score: 1980-2018	741
Best Energy Security Risk Score	637 (2003)
Worst Energy Security Risk Score	870 (1980)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	-13%
Best Relative Score	-26% (2013)
Worst Relative Score	-2% (2018)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	11
Number in Bottom Five	3



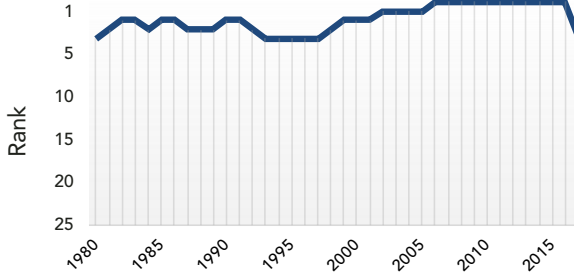
### Norway vs. OECD: Risk Index Scores



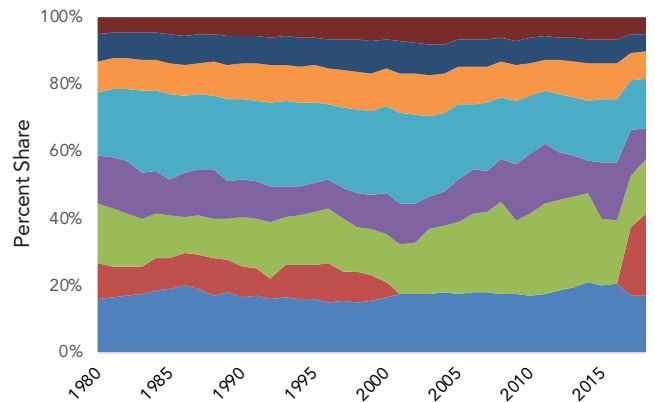
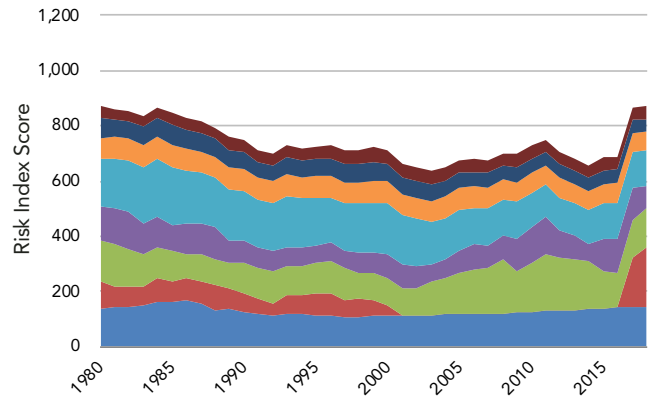
### Norway: Risk Variance from OECD



### Norway: Risk Ranking



### Norway: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Norway vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-45	-57	-57	-50	-79	-100	-100	-100	-100	-24	-8
Energy Expenditure Metrics	-24	-27	-12	4	-6	5	4	-7	-8	-10	-10
Price & Market Volatility Metrics	-17	-25	-10	-12	-8	-8	-9	-7	-7	-6	-10
Energy Use Intensity Metrics	19	42	53	55	54	45	24	30	33	32	31
Electric Power Sector Metrics	14	25	25	29	24	21	18	23	27	29	31
Transportation Sector Metrics	1	-4	-2	-2	-6	-14	-7	-16	-17	-21	-24
Environmental Metrics	-29	-27	-23	-20	-21	-22	-17	-13	-10	-10	-10
<b>Total Weighted Index</b>	<b>-13</b>	<b>-12</b>	<b>-6</b>	<b>-2</b>	<b>-10</b>	<b>-20</b>	<b>-22</b>	<b>-24</b>	<b>-24</b>	<b>-5</b>	<b>-2</b>



# POLAND



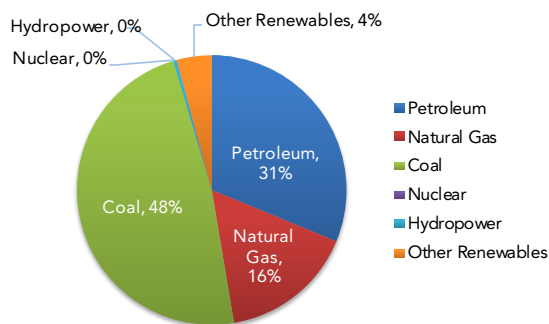
## Poland: Energy at a Glance

Production:	World Rank
Petroleum	63
Natural Gas	53
Coal	10
Consumption:	World Rank
Petroleum	35
Natural Gas	34
Coal	11
Total Energy	29
Power Generation:	World Rank
Conventional Fossil	22
Nuclear	NA
Hydropower	89
Other Renewables	16
Total Generation	28
Net Importer/Exporter of:	Status in 2018
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

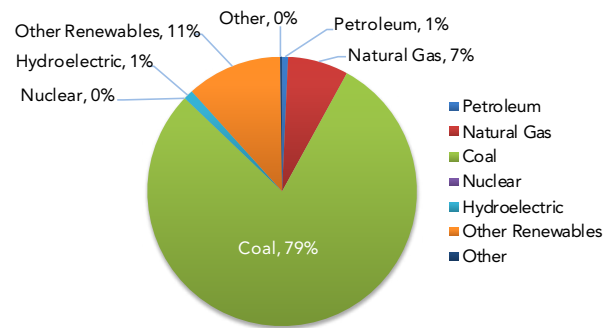
## Poland: Energy Security Risk Summary

Risk Scores:	
2018 Energy Security Risk Score	967
2018 Large Energy User Group Rank	12
Score in Previous Year	1,010
Rank in Previous Year	12
Score in 1980	1,785
Average Score: 1980-2018	1,188
Best Energy Security Risk Score	910 (2002)
Worst Energy Security Risk Score	1,875 (1984)
Risk Scores Relative to OECD Average:	
Average Annual Difference 1980-2018	38%
Best Relative Score	6% (2008)
Worst Relative Score	91% (1985)
Country-Specific Metric Ranking—2018:	
Number in Top Five	1
Number in Bottom Five	2

## Poland: Energy Mix

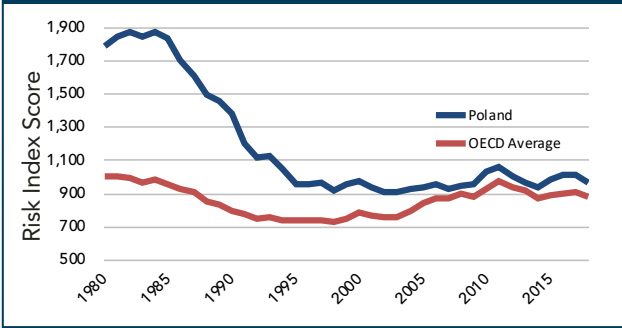


## Poland: Power Generation Mix

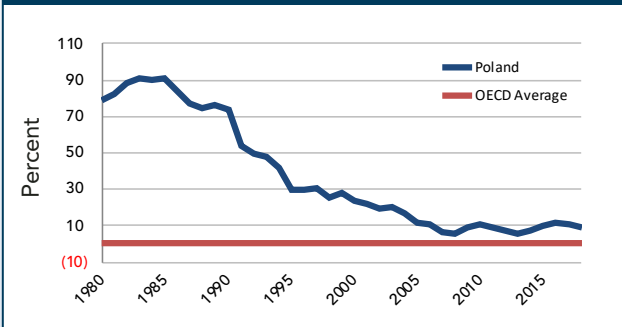




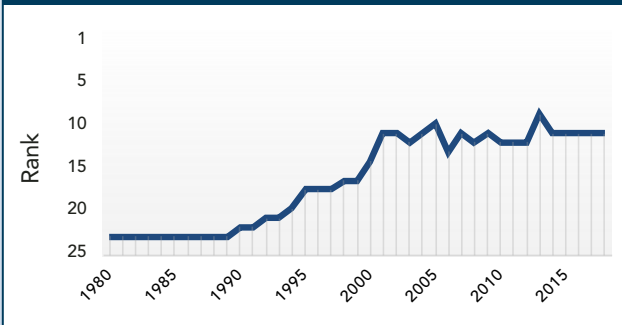
### Poland vs. OECD: Risk Index Scores



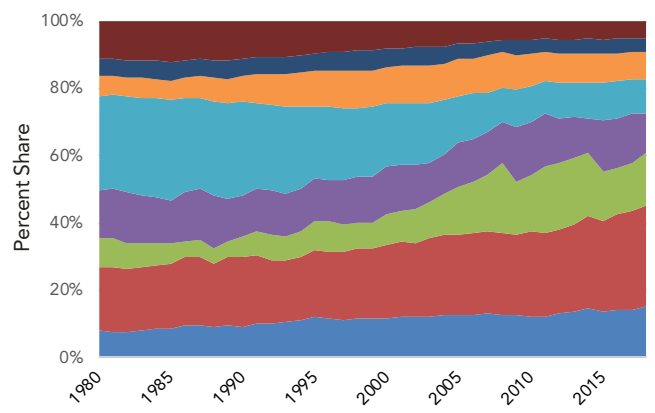
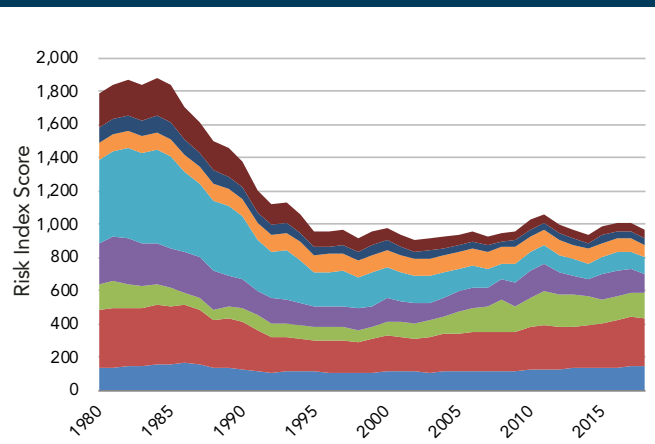
### Poland: Risk Variance from OECD



### Poland: Risk Ranking



### Poland: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Poland vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	101	95	87	24	27	11	19	20	24	25	25
Energy Expenditure Metrics	-22	-23	-37	-25	-16	-5	2	-1	0	-2	-3
Price & Market Volatility Metrics	68	89	88	71	50	33	14	22	20	19	24
Energy Use Intensity Metrics	256	271	227	80	54	26	9	10	13	7	2
Electric Power Sector Metrics	49	63	69	70	67	62	58	43	45	45	45
Transportation Sector Metrics	27	33	12	-24	-16	-33	-25	-27	-26	-29	-32
Environmental Metrics	239	268	183	66	33	7	4	3	6	2	-1
<b>Total Weighted Index</b>	<b>79</b>	<b>91</b>	<b>74</b>	<b>29</b>	<b>24</b>	<b>11</b>	<b>10</b>	<b>10</b>	<b>12</b>	<b>10</b>	<b>9</b>



# RUSSIAN FEDERATION



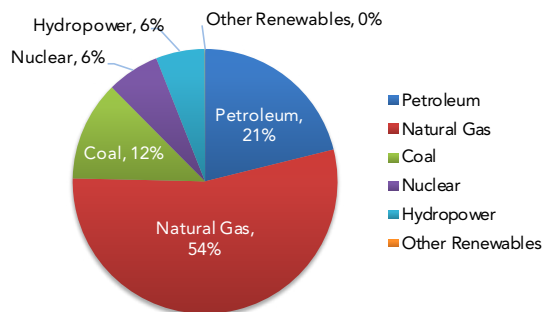
## Russian Federation: Energy at a Glance

Production:	World Rank
Petroleum	3
Natural Gas	2
Coal	5
Consumption:	World Rank
Petroleum	4
Natural Gas	2
Coal	4
Total Energy	3
Power Generation:	World Rank
Conventional Fossil	5
Nuclear	4
Hydropower	5
Other Renewables	36
Total Generation	4
Net Importer/Exporter of:	Status in 2018
Petroleum	Exporter
Natural Gas	Exporter
Coal	Exporter

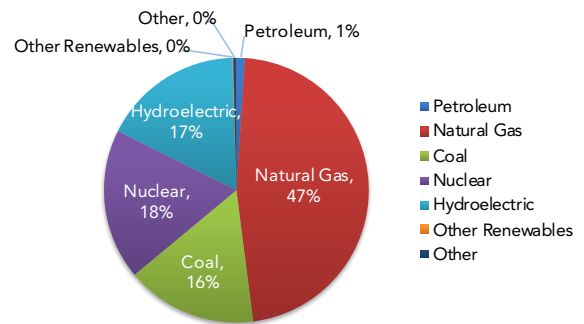
## Russian Federation: Energy Security Risk Summary

Risk Scores:	
2018 Energy Security Risk Score	875
2018 Large Energy User Group Rank	7
Score in Previous Year	914
Rank in Previous Year	7
Score in 1992	1,245
Average Score: 1992-2018	1,092
Best Energy Security Risk Score	772 (2013)
Worst Energy Security Risk Score	1,882 (1999)
Risk Scores Relative to OECD Average:	
Average Annual Difference 1992-2018	35%
Best Relative Score	-100% (23826)
Worst Relative Score	152% (1999)
Country-Specific Metric Ranking—2018:	
Number in Top Five	6
Number in Bottom Five	5

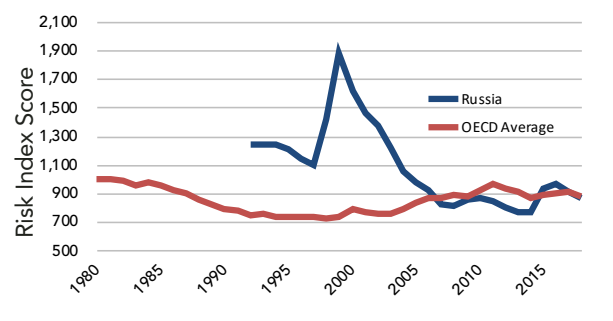
## Russian Federation: Energy Mix



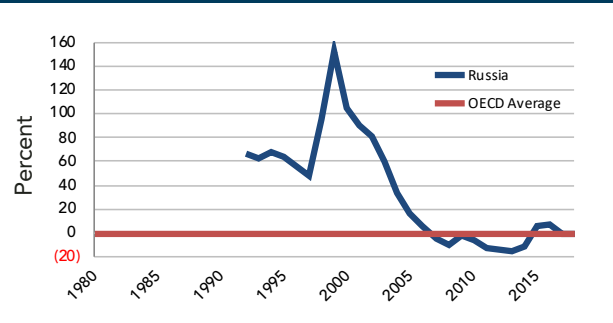
## Russian Federation: Power Generation Mix



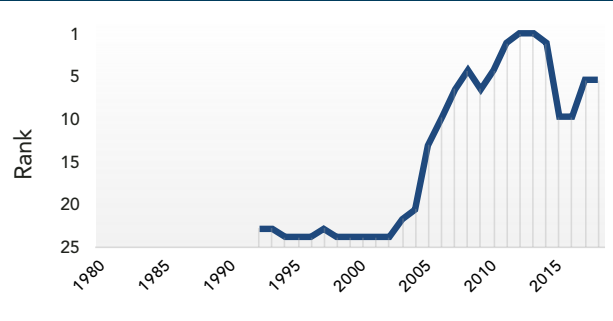
### Russian Federation vs. OECD: Risk Index Scores



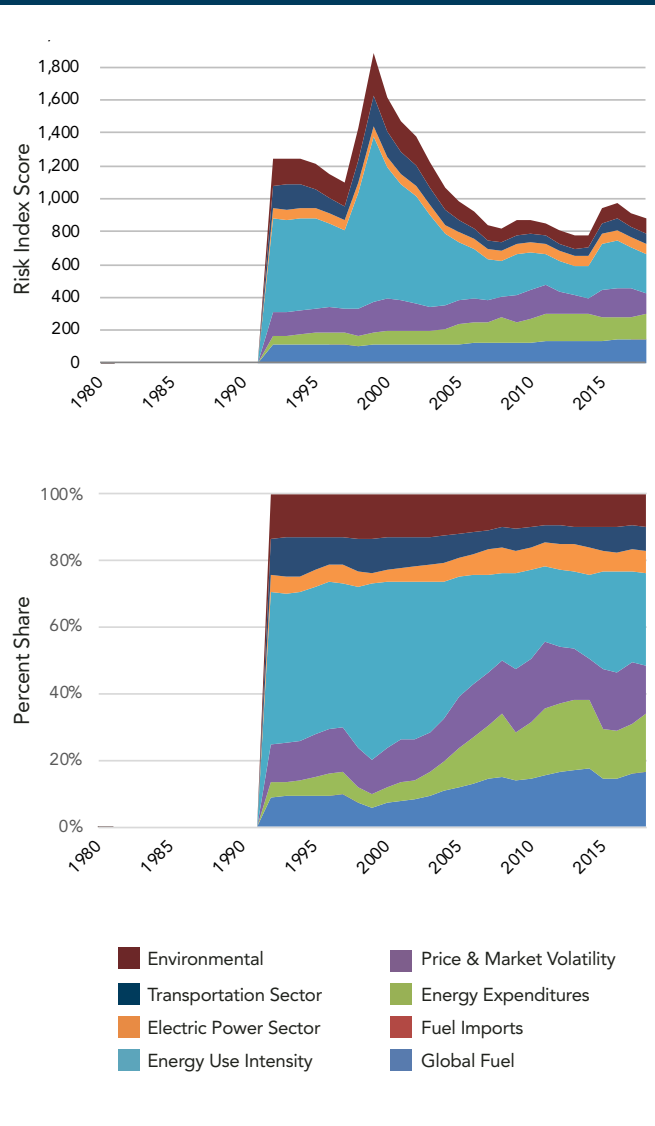
### Russian Federation: Risk Variance from OECD



### Russian Federation: Risk Ranking



### Russian Federation: Risk Scores by Metric Group and Share of Total Risk by Metric Group



### Russian Federation vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	N/A	N/A	N/A	0	0	0	0	0	0	0	0
Fuel Import Metrics	N/A	N/A	N/A	-100	-100	-100	-100	-100	-100	-100	-100
Energy Expenditure Metrics	N/A	N/A	N/A	-37	-24	-16	-14	-4	0	-5	-3
Price & Market Volatility Metrics	N/A	N/A	N/A	113	107	62	18	36	37	37	36
Energy Use Intensity Metrics	N/A	N/A	N/A	383	568	243	130	179	197	156	155
Electric Power Sector Metrics	N/A	N/A	N/A	1	-3	-4	1	4	3	4	5
Transportation Sector Metrics	N/A	N/A	N/A	91	128	12	-11	14	23	10	12
Environmental Metrics	N/A	N/A	N/A	183	262	96	57	83	91	74	73
<b>Total Weighted Index</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>64</b>	<b>105</b>	<b>17</b>	<b>-6</b>	<b>5</b>	<b>8</b>	<b>0</b>	<b>-1</b>

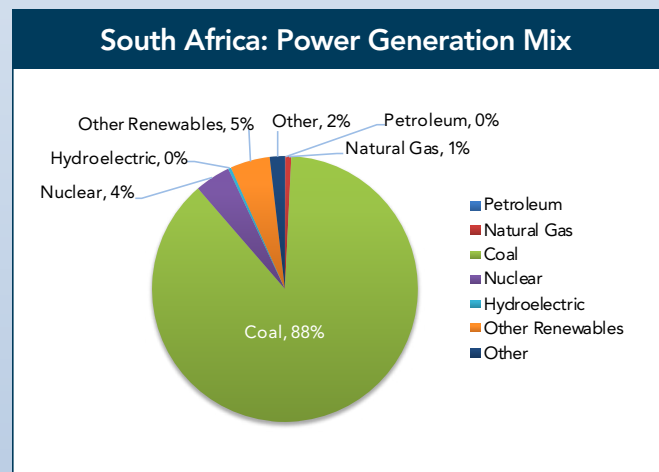
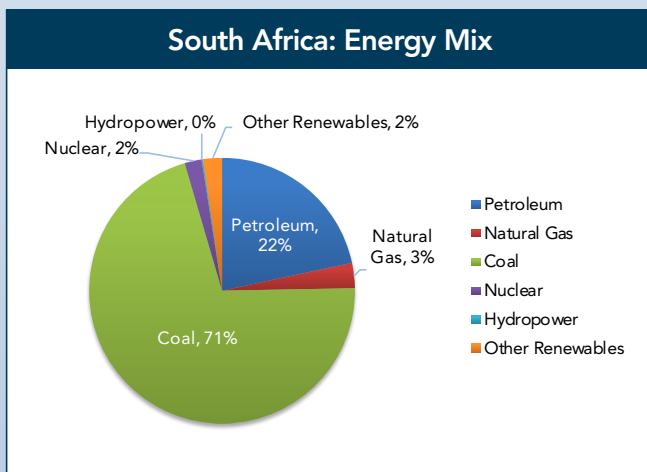


# SOUTH AFRICA

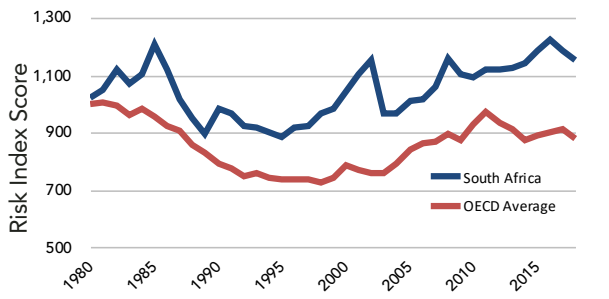


South Africa: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	32
Natural Gas	8
Coal	4
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	29
Natural Gas	51
Coal	6
Total Energy	22
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	12
Nuclear	25
Hydropower	102
Other Renewables	30
Total Generation	16
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Exporter

