

# PERSPECTIVES ON THE GLOBAL RENEWABLE ENERGY TRANSITION



TAKEAWAYS

from the REN21  
Renewables  
2019 Global  
Status Report

2019

# REN21 MEMBERS

## INDUSTRY ASSOCIATIONS

Africa Minigrad Developers Association (AMDA)  
Alliance for Rural Electrification (ARE)  
American Council on Renewable Energy (ACORE)  
Associação Portuguesa de Energias Renováveis (APREN)  
Association for Renewable Energy of Lusophone Countries (ALER)  
Chinese Renewable Energy Industries Association (CREIA)  
Clean Energy Council (CEC)  
European Renewable Energies Federation (EREF)  
Global Off-Grid Lighting Association (GOGLA)  
Global Solar Council (GSC)  
Global Wind Energy Council (GWEC)  
Indian Renewable Energy Federation (IREF)  
International Geothermal Association (IGA)  
International Hydropower Association (IHA)  
Renewable Energy Solutions for the Mediterranean (RES4MED)  
World Bioenergy Association (WBA)  
World Wind Energy Association (WWEA)

## SCIENCE AND ACADEMIA

AEE - Institute for Sustainable Technologies (AEE INTEC)  
Fundación Bariloche (FB)  
International Institute for Applied Systems Analysis (IIASA)  
International Solar Energy Society (ISES)  
National Renewable Energy Laboratory (NREL)  
South African National Energy Development Institute (SANEDI)  
The Energy and Resources Institute (TERI)

## INTER-GOVERNMENTAL ORGANISATIONS

Asia Pacific Energy Research Centre (APEREC)  
Asian Development Bank (ADB)  
ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE)  
European Commission (EC)  
Global Environment Facility (GEF)  
International Energy Agency (IEA)  
International Renewable Energy Agency (IRENA)  
Islamic Development Bank (IsDB)  
Regional Center for Renewable Energy and Energy Efficiency (RCREEE)  
United Nations Development Programme (UNDP)  
United Nations Environment Programme (UN Environment)  
United Nations Industrial Development Organization (UNIDO)  
World Bank (WB)

## GOVERNMENTS

Afghanistan  
Brazil  
Denmark  
Germany  
India  
Mexico  
Norway  
South Africa  
Spain  
United Arab Emirates  
United States of America

## NGOS

Association Africaine pour l'Electrification Rurale (Club-ER)  
CLASP  
Clean Cooking Alliance (CCA)  
Climate Action Network International (CAN-I)  
Council on Energy, Environment and Water (CEEW)  
Energy Cities  
Fundación Energías Renovables (FER)  
Global 100% Renewable Energy  
Global Forum on Sustainable Energy (GFSE)  
Global Women's Network for the Energy Transition (GWNET)  
Greenpeace International  
ICLEI – Local Governments for Sustainability, South Asia  
Institute for Sustainable Energy Policies (ISEP)  
International Electrotechnical Commission (IEC)  
Jeunes Volontaires pour l'Environnement (JVE)  
Mali Folkecenter (MFC)  
Partnership for Sustainable Low Carbon Transport (SLoCaT)  
Power for All  
Renewable Energy and Energy Efficiency Partnership (REEEP)  
Renewable Energy Institute (REI)  
Solar Cookers International (SCI)  
World Council for Renewable Energy (WCRE)  
World Future Council (WFC)  
World Resources Institute (WRI)  
World Wildlife Fund (WWF)

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Michael Eckhart  
Mohamed El-Ashry  
David Hales  
Kirsty Hamilton  
Peter Rae

## CHAIR

Arthouros Zervos  
National Technical University of Athens (NTUA)

## EXECUTIVE SECRETARY

Rana Adib  
REN21

# REN21

## COMMUNITY

REN21 is an international policy network of experts from governments, inter-governmental organisations, industry associations, NGOs, and science and academia. It grows from year to year and represents an increasing diversity of sectors. REN21 provides a platform for this wide-ranging community to exchange information and ideas, to learn from each other and to collectively build the renewable energy future.

This network enables the REN21 Secretariat to, among other activities, produce its annual flagship publication, the *Renewables Global Status Report (GSR)*, making the report process a truly collaborative effort.



### REN21 COMMUNITY INVOLVEMENT IN THE GSR:

### INPUT FOR GSR 2019:



Over

# 1,500

experts have contributed to the GSR since its start in 2005.



# 70%

of these experts have participated in more than one GSR.



On average, nearly

# 60%

of the community consists of new experts each year.



Over

# 350

experts contributed to GSR 2019, working alongside an international authoring team and the REN21 Secretariat.



# 45%

of these were new experts.

# RENEWABLE ENERGY POLICY NETWORK FOR THE 21<sup>st</sup> CENTURY

## BUILDING THE SUSTAINABLE ENERGY FUTURE

REN21 is an international policy network of passionate players dedicated to building a sustainable renewable energy future. This means...

... **having a clear vision:** REN21 stands for a renewables-based energy system that includes all renewable energy technologies and serves all energy end-use sectors.

... **making the right decisions:** REN21 provides high-quality, up-to-date information to shape the energy debate.

... **telling a compelling story:** REN21 consolidates information about what is happening across the energy landscape to show that the global transition to renewables can happen.

... **inspiring and mobilising people:** REN21 builds on a worldwide community of players from governments, inter-governmental and non-governmental organisations, industry, science and academia.

... **moving beyond the familiar:** REN21 makes renewable energy relevant to decision makers outside the energy world, by developing an understanding of relevant concerns in these sectors.

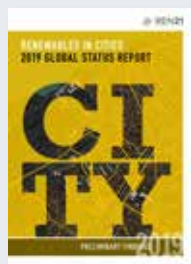
Making  
the invisible  
visible.

REN21 changes the way  
we think about renewable  
energy.

SHAPE THE FUTURE



## KNOWLEDGE



### RENEWABLE IN CITIES - GLOBAL STATUS REPORT (REC-GSR)

The cities report is the first comprehensive resource to map out the current trends and renewable energy developments in cities. It uses the same rigorous standards found in the *Renewables Global Status Report* series.



### RENEWABLES GLOBAL STATUS REPORT (GSR)

First released in 2005, this report is the industry standard for the status of renewables for a given year. The GSR's robust process for collecting data and information makes it the most frequently referenced report on renewable energy market, industry and policy trends.



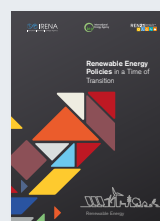
### REGIONAL REPORTS

These reports detail renewable energy developments in a region, improving data and knowledge and, in turn, informing decision making and changing perceptions.



### GLOBAL FUTURES REPORT (GFR)

This series captures the current thinking about a sustainable energy future. Each report presents the collective and contemporary thinking of many experts.



### THEMATIC REPORTS

Each report covers, in detail, a specific topic where a knowledge gap exists.

## DEBATES



### REN21 RENEWABLES ACADEMY

A biennial event developed by, and for, the REN21 community, where members meet and discuss how to spur the renewable energy transition. The REN21 Academy's structure reflects REN21's collaborative and transparent culture.



### INTERNATIONAL RENEWABLE ENERGY CONFERENCE (IREC)

A high-level political event where government, private sector and civil society meet to build collective know-how to advance renewables at the international, national and sub-national levels. The IREC is hosted by a national government and is held biennially.





# PERSPECTIVES ON THE GLOBAL RENEWABLE ENERGY TRANSITION

This document presents the overarching renewable energy trends and perspectives from 2019 so that policy makers and other decision makers can more easily understand the significance of the latest developments. It outlines what is happening to drive the energy transition and details why it is not happening fast enough or as fast as possible. It draws on the meticulously documented data found in **REN21's Renewables 2019 Global Status Report**. See the endnotes and methodological notes in the full report for further details, at [www.ren21.net/gsr](http://www.ren21.net/gsr).



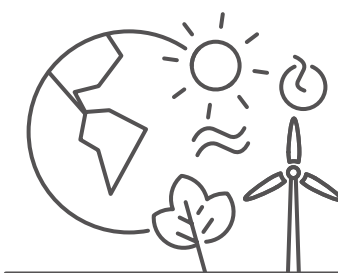
*Solar photovoltaics is the fastest-growing source of new renewable power.*

## TAKEAWAYS FROM THE REN21 RENEWABLES 2019 GLOBAL STATUS REPORT

The REN21 *Renewables 2019 Global Status Report* provides strong evidence that renewable energy is now a fully mainstream element in the global electricity mix. Alongside energy efficiency, renewables are playing a critical role in reducing emissions in the energy sector and in end-use sectors. In many locations, new renewable energy is now the lowest-cost way to provide electricity services and can be brought online the fastest. Around the world, renewable electricity has spread thanks to both transferable and reliable technologies and effective policy frameworks.

Despite these significant advances, the deployment of renewable energy needs to be accelerated now, more than ever, if renewables are to play their full part in securing a sustainable future. More ambitious targets and comprehensive, predictable policies are necessary to further mainstream renewable electricity and, especially, to meet rising heating and cooling needs as well as energy demand in the rapidly growing transport sector.

With a higher level of ambition backed by continuous policy support, renewables can play a major role in responding to both the climate emergency and the global development imperative, delivering affordable energy services and increasing energy security. The success of renewables in the power sector has shown clearly that an energy transition is possible.



Renewables  
accounted for

**64%**

of new net electricity  
generation capacity  
in 2018.

# 01 RENEWABLE POWER IS HERE TO STAY

Longstanding and ambitious commitments and stable regulatory policies have established renewables as a mainstream option in the power sector in nearly all parts of the world. The recent growth in renewable power capacity has been led by wind energy and solar photovoltaics (PV), with 100 gigawatts (GW) of new solar PV capacity alone installed in 2018. Hydropower remains the main contributor to the renewable electricity sector and has grown consistently for many years, having played a fundamental role in the power sector for longer than any other renewable energy technology. Bio-power, geothermal power and concentrating solar thermal power (CSP) also are contributing to growth but to a lesser degree.

In 2018, renewables accounted for about two-thirds of global investment in power generation and for about the same share of new net electricity generation capacity. For the fourth consecutive year, more renewable power capacity was installed than net additions to fossil fuel capacity. (→ See figure on page 10.) Renewables now represent more than one-third of the global installed electricity generation capacity.

Renewable energy supplies more than a quarter (26%) of global electricity production. Not including hydropower, electricity generation from renewables has grown more than 10-fold since 2000, with wind energy and solar PV leading the way. Despite this promising growth, however, rising electricity demand worldwide poses challenges in increasing the share of renewable power in global electricity production.

The continued momentum of renewables in the power sector **no longer depends entirely on just a few countries**. Although annual installations and investment in China, the world leader in renewable capacity and investment, declined in 2018 compared to the previous year, the global deployment of renewables continued. Investment grew in other regions, including the European Union, as well as in a wide range of countries.



*The success of offshore wind power in Europe has sparked interest in almost every other region.*

# RENEWABLE ENERGY IS POWERING THE WORLD



Reliable and Mainstream:  
Renewable power is here to stay!



30 countries have more than **10GW** of renewable power capacity



Renewables account for **1/3** of global power capacity



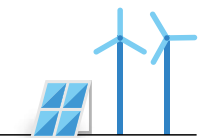
More than 180 GW of renewable power was installed in 2018, including **100GW** of solar PV

At least 9 countries now have over **20%** solar PV and wind in their electricity mix

**162** countries have targets and **135** countries have regulatory policies

## POLICIES

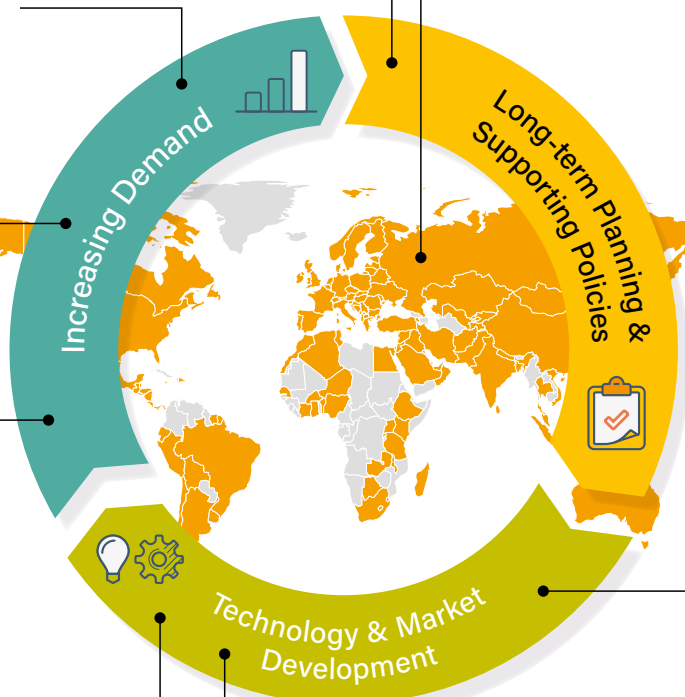
have made renewables a solid alternative in the power sector.



Wind and solar PV are now **cost-competitive** with fossil fuel power plants

**RENEWABLE POWER TECHNOLOGIES** are overtaking fossil fuels.

Renewables made up **64%** of global net capacity additions in 2018



Renewables are now deployed in all regions of the world, with 17 countries boasting renewable power capacity (not including hydropower) greater than 10 GW – mainly wind power and solar PV – and 45 countries having capacity above 1 GW. If hydropower is included, more than 90 countries had more than 1 GW of renewable power capacity, and 30 countries had more than 10 GW. Across Africa and developing Asia, nearly 150 million people have gained access to electricity through off-grid solar PV systems. To continue the growth in renewables, supportive policy and regulatory frameworks are critical to create favourable conditions for renewable energy markets and industries and to provide a level playing field that fosters growth in the sector.

