RENEWABLES 2018
GLOBAL STATUS REPORT

REN21 Renewable Energy Policy Network for the 21st Century

2018

4 June 2018
REN21 Secretariat
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Another Extraordinary Year for Renewable Energy

- **Total global capacity:** up almost **9%** compared to 2016, **2,195 GW** at year's end (**1,081 GW** not incl. hydro)
- Share in **newly installed renewable power capacity:**
  - Solar PV: 55%
  - Wind: 29%
  - Hydropower: 11%
  - Bio-power: 4.6%

RENEWABLE ENERGY INDICATORS 2017

		2016	2017
INVESTMENT			
New investment (annual) in renewable power and fuels[1]	billion USD	274	**279.8**
POWER			
Renewable power capacity (including hydro)	GW	2,017	**2,195**
Renewable power capacity (not including hydro)	GW	922	**1,081**
Hydropower capacity[2]	GW	1,095	**1,114**
Bio-power capacity	GW	114	**122**
Bio-power generation (annual)	TWh	501	**555**
Geothermal power capacity	GW	12.1	**12.8**
Solar PV capacity[3]	GW	303	**402**
Concentrating solar thermal power (CSP) capacity	GW	4.8	**4.9**
Wind power capacity	GW	487	**539**
Ocean energy capacity	GW	0.5	**0.5**
HEAT			
Solar hot water capacity[4]	GW_{th}	456	**472**
TRANSPORT			
Ethanol production (annual)	billion litres	103	**106**
FAME biodiesel production (annual)	billion litres	31	**31**
HVO production (annual)	billion litres	5.9	**6.5**

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Renewable Energy “Champions”

TOP 5 COUNTRIES 2017

Annual Investment / Net Capacity Additions / Production in 2017

	1	2	3	4	5
Investment in renewable power and fuels (not including hydro over 50 MW)	**China**	United States	Japan	India	Germany
Investment in renewable power and fuels per unit GDP[1]	**Marshall Islands**	Rwanda	Solomon Islands	Guinea-Bissau	Serbia
Geothermal power capacity	**Turkey**	Indonesia	Chile	Iceland	Honduras
Hydropower capacity	**China**	Brazil	India	Angola	Turkey
Solar PV capacity	**China**	United States	India	Japan	Turkey
Concentrating solar thermal power (CSP) capacity[2]	**South Africa**	-	-	-	-
Wind power capacity	**China**	United States	Germany	United Kingdom	India
Solar water heating capacity	**China**	Turkey	India	Brazil	United States
Biodiesel production	**United States**	Brazil	Germany	Argentina	Indonesia
Ethanol production	**United States**	Brazil	China	Canada	Thailand

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Renewable Energy “Champions”

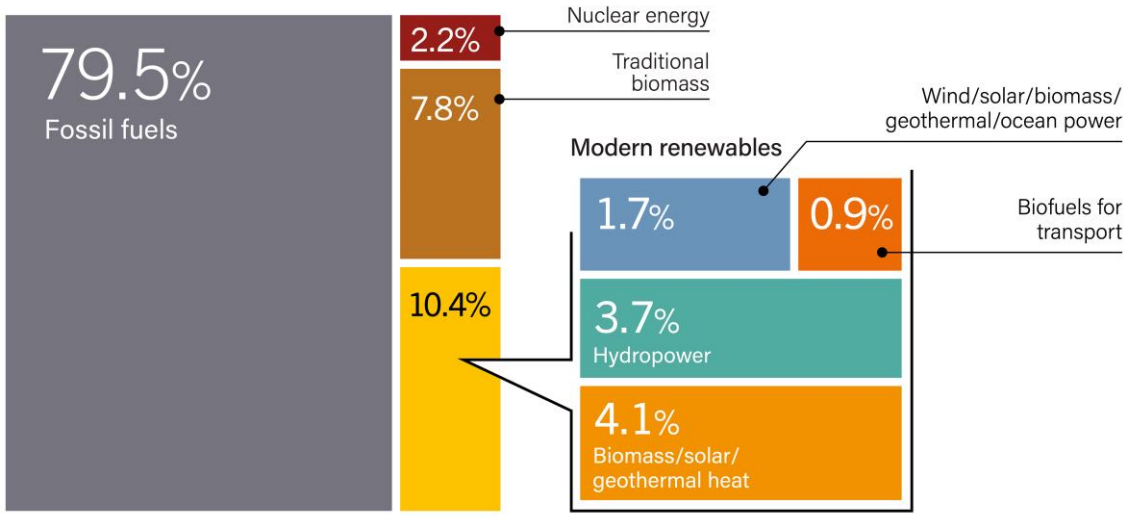
Total Capacity or Generation as of End-2017

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

Renewable Energy in Total Final Energy Consumption

- As of **2016**, renewable energy provided an estimated **18.2%** of **global final energy consumption**
  - **10.4%** was provided by **modern renewables** (**+0.2%** relative to 2015)
  - **7.8%** was provided by **traditional biomass** (**-2.4%** relative to 2015)

Estimated Renewable Share of Total Final Energy Consumption, 2016



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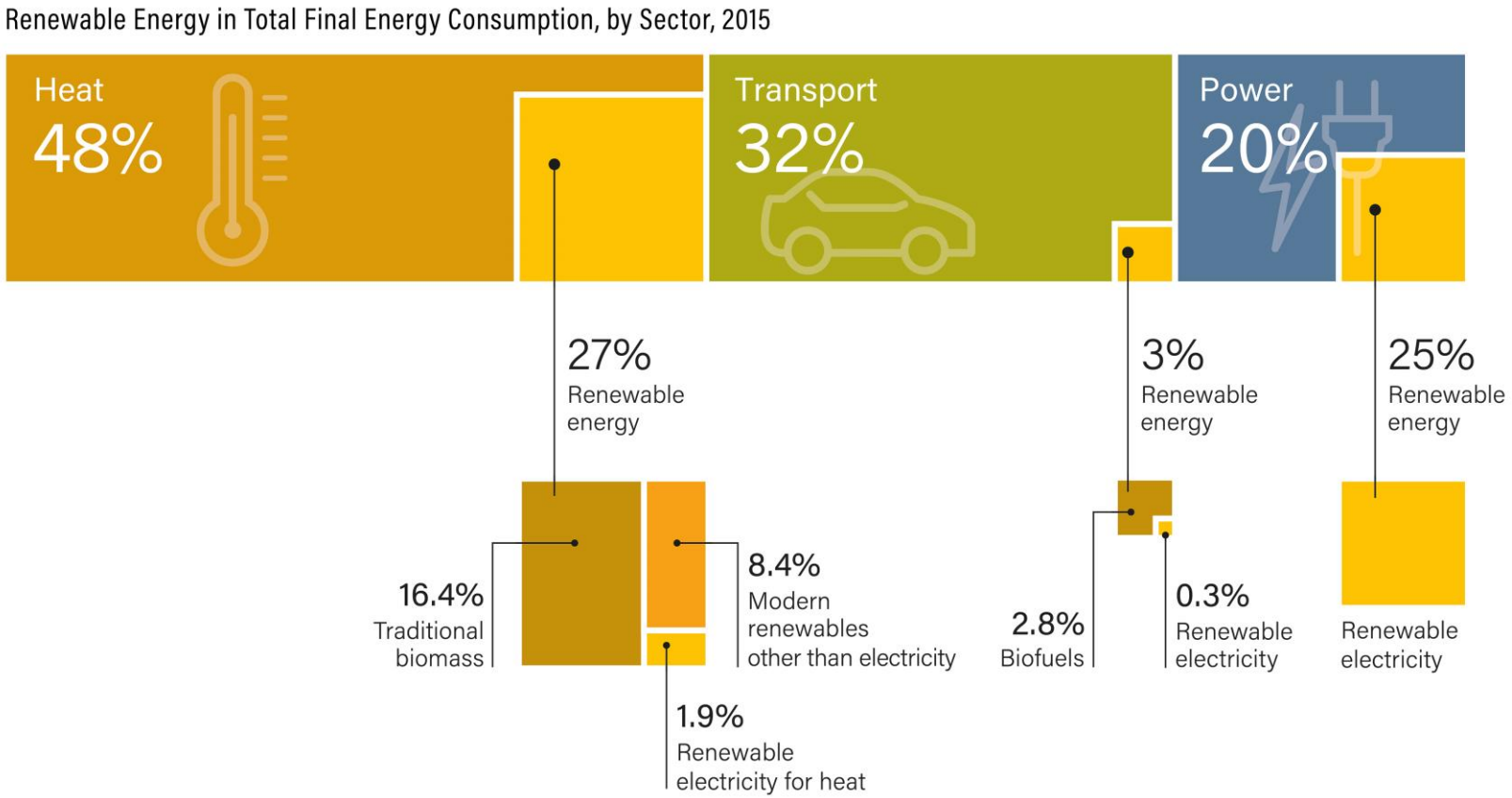
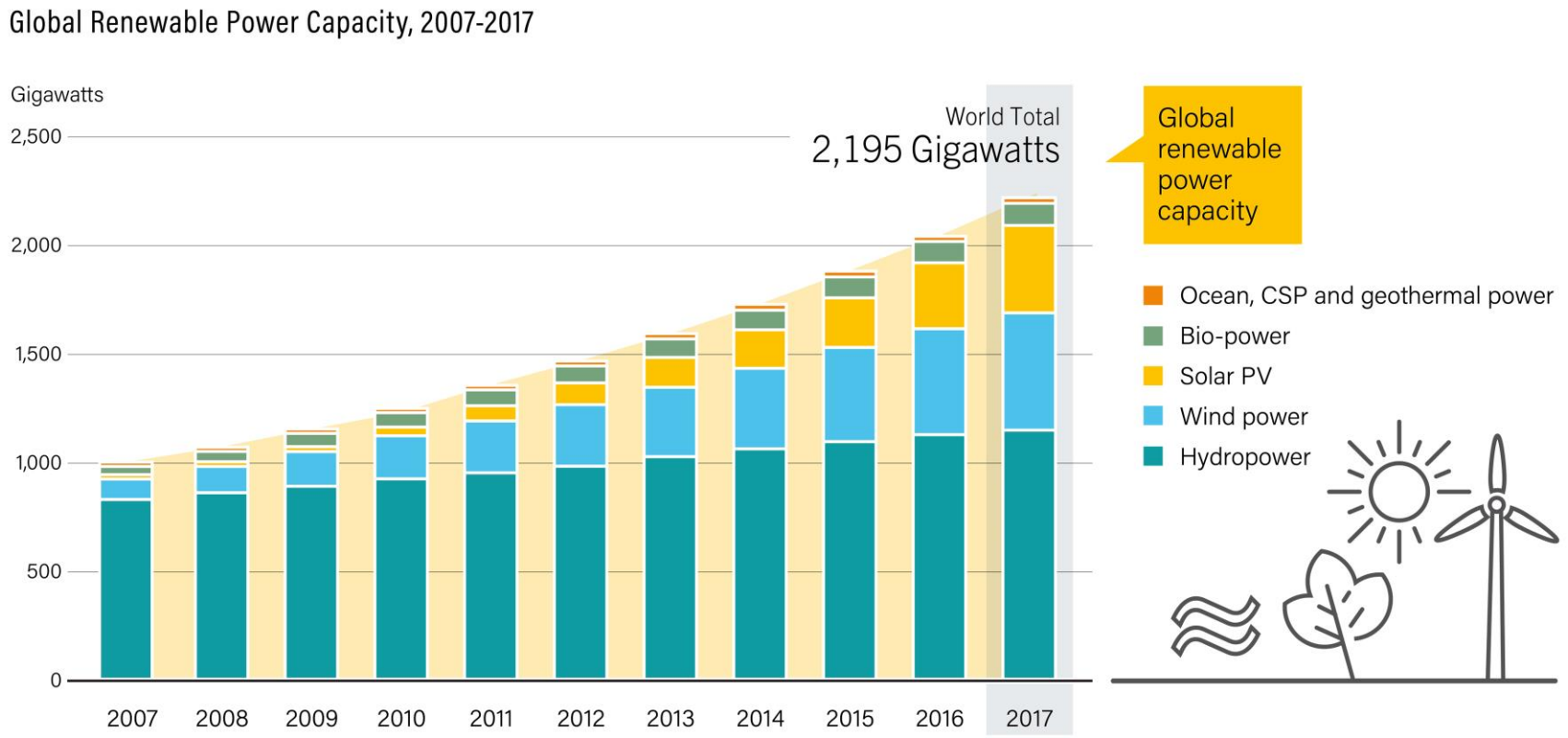
Renewable Energy in TFEC by Sector