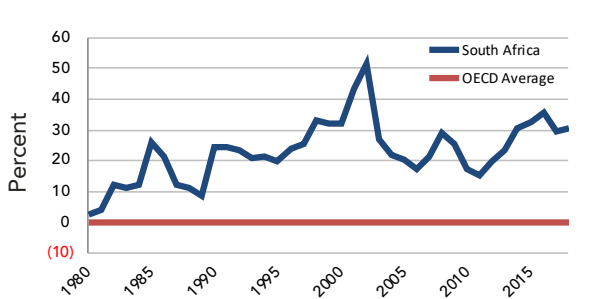
South Africa: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	1,156
2018 Large Energy User Group Rank	18
Score in Previous Year	1,185
Rank in Previous Year	18
Score in 1980	1,026
Average Score: 1980-2018	1,050
Best Energy Security Risk Score	888 (1995)
Worst Energy Security Risk Score	1,226 (2016)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	23%
Best Relative Score	3% (1980)
Worst Relative Score	51% (2002)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	4
Number in Bottom Five	8



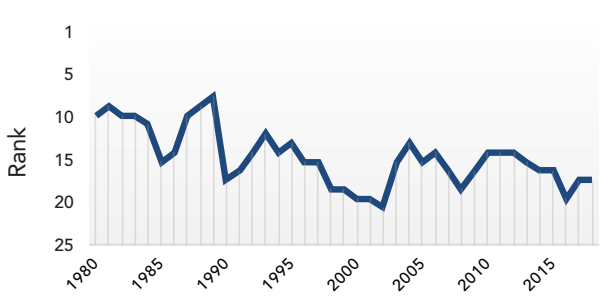
### South Africa vs. OECD: Risk Index Scores



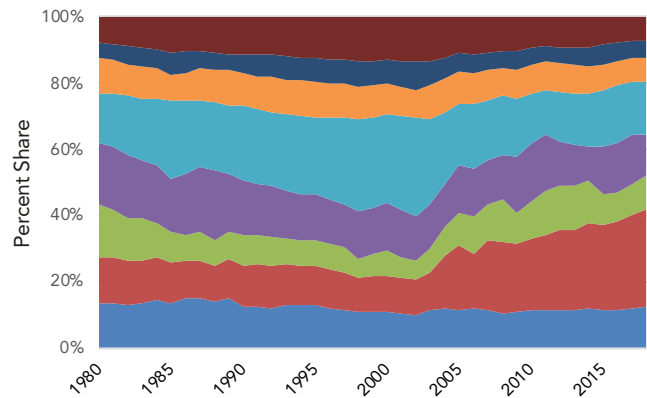
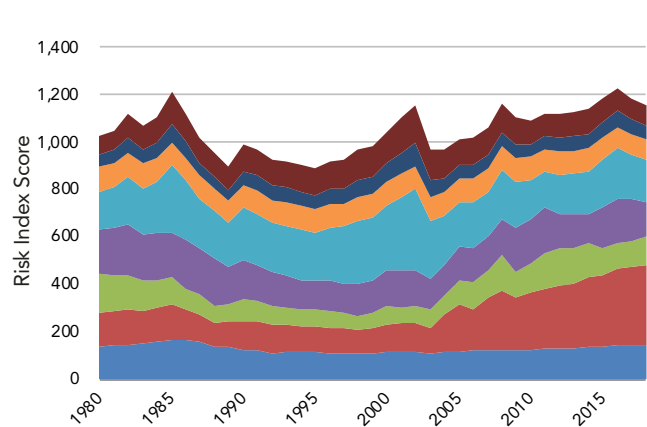
### South Africa: Risk Variance from OECD



### South Africa: Risk Ranking



### South Africa: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### South Africa vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-17	-14	-21	-31	-32	-5	10	38	42	40	44
Energy Expenditure Metrics	-17	-25	-27	-34	-28	-27	-29	-24	-22	-25	-23
Price & Market Volatility Metrics	24	57	77	71	64	54	34	39	42	42	56
Energy Use Intensity Metrics	11	89	90	83	130	85	62	102	118	93	92
Electric Power Sector Metrics	54	51	55	57	55	55	62	59	54	53	52
Transportation Sector Metrics	-27	7	-12	0	17	-9	-11	16	22	7	4
Environmental Metrics	31	117	105	99	128	86	89	96	84	72	70
<b>Total Weighted Index</b>	<b>3</b>	<b>26</b>	<b>24</b>	<b>20</b>	<b>32</b>	<b>20</b>	<b>17</b>	<b>32</b>	<b>36</b>	<b>30</b>	<b>31</b>

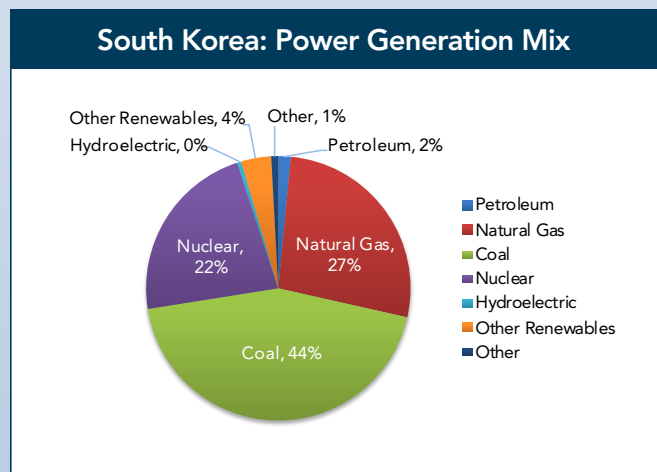
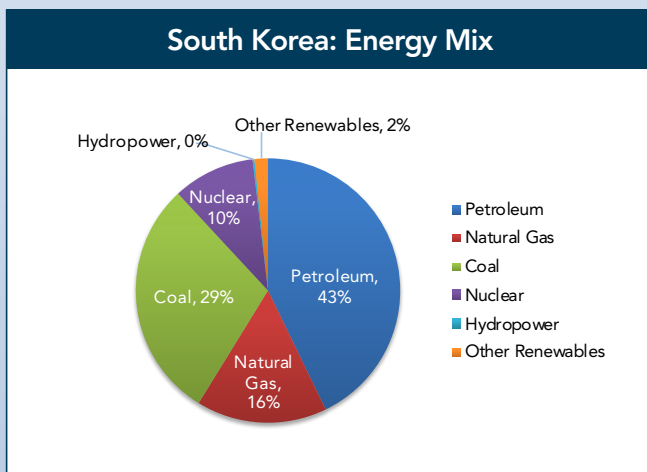


# SOUTH KOREA

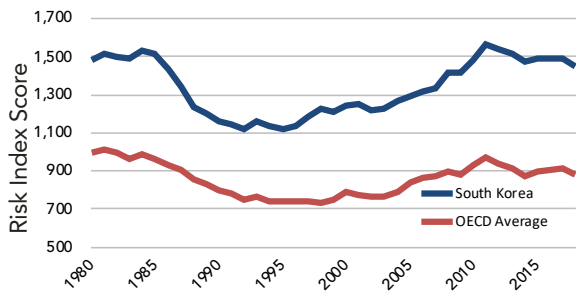


South Korea: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	NA
Natural Gas	71
Coal	44
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	10
Natural Gas	17
Coal	7
Total Energy	11
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	7
Nuclear	5
Hydropower	76
Other Renewables	85
Total Generation	10
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

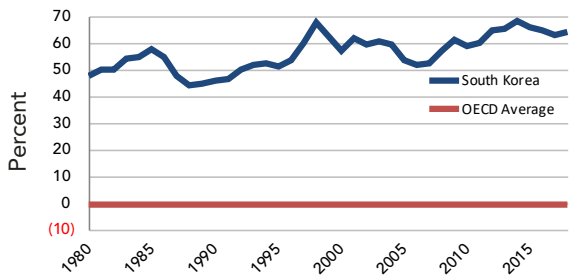
South Korea: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	1,453
2018 Large Energy User Group Rank	24
Score in Previous Year	1,492
Rank in Previous Year	24
Score in 1980	1,481
Average Score: 1980-2018	1,341
Best Energy Security Risk Score	1,120 (1995)
Worst Energy Security Risk Score	1,561 (2011)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	56%
Best Relative Score	44% (1988)
Worst Relative Score	68% (2014)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	0
Number in Bottom Five	9



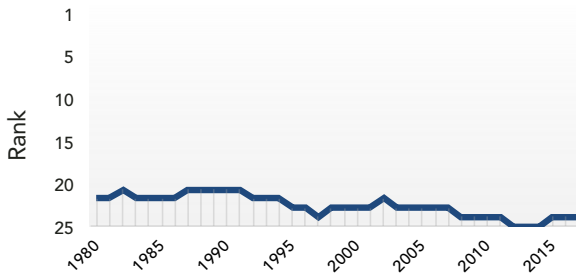
### South Korea vs. OECD: Risk Index Scores



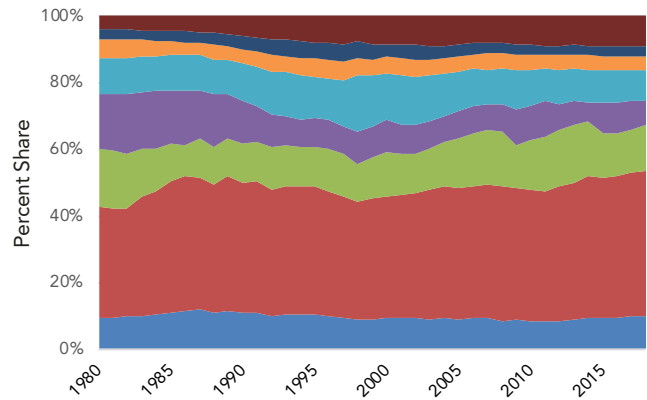
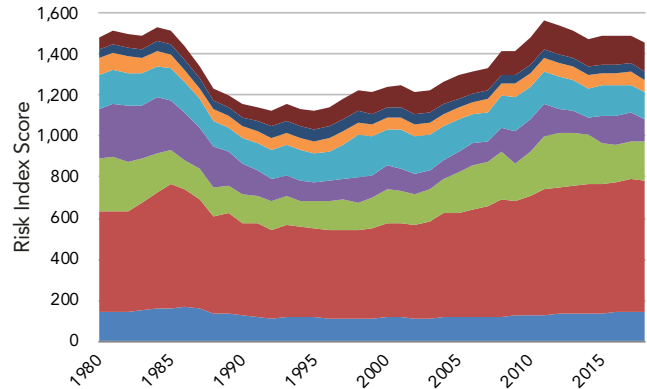
### South Korea: Risk Variance from OECD



### South Korea: Risk Ranking



### South Korea: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### South Korea vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	192	239	192	182	171	150	168	185	173	172	173
Energy Expenditure Metrics	28	16	7	23	56	38	26	36	36	31	27
Price & Market Volatility Metrics	62	97	66	30	25	15	11	12	10	9	13
Energy Use Intensity Metrics	15	7	10	25	45	46	59	45	45	41	41
Electric Power Sector Metrics	23	-2	-18	-2	-2	-3	8	9	11	12	13
Transportation Sector Metrics	-44	-37	-25	-7	-23	-31	-28	-27	-27	-28	-27
Environmental Metrics	1	13	22	58	75	90	137	164	172	171	172
<b>Total Weighted Index</b>	<b>48</b>	<b>58</b>	<b>46</b>	<b>52</b>	<b>57</b>	<b>54</b>	<b>59</b>	<b>66</b>	<b>65</b>	<b>63</b>	<b>64</b>

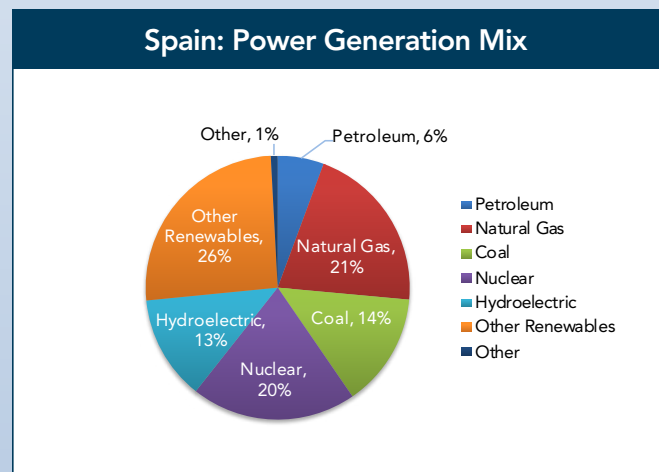
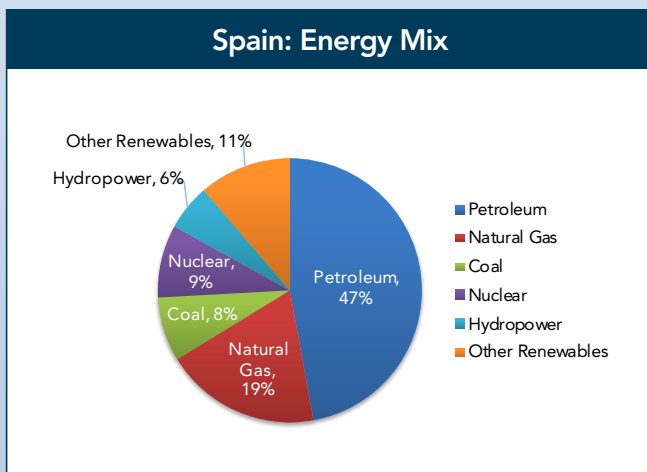


# SPAIN



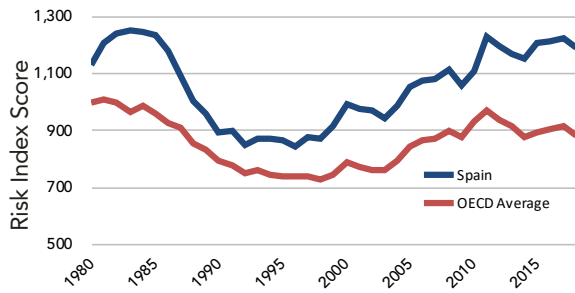
Spain: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	82
Natural Gas	87
Coal	37
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	19
Natural Gas	26
Coal	27
Total Energy	17
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	27
Nuclear	11
Hydropower	27
Other Renewables	9
Total Generation	18
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

Spain: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	1,189
2018 Large Energy User Group Rank	19
Score in Previous Year	1,225
Rank in Previous Year	19
Score in 1980	1,132
Average Score: 1980-2018	1,058
Best Energy Security Risk Score	842 (1996)
Worst Energy Security Risk Score	1,252 (1983)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	23%
Best Relative Score	13% (1990)
Worst Relative Score	35% (2015)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	1
Number in Bottom Five	4

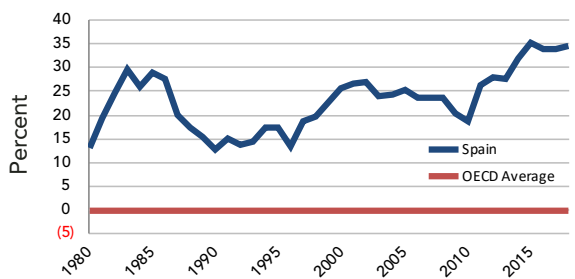




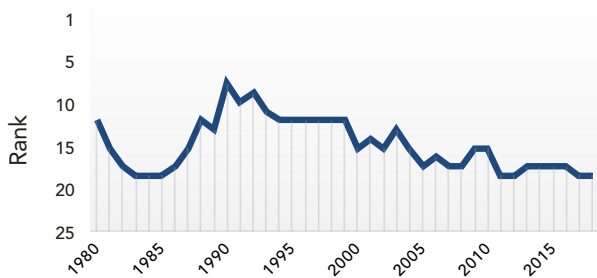
### Spain vs. OECD: Risk Index Scores



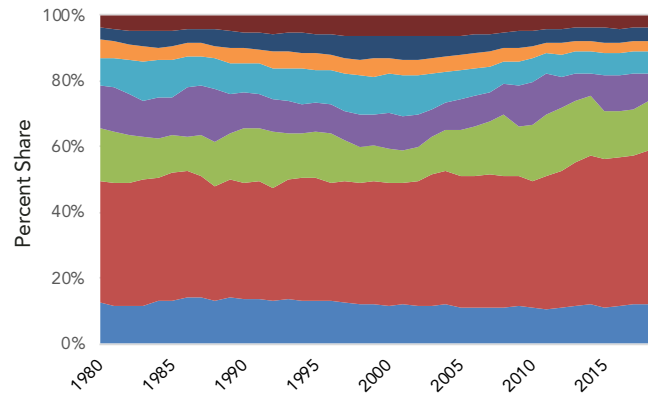
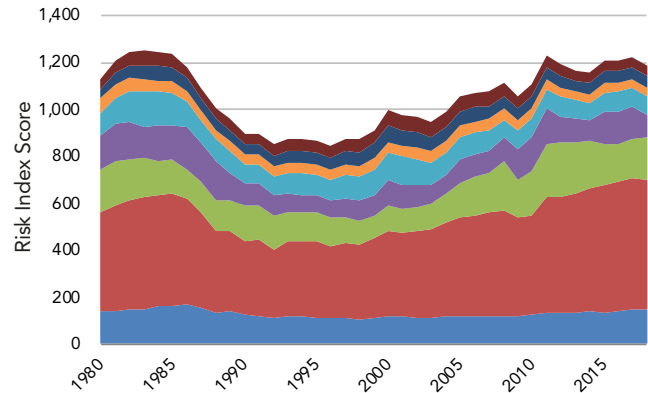
### Spain: Risk Variance from OECD



### Spain: Risk Ranking



### Spain: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Spain vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells  $\geq 10\%$  Above OECD; Green Cells  $\leq 10\%$  Below OECD; White Cells  $< 10\%$  to  $< -10\%$  of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	149	171	102	110	119	105	93	147	137	136	138
Energy Expenditure Metrics	-11	-3	18	14	1	8	11	18	19	19	17
Price & Market Volatility Metrics	0	16	6	2	14	6	3	7	6	6	7
Energy Use Intensity Metrics	-33	-4	-32	-22	-1	-10	-21	-15	-16	-17	-18
Electric Power Sector Metrics	-12	-29	-33	-27	-26	-18	-35	-33	-35	-34	-33
Transportation Sector Metrics	-41	-16	-29	-18	4	-4	-9	-12	-12	-14	-16
Environmental Metrics	-26	-6	-19	-12	5	10	-6	-10	-5	-5	-6
<b>Total Weighted Index</b>	<b>48</b>	<b>58</b>	<b>46</b>	<b>52</b>	<b>57</b>	<b>54</b>	<b>59</b>	<b>66</b>	<b>65</b>	<b>63</b>	<b>64</b>

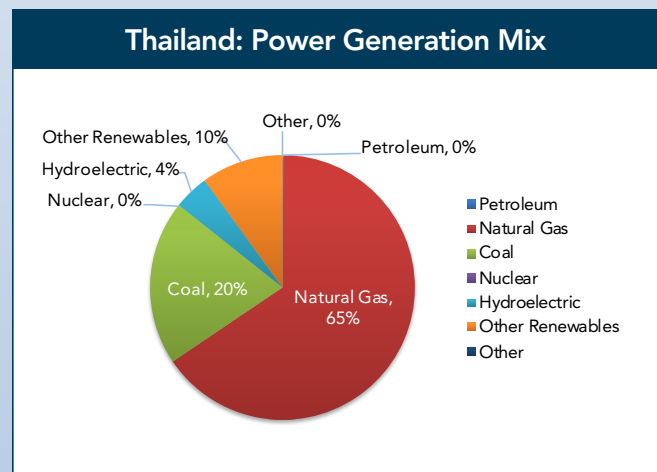
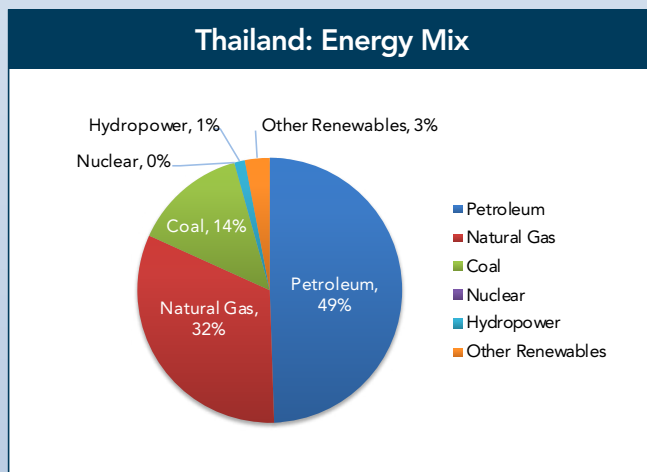


# THAILAND

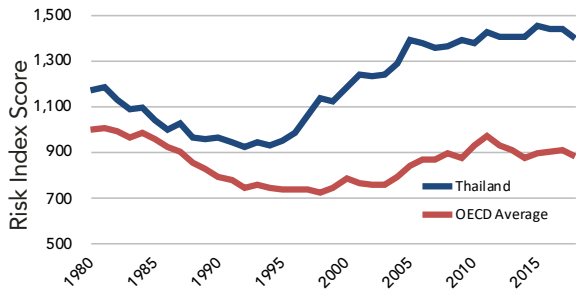


Thailand: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	30
Natural Gas	21
Coal	24
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	17
Natural Gas	16
Coal	20
Total Energy	23
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	19
Nuclear	NA
Hydropower	26
Other Renewables	12
Total Generation	23
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