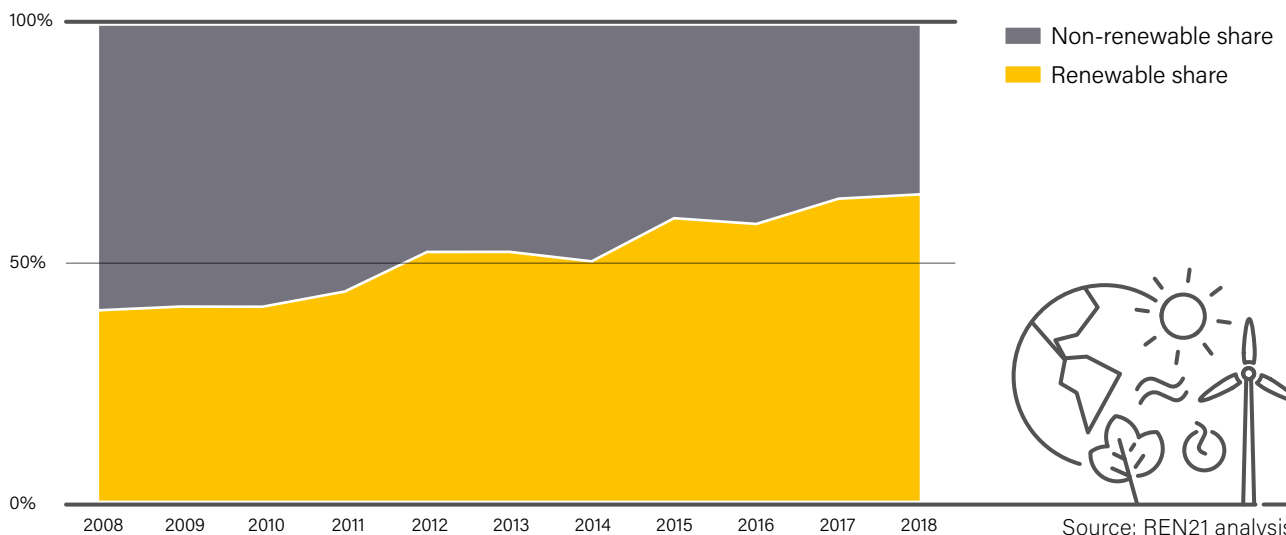
**Widespread policy commitments** have been instrumental in mainstreaming renewable energy in power generation. In 2018, as many as 135 countries had regulatory policies (such as feed-in tariffs or utility quotas) in place for renewables in the power sector, compared to only around 75 countries in 2010. In some countries, a long-term

vision, investment in research and development, and an industrial strategy have enabled global cost reductions in renewable technologies and attracted private sector finance. Based on the successes of pioneering countries, renewable energy technologies along with effective policy packages and business models have spread worldwide.

Growing experience with renewables around the world has shattered negative myths about their viability to meet global energy needs. **Renewable energy technologies have been proven reliable** and now provide the lowest-cost power generation options in many situations. Renewables also can be successfully integrated into grid operations: in 2018, at least nine countries generated more than 20% of their electricity with variable renewable energy (wind power and solar PV).

Nine countries generated more than **20%** of their electricity with wind and solar PV.

RENEWABLE SHARE OF NET ANNUAL ADDITIONS OF POWER CAPACITY, 2008-2018



## 01 | KEY TAKEAWAY:

**Renewable energy** in the power sector has proven, again and again, that it **can deliver as a cost-competitive solution** while providing a variety of benefits. The technologies are ready to be put in place, and the policy models are waiting to be replicated and tailored to local conditions. With the right market conditions and policy frameworks, renewables can help countries anywhere in the world provide reliable electricity services, improve energy security and reduce harmful emissions and air pollution.



*Hydropower, wind power and solar photovoltaics are the biggest players in the renewable power sector.*

## 02 PROGRESS IN THE POWER SECTOR OFFERS MAJOR INSIGHTS FOR **OVERCOMING SLOW GROWTH OF RENEWABLES IN HEATING, COOLING AND TRANSPORT.**

While renewables are making great strides in the power sector, this alone is not sufficient to achieve the energy transition that is needed to limit overall emissions. Electricity accounts for only around 17% of worldwide energy demand, so there is an urgent need to decarbonise heating, cooling and transport as well.

So far, the progress seen in renewable electricity has not been achieved in these other sectors. Whereas renewables supply more than 26% of global electricity production, they provide only 10% of the energy used for heating and cooling, and just over 3% of energy use for transport. Shares of renewables in these latter sectors are growing so slowly that renewable energy consumption is barely keeping up with global growth in energy demand.

Many factors contribute to the slower uptake of renewables in heating, cooling and transport. On a global level, these sectors remain heavily reliant on fossil fuels, which are highly subsidised in many countries. In addition, the policy effort focused on these sectors has been insufficient compared to the power sector. As of 2018, only 20 countries had regulatory policies for renewable heat and 70 countries had mandates for renewable transport, compared with 135 countries that had regulatory policies for renewables in the power sector.

A broad range of proven renewable energy technologies exist to meet the thermal needs of buildings and industry – including bioenergy, solar thermal and geothermal heat, and renewable power for heating and cooling. However, challenges remain in integrating renewables to meet the different energy demands in these sectors.

The buildings sector is very diverse, with varying thermal energy requirements, climates, and available infrastructure, which lead to different patterns of demand. In industry, the use of renewable heat is limited mostly to a few sectors involved in the bio-economy, such as pulp and paper, timber and cement. The options for expanding the use of renewables are industry-specific and are not yet widely deployed. As such, no “one-size-fits-all” technology solutions exist for either the buildings or industry sector. Dedicated policies are fundamental in increasing the uptake of renewables in these sectors and need to take these specifics into account.

**Opportunities in the buildings sector** are plentiful, but policy support for renewable energy and energy efficiency is still far from widespread. Effective policies range from building energy codes to renewable heat incentives and mandates, as well as indirect approaches such as carbon taxes; however, these policies remain under-utilised on a global scale. Another major opportunity is promoting the uptake of renewable electricity to meet heating demands in buildings, including through the use of heat pumps.

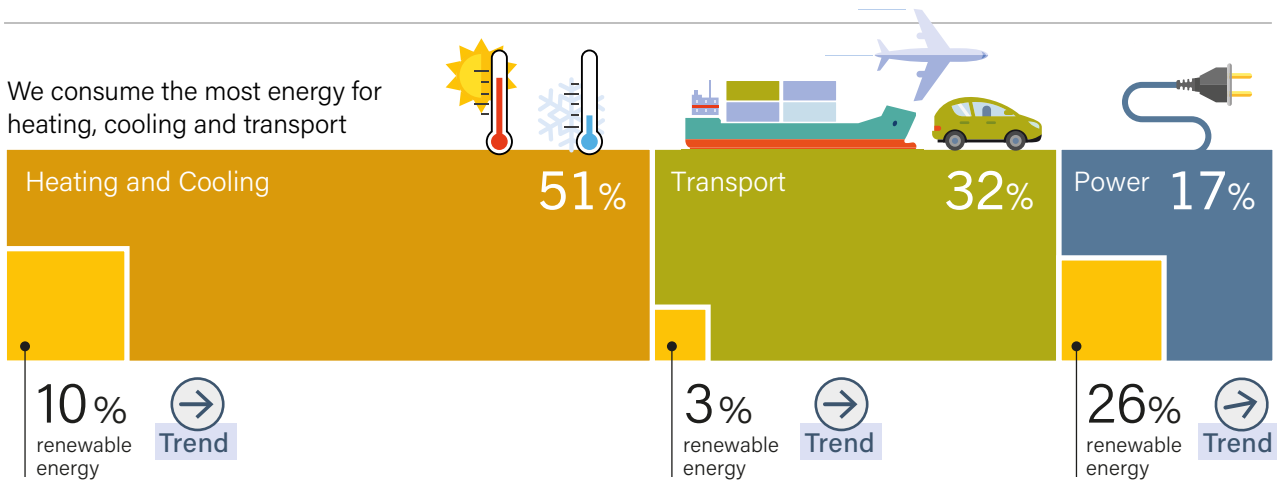
Only **20 countries** had renewable heat regulatory policies and **70 countries** had renewable transport mandates as of 2018.

*Electric vehicles offer an opportunity to make the transport sector more renewable.*

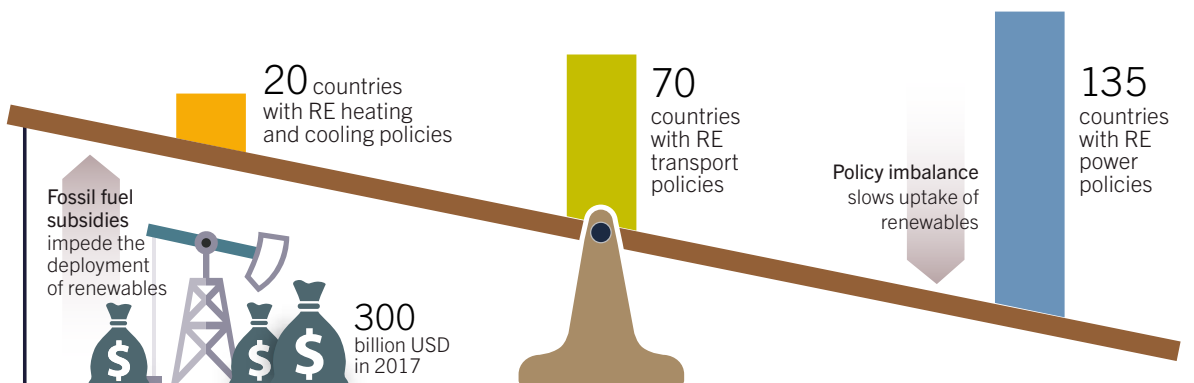


# WE MUST MOVE FROM AN ELECTRICITY TRANSITION TO AN ENERGY SYSTEM TRANSFORMATION

We consume the most energy for heating, cooling and transport



**RENEWABLE ENERGY...** ... is **STAGNATING** in the heating, cooling and transport sectors ... and **NOT PROGRESSING FAST ENOUGH** in the power sector



Transforming the energy system requires **spreading RE policies across all sectors** and **stopping support to fossil fuels**

## POLICY MAKERS SHOULD:

- Create a level playing field by removing fossil fuel subsidies and adopting carbon pricing** (Icon: Money bags, CO<sub>2</sub> cloud)
- Encourage sector integration among power, heating and cooling, and transport** (Icon: Car, power plug, wind turbine, solar panel)
- Align national, sub-national and local policies** (Icon: Map showing Country, Region, and City levels)
- Link renewables and energy efficiency** (Icon: Wind turbines and energy efficiency scale A-G)

**Opportunities in industry** exist but are not being taken advantage of fully. For example, the use of solar heating and cooling in industrial processes, such as food processing and pulp and paper, has continued to grow in recent years; however, without ongoing policy support the global market has been unable to maintain a stable footing. Renewable electricity could be used in industry as well, for example by producing renewable hydrogen to meet the needs of industrial processes in the iron and steel and chemical industries.

Reducing the energy demand of buildings and industry also is key to transitioning to a renewables-based energy system. As such, an integrated policy approach to renewable energy and energy efficiency is fundamental. As it stands, nearly two-thirds of the energy use in buildings globally occurs in countries without energy efficiency policies, while standards and targets for energy efficiency cover only about a quarter of total industrial energy use. Sub-national governments play a key role in driving policy

## Dedicated policies

will lay the foundation for renewable energy in heating, cooling and transport.

action for renewables and efficiency in buildings, as many of these approaches emerge from the “bottom up” and are specific to local conditions and markets.

Fortunately, the heating and cooling sector can draw on examples of effective policy action in the power sector.

Targeted policies are

essential to support the industry by improving the cost-effectiveness of established technologies, deploying further market-ready solutions and advancing progress in emerging technologies, especially those with cross-sectoral potential.

Promising **opportunities in transport** also exist, although fossil fuels still meet the vast majority of energy needs in the sector. Policies are needed to support renewable energy use in all transport sectors in order to accelerate decarbonisation.

The role of renewables can be increased through wider use of sustainable biofuels, high-percentage biofuel blends and drop-in biofuels. Comprehensive policy support is needed to expand the use of ethanol and biodiesel, as well as advanced biofuels, through the deployment of a wide range of technologies and supply chains. Ambitious policies, such as Brazil's 27% ethanol blending mandate, have successfully demonstrated how biofuels can expand the contribution of renewables to the transport sector. Similar efforts are spreading to Europe, including policies supporting advanced biofuels. Dedicated blending mandates are key to guaranteeing demand for advanced biofuels and securing needed investment.

*Community renewable energy is spreading, delivering numerous social and environmental benefits to young and old.*



Another opportunity in transport comes through the increased use of renewable electricity for the world's growing fleet of electric vehicles (EVs). The potential for EVs to provide balancing services to the grid is a further possibility for sector integration. Integrated policy approaches that link renewable electricity with EVs will foster the mutual uptake of both; as of the end of 2018, Austria was the only country with a policy directly linking renewables with EVs. Renewable electricity also can be used to produce electro-fuels, such as hydrogen. Renewable electro-fuels offer options for further use of renewable energy in the transport sector, for example in aviation and shipping (and have potential uses in the heating sector as well).

The success of renewables in the power sector could be mirrored in transport by strengthening investment in applied research and development to accelerate large-scale solutions and reduce costs in technologically less-mature renewable fuels. This is particularly crucial for sectors such as long-haul transport, aviation and shipping, where fewer alternatives are immediately available.

## 02 | KEY TAKEAWAY:

Slow growth of renewable energy in heating, cooling and transport presents a challenge, yet **addressing these sectors is mandatory for decarbonisation**. The history of the power sector has proven that ambitious targets and comprehensive, stable policies are key to the growth of renewables. By supporting proven technologies, creating favourable policy frameworks, and identifying and promoting opportunities for cross-sectoral integration, **renewable energy will be able to reach its full potential across all sectors**.



A focus on reducing overall fuel demand in the transport sector is critical and can be accomplished through policies that promote energy efficiency and conservation, such as adopting fuel economy policies and encouraging a modal shift to public transport, walking and cycling.

The continued advance of renewable energy in the power sector presents a major opportunity for the heating, cooling and transport sectors. **Sector integration** has emerged as an important route to increase energy efficiency, reduce overall system costs and ultimately boost the share of renewables in all sectors. The electrification of heating and transport also contributes to the unlocking of flexibility in the power sector, helping to integrate higher shares of renewable energy and further accelerating its uptake in the power sector. Policies that help spur the integration of electricity, heating and transport are crucial to decarbonising all sectors.



# 03 THE PATHWAY TO A SUSTAINABLE ENERGY FUTURE CALLS FOR VISION, AMBITION AND POLICIES

Progress in renewable energy over the last decade has been remarkable, but **the world is facing a climate crisis**. As emphasised in recent reports from the Intergovernmental Panel on Climate Change (IPCC), energy-related carbon dioxide emissions are contributing to radical alterations in the Earth's climate, and only about a decade remains to limit global warming to 1.5 degrees Celsius, thereby avoiding the worst effects of climate change. The steps taken so far to decarbonise the energy system are positive but are vastly insufficient.

