

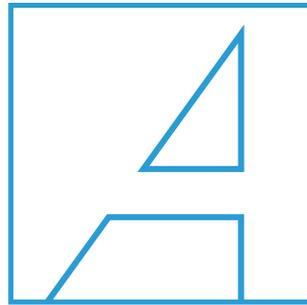


Konrad
Adenauer
Stiftung

Asia's Climate Change and Energy Security in Figures



**Facts and Trends of
Climate Change and Energy Security in Asia**



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Climate Change and Energy Security in Asia

2018



Konrad
Adenauer
Stiftung

Regional Project Energy Security and Climate Change in Asia and Pacific
Konrad-Adenauer-Stiftung, Hong Kong SAR.

Asia's Climate Change And Energy Security In Figures

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FOREWORD



ENERGY security, access to natural resources and the impact of climate change—these three factors will massively shape the prospects of the people in Asia-Pacific and beyond. These challenges are very complex, which make coordinated and strategic political action across borders difficult. Yet, solutions can only be found by regional and global cooperation. Furthermore, fundamental changes in behaviour can happen only on the basis of a broad and scientifically proved evidence.

Asia's pursuit of clean energy is at the heart of the region's aspirations for a better future, as reflected in the commitments made by Asian countries at the 2015 Paris Climate Conference. The Asian countries have articulated in their nationally determined contributions (NDCs) to undertake emission reductions. Most major Asian countries have resolved to significantly bend their national emissions curves.

Across the region, due to rising energy demands, Asian countries are diversifying their energy sources. Many countries are moving from fossil fuels to renewable sources such as solar and wind. This energy revolution is driven by the economic and strategic consideration and will change the lives of millions of people in Asia who are still struggling through life with no electricity.

While China is powering ahead of other countries as the biggest

investor in renewable energy, other Asian countries are emerging as significant renewable markets as well. Much as the sources of renewable energy are making headways in Asia, Coal however, remains a major source of energy in the region. Today Asian countries are the main driving force of the global coal demand growth thanks to their economic expansion and their large population.

The dependence on fossil fuels is why China and India rank among leading global greenhouse gas emitters. Both the countries, which are set to contribute more than half of the global increase in carbon emissions in the next 25 years, will play a critical role in any effort to address clean energy and climate change.

Asia's overall population is expected to add 0.9 billion people to the world's expanding population by 2050, putting more pressure on space and all other resources.

Since 2015, Konrad-Adenauer-Stiftung's Regional Programme Energy Security and Climate change in Asia-Pacific, in cooperation with the India-based data-driven organisation DataLEADS, has developed a unique and well-received series of infographics on energy and climate change related topics in the region and on global matters.

Each month we publish infographics on a wide range of topics in energy, climate and environment. To make this information available in an attractive manner, we chose a selection of the most compelling infographics, grouped around the five key topics of climate change, energy landscapes, renewable energies, nuclear and fossil fuels and energy finance. Each infographic is accompanied by a short analysis.

The aim of this publication is to take information to a next level, build engagement and to inspire fresh discussions in politics, business and civil society.

We would like to thank all contributors for their ideas and skillful realisation of the project.

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Chapter 1

Climate Change



Asia Is Integral To The Fight Against Climate Change

ASIA is going to make or break the climate change. The region is responsible for 35 per cent of worldwide energy related carbon emissions, compared to 17 per cent in 1990.

Eight of the top 10 countries in the world with the largest number of people living in low-lying areas are in Asia and around 17 per cent of total annual global emissions come from forest and land use change, with about one-third from Asia and the Pacific.

Without greater use of renewable energy, Asia's share in global energy-related emissions could reach about 45 per cent by 2030. Asia's overall population is expected to expand by more than 30 per cent to over 5.4 billion by 2050, putting more pressure on space and all other resources.

Ahead of the Paris Conference on Climate Change in 2015, every Asian nation committed to reducing greenhouse gas emissions and ways to adapt to the impacts of climate change. Two Asian giants — China and India — are increasingly keen to be seen tackling climate change. Both the countries want to invest more in the clean and renewable energy and increase investments in climate change adaptation.

There is a wider agreement that climate change is no longer an issue for the distant future. It is already taking place and the Asian countries, particularly the poorest people, are most at risk.



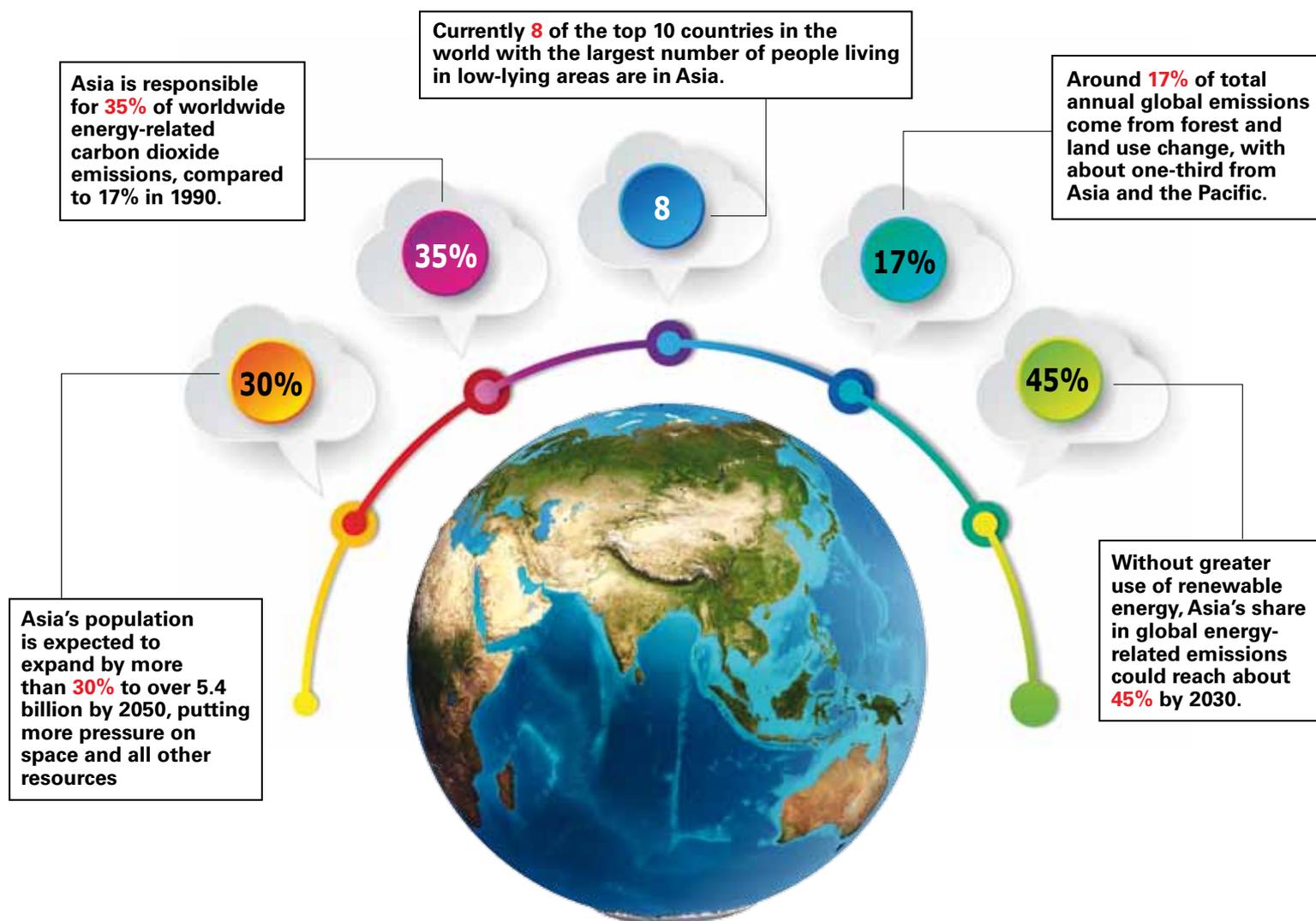
CLIMATE CHANGE

90%

of climate scientists agree that climate-warming trends over the past century are very likely due to human activities.



Why Asia Is The Key To Tackle Climate Change?



The Countries Hit Hardest By Extreme Weather

EXTREME weather is one way that people experience climate change. Throughout history, extreme weather has affected human society.

Six Asian countries are ranked among the world's top 10 countries most affected by extreme weather events in the last 20 years (1996-2015), according to a report by the NGO Germanwatch. These six countries are: Myanmar, Philippines, Bangladesh, Pakistan, Vietnam and Thailand.



CLIMATE CHANGE

By compiling a Climate Risk Index, Germanwatch has combined average numbers of deaths and the value of financial losses over the last 20 years to rank the countries that have been most gravely affected by such incidents. While single extreme events can't be attributed to man-made climate change, Germanwatch pointed out that climate change is nonetheless becoming an increasingly important factor for changing the odds of occurrence and intensity of these events.

Myanmar, with a population of 53 million people, is identified as the second most affected country in the last 20 years. Other countries such as the Philippines (ranked fifth) have been affected more continuously. In Bangladesh, sea surface temperatures have seen a marked rise over the years. Increase in floods, rise in temperatures, heat waves and droughts portend the severe effects of the climate change in Pakistan. Scientific evidence shows that extreme events are increasing worldwide, and will continue to increase as the amount of heat in atmosphere and sea level is increasing.

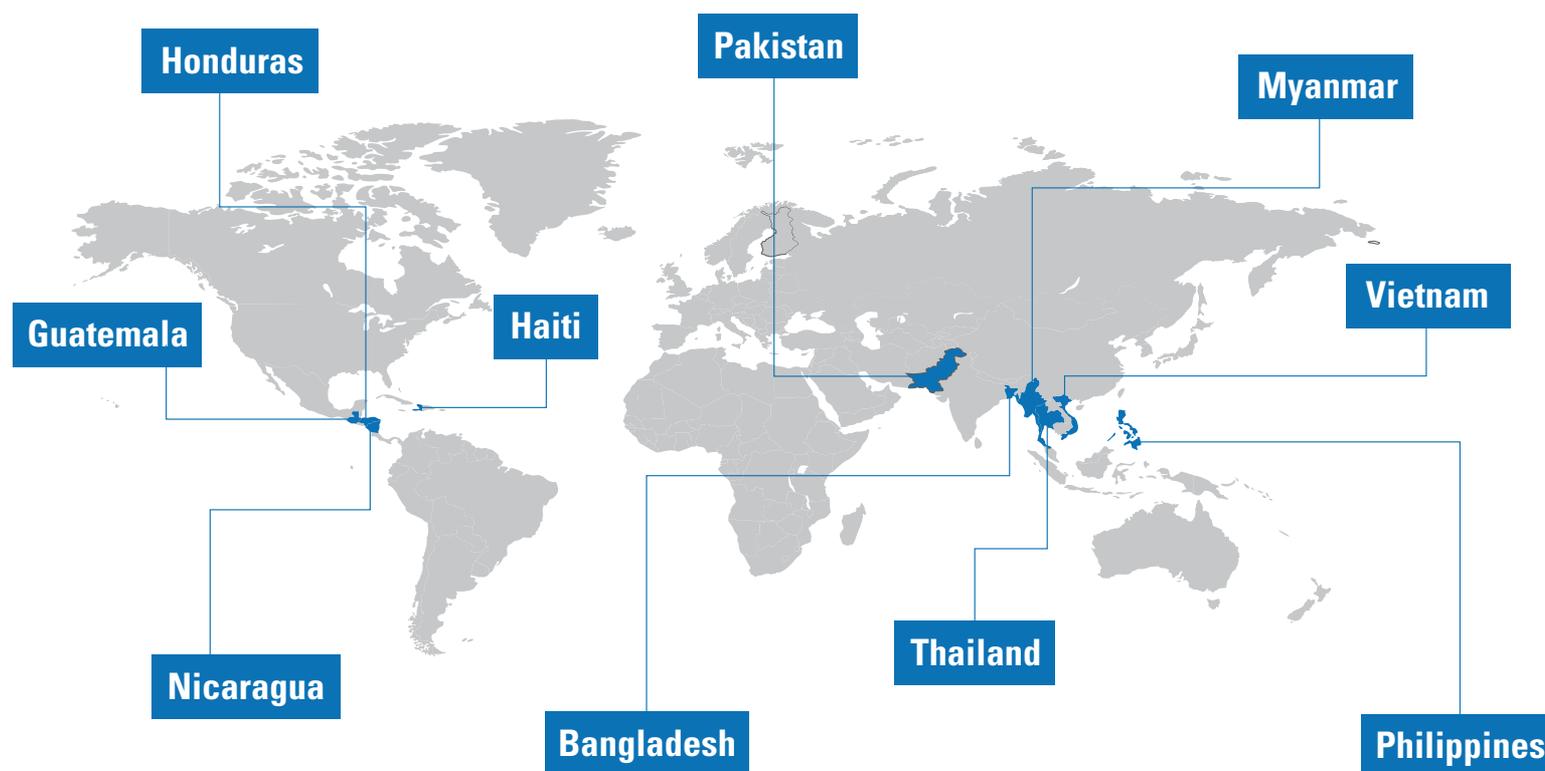
524,000

Worldwide, 524,000 people lost their lives between 1997 and 2016, with financial losses totalling USD 3.16 trillion as a direct result of extreme weather events across the two decades.



Who Suffers Most From Extreme Weather Events?

Six of Asia's countries are ranked among the world's top 10 countries most affected by climate risk based on frequency, death tolls and economic losses, according to the Global Climate Risk Index by think-tank Germanwatch.



CO2 Emissions: Where Do Asian Countries Stand?

THE CO2 emissions are rising in Asia. There are many reasons, but the biggest is that China is burning more coal. China, which is the largest CO2 emitting country in Asia, contributed emissions of 104,432,751 Ktons in 2016 compared to 2,305,424 in 1990, as per the Emissions Database for Global Atmospheric Research, EU.

Carbon dioxide, a greenhouse gas, is the main pollutant that is warming Earth. It is produced as a by-product of human activities. Burning fossil fuels—coal, oil, and natural gas—is the number one source of global CO2 emissions.

China is followed by India and Japan which emitted about 2,533,638 Ktons, and 1,239,592 Ktons respectively in 2016, followed by Australia, South Korea, Indonesia and North Korea. Both China and India primarily rely on coal as the biggest source of energy while Japan is mostly dependent on oil for its energy needs.

Other Asia Pacific countries like Australia emitted carbon emissions of up to 414,988 ktons in 2016, while South Korea and Indonesia emitted 604,043 ktons and 530,035 ktons respectively. The other major greenhouse gas emitters in Asia are Thailand, Pakistan and Malaysia. The best performing Asian countries, with respect to carbon emissions, are Laos, Bhutan and Maldives. Global CO2 emissions from energy use remained roughly flat in 2016 (+0.1%), well below the 10-year average growth of 1.6 per cent, according to a report from BP, a big oil firm.



CLIMATE CHANGE

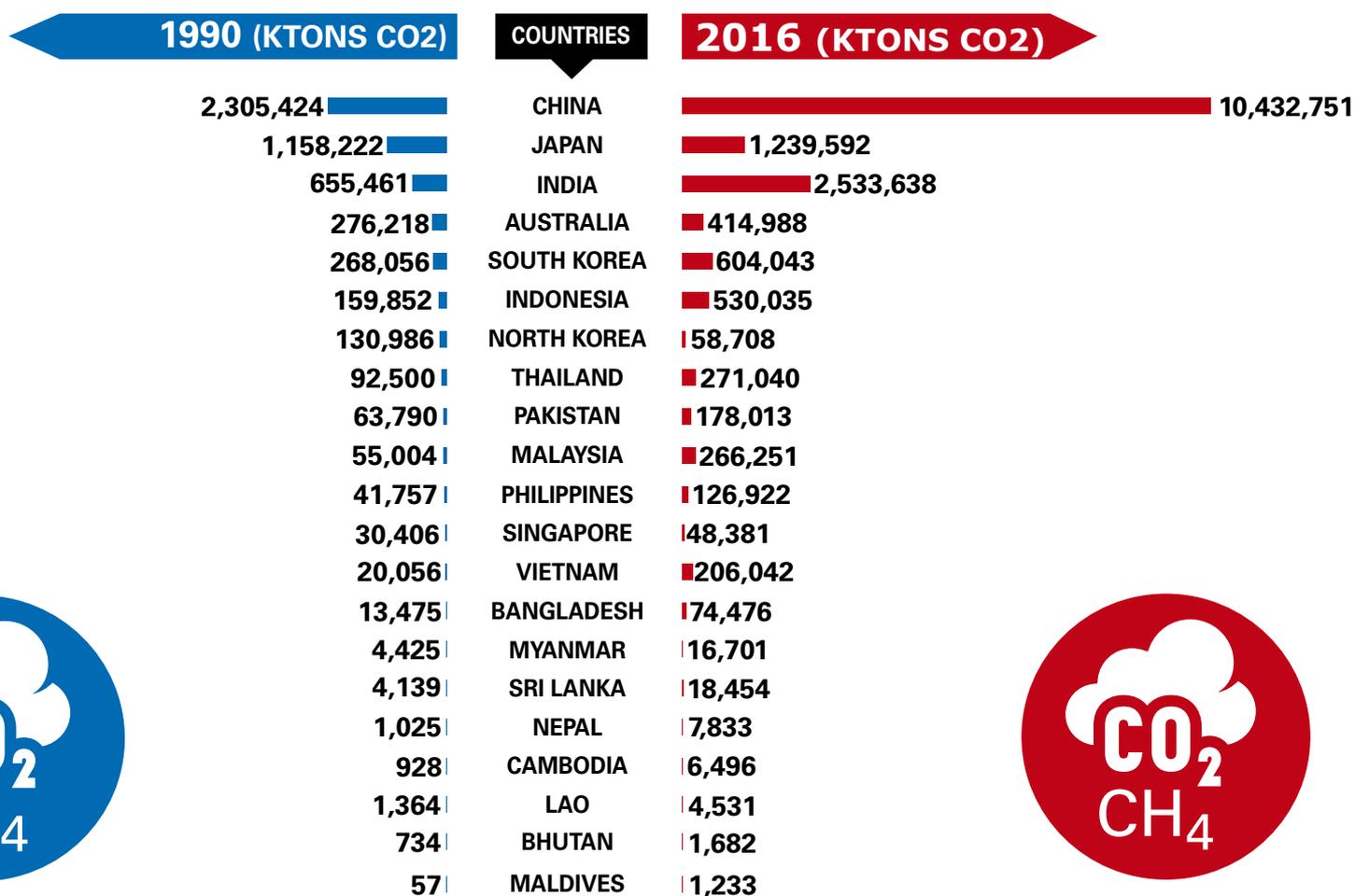
80

A human who lives for 80 years will produce about 29 metric tonnes of carbon dioxide through respiration.



Asia's CO2 Emissions

Country-specific CO2 emissions from fossil fuel combustion and from industrial processes (cement and metal production) have increased all over Asia since 1990. Overall China remains the largest emitting country, followed by India and Japan.





CLIMATE CHANGE

Thirteen Of The 20 Most Polluted Cities In The World Are In India

HALF of the top 20 cities in the world with the highest levels of PM2.5 were in India, according to the pollution data released by the WHO, which included 1,622 cities.

India’s national capital, New Delhi has the highest level of the airborne particulate matter, PM2.5 considered most harmful to health, with 153 micrograms. Not far behind was another Indian city, Patna with 149 micrograms. These figures are six times what the WHO considers a “safe” limit—which is 25 micrograms. Gwalior city in the central state of Madhya Pradesh was the third most polluted city in India having PM2.5 concentration with 144 micrograms.

Raipur, the capital of India’s mineral-rich state of Chhattisgarh was the fourth most polluted city having PM2.5 concentration of 134 micrograms. Housing large textile industries, Ahmedabad in the western state of Gujarat has PM 2.5 concentration of 100 micrograms making it fifth most polluted city of the country.

Other cities with high levels were located in Pakistan and Bangladesh. No Chinese cities ranked in the top 20 most polluted cities, despite thick, grey smog filling its cities and millions of residents commuting behind surgical masks. Beijing reported 56 micrograms of PM2.5. Cities with the lowest level of pollution were located in Canada, the United States, Finland, Iceland and Sweden.

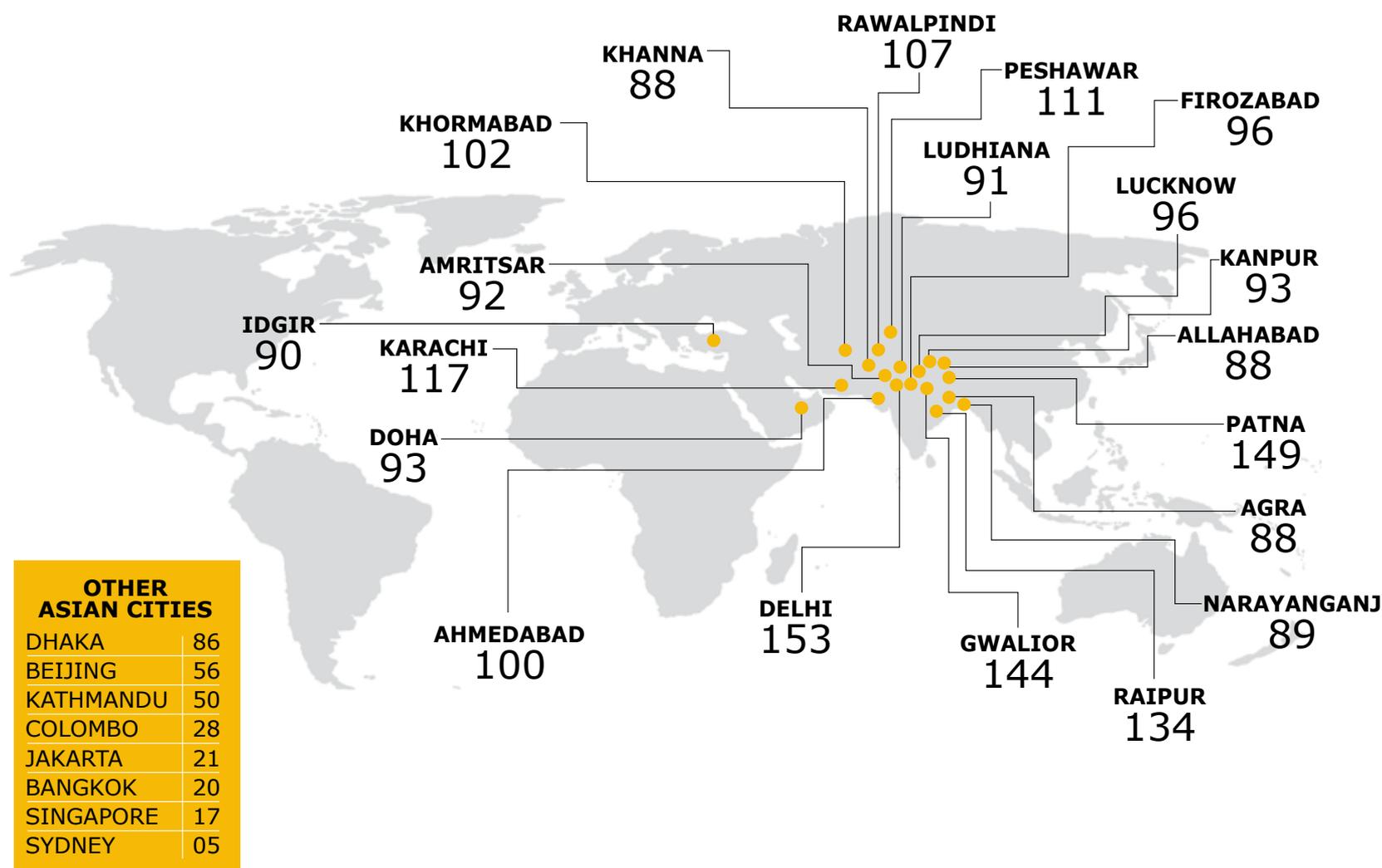
1,622

Of the 1,622 cities covered in the WHO data, 510 were in two countries – the US and Canada. Just 16 were in Africa. That’s 0.75% of the monitoring for 15% of the world’s population



World's Most Polluted Cities

Half of the top 20 cities in the world with the highest levels of PM2.5 were in India, according to the data released by the WHO, which included 1,622 cities.



Ten Most Threatened Forest Hot Spots

FORESTS cover only 30 per cent of the earth’s area but are home to 80 per cent of the world’s land animals and plants. In addition to housing diverse species, forests provide vital benefits for humans, including timber, food, shelter, recreation, fresh water, and erosion prevention. They provide employment too. Around 13.2 million people in the world are employed formally in forest sector, besides millions others in the informal sector.

While we often think that forests are being fast lost, there is some good news. Thanks to aggressive reforestation projects in Europe, North America and Asia—especially in China—the loss of trees isn’t as bad as it could be. But there are areas in the world where forests of iconic importance and the wildlife they support are under threat.

The Conservation International (CI), an American environmental think tank listed the 10 most vulnerable forest hotspots in the world, forests that have lost more than 90 per cent of their original habitat and which harbour at least 1,500 plant species that are found nowhere else in the world. The CI report focuses on hotspots—areas of the planet that host endemic species, knowing that when the habitat goes, so does the wildlife. Overall Asia dominates the list of the top 10 nations that have reported the greatest forest area gain between 2010 and 2015.