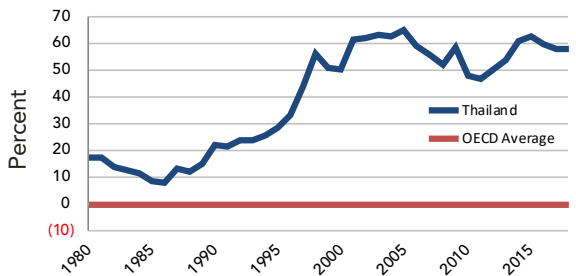
Thailand: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	1,396
2018 Large Energy User Group Rank	23
Score in Previous Year	1,441
Rank in Previous Year	23
Score in 1980	1,171
Average Score: 1980-2018	1,192
Best Energy Security Risk Score	925 (1992)
Worst Energy Security Risk Score	1,456 (2015)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	40%
Best Relative Score	8% (1986)
Worst Relative Score	65% (2005)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	0
Number in Bottom Five	8



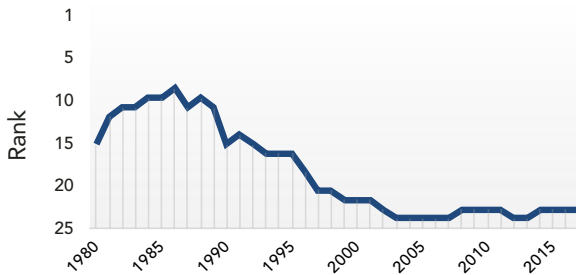
### Thailand vs. OECD: Risk Index Scores



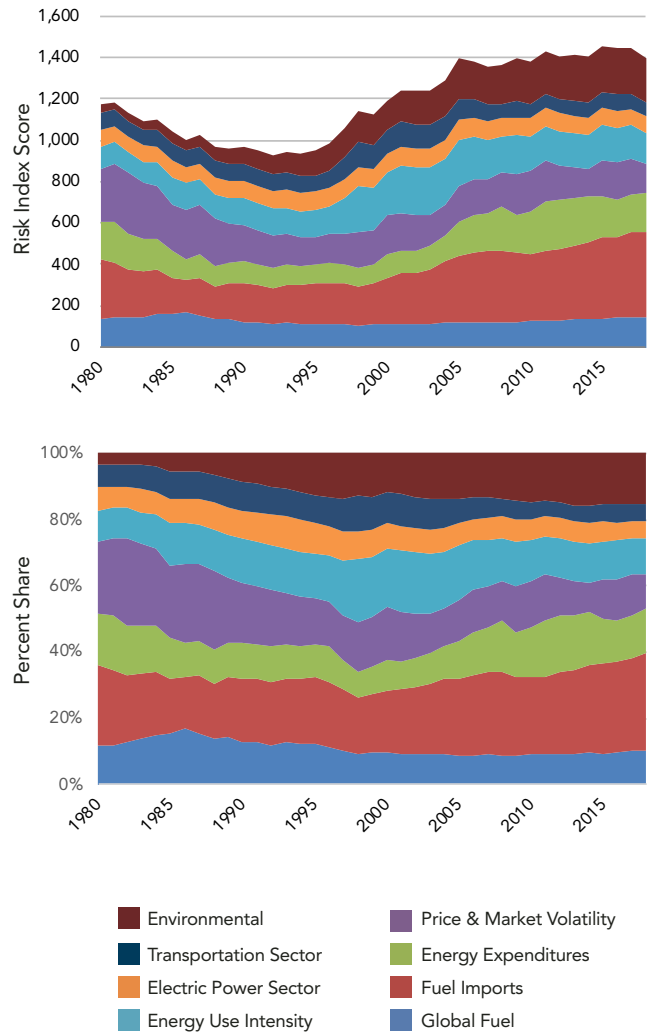
### Thailand: Risk Variance from OECD



### Thailand: Risk Ranking



### Thailand: Risk Scores by Metric Group and Share of Total Risk by Metric Group



### Thailand vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	66	-5	18	25	30	58	49	81	70	72	75
Energy Expenditure Metrics	-11	-11	-16	-13	5	14	18	30	31	26	23
Price & Market Volatility Metrics	73	82	92	85	102	89	38	40	37	40	57
Energy Use Intensity Metrics	-26	-10	11	13	73	120	63	74	73	63	55
Electric Power Sector Metrics	20	22	34	46	46	45	51	49	42	39	36
Transportation Sector Metrics	19	18	35	30	70	67	16	29	29	24	19
Environmental Metrics	-36	-10	48	116	136	222	275	336	341	338	336
<b>Total Weighted Index</b>	<b>17</b>	<b>9</b>	<b>22</b>	<b>29</b>	<b>50</b>	<b>65</b>	<b>48</b>	<b>63</b>	<b>60</b>	<b>58</b>	<b>58</b>



# TURKEY



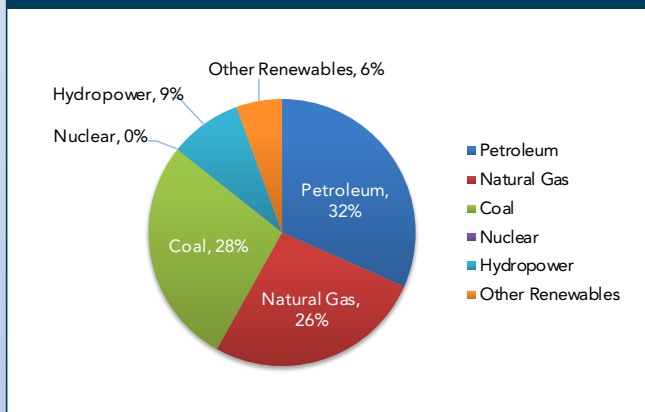
## Turkey: Energy at a Glance

Production:	World Rank
Petroleum	49
Natural Gas	76
Coal	17
Consumption:	World Rank
Petroleum	30
Natural Gas	15
Coal	14
Total Energy	21
Power Generation:	World Rank
Conventional Fossil	16
Nuclear	NA
Hydropower	8
Other Renewables	14
Total Generation	20
Net Importer/Exporter of:	Status in 2018
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

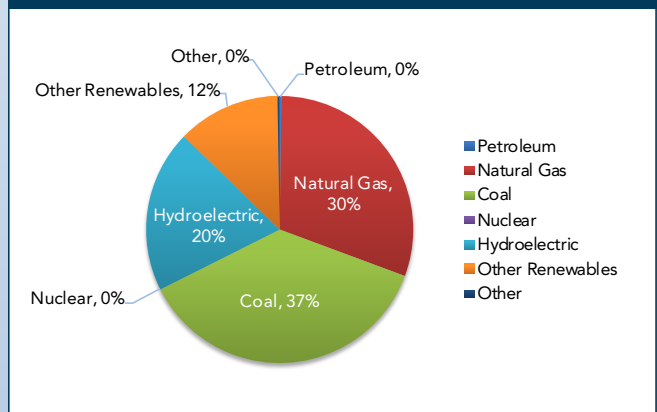
## Turkey: Energy Security Risk Summary

Risk Scores:	
2018 Energy Security Risk Score	1,267
2018 Large Energy User Group Rank	21
Score in Previous Year	1,262
Rank in Previous Year	21
Score in 1980	953
Average Score: 1980-2018	1,075
Best Energy Security Risk Score	896 (1998)
Worst Energy Security Risk Score	1,267 (2018)
Risk Scores Relative to OECD Average:	
Average Annual Difference 1980-2018	26%
Best Relative Score	-7% (1981)
Worst Relative Score	43% (2018)
Country-Specific Metric Ranking—2018:	
Number in Top Five	2
Number in Bottom Five	3

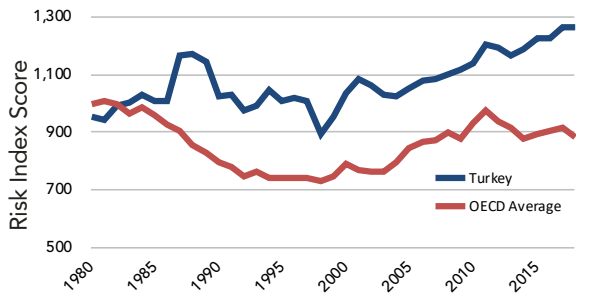
## Turkey: Energy Mix



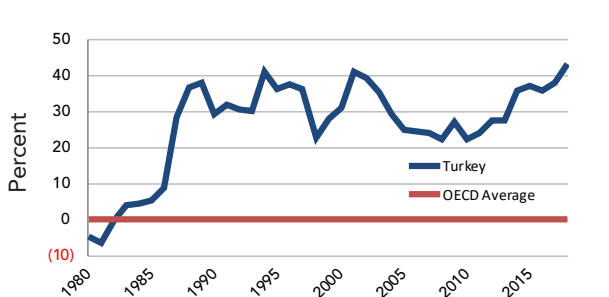
## Turkey: Power Generation Mix



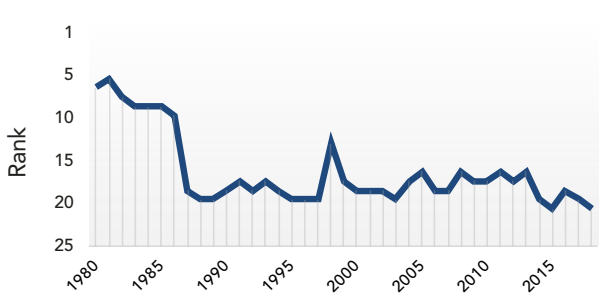
### Turkey vs. OECD: Risk Index Scores



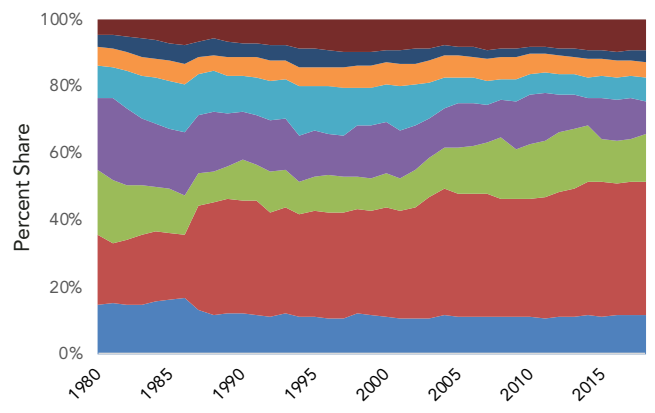
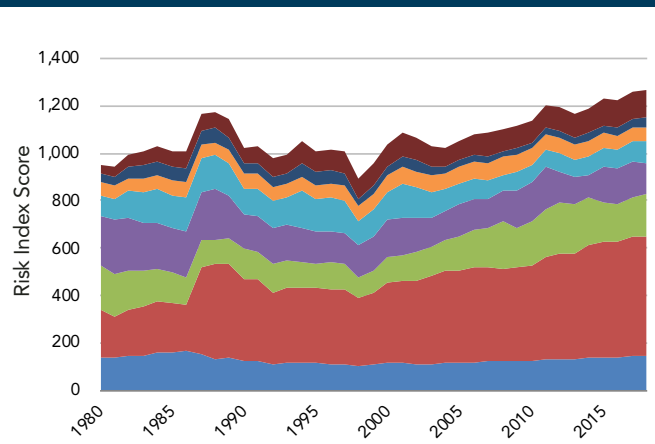
### Turkey: Risk Variance from OECD



### Turkey: Risk Ranking



### Turkey: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Turkey vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	18	15	124	107	101	88	86	124	111	114	118
Energy Expenditure Metrics	-8	-11	-2	-5	2	6	7	10	10	12	15
Price & Market Volatility Metrics	38	50	60	89	71	49	18	21	21	23	36
Energy Use Intensity Metrics	-35	-6	-8	21	-5	-20	-28	-19	-18	-15	-4
Electric Power Sector Metrics	-19	-2	-5	-6	9	10	11	5	2	3	3
Transportation Sector Metrics	-52	-26	-30	-9	-42	-56	-56	-42	-39	-33	-21
Environmental Metrics	-32	15	27	54	59	41	67	116	126	128	134
<b>Total Weighted Index</b>	<b>-5</b>	<b>5</b>	<b>29</b>	<b>36</b>	<b>31</b>	<b>25</b>	<b>22</b>	<b>37</b>	<b>36</b>	<b>38</b>	<b>43</b>



# UKRAINE



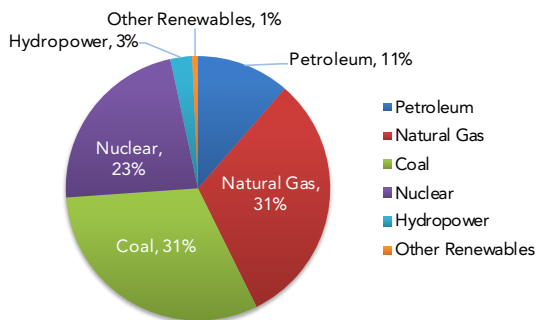
## Ukraine: Energy at a Glance

Production:	World Rank
Petroleum	32
Natural Gas	8
Coal	4
Consumption:	World Rank
Petroleum	46
Natural Gas	27
Coal	15
Total Energy	26
Power Generation:	World Rank
Conventional Fossil	33
Nuclear	7
Hydropower	71
Other Renewables	54
Total Generation	22
Net Importer/Exporter of:	Status in 2018
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

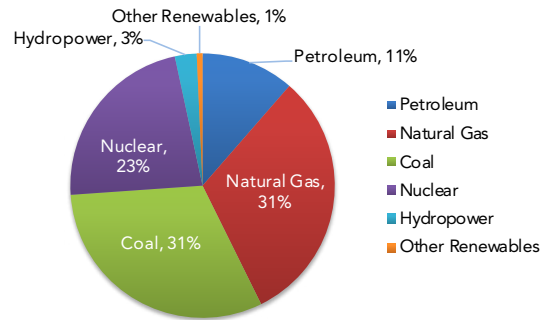
## Ukraine: Energy Security Risk Summary

Risk Scores:	
2018 Energy Security Risk Score	1,463
2018 Large Energy User Group Rank	25
Score in Previous Year	1,594
Rank in Previous Year	25
Score in 1992	2,515
Average Score: 1992-2018	2,171
Best Energy Security Risk Score	1,280 (2013)
Worst Energy Security Risk Score	3,393 (2000)
Risk Scores Relative to OECD Average:	
Average Annual Difference 1992-2018	170%
Best Relative Score	-100% (23826)
Worst Relative Score	340% (1999)
Country-Specific Metric Ranking—2018:	
Number in Top Five	2
Number in Bottom Five	8

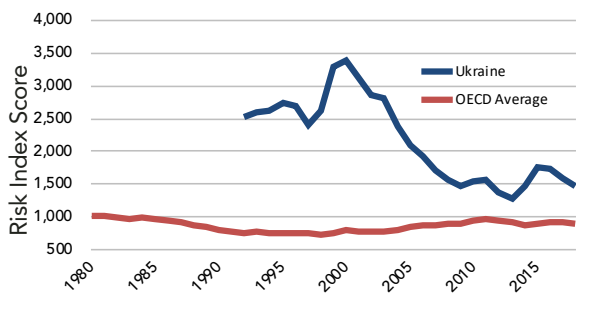
## Ukraine: Energy Mix



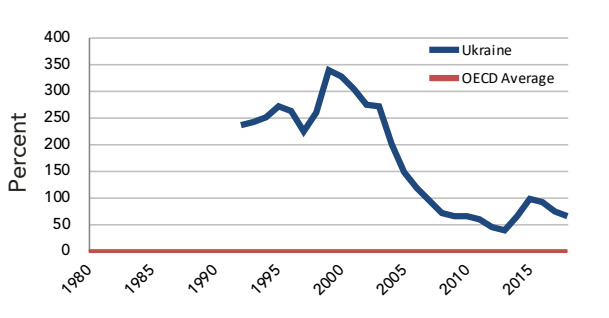
## Ukraine: Power Generation Mix



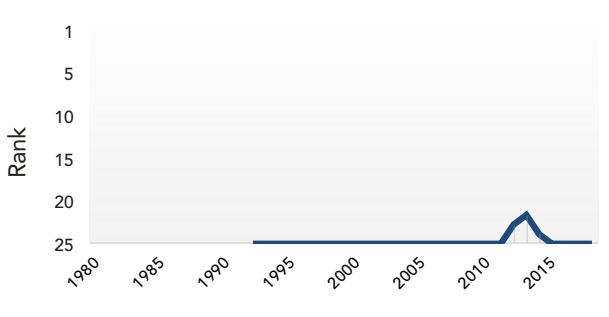
### Ukraine vs. OECD: Risk Index Scores



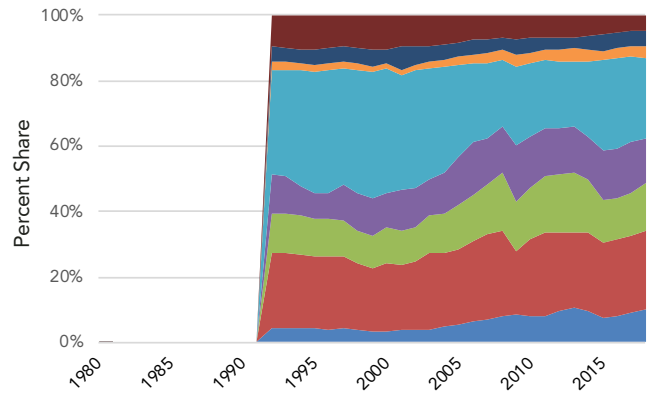
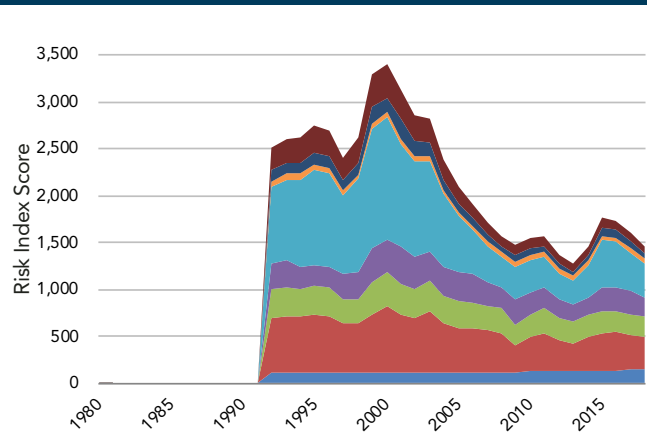
### Ukraine: Risk Variance from OECD



### Ukraine: Risk Ranking



### Ukraine: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### Ukraine vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	N/A	N/A	N/A	0	0	0	0	0	0	0	0
Fuel Import Metrics	N/A	N/A	N/A	297	314	133	67	82	74	57	52
Energy Expenditure Metrics	N/A	N/A	N/A	188	248	101	40	59	62	46	38
Price & Market Volatility Metrics	N/A	N/A	N/A	195	280	232	69	111	103	100	115
Energy Use Intensity Metrics	N/A	N/A	N/A	806	982	476	246	396	390	322	278
Electric Power Sector Metrics	N/A	N/A	N/A	-6	-13	-18	-15	-16	-13	-13	-12
Transportation Sector Metrics	N/A	N/A	N/A	118	118	40	11	47	46	28	16
Environmental Metrics	N/A	N/A	N/A	423	496	199	103	107	77	59	48
<b>Total Weighted Index</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>272</b>	<b>329</b>	<b>148</b>	<b>66</b>	<b>97</b>	<b>92</b>	<b>74</b>	<b>65</b>



# UNITED KINGDOM



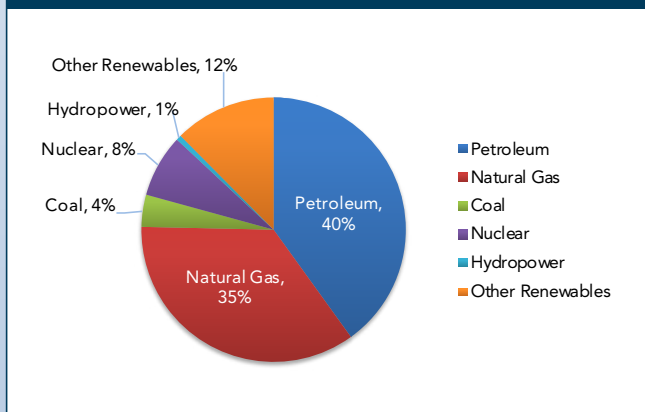
## United Kingdom: Energy at a Glance

Production:	World Rank
Petroleum	19
Natural Gas	18
Coal	28
Consumption:	World Rank
Petroleum	16
Natural Gas	9
Coal	17
Total Energy	14
Power Generation:	World Rank
Conventional Fossil	18
Nuclear	9
Hydropower	56
Other Renewables	7
Total Generation	12
Net Importer/Exporter of:	Status in 2018
Petroleum	Importer
Natural Gas	Importer
Coal	Importer

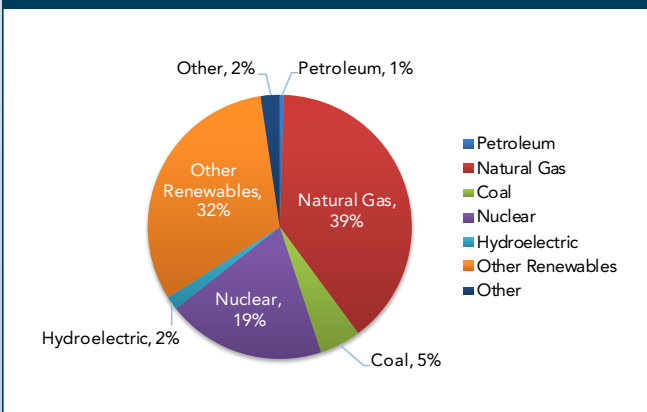
## United Kingdom: Energy Security Risk Summary