As a global society, we also face considerable challenges in development. The 2019 annual review of United Nations Sustainable Development Goal 7 found that international objectives related to expanding energy access and increasing global deployment of renewables and energy efficiency by 2030 will not be achieved unless efforts are greatly scaled up. Clearly, the growth in renewable energy – and its integration with energy efficiency – must be accelerated in response.

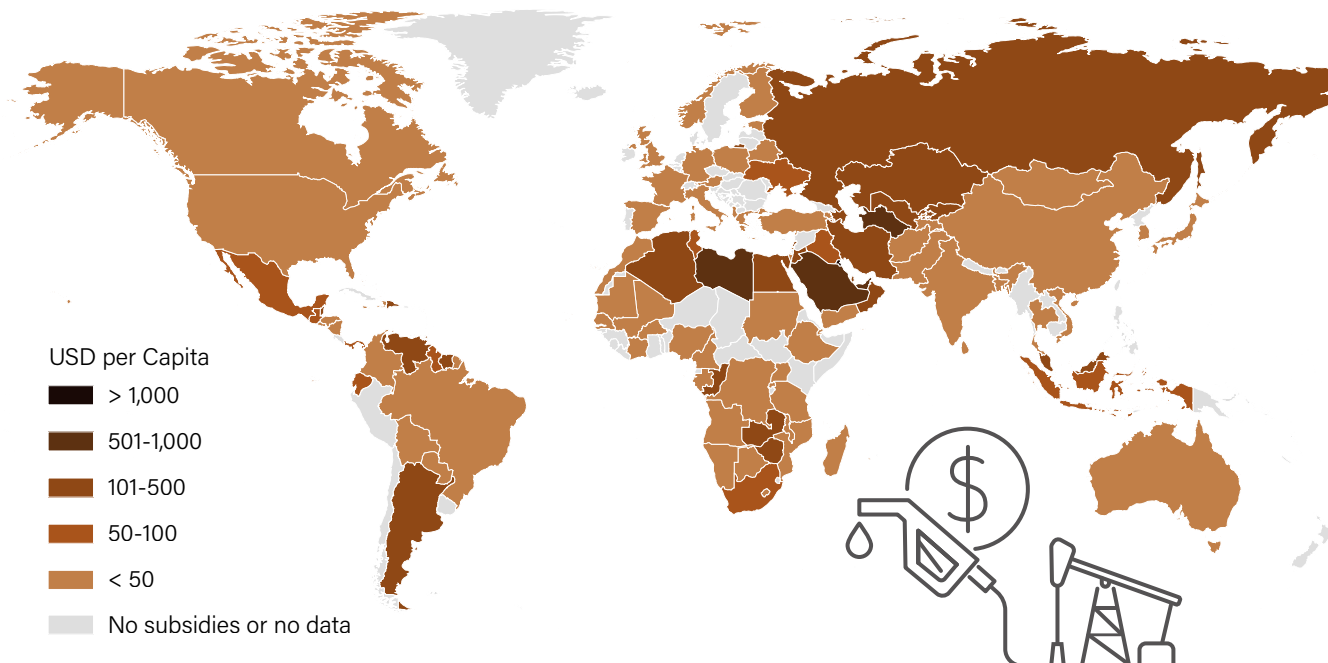
Global subsidies for fossil fuel consumption were an estimated **300 billion USD** in 2017, more than double the support for renewables.

Achieving the progress needed on both climate and development requires not only expanding the role of renewable energy, but also **curtailing the widespread use of fossil fuels**.

It is inconsistent, and ultimately counterproductive, to strive to meet urgent climate goals while at the same time increasing oil and gas production capacity, further extracting coal and developing additional coal-fired power generation. To level the playing field that currently undermines the prospects for renewable energy, subsidies to fossil fuels need to end, and both the public and private sectors must accelerate divestment from these harmful resources.

In the two years between the adoption of the Paris Agreement in 2016 and the end of 2018, cumulative bank finance for fossil fuels amounted to USD 1.9 trillion. Global subsidies for fossil fuel consumption increased to around USD 300 billion in 2017, up 11% from the previous year. This was about double the support for renewable power generation. On top of the billions of dollars spent to subsidise fossil fuels, one estimate places their true cost (including the negative environmental and social externalities associated with extraction, production and use) at upwards of USD 5.2 *trillion*. While at least 40 countries have undertaken some level of fossil fuel subsidy reform since 2015, fossil fuel subsidies remained in place in at least 115 countries in 2017, with at least 73 countries providing subsidies of over USD 100 million each year. (→ See figure below.)

COUNTRIES WITH FOSSIL FUEL SUBSIDIES, USD per Capita, 2017



Note: Shading depicts pre-tax consumption subsidies only.

Source: IMF.

# A SUSTAINABLE ENERGY FUTURE REQUIRES IMMEDIATE AND STRONGER POLICY ACTION



## THE WORLD IS **NOT ON TRACK**...

- ... to **limit global warming** to 1.5°C as outlined in the Paris Agreement
- ... to **achieve SDG7 goals** for renewables, energy efficiency and energy access

→ CLIMATE AND DEVELOPMENT CHALLENGES CALL FOR **ACCELERATING THE TRANSITION** FROM FOSSIL FUELS TO **RENEWABLE ENERGY**



## POLICIES

### CREATE A LEVEL PLAYING FIELD

- Remove **fossil fuel subsidies**
- Enact **effective carbon pricing policies**
- Divest** from fossil fuels

### SUPPORT GROWTH OF RENEWABLES

- Set **ambitious targets** that cover all energy sectors
- Enact **stable policies** that foster attractive market conditions
- Adopt **strong policies** for heating and transport

**Leadership from national governments** is paving the way towards 100% renewables in countries.

**Cities and sub-national governments** are setting more ambitious policies than their national governments.

**1000+ organisations**, totalling USD 8 trillion of managed assets, have committed to divesting from fossil fuels.

The **private sector** has doubled its investment in sourcing renewable power.

**WE WANT YOU TO ACT!**



Additionally, the coal industry and major oil and gas companies continue to spend hundreds of millions of dollars on lobbying to delay, control or block policies aimed at addressing climate change and on advertisements to influence public opinion. However, shareholder pressure and the rising competitiveness of the renewables sector have resulted in increased investment by the fossil fuel industry (including some large oil corporations) in both renewable energy projects and companies, as well as in the setting of climate targets.

A more favourable landscape for climate-friendly technologies needs to be created by **putting a meaningful price on carbon emissions**, across a wide spectrum of energy uses. As of 2018, only 44 national governments, 21 states/provinces and 7 cities had implemented carbon pricing policies, covering only 13% of global carbon dioxide emissions.

Positive signs suggest that **more and more players are taking action** to support the energy transition. A number of countries took pioneering steps towards decarbonisation during 2018. For example, Ireland became the first country to commit to divesting its public sovereign development fund from coal, oil and natural gas. In addition, Costa Rica, which already generates nearly 100% of its electricity with renewable sources, announced its plan to ban fossil fuels entirely and become the world's first decarbonised country.

## Cities are taking a leading role

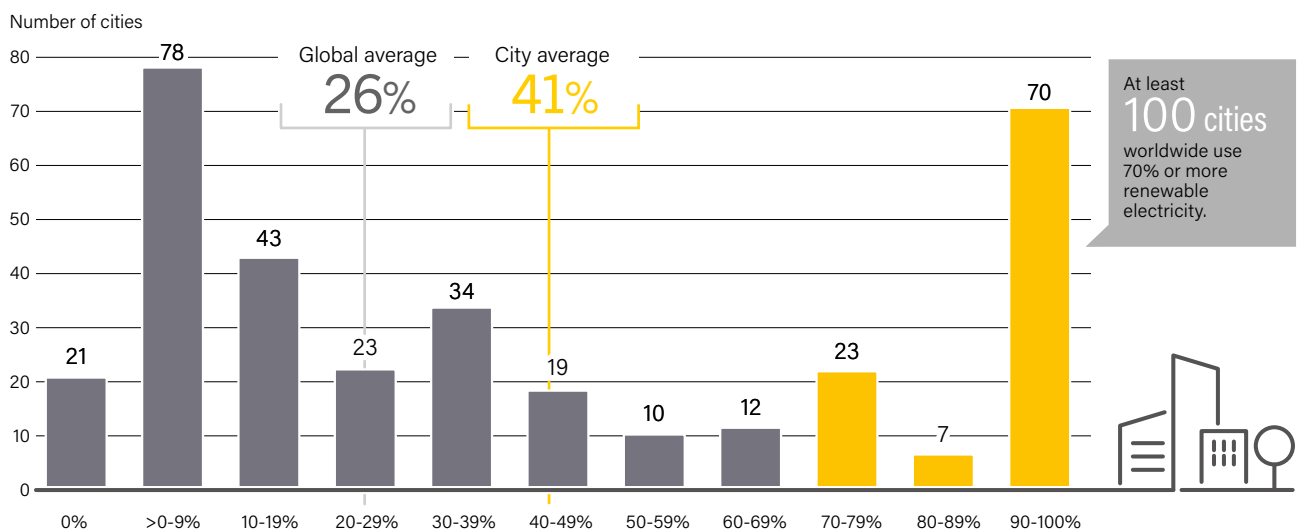
in renewable energy deployment, adopting some of the most ambitious targets globally.



At the sub-national level, cities are taking a leading role in renewable energy deployment and are adopting some of the most ambitious targets for renewables globally. In numerous cases, these commitments and actions have exceeded ambition at the national and state/provincial levels. (→ See figure below.)

On the financial side, more than 1,000 organisations, responsible for USD 8 trillion in managed financial assets, have committed to divest their assets from fossil fuel production and use. In addition, the private sector is ramping up corporate sourcing of renewables, signing agreements in 2018 to secure 13 GW of renewable capacity, more than twice the level of 2017.

RENEWABLE POWER IN CITIES\*, BY NUMBER OF CITIES AND RENEWABLE SHARE, 2017



\* The figure shows shares of renewables in the electricity consumption of 340 cities that self-reported to CDP.

Source: CDP.

Note: City average is calculated based on the 340 cities shown. Categories include all values below the lower limit of adjacent category.



Governments can capitalise on these key developments and engaged actors through a range of measures. To stimulate the growth of renewable solutions, **comprehensive, predictable policy frameworks** that directly support renewable energy are needed to:

- Set ambitious targets globally, across regions, countries and sectors;
- Create the right market conditions that allow industry to invest with confidence and that enable large energy consumers to integrate renewables into their decarbonisation strategies;
- Accelerate investment in renewable power, while also establishing new (and strengthening existing) policies for renewables in heating, cooling and transport;
- Encourage sector integration by identifying and supporting synergies among the power, heating and cooling, and transport sectors;
- Align regional, national and sub-national policies, and support cities in their actions;
- Enact integrated policies that enforce energy efficiency measures while promoting the uptake of renewable energy technologies;
- Support local job creation and a just transition;
- Build social acceptance and increase public buy-in.

**Governments can no longer turn their backs** to the growing worldwide calls for immediate action to address climate change and achieve sustainable development goals.

The uptake of renewable energy is the cornerstone of the global energy transition. It will be possible only if policy makers step up their ambition and lead by example.

### 03 | KEY TAKEAWAY:

A sustainable energy future requires **immediate and stronger policy action**. In addition, renewable energy is not competing on a level playing field. Ambitious policy frameworks directly supporting renewables must be complemented by effective carbon pricing and removal of financial support for fossil fuels by eliminating global subsidies and accelerating divestment.














**A high level of ambition, backed by concrete, comprehensive policy measures, will allow renewables to reach their full potential in responding to the climate emergency and to the global development imperative.**

To learn more, read the *Renewables 2019 Global Status Report* – GSR 2019 – available at [www.ren21.net/gsr](http://www.ren21.net/gsr)



# RENEWABLE ENERGY INDICATORS 2018

		2017	2018
<b>INVESTMENT</b>			
New investment (annual) in renewable power and fuels <sup>1</sup>	billion USD	326	<b>289</b>
<b>POWER</b>			
Renewable power capacity (including hydro)	GW	2,197	<b>2,378</b>
Renewable power capacity (not including hydro)	GW	1,081	<b>1,246</b>
 Hydropower capacity <sup>2</sup>	GW	1,112	<b>1,132</b>
 Wind power capacity	GW	540	<b>591</b>
 Solar PV capacity <sup>3</sup>	GW	405	<b>505</b>
 Bio-power capacity	GW	121	<b>130</b>
 Geothermal power capacity	GW	12.8	<b>13.3</b>
 Concentrating solar thermal power (CSP) capacity	GW	4.9	<b>5.5</b>
 Ocean power capacity	GW	0.5	<b>0.5</b>
 Bio-power generation (annual)	TWh	532	<b>581</b>
<b>HEAT</b>			
 Solar hot water capacity <sup>4</sup>	GW <sub>th</sub>	472	<b>480</b>
<b>TRANSPORT</b>			
 Ethanol production (annual)	billion litres	104	<b>112</b>
 FAME biodiesel production (annual)	billion litres	33	<b>34</b>
 HVO biodiesel production (annual)	billion litres	6.2	<b>7.0</b>
<b>POLICIES<sup>5</sup></b>			
Countries with national/state/provincial renewable energy targets <sup>6</sup>	#	179	<b>169</b>
Countries with 100% renewable energy in primary or final energy targets	#	1	<b>1</b>
Countries with 100% renewable heating and cooling targets	#	1	<b>1</b>
Countries with 100% renewable transport targets	#	1	<b>1</b>
Countries with 100% renewable electricity targets	#	57	<b>65</b>
States/provinces/countries with heat obligations/mandates	#	19	<b>18</b>
States/provinces/countries with biofuel mandates <sup>7</sup>	#	70	<b>70</b>
States/provinces/countries with feed-in policies	#	112	<b>111</b>
States/provinces/countries with RPS/quota policies	#	33	<b>33</b>
Countries with tendering (held in 2018)	#	29	<b>48</b>
Countries with tendering (cumulative) <sup>8</sup>	#	84	<b>98</b>

1 Investment data are from BloombergNEF and include all biomass, geothermal and wind power projects of more than 1 MW; all hydropower projects of between 1 and 50 MW; all solar power projects, with those less than 1 MW estimated separately; all ocean power projects; and all biofuel projects with an annual production capacity of 1 million litres or more.

2 The GSR strives to exclude pure pumped storage capacity from hydropower capacity data.

3 Solar PV data are provided in direct current (DC). See Methodological Notes for more information.

4 Solar hot water capacity data include water collectors only. The number for 2018 is a preliminary estimate.

5 A country is counted a single time if it has at least one national or state/provincial target or policy.

6 The decline in the number of jurisdictions with targets is due primarily to several targets having expired and not having been replaced.