Global Renewable Power Capacity



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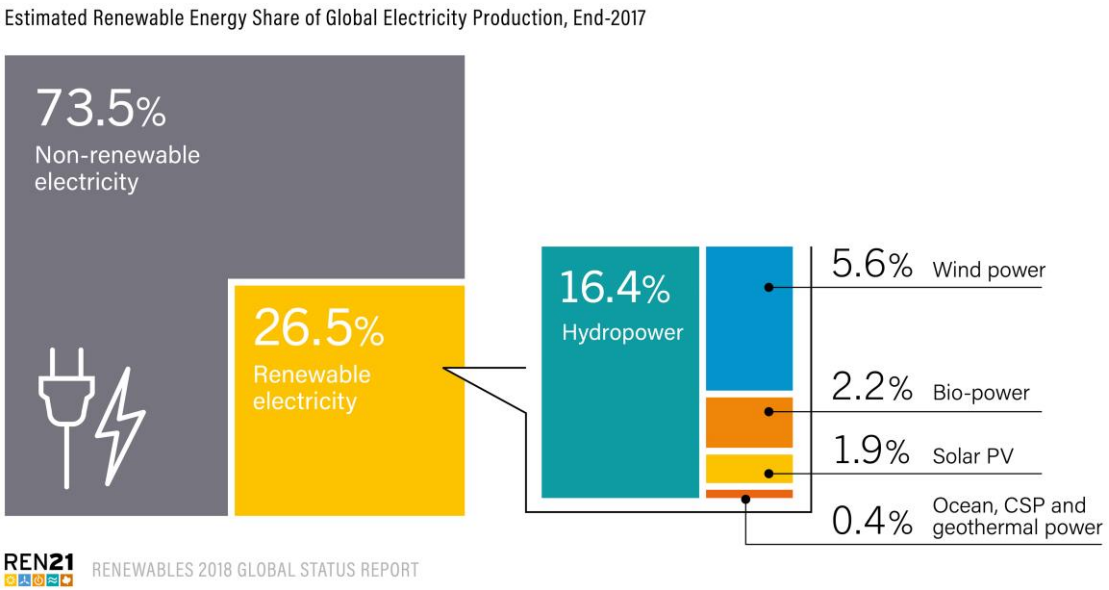
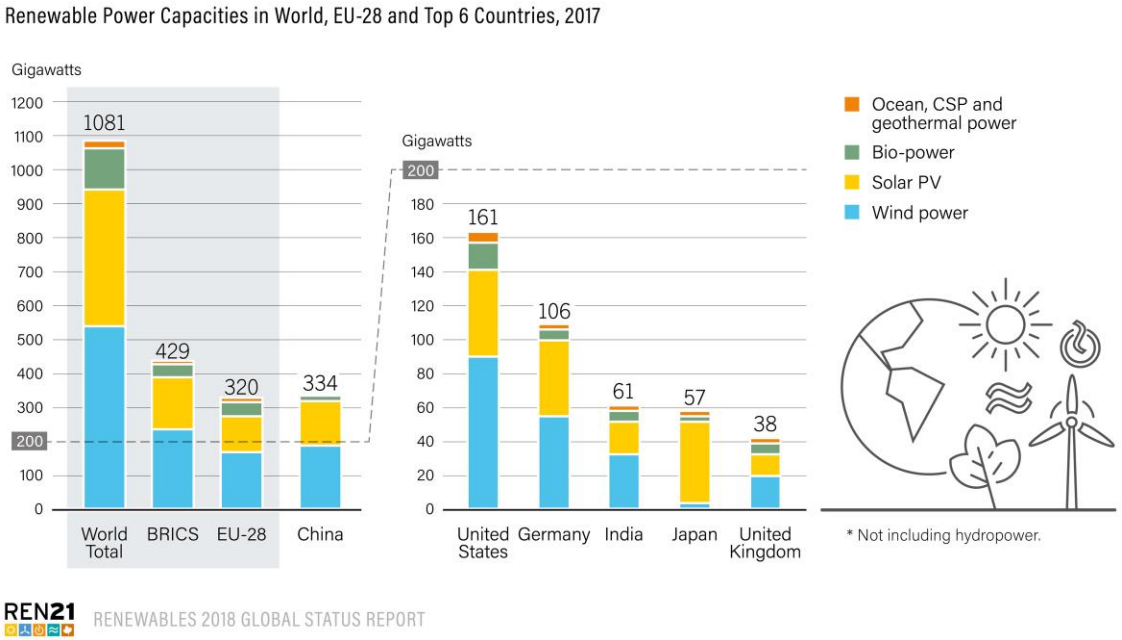
Power Sector

- In 2017, renewables accounted for: **70%** of net additions to global power generation capacity
- Providing **26.5%** of global electricity demand
- **Progress in the power sector shows that the transition to renewable energy is possible!**

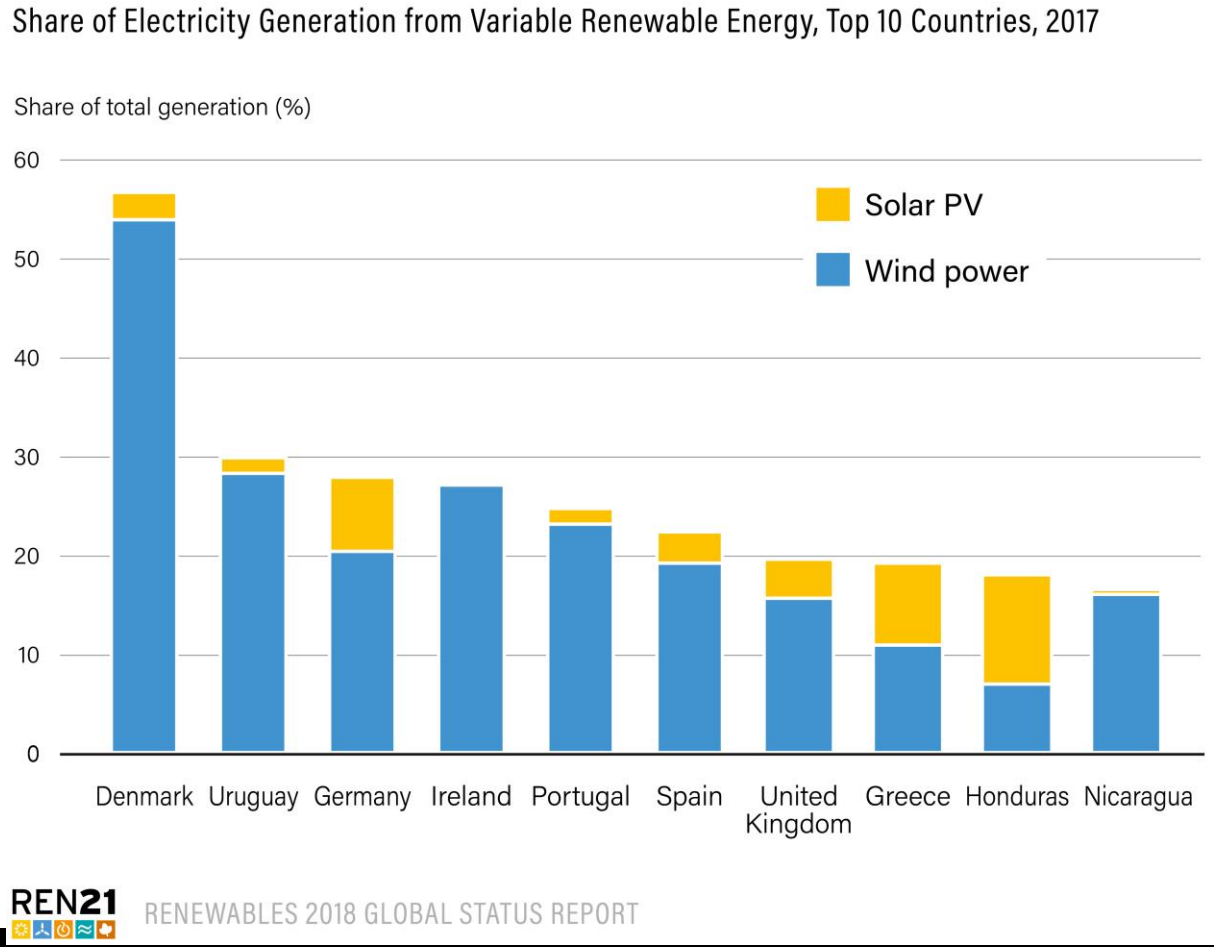


Renewable Power Capacities in the World

- By the end of 2017, **China** alone was home to nearly **30%** of the **world's renewable power capacity** (approx. 647 GW)

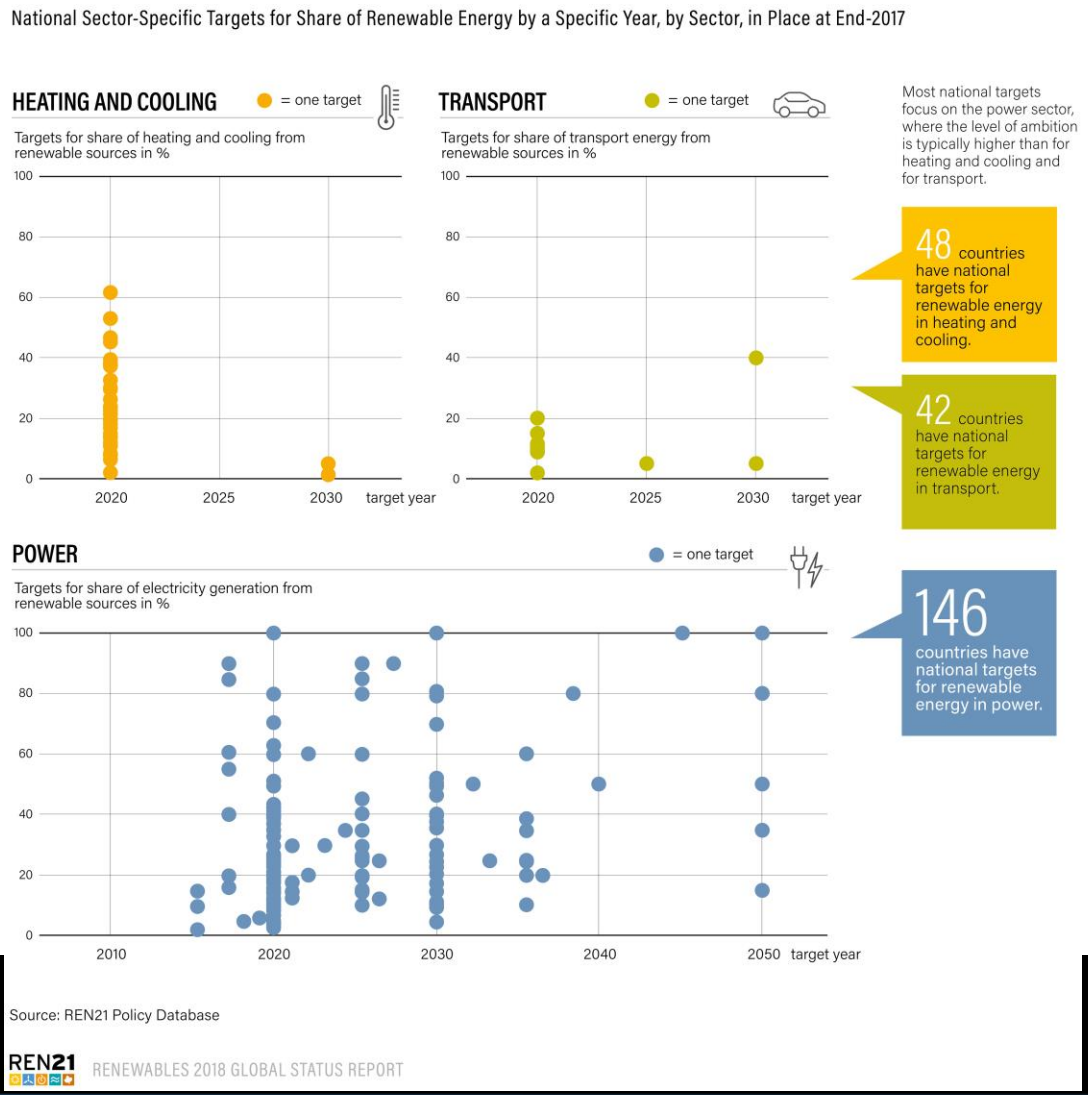


High Shares of Variable Renewable Power on the Grid



Renewable Energy Targets

- **179** countries had **renewable energy targets**
- **48** countries had renewable **heating and cooling targets**
- **42** countries had renewable **transport targets**
- **146** countries had renewable **power targets**



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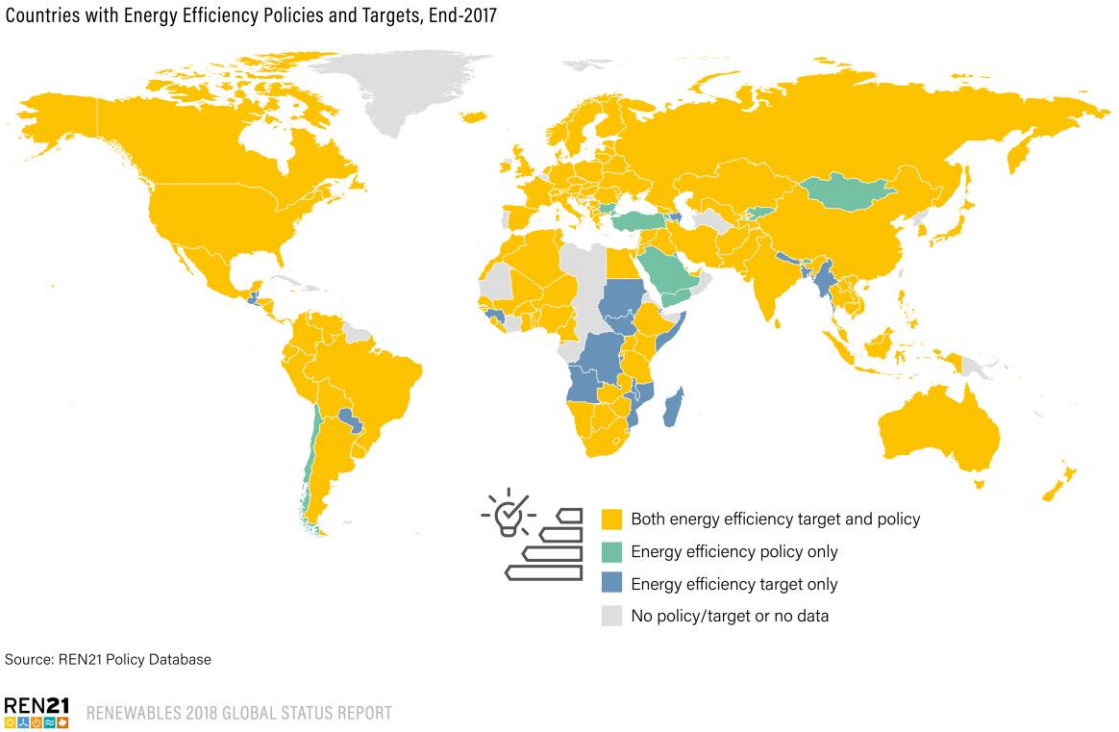
Heating and Cooling