CLIMATE CHANGE

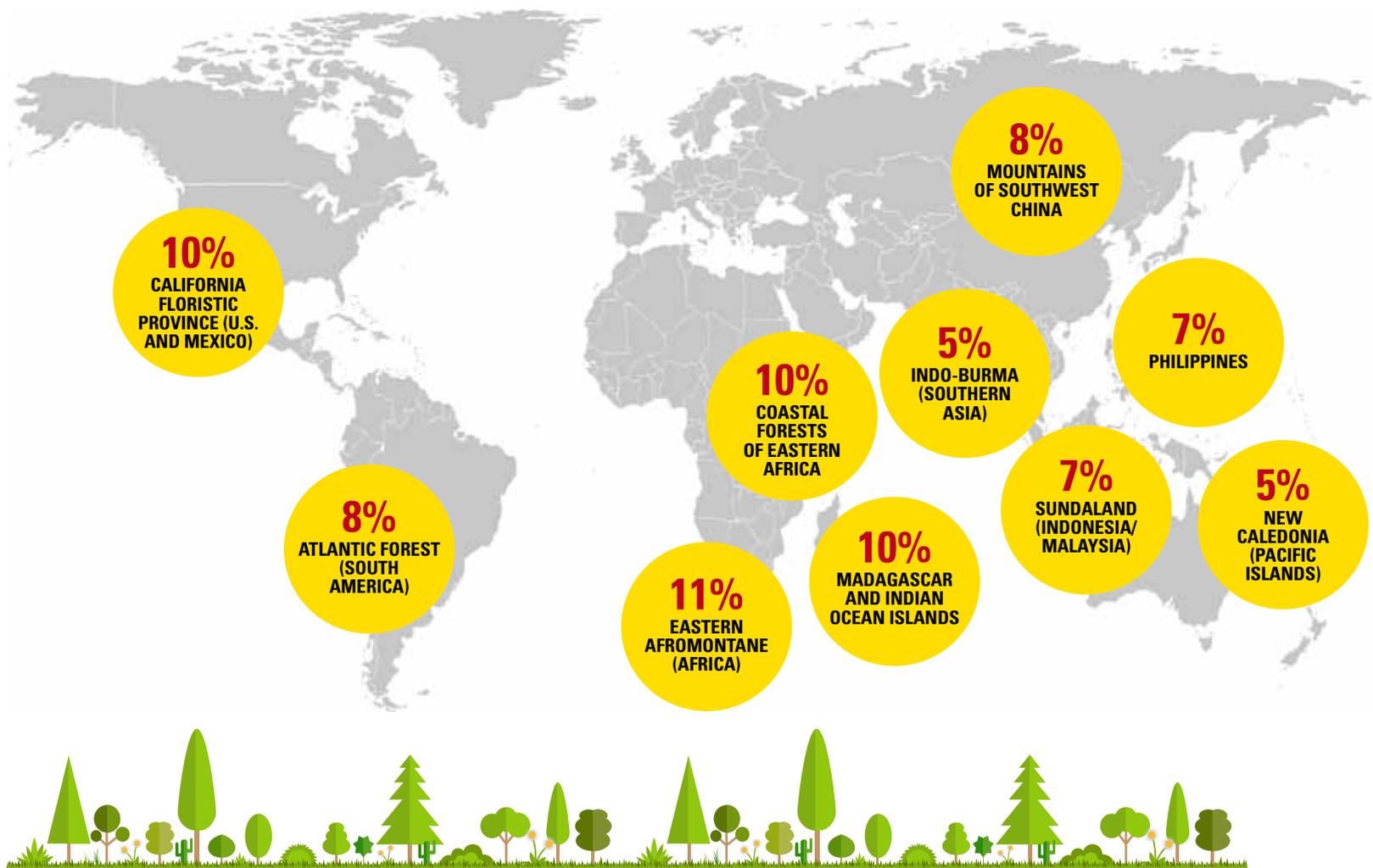
15%

The emissions resulting from deforestation represent approximately 15% of total greenhouse gas emissions, and they are superior stores of carbon.



World's 10 Most Threatened Forest Hotspots

These forests have all lost 90% or more of their original woodlands to human activity. Five of the endangered forests are in the Asia-Pacific region.





CLIMATE CHANGE

COP21: A Landmark Climate Change Agreement

THE COP21 follows over two decades of climate-related talks. When world leaders met in Paris on 22 April 2015 there was a lot of scepticism. The task was huge: to get 195 countries to agree on how to deal with the issue of climate change. Every year since 1992 the Conference of the Parties (COP) has taken place with negotiators trying to put together a practical plan of action, with little to show for them.

The effort came close, twice. The first treaty, the Kyoto Protocol, was established in 1997 and ratified by most nations in 2005, with one significant exception: The United States, which refused because emissions cuts were only required of developed nations and they would have been legally binding. Then, in 2009, in Copenhagen, countries agreed that rising temperatures must be capped but they did not produce actual plans for achieving emissions cuts.

The world leaders were finally able to achieve that target in 2015 at the United Nations Climate Change Conference, COP 21 which was held in Paris, from November 30 to December 12, 2015. The conference negotiated a milestone agreement, a global agreement on the reduction of climate change. A momentous pact was approved by 195 nations to keep global temperature increase below two degrees Celsius (3.6F) and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. As of November 2017, 195 UNFCCC members have signed the agreement, and 172 have become party to it.

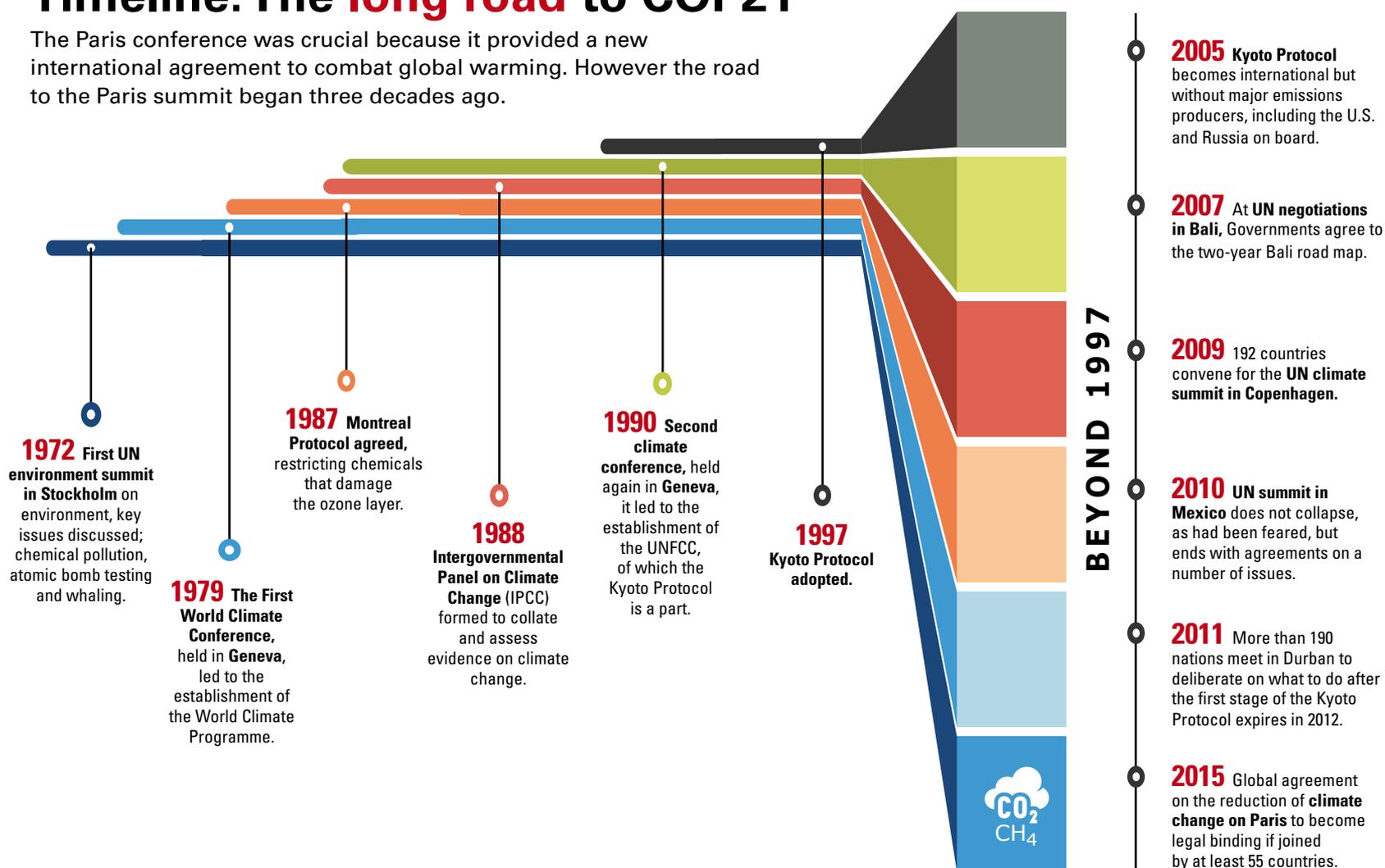
2°C

The Paris Agreement pushed signatories to reduce their carbon output and halt global warming below two degrees Celsius by the end of the century.



Timeline: The long road to COP21

The Paris conference was crucial because it provided a new international agreement to combat global warming. However the road to the Paris summit began three decades ago.





CLIMATE CHANGE

Climate Change: What Each Asian Country Is Up To

THE Kyoto Protocol failed because it imposed emissions reduction targets only on developed countries, giving developing nations like China, India and Brazil a free pass. From the beginning, the treaty that was adopted in 1997 in Kyoto, Japan, was problematic.

Critics denied the science of climate change and claimed the treaty was a socialist plot. Environmentalists decried the lack of ambition in Kyoto and warned of dire consequences for future generations. Also the targets varied between nations. Some were allowed to increase their emissions by a certain amount; others were required to make significant cuts.

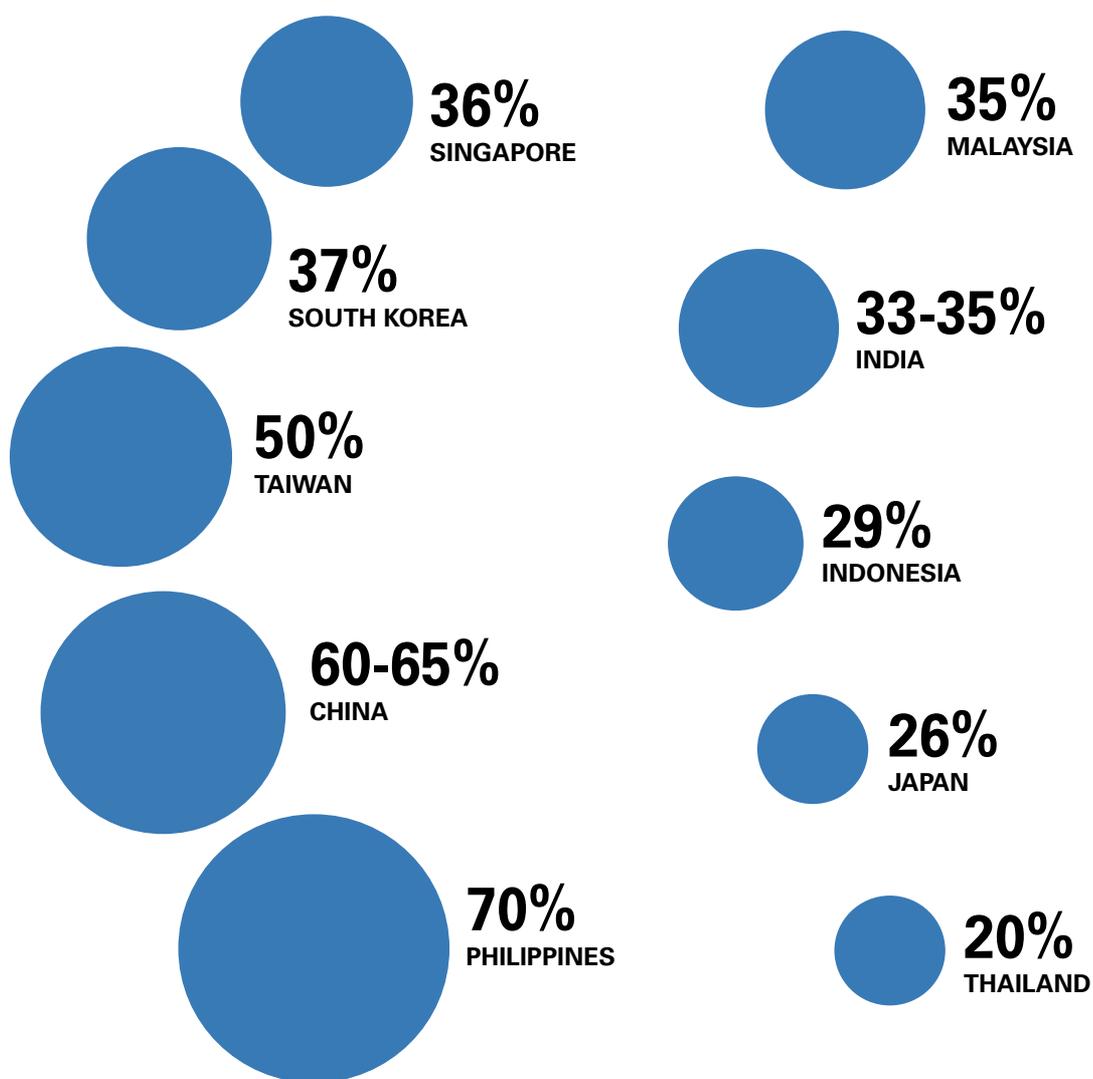
While the sum of emissions from nations with Kyoto targets decreased significantly, however, emissions in the rest of the world increased sharply—especially in China and other emerging economies. Overall, the result is that global emissions have shown no signs of slowing down.

The success of the Paris conference was that instead of pursuing a top-down agreement with mandated targets, each country was asked to make and submit its own national pledge rather than sign up to a collectively enforced goal that lays out how and by how much they plan to reduce emissions in the years ahead.

\$100 billion

Financing is one of the most challenging aspects of the whole climate deal as rich countries have pledged to provide \$100 billion a year in climate financing for poorer ones by 2020.





Asia's 2030 Climate Change Targets

China has redoubled pledges to lower carbon dioxide emissions per unit of gross domestic product by between 60% and 65% of 2005 levels by 2030.

SOURCE: INTENDED NATIONALLY DETERMINED CONTRIBUTIONS, UNFCCC



CLIMATE CHANGE

COP21: Who is taking the lead on climate change?

AHEAD of the 2015 Paris Climate Conference in December, countries around the world submitted their pledges to the UN, setting out how far they intend to reduce their greenhouse gas emissions. These are called Intended Nationally Determined Contributions—or INDCs. For the first time ever almost all of the top polluters are making plans for a cleaner energy future.

The Asian countries have also articulated their plans to reduce emission reductions. While the U.S. has decided to withdraw from the Paris climate agreement, emerging economies like China and India have submitted robust plans to curtail emissions, which they did not do under the Kyoto Protocol. There are three key parts in the Paris agreement; to keep global temperature increase below 2°C, to pursue efforts to limit it to 1.5°C and to peak greenhouse gas emissions as soon as possible. The important part of the deal is also to review progress every five years and to create a fund of \$100bn a year in climate finance for developing countries by 2020.

China says it is on track to achieve its pledge under the Paris Agreement to peak its carbon emissions by 2030. And India is also making progress to limit a surge in emissions driven by more coal use. India has pledged to achieve 40 per cent of cumulative electricity from non-fossil fuel based resources by 2030. Other countries which are at high risk from Climate Change like Bangladesh and Maldives have also pledged to reduce greenhouse emissions. It is not clear if some countries will be able to achieve what they set out to in their pledges.

2°C

INDCs will largely determine whether the world achieves the long-term goals of the Paris Agreement to hold the increase in global average temperature to well below 2°C.



What Are Asia's Pledges On Climate Change?

Before the Paris summit, individual countries submitted their plans for cutting greenhouse gas emissions by 2030. These pledges, commonly called INDCs, form the cornerstone of a global treaty on climate change.



CHINA

Pledges to source 20% of energy from low-carbon sources



MALAYSIA

Intends to reduce its greenhouse gas emissions intensity of GDP by 45%



PHILIPPINES

Reduction in emissions of about 70%




SOUTH KOREA

37% reduction on business-as-usual emissions



SINGAPORE

36% reduction in emission intensity



INDIA

33% reduction in emissions intensity



MALDIVES

10% reduction in energy sector emissions



SRI LANKA

7% emissions cut



BANGLADESH

Unconditional 5% reduction in greenhouse gas emissions



INDONESIA

29% reduction in emissions



MYANMAR

Increase hydropower capacity to 9.4 gigawatts



THAILAND

20% reduction in emissions



BHUTAN

Remain carbon neutral



JAPAN

26% reduction in emissions



PAKISTAN

Submitted INDC, 5% to 18% reduction in the emissions



VIETNAM

8% reduction in emissions





Chapter 2

Energy Landscape



Asian Energy Demand Growth Driver Is Shifting

GLOBAL energy markets are changing. Rapid economic growth and improving prosperity mean growth in energy demand is increasingly coming from developing economies, particularly within Asia. And coal is still the biggest source of energy. Today Asian giants China and India receive more than half of their primary energy from coal.

Growth in energy consumption was again driven by China (1.3%, 47 mtoe) and India (5.4%, 39 mtoe), contributing almost identical increments, and together accounting for around half of the increase in global demand. As the 2017 report of BP Statistical Review Of World Energy pointed out these similar contributions disguise sharply contrasting trends.

India's energy consumption grew at a similar rate to the recent past, underpinned by solid economic growth. In contrast, China's energy consumption grew at less than a quarter of the rate seen over the previous 10 years. This brake in China's energy consumption partly reflects the gradual slowing in economic growth, but it has been greatly compounded by pronounced weakness in China's most energy-intensive sectors, particularly iron, steel and cement.

The share of renewables in the total energy consumption in India and Japan is 6 per cent and 8 per cent respectively, while in Singapore around 13 per cent, in Philippines only 4 per cent, in Indonesia 3 per cent and in Thailand 2 per cent.



ENERGY LANDSCAPE

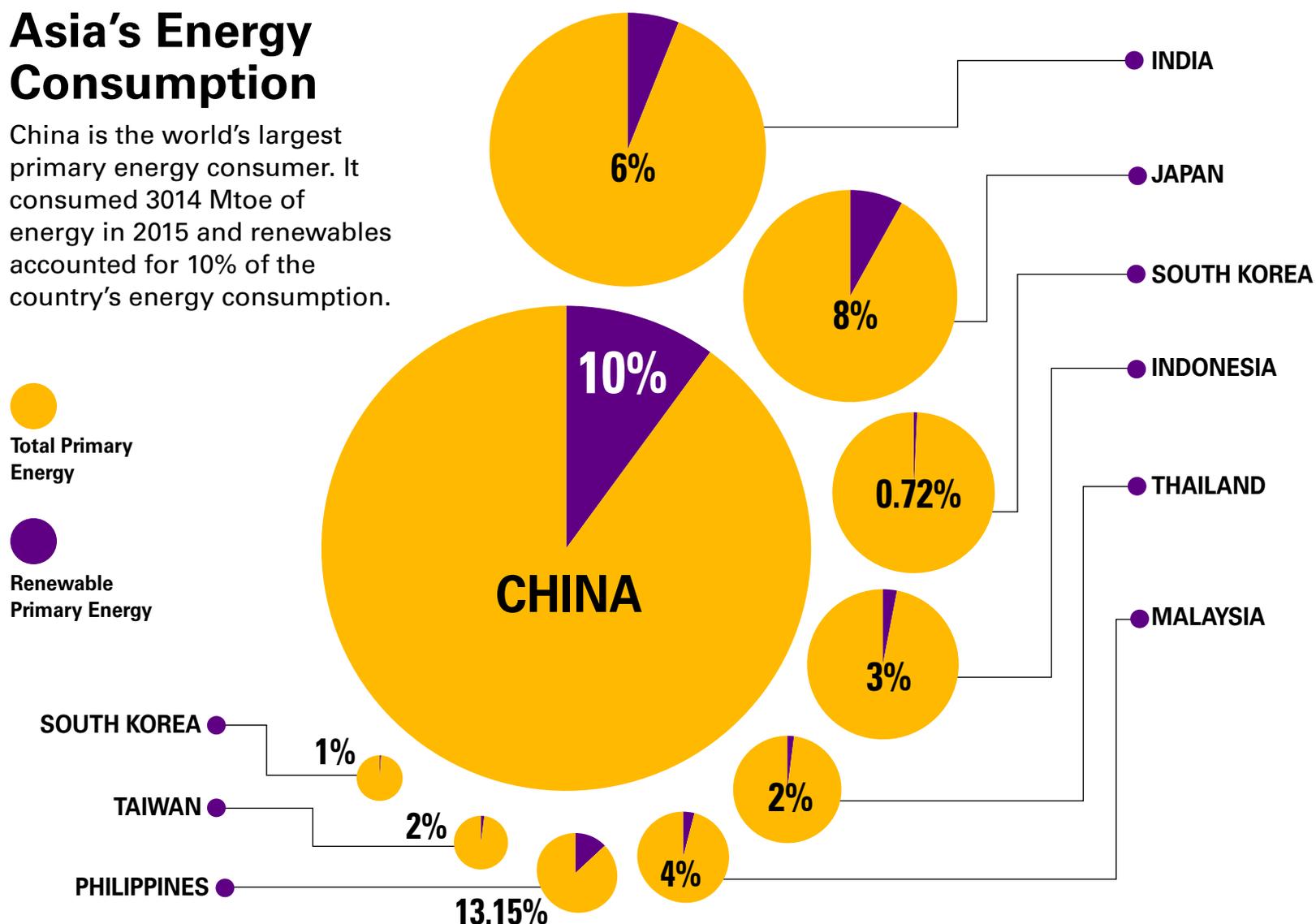
1%

Worldwide energy consumption grew slowly again in 2016—the third consecutive year in which demand has grown by 1% or less—much weaker than the rates of growth we had become used to over the previous 10 years or so.



Asia's Energy Consumption

China is the world's largest primary energy consumer. It consumed 3014 Mtoe of energy in 2015 and renewables accounted for 10% of the country's energy consumption.



Access To Electricity: 1.3 Billion People Are Living In Darkness

AROUND the world, 1.3 billion people lack access to electricity out of which more than 526 million are in Asia. India has the largest population of around 237 million that does not have access to electricity, according to the International Energy Agency, the global energy watchdog, which amassed the data. While 94 per cent of Indians living in urban areas have electricity, only 67 per cent in rural areas have power.

North Korea, Myanmar and Cambodia have it even worse. About 70 per cent of their total population does not have electricity. Bangladesh, Pakistan and Indonesia have 60 million, 50 million and 49 million people respectively without access to electricity. Philippines and Nepal also have to meet the challenge of providing electricity access to 21 and 7 million people respectively.

Many Asian countries, however, have succeeded in providing 100 per cent electricity to their populations. Brunei, Malaysia and Singapore, have mostly achieved the goal of providing electricity access to all its citizens. China, Thailand, Laos and Sri Lanka have also been successful in providing access to electricity to all their citizens, with each country now with one million people without access to electricity.

Most progress has been made in developing Asia, where 870 million gained access since 2000, of which India accounts for 500 million gaining access—one of the largest electrification success stories in history.



ENERGY LANDSCAPE

1%

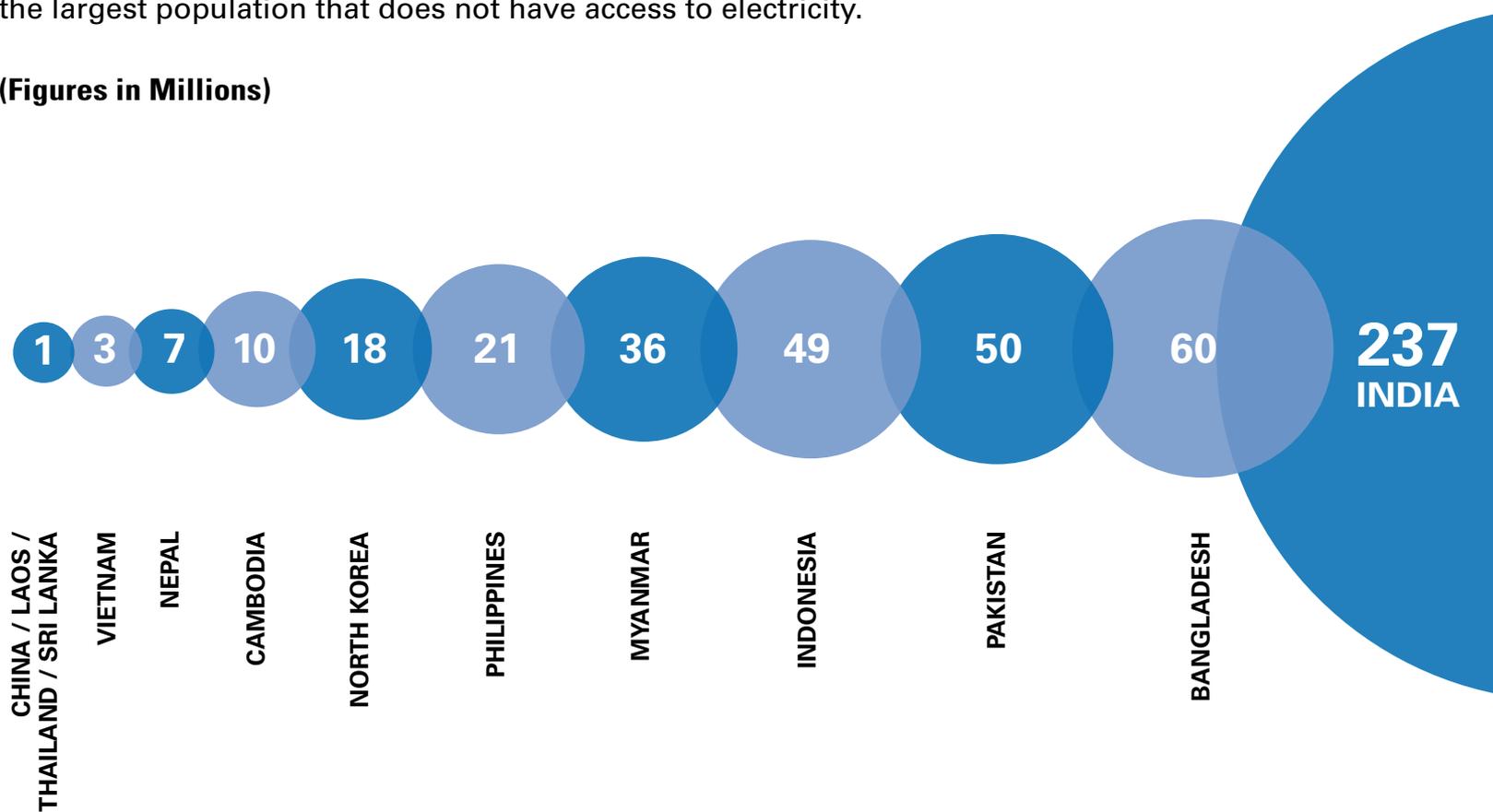
Worldwide providing electricity for all by 2030 would require annual investment of \$52 billion per year, according to IEA, the world's most prominent energy forecaster.



Power To The People

Of the world's 1.3 billion people who live without access to electricity, a half of them—about 622 million—live in Asia. India has the largest population that does not have access to electricity.

(Figures in Millions)





ENERGY LANDSCAPE

Which Region Has Largest Coal Reserves?