7 Biofuel policies include policies listed both under the biofuel obligation/mandate column in Table 2 (Renewable Energy Targets and Policies, 2018) and in Reference Table R10 (Renewable Transport Mandates at the National/State/Provincial Levels, End-2018).







8 Data for tendering reflect all countries where tenders have been held at any time up through the year of focus at the national or state/provincial level.

Note: All values are rounded to whole numbers except for numbers <15, biofuels and investment, which are rounded to one decimal point.














FAME = fatty acid methyl esters; HVO = hydrotreated vegetable oil; RPS = renewable portfolio standard.

## TOP FIVE COUNTRIES

### Annual Investment / Net Capacity Additions / Production in 2018

	1	2	3	4	5
Investment in renewable power and fuels (not including hydropower over 50 MW)	<b>China</b>	United States	Japan	India	Australia
Investment in renewable power and fuels per unit GDP <sup>1</sup>	<b>Palau</b>	Djibouti	Morocco	Iceland/Serbia	
 Geothermal power capacity	<b>Turkey</b>	Indonesia	United States	Iceland	New Zealand
 Hydropower capacity	<b>China</b>	Brazil	Pakistan	Turkey	Angola
 Solar PV capacity	<b>China</b>	India <sup>2</sup> /United States		Japan	Australia
 Concentrating solar thermal power (CSP) capacity	<b>China/Morocco</b>		South Africa	Saudi Arabia	–
 Wind power capacity	<b>China</b>	United States	Germany	India	Brazil
 Solar water heating capacity	<b>China</b>	Turkey	India	Brazil	United States
 Biodiesel production	<b>United States</b>	Brazil	Indonesia	Germany	Argentina
 Ethanol production	<b>United States</b>	Brazil	China	Canada	Thailand

### Total Capacity or Generation as of End-2018

	1	2	3	4	5
<b>POWER</b>					
Renewable power capacity (including hydropower)	<b>China</b>	United States	Brazil	India	Germany
Renewable power capacity (not including hydropower)	<b>China</b>	United States	Germany	India	Japan
Renewable power capacity <i>per capita</i> (not including hydropower) <sup>3</sup>	<b>Iceland</b>	Denmark	Germany/Sweden		Finland
 Bio-power generation	<b>China</b>	United States	Brazil	Germany	India
 Bio-power capacity	<b>China</b>	United States	Brazil	India	Germany
 Geothermal power capacity	<b>United States</b>	Indonesia	Philippines	Turkey	New Zealand
 Hydropower capacity <sup>4</sup>	<b>China</b>	Brazil	Canada	United States	Russian Federation
 Hydropower generation <sup>4</sup>	<b>China</b>	Canada	Brazil	United States	Russian Federation
 Solar PV capacity	<b>China</b>	United States	Japan	Germany	India
 Solar PV capacity <i>per capita</i>	<b>Germany</b>	Australia	Japan	Belgium	Italy
 Concentrating solar thermal power (CSP) capacity	<b>Spain</b>	United States	South Africa	Morocco	India
 Wind power capacity	<b>China</b>	United States	Germany	India	Spain
 Wind power capacity <i>per capita</i>	<b>Denmark</b>	Ireland	Germany	Sweden	Portugal
<b>HEAT</b>					
 Solar water heating collector capacity <sup>5</sup>	<b>China</b>	United States	Turkey	Germany	Brazil
 Solar water heating collector capacity <i>per capita</i>	<b>Barbados</b>	Austria	Cyprus	Israel	Greece
 Geothermal heat output <sup>6</sup>	<b>China</b>	Turkey	Iceland	Japan	Hungary

1 Countries considered include only those covered by BloombergNEF; GDP (at purchasing power parity) data for 2017 from World Bank. BloombergNEF data include the following: all biomass and waste-to-energy, geothermal and wind power projects of more than 1 MW; all hydropower projects of between 1 and 50 MW; all solar power projects, with those less than 1 MW (small-scale capacity) estimated separately; all ocean power projects; all biofuel projects with an annual production capacity of 1 million litres or more. Small-scale capacity data used to help calculate investment per unit of GDP cover only those countries investing USD 200 million or more.

2 Solar PV data for India are highly uncertain. See Solar PV section in Market and Industry chapter for details.

3 Per capita renewable power capacity (not including hydropower) ranking based on data gathered from various sources for more than 70 countries and on 2017 population data from the World Bank.

4 Country rankings for hydropower capacity and generation differ because some countries rely on hydropower for baseload supply whereas others use it more to follow the electric load to match peaks in demand.

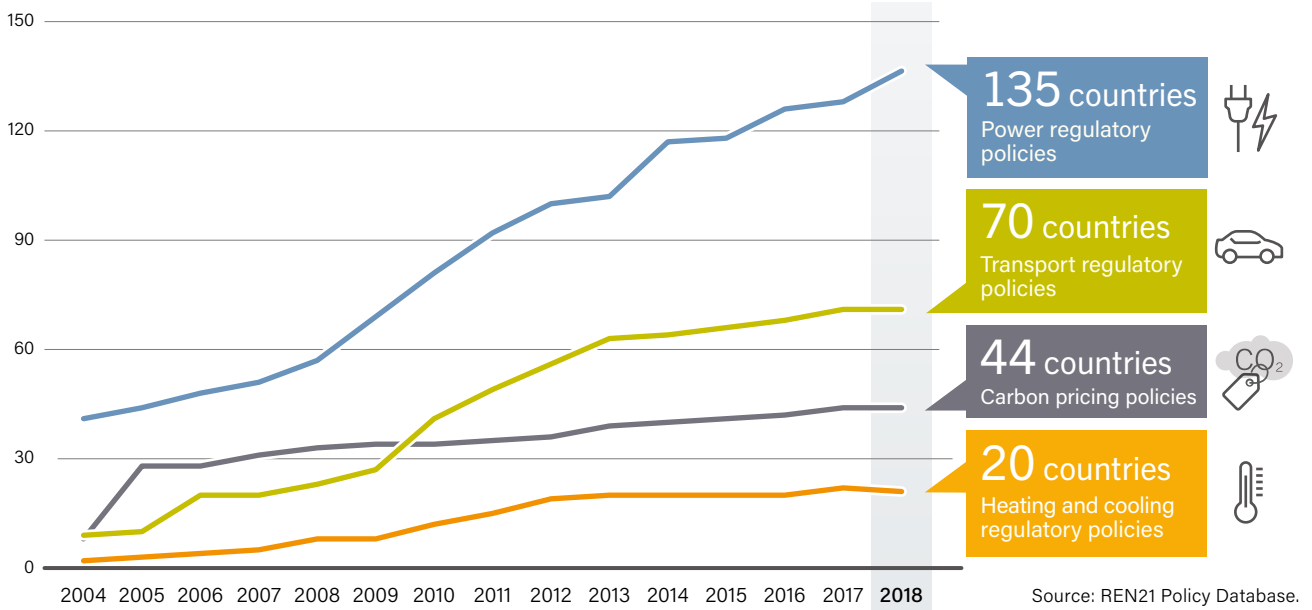
5 Solar water heating collector rankings for total capacity and per capita are for year-end 2017 and are based on capacity of water (glazed and unglazed) collectors only. Data from International Energy Agency Solar Heating and Cooling Programme. Total capacity rankings are estimated to remain unchanged for year-end 2018.

6 Not including heat pumps. Data are from 2015.

Note: Most rankings are based on absolute amounts of investment, power generation capacity or output, or biofuels production; if done on a basis of per capita, national GDP or other, the rankings would be different for many categories (as seen with per capita rankings for renewable power not including hydropower, solar PV, wind power and solar water heating collector capacity).

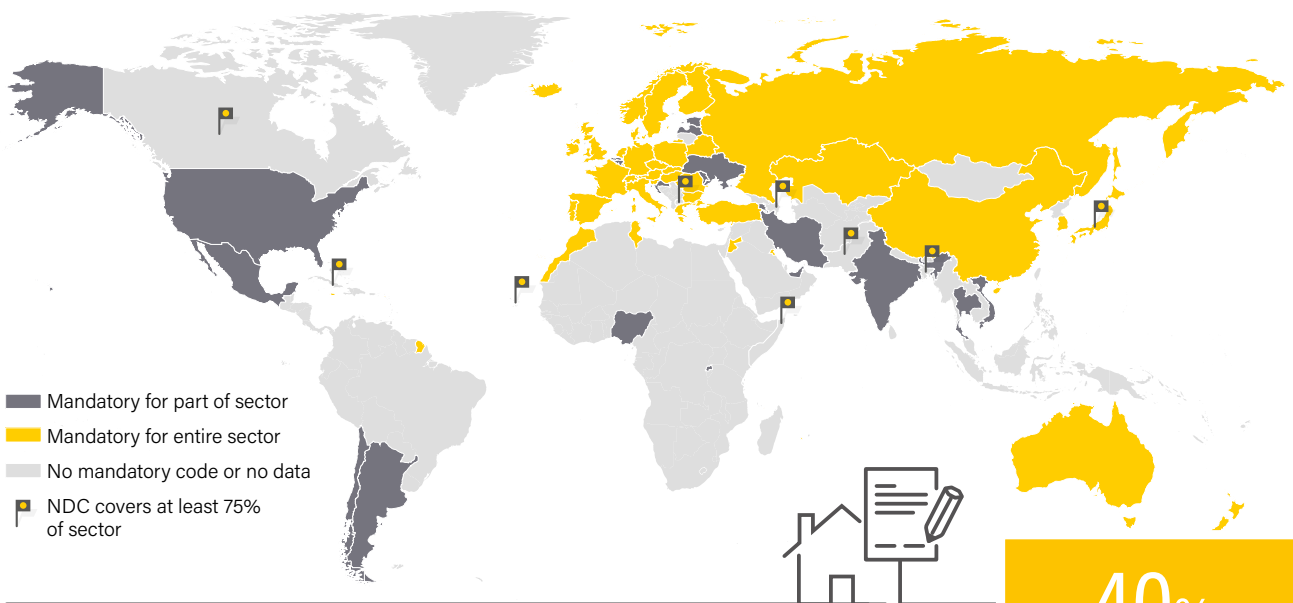
# POLICY LANDSCAPE 2018

NUMBER OF COUNTRIES WITH RENEWABLE ENERGY REGULATORY POLICIES AND CARBON PRICING POLICIES, 2004-2018



Note: Figure does not show all policy types in use. In many cases countries have enacted additional fiscal incentives or public finance mechanisms to support renewable energy. A country is considered to have a policy (and is counted a single time) when it has at least one national or state/provincial-level policy in place. Power policies include feed-in tariffs (FITs) / feed-in premiums, tendering, net metering and renewable portfolio standards. Heating and cooling policies include solar heat obligations, technology-neutral renewable heat obligations and renewable heat FITs. Transport policies include biodiesel obligations/mandates, ethanol obligations/mandates and non-blend mandates. Carbon pricing policies include carbon taxes and emissions trading systems and, in and of themselves, are not renewable energy policies.

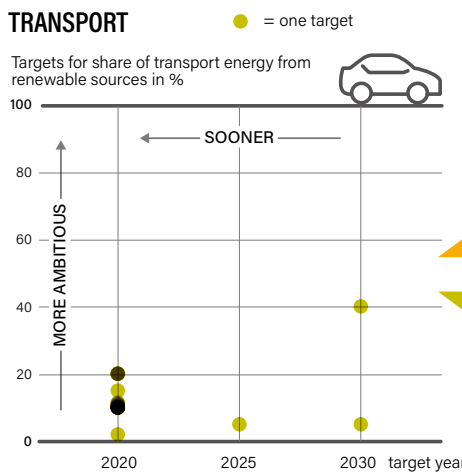
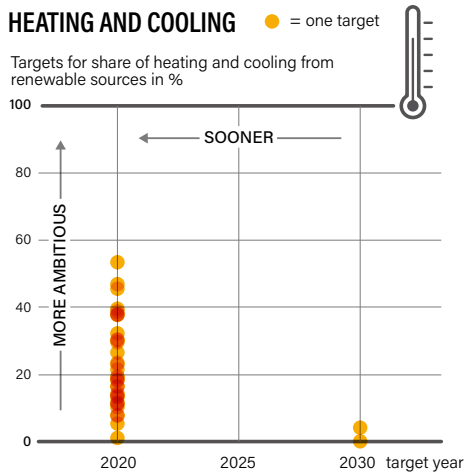
## COUNTRIES WITH MANDATORY BUILDING ENERGY CODES, END-2018



Note: Energy codes or standards for buildings focus on decreasing energy use for specific end-uses or building components and can apply to new and/or existing buildings. Nationally Determined Contributions (NDCs) for the sector have focused on strengthening energy codes and standards, energy conservation and phasing out inefficient products and equipment.

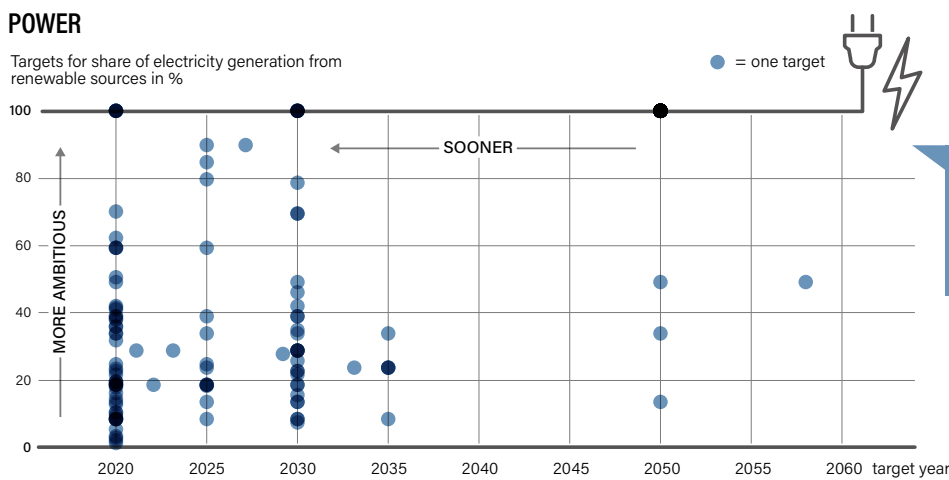
Source: OECD/IEA.