Risk Scores:	
2018 Energy Security Risk Score	944
2018 Large Energy User Group Rank	10
Score in Previous Year	979
Rank in Previous Year	10
Score in 1980	789
Average Score: 1980-2018	764
Best Energy Security Risk Score	568 (2002)
Worst Energy Security Risk Score	979 (2017)
Risk Scores Relative to OECD Average:	
Average Annual Difference 1980-2018	-12%
Best Relative Score	-26% (2002)
Worst Relative Score	7% (2017)
Country-Specific Metric Ranking—2018:	
Number in Top Five	7
Number in Bottom Five	0

## United Kingdom: Energy Mix

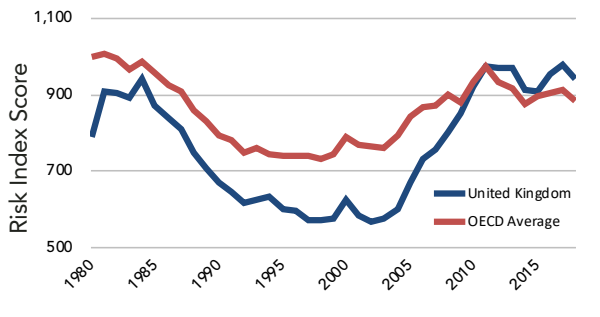


## United Kingdom: Power Generation Mix

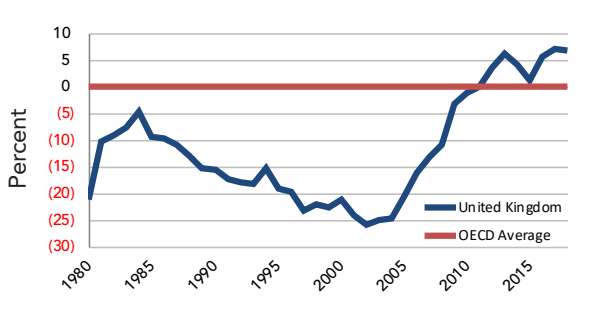




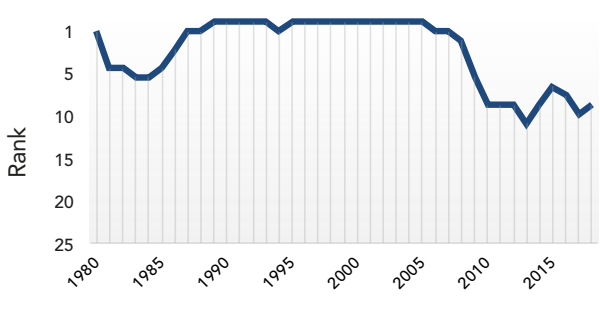
### United Kingdom vs. OECD: Risk Index Scores



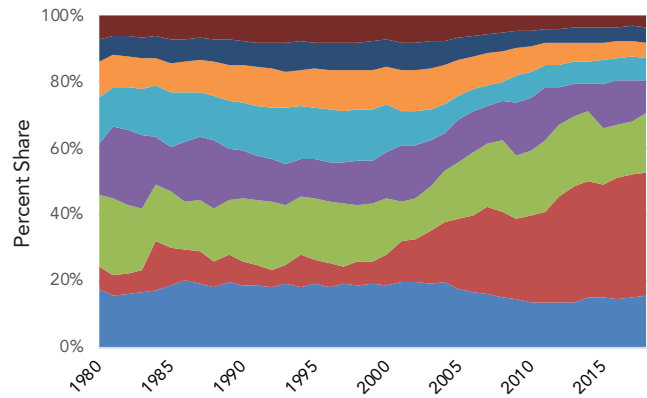
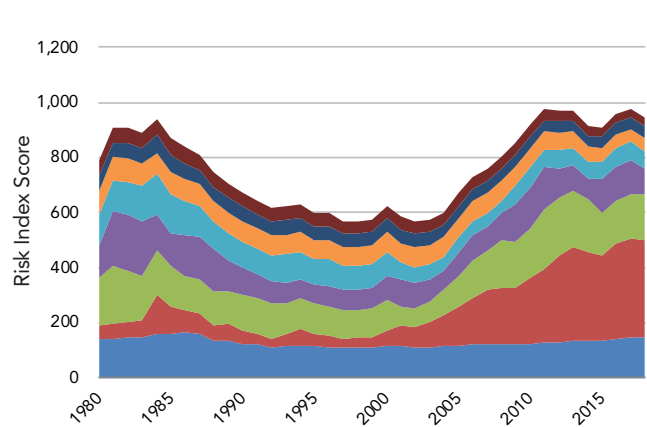
### United Kingdom: Risk Variance from OECD



### United Kingdom: Risk Ranking



### United Kingdom: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### United Kingdom vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

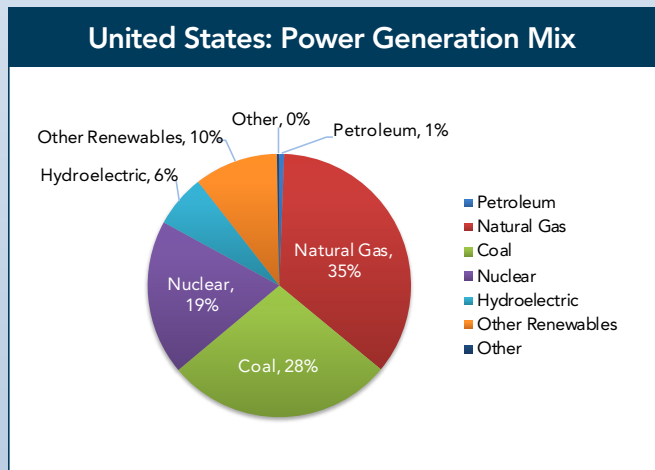
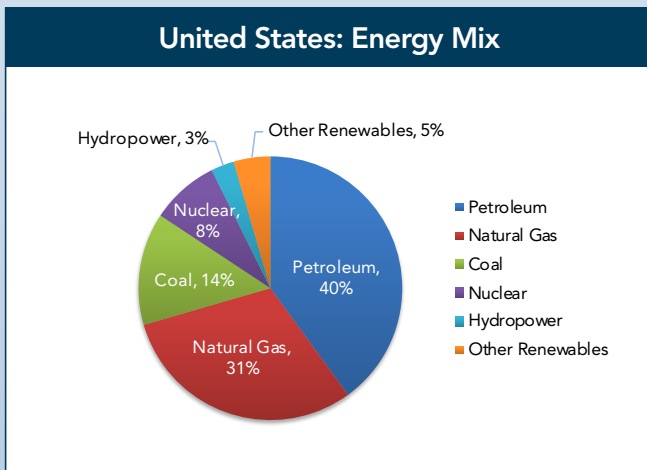
Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-70	-45	-69	-71	-65	-31	10	40	51	53	52
Energy Expenditure Metrics	-14	1	1	1	0	-18	5	5	8	8	8
Price & Market Volatility Metrics	-19	-3	8	-2	-6	-5	5	-1	0	-1	-1
Energy Use Intensity Metrics	-22	-5	-18	-16	-27	-51	-30	-37	-33	-31	-32
Electric Power Sector Metrics	26	21	21	12	16	13	19	-16	-17	-17	-16
Transportation Sector Metrics	-26	-17	-20	-21	-24	-29	-26	-30	-27	-25	-26
Environmental Metrics	-6	1	-9	-14	-22	-24	-24	-37	-37	-36	-37
<b>Total Weighted Index</b>	<b>-21</b>	<b>-9</b>	<b>-16</b>	<b>-19</b>	<b>-21</b>	<b>-20</b>	<b>-1</b>	<b>1</b>	<b>6</b>	<b>7</b>	<b>7</b>



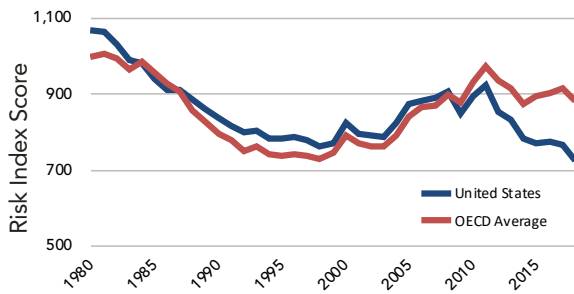
# UNITED STATES

United States: Energy at a Glance	
<b>Production:</b>	<b>World Rank</b>
Petroleum	1
Natural Gas	1
Coal	2
<b>Consumption:</b>	<b>World Rank</b>
Petroleum	1
Natural Gas	1
Coal	3
Total Energy	2
<b>Power Generation:</b>	<b>World Rank</b>
Conventional Fossil	2
Nuclear	1
Hydropower	4
Other Renewables	2
Total Generation	2
<b>Net Importer/Exporter of:</b>	<b>Status in 2018</b>
Petroleum	Importer
Natural Gas	Importer
Coal	Exporter

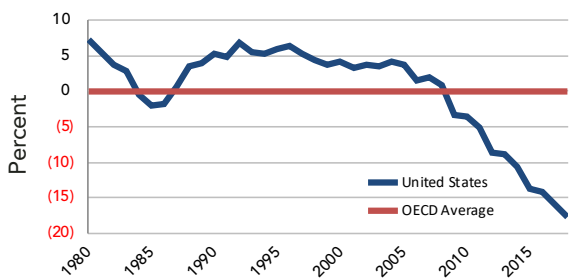
United States: Energy Security Risk Summary	
<b>Risk Scores:</b>	
2018 Energy Security Risk Score	727
2018 Large Energy User Group Rank	1
Score in Previous Year	769
Rank in Previous Year	1
Score in 1980	1,071
Average Score: 1980-2018	855
Best Energy Security Risk Score	727 (2018)
Worst Energy Security Risk Score	1,071 (1980)
<b>Risk Scores Relative to OECD Average:</b>	
Average Annual Difference 1980-2018	0%
Best Relative Score	-18% (2018)
Worst Relative Score	7% (1980)
<b>Country-Specific Metric Ranking—2018:</b>	
Number in Top Five	7
Number in Bottom Five	3



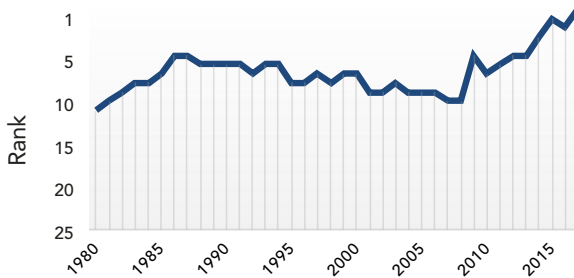
### United States vs. OECD: Risk Index Scores



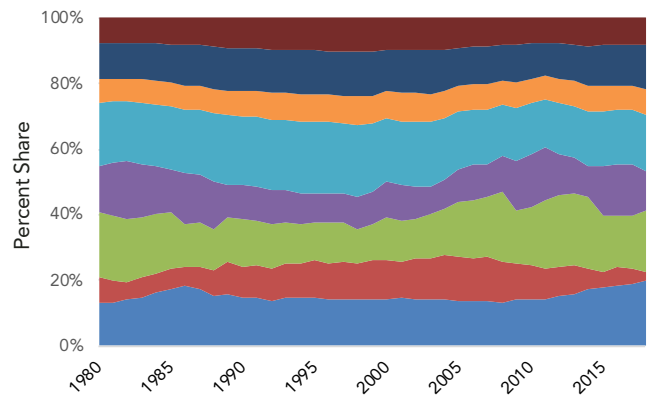
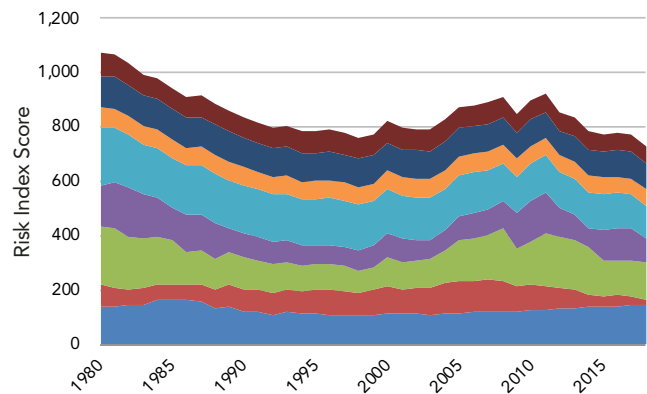
### United States: Risk Variance from OECD



### United States: Risk Ranking



### United States: Risk Scores by Metric Group and Share of Total Risk by Metric Group



- Environmental
- Transportation Sector
- Electric Power Sector
- Energy Use Intensity
- Price & Market Volatility
- Energy Expenditures
- Fuel Imports
- Global Fuel

### United States vs. OECD: Percent Difference (Weighted Within Group)

(Red Cells ≥10% Above OECD; Green Cells ≤10% Below OECD; White Cells <10% to <-10% of OECD)

Metric Group	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Global Fuels Metrics	0	0	0	0	0	0	0	0	0	0	0
Fuel Import Metrics	-51	-66	-50	-42	-40	-42	-56	-83	-80	-86	-92
Energy Expenditure Metrics	7	10	-3	-15	0	4	-7	-11	-12	-13	-12
Price & Market Volatility Metrics	1	-2	-6	-4	-4	-2	2	-4	-4	-4	-7
Energy Use Intensity Metrics	50	21	51	52	34	46	38	30	29	29	30
Electric Power Sector Metrics	4	7	4	5	7	9	9	6	4	5	5
Transportation Sector Metrics	68	48	71	70	57	64	65	60	62	65	67
Environmental Metrics	40	26	42	41	35	33	29	25	22	22	22
<b>Total Weighted Index</b>	<b>7</b>	<b>-2</b>	<b>5</b>	<b>6</b>	<b>4</b>	<b>4</b>	<b>-4</b>	<b>-14</b>	<b>-14</b>	<b>-16</b>	<b>-18</b>

## METHODOLOGY USED TO DEVELOP THE INDEX OF U.S. ENERGY SECURITY RISK

### INTRODUCTION

In an increasingly interconnected world, where the risks faced by other nations affect our risks as well, a well-designed index covering many countries can improve our understanding of global energy security risks. Many aspects of U.S. energy security are by their very nature global. Recent years have seen global energy markets facing unprecedented challenges as well as opportunities. In previous decades, when the U.S. comprised a bigger share of global energy production and consumption, our policies and actions had a bigger impact on global markets. Increasingly, however, geopolitical risks are imposed upon us rather than set by us.

Energy is a fundamental prerequisite of growth and development around the world, and despite the global financial crisis, energy demand has been steadily growing, especially in the large emerging economies of China, India, and Brazil. In large part, energy security is complicated because key energy resources are geopolitically concentrated. Most of the world's oil and gas reserves are found in a handful of countries, several of which are in political turmoil and/or not especially friendly to U.S. interests. Further, there is relatively little overlap between those countries that are the leading energy resource countries and those that are the major energy consuming countries. Reliance on international trade is large, growing, and vulnerable to disruptions. For these global commodities, events anywhere can affect supply and prices everywhere, even for self-sufficient countries. Energy security risks, therefore, pose challenges to all countries—some are common challenges while others are more country-specific.

An enhanced understanding of energy security in other countries can deepen our insight into that of the U.S. Through the development of these metrics, we can observe not only absolute trends of interest,

but to also see relative movement among and across countries. In a global marketplace, both matter. Communicating these energy security risks to an international audience helps the U.S. as well. Many of the benefits of improved technologies, greater energy efficiency, or democratic reforms anywhere can create energy security benefits everywhere.

### BASIC APPROACH TO THE INTERNATIONAL INDEX

The International Index of Energy Security Risk is designed to allow comparisons of energy security risks across countries and country groups, and how these risks change over time. The International Index measures energy security risks in two ways: (1) in absolute terms; and (2) relative to a baseline average of the OECD countries.

The methods used to develop it build off much of the work and concepts used in developing the Energy Institute's Index of U.S. Energy Security Risk® (U.S. Index). The task of boiling down U.S. energy security risks to a single number posed many analytical challenges. The U.S. Index was constructed from a foundation of 37 metrics measuring broad aspects of energy security. The U.S. Index uses historical and forecast data from EIA.

The idea of extending the methodology used in the U.S. Index to other countries proved to be a difficult task, especially when it came to data availability. Accordingly, in developing the International Index, the measures and methodology developed for the U.S. Index had to be adapted.

The United States has a comparative wealth of richly detailed and comprehensive data covering long time spans. The available international databases, however,

are something of a mixed bag, and even at their best, they are not as complete and consistent as those we have for the United States. The data typically do not have the historical coverage we have in the United States, and often there are gaps. Data on energy prices and expenditures show gaps in coverage, particularly for non-OECD countries.

Further, whereas the United States has a detailed forecasting system extending decades into the future and dovetails well with historical data, the international forecasts necessarily entail aggregations that prevent the goal of country-by-country analysis.

## DATA CRITERIA AND SOURCES

Data limitations make it necessary to strike a balance between the theoretically ideal and the realistically possible. Not every risk metric can be measured with solid data, but that does not mean that less-than-perfect data cannot be used provided its usefulness and limitations are well understood. Even data we commonly view as reliable—U.S. employment, inflation rates, GDP, etc.—are themselves developed from samples and extrapolations, and are best thought of as estimates rather than complete compilations. These issues are magnified when dealing with international data. The approach adopted to develop the International Index was, therefore, not to let the perfect be the enemy of the good.

One of the first tasks in developing the International Index was ensuring that the data being used were useful analytically and would be considered reliable by users of the Index. Before selecting the data, we established criteria to ensure the data used possessed several important characteristics. The criteria settled on are listed in table A1-1.

The primary data source for the International Index is the EIA's International Energy Statistics database, which is in turn compiled from hundreds of documents and data sources. Other key data come

TABLE A1-1

### Data Criteria used for International Index

<b>Sensible</b>	The data must relate to commonsense expectations.
<b>Credible</b>	The data must be well-recognized and authoritative.
<b>Accessible</b>	The data must be readily available to the public.
<b>Transparent</b>	Data derivations and manipulations must be clear.
<b>Complete</b>	The data must have a record extending back in history for a reasonable amount of time (in this case back to 1980)
<b>Updatable</b>	The historical data must be revised each year so that changes over time can be measured.

from organizations such as the World Bank, IEA, OECD, and others. EIA's database reflects its efforts to compile and curate many disparate sources of information.

Where feasible, data from EIA were preferred over other those from other sources. This allowed for greater consistency in data collection, definitions, country names and changes, etc. Where circumstances warranted, EIA's source documents or other sources of information were employed. In particular, energy price data from IEA, transportation and power generation data from the World Bank, and refinery utilization data from British Petroleum were used.

Another important data series not presented in the EIA database but nonetheless conceptually vital to the International Index is a country-by-country measure of freedom over time. Several metrics related to global reserves and production and imports take into consideration the "freedom" and the diversity of global fuel supplies. Freedom House, an independent nongovernmental organization, has developed

composite indices for political rights and civil liberties that when averaged comprise a measure freedom for over 190 countries. The presumption is that countries exhibiting the greatest degree of political rights and civil liberties are more likely to be politically stable and reliable trading partners and are less likely to join cartels or use oil supplies to achieve geopolitical aims. Hence, by weighting each country's reserves or production of oil, natural gas, and coal by its respective Freedom House weighting, we can develop an aggregate global Freedom-weighted metric that provides a proxy for reliability and that can be tracked over time.

## TIME DIMENSIONS AND GEOGRAPHIC COVERAGE OF METRICS

The data limitations discussed above compelled a starting date of 1980, more than sufficient for the purposes of the International Index. Further, because forecast data are not available at the desired level of detail, the series ends in the most recent year for which data are available.

EIA, IEA, the World Bank, and other sources provide comprehensive, country-by-country information on many measures of energy production, energy consumption, population, GDP, carbon dioxide emissions, and other energy-related measures. Accordingly, for a wide range of energy security risk metrics, time series were developed for all individual countries as well as groups of countries such as the OECD nations. The International Index incorporates the risk index scores for all of the countries globally.

However, differences in geographic coverage also shape the limits of what is possible. Particularly for some of the smaller and/or developing nations, the data are less complete, and it became necessary to develop neutral proxy assumptions and methods for filling in gaps in the historical record. Because of these data limitations, as well as recognition that fewer than 25 of the major economies account for well over half of total world energy consumption, the focus of this

published report is aimed at the countries listed below:

Australia	New Zealand
Brazil	Norway
Canada	Poland
China	Russia
Denmark	South Africa
France	South Korea
Germany	Spain
India	Thailand
Indonesia	Turkey
Italy	Ukraine
Japan	United Kingdom
Mexico	United States
Netherlands	

## METRICS OF ENERGY SECURITY RISK

The individual energy security measures selected were organized around eight broad categories that represent and balance some key and often competing aspects of energy security. These are found in table A1-2. Using these categories as guides, 29 individual metrics were developed covering a wide range of energy supplies, energy end uses, generating capacity, operations, and emissions.

In assessing security and risk, the ultimate goal is an improved understanding of the likelihood of an energy shock of some kind and how that might impact a countries economy. However, the data currently available typically describes only what actually happened, not what nearly happened or could have happened. So in this sense, some of the metrics are proxies for things that cannot be measured directly.

