

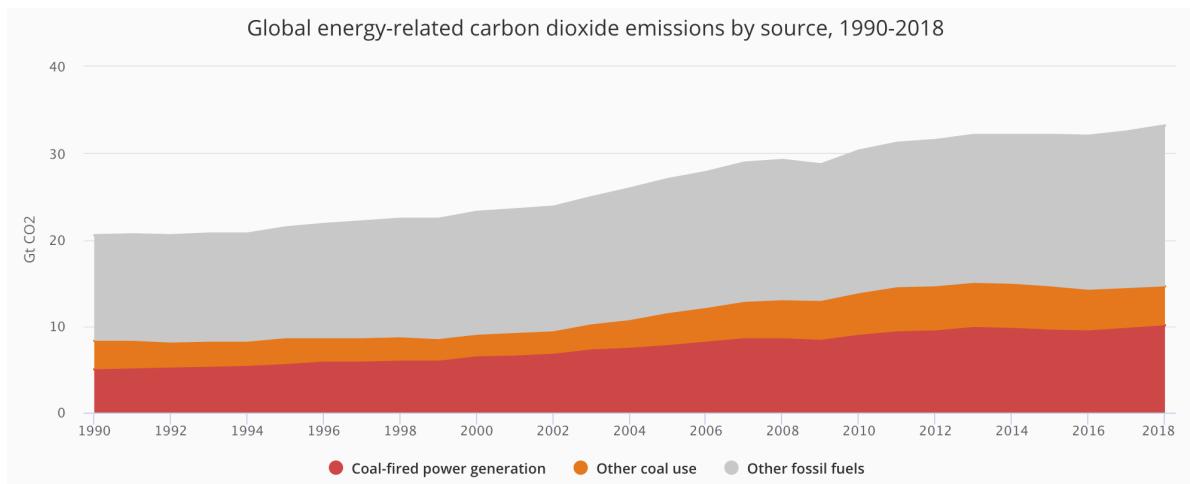
Can the World Solve the Climate Urgency with Renewable Energy?

Dave Renné
President, International Solar Energy Society

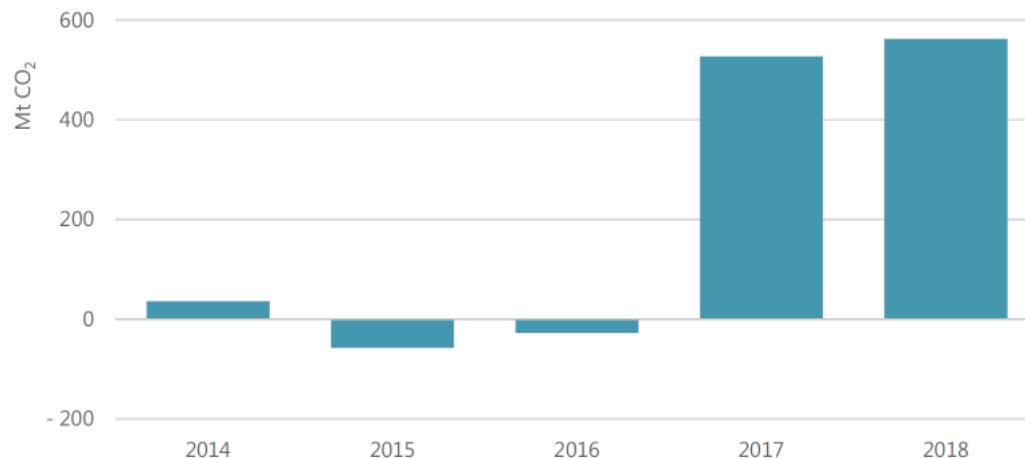
ASES Solar 2019, Minneapolis
Tuesday Plenary
6 June 2019