THE Asian Pacific region holds the most proved reserves of coal (46.5% of total). The US remains the largest reserve holder with (22.1%) of the total. North America has the highest regional R/P ratio (356 years). Coal is the cheapest but also most polluting forms of energy.

In Asia, the largest reserves are found in China, Australia, India and Indonesia. China produces and burns about half the world’s coal, accounting for 64 per cent of the country’s energy supply last year and it holds world’s 21.4 per cent coal reserves. It is by far the world’s largest coal producer, importer and consumer. It consumes more coal than whole Asia Pacific countries combined.

India, the world’s third-largest carbon emitter, also relies on coal for 58 per cent of its primary energy needs. It has an ambitious plan to double its coal production to 1.5 billion tonnes (about 1.63 U.S. tonnes) a year by 2020.

Coal consumption has increased in South Korea, Indonesia, Thailand and the Philippines. In Mongolia which hosts 10 per cent of the world’s known coal reserves, coal deposits are seen potential source to revive flagging economy.

Pakistan is also attempting to revise its coal industry with five new power plants scheduled to start producing electricity by 2018 to solve the country’s electricity crisis. More than 80 per cent of the world’s total proved coal reserves are located in just 10 countries.

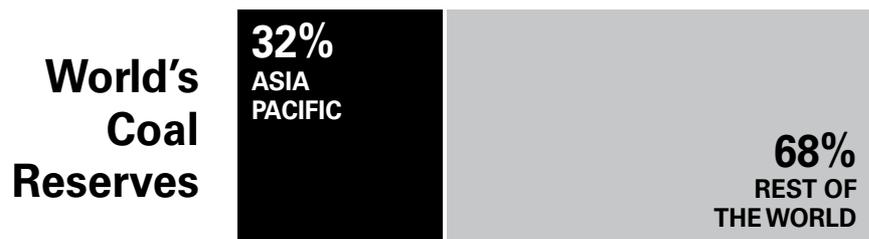
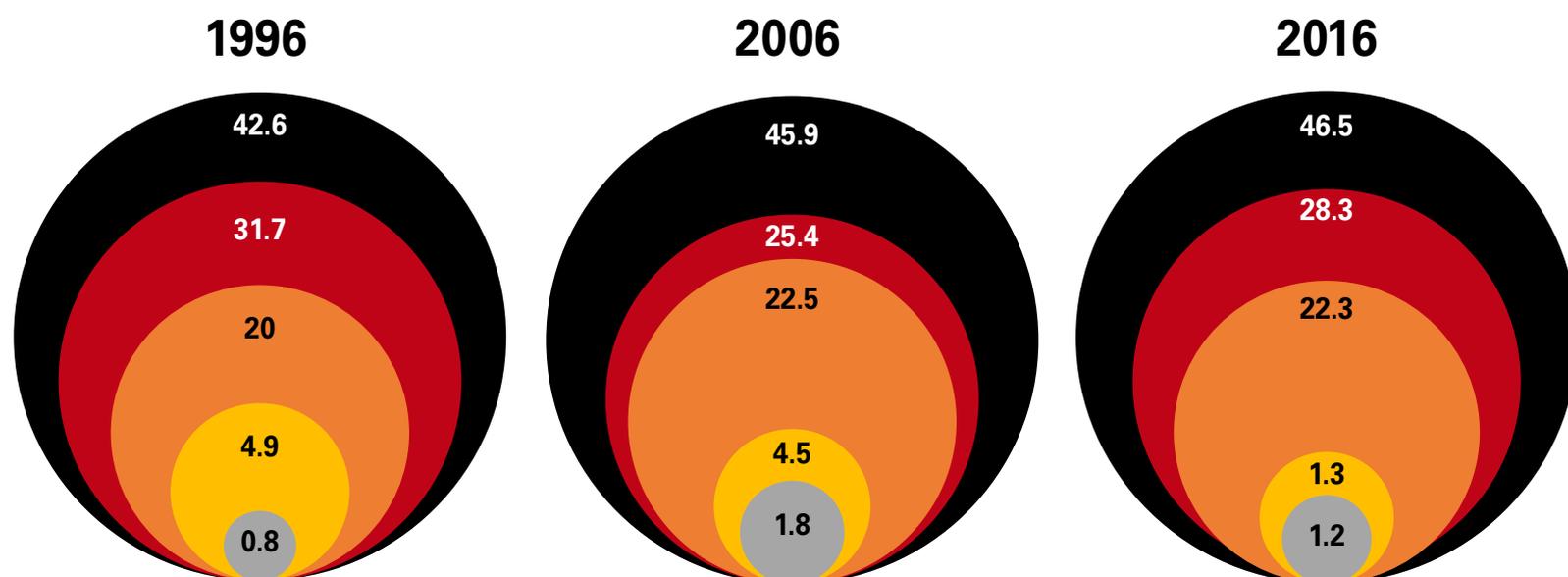
153

World’s proved coal reserves are currently sufficient to meet 153 years of global production, roughly three times the R/P ratio for oil and gas.



Distribution Of Coal Reserves

Asian Pacific holds the most proved reserves (46.5% of total) in the world, with China, Australia, India and Indonesia holding largest reserves in the region.



- ASIA PACIFIC
- EUROPE & EURASIA
- NORTH AMERICA
- MIDDLE EAST & AFRICA
- SOUTH & CENTRAL AMERICA



ENERGY LANDSCAPE

Asia’s Gas Demand Rises But Coal Is Still King

COAL will remain the dominant fuel in Asia’s electricity mix as countries continue to ramp-up their domestic coal-fired power capacity, as per the World Energy Outlook report. There may be a focus on renewable energy sources, but it seems coal is still the fuel of choice for many countries.

Coal as the largest contributor to electricity generation is projected to decline marginally from the year 2030, but will continue to remain much higher than other sources like oil, natural gas, hydro and solar. In 2020, the share of coal in electricity generation is projected to remain at 56 per cent, while in 2030 it will remain 55 per cent.

While coal will be a receding player in electricity generation, natural gas will see a small but steady rise from the year 2020 (14%) to 2030 (16%). Nuclear power is also likely to retain a larger share of electricity generation until the year 2040. It will be steady at 9 per cent from the year 2020 till 2030, going up to 10 per cent in the year 2040.

Sources of energy like solar and geothermal will still fall short of becoming a mainstream electricity generating source. Solar power share of electricity generation will see just a tiny increase from 2 per cent to a projected 4 per cent in 2020 and is likely to go up to just 5 per cent in 2040.

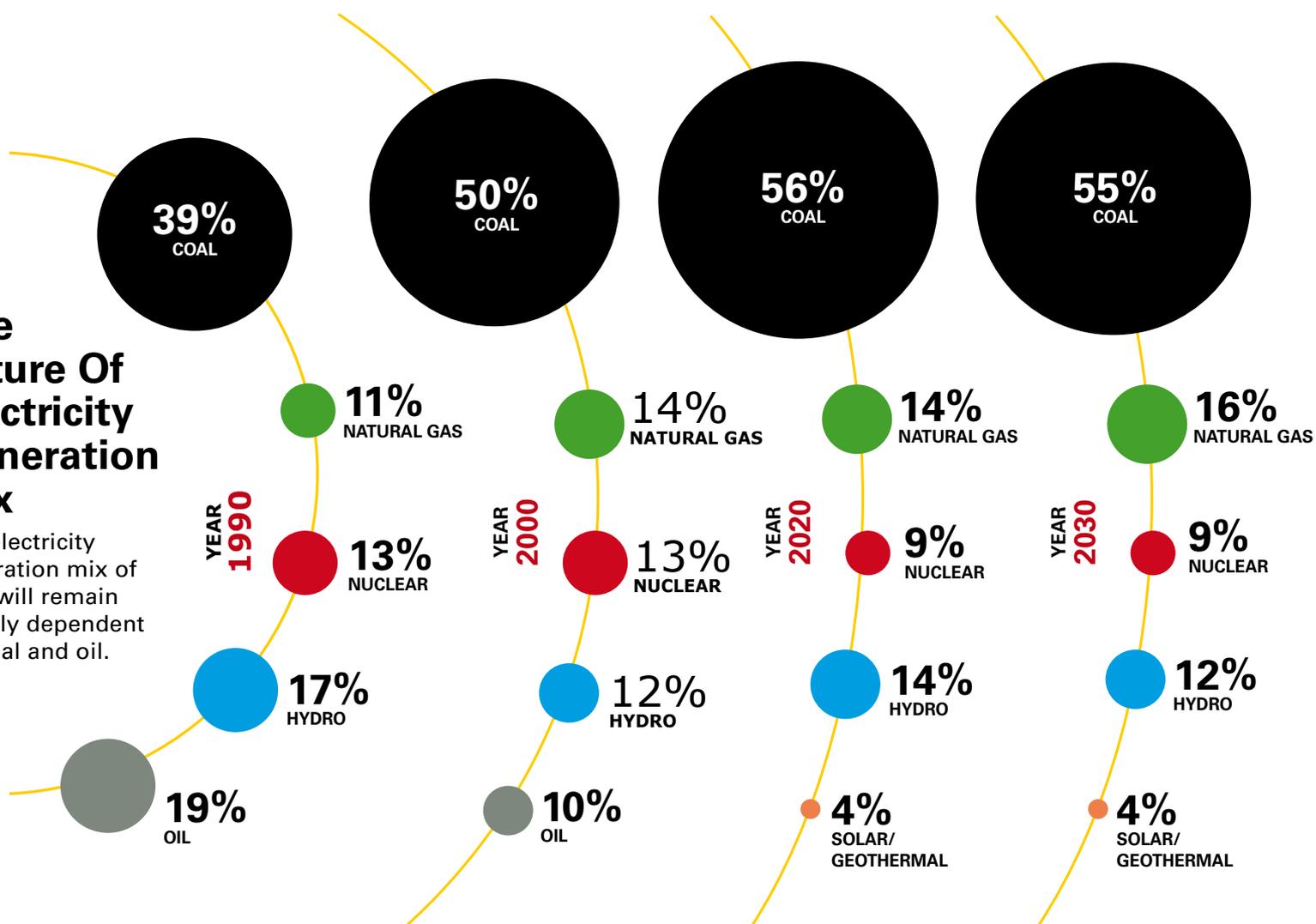
32%

Asia’s energy production is set to rise 32% by 2025, with coal remaining the dominant source of energy, as per the Energy Information Association.



The Future Of Electricity Generation Mix

The electricity generation mix of Asia will remain heavily dependent on coal and oil.



How Much Natural Gas Is There In The World?

LIKE other fossil fuels such as coal and oil, natural gas forms from the plants, animals, and microorganisms that lived millions of years ago. About 80 per cent of the world's total proven natural gas reserves are in ten countries.

By region, the Middle East holds the largest proved reserves (79.4 tcm, 42% of the global total), while by country Iran is the largest reserve holder (33.5 tcm, 18% of the total), as per the BP Statistical Review 2016. North America has the lowest proven natural gas reserve in the world. Natural gas is used in countless ways for industrial, commercial, residential, and transportation purposes.

Currently, there are more than 5 million natural gas vehicles (NGV) worldwide, and more than 150,000 in the United States. Australia, Indonesia, India and Malaysia are among the highest reserves of natural gas. Australia has about 3.5 trillion cubic metres of natural gas reserves while Indonesia, India and Malaysia have 2.8, 1.5 and 1.2 trillion cubic metres of natural gas reserves respectively.

Overall global natural gas production is growing more rapidly than consumption but Asian countries still consume more natural gas than they produce. The total Asia Pacific production of natural gas in the year 2015 was 556.7 billion cubic metres out of the world total of 3,538 billion cubic metres.



ENERGY LANDSCAPE

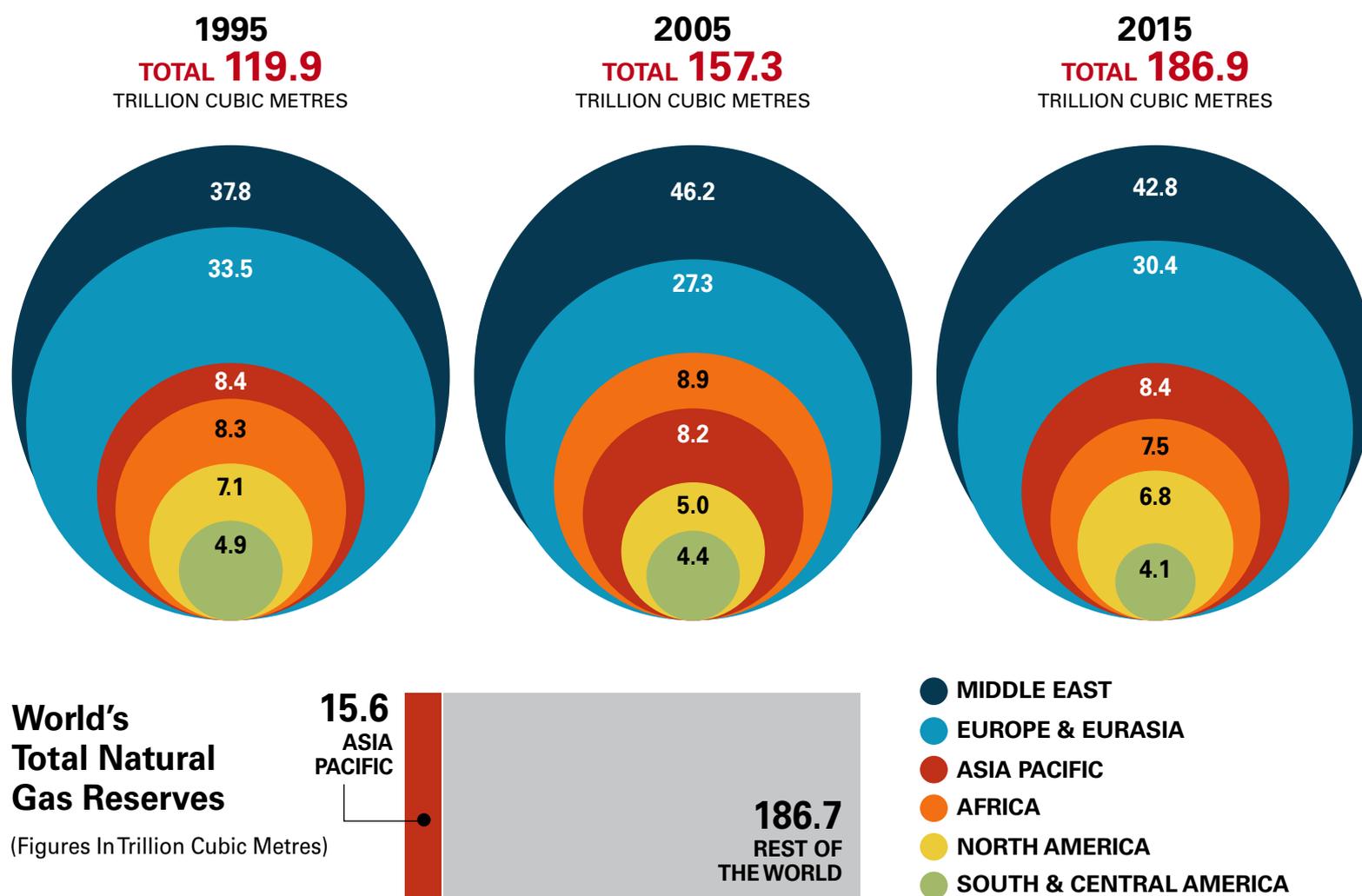
1.2 trillion

Global proved gas reserves in 2016 rose slightly by 1.2 trillion cubic metres (tcm) or 0.6% to 186.6 tcm.



Distribution Of world's Natural Gas Reserves

This graph shows the distribution of proved natural gas reserves from 1995, 2005 and 2015, by region.



Coal Dominates In Asia’s Energy Mix

WHILE China and India still obtain more than half of their primary energy from coal, Singapore has an energy mix with almost no coal. It also has a much lower proportion of renewable. China derives over 60 per cent of its energy from coal and India derives a little less than 60 per cent. Indonesia also gets more than 40 per cent of its total primary energy from coal.

There are significant differences in the mix of renewable power across Asian countries. Malaysia has the highest share of hydropower in renewables in electricity generation. But China and India also have 80 and 65 per cent share of hydropower in renewables respectively.

In contrast, Australia and India have the highest proportions of wind. For solar, South Korea has the highest share (with 38%), followed by Japan (19%) and Thailand (17%). Singapore, by far, has the highest share of geothermal resources in renewable in electricity generation (89%).

Coal and natural gas will both play a key role in Asia’s fuel mix. Both are abundant, and gas is becoming even more so thanks to new technologies. Coal will continue to play a relevant role in meeting Asia’s energy demands—comprising the biggest share of the region’s energy mix through 2040—despite concerns about carbon emissions.



ENERGY LANDSCAPE

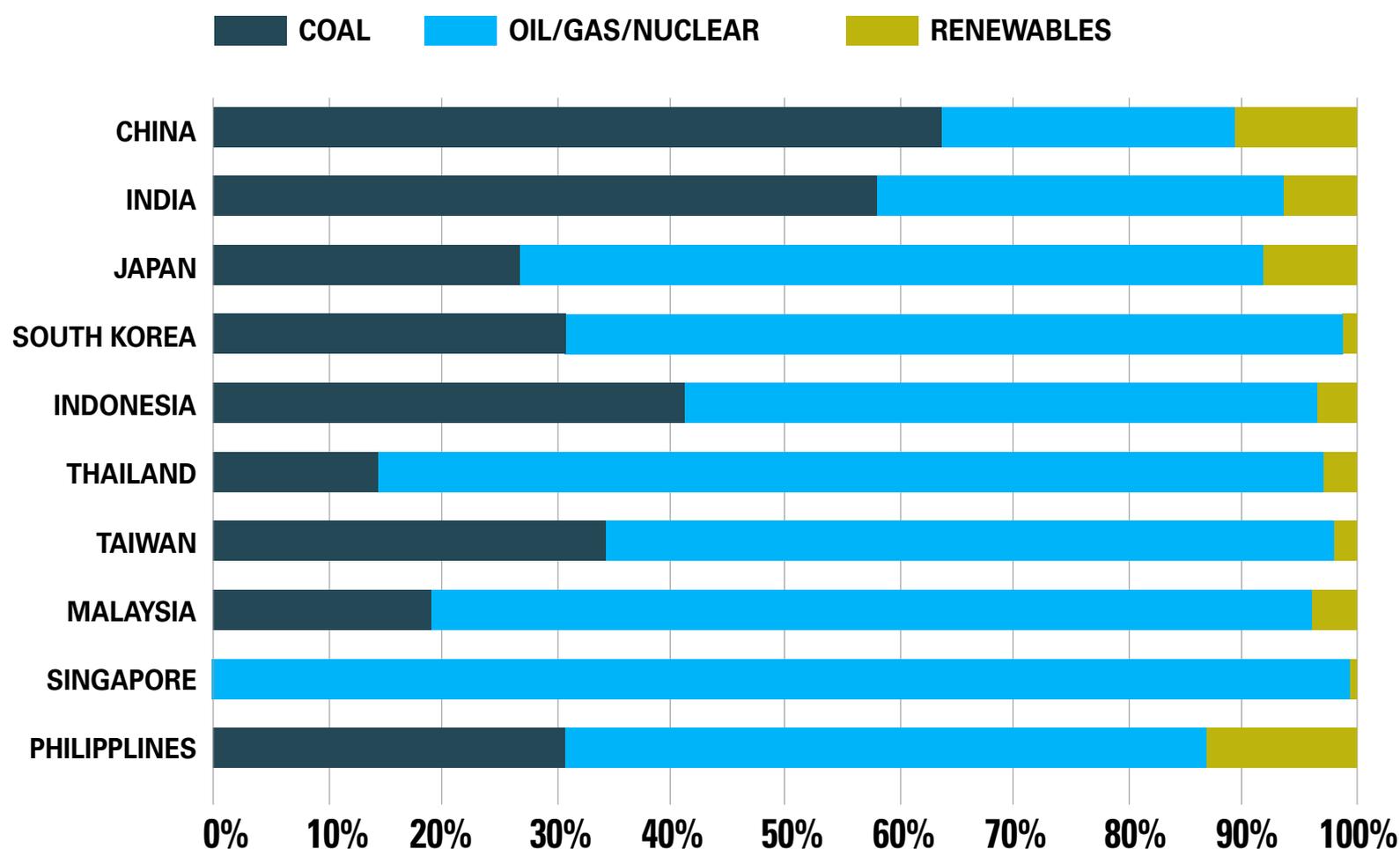
60%

Energy demand in Southeast Asia is expected to climb nearly 60% by 2040 from now, with coal and oil leading growth in the region’s power and transport sectors.



Asia's Primary Energy By Source In 2015 (Mtoe)

China and India still obtain more than half of their primary energy from coal.
By contrast Singapore has an energy mix with almost no coal.



Asia's Growing dependence on Liquid Fuel

OVER the last decade, Liquefied Petroleum Gas (LPG) demand has expanded more rapidly than overall oil demand in Asia. LPG now accounts for about 9 per cent of all oil-product demand in Asia, according to the International Energy Agency data. China, India and Japan together make up about 45 per cent of global LPG purchases.

By far the largest use of LPG in Asia is in the residential and commercial sector; which consumes 67% with a steadily rising share. Transport consumes 10%, petrochemicals 7% and power 4% of LPG in Asia.

LPG is cheap compared to other energy sources and is readily available and is almost entirely derived from fossil fuel sources. Overall LPG fuel is considered a promising alternative and clean energy source in view of cost and emission reduction.

The Asia Pacific region, which is currently producing 397.8 million tonnes of oil, will likely produce 356.4 million tonnes in 2035. Fossil fuels will still account for 83 per cent of energy demand in Asia Pacific by 2035, while the global average is expected to stay at 81 per cent. The region's total LPG consumption was estimated to grow to 121 million tonnes by the end of 2017.



ENERGY LANDSCAPE

50%

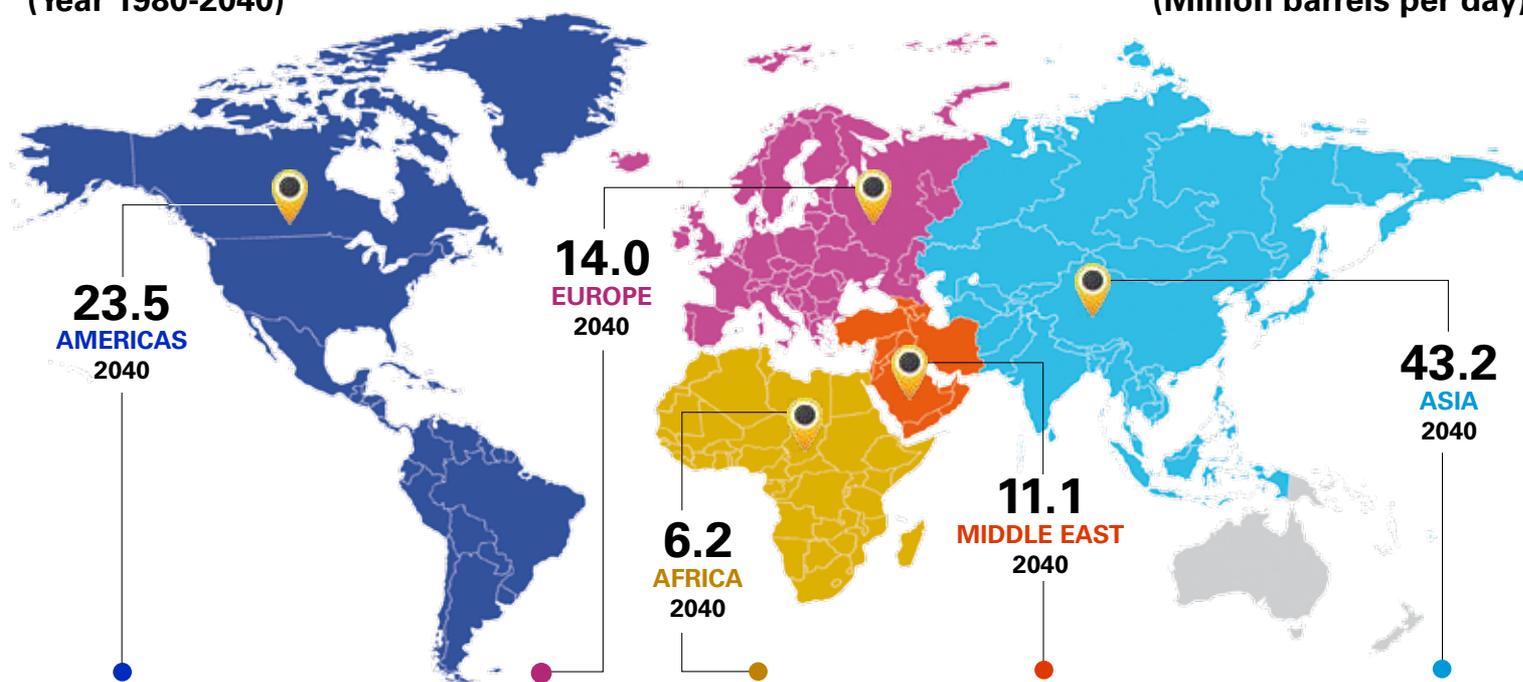
Almost 50% of all LPG is used for domestic applications in Asia, according to the data released by the World LPG Association.



Asia Shows The Largest Growth In Liquid Fuels Consumption Worldwide

(Year 1980-2040)

(Million barrels per day)



AMERICAS	
Year	Consumption
1980	20.3
1990	20.4
2000	24.0
2010	23.5
2020	24.3
2030	23.6

EUROPE	
Year	Consumption
1980	15.2
1990	13.9
2000	15.6
2010	14.8
2020	14.1
2030	14.0

AFRICA	
Year	Consumption
1980	1.5
1990	2.1
2000	2.5
2010	3.4
2020	3.9
2030	4.8

MIDDLE EAST	
Year	Consumption
1980	1.9
1990	3.3
2000	4.5
2010	6.7
2020	8.4
2030	9.6

ASIA	
Year	Consumption
1980	4.5
1990	6.6
2000	12.2
2010	19.8
2020	26.5
2030	34.8

SOURCE: INTERNATIONAL ENERGY OUTLOOK 2014

Where Is India's and China's Energy Consumption Heading?

CHINA and India will remain heavily dependent on coal, mostly produced indigenously, to strengthen their economies. Both the countries rely massively on fossil fuels to meet the energy requirements of their expanding economies, with coal serving as the primary source of the energy consumption. These two Asian economies collectively consume about 60 per cent of the coal produced in the world.