As an example, this Index uses measures of political and civil liberties to gauge a country's political stability, and indirectly its reliability as an energy supplier and trading partner. This does not mean that

**TABLE A1-2**

**Classification of Energy Security Metrics Used in the International Index**

<b>Metric Category</b>	<b>General Description of the Metrics</b>
<b>1. Global Fuels</b>	Measure the reliability and diversity of global reserves and supplies of oil, natural gas, and coal. Higher reliability and diversity mean a lower risk to energy security.
<b>2. Fuel Imports</b>	Measure the exposure of the national economies to unreliable and concentrated supplies of oil and natural gas, and coal. Higher supply reliability and diversity and lower import levels mean a lower risk to energy security.
<b>3. Energy Expenditures</b>	Measure the magnitude of energy costs to national economies and the exposure of consumers to price shocks. Lower costs and exposure mean a lower risk to energy security.
<b>4. Price &amp; Market Volatility</b>	Measure the susceptibility of national economies to large swings in energy prices. Lower volatility means a lower risk to energy security.
<b>5. Energy Use Intensity</b>	Measure energy use in relation to population and economic output. Lower use of energy by industry to produce goods and services means a lower risk to energy security.
<b>6. Electric Power Sector</b>	Measure indirectly the reliability of electricity generating capacity. Higher diversity means a lower risk to energy security.
<b>7. Transportation Sector</b>	Measure efficiency of energy use in the transport sector per unit of GDP and population. Greater efficiency means a lower risk to energy security.
<b>8. Environmental</b>	Measure the exposure of national economies to national and international greenhouse gas emission reduction mandates. Lower emissions of carbon dioxide from energy mean a lower risk to energy security.

countries that perform poorly in these metrics have been unreliable suppliers in the past or necessarily will be unreliable suppliers in the future. But it does mean the risks of a disruption are higher in countries that do not score well in this metric when compared to countries that do score well.

Recognizing that fuel imports and exports account for a higher share of supply in many countries than they do in the United States, new metrics were created. Coal is an example. The United States has long-term (over 250 years) and secure supplies of coal and risks to supply are largely regulatory in nature, so coal does not feature in the import metrics of the U.S. Index while oil and natural gas do. This is not the case in many other countries that rely on imported coal to meet domestic needs. Therefore, a metric measuring the net import exposure of coal was created in addition to the metrics for oil and natural gas.

These fuel-specific measures, however, do not do a good job of indicating how important that fuel is in the overall energy mix of the country. Consider two countries that meet most of their demand for a particular fuel, say natural gas, through imports. If in one of these countries gas is a relatively small part of the energy mix and in the other gas is a very large part of the energy mix, their level of risk is quite different. To help account for these broader dependencies as well as the fuel-specific concerns, a metric measuring total energy import exposure is used to reflect the diversity of the different fuel mix in the country. This metric helps even out the effects of outlying values for individual fuels and picks up nuclear and renewable energies.

Energy price and expenditure data are very important measures of certain aspects of energy security, but the availability and quality of these data varies greatly and overall there is much less coverage of prices by sector and fuel than there is in the United States. As a result, the focus of the International Index is on overall energy prices rather than sector-level or end-use prices.

The primary source of energy price and expenditure data for the International Index is the IEA. Given IEA's mission and origins, it is not surprising that the

amount and extent of price data for OECD countries is much greater than it is for non-OECD countries, but even the coverage in many OECD countries is less than ideal. To include energy price and expenditure metrics in the International Index, proxies had to be developed for energy prices for countries where IEA data were incomplete or unavailable. Using IEA price and consumption data for different fuels, we

developed rough approximations of energy prices and expenditures that, while imperfect, meet the needs of the International Index.

Given all of these considerations, 29 metrics were developed for use in the International Index. These are listed and described in figure A1-3.

**TABLE A1-3**

### Metrics Used to Create International Index of Energy Security Risk

METRIC BY CLASSIFICATION		DEFINITION	IMPORTANCE	WEIGHT (PERCENT)
<b>Global Fuel Metrics</b>				<b>14</b>
1.	<b>Security of World Oil Reserves</b>	Global proved oil reserves weighted by each country's relative Freedom Index and by an index of global diversity of oil reserves.	Indicates risk attached to the average barrel of global crude oil reserves. As a measure of reserves, it largely reflects longer-term concerns.	<b>2</b>
2.	<b>Security of World Oil Production</b>	Global oil production weighted by each country's relative Freedom Index and by an index of global diversity of oil production.	Indicates the level of risk attached to the average barrel of crude oil production globally.	<b>3</b>
3.	<b>Security of World Natural Gas Reserves</b>	Global proved natural gas reserves weighted by each country's relative Freedom Index and by an index of global diversity of gas reserves.	Indicates the risk attached to the average cubic foot of natural gas reserves globally. As a measure of reserves, it largely reflects longer-term concerns.	<b>2</b>
4.	<b>Security of World Natural Gas Production</b>	Global natural gas production weighted by each country's Freedom Index and by global diversity of gas production.	Indicates the level of risk attached to the average cubic foot of natural gas production globally.	<b>3</b>
5.	<b>Security of World Coal Reserves</b>	Global proved coal reserves weighted by each country's relative Freedom Index and by an index of global diversity of coal reserves.	Indicates the risk attached to the average ton of coal reserves globally. As a measure of reserves, it largely reflects longer-term concerns.	<b>2</b>
6.	<b>Security of World Coal Production</b>	Global coal production weighted by each country's relative Freedom Index and by an index of global diversity of coal production.	Indicates the level of risk attached to the average ton of coal production globally.	<b>2</b>



TABLE A1-3

(CONTINUED)

## Metrics Used to Create International Index of Energy Security Risk

METRIC BY CLASSIFICATION		DEFINITION	IMPORTANCE	WEIGHT (PERCENT)
<b>Fuel Import Metrics</b>				<b>17</b>
7.	<b>Petroleum Import Exposure</b>	Net petroleum imports as a percentage of total national petroleum supply, adjusted to reflect the reliability of international petroleum production (measured using the Freedom Index) and the diversity across producing countries.	Indicates the degree to which changes in import levels expose the country to potentially unreliable and/or concentrated supplies of crude and refined petroleum.	<b>3</b>
8.	<b>Natural Gas Import Exposure</b>	Net natural gas imports as a percentage of total national gas supply, adjusted to reflect the reliability of international gas production (measured using the Freedom Index) and the diversity across producing countries.	Indicates the degree to which changes in import levels expose the country to potentially unreliable and/or concentrated supplies of natural gas.	<b>3</b>
9.	<b>Coal Import Exposure</b>	Net coal imports as a percentage of total national coal supply, adjusted to reflect the reliability of international coal production (measured using the Freedom Index) and the diversity across producing countries.	Indicates the degree to which changes in import levels expose the country to potentially unreliable and/or concentrated supplies of coal.	<b>2</b>
10.	<b>Total Energy Import Exposure</b>	Net energy imports as a share of total primary energy consumption.	Indicates the degree to the country is reliant on foreign sources for its energy needs.	<b>4</b>
11.	<b>Fossil Fuel Import Expenditures per GDP</b>	Net fossil fuel import costs as a share of GDP.	Indicates the susceptibility of a country to imported fossil fuel price shocks.	<b>5</b>
<b>Energy Expenditure Metrics</b>				<b>20</b>
12.	<b>Energy Expenditure Intensity</b>	Total real cost of energy consumed per real \$1,000 USD of GDP per year.	Indicates the magnitude of energy costs in the economy to energy price shocks, and exposure to price changes.	<b>4</b>
13.	<b>Energy Expenditures per Capita</b>	Total real dollar cost of the energy consumed per person per year.	Indicates the importance of energy in personal budgets and the susceptibility of households to energy price shocks.	<b>3</b>
14.	<b>Retail Electricity Prices</b>	Average electricity costs in real cents per kWh.	Indicates the availability of low-cost, reliable forms of power generation.	<b>6</b>
15.	<b>Crude Oil Prices</b>	Real cost per barrel of crude oil.	Indicates the susceptibility of the economy to high prices for petroleum, which supplies a significant portion of national energy demand.	<b>7</b>

## Metrics Used to Create International Index of Energy Security Risk

METRIC BY CLASSIFICATION	DEFINITION	IMPORTANCE	WEIGHT (PERCENT)	
<b>Price &amp; Market Volatility Metrics</b>			<b>15</b>	
16.	<b>Crude Oil Price Volatility</b>	Annual change in crude oil prices, averaged over a three-year period.	Indicates the susceptibility of the economy to large swings in the price of petroleum.	5
17.	<b>Energy Expenditure Volatility</b>	Average annual change in energy expenditures per \$1,000 USD of GDP.	Indicates the susceptibility of the economy to large swings in expenditures for all forms of energy.	4
18.	<b>World Oil Refinery Utilization</b>	Average percent utilization of global petroleum refinery capacity.	Indicates the likelihood of higher prices at high capacity utilization, and higher risk of supply limitations during refinery outages or disruptions.	2
19.	<b>GDP per Capita</b>	Total real dollar GDP per person per year.	Indicates the importance of wealth and productivity to the ability to innovate and respond to energy shocks.	4
<b>Energy Use Intensity Metrics</b>			<b>14</b>	
20.	<b>Energy Consumption per Capita</b>	Million British thermal units (Btu) consumed per person per year.	Indicates changes in both energy intensity and in per-capita GDP and importance of energy to individuals.	4
21.	<b>Energy Intensity</b>	Million Btu of primary energy used in the domestic economy per \$1,000 USD of real GDP.	Indicates the importance of energy as a component of economic growth.	7
22.	<b>Petroleum Intensity</b>	Million Btu of petroleum consumed per \$1,000 USD of real GDP.	Indicates the importance of petroleum as a component of economic growth.	3
<b>Electric Power Sector Metrics</b>			<b>7</b>	
23.	<b>Electricity Diversity</b>	Average of market share concentration indexes (HHI) of: (1) the primary categories of electric power generating capacity, adjusted for availability; and (2) primary categories of electric power generation.	Indicates the flexibility of the power sector and its ability to dispatch electricity from a diverse range of sources.	5
24.	<b>Non-CO<sub>2</sub> Emitting Share of Electricity Generation</b>	Percentage of total electric power generation contributed by renewables, hydroelectric, nuclear and fossil-fired plants operating with carbon capture and storage technology.	Indicates the degree to which the power sector is employing non-CO <sub>2</sub> emitting generation.	2

TABLE A1-3

(CONTINUED)

## Metrics Used to Create International Index of Energy Security Risk

METRIC BY CLASSIFICATION		DEFINITION	IMPORTANCE	WEIGHT (PERCENT)
<b>Transportation Sector Metrics</b>				<b>7</b>
25.	<b>Transportation Energy per Capita</b>	Million Btu consumed in the transportation sector per person per year.	Indicates changes in both transportation energy intensity and in per-capita GDP and importance of transportation energy to individuals.	<b>3</b>
26.	<b>Transportation Energy Intensity</b>	Million Btu of primary energy used in the transportation sector per \$1,000 USD of real GDP.	Indicates the importance of energy used in transportation as a component of economic growth.	<b>4</b>
<b>Environmental Metrics</b>				<b>6</b>
27.	<b>CO<sub>2</sub> Emissions Trend</b>	Annual change in total national energy-related CO <sub>2</sub> emissions.	Indicates the exposure of the economy to domestic and international emissions reduction mandates.	<b>2</b>
28.	<b>Energy-Related Carbon Dioxide Emissions per Capita</b>	Metric tons of CO <sub>2</sub> emissions (energy-related), per capita.	Indicates the joint effect of the amount of energy used per capita, and the carbon intensity of that energy use.	<b>2</b>
29.	<b>Energy-Related Carbon Dioxide Emissions Intensity</b>	Metric tons of CO <sub>2</sub> per \$1,000 USD of real GDP.	Indicates the importance of carbon-based fuels as a component of the economy.	<b>2</b>

## NORMALIZING THE METRICS INTO INDEXES

The International Index provides an understanding of the absolute trends in energy security risks in selected countries and the relative trends vis-à-vis to other countries. Tracking a country’s relative progress in this way can provide insights into market conditions, policies, and other events affecting energy security at a national level.

The various metrics used in the index are measured in many different units making it necessary to transform them into comparable “building blocks” that could then be assembled into an index.

For the International Index to convey information about both changes in energy security risk within a country over time and changes in risk compared to other countries over time, an international benchmark against which the individual countries could be compared had to be created. For this, we selected the average of the present roster of OECD nations.

As a group, the OECD countries provide a good reference measure, with broad coverage across a range of developed nations. Importantly, data for the OECD nations generally are timely, complete, and wide-ranging, which enable an OECD-wide value for all of our metrics.

To set the OECD baseline, each of the 29 metric was normalized so that the value for 1980 equaled 1,000. For subsequent years, the indexed value for each metric was adjusted proportionally higher or lower relative to this 1980 value.

TABLE A1-4

### Input Weights by Metric Category

Category	U.S. Index Weightings	International Index Weightings
Global Fuels	15.1	14
Fuel Imports	11.8	17
Energy Expenditures	18.3	20
Price & Market Volatility	12.6	15
Energy Use Intensity	15.3	14
Electric Power Sector	6.2	7
Transportations Sector	9.8	7
Environmental	7.6	6
R&D	3.3	NA

The country-level metrics were normalized by calibrating their 1980 values in reference to the common OECD 1980 baseline. If, for example, a country’s 1980 value in energy intensity was 17% higher than the OECD average value for that metric, the 1980 value for that metric would be set at 1,170. Normalized metric scores for subsequent years would rise or fall relative to that starting point. In this way, both a country’s relative performance against the OECD average and its absolute performance can be measured for each metric.

## WEIGHING THE METRIC INDEXES

The 29 normalized metrics produced for each country from the procedure described above were combined to produce an overall risk score for each country that represents their weighted average.

The weighing of the 29 International metrics began with placing them into eight logical groupings. Each of the categories includes at least two and no more than six metrics (Table A1-3).

For weighting the metrics, the approximate weights of each metric category in the U.S. Index were assigned these categories in the International Index (Table A1-4). Fuel Imports were given a greater weighting in the International Index, and a lack of reliable and current data meant that no R&D metrics were used. Next, weights were allocated to the individual metrics based on weight of the category to which it belongs and, where possible, its relative importance within that category.

Using these steps, we were able to construct an energy security risk index for each country, as well as for the OECD. For each country, there are 29 metrics, each with a time series value that has been normalized into a risk measure where the OECD 1980 value is set to 1,000. For each country and each year, the 29 metrics are weighted according to the values shown in Table A1-3. The risk index for a country in any given year is then the sum of the metric values, each multiplied by its assigned weighted share.<sup>21</sup> Using this logic, the OECD reference group, where each metric was normalized so that 1980 equals 1,000, therefore will have a 1980 total value of 1,000.

TABLE A2-1

## International Energy Security Risk Index Scores: OECD Average

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,000	788	764	779	748	838	845	765	823	816	744
Gas Import Exposure	1,000	1,885	1,446	1,348	1,626	2,018	2,055	1,954	2,168	2,350	2,358
Coal Import Exposure	1,000	1,233	1,092	1,198	1,274	2,090	3,049	4,094	4,249	4,323	4,280
Total Energy Import Exposure	1,000	891	1,005	1,086	1,145	1,202	1,064	850	850	847	843
Fossil Fuel Import Expenditure per GDP	1,000	740	545	454	523	589	545	455	444	423	399
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	1,000	867	551	427	469	509	556	595	578	553	526
Energy Expenditures per Capita	1,000	736	725	650	683	869	998	996	968	942	921
Retail Electricity Prices	1,000	816	884	875	626	716	873	888	894	899	905
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	1,000	940	299	195	125	36	103	58	56	55	77
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	1,000	1,085	872	811	829	765	746	773	772	766	756
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	1,000	963	1,022	1,080	1,129	1,081	1,083	1,030	1,026	1,024	1,023
Energy Intensity	1,000	1,134	777	710	776	633	603	615	612	601	584
Petroleum Intensity	1,000	1,051	725	653	703	532	501	501	494	480	462
<b>Electric Power Sector</b>											
Electricity Diversity	1,000	920	896	888	891	902	857	810	793	775	754
Non-Carbon Generation	1,000	885	870	851	879	899	876	852	849	848	848
<b>Transportation Sector</b>											
Transport Energy per Capita	1,000	968	1,041	1,097	1,154	1,183	1,120	1,100	1,104	1,110	1,117
Transport Energy Intensity	1,000	1,139	791	721	793	693	624	657	659	651	638
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	979	1,050	1,122	1,207	1,278	1,219	1,151	1,141	1,132	1,123
CO <sub>2</sub> per Capita	1,000	941	971	993	1,031	1,053	970	888	874	862	851
CO <sub>2</sub> GDP Intensity	1,000	1,107	737	653	709	617	540	530	521	506	486
<b>Total Index</b>	<b>1,000</b>	<b>960</b>	<b>795</b>	<b>739</b>	<b>791</b>	<b>843</b>	<b>932</b>	<b>895</b>	<b>904</b>	<b>915</b>	<b>884</b>

TABLE A2-2



## International Energy Security Risk Index Scores: Australia

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	437	15	169	279	96	513	568	890	973	1,033	1,001
Gas Import Exposure	180	0	0	0	0	0	0	0	0	0	0
Coal Import Exposure	0	0	0	0	0	0	0	0	0	0	0
Total Energy Import Exposure	370	12	158	275	92	436	471	771	789	810	772
Fossil Fuel Import Expenditure per GDP	383	12	119	182	73	357	303	469	520	476	415
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	794	685	455	529	534	615	544	588	656	595	556
Energy Expenditures per Capita	916	687	622	715	709	1,145	1,407	1,522	1,480	1,426	1,380
Retail Electricity Prices	626	538	615	646	438	595	725	738	742	747	752
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	794	834	398	143	122	99	106	45	59	101	124
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	931	999	855	860	868	733	622	621	666	646	635
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	1,050	1,130	1,222	1,250	1,411	1,555	1,465	1,320	1,302	1,284	1,269
Energy Intensity	911	1,128	893	925	1,063	836	566	510	577	536	511
Petroleum Intensity	882	994	770	804	833	618	433	441	494	455	429
<b>Electric Power Sector</b>											
Electricity Diversity	1,118	1,185	1,202	1,216	1,223	1,223	1,228	1,083	1,079	1,055	1,028
Non-Carbon Generation	1,245	1,283	1,315	1,316	1,334	1,326	1,328	1,275	1,287	1,282	1,281
<b>Transportation Sector</b>											
Transport Energy per Capita	1,267	1,279	1,355	1,416	1,456	1,554	1,665	1,687	1,667	1,645	1,625
Transport Energy Intensity	1,099	1,277	991	1,047	1,097	836	643	652	738	687	655
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,136	1,365	1,487	1,749	2,099	2,205	1,940	1,948	1,931	1,915
CO <sub>2</sub> per Capita	1,192	1,262	1,400	1,441	1,599	1,802	1,753	1,427	1,410	1,375	1,342
CO <sub>2</sub> GDP Intensity	1,034	1,259	1,024	1,066	1,205	969	677	551	625	574	541
<b>Total Index</b>	<b>858</b>	<b>804</b>	<b>717</b>	<b>705</b>	<b>741</b>	<b>811</b>	<b>856</b>	<b>825</b>	<b>846</b>	<b>842</b>	<b>805</b>

TABLE A2-3



## International Energy Security Risk Index Scores: Brazil

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,296	623	658	673	394	205	216	253	271	269	330
Gas Import Exposure	0	0	0	0	1,047	2,343	2,502	2,732	2,220	1,924	1,386
Coal Import Exposure	3,840	4,775	4,501	4,414	4,056	5,879	8,302	8,853	8,788	9,641	10,058
Total Energy Import Exposure	1,529	774	973	1,019	700	472	484	598	552	545	617
Fossil Fuel Import Expenditure per GDP	1,420	745	665	494	502	341	221	417	389	327	417
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	2,508	2,445	1,498	625	1,323	1,495	962	1,648	1,650	1,467	1,644
Energy Expenditures per Capita	553	353	349	197	304	392	540	663	649	642	635
Retail Electricity Prices	1,105	902	1,157	694	671	768	936	953	959	965	971
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	2,508	1,891	1,695	1,305	633	351	306	297	303	440	233
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	2,131	2,632	2,073	1,779	2,087	1,954	1,335	1,577	1,595	1,512	1,609
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	185	188	216	241	272	277	326	336	330	324	318
Energy Intensity	841	1,305	926	762	1,183	1,059	580	836	838	739	823
Petroleum Intensity	1,100	1,380	1,062	877	1,336	1,109	615	990	1,042	965	1,126
<b>Electric Power Sector</b>											
Electricity Diversity	1,343	1,347	1,373	1,374	1,221	1,120	974	774	787	746	707
Non-Carbon Generation	84	62	63	69	121	143	173	311	213	211	210
<b>Transportation Sector</b>											
Transport Energy per Capita	263	245	212	245	350	299	379	459	478	497	518
Transport Energy Intensity	1,194	1,693	912	776	1,522	1,142	674	1,142	1,215	1,136	1,339
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,040	1,287	1,574	1,879	1,988	2,477	2,926	2,926	2,899	2,873
CO <sub>2</sub> per Capita	140	130	146	164	182	181	214	242	240	236	232
CO <sub>2</sub> GDP Intensity	636	901	627	520	792	690	381	602	611	539	600
<b>Total Index</b>	<b>1,156</b>	<b>1,098</b>	<b>930</b>	<b>778</b>	<b>914</b>	<b>957</b>	<b>980</b>	<b>1,078</b>	<b>1,065</b>	<b>1,058</b>	<b>1,059</b>