NATIONAL SECTOR-SPECIFIC TARGETS FOR SHARE OF RENEWABLE ENERGY BY A SPECIFIC YEAR, BY SECTOR, END-2018



**47 countries** have national targets for renewable energy in heating and cooling.

**45 countries** have national targets for renewable energy in transport.



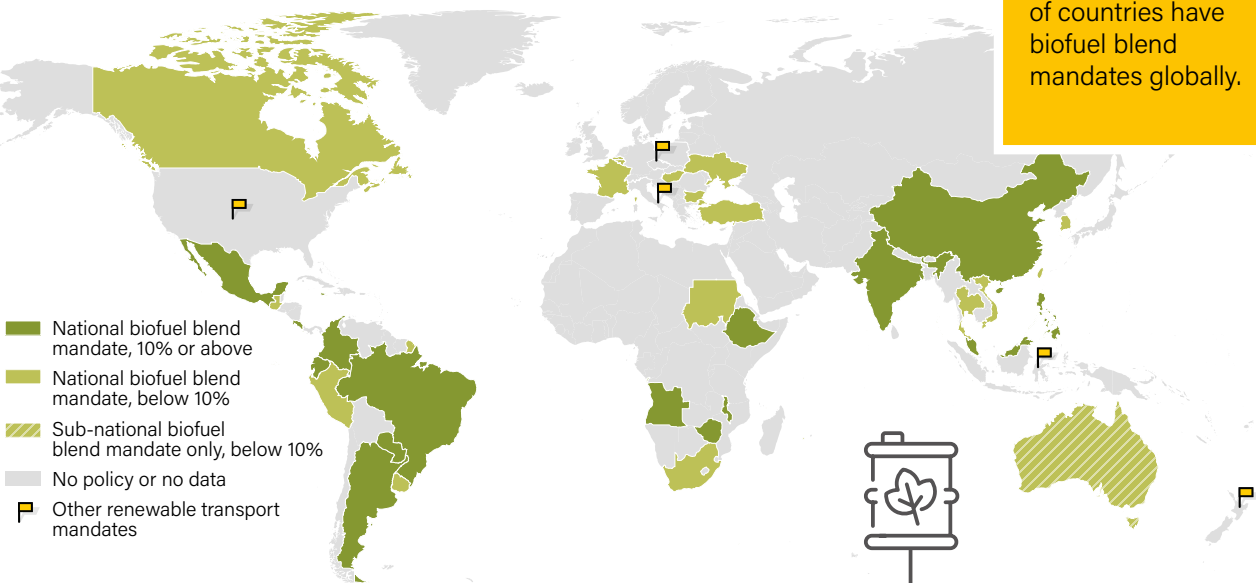
**162 countries** have national targets for renewable energy in power.

Source: REN21 Policy Database.

Note: Each dot can represent more than one country and is based on the highest target that a country has set at the national level. Figure includes only countries with targets in these sectors that are for a specific share from renewable sources by a specific year.

Only **36%** of countries have biofuel blend mandates globally.

NATIONAL AND SUB-NATIONAL RENEWABLE TRANSPORT MANDATES, END-2018

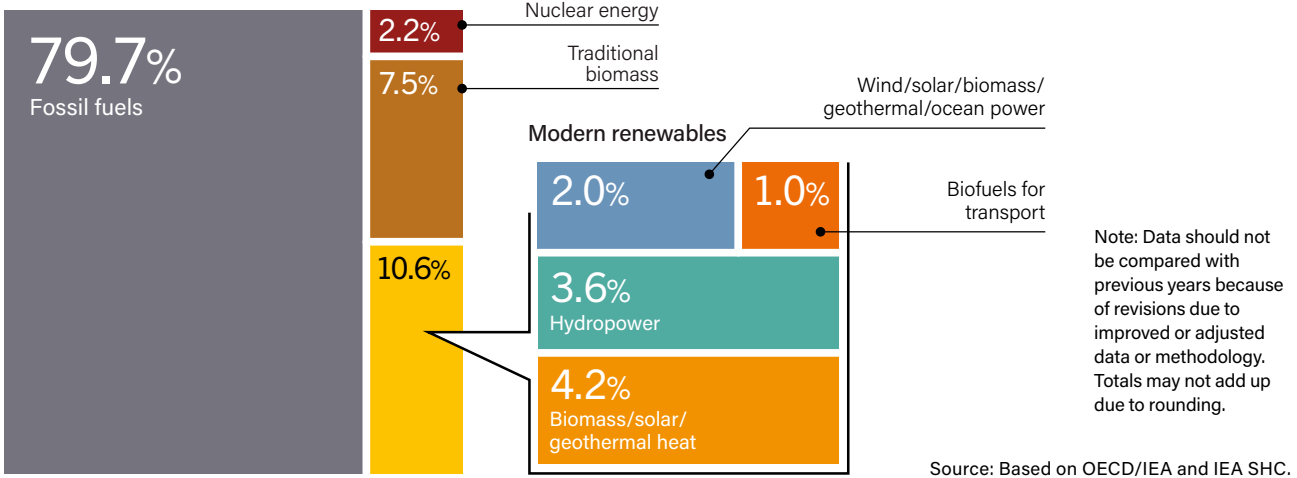


Note: Shading shows countries and states/provinces with mandates for either biodiesel, ethanol or both. "Other renewable transport mandates" includes mandates for advanced biofuels and for sectors other than road transport.

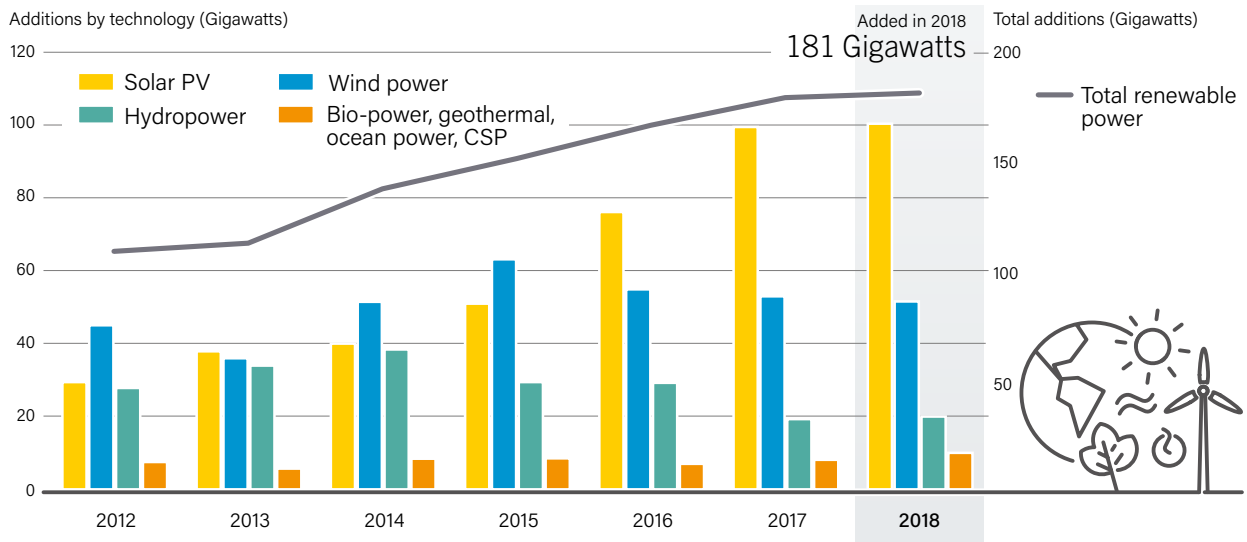
Source: REN21 Policy Database.

# GSR 2019 KEY FIGURES

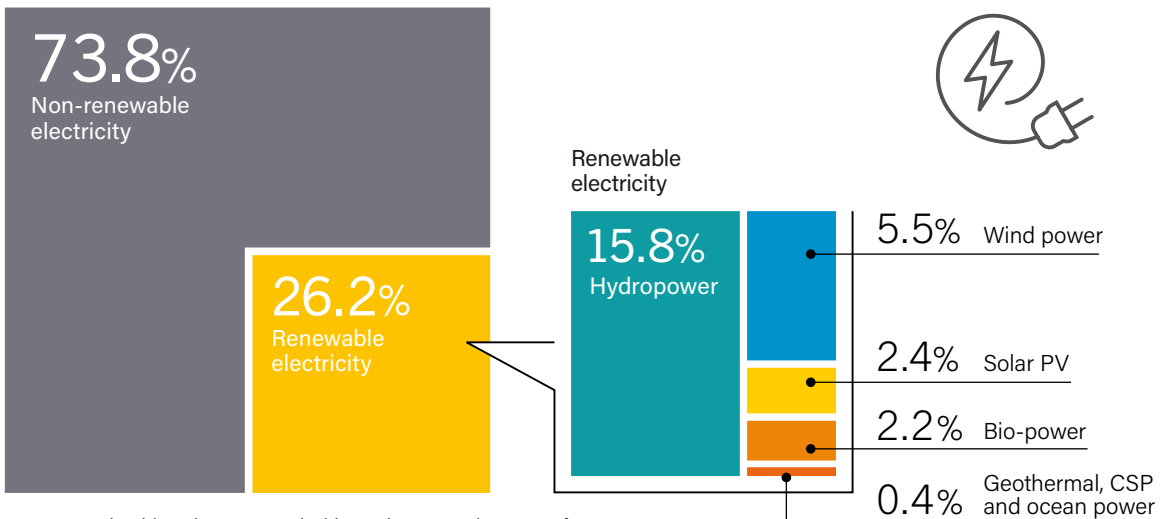
ESTIMATED RENEWABLE ENERGY SHARE OF TOTAL FINAL ENERGY CONSUMPTION, 2017



ANNUAL ADDITIONS OF RENEWABLE POWER CAPACITY, BY TECHNOLOGY AND TOTAL, 2012-2018

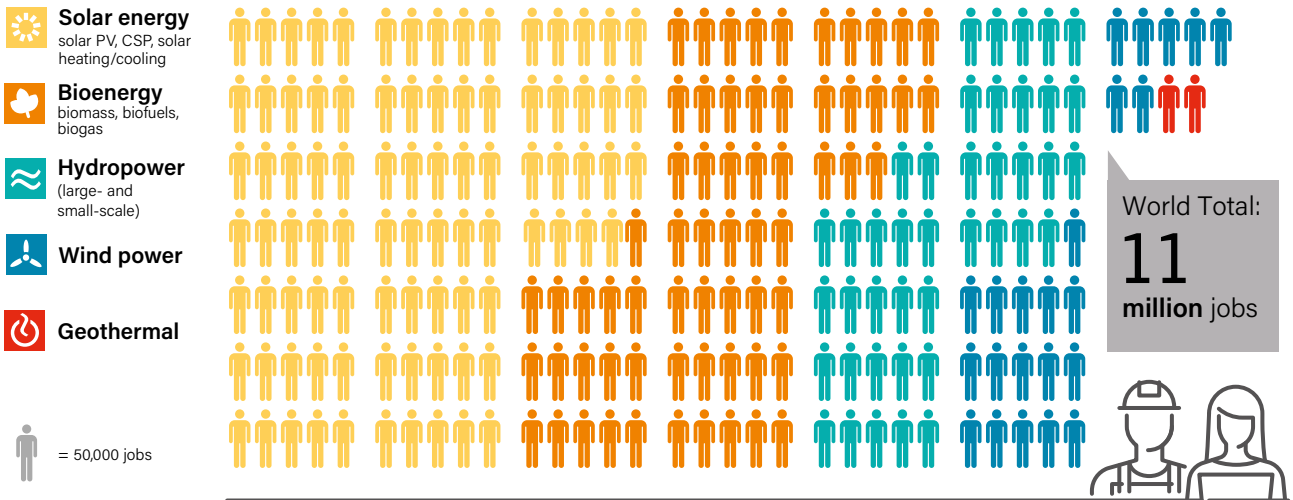


ESTIMATED RENEWABLE ENERGY SHARE OF GLOBAL ELECTRICITY PRODUCTION, END-2018



# JOBS

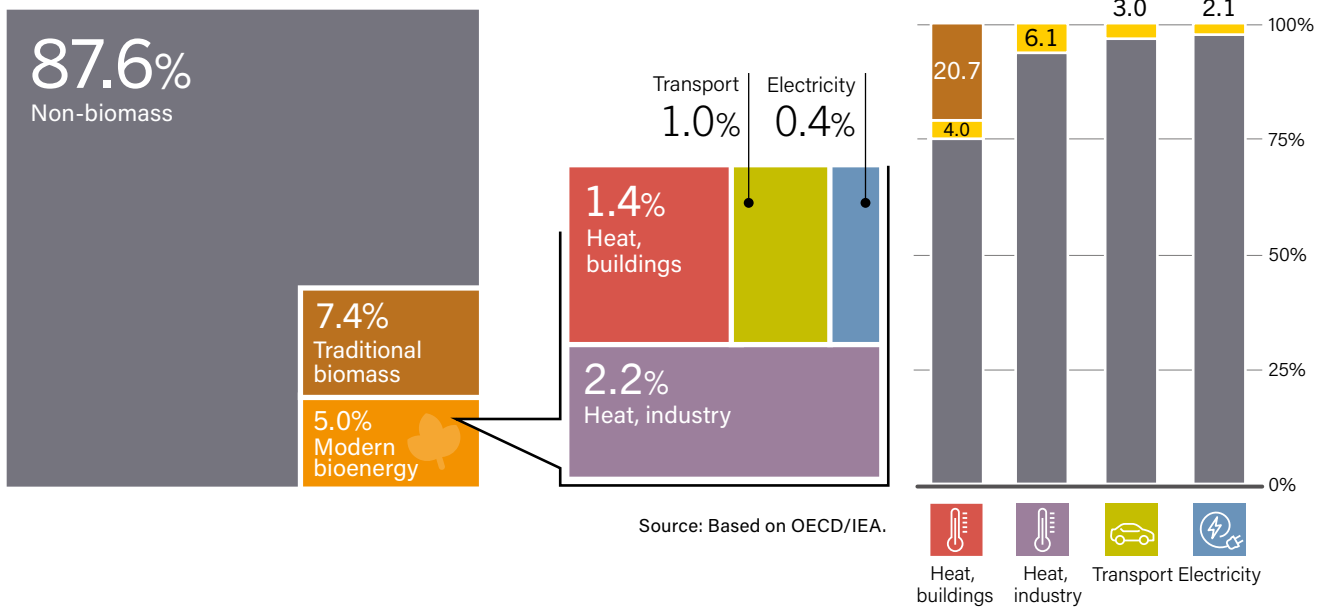
## JOBS IN RENEWABLE ENERGY



Source: IRENA.