The share of coal in China's energy mix stands at a staggering 70 per cent, followed by oil at 19 per cent. Hydropower, natural gas and nuclear power all account for 12 per cent of the total usage. Coal also remains India's main energy source. India is the world's third-largest coal producer and depends on coal for about three-fifths of its energy needs.

By 2047, however, coal's share of India's energy mix is estimated to shrink to 42-48%, from about 54% in 2015. Oil provides 29% of India's energy and it would largely continue to be met through imports. On the other hand, natural gas, nuclear energy and hydroelectricity remain under-utilised with 13 per cent share in total. China plans to spend \$363 billion on developing renewable power capacity by 2020. India's government has also unveiled plans to build 175 gigawatts of renewable energy generation by 2022.



ENERGY LANDSCAPE

31%

China and India together will consume 31% of the world's energy in 2035, while China's projected energy consumption is set to be 68% higher than the U.S. in the same year.





CHINA
1.36 Billion
 Population

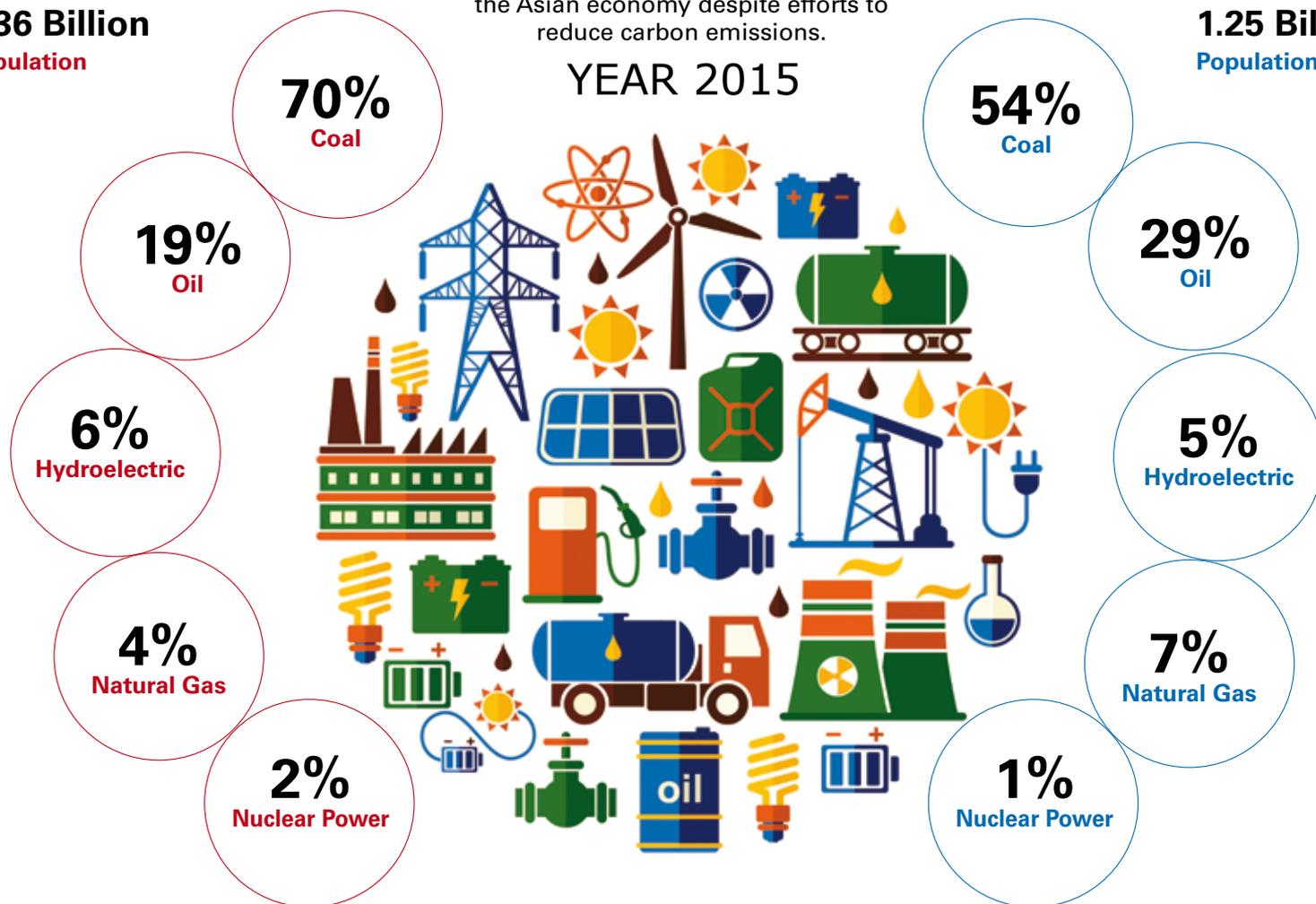


INDIA
1.25 Billion
 Population

Energy Mix INDIA AND CHINA

Coal's share of the Asia's energy mix continues to grow each year. China's 70% and India's 54% energy consumption is fulfilled by coal. Coal is expected to remain a key fuel for the Asian economy despite efforts to reduce carbon emissions.

YEAR 2015

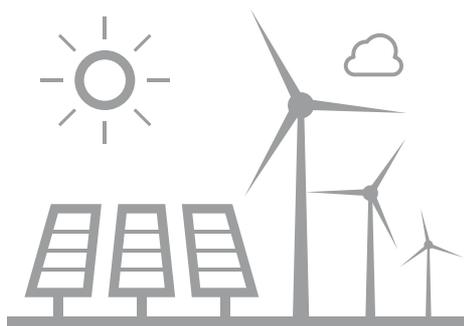




Chapter 3

Renewable Energies





RENEWABLE ENERGIES

Renewable Energy In Asia

RENEWABLES will play an increasingly key role in a lower carbon future. They are projected to grow seven times faster than all other energy types combined. Overall they are estimated to provide 19.3 per cent of global final energy consumption, according to Renewables 2017 Global Status Report. Yet renewable energy still represents only a small fraction of today’s global energy consumption.

Renewable electricity generation (excluding hydro), is estimated to account for nearly 8 per cent of global electricity generation. Renewables do, however, play a major role in the growth of electricity, contributing almost 40 per cent of the growth in global power generation in 2016, according to the BP Statistical Review report.

Denmark leads with 59 per cent of its electricity coming from renewables. In EU, the renewables share is 26 per cent in Germany, 25 per cent in Spain, and 23 per cent in both Italy and the UK. In volume terms, the largest increase in 2016 was in China, followed by the US; with Japan, India and Brazil making up the rest of the top five. China remains the undisputed leader of renewable electricity capacity expansion. It is also biggest consumer of the renewables. It consumed approximately 86.1 million metric tonnes of oil equivalent in 2016, followed by Japan and India.

2022

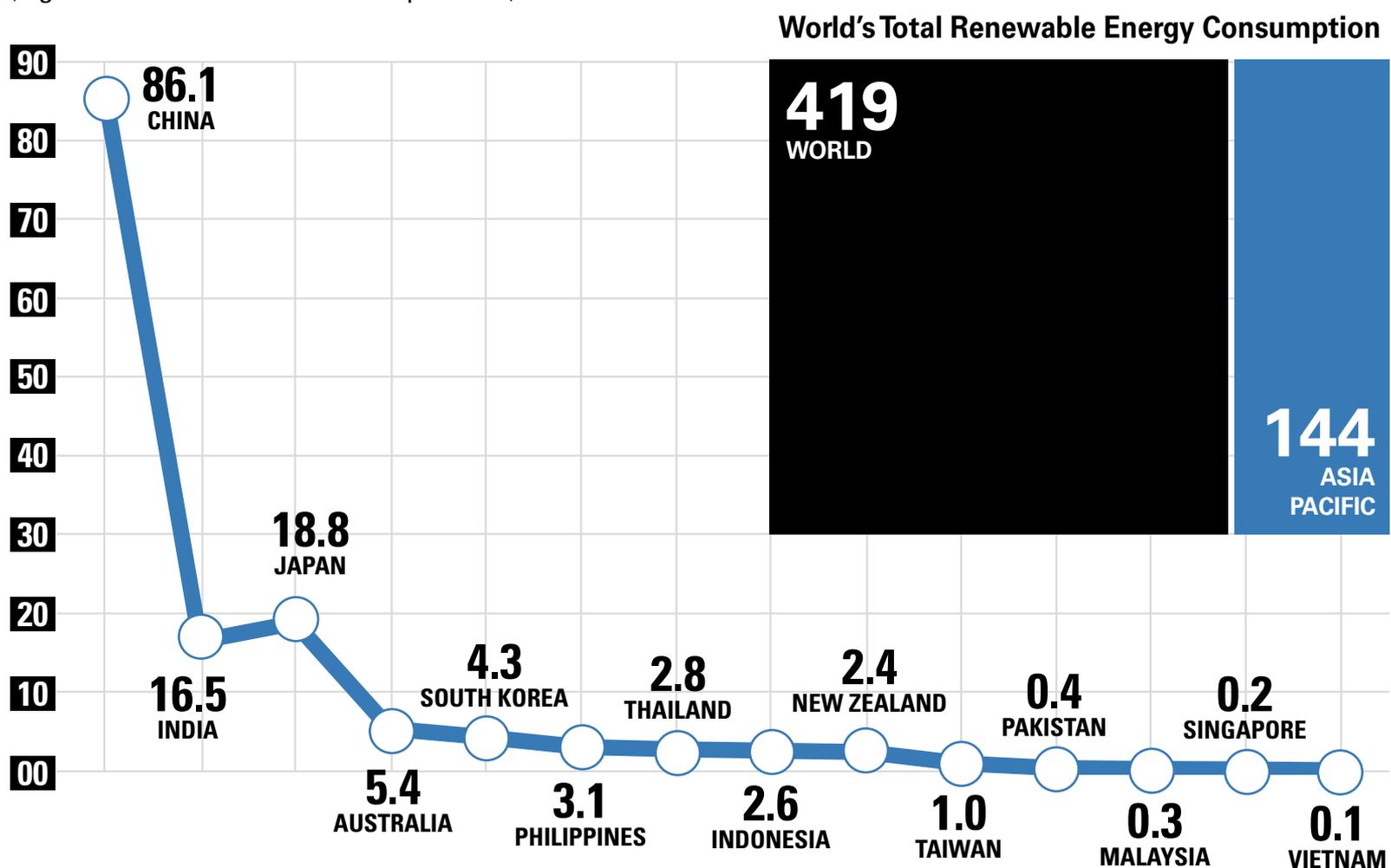
India’s renewable energy capacity will more than double by 2022, which would be enough to overtake renewable expansion in the EU for the first time, according to the IEA.

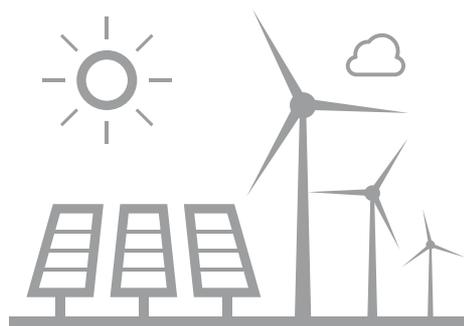


Renewable Energy Consumption In Asia Pacific In 2016; By Country

China overtook the U.S. to be the largest single renewable producer. It is also one of the world's biggest consumers of renewable energy.

(Figures in million tonnes of oil equivalent)





RENEWABLE ENERGIES

Asia’s Consumption Of Renewables Is Growing

THERE is a global energy transition under way, with record new additions of installed renewable energy capacity. Renewable energy over the past decade has been increasing substantially with consumption rising across the world. In Asia renewable energy consumption has been on the rise with installed energy capacity increasing over the last decade mainly in China and India. China is the single largest developer of renewable power and heat over the past eight years.

Over the past decade renewable energy consumption has seen an upward curve from 93.2 mtoe to 419.6 mtoe. The consumption in Asia rose from 92.2 to 144.5 mtoe. In 2006, Asia Pacific’s share in global renewable energy consumption was 22 per cent. Today it is 34 per cent. The power sector experienced the greatest increases in renewable energy capacity in 2016, whereas the growth of renewables in the heating and cooling and transport sectors was comparatively slow according to the Renewables Global Status Report, 2017.

Renewable energy has also spread to a growing number of developing and emerging economies in Asia, some of which have become important markets now like India. For the third consecutive year, global energy-related carbon dioxide emissions from fossil fuels and industry were nearly flat in 2016, due largely to declining coal use worldwide but also due to improvements in energy efficiency and to increasing use of renewable energy.

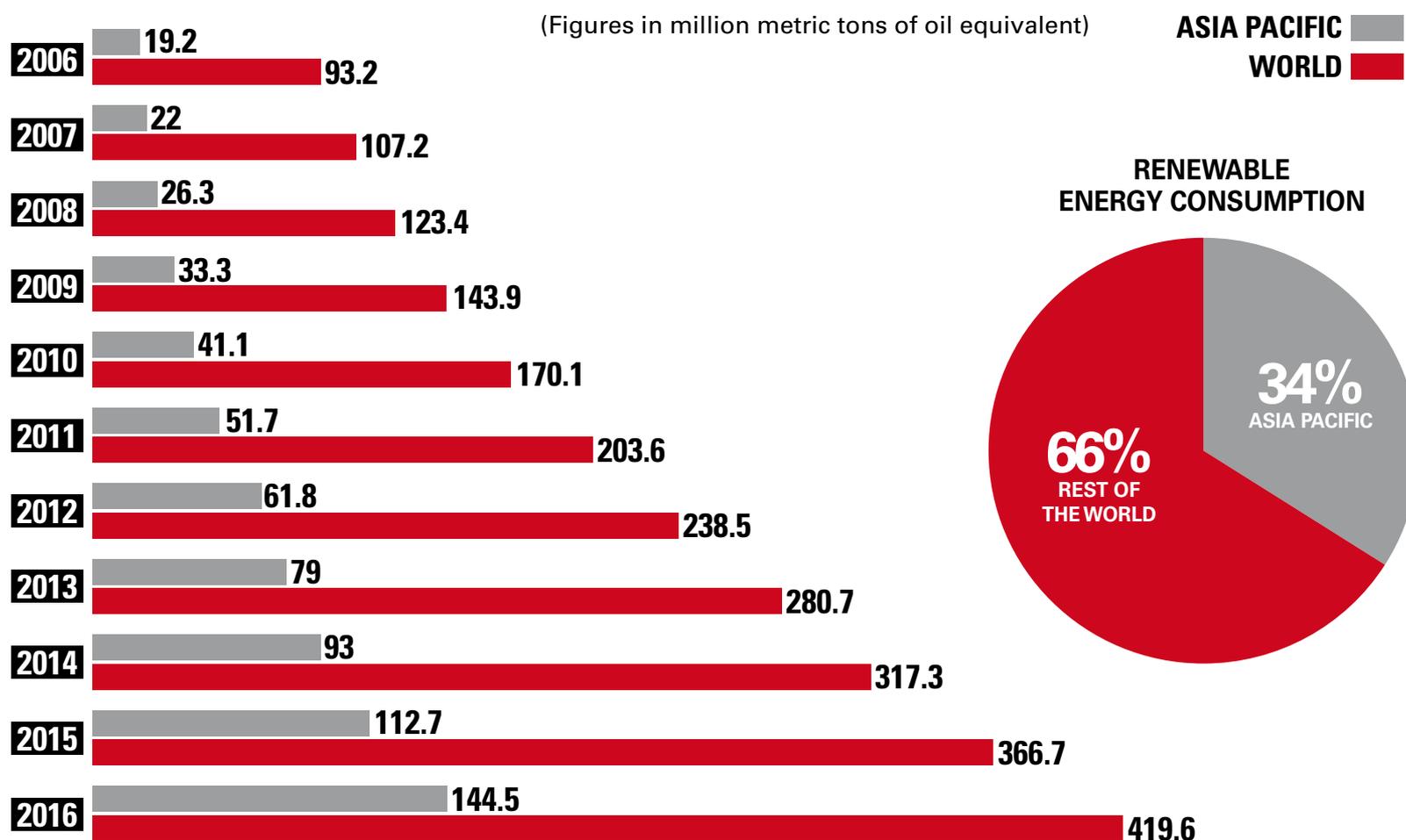
161

Renewable power generating capacity saw its largest annual increase ever in 2016, with an estimated 161 gigawatts of capacity added. Total global capacity was up nearly 9% compared to 2015, to almost 2,017 gigawatts at year’s end.

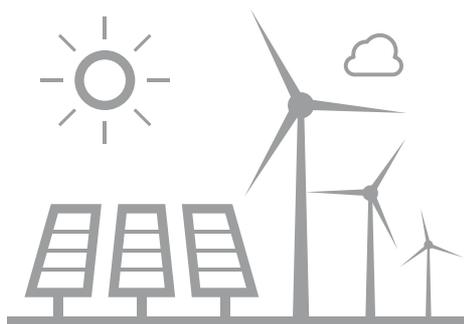


Renewable Energy Consumption From 2006 To 2016

The use of renewable energy is increasing worldwide, with the Asian region accounting for 34% consumption of world's renewable energy.



SOURCE: BP STATISTICAL REVIEW OF WORLD ENERGY 2017



RENEWABLE ENERGIES

Three Asian Countries With The Highest Consumption OF Renewables

CHINA is powering ahead of other major countries in renewable energy sector. The country has built vast solar and wind farms, helping the growth of industries that sell their products around the world. China’s National Energy Administration has set up a target to reduce coal energy consumption. It has also set a goal for clean energy to meet 20 per cent of China’s energy needs by 2030.

China is a major manufacturer and exporter of renewable energy technology, supplying some two-thirds of the world’s solar pannels. China has already surpassed the targets set for 2020. By the end of July, 2017 China’s solar PV capacity topped 112 gigawatts, after installing a 35 gigawatts in just seven months—more than twice as much as installed by any other country in all of 2016.

The country has already set new targets for 2020 aiming to increase the capacity to five times more than that of the United States. While the scale of renewable-energy projects may be smaller than large utility-scale projects in China, Japan’s progress in renewable energy sector adds a new chapter to the ongoing conversation about energy and climate change. India has also set a target of producing 40 per cent of its total energy needs through renewable sources by 2030.

9%

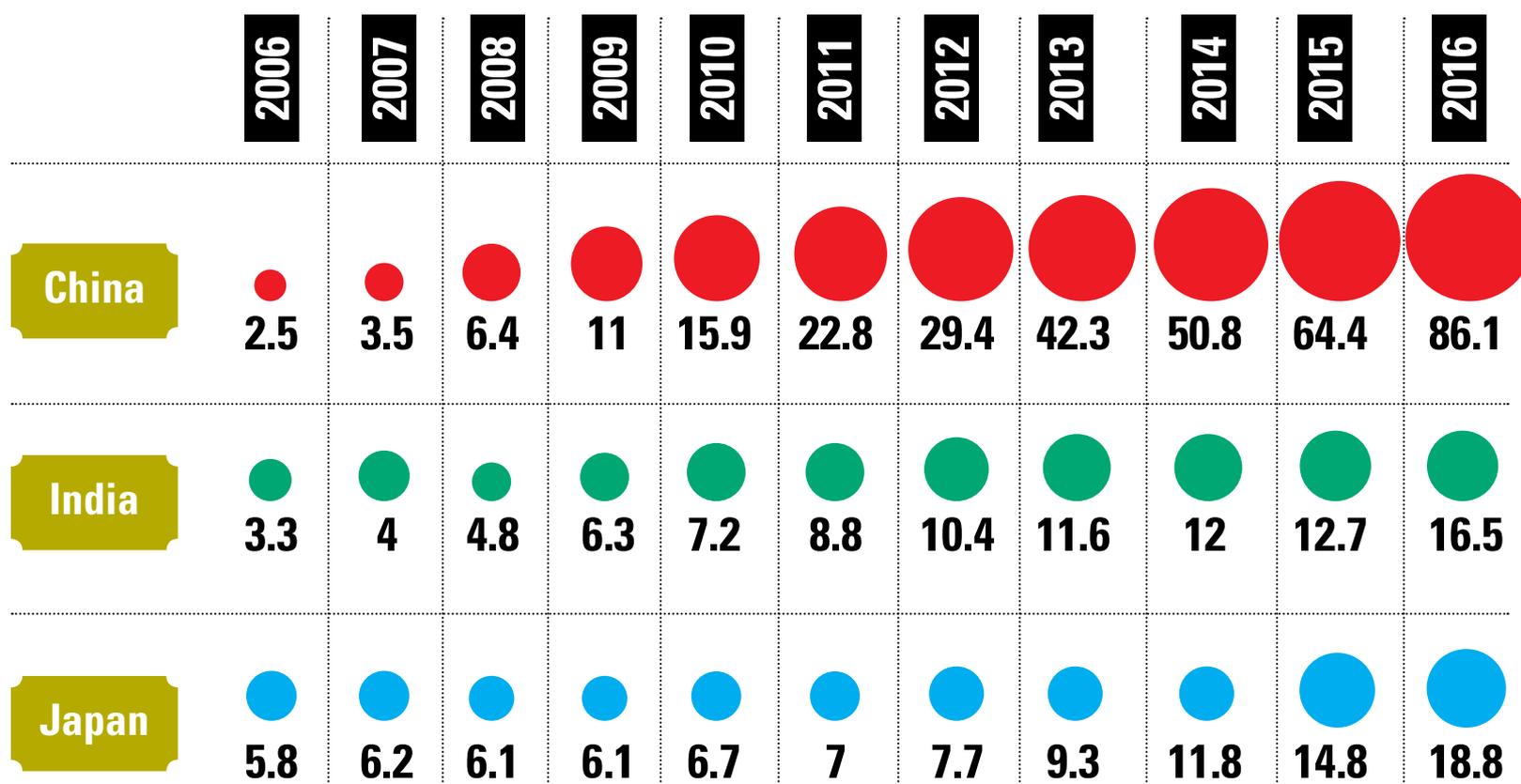
Japan, a mountainous island nation with a sunny climate, has lots of potential ways to generate renewable energy. Yet prior to 2011, just 9% of Japan’s power came from renewables — and almost all of that from hydropower. Only 1% came from solar.



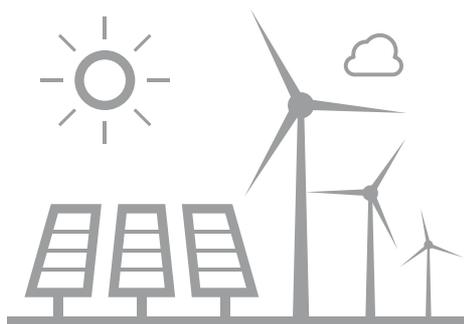
China's Soaring Consumption Of Renewables

A decade ago Japan and India were consuming more renewable energy than China. Today China is way ahead as it gets 20% of its energy from renewable sources.

(Figures in million metric tonnes of oil equivalent)



SOURCE: BP STATISTICAL REVIEW OF WORLD ENERGY, 2017



RENEWABLE ENERGIES

Asia Has Taken Centre Stage For Hydropower Capacity

HARNESSING the power of water is the cheapest form of energy. Today hydroelectric power provides almost one-fifth of the world’s electricity. Asia Pacific added 14,154 MW of hydroelectricity generating capacity in 2016, far ahead of other regions. China alone accounted for 26 per cent of the global installed capacity in 2015, far ahead of USA (8.4%), Brazil (7.6%) and Canada (6.5%).

Hydropower development worldwide grew steadily with an estimated 31.5 gigawatts of capacity added in 2016. It is nearly twice the amount installed in 2015, and brings the world’s total installed hydro capacity to 1,246 gigawatts, according to the International Hydropower Association. The total hydro generation for 2016 was estimated at 4,102 TWh², the greatest ever contribution from a renewable source.

South America added 9,738 MW of hydropower in 2016 with Brazil contributing the most in the region adding 6,365 MW. Africa added 3,413 MW followed by Europe and Central and South Asia that added 1,810 and 1,315 respectively.

The drivers for the upsurge in hydropower development include the increased demand for electricity, energy storage, flexibility of generation, freshwater management, and climate change mitigation and adaptation solutions.

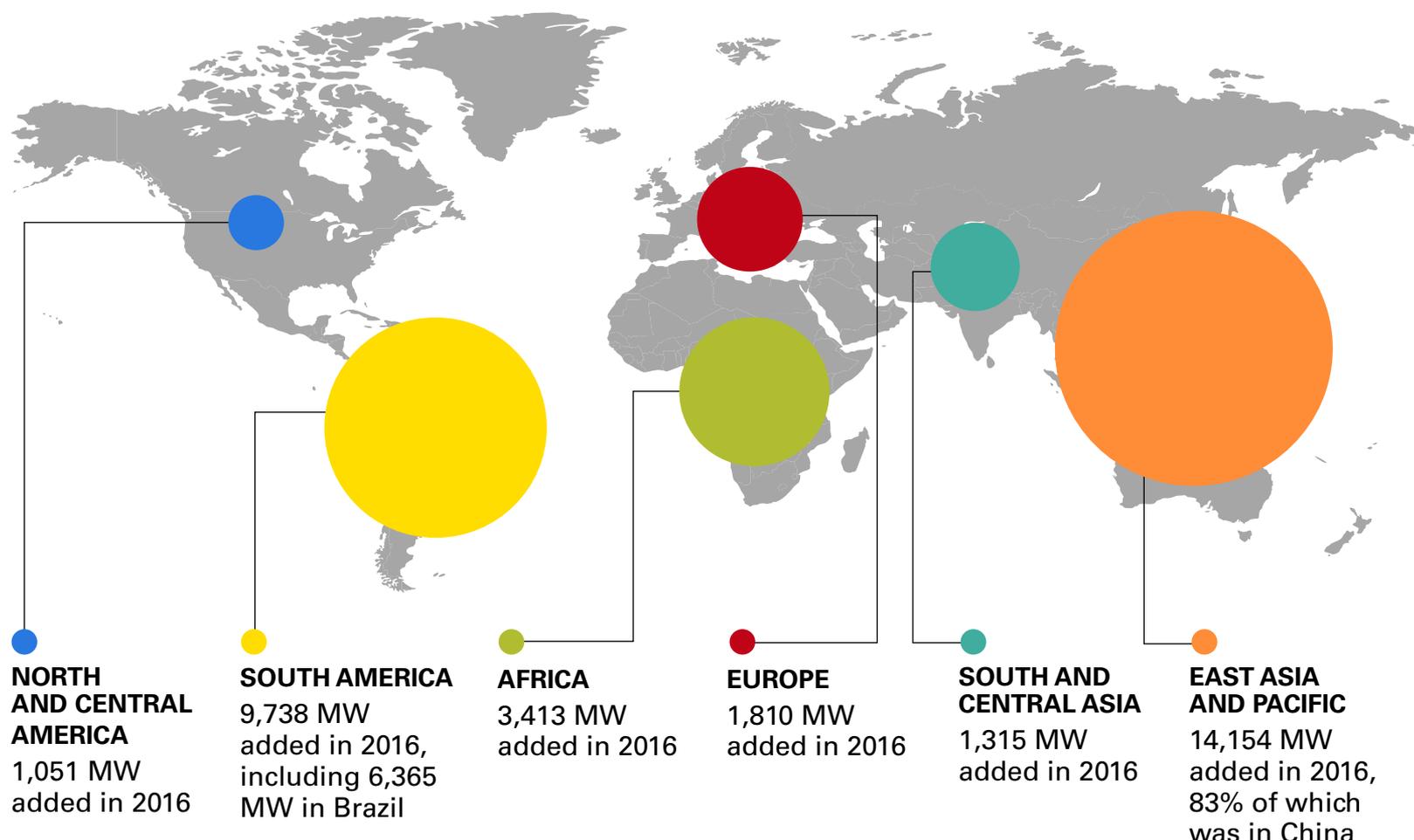
16.4%

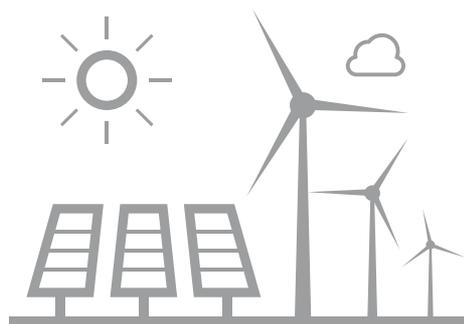
Hydropower is the leading renewable source for electricity generation globally, supplying 71% of all renewable electricity. It generated 16.4% of the world’s electricity from all sources.