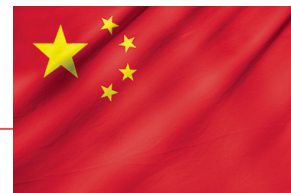
TABLE A2-4



## International Energy Security Risk Index Scores: Canada

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	200	0	0	0	0	0	0	0	0	0	0
Gas Import Exposure	0	0	0	0	0	0	0	0	0	0	0
Coal Import Exposure	0	0	0	0	0	0	0	0	0	0	0
Total Energy Import Exposure	153	0	0	0	0	0	0	0	0	0	0
Fossil Fuel Import Expenditure per GDP	314	0	0	0	0	0	0	0	0	0	0
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	982	939	720	595	641	776	707	935	920	864	852
Energy Expenditures per Capita	1,241	1,161	1,159	816	949	1,539	1,669	1,856	1,755	1,724	1,702
Retail Electricity Prices	403	403	481	438	370	471	545	613	617	621	625
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	982	714	385	194	160	128	181	88	99	135	107
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	890	899	788	854	822	710	651	710	724	708	708
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	2,251	2,185	2,210	2,318	2,366	2,375	2,239	2,256	2,235	2,215	2,193
Energy Intensity	1,781	1,767	1,372	1,690	1,597	1,197	949	1,137	1,171	1,109	1,097
Petroleum Intensity	1,596	1,159	939	1,076	1,067	849	680	807	824	773	757
<b>Electric Power Sector</b>											
Electricity Diversity	820	787	730	718	744	713	692	641	648	643	641
Non-Carbon Generation	317	289	317	304	387	362	331	309	289	288	288
<b>Transportation Sector</b>											
Transport Energy per Capita	2,246	1,758	1,706	1,677	1,811	1,848	1,909	1,939	1,919	1,898	1,874
Transport Energy Intensity	1,777	1,421	1,059	1,223	1,222	932	808	977	1,006	951	938
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	953	1,019	1,106	1,222	1,418	1,363	1,396	1,389	1,377	1,365
CO <sub>2</sub> per Capita	1,604	1,450	1,448	1,484	1,567	1,729	1,576	1,538	1,512	1,482	1,449
CO <sub>2</sub> GDP Intensity	1,270	1,173	899	1,082	1,058	872	668	775	793	742	725
<b>Total Index</b>	<b>1,009</b>	<b>880</b>	<b>754</b>	<b>740</b>	<b>779</b>	<b>787</b>	<b>825</b>	<b>833</b>	<b>834</b>	<b>830</b>	<b>802</b>

TABLE A2-5

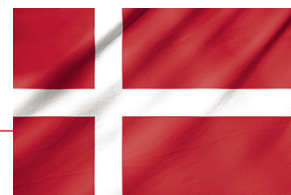


## International Energy Security Risk Index Scores: China

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	0	0	0	99	316	513	638	808	911	971	1,000
Gas Import Exposure	0	0	0	0	0	0	576	1,722	2,028	2,474	2,727
Coal Import Exposure	327	0	61	0	0	241	227	646	1,516	1,196	819
Total Energy Import Exposure	116	0	27	50	204	325	332	549	794	775	754
Fossil Fuel Import Expenditure per GDP	137	0	28	140	462	812	610	625	701	682	642
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	2,015	1,415	1,666	867	638	843	798	605	600	557	505
Energy Expenditures per Capita	44	37	40	35	38	81	181	222	219	216	214
Retail Electricity Prices	372	303	328	275	262	299	365	371	373	376	378
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	2,015	2,451	1,135	1,069	310	151	57	145	95	83	96
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	6,737	6,226	6,472	4,965	4,126	3,229	2,102	1,652	1,656	1,605	1,537
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	102	117	139	160	181	305	429	470	463	455	449
Energy Intensity	4,635	4,534	5,831	3,936	3,076	3,175	1,896	1,283	1,268	1,173	1,061
Petroleum Intensity	2,149	1,820	2,190	1,750	1,621	1,359	736	571	593	575	545
<b>Electric Power Sector</b>											
Electricity Diversity	1,025	998	1,048	1,044	1,051	1,067	1,006	852	821	791	759
Non-Carbon Generation	1,165	1,118	1,150	1,121	1,158	1,184	1,148	1,042	1,036	1,026	1,019
<b>Transportation Sector</b>											
Transport Energy per Capita	36	36	40	62	90	123	172	223	228	234	239
Transport Energy Intensity	1,653	1,400	1,684	1,533	1,535	1,280	759	608	626	602	565
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,232	1,591	1,891	2,129	3,862	5,459	5,968	5,870	5,815	5,762
CO <sub>2</sub> per Capita	139	159	191	213	229	403	555	592	579	570	563
CO <sub>2</sub> GDP Intensity	6,290	6,180	7,982	5,261	3,903	4,200	2,451	1,615	1,588	1,470	1,329
<b>Total Index</b>	<b>1,436</b>	<b>1,327</b>	<b>1,413</b>	<b>1,090</b>	<b>997</b>	<b>1,067</b>	<b>982</b>	<b>918</b>	<b>957</b>	<b>956</b>	<b>912</b>

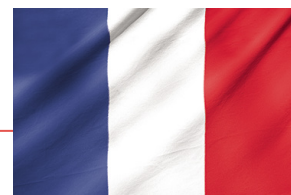
TABLE A2-6

## International Energy Security Risk Index Scores: Denmark



METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,527	1,061	459	206	0	0	0	0	103	130	334
Gas Import Exposure	1,507	0	0	0	0	0	0	0	0	0	0
Coal Import Exposure	6,625	7,118	5,592	5,509	5,220	7,405	9,872	10,914	10,706	11,018	11,018
Total Energy Import Exposure	2,803	2,265	1,454	1,111	511	502	540	285	419	427	584
Fossil Fuel Import Expenditure per GDP	1,540	1,068	263	125	22	20	24	11	43	46	91
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	854	739	623	577	657	571	560	552	529	487	448
Energy Expenditures per Capita	1,342	793	1,258	1,356	1,237	1,524	1,618	1,340	1,299	1,235	1,176
Retail Electricity Prices	1,211	821	1,098	1,142	915	1,258	1,401	1,419	1,428	1,437	1,446
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	854	681	375	87	139	100	109	86	98	92	94
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	798	965	704	652	729	612	589	642	638	628	617
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	952	879	833	943	915	871	841	729	724	722	721
Energy Intensity	606	819	412	401	486	326	291	300	295	285	275
Petroleum Intensity	946	1,047	472	464	533	322	266	281	273	262	250
<b>Electric Power Sector</b>											
Electricity Diversity	1,635	1,631	1,580	1,542	1,112	937	879	881	852	867	886
Non-Carbon Generation	1,458	1,458	1,410	1,370	1,198	1,013	944	405	500	499	498
<b>Transportation Sector</b>											
Transport Energy per Capita	1,475	1,382	1,280	1,376	1,288	1,224	1,165	1,076	1,059	1,044	1,030
Transport Energy Intensity	939	1,287	634	585	684	459	403	443	431	412	392
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	940	871	1,072	838	840	818	551	522	518	513
CO <sub>2</sub> per Capita	1,096	1,032	951	1,150	882	871	828	545	512	504	497
CO <sub>2</sub> GDP Intensity	698	961	471	489	468	326	287	224	208	199	189
<b>Total Index</b>	<b>1,263</b>	<b>1,120</b>	<b>860</b>	<b>797</b>	<b>755</b>	<b>800</b>	<b>919</b>	<b>861</b>	<b>864</b>	<b>876</b>	<b>864</b>

TABLE A2-7



## International Energy Security Risk Index Scores: France

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,527	1,371	1,172	1,133	1,066	1,142	1,213	1,312	1,389	1,423	1,431
Gas Import Exposure	4,499	7,663	5,292	3,866	4,403	4,828	4,926	5,667	5,885	6,365	6,346
Coal Import Exposure	4,060	4,159	3,378	3,688	4,466	7,405	9,872	10,914	10,706	11,018	11,018
Total Energy Import Exposure	2,128	1,720	1,617	1,562	1,632	1,657	1,588	1,434	1,456	1,446	1,439
Fossil Fuel Import Expenditure per GDP	1,222	1,214	603	493	711	704	684	760	747	705	654
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	860	796	433	413	465	448	484	545	539	511	475
Energy Expenditures per Capita	1,237	681	708	739	637	852	979	911	900	875	853
Retail Electricity Prices	1,267	718	999	942	504	629	873	965	971	977	983
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	860	545	252	67	109	69	146	110	93	82	75
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	834	1,081	782	748	855	725	703	774	774	764	746
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	857	823	875	944	996	1,006	942	891	889	892	893
Energy Intensity	596	962	535	528	727	529	466	533	533	520	497
Petroleum Intensity	739	906	480	452	605	418	352	379	375	363	343
<b>Electric Power Sector</b>											
Electricity Diversity	582	672	793	813	818	834	763	754	723	714	704
Non-Carbon Generation	687	235	163	112	133	155	141	92	124	124	124
<b>Transportation Sector</b>											
Transport Energy per Capita	1,041	926	963	1,002	1,049	1,024	970	897	879	864	848
Transport Energy Intensity	724	1,082	589	560	766	539	480	537	527	504	472
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	815	755	774	828	861	792	687	695	689	683
CO <sub>2</sub> per Capita	799	634	572	573	599	601	537	455	458	454	449
CO <sub>2</sub> GDP Intensity	556	741	349	320	437	316	265	272	274	265	250
<b>Total Index</b>	<b>1,152</b>	<b>1,172</b>	<b>910</b>	<b>821</b>	<b>912</b>	<b>992</b>	<b>1,118</b>	<b>1,133</b>	<b>1,137</b>	<b>1,160</b>	<b>1,128</b>

TABLE A2-8



## International Energy Security Risk Index Scores: Germany

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,510	1,378	1,186	1,145	1,059	1,181	1,200	1,298	1,374	1,409	1,419
Gas Import Exposure	4,269	6,268	4,368	3,347	3,543	3,979	4,285	5,136	5,357	5,895	5,943
Coal Import Exposure	1,063	1,116	1,041	899	1,539	2,401	4,000	4,946	5,192	5,149	4,974
Total Energy Import Exposure	1,754	1,564	1,683	1,755	1,797	1,214	1,895	1,922	1,977	1,992	1,979
Fossil Fuel Import Expenditure per GDP	1,263	1,432	669	484	698	184	748	825	801	767	712
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	1,139	1,186	675	544	557	167	693	633	618	594	552
Energy Expenditures per Capita	1,558	976	1,126	1,149	809	316	1,440	1,197	1,185	1,175	1,152
Retail Electricity Prices	1,292	806	1,305	1,312	588	988	1,393	1,602	1,612	1,622	1,632
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	1,139	846	603	115	147	18	374	114	110	90	87
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	855	1,102	774	688	830	726	694	728	723	711	692
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	1,067	1,070	1,020	982	963	585	957	923	917	916	917
Energy Intensity	780	1,301	611	465	663	308	461	488	479	463	439
Petroleum Intensity	744	1,049	508	420	584	367	366	385	374	358	336
<b>Electric Power Sector</b>											
Electricity Diversity	1,140	962	939	894	797	697	635	654	666	668	673
Non-Carbon Generation	1,219	1,018	1,001	952	918	912	864	823	845	842	841
<b>Transportation Sector</b>											
Transport Energy per Capita	1,101	1,076	1,105	1,153	1,097	1,025	1,002	947	911	881	852
Transport Energy Intensity	805	1,308	662	546	755	540	482	501	476	445	408
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	982	905	774	720	738	704	658	659	653	648
CO <sub>2</sub> per Capita	1,320	1,306	1,178	980	905	924	890	832	827	817	808
CO <sub>2</sub> GDP Intensity	965	1,587	706	464	623	487	428	441	432	413	387
<b>Total Index</b>	<b>1,189</b>	<b>1,232</b>	<b>962</b>	<b>828</b>	<b>865</b>	<b>798</b>	<b>1,077</b>	<b>1,087</b>	<b>1,100</b>	<b>1,119</b>	<b>1,085</b>

TABLE A2-9



## International Energy Security Risk Index Scores: India

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,125	433	522	617	713	805	903	1,025	1,103	1,138	1,162
Gas Import Exposure	0	0	0	0	0	849	1,015	2,165	2,582	2,809	3,014
Coal Import Exposure	0	321	449	479	602	928	2,329	3,525	3,174	2,860	2,435
Total Energy Import Exposure	723	360	501	552	784	848	984	1,504	1,520	1,497	1,495
Fossil Fuel Import Expenditure per GDP	878	416	627	877	1,240	1,376	1,232	1,420	1,341	1,175	1,185
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	570	872	861	849	1,233	1,345	1,106	1,124	1,048	921	923
Energy Expenditures per Capita	17	23	24	21	34	53	75	82	82	81	81
Retail Electricity Prices	624	509	551	507	535	270	329	334	336	338	341
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	570	454	433	456	648	289	402	203	198	198	186
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	5,759	6,205	6,019	6,341	6,069	5,057	3,848	3,695	3,579	3,375	3,384
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	32	40	50	66	70	81	107	98	95	93	92
Energy Intensity	1,052	1,520	1,806	2,650	2,586	2,064	1,580	1,332	1,222	1,065	1,050
Petroleum Intensity	794	1,119	1,236	1,669	1,869	1,416	980	993	957	874	904
<b>Electric Power Sector</b>											
Electricity Diversity	805	888	955	1,050	1,057	1,003	998	1,034	1,011	972	929
Non-Carbon Generation	853	999	1,054	1,169	1,213	1,176	1,192	1,212	1,243	1,232	1,223
<b>Transportation Sector</b>											
Transport Energy per Capita	20	25	31	41	45	44	62	74	76	79	82
Transport Energy Intensity	678	955	1,119	1,629	1,657	1,130	914	1,004	977	901	940
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,449	2,016	2,703	3,329	4,534	6,777	7,214	7,360	7,292	7,225
CO <sub>2</sub> per Capita	34	44	56	67	76	95	132	132	134	131	128
CO <sub>2</sub> GDP Intensity	1,140	1,710	2,010	2,710	2,789	2,429	1,954	1,806	1,711	1,492	1,470
<b>Total Index</b>	<b>928</b>	<b>943</b>	<b>963</b>	<b>1,086</b>	<b>1,186</b>	<b>1,136</b>	<b>1,176</b>	<b>1,216</b>	<b>1,205</b>	<b>1,170</b>	<b>1,145</b>

TABLE A2-10

## International Energy Security Risk Index Scores: Indonesia



METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	0	0	0	0	0	162	383	671	697	776	840
Gas Import Exposure	0	0	0	0	0	0	0	0	0	0	0
Coal Import Exposure	0	786	0	0	0	0	0	0	0	0	0
Total Energy Import Exposure	0	11	0	0	0	235	432	695	671	702	684
Fossil Fuel Import Expenditure per GDP	0	3	0	0	0	375	461	860	783	804	874
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	602	949	725	564	331	978	673	766	714	678	688
Energy Expenditures per Capita	34	43	32	39	16	68	105	117	115	115	116
Retail Electricity Prices	633	517	620	636	270	438	419	427	429	432	435
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	602	523	508	454	244	379	427	47	60	91	93
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	4,241	4,699	4,771	3,827	4,575	3,804	2,537	2,565	2,494	2,426	2,435
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	44	53	73	93	104	113	146	158	164	178	205
Energy Intensity	787	1,159	1,652	1,367	2,169	1,630	938	1,038	1,020	1,045	1,216
Petroleum Intensity	1,271	1,585	2,089	1,532	2,603	2,056	976	1,073	1,037	1,023	1,078
<b>Electric Power Sector</b>											
Electricity Diversity	1,093	1,186	1,085	1,113	1,079	1,129	1,101	1,243	1,243	1,243	1,248
Non-Carbon Generation	1,205	1,227	1,196	1,195	1,215	1,252	1,217	1,278	1,273	1,282	1,375
<b>Transportation Sector</b>											
Transport Energy per Capita	65	67	91	120	136	168	194	218	220	222	224
Transport Energy Intensity	1,176	1,467	2,077	1,761	2,849	2,430	1,247	1,431	1,366	1,306	1,330
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,209	1,861	2,511	3,116	3,856	5,282	5,923	6,031	6,021	6,026
CO <sub>2</sub> per Capita	53	57	80	99	114	132	169	178	179	177	175
CO <sub>2</sub> GDP Intensity	946	1,255	1,811	1,449	2,392	1,913	1,091	1,170	1,112	1,038	1,036
<b>Total Index</b>	<b>799</b>	<b>868</b>	<b>897</b>	<b>778</b>	<b>965</b>	<b>978</b>	<b>894</b>	<b>930</b>	<b>920</b>	<b>930</b>	<b>932</b>

TABLE A2-11



## International Energy Security Risk Index Scores: Italy

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,525	1,384	1,159	1,110	1,028	1,075	1,142	1,210	1,316	1,338	1,330
Gas Import Exposure	3,498	5,367	3,776	2,713	3,516	4,243	4,495	5,102	5,408	5,898	5,908
Coal Import Exposure	6,170	6,565	5,344	5,456	5,216	7,376	9,828	10,870	10,706	11,018	11,018
Total Energy Import Exposure	2,372	2,298	2,337	2,298	2,339	2,422	2,361	2,154	2,213	2,254	2,245
Fossil Fuel Import Expenditure per GDP	1,493	1,456	682	687	819	820	811	869	876	858	810
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	859	884	605	676	754	724	712	778	764	748	709
Energy Expenditures per Capita	819	617	943	927	926	1,266	1,269	1,070	1,064	1,066	1,054
Retail Electricity Prices	1,231	967	1,323	1,153	895	1,370	1,755	2,013	2,025	2,038	2,051
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	859	536	202	52	144	139	124	176	128	116	89
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	1,024	1,197	801	854	902	756	749	852	848	838	820
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	601	594	662	691	742	781	724	627	629	632	636
Energy Intensity	630	851	425	504	604	447	406	456	452	444	428
Petroleum Intensity	917	1,111	542	636	674	444	367	375	369	359	342
<b>Electric Power Sector</b>											
Electricity Diversity	891	858	996	1,007	992	1,009	870	669	683	669	656
Non-Carbon Generation	1,044	1,045	1,218	1,200	1,180	1,213	1,060	875	915	912	910
<b>Transportation Sector</b>											
Transport Energy per Capita	653	696	753	800	821	832	745	678	696	715	735
Transport Energy Intensity	685	997	483	584	669	476	417	492	500	502	494
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	973	1,107	1,153	1,191	1,267	1,135	947	976	967	959
CO <sub>2</sub> per Capita	601	583	662	688	710	742	650	529	546	542	539
CO <sub>2</sub> GDP Intensity	631	836	425	502	578	424	364	384	393	381	363
<b>Total Index</b>	<b>1,184</b>	<b>1,216</b>	<b>985</b>	<b>926</b>	<b>995</b>	<b>1,101</b>	<b>1,224</b>	<b>1,225</b>	<b>1,240</b>	<b>1,270</b>	<b>1,240</b>



TABLE A2-12



## International Energy Security Risk Index Scores: Japan

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,555	1,420	1,217	1,167	1,083	1,153	1,221	1,322	1,400	1,433	1,443
Gas Import Exposure	5,856	8,886	5,652	4,122	4,438	4,732	4,830	5,534	5,748	6,207	6,184
Coal Import Exposure	5,250	6,068	5,228	5,253	5,117	7,353	9,809	10,840	10,637	10,938	10,929
Total Energy Import Exposure	2,496	2,368	2,439	2,393	2,323	2,365	2,324	2,634	2,657	2,608	2,581
Fossil Fuel Import Expenditure per GDP	1,719	1,212	723	432	527	811	769	1,143	1,008	1,006	980
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	1,458	962	634	457	458	543	610	950	853	861	852
Energy Expenditures per Capita	1,561	977	1,207	1,322	1,081	1,105	1,351	1,497	1,494	1,462	1,450
Retail Electricity Prices	1,730	1,447	1,580	2,066	1,429	1,104	1,244	1,273	1,281	1,289	1,298
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	1,458	1,478	304	272	80	46	214	64	105	116	116
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	966	993	725	588	651	701	672	797	756	767	767
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	744	731	849	935	981	987	943	859	862	866	871
Energy Intensity	695	720	446	323	416	485	426	546	492	510	512
Petroleum Intensity	1,047	900	561	388	454	504	384	520	465	478	475
<b>Electric Power Sector</b>											
Electricity Diversity	848	757	770	741	743	741	739	959	917	895	869
Non-Carbon Generation	1,019	904	940	885	861	914	882	1,196	1,186	1,182	1,180
<b>Transportation Sector</b>											
Transport Energy per Capita	546	568	739	842	867	847	683	658	645	633	621
Transport Energy Intensity	510	560	388	291	367	416	308	418	368	373	365
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	989	1,111	1,198	1,232	1,328	1,231	1,199	1,167	1,157	1,147
CO <sub>2</sub> per Capita	736	704	773	821	835	894	826	810	790	784	779
CO <sub>2</sub> GDP Intensity	687	693	406	284	354	439	373	514	451	462	458
<b>Total Index</b>	<b>1,357</b>	<b>1,336</b>	<b>1,063</b>	<b>972</b>	<b>978</b>	<b>1,077</b>	<b>1,201</b>	<b>1,293</b>	<b>1,278</b>	<b>1,307</b>	<b>1,281</b>