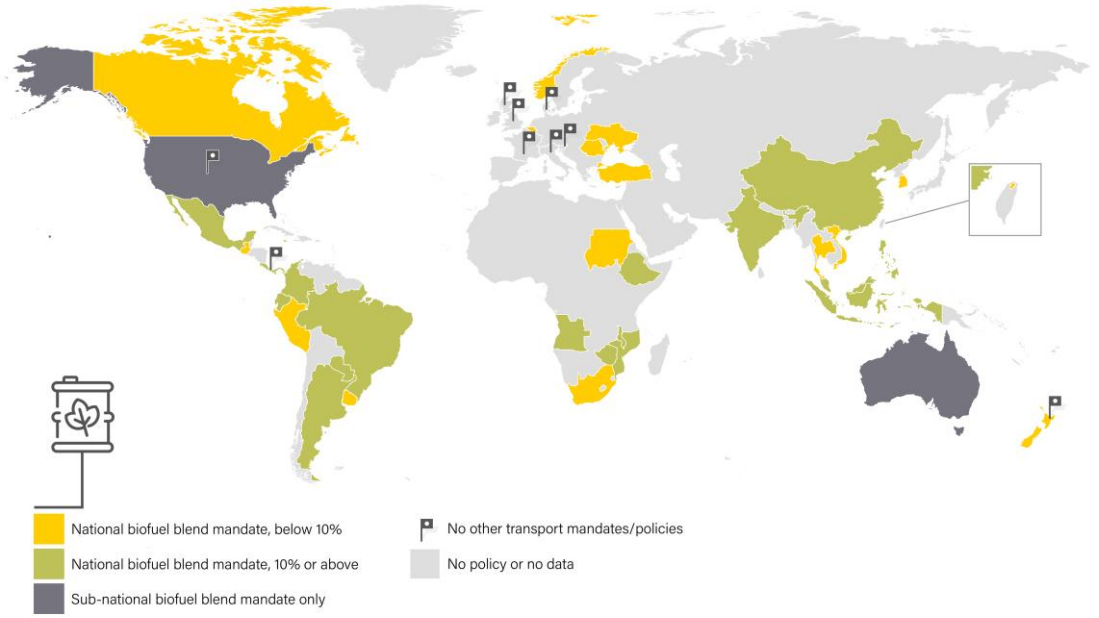
- By end-2017, at least **145 countries** had enacted some kind of **energy efficiency policy**
- At least **157 countries** had enacted **one or more energy efficiency target**
- Mandatory and voluntary **energy codes for buildings** exist in **more than 60 countries** worldwide



Transport

- New or revised **ethanol and biodiesel blend mandates** were enacted in 2017
- Biofuel promotion policies began including **specific requirements for the use of next-generation cellulosic biofuels**
- **Fiscal incentives** for biofuel production and **grants** for the development of second-generation biofuels
- Other jurisdictions have set **goals or incentives for electric or fuel-efficient vehicles**

National and Sub-National Renewable Transport Mandates, End-2017



Source: REN21 Policy Database

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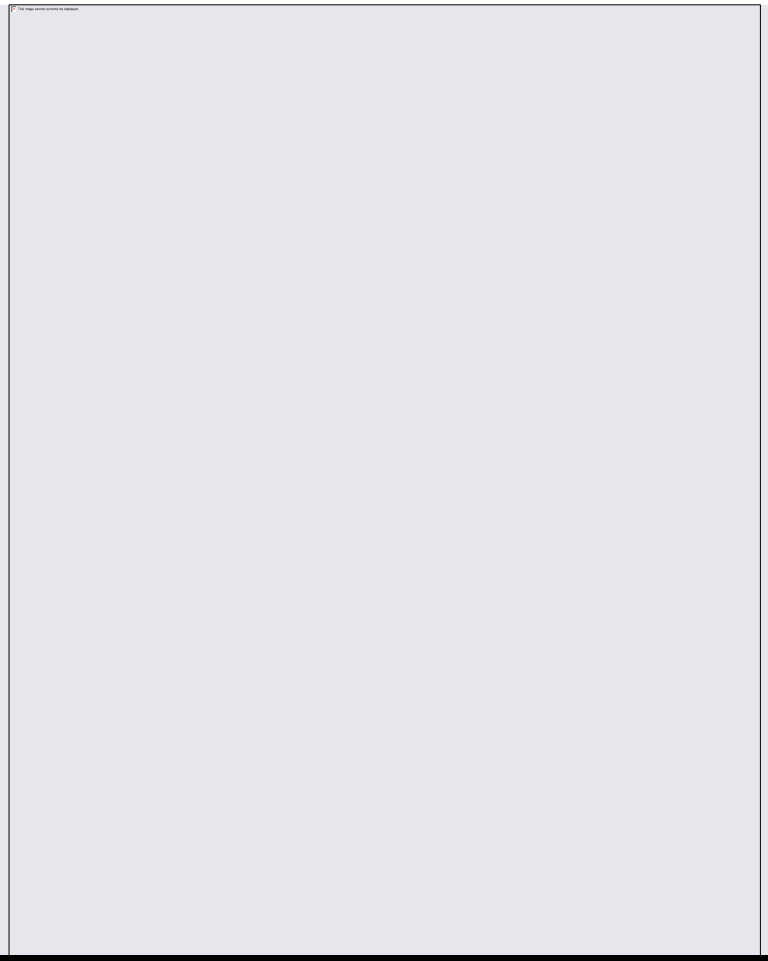
Sector Coupling: Targets for RE and EVs

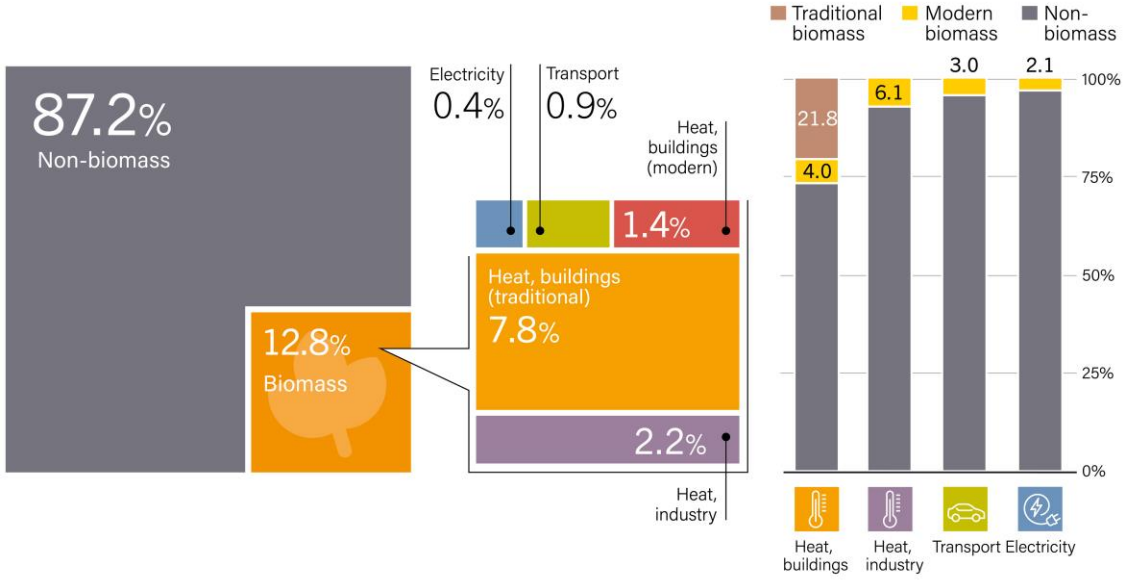
- Limited examples of **policies that encourage/mandate the use of renewable energy in EVs (Austria and Germany)**
- Countries with **targets for both EVs and renewable energy in power** may encourage the use of renewable deployment in transport
- Governments also are supporting EVs through **public procurement**



Bioenergy

- **Biomass** accounted for **12.8%** of **total final energy consumption** in 2016
- **Traditional biomass** in TFEC declining: **9.2%** in 2005 to estimated **7.8%** in 2016
- **Modern bioenergy** contributed **5%** to final energy consumption

Shares of Bioenergy in Total Final Energy Consumption, Overall and by End-Use Sector, 2016



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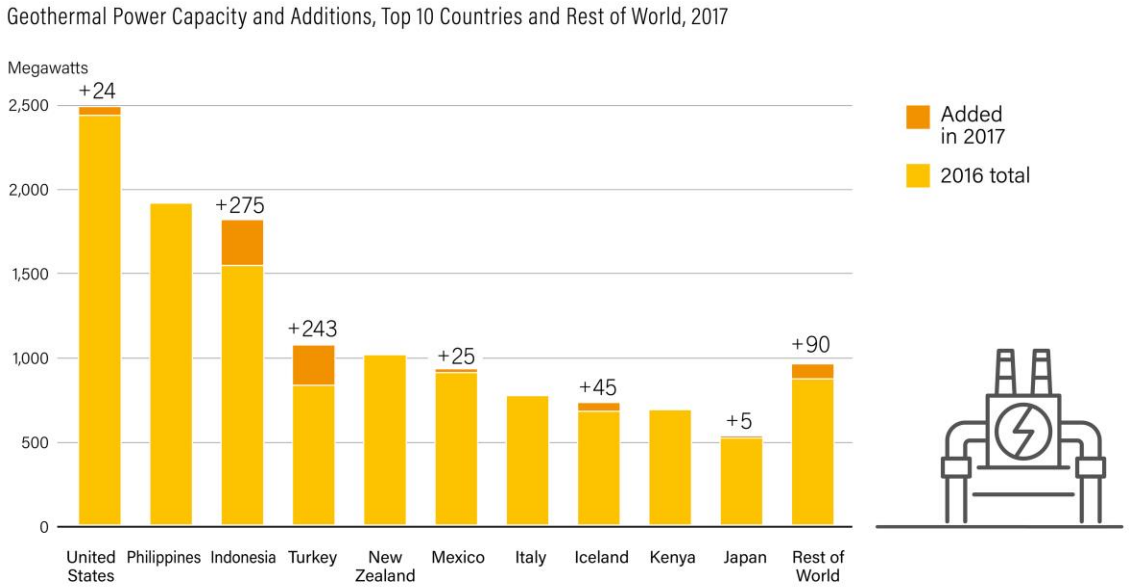
Geothermal Power and Heat

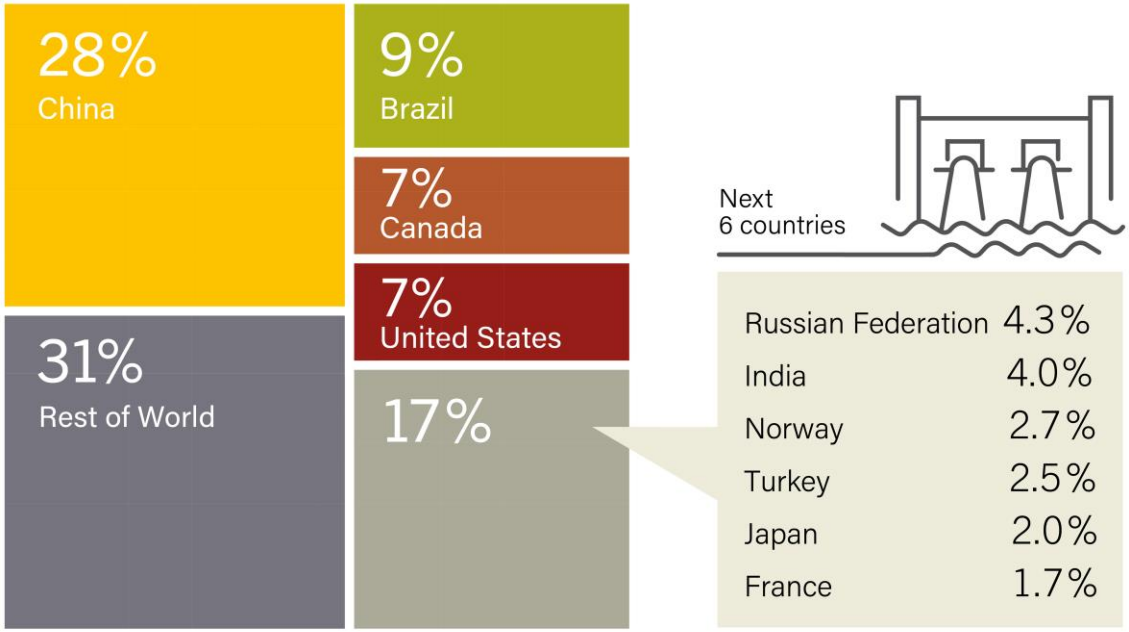
- The **United States** is the global leader for installed geothermal power capacity, but expansion remains slow
- Total capacity was around **2.5 GWnet** at year's end, and geothermal power generated about **16 TWh** during the year, accounting for **0.4% of US net generation**