Worldwide Hydropower Continues Steady Growth

Hydropower development shows a steady growth trend, driven by a demand for reliable, clean and affordable power as more and more countries seek to meet the carbon reduction goals set out in the Paris Agreement.





RENEWABLE ENERGIES

Which Countries Generate The Most Energy From Hydropower In Asia?

THE leading hydropower generating countries in Asia are China, India, Japan and Vietnam. China in fact has established itself at the forefront of global hydropower development making significant additions to its hydropower market than any other country. China has nearly seven times higher hydropower installed capacity than India and more than the rest of Asian countries combined. It represents more than a quarter of the world's total hydropower capacity.

Other countries with most hydroelectric generating capacity installed in the region include Australia (8,790 MW), Pakistan (7,320 MW), South Korea (6,471 MW), Malaysia (6,094 MW), New Zealand (5,346) and Indonesia (5,3058 MW). According to World Energy Council (WEC) there are three types of hydropower stations: 'run of river', where the electricity is generated through the flow of a river'; 'reservoir', where power is generated through the release of stored water; and 'pumped storage', where stored water is recycled by pumping it back up to a higher reservoir in order to be released again.

Bangladesh, Nepal, Cambodia and Bhutan are the Asian countries with the least hydroelectric generating capacity installed, as per the International Hydropower Association, 2017. Bangladesh has a total installed hydroelectric generating capacity of just 230 MW, the lowest in the Asia Pacific region, while Nepal has 867 MW. Cambodia and Bhutan have 1,267 MW and 1,615 MW of installed hydroelectric generating capacity respectively.

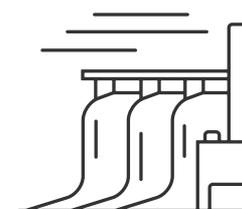
71%

Hydropower is the cheapest way to generate electricity and worldwide it is the leading renewable source for electricity generation, supplying 71% of all renewable electricity.

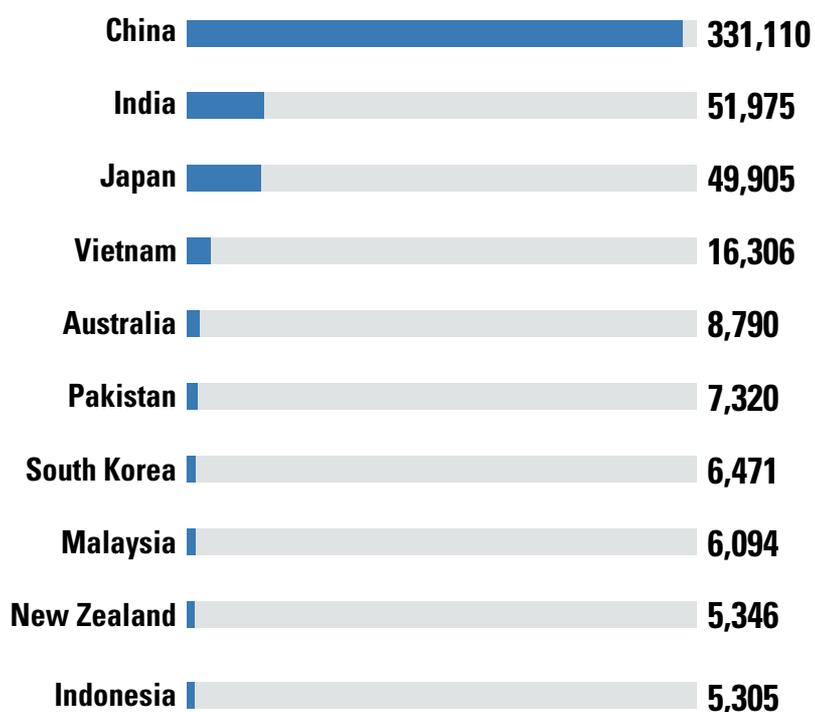


Hydropower In Asia

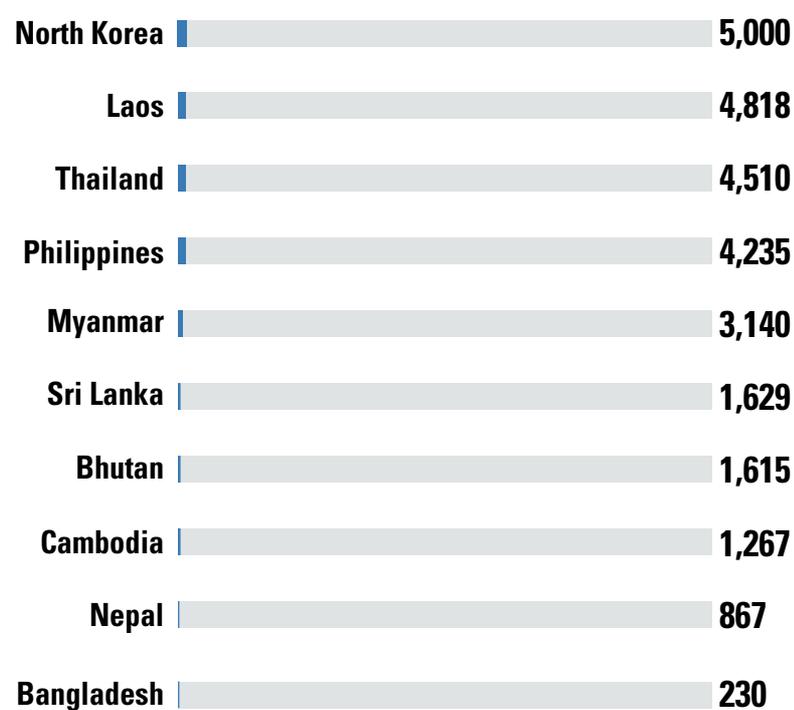
Hydroelectricity is China's largest renewable energy source and the second overall after coal. The country is adding more new installed hydropower capacity than the rest of the world combined.

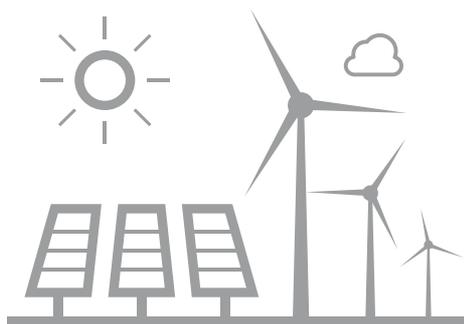


10 Asian Countries With Most Hydroelectric Generating Capacity Installed (Mw)



10 Asian Countries With Least Hydroelectric Generating Capacity Installed (Mw)





RENEWABLE ENERGIES

Renewable Energy Jobs Continue To Shift Towards Asia

THE renewable energy sector has generated many new jobs and employment has shifted further towards Asia, which accounted for 62 per cent of all renewable energy jobs compared to 51 per cent in 2013. China has benefited from this transition, increasing its share of global jobs from 41 per cent in 2013 to 44 per cent in 2016. Globally the renewable energy sector employed 9.8 million people in 2016, an increase of 1.1 per cent over 2015.

The employment in renewables has climbed since 2012 with the photovoltaic becoming the most employment generating sector. It employed 3.09 million people, followed by liquid biofuels at 1.7 million. The wind industry had 1.2 million employees, a 7 per cent increase from 2015. Biofuels employment increased around 3 per cent to an estimated 1.7 million. Indonesia’s palm oil-based biodiesel sector saw employment increase by around 60 per cent to 154,000 jobs. Biofuel production also rose in South-Eastern Asia, including in Thailand, Malaysia and the Philippines, which together employed close to 192,000 people in 2016.

Globally, as per the International Renewable Energy Agency’s annual report, the employment in renewables increased 2.8 per cent last year to 8.3 million people, with China, Brazil, the U.S., India, Japan and Germany leading the job markets. Renewables jobs could total 24 million in 2030, as more countries take steps to combat climate change, as per the report.

46%

Malaysia’s role as a solar PV manufacturing hub for export markets continued to expand, with employment increasing upto 46% (to about 27,900) in renewables.

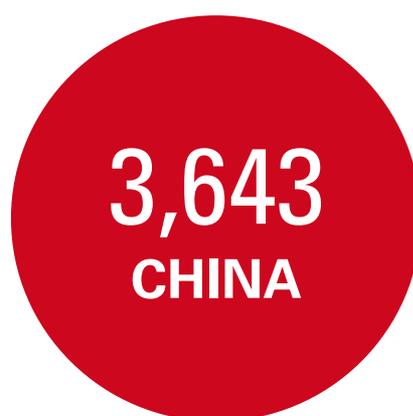


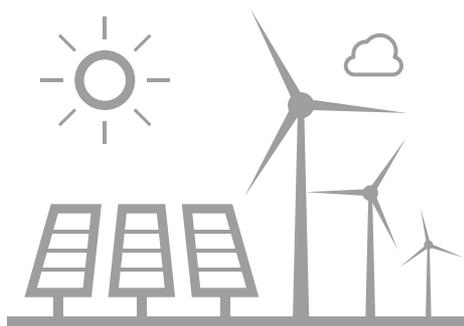
Jobs In Renewable Energy

Employment in renewable energy sector is increasing, with China, the U.S. and India leading the job market.

(Jobs in thousands)

	WORLD	CHINA	USA	INDIA
Solar PV	3,095	1,962	241	121
Liquid Biofuels	1,724	51	283	35
Wind Power	1,155	509	102	60





RENEWABLE ENERGIES

Asia’s Geothermal Energy Potential Remains Largely Untapped

THE Asia pacific region has a total of just 6 per cent of global thermal power capacity. The countries with the most installed capacity are the Philippines, New Zealand, Indonesia and Thailand. Philippines’ geothermal energy provides 16 per cent of the country’s electricity. Geothermal power generation of New Zealand has increased about 20 per cent per year and accounts for about 16 per cent of national electricity generation.

The total estimated potential of Indonesia is about 29 gigawatts, with only 5 per cent of it being utilised. The current generating capacity of roughly 1.4 gigawatts is located in Java, Bali, North Sumatra and North Sulawesi. Less than 3 per cent of total electricity generation capacity is sourced from geothermal, with plans from central government to further increase the share by adding new 5 gigawatts of geothermal capacity by 2022.

Taiwan has also made progress in exploring geothermal sources of energy with Sanxing project serving as the first geothermal demonstration plant. India on the other hand is also focusing on smaller-scale geothermal projects to increase energy efficiency consumption. The country is collaborating with Norway for a project in the northwest part of the Himalayas. Overall Asia’s geothermal energy potential remains largely untapped, despite the region’s vast geothermal resources.

1,465 MWe

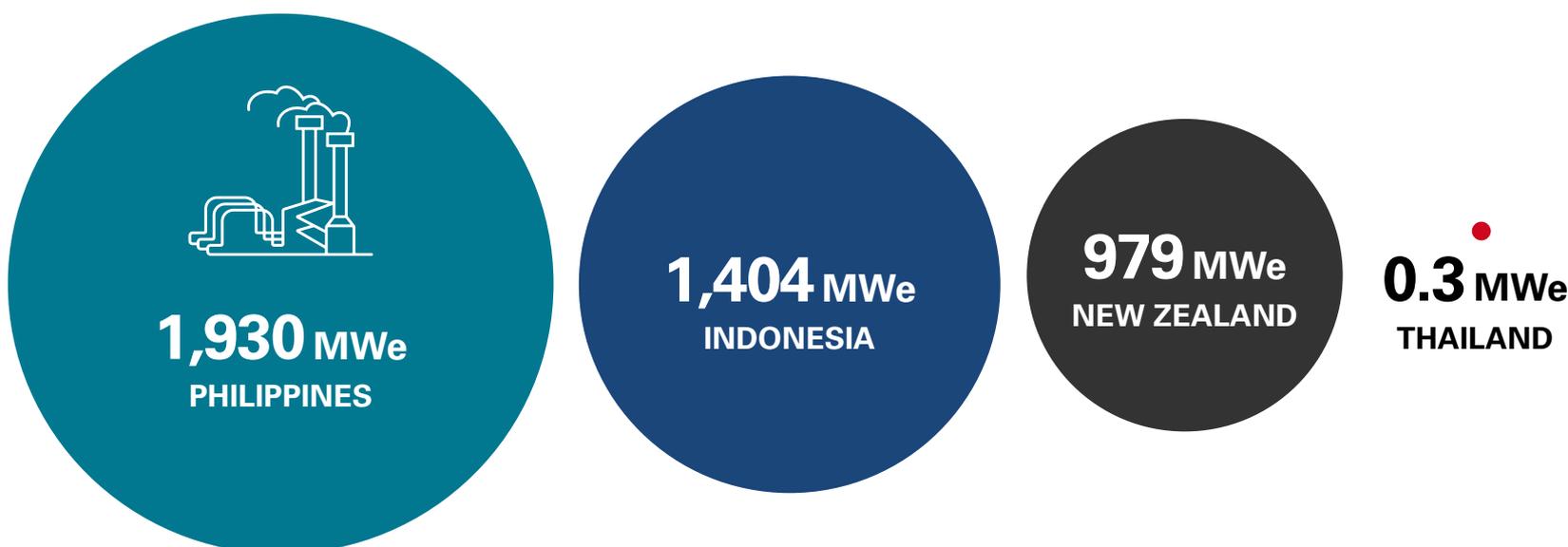
Philippines is the world’s second largest producer of geothermal energy after the United States. The country plans to add 1,465 MWe new geothermal energy generation capacity by 2030.



Geothermal Energy In Asia

Philippines is the world's second largest producer of geothermal energy, after the United States.

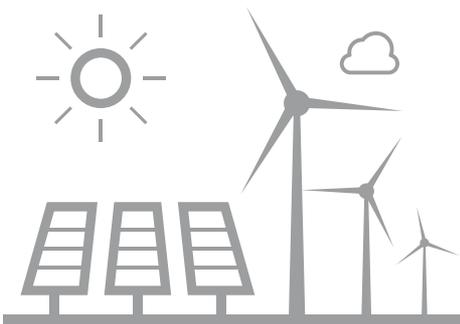
TOP COUNTRIES PER INSTALLED CAPACITY



GEOHERMAL INSTALLED CAPACITY

The region has a total installed geothermal generating capacity of 5.04 GW (electricity and thermal combined), representing just 6% of the global geothermal capacity.





RENEWABLE ENERGIES

China Leads World In Solar Power Production

CHINA while being the biggest carbon emitter is also one of the largest producers of the photovoltaic energy. China installed more than 34 gigawatts of solar capacity in 2016—more than double the figure for the US and nearly half of the total added capacity worldwide that year, according to the International Energy Agency.

The country has come a long way in establishing solar power capacity as one of the mainstays of its economy. It has been the world’s biggest solar market since 2013. It surpassed Germany as the country with the most installed photovoltaic power capacity two years ago. China could add more than 30 gigawatts of new solar capacity in 2017, though the market could face slower growth in subsequent years, according to the secretary general of the China Photovoltaic Industry Association,

The Asian superpower is pushing the boundaries of green tech, whether wind, solar or hydropower. It is leading the way in terms of finding green solutions. Clean-energy spending in China totalled \$87.8 billion in 2016, according to a report published by Bloomberg New Energy Finance. China dominated global shipments in 2016, for the eighth year running. Overall Asia accounted for 90 per cent (and China 65 per cent) of global module production; Europe’s share continued to fall, to about 5 per cent in 2016; and the US share remained at 2 per cent.

47%

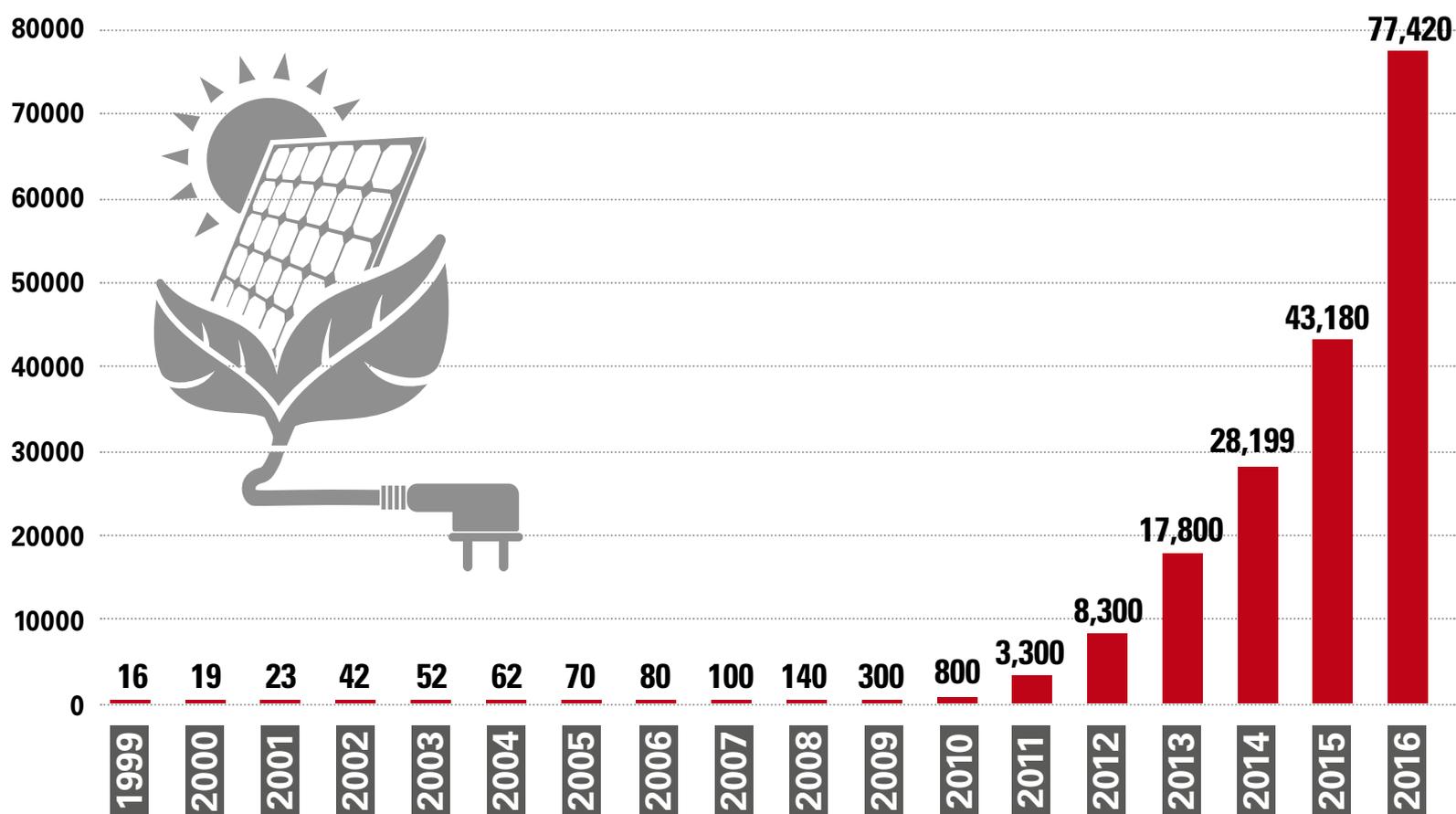
Worldwide solar PV represented about 47% of newly installed renewable power capacity in 2016, and wind and hydropower accounted for most of the remainder, contributing 34% and 15.5%, respectively.



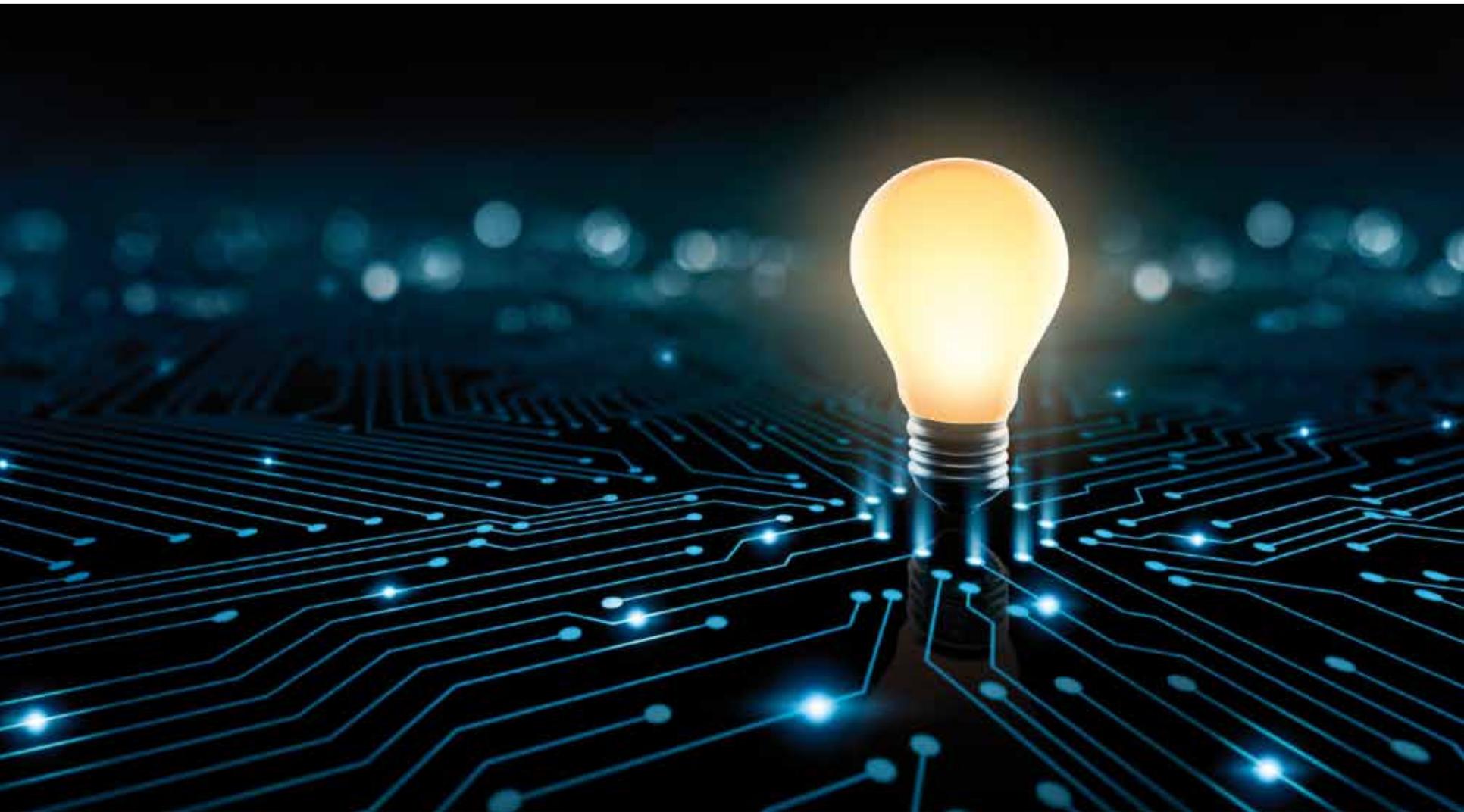
China's Solar Power

China is the world's largest producer of photovoltaic power and nearly half of the solar photovoltaic capacity installed worldwide in 2016 was in China.

(Photovoltaics capacity in MW)



SOURCE: IEA & CHINA NATIONAL ENERGY ADMINISTRATION, 2016



Chapter 4

Nuclear and Fossil Fuels



Mapped: The World's Nuclear Power Plants

OF the 31 countries in the world that have commercial nuclear power plants, the United States has the most nuclear capacity and generation, according to the IEA, the world's most prominent energy forecaster. Nuclear power has supplied about one-fifth of annual U.S. electricity since 1990. France has the second-highest nuclear electricity generation and obtains about 75 per cent of its total electricity from nuclear energy. Fifteen other countries generate more than 20 per cent of their electricity from nuclear power.



NUCLEAR AND FOSSIL FUELS

The first nuclear reactor to produce electricity was built in Idaho in the U.S. The Experimental Breeder Reactor began powering itself in 1951. The first nuclear power plant designed to provide energy to a community was established in Obninsk, Russia, in 1954. Since then governments across the world have been looking to nuclear power to solve some of the most pressing dilemmas they face—namely how to meet growing energy demand and increase energy security while reducing the CO2 emissions linked with global warming.

Today worldwide about 15 per cent of electricity is generated by nuclear power plants. Small nations such as Lithuania and Slovakia create almost all of their electricity from nuclear power plants. Asia is the main region in the world where electricity generating capacity and specifically nuclear power is growing significantly. The greatest growth in nuclear generation is expected in China, South Korea and India.