## BIOMASS ENERGY

ESTIMATED SHARES OF BIOENERGY IN TOTAL FINAL ENERGY CONSUMPTION, OVERALL AND BY END-USE SECTOR, 2017

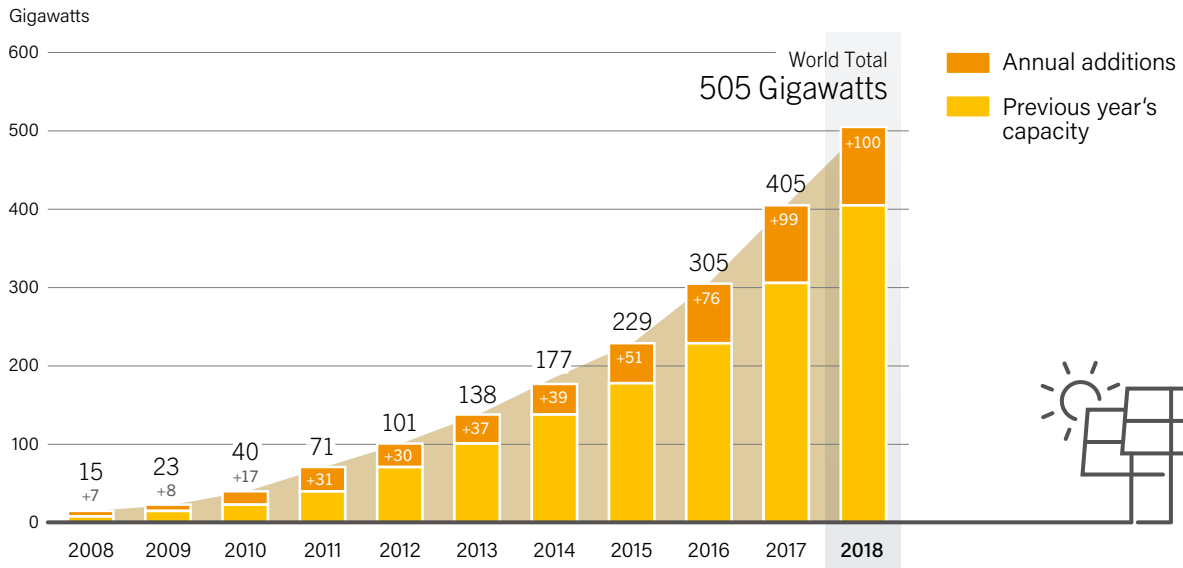


In 2017, modern bioenergy provided **5%** of final energy demand.



# SOLAR PV

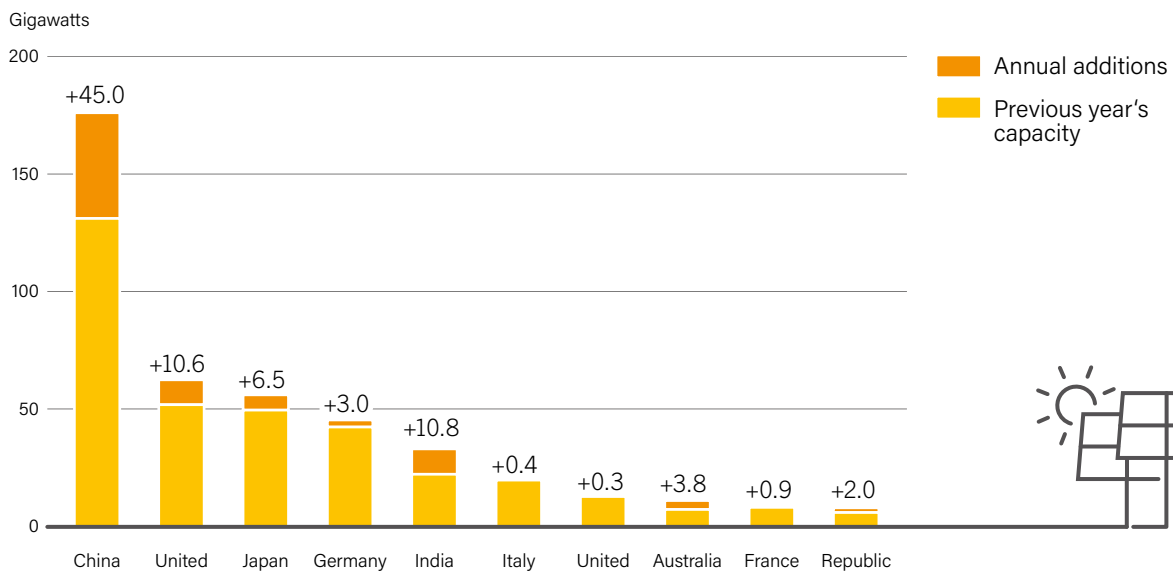
## SOLAR PV GLOBAL CAPACITY AND ANNUAL ADDITIONS, 2008-2018



Note: Data are provided in direct current (DC). Totals may not add up due to rounding.

Source: IEA PVPS.

## SOLAR PV CAPACITY AND ADDITIONS, TOP 10 COUNTRIES, 2018



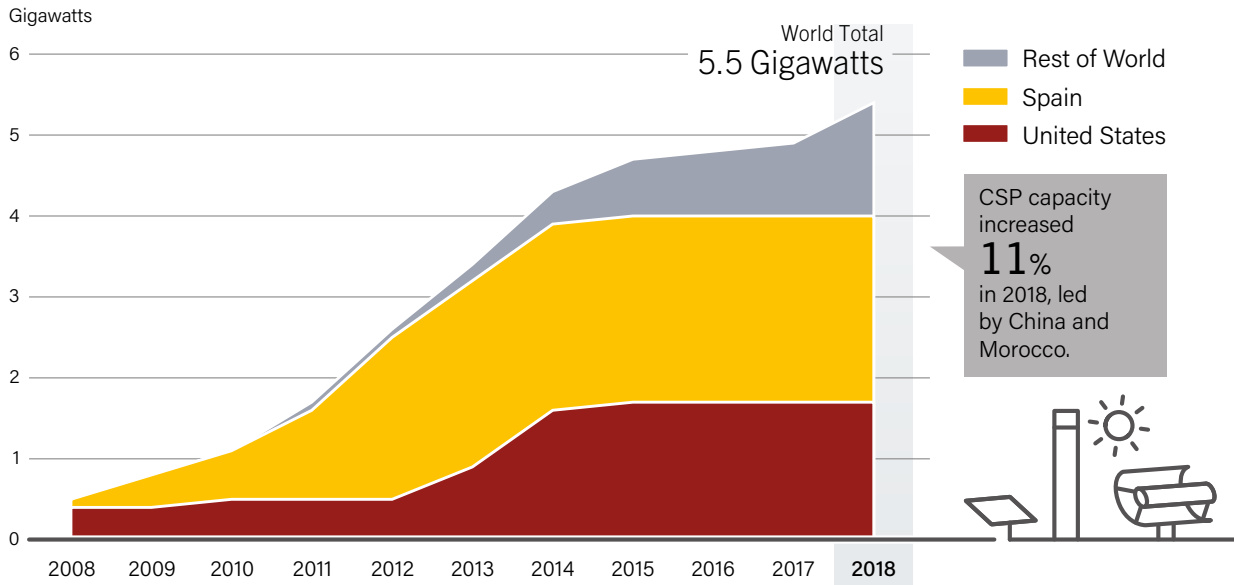
Note: Data are provided in direct current (DC). Data for India are highly uncertain.

**100 GW**  
of new solar PV capacity was installed in 2018.



# CONCENTRATING SOLAR THERMAL POWER (CSP)

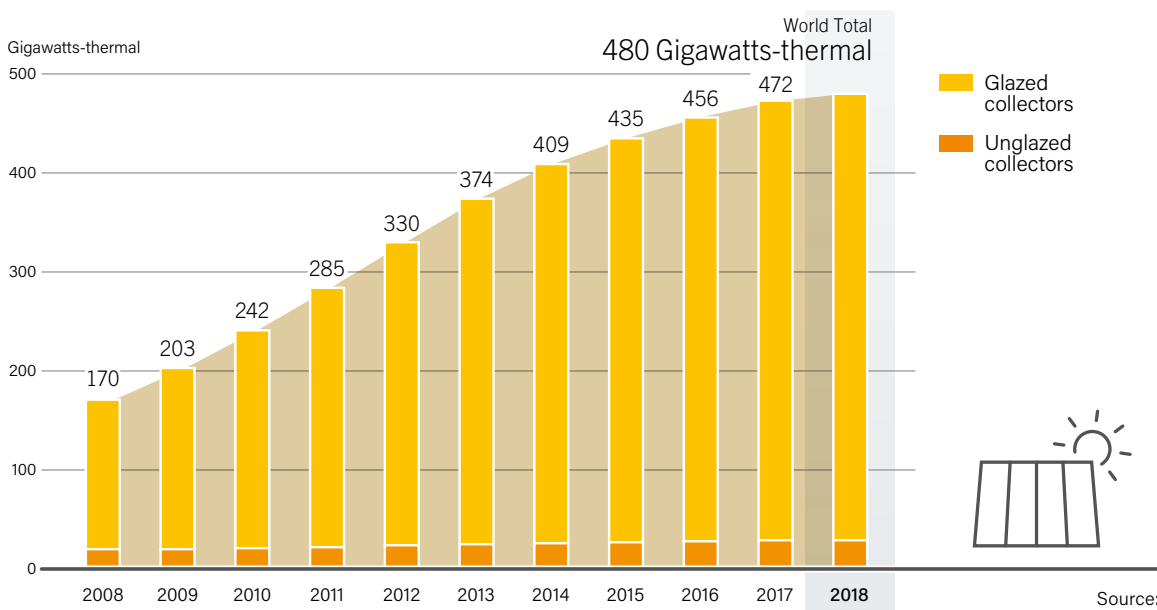
CSP GLOBAL CAPACITY, BY COUNTRY AND REGION, 2008-2018



More than **33 GW<sub>th</sub>** of new solar thermal capacity was commissioned in 2018.

# SOLAR THERMAL HEATING AND COOLING

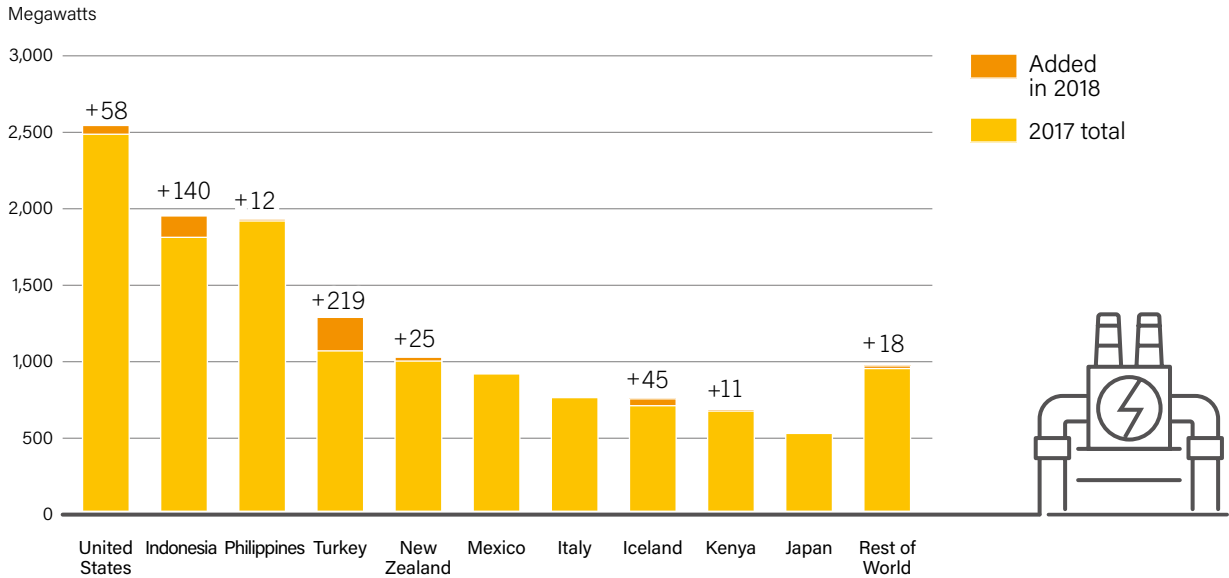
SOLAR WATER HEATING COLLECTORS GLOBAL CAPACITY, 2008-2018



Source: IEA SHC.