Hydropower

- In 2017, total global hydropower **capacity** increased to approximately **1,114 GW**
- **Generation** from hydropower was an estimated **4,185 TWh** worldwide, up about **2%** from 2016
- The **leading countries for cumulative capacity** remained the same: **China, Brazil, Canada, the US, the Russian Federation, India and Norway**

Hydropower Global Capacity, Shares of Top 10 Countries and Rest of World, 2017



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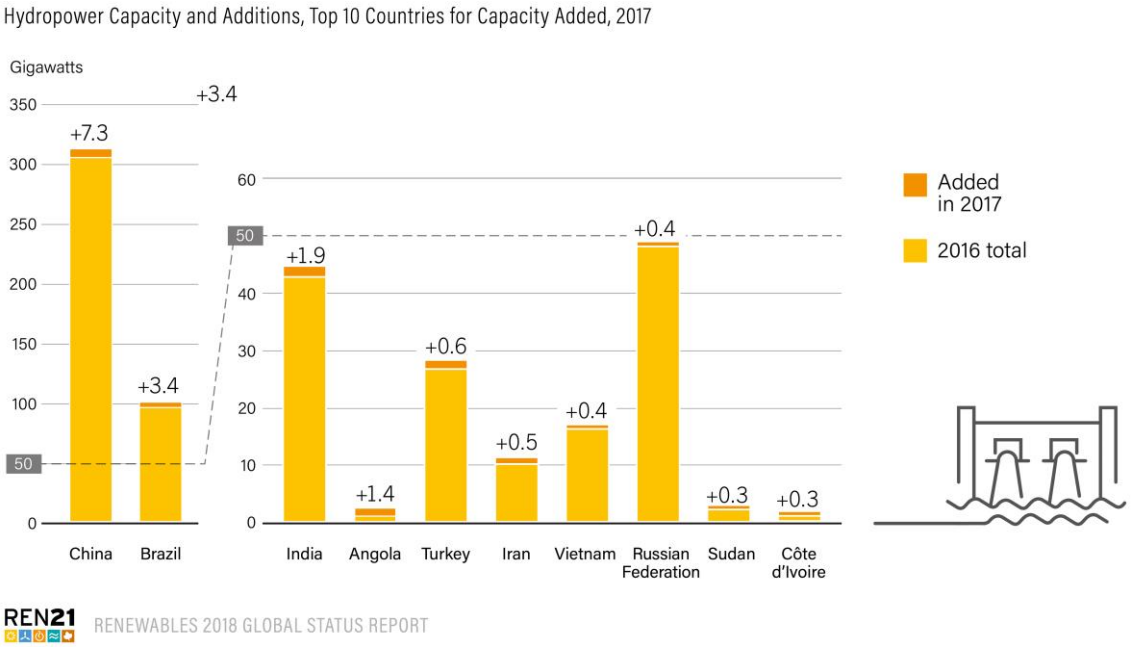
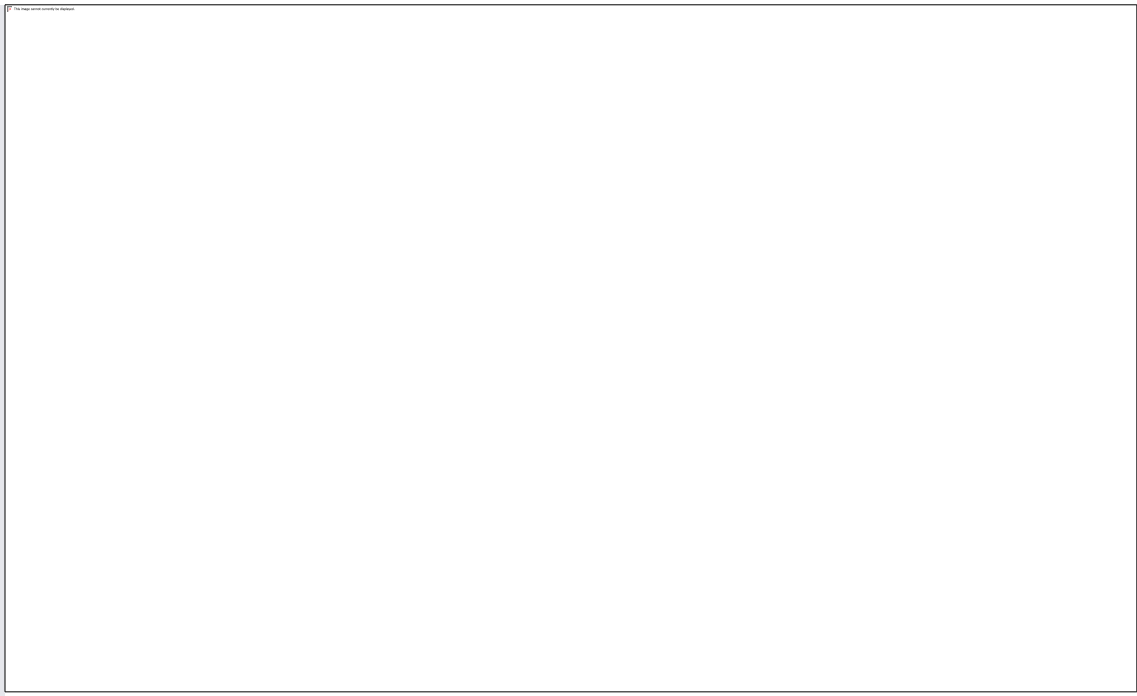
Hydropower

- **19 GW** of new hydropower capacity was commissioned in 2017
- While significant, this was the smallest annual increment over the past 5 years
- Most capacity added by China, followed by Brazil



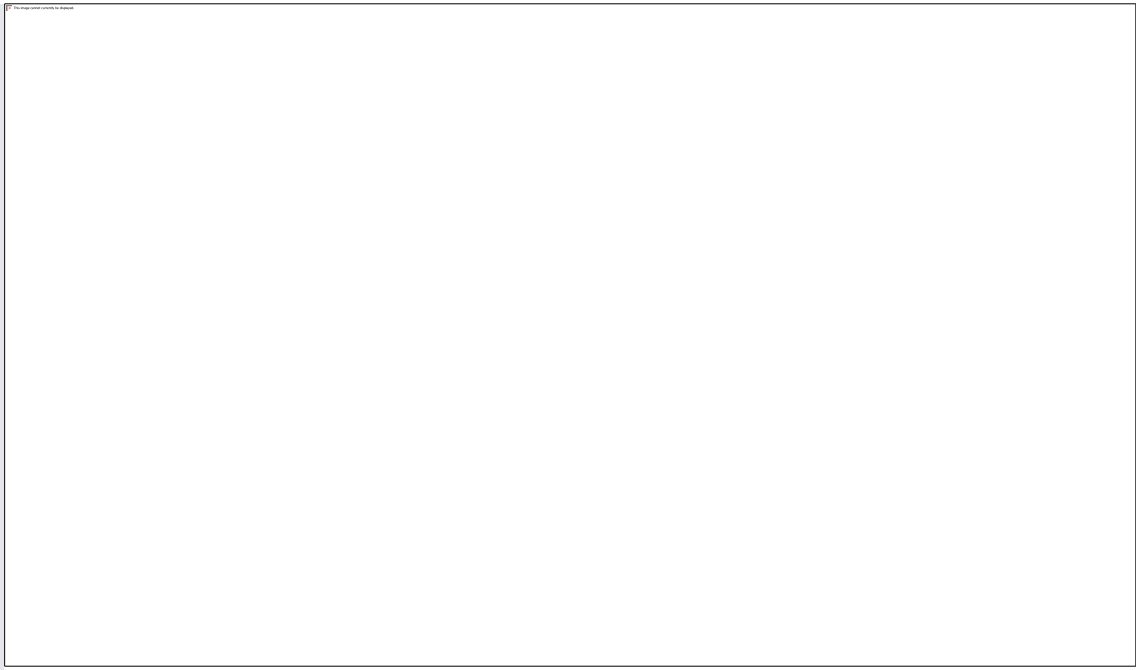
Solar PV

- **98 GW** of solar PV capacity added in 2017
- Global total increased **33%** to **402 GW** (equivalent of 40,000 PV panels every hour)
- **More solar PV was installed than the net capacity additions of fossil fuels and nuclear power combined**



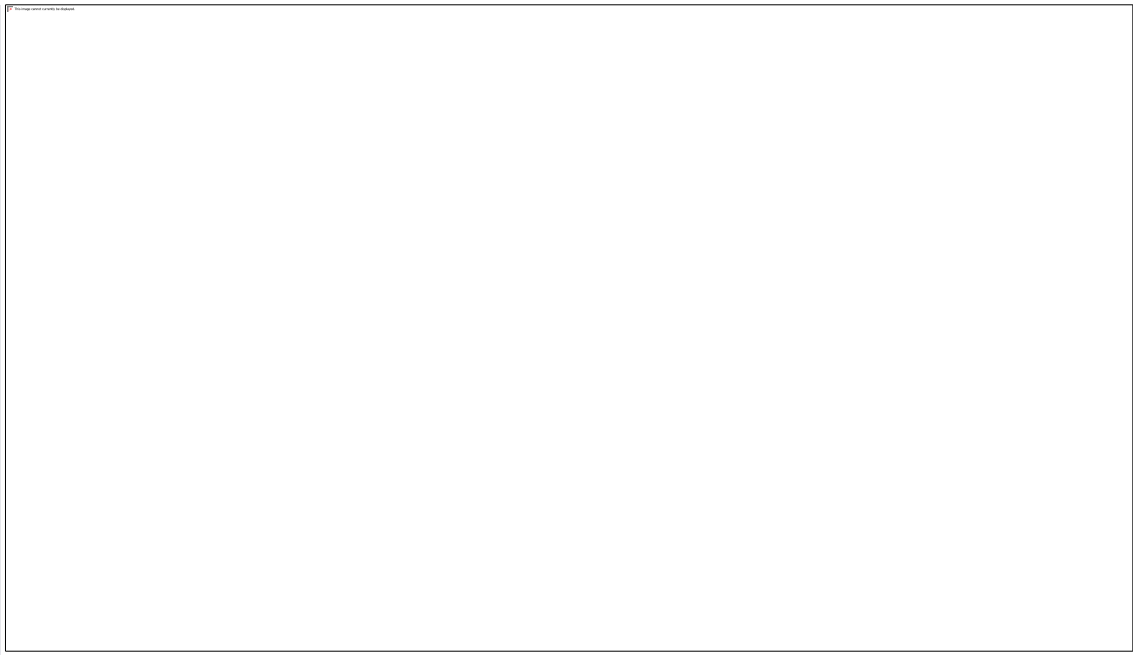
Solar PV

- By the end of 2017, **every continent had installed at least 1 GW**
- **At least 29 countries had 1 GW or more** of capacity
- The size and number of large projects continued to grow during 2017
- By year's end, **at least 196 solar PV plants of 50 MW and larger** were operating in **at least 28 countries**



Solar PV

- **China** added **53.1 GW** in 2017, **more than was added worldwide in 2015**, increasing its total solar PV capacity to **131.1 GW**
- **China reached its 2020 target** for solar installations in 2017
- The **United States** remained a distant second, adding **10.6 GW** for a total of **51 GW**



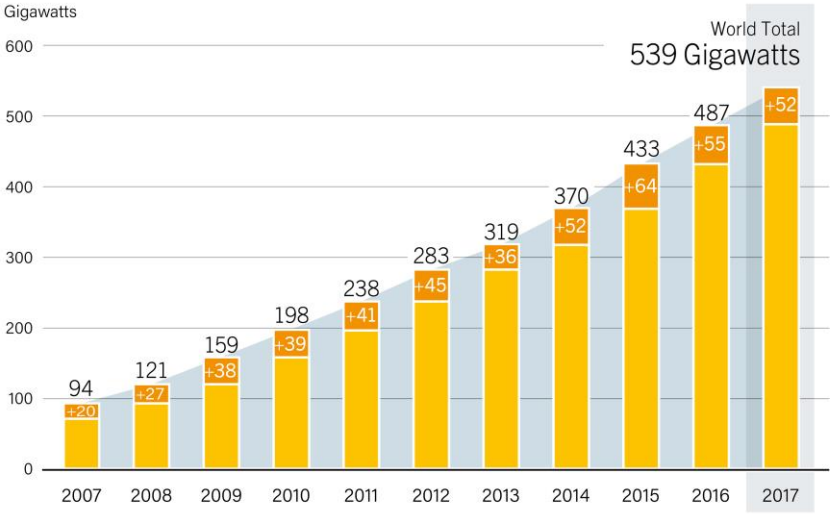
Solar Thermal Heating and Cooling

- Globally, **35 GWth** of capacity of glazed (flat plate and vacuum tube technology) and unglazed collectors was **newly commissioned** in 2017
- The total global capacity was an estimated **472 GWth** by year-end
- Gross additions for the year were **down 3%**, from 36.2 GWth in 2016