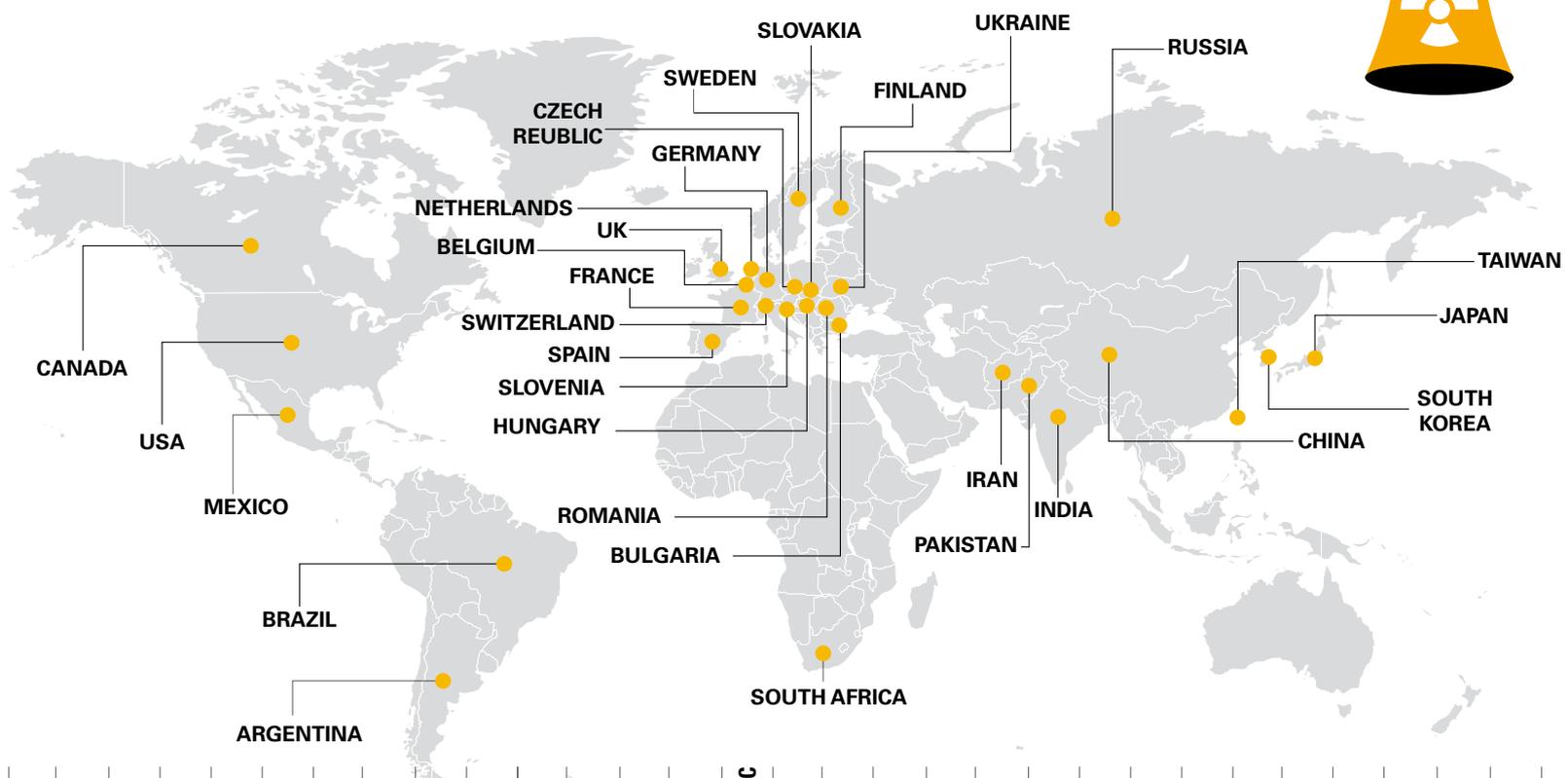
95%

About 90% of a plant's nuclear waste, called low-level waste, contains 1% of its radioactive content and can be handled easily without shielding. But some 3% of a plant's waste, known as high-level waste, contains 95% of its radioactive content.



Nuclear Power Plants

Worldwide 31 countries are operating 441 nuclear reactors for electricity generation and majority of them are in Asia.



USA	99
FRANCE	58
JAPAN	43
RUSSIA	35
CHINA	31
SOUTH KOREA	24
INDIA	21
CANADA	19
UK	15
UKRAINE	15
SWEDEN	10
GERMANY	8
SPAIN	7
BELGIUM	7
CZECH REPUBLIC	6
TAIWAN	6
SWITZERLAND	5
FINLAND	4
HUNGARY	4
SLOVAKIA	4
ARGENTINA	3
PAKISTAN	3
MEXICO	2
ROMANIA	2
SOUTH AFRICA	2
BRAZIL	2
BULGARIA	2
NETHERLANDS	1
IRAN	1
SLOVENIA	1
ARMENIA	1

China’s Nuclear Energy Sector Is Poised For Rapid Growth

WITH 38 nuclear power reactors in operation and 24 under construction, China has increased its number of operating reactors by more than ten times since 2000. According to BMI research, while trying to meet its mammoth energy requirements, China will end up overtaking the U.S. as the nation with the largest atomic power capacity by 2026. Both India and South Korea are also rapidly generating nuclear power for their energy use.



NUCLEAR AND FOSSIL FUELS

China started focusing on nuclear energy after its economic expansion which got a boost after 1990s when the world witnessed massive economic growth. Now that China is positioning itself as the world’s biggest economy, the country has long-term goals about nuclear energy to meet extremely high energy demand. South Korea, which has 24 units in operation producing 21.7 gigawatts, 4 under construction, 8 planned and two research reactors, meets 30 per cent of its electricity needs from nuclear power. The national plan is to expand to 36 nuclear power reactors by 2030. India also has six nuclear plants under construction and the country’s energy policy calls for 25 per cent of electricity to be generated from nuclear power by 2050.

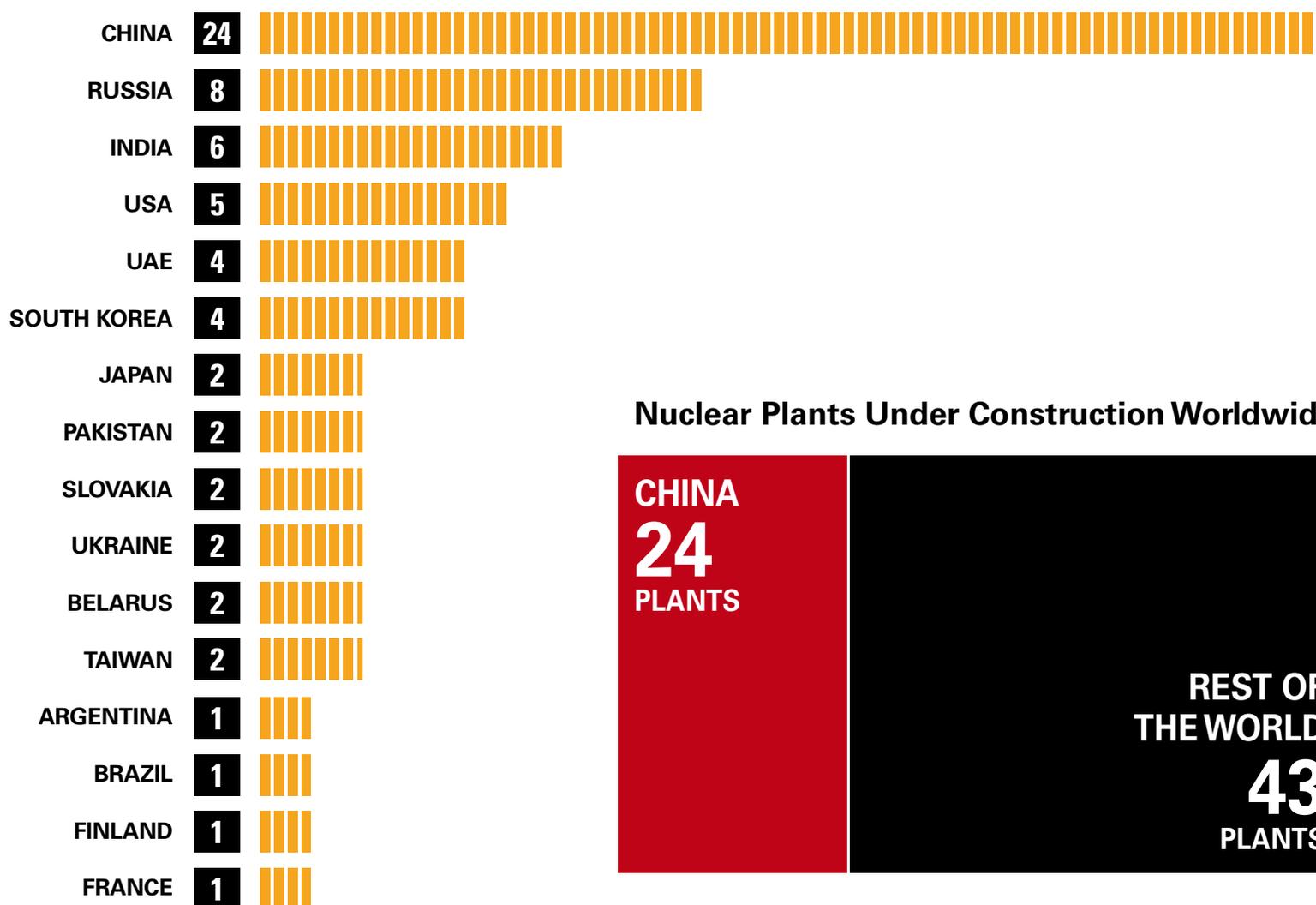
Neighbouring Pakistan has remained outside the reach of the international commercial market place but that has not stopped the country from developing nuclear power. It currently operates three reactors and is building two more.

60

Over 60 of the world’s operating nuclear reactors were opened before 1975, the vast majority in the US.



China's Big Nuclear Energy Ambitions



Nuclear Plants Under Construction Worldwide



SOURCE: INTERNATIONAL ATOMIC ENERGY AGENCY, 2015

Asia Remains Biggest Area For Nuclear Growth

WITH growing energy and electricity demands, Asian countries are relying on nuclear power generation to meet their energy and electricity requirements. Nuclear energy consumption in Asia Pacific is estimated to rise over 210.8 million metric tonnes of oil equivalent in 2020 and over 377 million metric tonnes of oil equivalent in 2030.

The amount of electricity generated by nuclear power in Asia is twice that of 30 years ago. In the last 10 years, nuclear generation has more than doubled in India and Pakistan and more than tripled in China. Nuclear generation in Asia now represents 18 per cent of the global total of 2476 TWh. Though the greatest growth in nuclear generation is expected in China, South Korea and India, there are other countries that are keen on developing nuclear power for the future.

A total of 57 reactors with a combined generating capacity of 60,430 MWe are planned or proposed in Bangladesh, Indonesia, Malaysia, Thailand and Vietnam. Although the 2011 Fukushima incident in Japan caused consternations among the Asian countries developing nuclear power, it didn't stop the story of nuclear development.



NUCLEAR AND FOSSIL FUELS

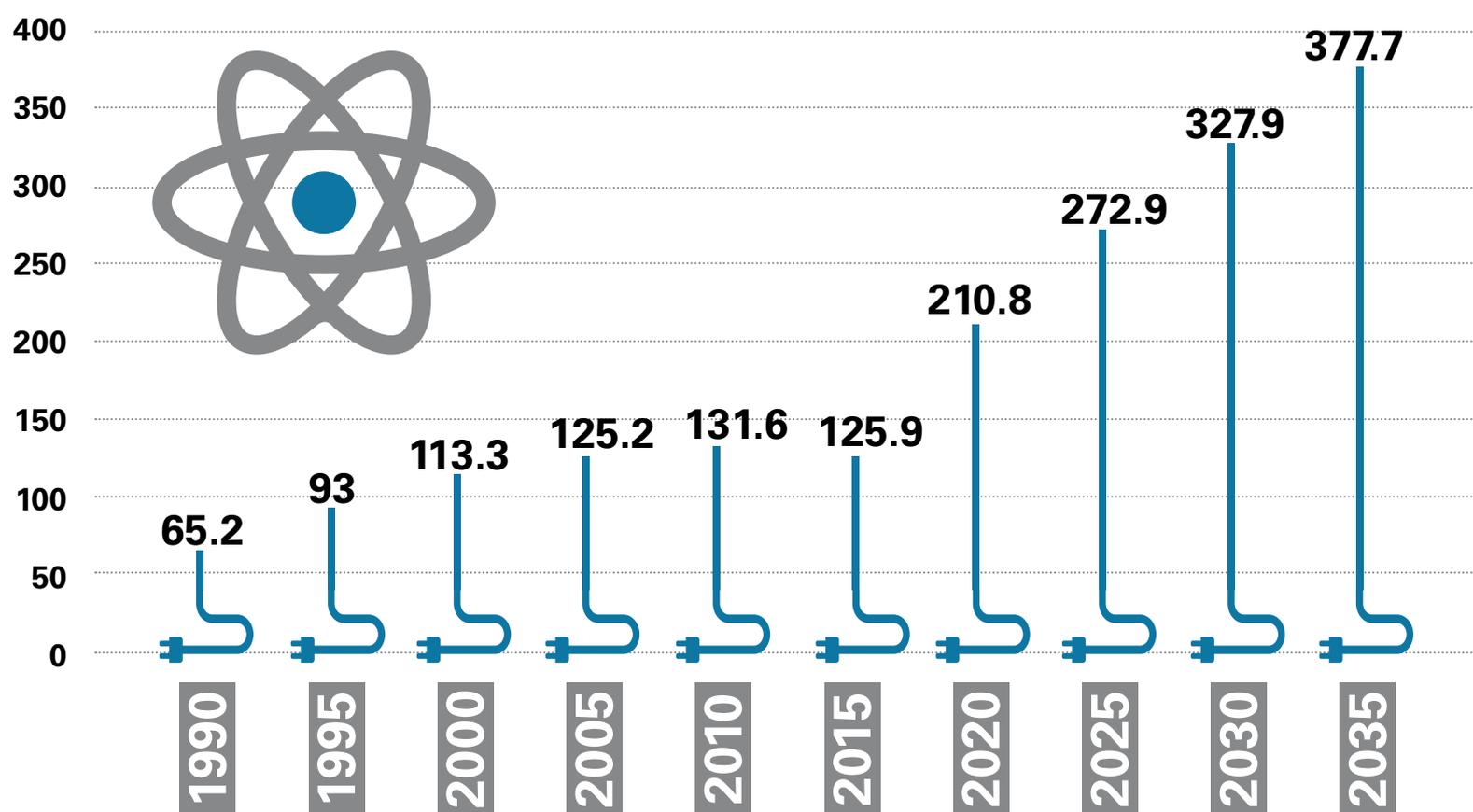
10

Asian countries continue to dominate the market for new nuclear build. Of the 10 new nuclear power reactors that started up worldwide in 2016, eight were located in Asia.



Nuclear Energy Consumption In Asia Pacific, Scenario 1990 To 2035

Nuclear energy consumption in Asia Pacific will rise to over 377 million metric tons of oil equivalent in 2035.





NUCLEAR AND FOSSIL FUELS

Japan Circling Back To Nuclear Power

ON March 11, 2011, one of the biggest earthquakes in history shook Japan’s northeast. The quake was so strong that it triggered a 10-metre tsunami which smashed into the Fukushima Daiichi nuclear power plant, triggering a meltdown and forcing nearby towns to evacuate. The disaster killed more than 19,000 people across Japan and caused an estimated 16.9 trillion yen (137 billion euros) in damages. More than 160,000 people were evacuated from towns around the Daiichi nuclear plant due to radiation contamination.

In the immediate aftermath of the earthquake, Japan idled all 54 of its nuclear plants. Now, though, five of them are back. Eleven are in the process of being decommissioned—six of these are at Fukushima—and decisions are yet to be made about 42 other reactors.

Today nuclear energy is providing 1.7 per cent of Japan’s electricity, which is down from 30 per cent before the 2011 accident. Japan’s government says that if the country is to meet its obligations under the Paris climate accord, then nuclear energy needs to make up between 20-22 per cent of the nation’s portfolio mix in 2030. Japan has committed to cut its CO2 emissions by 26 per cent between 2013 and 2030 and it wants to increase its green energy mix from 9 per cent today to 22-24 per cent by 2030. That requires having about 30 reactors operating by then.

1965

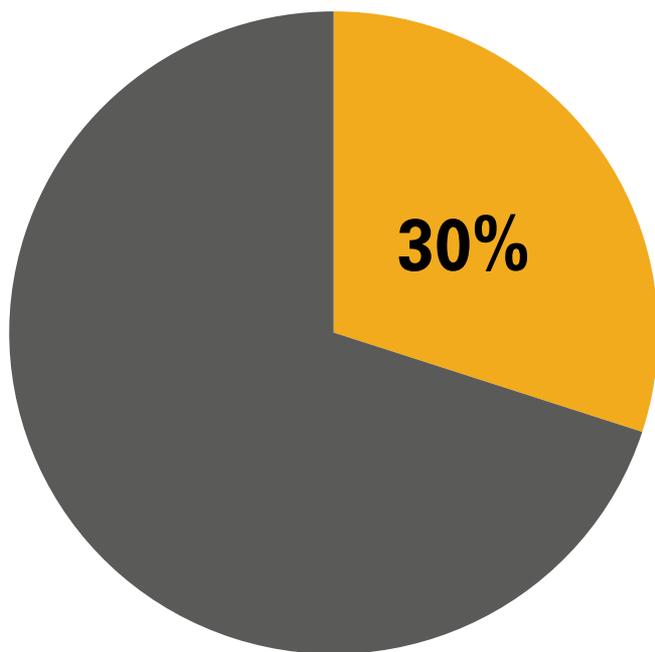
Japan’s first nuclear reactor was completed in 1965 and between then and 2011, Japan invested hundreds of billions of dollars into the industry.



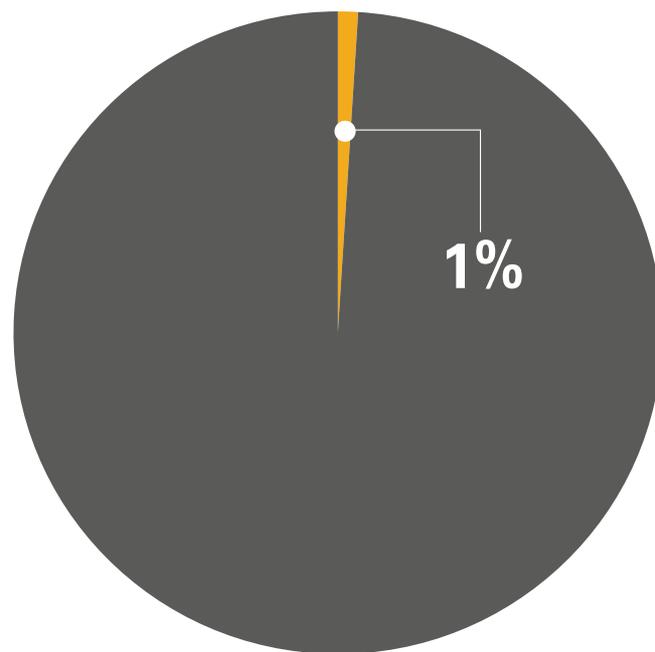
Before And After The Fukushima Disaster

Japan had generated 30% of its electrical power from nuclear reactors in 2010.
Today nuclear energy generates less than 1% of Japan's electricity.

2010



2016



SOURCE: WORLD NUCLEAR ASSOCIATION, UK, 2016



NUCLEAR AND FOSSIL FUELS

Coal Demand Is Shifting To Asia

ASIA is set to drive global coal demand through 2040 despite China planning to cut use of the fossil fuel to fight pollution, according to the International Energy Agency. India and Southeast Asia will account for the majority of the use of coal in the coming years, as those areas’ economies continue to grow and demand for electricity rises. What will drive projected consumption is not only because coal is markedly cheaper than natural gas, but also because coal projects are in many cases easier to pursue as they do not require the capital-intensive infrastructure associated with gas, according to the IEA.

An estimated 100 gigawatts of new coal-fired power generation capacity is to come online in Southeast Asia by 2040, increasing the region’s installed capacity to about 160 gigawatts. The IEA said 40 per cent of the new capacity will be built in Indonesia. Vietnam, the second-largest consumer of coal in Southeast Asia behind Indonesia, will become the region’s largest importer of coal by 2040. Imports into Pakistan, Bangladesh, India, and other parts of South Asia will jump to 284 million metric tonnes during that period, a 72 per cent increase from 2016.

But at the same time, Chinese imports of coal will drop about 40 per cent over the next two decades as the country ramps up its use of other energy sources, including wind and particularly solar, where it dominates the world market in terms of installed solar capacity and the production of solar panels.

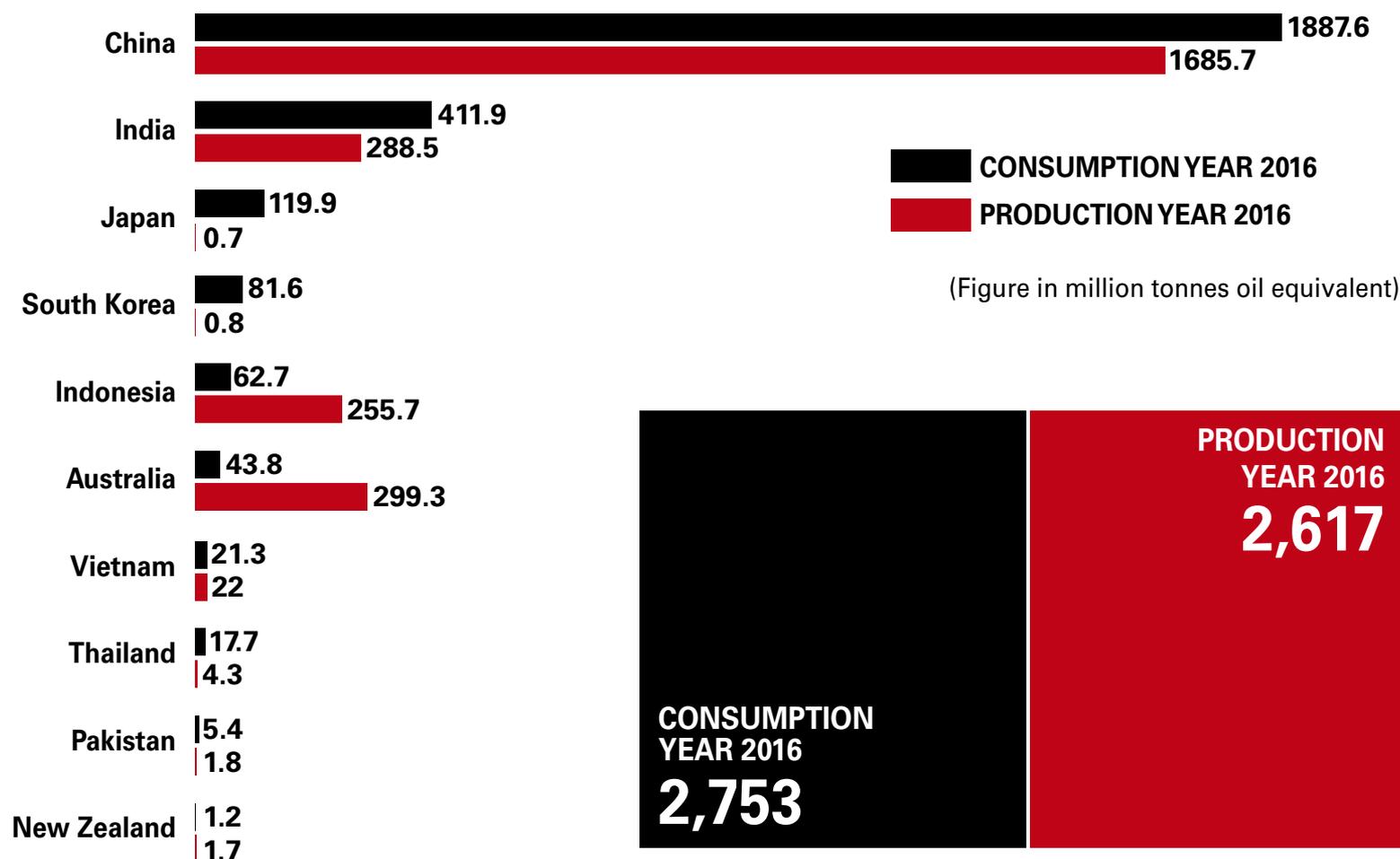
67%

48 nations of the Asia Pacific region will collectively increase their energy demand by 67% between 2010 and 2035, accounting for more than half the planet’s consumption, according to the Asian Development Bank.



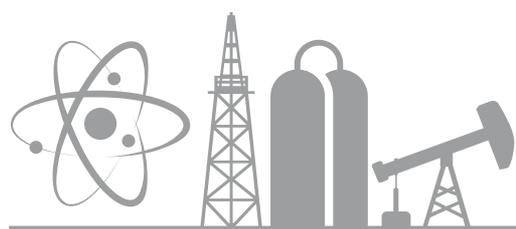
Which Countries Are Driving Coal Demand In Asia?

Asian countries are the main driving force of the global coal demand growth, thanks to their economic expansion and their large population.



Asia Keeps Oil Demand High

CHINA, India and Japan make up a fifth of 97 million barrels per day in global oil consumption, and any hiccups among them will mean lower-than-expected oil demand growth in Asia. Put together these three countries consume 63 per cent oil consumption in Asia. Over the past decade China and India have witnessed biggest growth in oil consumption, while Japan's oil consumption has fallen. Oil demand in many other Asian countries is almost at a standstill.



NUCLEAR AND FOSSIL FUELS

The BP Statistical Review of World Energy data show that China remains Asia's biggest oil consumer, accounting for 27 per cent of the region's demand and 13 per cent of global demand. China consumed 12,381 thousand barrels per day in 2016. It was remotely followed by India (4,489) and Japan (4,037). Bangladesh at 113 thousand barrels per day had the lowest consumption of oil in the region.

China also held proved oil reserves of 24.6 billion barrels at the end of 2014, which is the highest in the Asia-Pacific region. Yet, China resorts to global oil imports to satisfy its domestic energy demand needs. India, in comparison, held proved oil reserves of only 5.7 billion barrels at the end of 2014, which are almost negligible compared to the global oil reserves of 1,493 billion barrels. The country has to rely heavily on imports for oil, as its domestic production is not sufficient to meet the country's oil consumption.