TABLE A2-13



## International Energy Security Risk Index Scores: Mexico

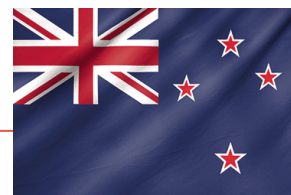
METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	0	0	0	0	0	0	0	0	0	0	0
Gas Import Exposure	0	0	91	665	540	1,098	1,071	2,620	3,119	3,806	4,190
Coal Import Exposure	1,746	374	380	776	716	3,082	3,895	4,299	4,346	4,657	4,862
Total Energy Import Exposure	18	4	17	122	100	281	286	574	660	736	816
Fossil Fuel Import Expenditure per GDP	4	1	7	53	29	103	115	291	385	420	465
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	351	637	727	554	636	750	703	760	809	742	697
Energy Expenditures per Capita	120	143	170	145	279	339	324	333	319	305	293
Retail Electricity Prices	680	342	470	320	484	684	665	702	706	710	715
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	351	438	708	414	80	85	113	92	112	118	125
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	1,709	2,108	2,069	1,956	1,510	1,486	1,472	1,510	1,592	1,560	1,543
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	305	321	308	325	359	352	355	343	340	337	335
Energy Intensity	890	1,428	1,320	1,242	818	778	769	783	862	820	796
Petroleum Intensity	1,356	2,088	1,958	1,796	1,160	1,051	934	894	974	918	883
<b>Electric Power Sector</b>											
Electricity Diversity	926	953	933	897	937	1,017	1,050	1,000	1,020	1,002	981
Non-Carbon Generation	1,055	1,027	1,071	1,028	1,097	1,156	1,175	1,210	1,259	1,254	1,253
<b>Transportation Sector</b>											
Transport Energy per Capita	390	358	382	377	407	444	473	445	439	433	427
Transport Energy Intensity	1,140	1,589	1,635	1,441	929	980	1,026	1,016	1,113	1,053	1,016
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,160	1,257	1,348	1,588	1,686	1,869	1,898	1,945	1,928	1,913
CO <sub>2</sub> per Capita	322	334	327	321	351	348	358	340	345	338	331
CO <sub>2</sub> GDP Intensity	941	1,481	1,400	1,229	800	768	776	776	873	821	788
<b>Total Index</b>	<b>742</b>	<b>784</b>	<b>751</b>	<b>695</b>	<b>642</b>	<b>765</b>	<b>857</b>	<b>900</b>	<b>948</b>	<b>975</b>	<b>966</b>

TABLE A2-14

## International Energy Security Risk Index Scores: Netherlands

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,596	1,228	1,094	1,037	1,021	1,167	1,190	1,277	1,368	1,402	1,411
Gas Import Exposure	0	0	0	0	0	0	0	0	0	0	680
Coal Import Exposure	6,625	7,118	5,592	5,509	5,220	7,405	9,872	10,914	10,706	11,018	11,018
Total Energy Import Exposure	150	1,273	1,471	1,440	1,536	458	1,563	1,727	1,708	1,683	1,766
Fossil Fuel Import Expenditure per GDP	30	1,274	814	573	808	17	892	1,101	1,046	958	897
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	358	1,320	823	791	889	314	1,001	1,190	1,156	1,097	1,001
Energy Expenditures per Capita	558	1,148	1,316	1,539	1,424	722	2,537	2,453	2,400	2,355	2,298
Retail Electricity Prices	1,398	771	840	923	709	1,365	1,057	1,065	1,072	1,078	1,085
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	358	620	432	206	272	45	538	181	193	180	183
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	801	1,072	791	717	790	660	628	697	694	682	660
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	1,232	1,160	1,240	1,292	1,330	712	1,434	1,328	1,324	1,320	1,317
Energy Intensity	790	1,334	776	664	830	310	566	644	637	615	574
Petroleum Intensity	900	1,203	774	648	856	585	596	703	689	658	609
<b>Electric Power Sector</b>											
Electricity Diversity	1,472	1,486	1,481	1,473	1,384	1,231	1,195	1,119	1,081	1,051	1,020
Non-Carbon Generation	1,345	1,360	1,362	1,348	1,323	1,264	1,246	1,274	1,335	1,331	1,329
<b>Transportation Sector</b>											
Transport Energy per Capita	796	766	805	898	977	1,016	995	874	838	802	768
Transport Energy Intensity	510	881	503	461	610	442	393	424	403	374	335
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	942	1,036	1,101	1,215	1,253	1,164	1,158	1,162	1,152	1,143
CO <sub>2</sub> per Capita	1,299	1,194	1,273	1,309	1,403	1,411	1,288	1,257	1,255	1,236	1,219
CO <sub>2</sub> GDP Intensity	833	1,373	796	672	876	615	508	610	604	576	531
<b>Total Index</b>	<b>968</b>	<b>1,148</b>	<b>949</b>	<b>888</b>	<b>956</b>	<b>843</b>	<b>1,172</b>	<b>1,173</b>	<b>1,163</b>	<b>1,163</b>	<b>1,147</b>

TABLE A2-15



## International Energy Security Risk Index Scores: New Zealand

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,431	1,060	738	840	752	982	782	944	1,054	1,105	1,173
Gas Import Exposure	0	70	0	2	0	0	0	119	0	84	143
Coal Import Exposure	0	0	0	0	0	0	0	0	0	0	0
Total Energy Import Exposure	1,022	631	534	670	662	904	664	785	807	827	870
Fossil Fuel Import Expenditure per GDP	1,228	813	522	495	699	666	501	543	514	477	487
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	799	798	715	571	630	598	657	722	667	615	608
Energy Expenditures per Capita	675	531	734	661	527	907	1,101	1,270	1,204	1,152	1,105
Retail Electricity Prices	527	286	462	519	335	668	755	860	865	871	876
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	799	934	741	366	175	101	197	76	97	117	111
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	1,088	1,225	987	929	1,094	812	772	754	744	731	742
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	879	981	1,191	1,197	1,196	1,143	1,113	1,026	1,007	989	974
Energy Intensity	1,041	1,472	1,161	1,034	1,432	753	664	583	557	528	536
Petroleum Intensity	872	931	771	726	1,030	603	520	476	451	423	425
<b>Electric Power Sector</b>											
Electricity Diversity	1,067	907	925	975	795	740	683	680	705	695	688
Non-Carbon Generation	135	333	288	240	399	502	375	282	222	221	221
<b>Transportation Sector</b>											
Transport Energy per Capita	958	892	1,138	1,256	1,308	1,393	1,304	1,319	1,312	1,305	1,302
Transport Energy Intensity	1,134	1,339	1,109	1,085	1,566	918	778	749	726	697	716
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,193	1,537	1,645	1,852	2,206	2,048	2,053	2,041	2,023	2,007
CO <sub>2</sub> per Capita	541	619	778	755	809	899	793	753	733	711	692
CO <sub>2</sub> GDP Intensity	641	930	758	652	969	592	473	428	406	380	381
<b>Total Index</b>	<b>893</b>	<b>856</b>	<b>760</b>	<b>705</b>	<b>797</b>	<b>771</b>	<b>805</b>	<b>779</b>	<b>771</b>	<b>774</b>	<b>757</b>

TABLE A2-16



## International Energy Security Risk Index Scores: Norway

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	0	0	0	0	0	0	0	0	0	0	0
Gas Import Exposure	0	0	0	0	0	0	0	0	0	0	0
Coal Import Exposure	4,570	3,714	3,316	3,793	1,747	0	0	0	0	8,926	10,672
Total Energy Import Exposure	39	29	21	30	13	0	0	0	0	24	28
Fossil Fuel Import Expenditure per GDP	10	8	4	4	1	0	0	0	0	2	2
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	608	539	476	542	486	422	381	416	418	369	335
Energy Expenditures per Capita	1,084	743	1,010	1,258	1,136	1,541	1,662	1,415	1,340	1,238	1,186
Retail Electricity Prices	432	358	543	564	282	545	763	629	633	637	641
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	608	404	248	128	122	98	39	76	53	89	73
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	749	851	687	657	654	523	479	542	559	546	531
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	1,837	2,061	2,236	2,271	2,447	2,374	2,091	1,998	1,984	1,974	1,968
Energy Intensity	1,030	1,493	1,054	979	1,047	650	479	587	620	589	555
Petroleum Intensity	708	837	533	496	485	314	249	284	297	279	261
<b>Electric Power Sector</b>											
Electricity Diversity	1,590	1,594	1,560	1,583	1,541	1,520	1,400	1,403	1,427	1,422	1,417
Non-Carbon Generation	2	5	3	4	3	5	57	27	27	27	27
<b>Transportation Sector</b>											
Transport Energy per Capita	1,354	1,210	1,257	1,280	1,322	1,332	1,388	1,198	1,158	1,120	1,084
Transport Energy Intensity	759	877	593	551	566	365	318	352	362	334	306
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	998	1,046	1,129	1,207	1,269	1,308	1,284	1,319	1,307	1,297
CO <sub>2</sub> per Capita	720	707	725	762	790	807	787	728	741	728	717
CO <sub>2</sub> GDP Intensity	403	512	342	328	338	221	180	214	231	217	202
<b>Total Index</b>	<b>870</b>	<b>846</b>	<b>746</b>	<b>725</b>	<b>709</b>	<b>675</b>	<b>729</b>	<b>684</b>	<b>687</b>	<b>866</b>	<b>869</b>

TABLE A2-17

## International Energy Security Risk Index Scores: Poland



METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,527	1,403	1,211	1,153	1,050	1,115	1,196	1,275	1,343	1,375	1,377
Gas Import Exposure	2,979	4,917	4,304	2,727	3,072	3,360	3,577	4,156	4,453	4,921	4,953
Coal Import Exposure	0	0	0	0	0	0	777	160	537	504	499
Total Energy Import Exposure	561	503	627	682	882	980	1,185	1,079	1,156	1,166	1,162
Fossil Fuel Import Expenditure per GDP	3,680	2,722	2,005	947	1,103	1,084	1,063	1,105	1,117	1,007	903
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	1,492	1,293	822	736	731	792	851	886	888	792	707
Energy Expenditures per Capita	203	174	107	180	201	348	533	508	498	486	472
Retail Electricity Prices	332	246	224	457	400	666	965	906	912	917	923
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	1,371	1,289	410	269	207	56	94	189	115	141	159
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	3,182	3,452	2,773	2,020	1,906	1,510	1,263	1,320	1,335	1,276	1,223
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	792	741	588	545	530	552	611	572	574	575	577
Energy Intensity	5,820	6,598	4,519	2,225	1,928	1,259	975	997	1,022	937	864
Petroleum Intensity	1,990	2,092	1,443	839	970	685	581	562	571	518	473
<b>Electric Power Sector</b>											
Electricity Diversity	1,518	1,503	1,523	1,512	1,496	1,470	1,362	1,130	1,114	1,085	1,055
Non-Carbon Generation	1,429	1,442	1,448	1,443	1,439	1,426	1,355	1,301	1,321	1,316	1,314
<b>Transportation Sector</b>											
Transport Energy per Capita	266	229	208	244	318	352	468	433	437	441	444
Transport Energy Intensity	2,023	2,304	1,601	995	1,155	802	747	755	779	718	665
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,054	919	862	789	826	879	785	787	780	773
CO <sub>2</sub> per Capita	924	931	792	734	678	711	759	679	681	675	669
CO <sub>2</sub> GDP Intensity	8,260	9,146	6,090	2,995	2,464	1,621	1,211	1,184	1,213	1,099	1,001
<b>Total Index</b>	<b>1,785</b>	<b>1,834</b>	<b>1,381</b>	<b>956</b>	<b>981</b>	<b>939</b>	<b>1,029</b>	<b>985</b>	<b>1,010</b>	<b>1,010</b>	<b>967</b>

TABLE A2-18

## International Energy Security Risk Index Scores: Russian Federation



METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	-	-	-	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	-	-	-	751	697	742	786	851	901	922	928
Global Gas Reserves	-	-	-	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	-	-	-	666	715	768	778	882	916	991	988
Global Coal Reserves	-	-	-	566	582	644	616	615	615	615	615
Global Coal Production	-	-	-	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	-	-	-	0	0	0	0	0	0	0	0
Gas Import Exposure	-	-	-	0	0	0	0	0	0	0	0
Coal Import Exposure	-	-	-	0	0	0	0	0	0	0	0
Total Energy Import Exposure	-	-	-	0	0	0	0	0	0	0	0
Fossil Fuel Import Expenditure per GDP	-	-	-	0	0	0	0	0	0	0	0
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	-	-	-	1,031	1,139	1,016	1,028	1,457	1,565	1,332	1,345
Energy Expenditures per Capita	-	-	-	183	124	296	546	629	628	644	668
Retail Electricity Prices	-	-	-	41	29	289	392	399	401	404	406
Crude Oil Prices	-	-	-	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	-	-	-	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	-	-	-	668	398	373	131	411	411	527	252
World Oil Refinery Usage	-	-	-	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	-	-	-	2,375	3,036	1,853	1,372	1,522	1,579	1,438	1,419
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	-	-	-	1,049	995	1,088	1,168	1,145	1,130	1,117	1,107
Energy Intensity	-	-	-	5,912	9,173	3,736	2,198	2,651	2,816	2,308	2,227
Petroleum Intensity	-	-	-	2,907	4,134	1,660	1,017	1,510	1,685	1,449	1,465
<b>Electric Power Sector</b>											
Electricity Diversity	-	-	-	847	827	827	834	831	819	808	796
Non-Carbon Generation	-	-	-	978	956	955	973	914	884	876	869
<b>Transportation Sector</b>											
Transport Energy per Capita	-	-	-	461	379	422	498	550	566	582	600
Transport Energy Intensity	-	-	-	2,600	3,489	1,449	937	1,274	1,410	1,203	1,207
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	-	-	-	1,122	1,207	1,278	1,219	1,151	1,141	1,132	1,123
CO <sub>2</sub> per Capita	-	-	-	1,012	927	1,016	1,064	1,071	1,061	1,050	1,041
CO <sub>2</sub> GDP Intensity	-	-	-	5,706	8,541	3,489	2,003	2,481	2,645	2,170	2,094
<b>Total Index</b>	-	-	-	<b>1,216</b>	<b>1,619</b>	<b>985</b>	<b>873</b>	<b>944</b>	<b>976</b>	<b>914</b>	<b>875</b>

TABLE A2-19



## International Energy Security Risk Index Scores: South Africa

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,559	1,424	1,220	1,145	1,008	1,071	1,210	1,313	1,395	1,430	1,440
Gas Import Exposure	0	0	0	0	0	2,604	3,791	4,397	4,741	5,226	5,367
Coal Import Exposure	0	0	0	0	0	0	0	0	0	0	0
Total Energy Import Exposure	732	630	617	605	556	631	682	842	889	934	986
Fossil Fuel Import Expenditure per GDP	1,313	1,711	1,234	946	1,250	1,201	1,233	1,985	2,162	1,868	1,830
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	1,150	1,079	793	666	743	733	713	1,103	1,194	1,027	1,001
Energy Expenditures per Capita	378	200	187	166	138	216	260	288	284	279	275
Retail Electricity Prices	644	325	426	348	215	273	301	307	309	311	313
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	1,150	1,459	872	274	113	206	402	83	114	226	212
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	1,744	2,321	2,059	2,002	2,321	1,843	1,656	1,955	2,052	1,921	1,908
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	511	573	560	546	565	587	601	536	522	509	498
Energy Intensity	1,554	3,088	2,376	2,187	3,045	1,994	1,648	2,048	2,197	1,879	1,813
Petroleum Intensity	857	1,465	1,104	1,018	1,372	951	783	1,192	1,343	1,205	1,219
<b>Electric Power Sector</b>											
Electricity Diversity	1,579	1,363	1,375	1,380	1,390	1,399	1,401	1,320	1,256	1,220	1,180
Non-Carbon Generation	1,444	1,395	1,371	1,362	1,355	1,379	1,373	1,278	1,215	1,204	1,195
<b>Transportation Sector</b>											
Transport Energy per Capita	338	326	277	324	316	345	373	376	367	358	349
Transport Energy Intensity	1,029	1,759	1,175	1,299	1,701	1,173	1,024	1,439	1,545	1,320	1,271
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,304	1,437	1,574	1,710	1,897	2,059	1,800	1,606	1,591	1,576
CO <sub>2</sub> per Capita	723	824	806	784	785	818	829	671	590	576	563
CO <sub>2</sub> GDP Intensity	2,199	4,438	3,417	3,140	4,226	2,778	2,275	2,564	2,482	2,124	2,050
<b>Total Index</b>	<b>1,026</b>	<b>1,211</b>	<b>988</b>	<b>888</b>	<b>1,044</b>	<b>1,014</b>	<b>1,093</b>	<b>1,186</b>	<b>1,226</b>	<b>1,185</b>	<b>1,156</b>



TABLE A2-20



## International Energy Security Risk Index Scores: South Korea

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,559	1,424	1,220	1,170	1,085	1,156	1,226	1,326	1,404	1,437	1,446
Gas Import Exposure	5,235	9,866	5,893	4,279	4,596	4,854	4,938	5,646	5,868	6,322	6,249
Coal Import Exposure	2,037	3,393	3,450	4,821	4,904	7,165	9,708	10,774	10,577	10,899	10,912
Total Energy Import Exposure	2,353	2,242	2,322	2,561	2,524	2,460	2,520	2,667	2,718	2,682	2,639
Fossil Fuel Import Expenditure per GDP	3,139	2,099	1,571	1,442	1,757	1,797	2,059	1,920	1,849	1,689	1,579
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	2,032	1,379	963	1,057	1,683	1,567	1,657	1,653	1,595	1,464	1,376
Energy Expenditures per Capita	392	297	471	867	1,231	1,598	1,821	2,044	1,987	1,928	1,870
Retail Electricity Prices	1,548	1,082	884	761	535	525	459	545	548	552	555
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	2,032	2,827	1,257	443	357	158	294	293	264	216	263
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	2,278	2,155	1,430	1,104	1,169	990	954	899	896	871	858
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	253	303	496	787	937	1,083	1,237	1,206	1,203	1,201	1,202
Energy Intensity	1,313	1,408	1,013	959	1,281	1,062	1,126	975	965	912	885
Petroleum Intensity	1,969	1,636	1,281	1,385	1,574	1,126	1,041	926	909	850	817
<b>Electric Power Sector</b>											
Electricity Diversity	1,215	860	750	825	864	861	904	858	852	841	828
Non-Carbon Generation	1,260	961	677	952	885	893	1,000	998	1,021	1,017	1,016
<b>Transportation Sector</b>											
Transport Energy per Capita	166	217	421	726	601	632	637	690	701	712	724
Transport Energy Intensity	861	1,008	859	885	821	620	580	558	563	541	533
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,251	1,784	2,700	3,162	3,682	4,349	4,685	4,779	4,737	4,699
CO <sub>2</sub> per Capita	330	386	524	754	847	962	1,105	1,156	1,174	1,159	1,146
CO <sub>2</sub> GDP Intensity	1,713	1,792	1,070	919	1,157	943	1,005	935	942	880	843
<b>Total Index</b>	<b>1,481</b>	<b>1,514</b>	<b>1,160</b>	<b>1,121</b>	<b>1,244</b>	<b>1,296</b>	<b>1,479</b>	<b>1,488</b>	<b>1,490</b>	<b>1,492</b>	<b>1,453</b>

TABLE A2-21



## International Energy Security Risk Index Scores: Spain

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,508	1,350	1,190	1,154	1,082	1,154	1,223	1,321	1,400	1,432	1,441
Gas Import Exposure	6,427	8,409	4,389	4,069	4,551	4,909	4,994	5,658	5,877	6,360	6,340
Coal Import Exposure	1,226	1,877	1,802	2,277	2,912	4,602	5,016	9,797	9,790	9,649	9,571
Total Energy Import Exposure	2,108	1,752	1,839	2,089	2,170	2,306	2,109	2,058	2,012	2,031	2,020
Fossil Fuel Import Expenditure per GDP	1,515	1,612	740	760	1,114	1,066	998	1,131	1,073	1,015	931
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	789	990	461	515	631	611	598	737	703	673	622
Energy Expenditures per Capita	553	406	477	529	568	886	915	868	845	841	822
Retail Electricity Prices	1,011	823	1,452	1,134	588	821	1,189	1,311	1,319	1,327	1,335
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	789	945	331	48	216	103	150	134	115	113	113
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	1,195	1,561	984	987	1,055	830	809	921	912	895	870
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	461	484	565	606	760	836	749	683	683	684	684
Energy Intensity	659	1,178	546	590	846	577	490	579	569	547	518
Petroleum Intensity	996	1,371	633	738	1,004	649	518	556	541	516	483
<b>Electric Power Sector</b>											
Electricity Diversity	825	601	568	592	589	655	519	513	510	507	505
Non-Carbon Generation	1,002	772	676	747	813	940	662	638	561	559	558
<b>Transportation Sector</b>											
Transport Energy per Capita	476	490	648	736	930	1,052	946	820	823	825	827
Transport Energy Intensity	679	1,193	627	717	1,034	725	619	696	685	660	625
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,068	1,155	1,269	1,571	1,880	1,536	1,331	1,385	1,373	1,362
CO <sub>2</sub> per Capita	498	519	555	597	724	805	616	535	557	551	545
CO <sub>2</sub> GDP Intensity	712	1,263	537	581	805	555	403	454	463	441	412
<b>Total Index</b>	<b>1,132</b>	<b>1,237</b>	<b>896</b>	<b>867</b>	<b>995</b>	<b>1,055</b>	<b>1,107</b>	<b>1,210</b>	<b>1,211</b>	<b>1,225</b>	<b>1,189</b>