Wind Power

- **52 GW** of wind power capacity added in 2017
- The global total increased by **11% to 539 GW**

Wind Power Global Capacity and Annual Additions, 2007-2017



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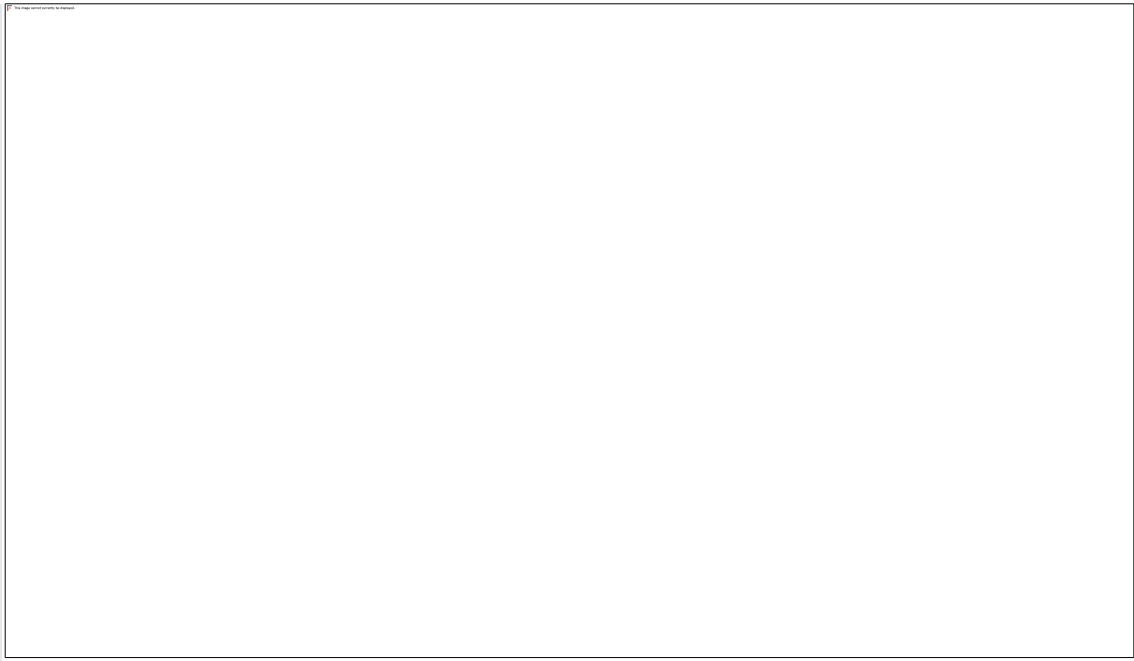
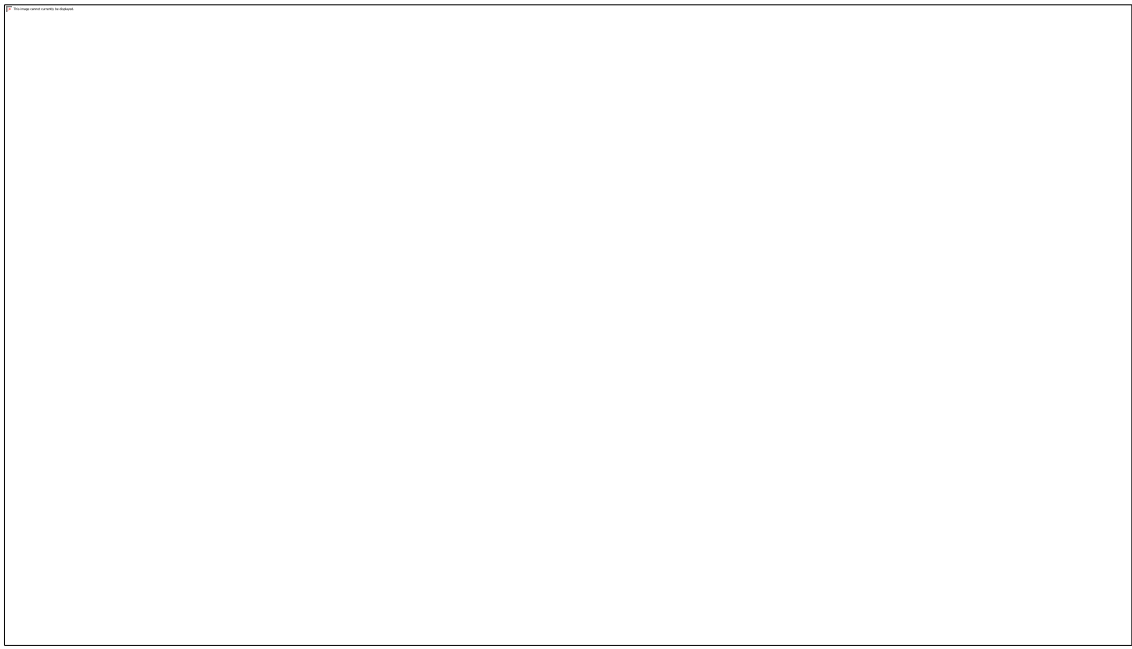
Wind Power

- **China** retained its lead position for wind power as well, adding nearly **19.7 GW** and reaching a total of **188.4 GW**
- It was followed distantly by the United States, Germany, the United Kingdom and India



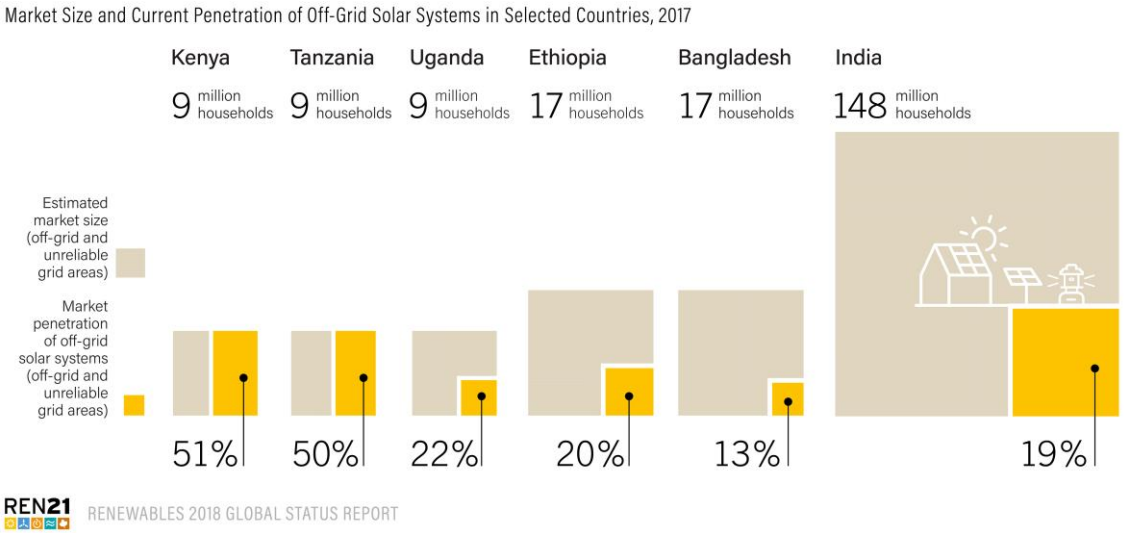
Wind Power

- There was an increase of **30%** in **global offshore capacity**
- A total of **17 countries** had **offshore wind capacity** by the end of 2017
- The **United Kingdom** maintained its lead for total capacity, with **6.8 GW** at year's end, followed by Germany (5.4 GW), China (2.8 GW), Denmark (1.3 GW) and the Netherlands (1.1 GW)
- **Europe was home to about 84% of global offshore capacity (down from 88% in 2016), with Asia accounting for nearly all the rest**



Distributed Renewables for Energy Access (DREA)

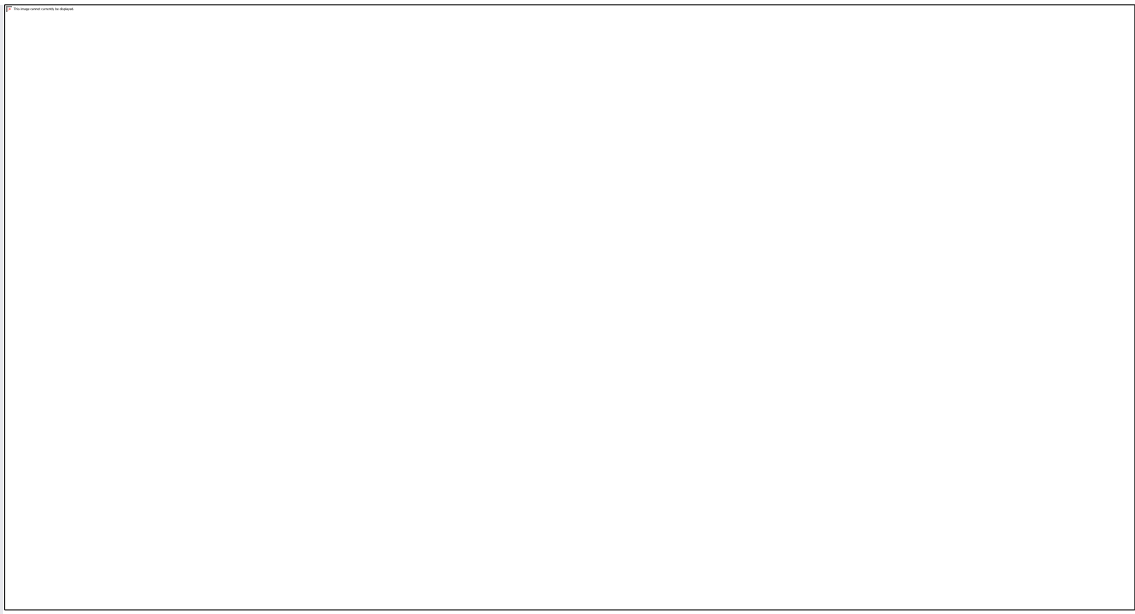
- **13%** of the population in **Bangladesh gained access to electricity through off-grid solar systems**
- **51%** of the off-grid population of **Kenya is served by DREA systems**
- In 2017, an increasing number of national governments demonstrated their **interest in DREA systems by enhancing the enabling environment**



Distributed Renewables for Energy Access

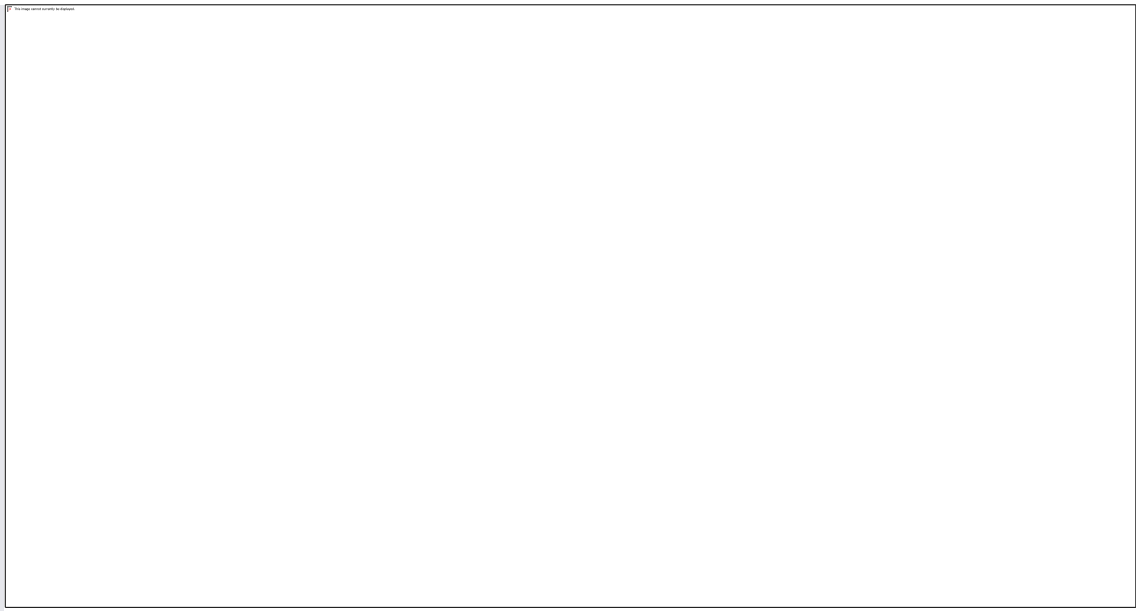
- In 2016: **14%** of the global population lived **without electricity** – approx. 1.06 billion people (majority in SSA and Asia-Pacific regions)

- **DREA systems** were serving **~300 million people by end-2016**



Distributed Renewables for Energy Access

- **Off-grid solar devices** (solar lanterns and solar home systems) experienced **60% annual growth** rates between 2010-2017
- **25.8 million off-grid solar systems (est.) were sold** in 2017, a **14% decrease from 2016 sales**
- **130 million off-grid solar systems sold cumulatively** by end-2017, providing **electricity access to about 360 million people worldwide**