# GEOTHERMAL POWER

GEOTHERMAL POWER CAPACITY AND ADDITIONS, TOP 10 COUNTRIES AND REST OF WORLD, 2018

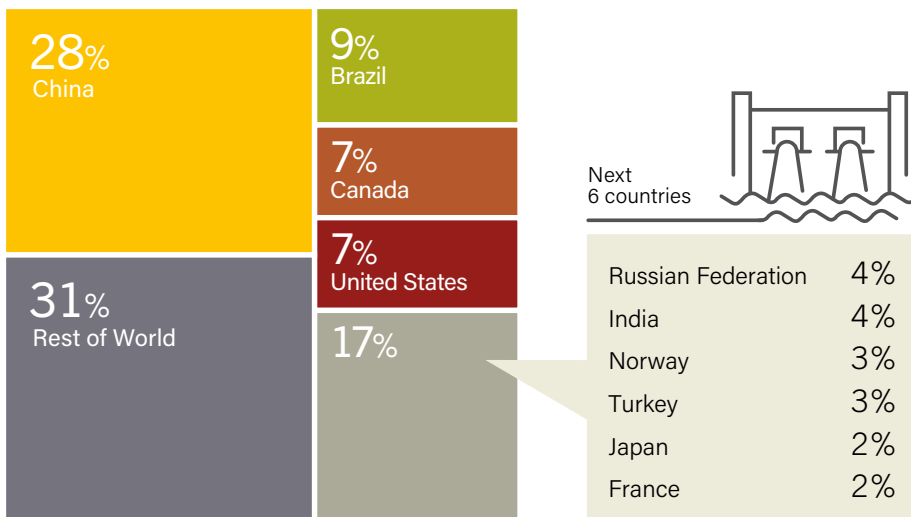


**0.5 GW**  
of geothermal power capacity was added in 2018, bringing the global total to 13.3 GW.



# HYDROPOWER

HYDROPOWER GLOBAL CAPACITY, SHARES OF TOP 10 COUNTRIES AND REST OF WORLD, 2018

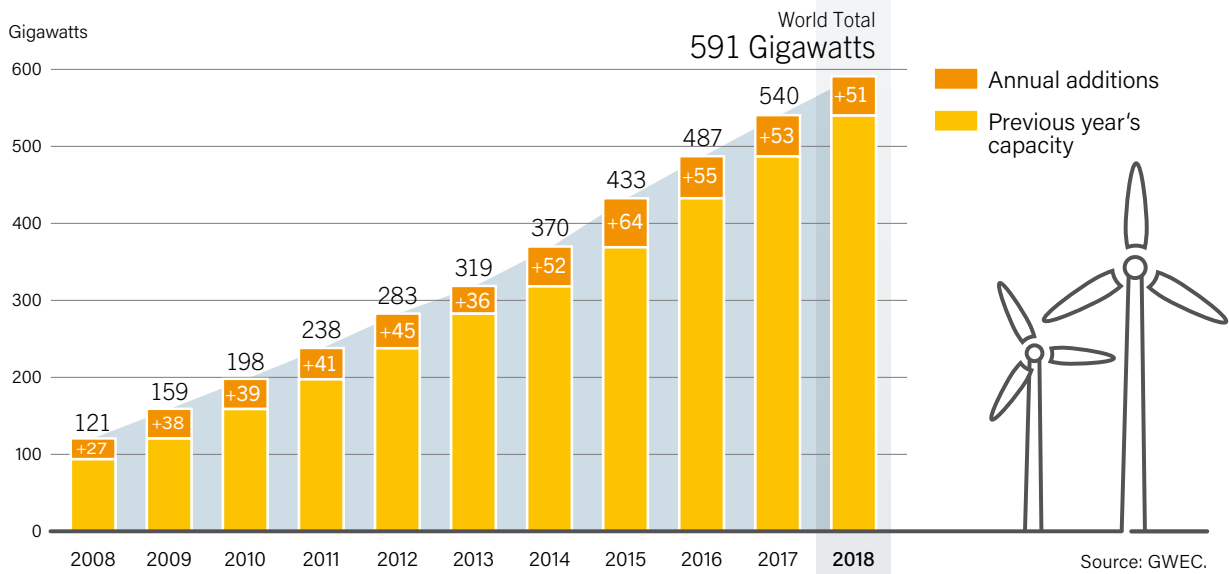


**20 GW**  
of hydropower capacity was brought online in 2018.

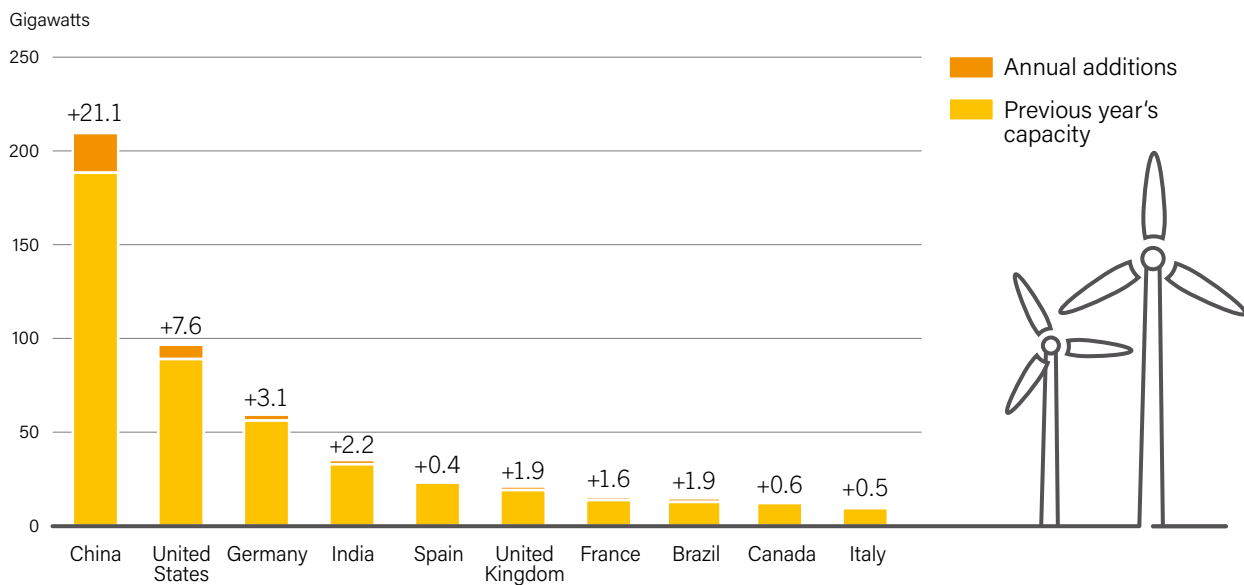


# WIND POWER

## WIND POWER GLOBAL CAPACITY AND ANNUAL ADDITIONS, 2008-2018



## WIND POWER CAPACITY AND ADDITIONS, TOP 10 COUNTRIES, 2018



Note: Additions are net of decommissioning.

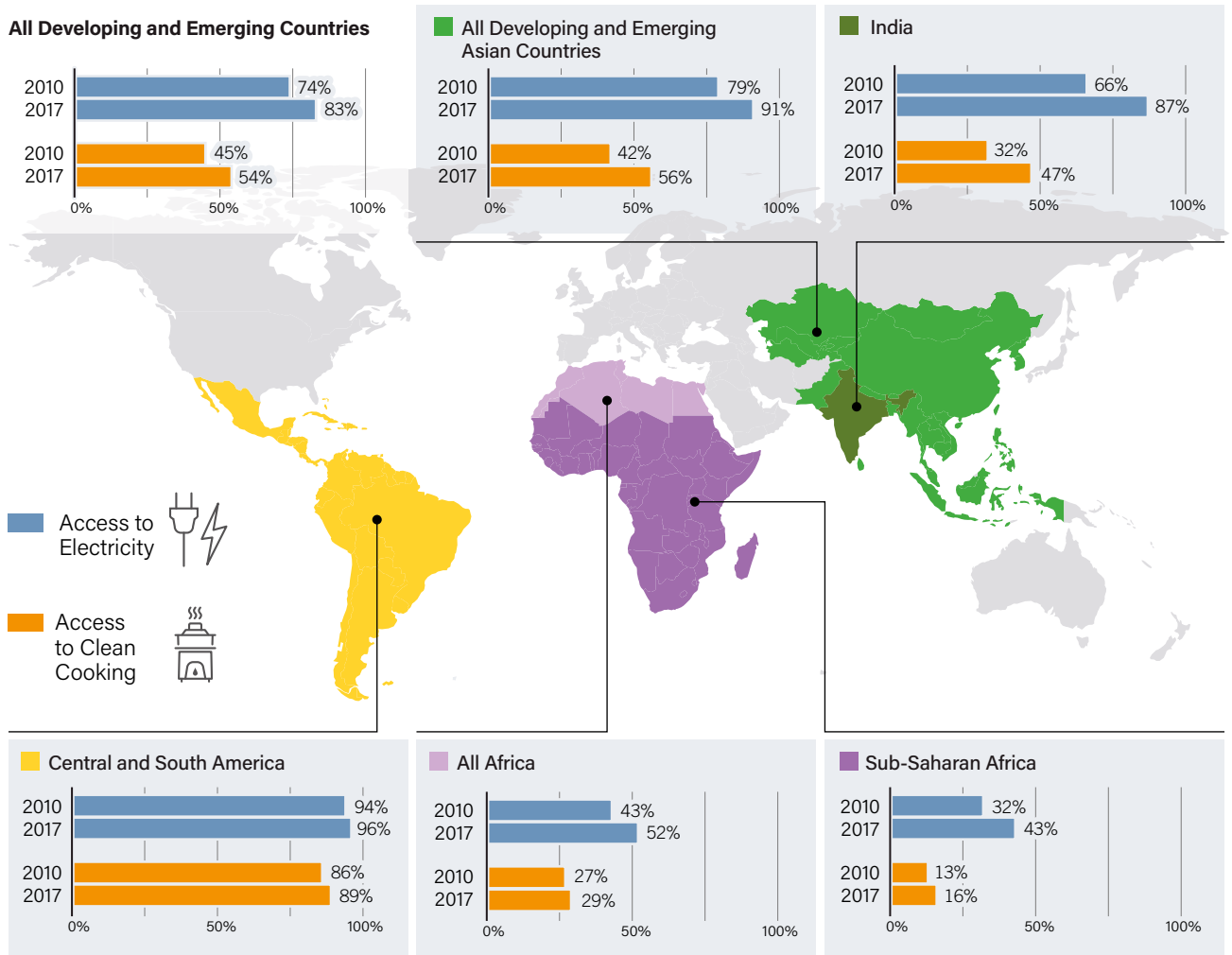


With 4.5 GW added in 2018, global capacity of offshore wind power increased

**24%.**

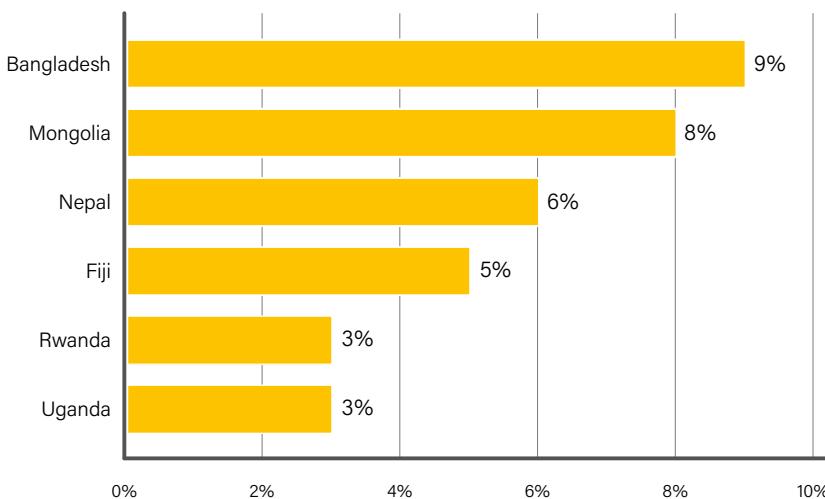
# DISTRIBUTED RENEWABLES FOR ENERGY ACCESS

ACCESS TO ELECTRICITY AND CLEAN COOKING BY REGION, 2010 AND 2017



Source: OECD/IEA.

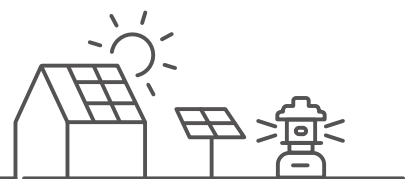
## TOP 6 COUNTRIES WITH HIGHEST OFF-GRID SOLAR ACCESS RATE (TIER 1 AND ABOVE), 2016



Nearly

**150 million**

people across Africa and Asia benefit from energy access through off-grid solar systems.

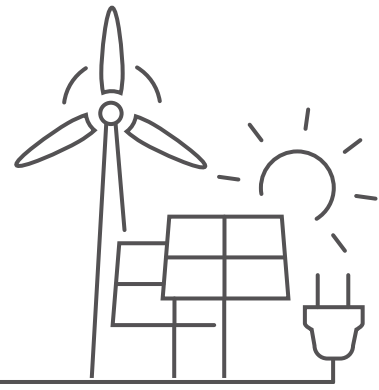
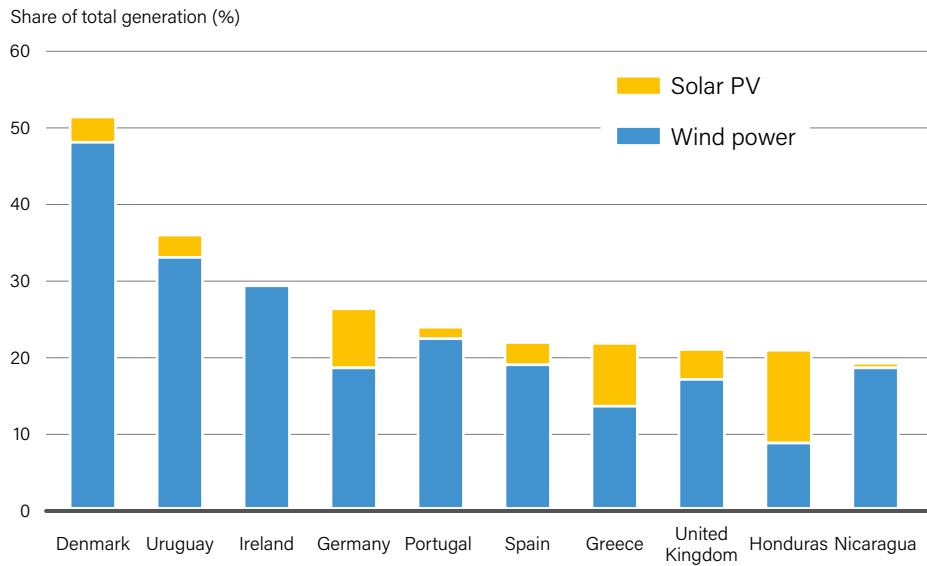


Note: Tier 1 access, as defined in the Multi-tier Framework for measuring access to household electricity supply, equals a minimum of 3 watts or 12 watt-hours per day of peak capacity, lighting of 1,000 lumen hours per day, and a minimum four hours per day or one hour per evening of electricity supply.

Source: World Bank.

# ENERGY SYSTEMS INTEGRATION

## SHARE OF ELECTRICITY GENERATION FROM VARIABLE RENEWABLE ENERGY, TOP 10 COUNTRIES, 2018

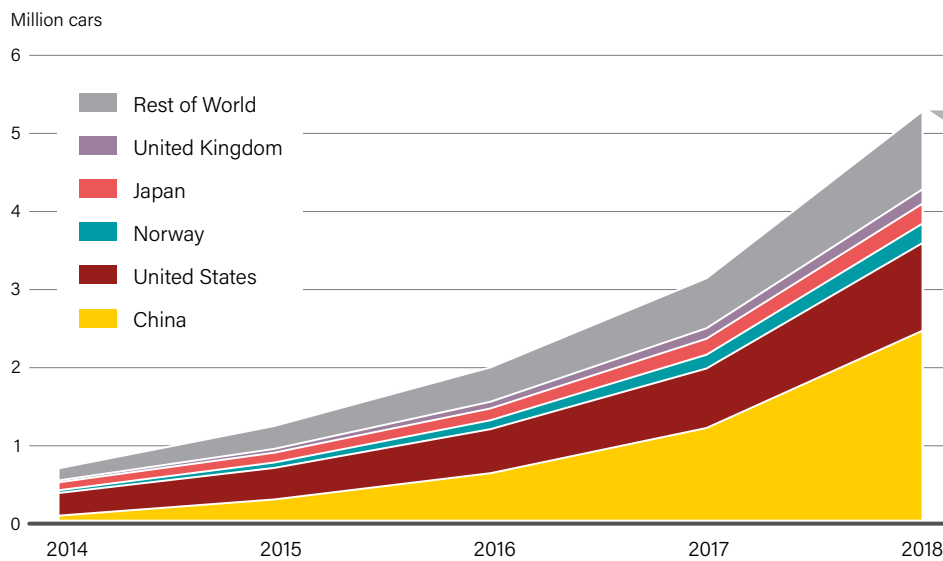


Source: REN21 analysis.