32,444

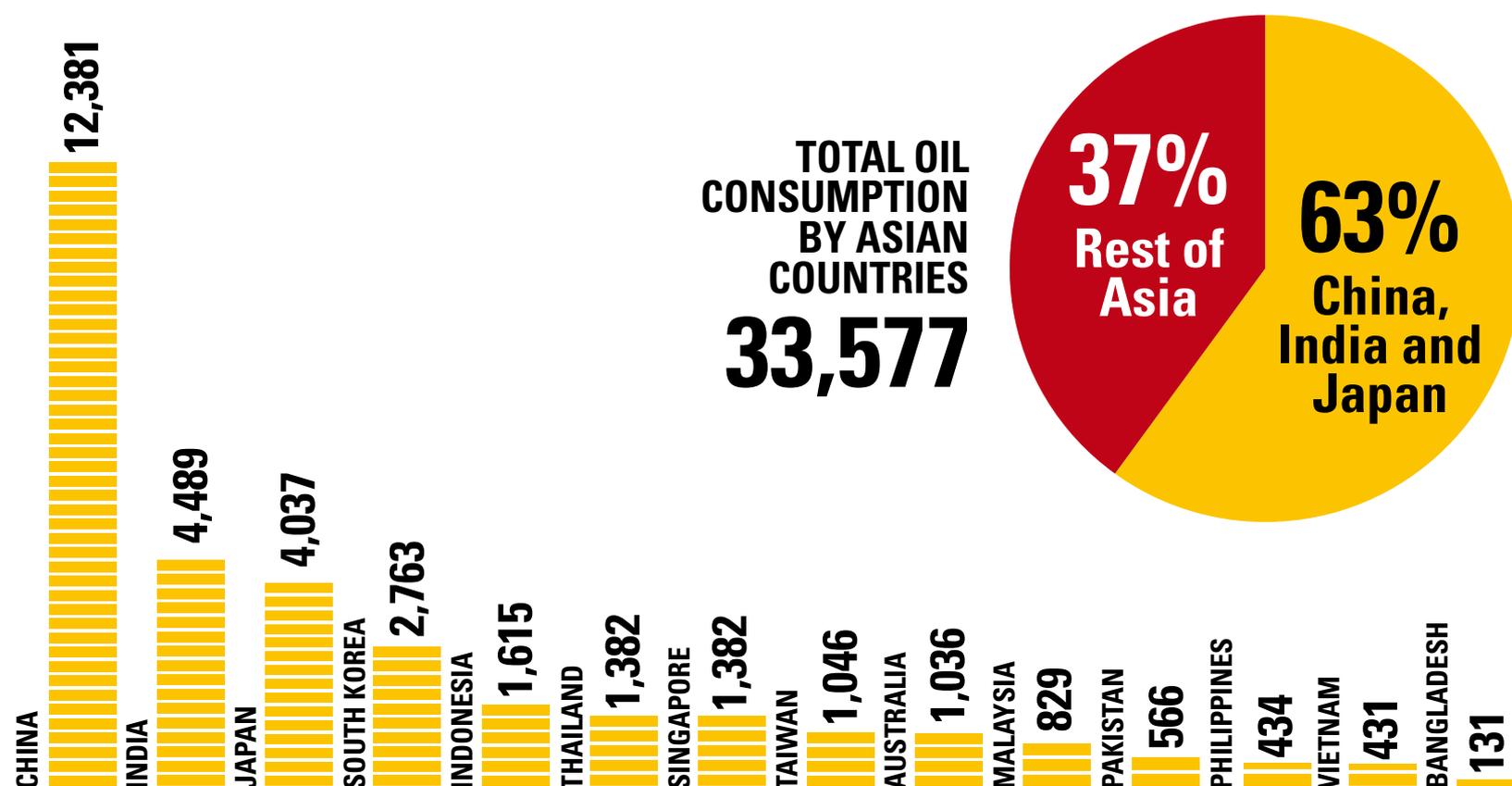
Overall oil production in Asia is way short of demand. While Asian countries consumed 32,444 thousand barrels per day in 2015, it produced only 8,346 thousand barrels per day, according to BP Statistical Review of World Energy report.



Which Asian Country Consumes More Oil?

Three countries—China, India and Japan—account for more than 63% of the Asia’s total oil consumption.

(Consumption in thousands of barrels per day)





NUCLEAR AND FOSSIL FUELS

In Asia, Oil Consumption Exceeded Production

IN Asia oil production is way short of demand. While Asian countries consumed 33,577 thousand barrels per day in 2016, they produced only 8,010 thousand barrels per day, according to BP Statistical Review of World Energy report.

Overall Asia’s share in global oil reserves remains small. For the continent’s most developed oil markets, Japan and South Korea, long-term demand is expected to steadily fall. Japan’s oil consumption, which was 5,354 thousand barrels per day ten years ago and 10 per cent of global demand, has fallen to 4,150 thousand barrels per day, or under 5 per cent of world consumption. It will fall further due to a declining, ageing population, and the rise of cars with better mileage or that use alternative fuels. Japan’s Economy and Trade Ministry calls for nuclear energy to account for 20-22 per cent of power generation by 2030, with 22-24 per cent coming from renewable energy sources, while coal’s share will be reduced to 26 per cent, LNG’s to 27 per cent and oil’s to just 3 per cent. In South Korea, oil demand in the last decade is almost standstill.

China, the world’s second-largest oil consumer, is also one of the biggest oil-producing nations. China alone accounts for 53 per cent of Asia’s total oil production. India, Indonesia and Malaysia are other major oil-producing nations in Asia. In total, Asia accounted for only 9.2 per cent of the world’s oil production.

6.6 million

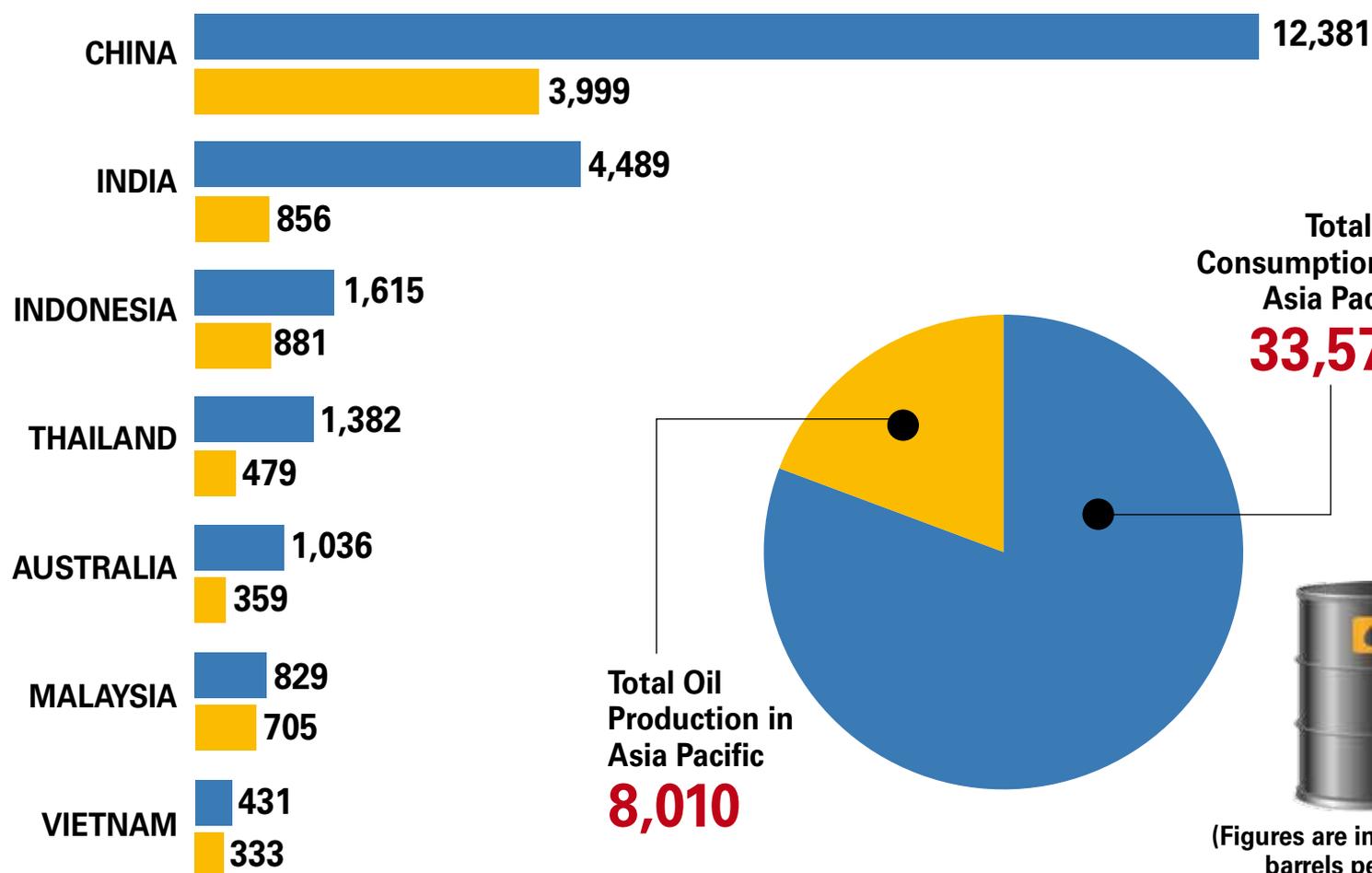
Oil consumption in Southeast Asia will further expand to around 6.6 million barrels per day by 2040 from 4.7 million bpd now, with the number of road vehicles increasing by two-thirds to around 62 million, according to the IEA.



Production Vs Consumption

Oil production in Asia is way short of demand.

■ CONSUMPTION ■ PRODUCTION



Evolving Natural Gas Market in Asia

ASIA is set to become the world's second-largest gas market, according to the International Energy Agency. Demand across the region remains robust, with many more countries building or planning to build receiving terminals. China, South Korea and Japan remain the major importers. However, the pace of development and demand of gas in China far exceeds that of either South Korea or Japan. China is expected to continue to grow and develop, consume energy and demand more gas. This demand will have a greater influence on the global gas market.



NUCLEAR AND FOSSIL FUELS

China's natural gas production has also soared in the last two decades. China's natural gas production in the year 2016 was 138 billion cubic metres compared to 51 billion cubic metres in the year 1995. Other Asian countries like Indonesia, Malaysia and Australia produced 69, 73 and 91 billion cubic metres of natural gas in 2016 respectively. Pakistan, India and Thailand respectively produced about 41, 27 and 38 billion cubic metres of natural gas in the same year.

Australia has about 3.5 trillion cubic metres of natural gas reserves while Indonesia, India and Malaysia have 2.8, 1.5 and 1.2 trillion cubic metres of respective natural gas reserves, according to the BP Statistical Review of World Energy, 2016. As Asia is not joined up by high-pressure pipelines to the same extent as these other regions, there's a lot of LNG shipping trade.

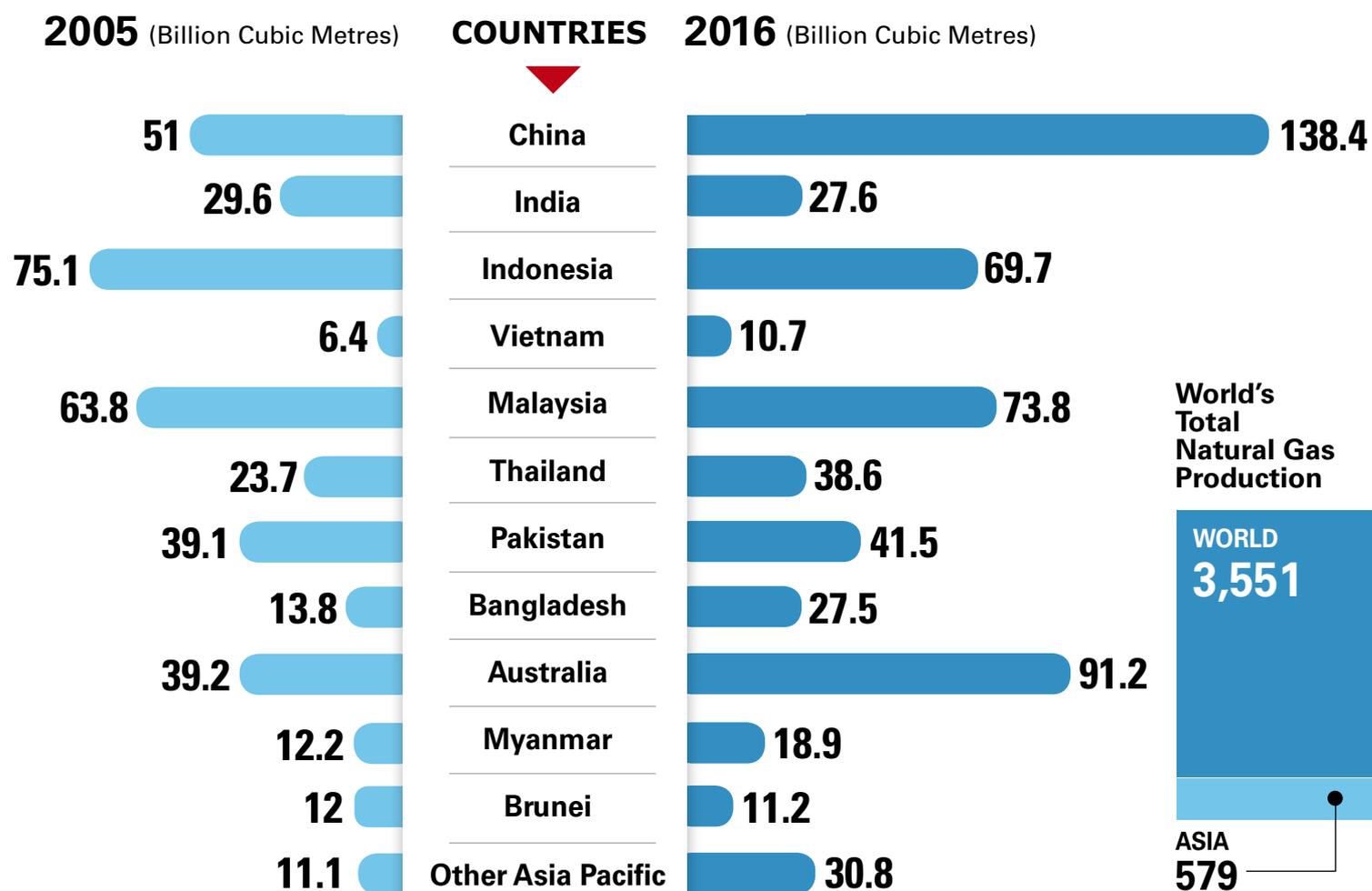
45%

China accounts for 7-8% of current global gas demand, but has less than 1% of proven global gas reserves. China's gas production, however, has impressively increased 45% since 2010 to nearly 138 Bcm.



Asia's Natural Gas Production

Natural gas is the world's fastest growing major fuel. In Asia, China's natural gas production has soared in the last two decades.





Chapter 5

Energy Finance





ENERGY FINANCE

Asia’s Pursuit Of Clean Energy

RENEWABLE energy is a dynamic and fast growing sector. It is at the heart of world’s aspiration for a better future. Renewables will create more jobs, commercial opportunities and more importantly it will generate clean energy. Globally renewable energy investment continues to be dominated by two sectors—solar and wind.

Both suffered declines in dollar investment in 2016, solar down 34 per cent to \$113.7 billion and wind down 9 per cent to \$112.5 billion, according to the UNEP report, 2016. The smaller sectors had mixed fortunes in 2016, geothermal seeing a 17 per cent increase to \$2.7 billion, while biomass and waste marked time at \$6.8 billion and small hydro at \$3.5 billion. Biofuels fell 37 per cent to \$2.2 billion, its lowest figure during the whole 2004-16 period and only 8 per cent of its 2006 peak.

The big three—China, India and Brazil have invested heavily in renewables over the last decade. China, India and Brazil, as a group, accounted for investment of \$94.7 billion, down 28 per cent, while the ‘other developing’ economies managed \$21.9 billion, down 37 per cent. Global new investment in renewables excluding large hydro fell by 23 per cent to \$270 billion, the lowest total since 2013, mostly because of two main reasons. One was lower costs of technologies and second was marked slowdown in financings in China, Japan and some emerging markets.

34%

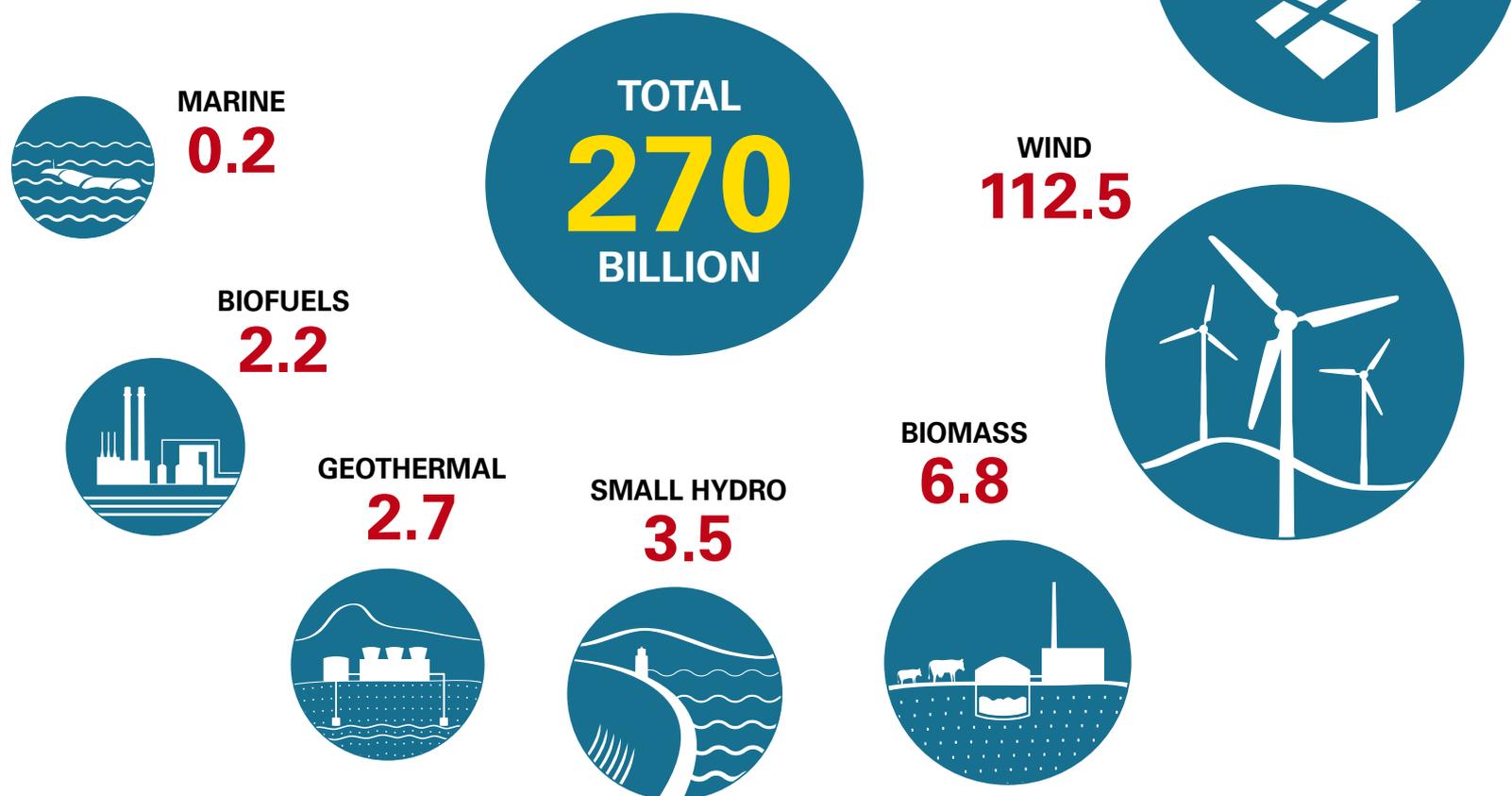
New investment in solar in 2016 totalled \$113.7 billion, down 34% from the all-time high in 2015, due in large part to sharp cost reductions—and to real slowdowns in activity in two of the largest markets, China and Japan.



Global Trends In Renewable Energy Investment By Sector

Solar and wind account for 92% of overall investment in renewable energy

(Figures in billion dollars)





ENERGY FINANCE

Lower Costs Partly Responsible For The Drop In Investment

THE developing economies including China, India and Brazil accounted for more than half of global investment in both wind and solar, but in 2016 they lost the lead in wind and only marginally maintained it in solar. Investment in developing countries fell 30 per cent to \$116.6 billion, while in developed economies it dropped 14 per cent to \$125 billion. China saw investment plunge 32 per cent to \$78.3 billion, breaking an 11-year rising trend.

Mexico, Chile and Uruguay saw falls in investment of 60 per cent, as per the UNEP report. The U.S. saw investments slip 10 per cent to \$46.4 billion and Europe enjoyed a 3 per cent increase to \$59.8 billion, led by the UK on \$24 billion and Germany on \$13.2 billion, down almost 1 per cent and 14 per cent respectively. Europe’s investment bounced due to record commitments to offshore wind, totalling \$25.9 billion, up 53 per cent. The decrease in investment is partly due to the falling cost of clean technology.

In 2016, developed countries maintained their advantage in biomass and waste, with \$5.2 billion against \$1.6 billion for emerging economies, and took the lead in biofuels, with \$1.8 billion against \$453 million. Geothermal saw developing countries ahead as usual, \$2 billion to \$775 million, as did small hydro, \$3.2 billion against \$229 million, as per the UNEP report.

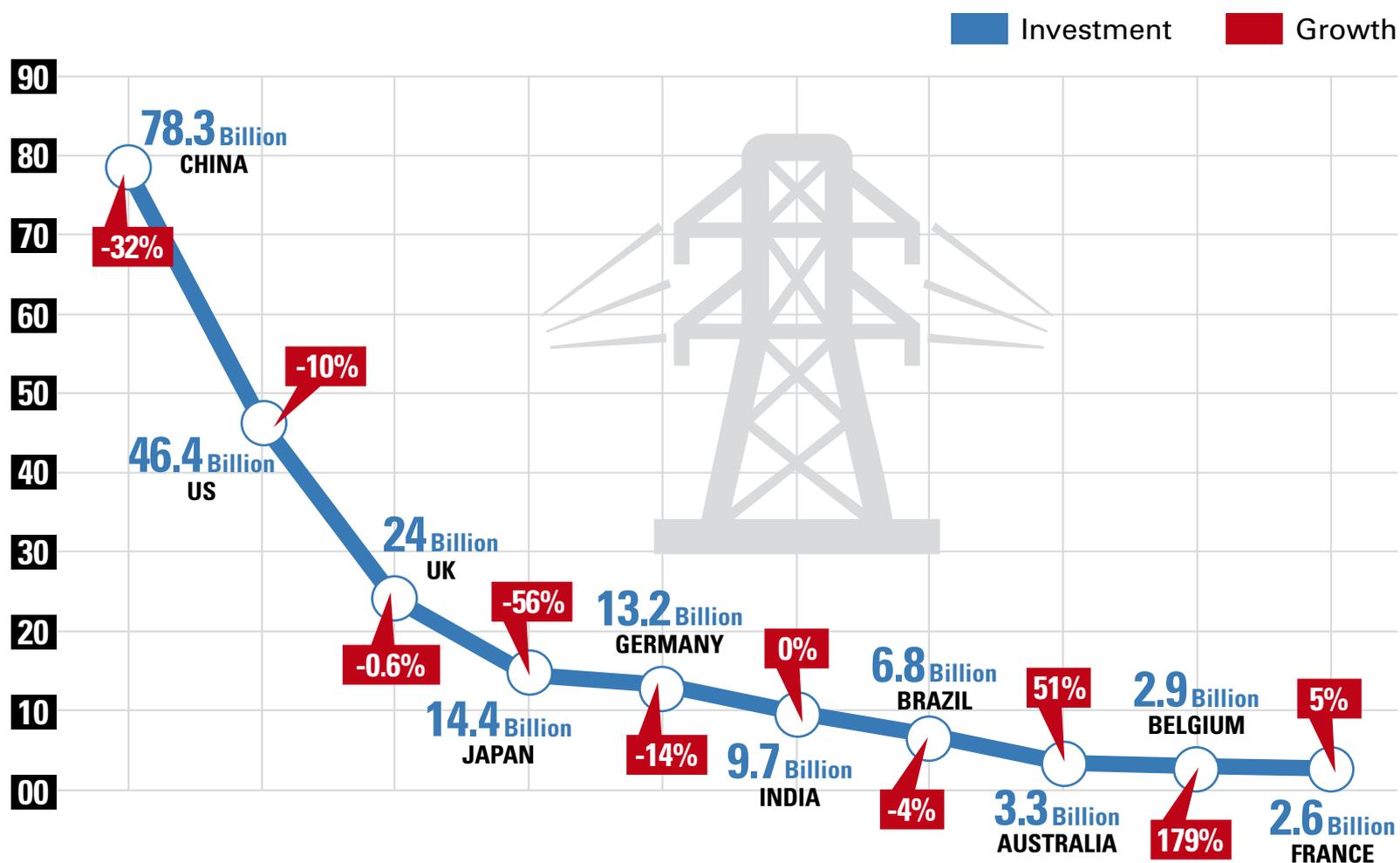
2.5 million

India has constructed world’s largest ever PV project in the southern state of Tamil Nadu. It comprises of 2.5 million solar panel modules, 576 inverters and 6,000 km of cables.



World Energy Investment By Region, 2016

China remained the largest destination of energy investment yet the makeup of investments in China has been changing. Year 2016 saw a 32% decline in investment.





ENERGY FINANCE

Renewable Energy Development In Asia

CHINA, the world’s biggest clean energy market, saw investment fall in renewable energy sector in 2016, yet it was way ahead of other countries in terms of investing in clean energy. India, considered as one of the most emerging markets for the next few years, recorded \$9.7 billion in 2016. As a signatory to the Paris Agreement on climate change, India is committed to ensuring that at least 40 per cent of its electricity will be generated from non-fossil-fuel sources by 2030.

In Thailand, the solar energy dominated total of \$1.4 billion which is its highest figure since 2013. The Philippines remains an active renewable energy market, with a 5 gigawatts pipeline of wind, solar geothermal, biomass and small hydro projects under development. Pakistan is seeing increasing interest in renewables, as the country of 230 million people seeks to meet the rising electricity demand.