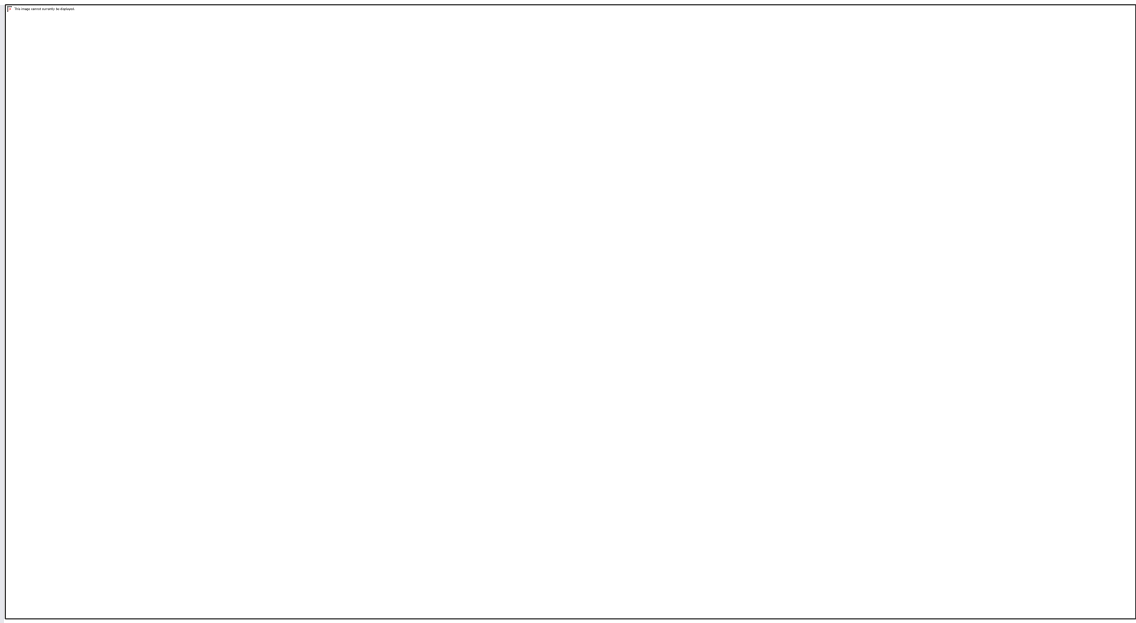
Distributed Renewables for Energy Access

- In 2017, an estimated **13 renewable energy-based large mini-grid projects** (>100 kW) were implemented in countries outside of the OECD and China, primarily in **Africa and Southeast Asia**

- **> 35 new mini-grid projects were announced in 2017**

Distributed Renewables for Energy Access

- **Clean cook stoves** made up **83%** (30.8 million) of the **37 million cook stoves distributed** in 2016
- **The number of clean cook stoves distributed more than tripled in 2016 compared to 2015**
- **India** became the main market for clean cook stoves with **20.3 million distributed** (two-thirds of the total globally)
- **China** continued to be a major market, with **6.2 million clean stoves distributed** in 2016, while **Bangladesh, Ghana and Kenya all matched or exceeded their 2015 numbers**

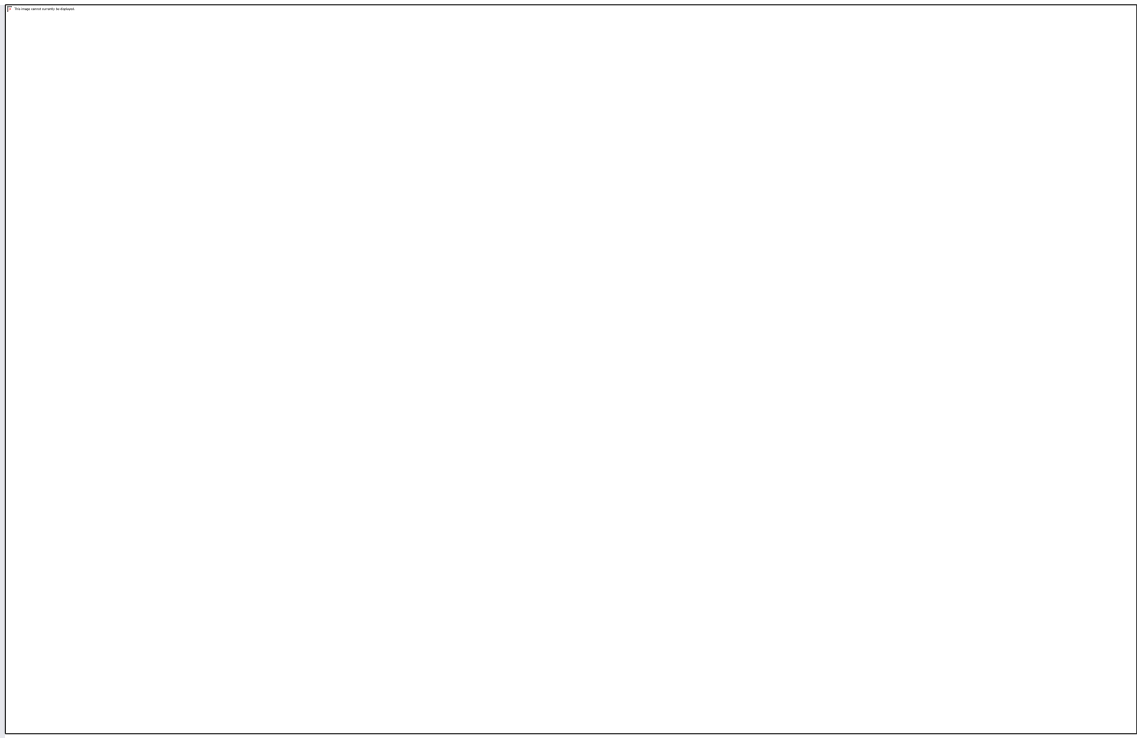


Distributed Renewables for Energy Access

- > **50 million biogas cook stoves** had been installed as of year-end 2016; **126 million people using biogas for cooking** (112 million in China and 10 million in India)
- **China:** 13 million m^3 of biogas production from biogas digester installations for cooking; and **India:** 2 million m^3
- The use of **biogas for cooking continued to grow** in **South-Central and South-Eastern Asian** countries (Bangladesh, Cambodia, Indonesia and Nepal), and also in **SSA** (Ethiopia, Kenya and Tanzania)

Distributed Renewables for Energy Access

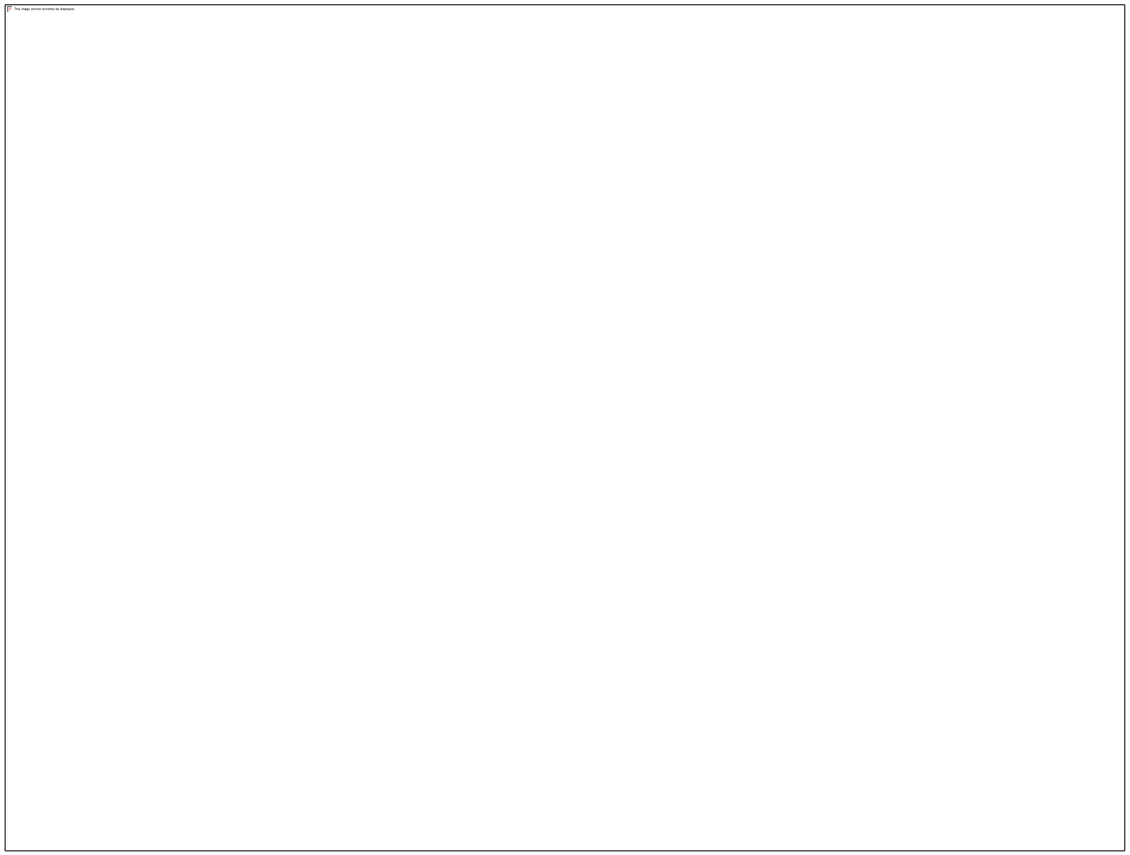
- **DREA systems** attracted some **USD 922 million** in investment between **2012-2017**, with a large portion of this for solar PV
- **In 2017,** off-grid solar companies raised **USD 284 million**, a **decrease of 10%** from the USD 317 million raised in 2016
- **PAYG companies attracted nearly all of the investment**, raising about **USD 263 million** in capital (+19% from 2016)



Global Investment in Renewable Energy

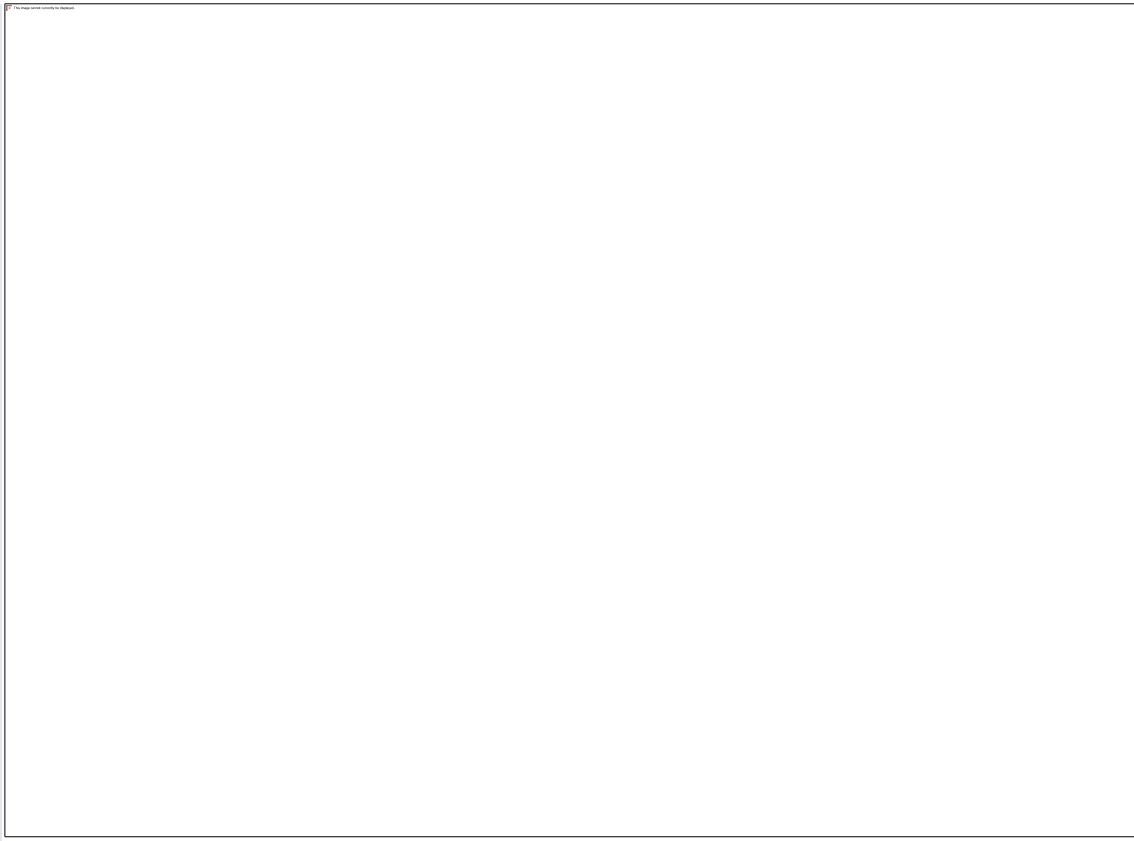
- Global **new investment** in renewable power and fuels in 2017: **USD 279.8 billion (+2.2%)** (USD 319.8 billion incl. large hydropower)

- **Investment in new renewable power** capacity was roughly **three times that in new fossil fuel** capacity