Global battery storage capacity totalled **3 GW** in early 2019.

## ELECTRIC CAR GLOBAL STOCK, TOP 5 COUNTRIES AND REST OF WORLD, 2014-2018



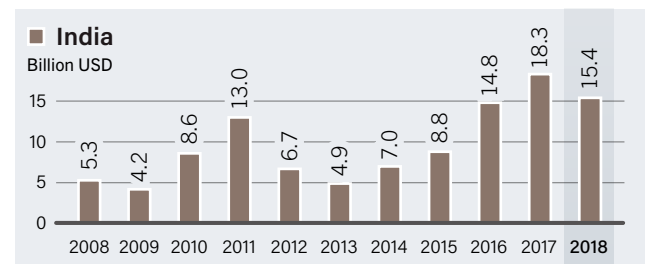
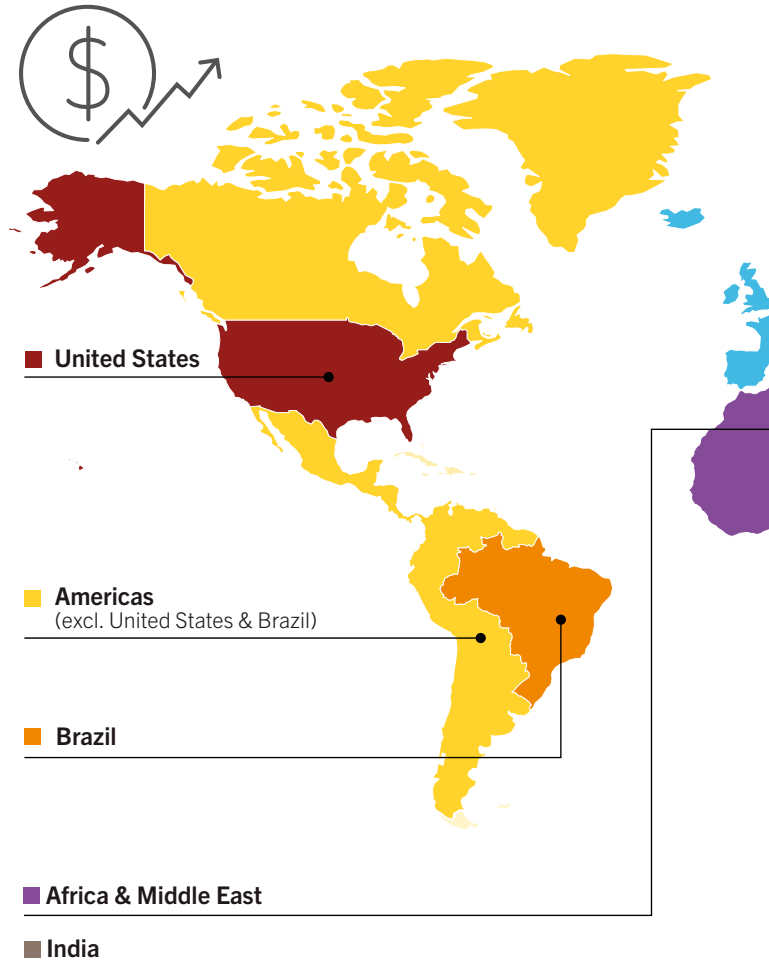
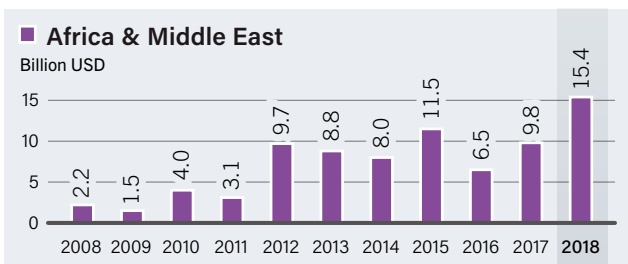
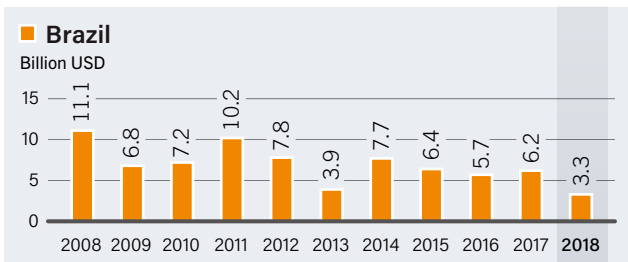
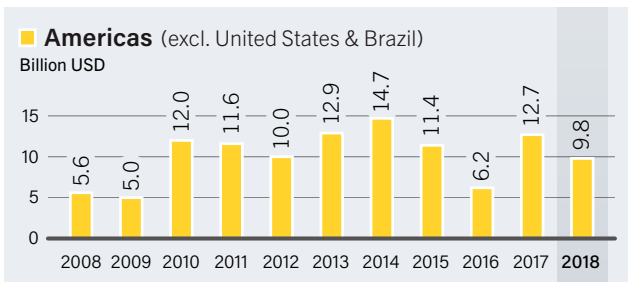
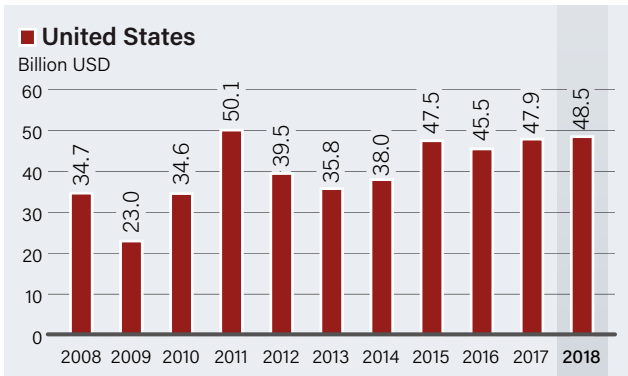
**5.1 million** electric cars and **260 million** electric two-wheelers were on the road in 2018.

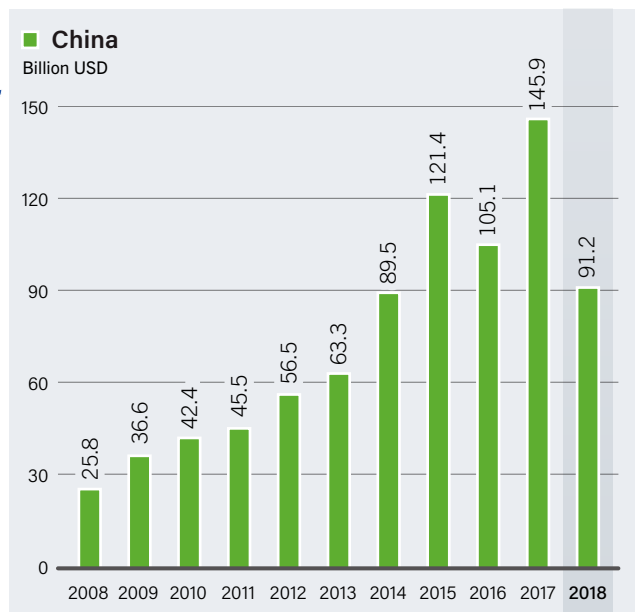
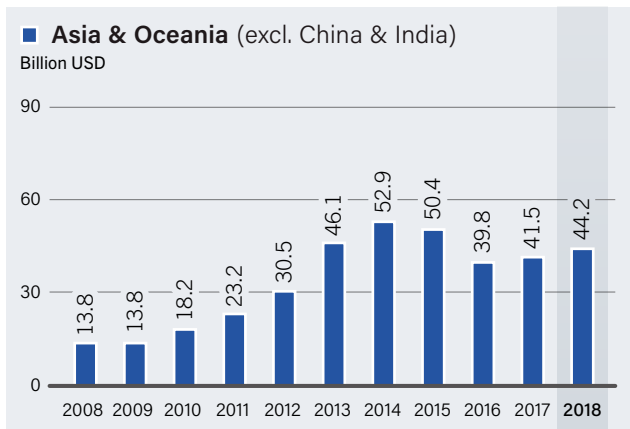
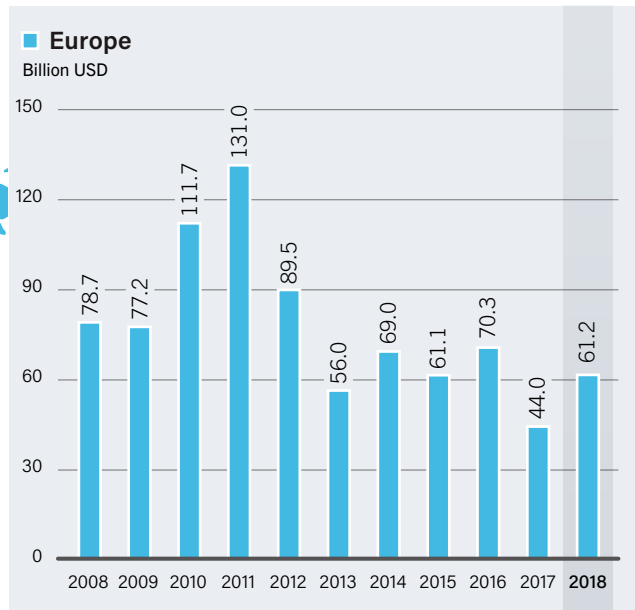
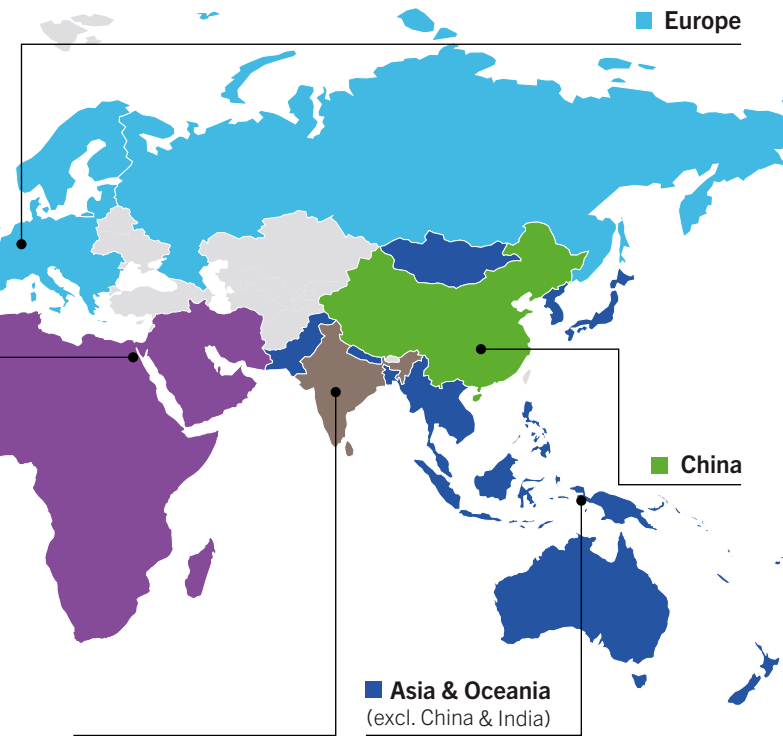


Source: OECD/IEA.

# GLOBAL INVESTMENT 2018

GLOBAL NEW INVESTMENT IN RENEWABLE POWER AND FUELS, BY COUNTRY OR REGION, 2008-2018





Source: BloombergNEF.



**Investment**  
in renewable power was  
**three times**  
higher than in new  
coal- and gas-fired  
generators combined.

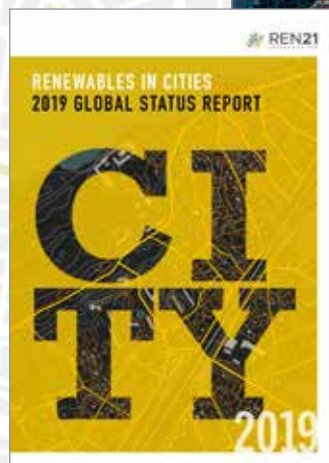
# MAKING THE CONNECTIONS

Good decisions require good information. REN21's *Renewables Global Status Report (GSR)* tracks the annual development of renewables using the most up-to-date information and data available. Its neutral, fact-based approach documents in detail the annual developments in market, industry and policy. The report is a collaborative effort, drawing on an international network of more than 900 authors, contributors and reviewers from over 155 countries. Now in its 14th year, the GSR is the most frequently referenced report on renewable energy market, industry and policy trends.

Since the first edition of the GSR in 2005, REN21 has continuously expanded its reporting. To highlight regional trends, REN21 has developed Regional Renewable Energy and Energy Efficiency Status Reports and is now reporting on renewable energy development in cities, considering the crucial involvement of cities in the energy transition and the existing data gap.

The *Renewables in Cities 2019 Global Status Report* builds on the success of the *Renewables Global Status Report* and focuses specifically on the state of renewables in cities around the world and on the role of local action in the renewable energy transition. It looks at trends and developments of renewable energy in cities and its associated benefits, including impacts on air pollution, energy security and access, and socio-economic issues. This publication will help improve understanding of cities' role in the energy transition, while also increasing visibility for local action and showcasing effective policies, finance and business models to inform decisions. The full publication will be available later in 2019.

**Access the reports:**  
[www.ren21.net/GSR](http://www.ren21.net/GSR)  
[www.ren21.net/cities](http://www.ren21.net/cities)



**Bridging and building the energy future.**

[www.ren21.net](http://www.ren21.net)

The REN21 Secretariat has produced this document to highlight the important trends that have occurred in 2018 and to put them in perspective of the global energy transition. It draws on elements from REN21's *Renewables 2019 Global Status Report*.

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### PRODUCTION

REN21 Secretariat, Paris, France

### EDITING, DESIGN AND LAYOUT

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Editor  
weeks.de Werbeagentur GmbH, Design

### PRODUCTION

REN21 Secretariat, Paris, France



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# PERSPECTIVES 2019



## RENEWABLES 2019 GLOBAL STATUS REPORT

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See Endnotes and Methodological Notes  
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ISBN 978-3-9818911-7-1