Vietnam, seen as a significant emerging wind market saw \$682 million of asset finance in that technology last year, the largest contributor to which was \$247 million for the 100 MW Cong Ly Ngoc Hien project. Indonesia aims to supply 23 per cent of energy through renewables by 2025 and 25 per cent by 2030. Mongolia’s renewable energy investment remains modest. But now with Japanese backing, it has built the country’s first commercial solar plant which is now supplying the central electricity grid.

\$700 billion

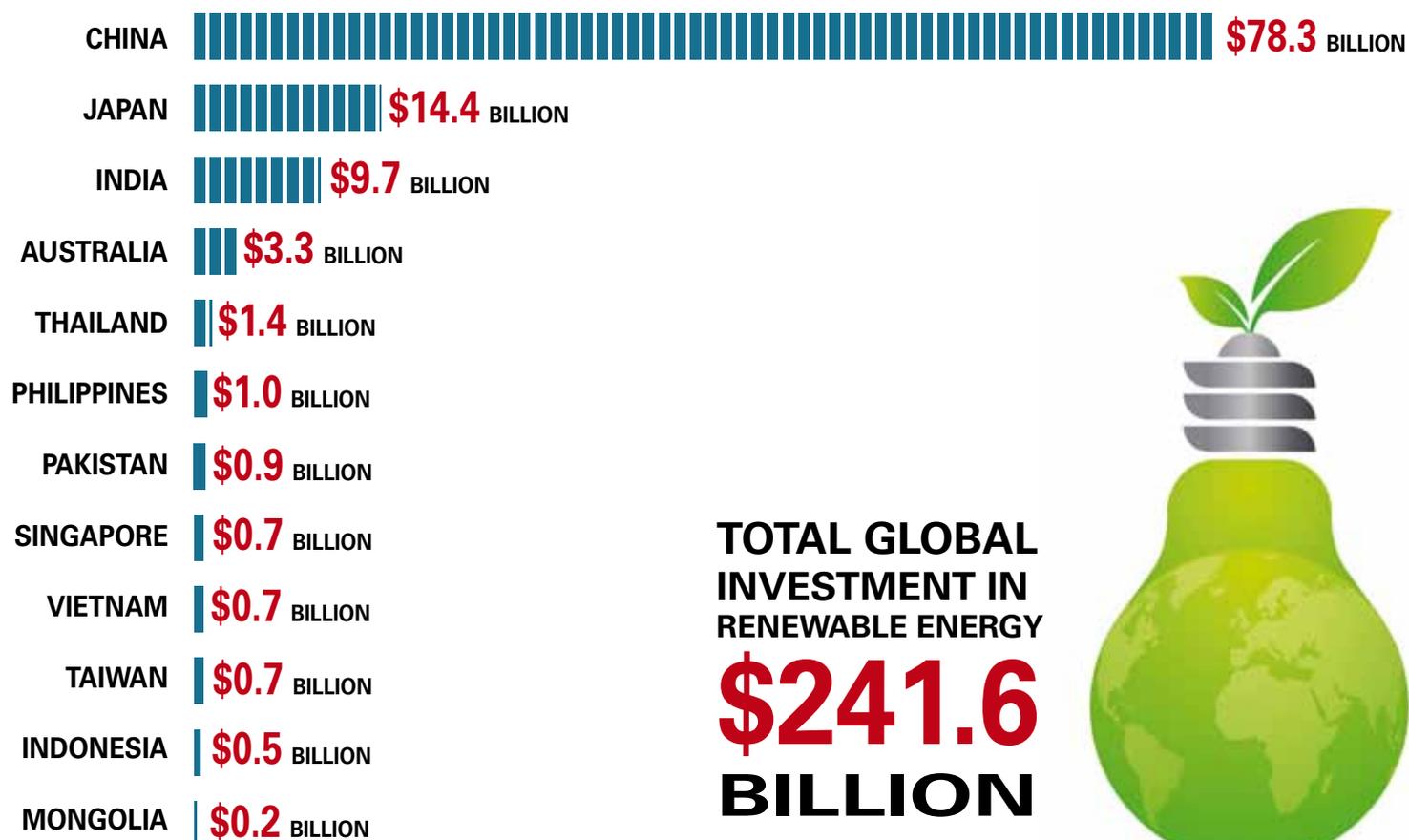
Asia needs around \$700 billion in energy investment through 2035, according to International Energy Agency estimates.





Asia's Top Investors In Renewable Energy

China remains biggest investor in renewable energy. Other Asian countries are emerging as significant renewable markets as well.



TOTAL GLOBAL
INVESTMENT IN
RENEWABLE ENERGY
\$241.6
BILLION





ENERGY FINANCE

Bonds That Fund Clean Energy Are Gaining Popularity In Asia

THE green bonds are investment products that have been created primarily to boost the development of renewable energy projects that slow carbon emissions. These bonds are similar to regular bonds but they fund projects that mitigate climate change or help people adapt to it. The hope is that these climate bonds will support a flurry of clean energy technologies. According to the CBI State of the Market 2016 review the total climate aligned bond issuance worldwide was USD 694 billion. Total issuance across the Asia Pacific markets covered was USD 293.4 billion, of which green-labelled bonds accounted for USD 14.3 billion.

China increasingly understands the growing significance of green development and infrastructure. The country is the largest issuer of climate bonds in the world with 246 billion investment in green bonds. There is also a growing appetite for green bonds in South Korea and India. In the labelled green bonds space, Hyundai issued South Korea’s first corporate green bond linked to energy efficient and electric vehicles in 2016.

India’s significant presence in the market was due to large issuers: Indian Railways and National Hydroelectric. Now many banks in India are offering green bonds which let investors link their money to environmental causes. However elsewhere in the region the green bonds are yet to take off in a big way.

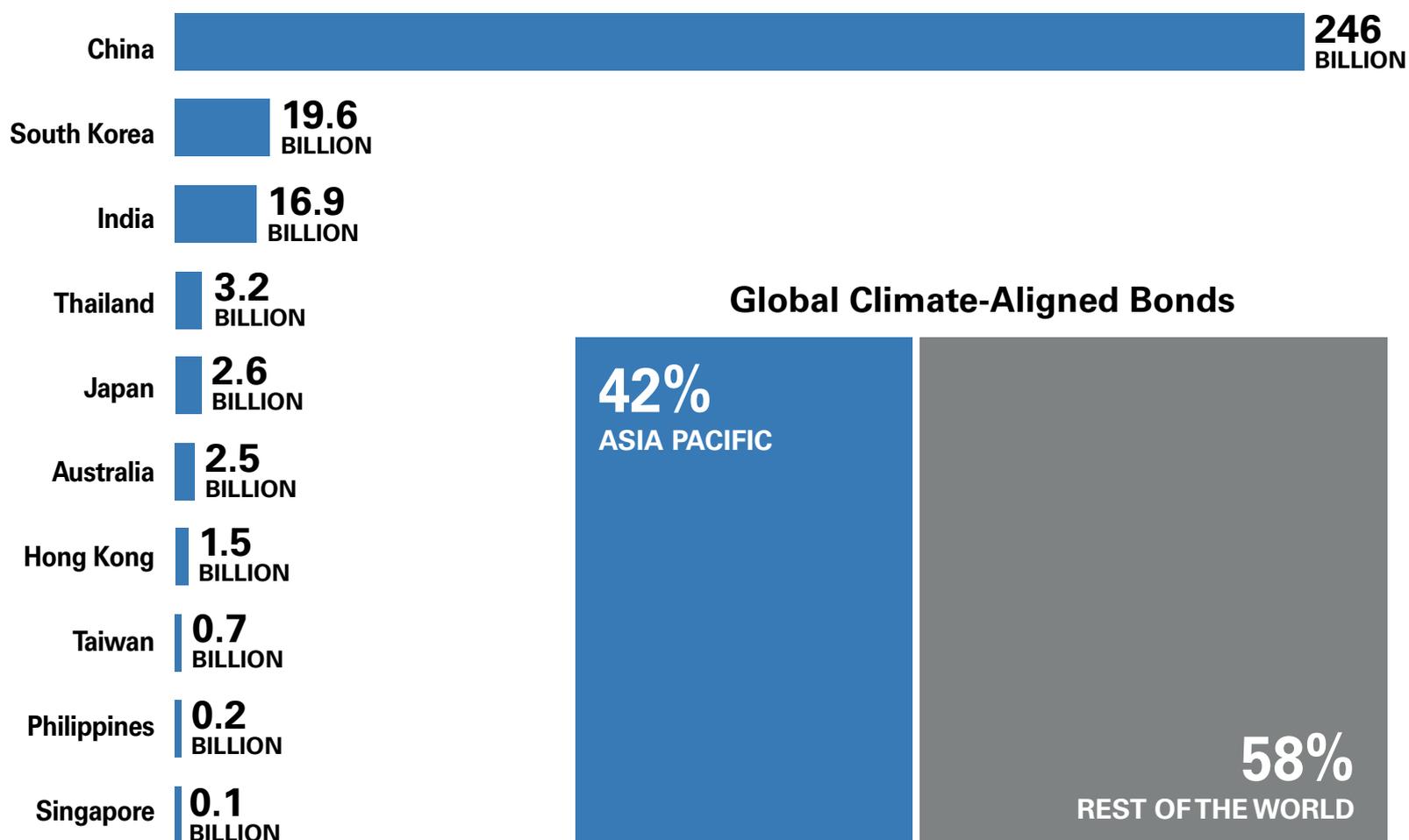
40%

China issued \$36bn of green bonds in 2016 alone. That was almost 40% of the \$81bn of green bonds issued globally last year.



Asia's Climate Bonds

The global climate-aligned bonds market is worth \$694 billion and China is the largest issuer of the climate bonds in the world.



SOURCE: THE CLIMATE BONDS INITIATIVE, UK, 2016



ENERGY FINANCE

Energy Investment Trends In Asia

THE energy investment outlook projects that over the period from 2010 to 2035 the demand for coal in Asia will increase by 52 per cent reaching 3,516.3 mtoe by 2035. Oil demand in Asia and the Pacific is projected to increase by 1.9 per cent yearly over the outlook period and reach 1,973.0 mtoe by 2035, 59.3 per cent higher than the 1,238.2 mtoe in 2010, according to the Asian Development Bank.

Demand for natural gas is projected to increase at 3.9 per cent per year, reaching 1,463.2 mtoe in 2035, 2.6 times the 2010 level of 566.7 mtoe. Electricity demand in Asia and the Pacific is projected to more than double between 2010 and 2035, reaching 16,169.2 terawatt-hours in 2035 owing to the growing economic and industrial development and higher living standards.

To meet energy demand Asia and the Pacific as a whole will need a cumulative investment of about \$11.7 trillion in the energy sector (2010-2035), from upstream energy extraction and production to midstream energy transformation and transportation to downstream energy distribution, as per the same report.

High-income Asian countries such as Singapore and Taiwan have a relatively low ratio of investments per GDP at around 2 per cent as their infrastructure is already developed. In contrast, the emerging countries undergoing industrialisation countries such as India, Indonesia, Malaysia, Pakistan, the Philippines, Thailand, and Vietnam show relatively high levels of energy investment per GDP at above 2 per cent.

21%

China remained the largest destination of energy investment, taking 21% of the global total.





ENERGY FINANCE

Future Of Nuclear Energy In Asia

INVESTMENTS worth \$1.2 trillion could be made in new nuclear power projects around the world, according to the latest forecast by the World Nuclear Association (WNA). More than half of this total will be made in Asia. The WNA estimates that the international market for suppliers could be worth \$30 billion per year. The largest region of growth will be Asia—primarily China—where 47 reactors are currently under construction and a further 142 are forecast by 2030.

Investment in nuclear projects in Asia could reach \$733 billion over that period. In total East Asia has 125 nuclear reactors planned and 36 under construction at the cost of 545 billion. South Asia and South East Asia are projected to spend 65 and 31 billion respectively. Investment is also envisaged to increase in Europe and Commonwealth of Independent States worth of 190 billion and 183 billion respectively.

In North America where five reactors are under construction and seven more are planned, investment could rise up to 90 billion by 2030. Latin America has one nuclear reactor planned with two under construction. The investment is projected to go up to 14 billion by 2030. African region has four reactors planned with none under construction as of now. The regional investment is projected to go up to 22 billion by 2030.

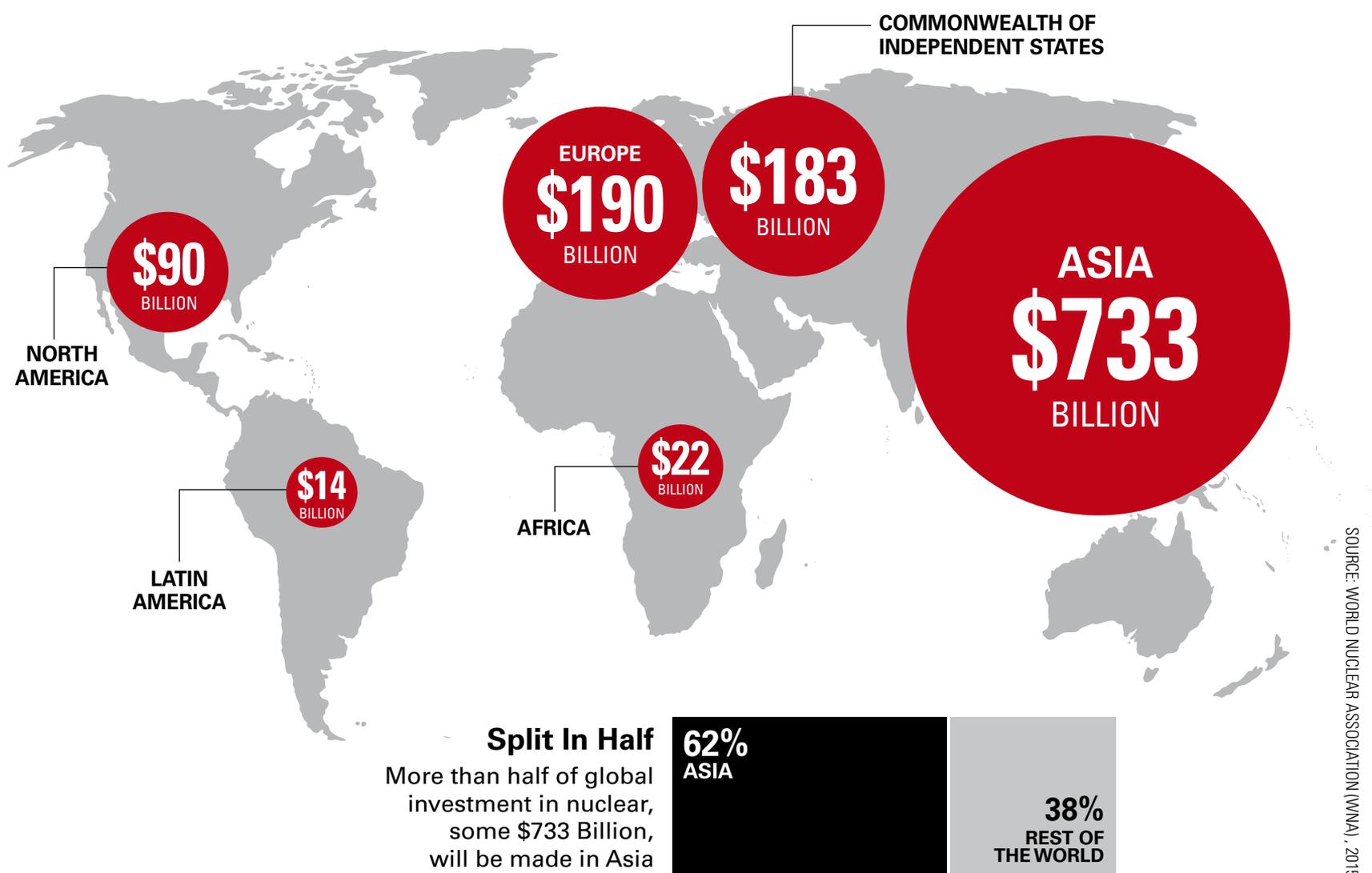
50%

More than half of the world's new nuclear capacity is under construction in Asia as the region is boosting its atomic industry to cut reliance on fossil fuels.



Asia Set To Lead In Nuclear Investment By 2030

By 2030 investments totalling some \$1.2 trillion could be made in new nuclear electricity projects around the world, according to the World Nuclear Association.





ENERGY FINANCE

Investments In Electricity Edge Ahead Of Fossil Fuels

WORLDWIDE the energy investment in 2016 was over \$1.7 trillion, accounting for 2.2 per cent of global GDP. Investment was down by 12 per cent compared to 2015 energy investment estimate of \$1.9 trillion, as per International Energy Agency. Energy efficiency expenditure jumped by 9 per cent while spending in electricity sector was up by 6 per cent. Oil and gas saw a continuing drop in investment. Falling unit capital costs, especially in upstream oil and gas, and solar photovoltaics (PV), was a significant reason for lower investment, along with the reduction in drilling and decreased use of fossil fuel-based power capacity also contributed.

Still two- fifths of global energy supply investment is represented by oil and gas even as the sector saw a fall of 38 per cent in capital spending between 2014 and 2016. As a result of this the share of low-carbon supply-side energy investments, including electricity networks rose by six percentage points to 43 per cent over the same period, according to the International Energy Agency. The investment in coal saw a decline from 66 billion in 2015 down to 59 billion in 2016 whereas renewables in transport and heat sector also incurred a downfall by 6 billion from 25 in 2015 to 19 billion in 2016. Overall China represented 21 per cent of total global energy investment.

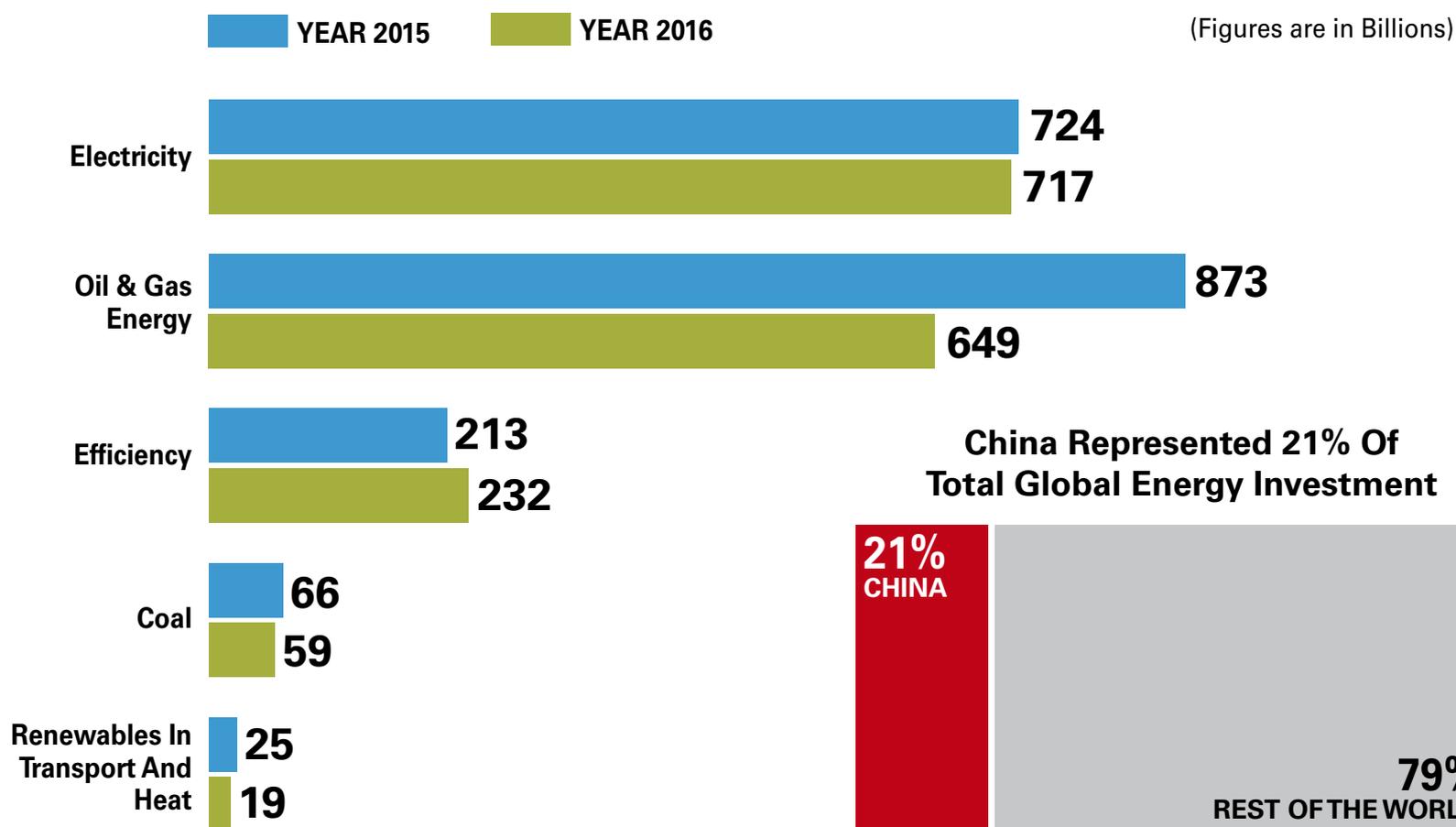
\$717 billion

Investment in the electricity sector exceeded for the first time the combined spending on oil, gas and coal supply with \$717 billion in 2016.



Energy Investment Trends By Sector In 2016

Global spending in energy efficiency rose by 9% while spending in electricity networks rose by 6%. However there was a drop in investment in upstream oil and gas and electricity generation.





ENERGY FINANCE

Renewable Energy Industry Outlook

RENEWABLES will be a huge player in the future of energy. Although the global new investment in renewables excluding large hydro fell by 23 per cent to \$241.6 billion, the lowest total since 2013, there was record installation of renewable power capacity worldwide in 2016.

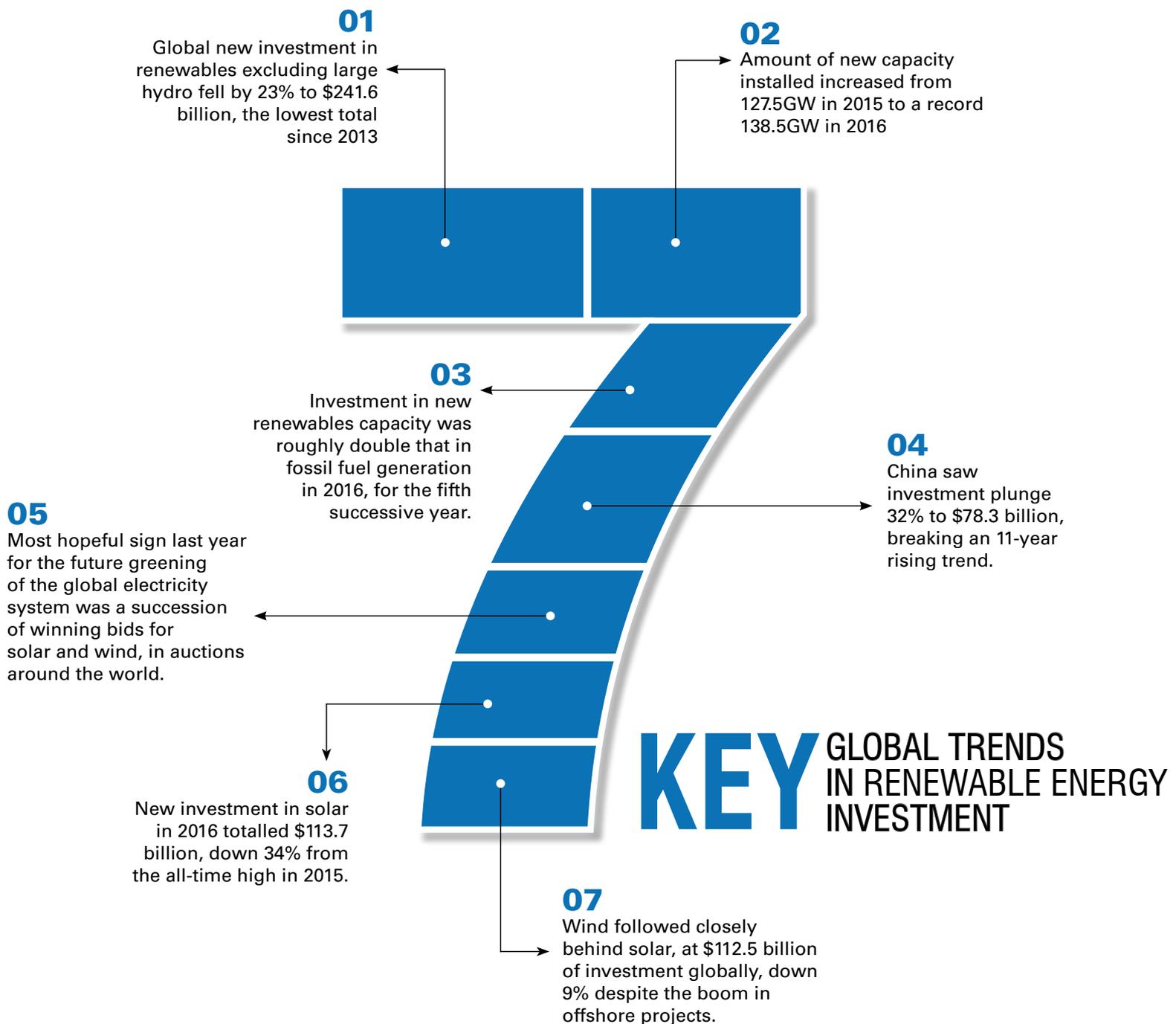
The amount of new capacity went up from 127.5 gigawatts in 2015 to a record 138.5 gigawatts in 2016. Wind, solar, biomass and waste-to-energy, geothermal, small hydro and marine sources between them added 138.5 gigawatts, up from 127.5 gigawatts, according to Global Trends in Renewable Energy report. Investment in new renewables capacity was almost double that in fossil fuel generation in 2016, for the fifth successive year.

The most hopeful for the future greening of the global electricity system was a succession of winning bids for solar and wind in auctions around the world. Most new renewable energy capacity is installed in developing countries, and largely in China. The renewable energy sector will also employ more people and employment is expected to shift further towards Asia, which already accounted for 62 per cent of all renewable energy jobs. Globally renewable energy use will soar as increasing wealth leads to a swelling middle class and the lifestyle trappings that it brings with it.

2.6%

Fifth of the world's primary energy supply already comes from renewable sources such as wind, solar, hydro and geothermal. This sector is expected to continue growing by 2.6% each year until 2040.





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Regional Project Energy Security And Climate Change Asia-Pacific

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