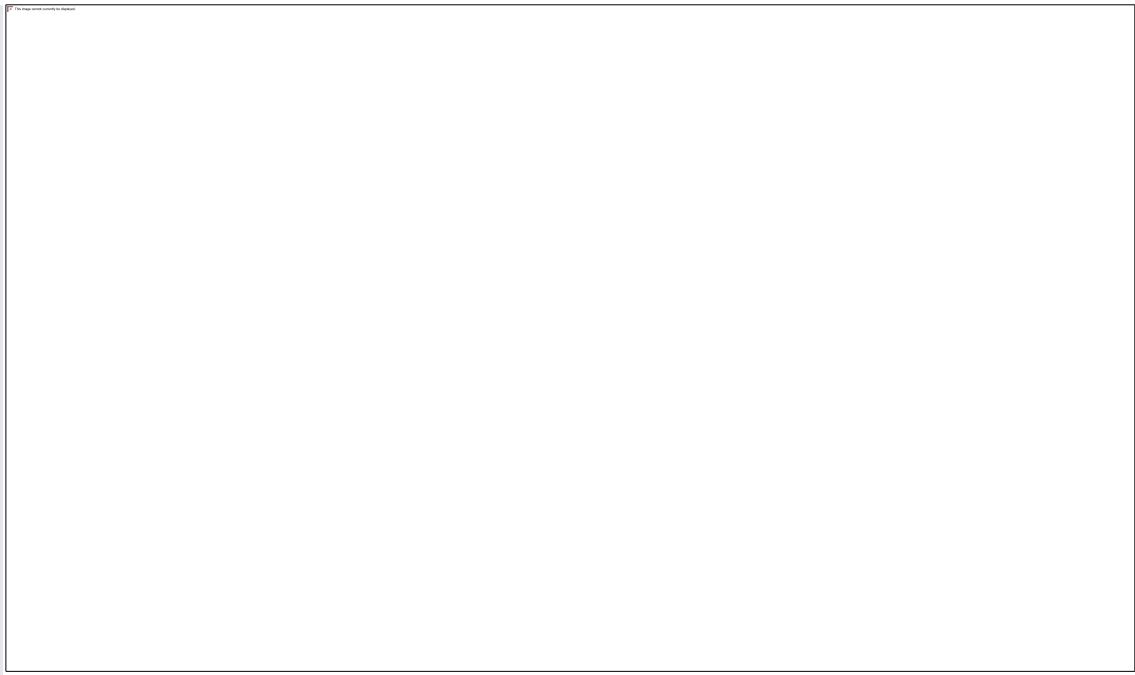
Global Investment in Renewable Energy

- Nearly all of the investment in 2017 was in **solar PV (57%)** and **wind power (38%)**
- **Solar PV** was the only technology to witness an increase in new investment (**+18%** compared to 2016)
- **Investment in all other technologies was down** in 2017 relative to 2016



Energy Systems Integration and Enabling Technologies

- → Markets for **energy storage continued to expand** in 2017
- → **Global stationary and grid-connected energy storage capacity: 159 GW** (est.), with **pumped storage** accounting for the vast **majority**
- → **> 3 GW of pumped storage capacity** was commissioned (approx. **153 GW** by year-end)
- → Pumped storage is followed distantly by **thermal storage** (molten salt storage at CSP plants: 82%), then by **battery (electro-chemical)** and **electro-mechanical storage**

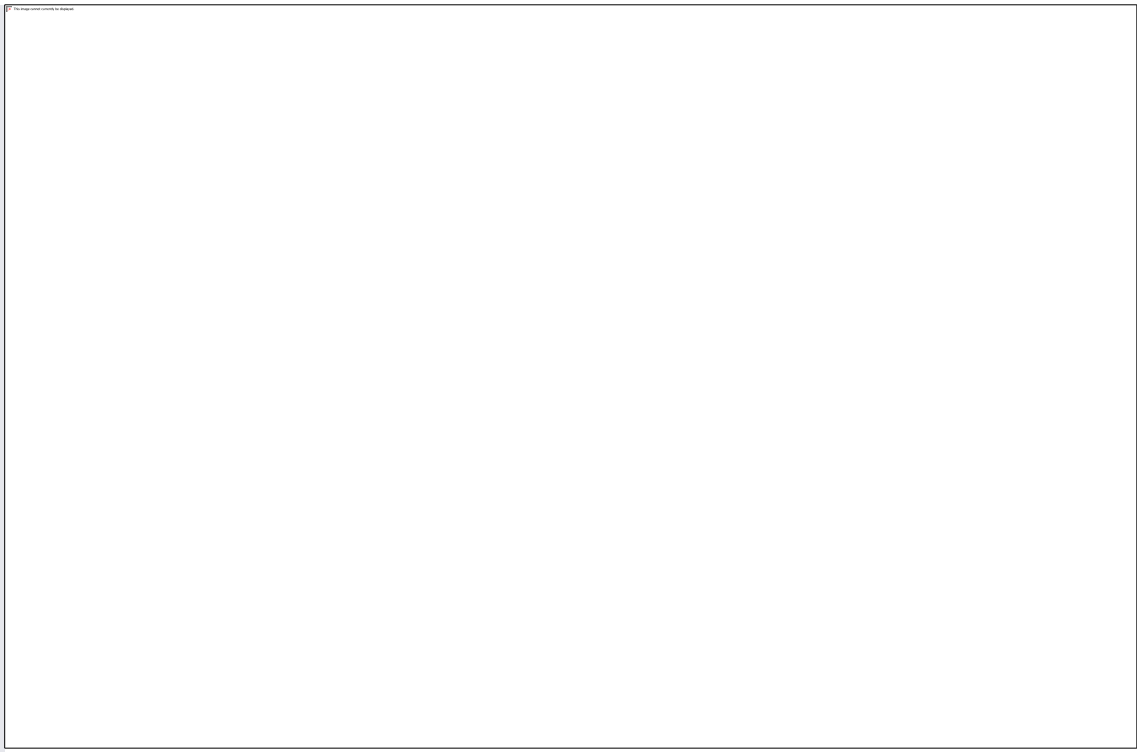


Enabling technologies can help to accommodate higher shares of VRE by contributing to

more flexible and integrated systems.

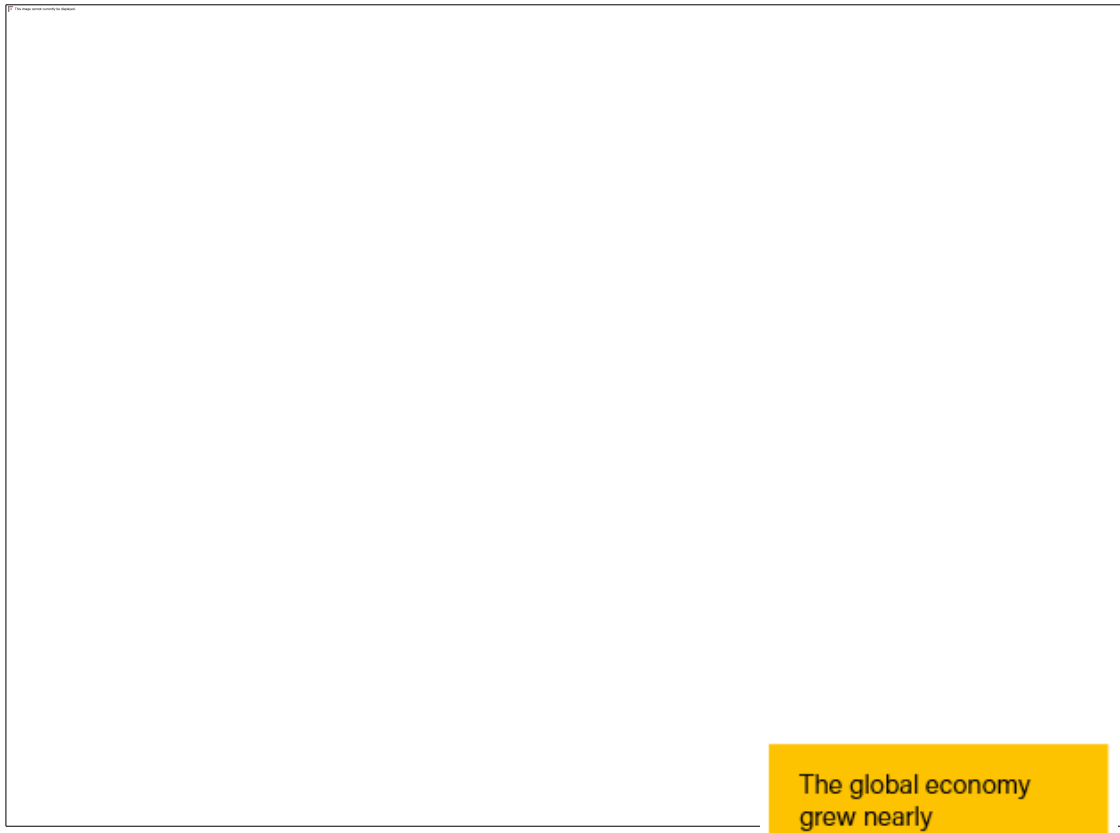
Energy Systems Integration and Enabling Technologies

- **Electrification trend in 2017**
- **Global sales of electric passenger cars** (including PHEVs) reached an estimated **1.2 million units,** up about **58%** over 2016
- **> 3 million electric passenger vehicles on the road** (**+70%** relative to 2016, but still only representing **1%** of light vehicle market)
- **Potential to create a new market for RE and facilitate integration of VRE**



Energy Efficiency

- **Between 2011-2016, primary energy intensity decreased by 10%** (average annual contraction of 2.1%)
- This moderated the **growth in primary energy consumption**, which grew **5.7%** (average annual growth of 1.1%)
- **In 2016, global GDP grew 3% and energy demand only 1.1%**



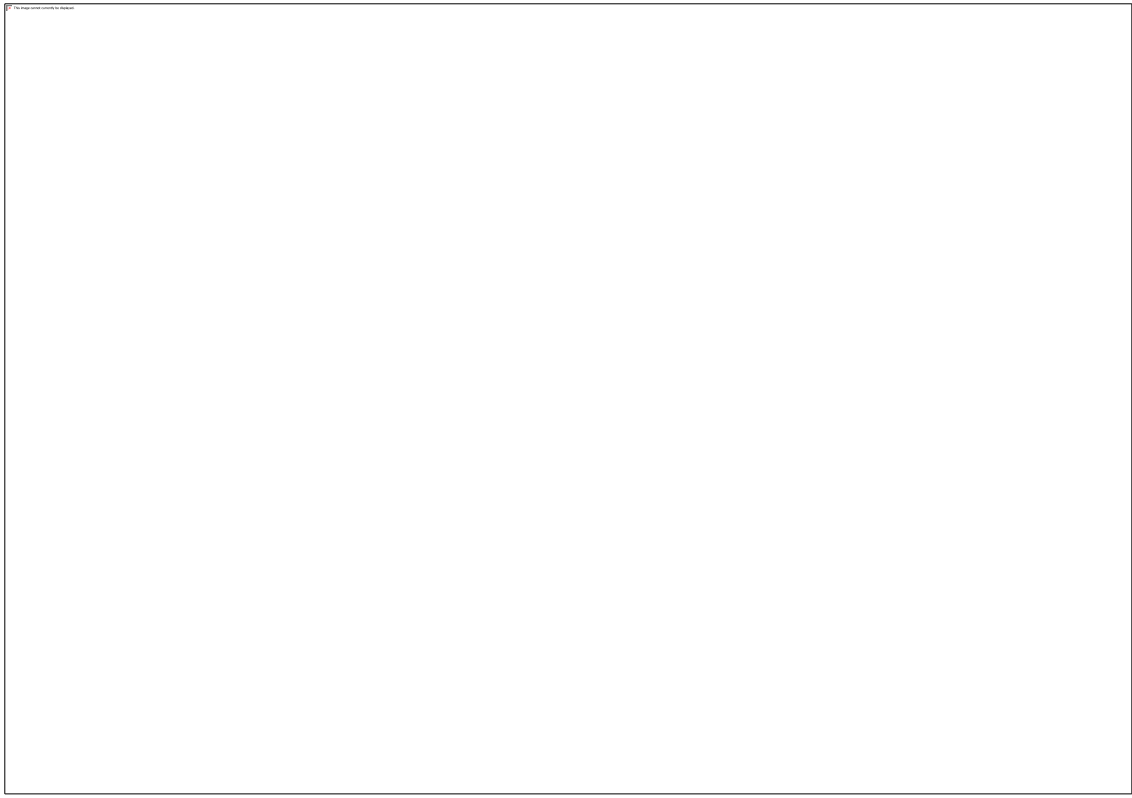
The global economy grew nearly
3 times faster
than global energy demand during 2011-2016, in part because of energy efficiency improvements