TABLE A2-22



## International Energy Security Risk Index Scores: Thailand

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,556	1,100	1,044	1,025	832	831	779	854	909	974	1,017
Gas Import Exposure	0	0	0	0	306	1,258	979	1,422	1,449	1,697	1,715
Coal Import Exposure	330	0	347	1,249	1,798	3,546	6,616	8,277	7,878	8,070	7,950
Total Energy Import Exposure	2,710	1,506	1,698	1,787	1,457	1,526	1,330	1,510	1,556	1,679	1,801
Fossil Fuel Import Expenditure per GDP	2,425	1,518	1,545	1,293	1,824	2,604	1,732	2,067	2,027	1,964	1,890
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	1,127	920	813	770	1,215	1,764	2,090	2,399	2,349	2,174	2,045
Energy Expenditures per Capita	87	60	92	146	149	279	528	639	634	634	644
Retail Electricity Prices	1,017	837	686	667	491	510	593	603	607	611	614
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	1,127	639	289	230	463	326	209	112	93	232	355
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	3,598	3,907	2,971	2,298	2,852	2,513	1,990	1,937	1,925	1,853	1,782
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	60	75	124	199	227	321	372	404	398	392	388
Energy Intensity	777	1,147	1,091	1,049	1,849	2,028	1,474	1,515	1,473	1,346	1,230
Petroleum Intensity	1,584	1,682	1,611	1,542	2,352	2,443	1,541	1,675	1,711	1,639	1,569
<b>Electric Power Sector</b>											
Electricity Diversity	1,153	1,068	1,151	1,262	1,272	1,279	1,277	1,192	1,108	1,055	999
Non-Carbon Generation	1,324	1,227	1,295	1,326	1,354	1,374	1,373	1,306	1,252	1,239	1,229
<b>Transportation Sector</b>											
Transport Energy per Capita	152	137	222	332	318	374	361	424	432	440	448
Transport Energy Intensity	1,971	2,094	1,958	1,754	2,582	2,362	1,428	1,591	1,600	1,508	1,420
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,379	2,643	4,486	4,775	7,019	8,294	9,187	9,215	9,116	9,024
CO <sub>2</sub> per Capita	67	84	147	238	239	338	389	422	421	415	410
CO <sub>2</sub> GDP Intensity	862	1,275	1,300	1,256	1,945	2,137	1,541	1,582	1,561	1,425	1,301
<b>Total Index</b>	<b>1,171</b>	<b>1,041</b>	<b>969</b>	<b>950</b>	<b>1,186</b>	<b>1,391</b>	<b>1,377</b>	<b>1,456</b>	<b>1,443</b>	<b>1,441</b>	<b>1,396</b>

TABLE A2-23



## International Energy Security Risk Index Scores: Turkey

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	1,329	1,256	1,023	1,032	992	1,073	1,126	1,235	1,304	1,335	1,330
Gas Import Exposure	0	0	5,533	4,169	4,402	4,773	4,911	5,625	5,842	6,325	6,306
Coal Import Exposure	1,119	1,040	1,574	1,362	2,144	3,553	4,605	6,699	6,118	5,876	5,582
Total Energy Import Exposure	1,692	1,587	1,635	1,761	1,969	2,088	2,024	2,267	2,214	2,301	2,264
Fossil Fuel Import Expenditure per GDP	1,416	1,642	1,112	1,301	1,114	1,107	999	1,276	1,238	1,337	1,498
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	1,063	1,199	1,020	884	790	932	899	1,069	1,038	1,085	1,205
Energy Expenditures per Capita	188	144	214	171	209	377	477	534	507	504	486
Retail Electricity Prices	1,090	610	793	728	691	830	1,105	1,051	1,057	1,064	1,071
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	1,063	661	352	335	666	340	120	71	64	64	78
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	2,377	2,888	2,183	2,277	1,945	1,574	1,372	1,415	1,431	1,466	1,575
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	134	151	204	238	279	307	346	367	362	357	354
Energy Intensity	757	1,260	973	1,233	1,054	759	652	735	741	768	876
Petroleum Intensity	1,069	1,564	1,063	1,349	976	589	413	476	476	489	552
<b>Electric Power Sector</b>											
Electricity Diversity	826	868	842	826	921	958	914	799	732	719	704
Non-Carbon Generation	754	958	853	836	1,082	1,087	1,059	1,022	1,059	1,056	1,054
<b>Transportation Sector</b>											
Transport Energy per Capita	130	151	201	235	213	218	245	311	326	342	359
Transport Energy Intensity	737	1,259	956	1,221	806	540	462	622	667	735	890
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	1,508	2,022	2,474	3,083	3,072	3,577	4,389	4,545	4,506	4,469
CO <sub>2</sub> per Capita	156	211	258	291	335	311	340	384	391	382	373
CO <sub>2</sub> GDP Intensity	883	1,757	1,227	1,507	1,266	769	640	768	801	820	924
<b>Total Index</b>	<b>953</b>	<b>1,010</b>	<b>1,026</b>	<b>1,008</b>	<b>1,037</b>	<b>1,052</b>	<b>1,137</b>	<b>1,229</b>	<b>1,226</b>	<b>1,262</b>	<b>1,267</b>

TABLE A2-24

## International Energy Security Risk Index Scores: Ukraine



METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	-	-	-	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	-	-	-	751	697	742	786	851	901	922	928
Global Gas Reserves	-	-	-	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	-	-	-	666	715	768	778	882	916	991	988
Global Coal Reserves	-	-	-	566	582	644	616	615	615	615	615
Global Coal Production	-	-	-	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	-	-	-	967	767	813	929	1,067	1,158	1,208	1,213
Gas Import Exposure	-	-	-	3,386	3,545	3,610	3,235	2,567	2,440	2,484	2,495
Coal Import Exposure	-	-	-	875	364	455	1,358	3,526	3,813	3,831	3,540
Total Energy Import Exposure	-	-	-	1,481	1,382	1,164	1,110	874	913	899	918
Fossil Fuel Import Expenditure per GDP	-	-	-	8,079	10,137	5,795	3,342	3,720	3,598	2,973	2,684
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	-	-	-	5,745	7,388	4,359	2,713	3,281	3,227	2,693	2,475
Energy Expenditures per Capita	-	-	-	358	288	436	400	302	302	299	314
Retail Electricity Prices	-	-	-	875	626	716	873	888	894	899	905
Crude Oil Prices	-	-	-	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	-	-	-	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	-	-	-	509	2,402	2,945	690	956	826	947	670
World Oil Refinery Usage	-	-	-	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	-	-	-	4,007	5,068	3,163	2,604	3,297	3,268	3,004	2,806
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	-	-	-	776	654	739	611	557	552	549	547
Energy Intensity	-	-	-	12,467	16,793	7,397	4,138	6,053	5,899	4,952	4,304
Petroleum Intensity	-	-	-	3,849	3,422	1,643	1,114	1,564	1,601	1,410	1,284
<b>Electric Power Sector</b>											
Electricity Diversity	-	-	-	814	799	773	760	762	770	762	754
Non-Carbon Generation	-	-	-	848	710	663	665	515	537	531	527
<b>Transportation Sector</b>											
Transport Energy per Capita	-	-	-	201	137	206	217	187	190	194	198
Transport Energy Intensity	-	-	-	3,219	3,509	2,060	1,468	2,033	2,034	1,750	1,557
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	-	-	-	1,122	1,207	1,278	1,219	1,151	1,141	1,132	1,123
CO <sub>2</sub> per Capita	-	-	-	782	613	686	555	350	287	285	283
CO <sub>2</sub> GDP Intensity	-	-	-	12,562	15,748	6,862	3,764	3,805	3,061	2,568	2,229
<b>Total Index</b>	-	-	-	<b>2,751</b>	<b>3,393</b>	<b>2,094</b>	<b>1,544</b>	<b>1,766</b>	<b>1,734</b>	<b>1,594</b>	<b>1,463</b>

TABLE A2-25



## International Energy Security Risk Index Scores: United Kingdom

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	0	0	0	0	0	108	185	468	434	453	358
Gas Import Exposure	1,431	2,226	789	42	0	377	1,966	2,373	2,823	2,935	2,926
Coal Import Exposure	0	707	742	1,731	2,518	4,967	6,365	8,483	9,545	10,116	10,064
Total Energy Import Exposure	129	251	201	196	221	632	912	1,017	1,119	1,087	1,009
Fossil Fuel Import Expenditure per GDP	51	118	36	18	11	35	224	272	308	305	261
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	341	995	475	456	429	129	547	481	534	529	495
Energy Expenditures per Capita	387	754	682	698	736	296	1,063	976	977	936	912
Retail Electricity Prices	1,268	737	978	858	626	828	978	1,104	1,111	1,118	1,125
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	341	771	527	161	49	17	310	88	87	42	75
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	939	1,149	835	808	764	661	717	702	739	752	737
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	884	859	900	923	924	569	797	728	724	721	719
Energy Intensity	779	1,133	628	602	539	249	410	359	396	408	391
Petroleum Intensity	645	951	538	503	430	344	328	282	308	315	299
<b>Electric Power Sector</b>											
Electricity Diversity	1,264	1,083	1,057	962	1,003	988	990	652	630	622	616
Non-Carbon Generation	1,261	1,156	1,128	1,028	1,085	1,089	1,118	778	771	768	767
<b>Transportation Sector</b>											
Transport Energy per Capita	789	751	864	870	948	943	851	832	837	842	848
Transport Energy Intensity	695	991	603	568	553	413	438	410	458	476	461
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	942	962	934	930	976	890	719	698	692	686
CO <sub>2</sub> per Capita	971	911	919	880	863	883	775	604	582	572	564
CO <sub>2</sub> GDP Intensity	856	1,202	641	574	504	386	399	298	318	324	306
<b>Total Index</b>	<b>789</b>	<b>870</b>	<b>672</b>	<b>599</b>	<b>625</b>	<b>671</b>	<b>921</b>	<b>907</b>	<b>956</b>	<b>979</b>	<b>944</b>

TABLE A2-26



## International Energy Security Risk Index Scores: United States

METRIC	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>Global Fuels</b>											
Global Oil Reserves	1,000	1,040	1,241	1,313	1,277	870	882	973	1,036	1,060	1,121
Global Oil Production	1,000	914	783	751	697	742	786	851	901	922	928
Global Gas Reserves	1,000	1,360	865	876	993	979	928	1,003	1,082	1,076	1,035
Global Gas Production	1,000	1,466	917	666	715	768	778	882	916	991	988
Global Coal Reserves	1,000	1,075	688	566	582	644	616	615	615	615	615
Global Coal Production	1,000	1,074	844	832	788	1,118	1,490	1,647	1,616	1,663	1,663
<b>Fuel Imports</b>											
Oil Import Exposure	624	446	575	616	661	775	729	397	453	394	215
Gas Import Exposure	104	385	384	677	803	877	564	25	156	41	41
Coal Import Exposure	0	0	0	0	0	0	0	0	0	0	0
Total Energy Import Exposure	522	396	587	692	806	901	711	313	353	284	155
Fossil Fuel Import Expenditure per GDP	801	380	502	457	487	660	562	243	254	195	99
<b>Energy Expenditures</b>											
Energy Expenditure Intensity	1,181	801	570	398	434	559	511	486	461	434	409
Energy Expenditures per Capita	1,680	1,281	1,023	760	967	1,348	1,233	1,259	1,205	1,152	1,110
Retail Electricity Prices	760	831	653	576	500	533	583	562	565	569	572
Crude Oil Prices	1,000	618	434	275	427	726	963	580	479	583	748
<b>Price &amp; Market Volatility</b>											
Crude Oil Price Volatility	1,000	425	410	155	605	671	1,702	1,310	1,391	1,342	678
Energy Expenditure Volatility	1,181	1,180	284	202	200	119	261	76	80	77	75
World Oil Refinery Usage	1,000	1,005	1,197	1,194	1,227	1,299	1,176	1,213	1,216	1,249	1,242
GDP per Capita	839	791	747	724	670	644	644	621	619	614	607
<b>Energy Use Intensity</b>											
Energy Consumption per Capita	1,919	1,793	1,890	1,910	1,956	1,894	1,760	1,692	1,683	1,677	1,674
Energy Intensity	1,349	1,122	1,054	1,000	879	785	730	653	644	632	617
Petroleum Intensity	1,291	993	914	827	744	691	581	508	497	483	466
<b>Electric Power Sector</b>											
Electricity Diversity	1,010	941	894	891	914	960	914	831	803	785	764
Non-Carbon Generation	1,118	1,059	1,011	999	1,034	1,047	1,020	974	951	948	947
<b>Transportation Sector</b>											
Transport Energy per Capita	2,019	2,001	2,061	2,054	2,167	2,231	2,071	2,094	2,129	2,167	2,206
Transport Energy Intensity	1,420	1,252	1,149	1,076	974	924	859	808	815	816	813
<b>Environmental</b>											
CO <sub>2</sub> Emissions Trend	1,000	970	1,064	1,129	1,246	1,282	1,192	1,126	1,095	1,085	1,077
CO <sub>2</sub> per Capita	1,885	1,746	1,826	1,816	1,891	1,858	1,651	1,504	1,452	1,430	1,410
CO <sub>2</sub> GDP Intensity	1,325	1,092	1,018	951	850	770	685	580	555	539	519
<b>Total Index</b>	<b>1,071</b>	<b>941</b>	<b>838</b>	<b>783</b>	<b>824</b>	<b>874</b>	<b>897</b>	<b>772</b>	<b>775</b>	<b>769</b>	<b>727</b>

TABLE A2-27

International Energy Security Risk Index Scores: Top 75 Energy-Consuming Countries: 1980-2018  
(OECD 1980=1,000)

COUNTRY	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
<b>OECD Group Average</b>	1,000	959	795	739	791	843	932	895	904	915	884
Algeria	940	928	891	1,089	991	976	1,087	1,199	1,244	1,269	1,251
Argentina	991	990	833	640	675	928	968	1,008	1,061	1,071	1,136
Australia	858	804	717	705	741	811	856	825	846	842	805
Austria	1,091	1,176	925	840	878	1,038	1,167	1,158	1,161	1,183	1,153
Azerbaijan	-	-	-	5,033	2,797	1,943	1,031	1,090	1,247	1,260	1,212
Bahrain	1,255	1,431	1,528	1,282	1,295	1,303	1,326	1,393	1,379	1,370	1,343
Bangladesh	1,061	1,052	956	997	1,013	1,144	1,187	1,171	1,154	1,157	1,139
Belarus	3,614	3,725	2,482	2,554	2,816	2,082	1,786	1,880	2,029	1,987	1,924
Belgium	1,398	1,434	1,142	1,049	1,148	1,214	1,358	1,347	1,346	1,362	1,323
Brazil	1,156	1,098	930	778	914	957	980	1,078	1,065	1,058	1,059
Bulgaria	2,137	2,504	1,847	1,719	1,843	1,226	1,200	1,172	1,161	1,163	1,111
Canada	1,009	880	754	740	779	787	825	833	834	830	802
Chile	822	929	885	786	1,071	1,155	1,235	1,200	1,208	1,213	1,178
China	1,436	1,327	1,413	1,090	996	1,067	982	918	957	956	912
Colombia	823	826	769	632	653	649	642	662	681	690	678
Croatia	-	-	-	880	1,020	1,026	1,078	1,117	1,135	1,187	1,181
Czech Republic	-	-	-	1,050	1,094	994	1,030	1,057	1,066	1,069	1,024
Denmark	1,263	1,120	860	797	755	800	919	861	864	876	864
Ecuador	800	815	888	818	1,032	910	1,064	1,022	1,024	1,045	1,042
Egypt	1,197	1,227	1,242	1,139	1,013	1,452	1,250	1,199	1,249	1,455	1,407
Finland	1,410	1,344	1,028	947	988	1,040	1,197	1,169	1,167	1,185	1,147
France	1,152	1,172	910	821	912	992	1,118	1,133	1,137	1,160	1,128
Germany	1,189	1,232	962	828	865	798	1,076	1,087	1,100	1,119	1,085
Greece	973	987	880	795	1,038	1,009	1,073	1,077	1,113	1,115	1,076
Hungary	1,678	1,623	1,218	985	1,046	1,017	1,088	1,098	1,113	1,139	1,113
India	928	943	963	1,086	1,186	1,136	1,176	1,216	1,205	1,170	1,144
Indonesia	799	868	897	778	965	978	894	930	920	930	932
Iran	879	777	960	1,380	1,511	1,356	1,196	1,428	1,393	1,403	1,371
Iraq	742	809	631	1,652	1,678	1,335	1,051	1,114	1,161	1,258	1,191
Ireland	1,224	1,151	916	869	1,030	1,113	1,248	1,211	1,104	1,100	1,048
Israel	1,262	1,200	989	911	958	1,061	1,250	1,095	1,083	1,076	1,044
Italy	1,184	1,216	985	926	995	1,101	1,224	1,225	1,240	1,270	1,240
Japan	1,357	1,336	1,063	972	978	1,077	1,200	1,293	1,278	1,307	1,281
Kazakhstan	-	-	-	1,900	1,914	1,053	834	793	903	881	889
Kuwait	1,014	1,008	1,109	1,094	1,224	1,256	1,399	1,577	1,651	1,676	1,645
Libya	1,226	1,184	898	980	919	1,092	1,155	1,827	1,941	1,667	1,526
Malaysia	981	1,042	1,007	916	1,061	1,146	1,226	1,255	1,251	1,287	1,272



**TABLE A2-27 (CONTINUED)**

International Energy Security Risk Index Scores: Top 75 Energy-Consuming Countries: 1980-2018  
(OECD 1980=1,000)

COUNTRY	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2018
Mexico	742	784	751	695	642	765	857	900	948	975	966
Morocco	923	1,095	986	962	1,096	1,245	1,434	1,521	1,522	1,537	1,498
Netherlands	968	1,148	949	888	956	843	1,172	1,172	1,163	1,163	1,147
New Zealand	892	856	760	705	797	770	804	779	771	774	757
Nigeria	680	699	818	1,052	816	688	650	623	811	849	837
Norway	870	846	746	725	709	675	728	684	687	866	869
Oman	795	831	908	864	1,015	1,170	1,556	1,664	1,701	1,736	1,731
Pakistan	1,084	1,165	1,218	1,154	1,231	1,195	1,276	1,176	1,199	1,204	1,211
Paraguay	845	970	1,008	987	1,154	1,200	1,041	1,042	1,079	1,095	1,094
Peru	906	907	814	691	813	836	893	841	874	890	884
Philippines	1,077	1,055	1,000	998	1,089	1,101	998	1,008	964	984	978
Poland	1,785	1,834	1,381	956	981	939	1,029	985	1,010	1,010	967
Portugal	1,089	1,311	1,083	1,023	1,101	1,169	1,227	1,283	1,287	1,316	1,279
Qatar	1,253	1,280	1,319	1,767	1,475	1,406	1,327	1,522	1,565	1,600	1,610
Romania	1,640	1,654	1,546	1,236	1,168	929	794	734	752	729	676
Russia	-	-	-	1,216	1,619	985	873	943	976	914	875
Saudi Arabia	927	1,220	1,214	1,163	1,191	1,281	1,404	1,482	1,514	1,541	1,518
Serbia	-	-	-	-	-	-	1,118	1,157	1,181	1,192	1,132
Singapore	2,058	1,915	1,789	1,495	1,628	1,927	2,160	2,226	2,228	2,246	2,211
Slovakia	-	-	-	1,197	1,157	1,120	1,207	1,203	1,207	1,221	1,178
South Africa	1,026	1,211	988	888	1,044	1,014	1,093	1,186	1,226	1,185	1,156
South Korea	1,481	1,514	1,160	1,120	1,244	1,296	1,479	1,488	1,490	1,492	1,453
Spain	1,132	1,237	896	867	995	1,055	1,107	1,209	1,211	1,225	1,189
Sweden	1,217	1,276	942	880	908	964	1,095	1,084	1,085	1,110	1,084
Switzerland	1,208	1,230	952	865	893	961	1,078	1,051	1,053	1,077	1,050
Taiwan	1,074	1,044	902	962	1,051	1,141	1,278	1,299	1,309	1,338	1,314
Thailand	1,171	1,041	969	950	1,186	1,391	1,377	1,456	1,442	1,441	1,396
Trinidad and Tobago	1,110	1,161	1,223	1,433	1,425	1,577	1,933	1,954	2,011	2,012	1,975
Tunisia	962	1,261	1,116	993	1,007	1,081	1,126	1,353	1,407	1,491	1,498
Turkey	953	1,010	1,026	1,008	1,037	1,052	1,137	1,229	1,226	1,262	1,267
Turkmenistan	-	-	-	2,549	2,977	2,465	1,822	1,810	1,883	1,915	1,894
Ukraine	-	-	-	2,751	3,393	2,094	1,544	1,766	1,734	1,594	1,463
United Arab Emirates	855	1,227	1,287	1,269	1,177	1,258	1,422	1,514	1,540	1,568	1,569
United Kingdom	789	870	671	599	625	671	921	907	956	979	944
United States	1,071	940	837	783	824	874	897	772	775	769	727
Uzbekistan	-	-	-	2,487	2,608	3,164	1,642	1,055	1,045	1,330	1,569
Venezuela	776	781	938	811	760	822	697	665	661	669	650
Vietnam	988	959	1,488	997	1,085	1,135	1,277	1,101	1,195	1,200	1,168

## DATA SOURCES

The Energy Institute relied primarily on government data from the Energy Information Administration and the International Energy Agency to develop its *International Index of Energy Security Risk*. Where historical data from government sources were not available, other widely-used and respected sources were employed. The following provides a list of the main sources of the data used to compile the metrics.

### BP:

*BP Statistical Review of World Energy*.

Available at: <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>. For refinery capacity and utilization data.

### Energy Information Administration:

*International Energy Statistics*. Available at: <http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm>.

For historical international energy production, consumption, reserve, import, export, electricity capacity, transportation energy, and other energy data.

*Annual Energy Review*. Available at: <http://www.eia.doe.gov/emeu/aer/contents.html>. For crude oil price data.

### Freedom House:

*Freedom in the World: Comparative and Historical Data*. Available at: <http://www.freedomhouse.org/report-types/freedom-world>. For historical international political rights and civil liberties data. Freedom House's annual index of political rights and civil liberties was used as a proxy for reliability of international trading partners.

### International Energy Agency:

*IEA Statistics, Energy Prices and Taxes*. Available at: <https://www.iea.org/data-and-statistics>. Subscription required. For energy price and expenditure data.

### World Bank:

*Development Indicators*. Available at: <https://data.worldbank.org/indicator?tab=all>. For population, gross domestic product, net energy imports, and electricity generation by energy source.





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