Energy Efficiency

- **Annual changes in energy intensities vary widely at the regional level**

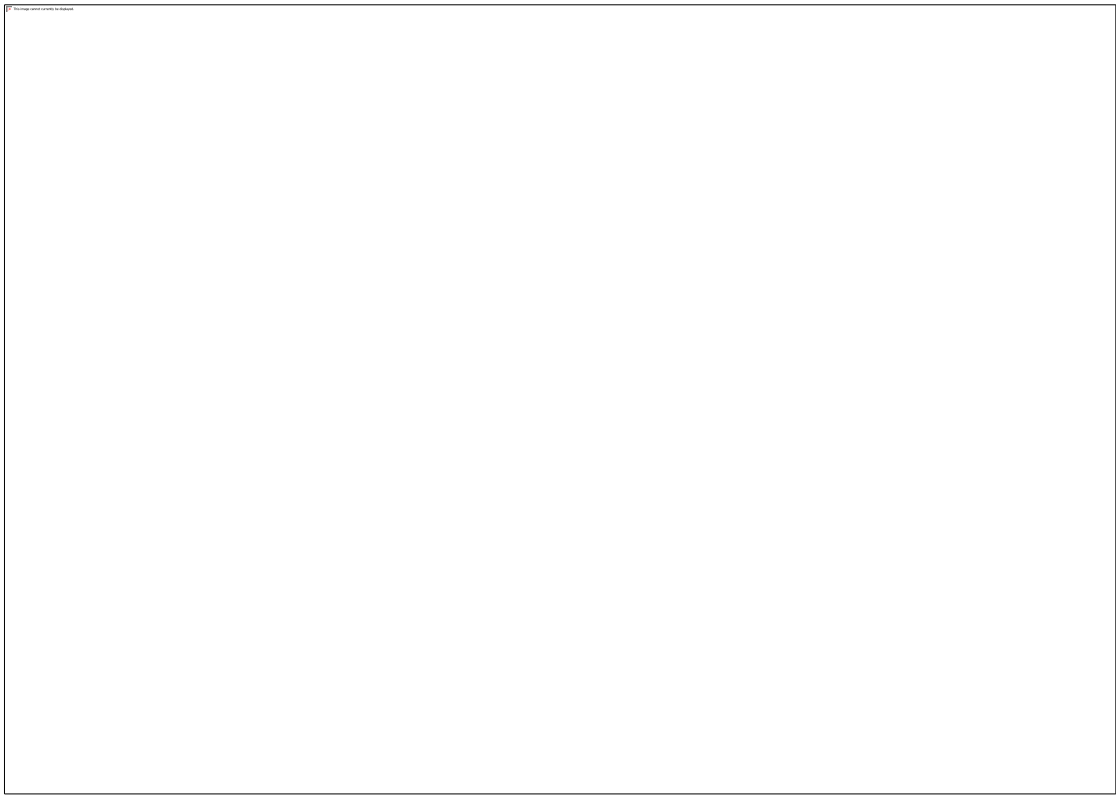
Between 2011-2016:

- **Asia and Oceania had the largest reductions** (average annual declines of **3.3%** and **2.5%**, respectively)
- **Latin America's energy intensity remained flat**
- **The Middle East** was the only region that saw an **overall increase** (3.1% decline in 2016)



Energy Efficiency

- **Energy intensity in industry decreased** by an average annual rate of **2.6%** between 2011-2016
- **Regions with the most marked decreases in energy intensity:**
  - **Asia** (average annual decline of **4%**) and the **Commonwealth of Independent States (3.6%)**
  - Only the **Middle East did not** show notable improvement in energy intensity for the period



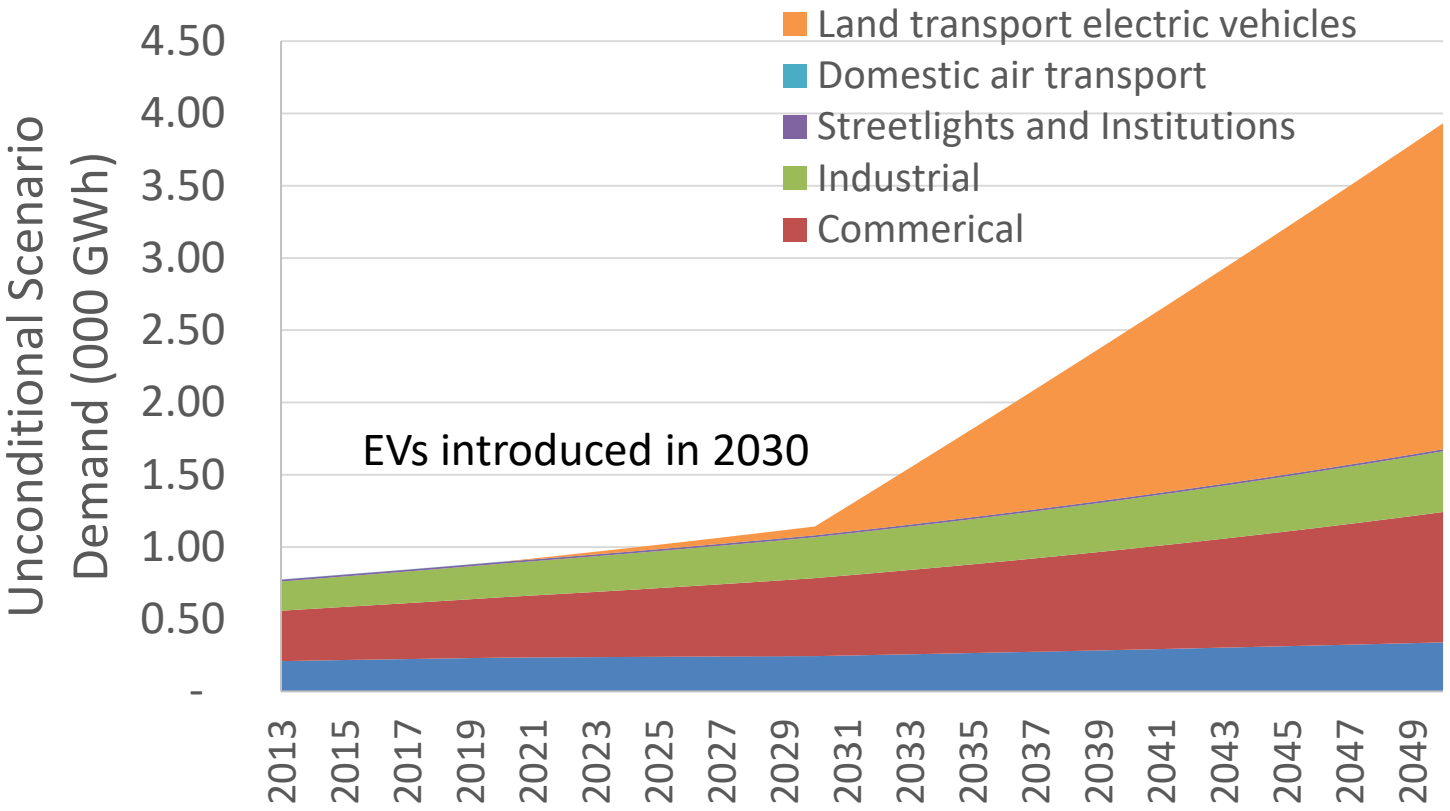
Future is All (Renewable)Electric

Future is All Electric

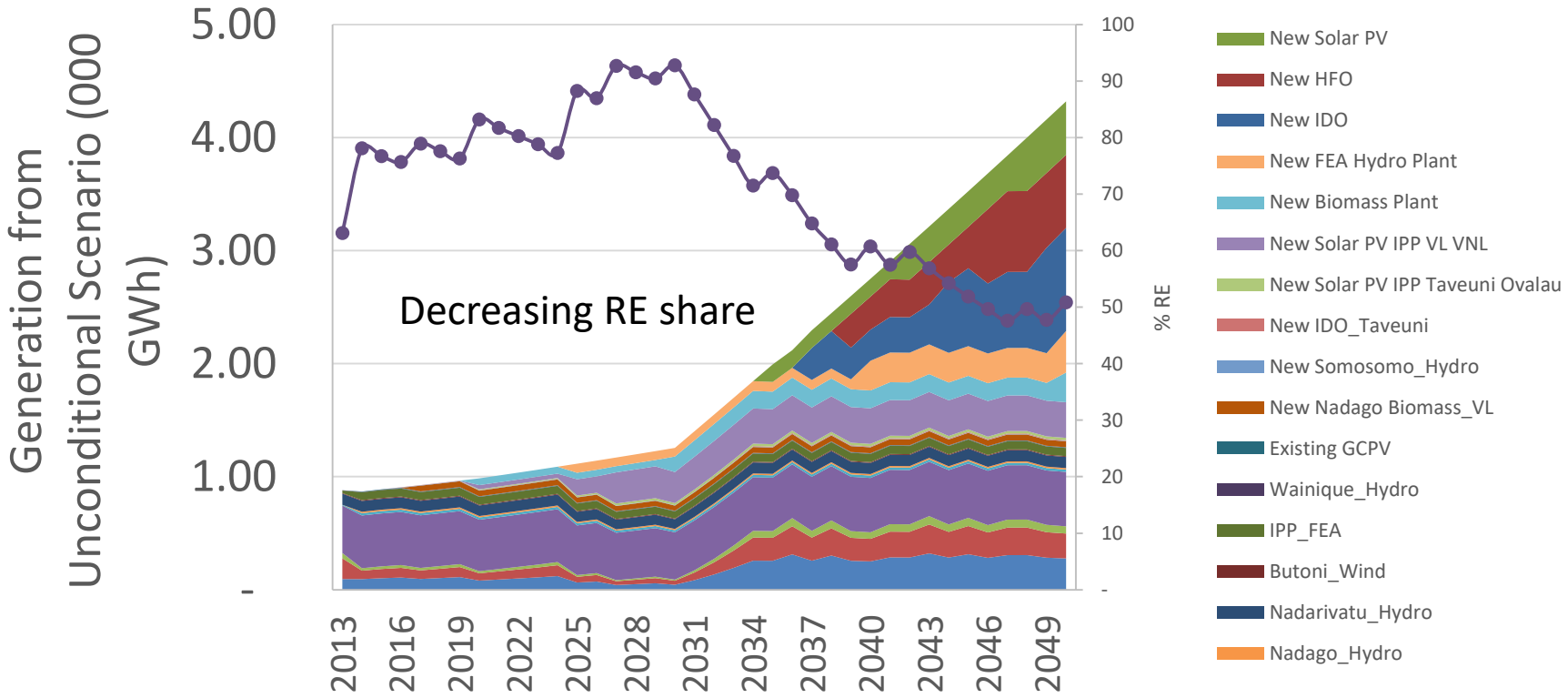
Solar at Gate (ICAO/UNDP/GEF Project)

- Pilot Project in Jamaica
- Replaces jet fuel based Auxiliary Power Units (APU) and/or Diesel Power
  powering on-board systems
  heating/cooling of parked ai
- Reduces aviation related car
- 100 kW_p system
- Offsets 522 tonnes of CO_2 annually.

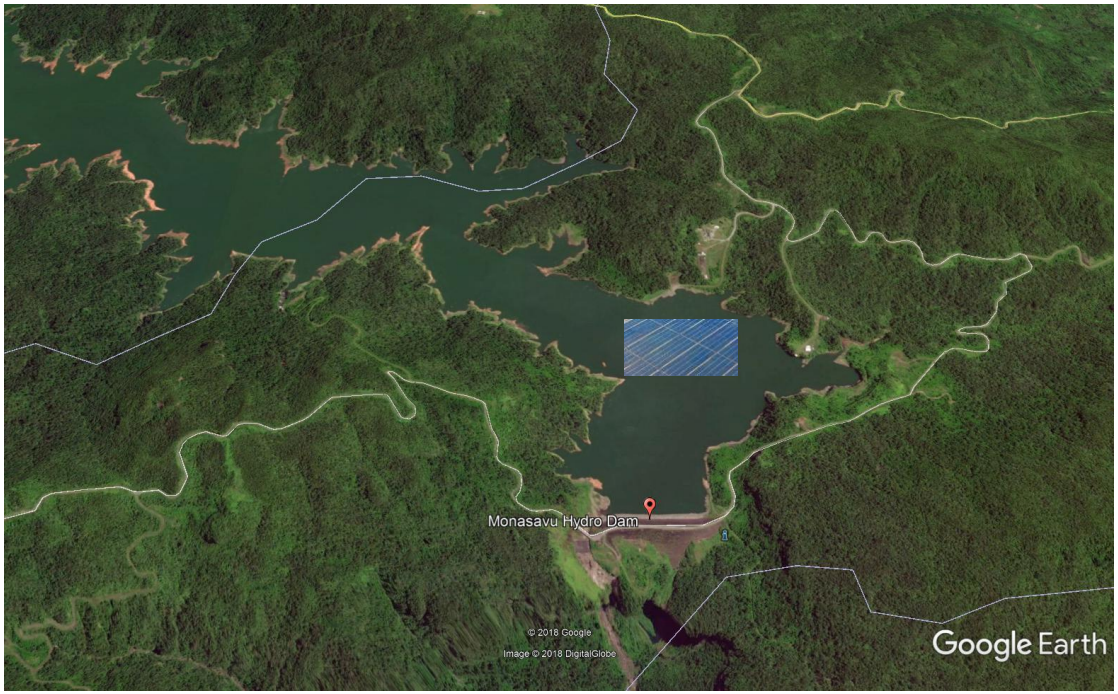
Fiji Demand Scenario



Generation Scenario



Hydropower and Solar PV



- A 7.5 MW floating solar (FPV) farm at Monasavu reservoir covering 0.06 sq km
- Can produce about 10.5 GWh of electricity annually
- Helps in the land issue for PV installations
- Saves water for peak demand and nighttime.
- PV efficiency increases due to cooler temperatures.

Workshop on High Penetration Variable Renewables in the Pacific: Small grids and Off-grid

Where: **Colombo Theatres, UNSW Sydney**
Cost: **Free, but registration required**
Registration: **Please contact Dr Anna Bruce at a.bruce@unsw.edu.au**

Program

Introduction to the Workshop, Iain MacGill, CEEM UNSW
Overview of Status and Challenges for RE in the Pacific, Atul Raturi, USP
Roadmaps for VRE Upscaling - challenges & issues, IT Power Australia
Panel Presentations from regional stakeholders including:

- Pacific Island utilities
- Project developers, consultants
- Donors and financiers

Panel Q&A and Discussion – opportunities, priorities for research and collaboration
Conclusions - key themes and issues emerging from the workshop, future work

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Thank You