CO₂ Emission Trends



33.1 Gt by
end of 2018

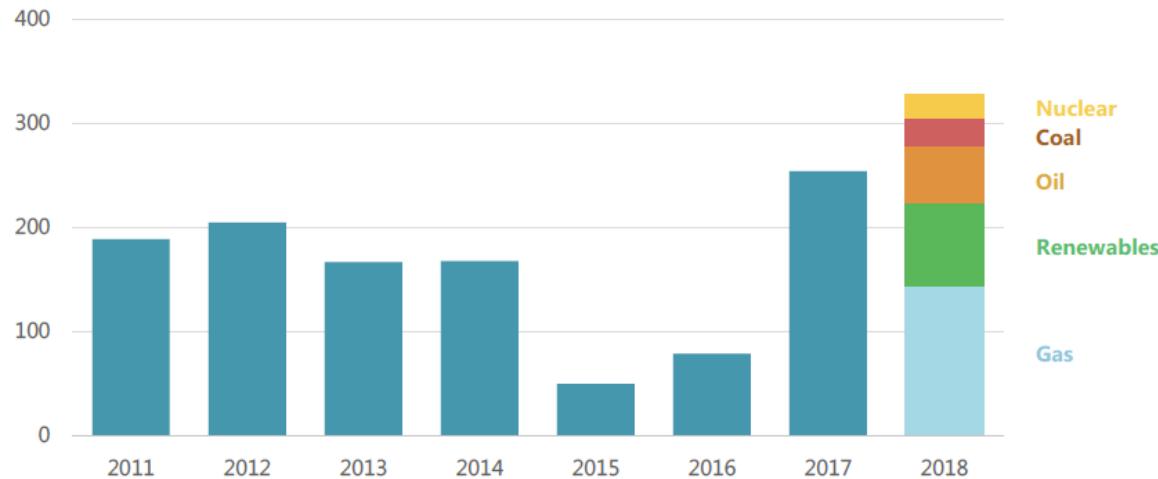


Annual change in
Global CO₂ emissions

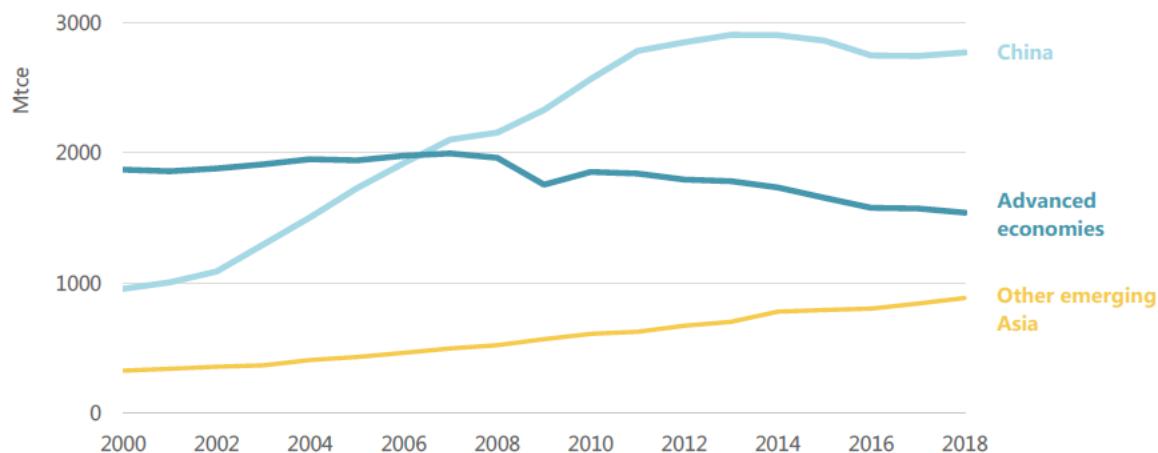
Coal is the single largest
source of global temperature
increase

Source: <https://www.iea.org/k3k0/emissions/>

Global Energy Demand Trends



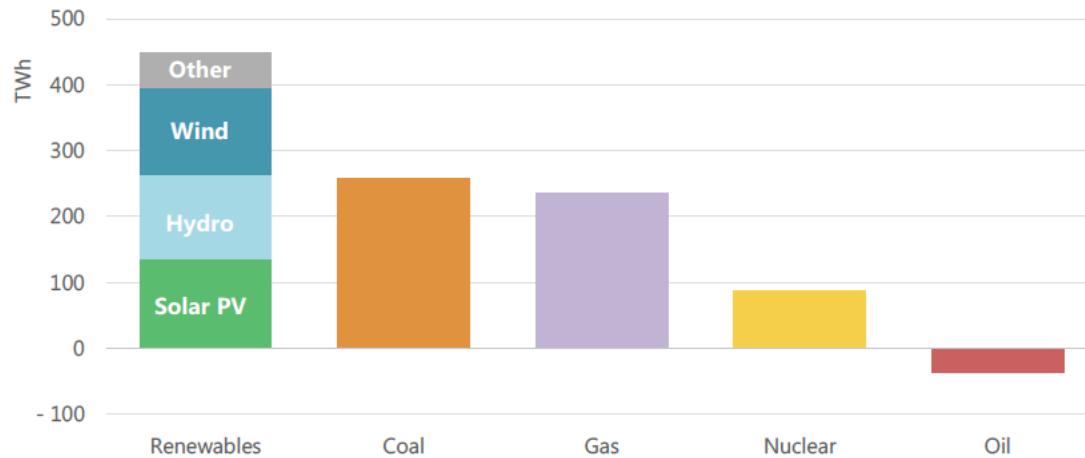
Annual average primary energy demand growth by fuel



Coal demand by selected economies

Source: <https://www.iea.org/k3k0/emissions/>

Global Energy Supply Trends



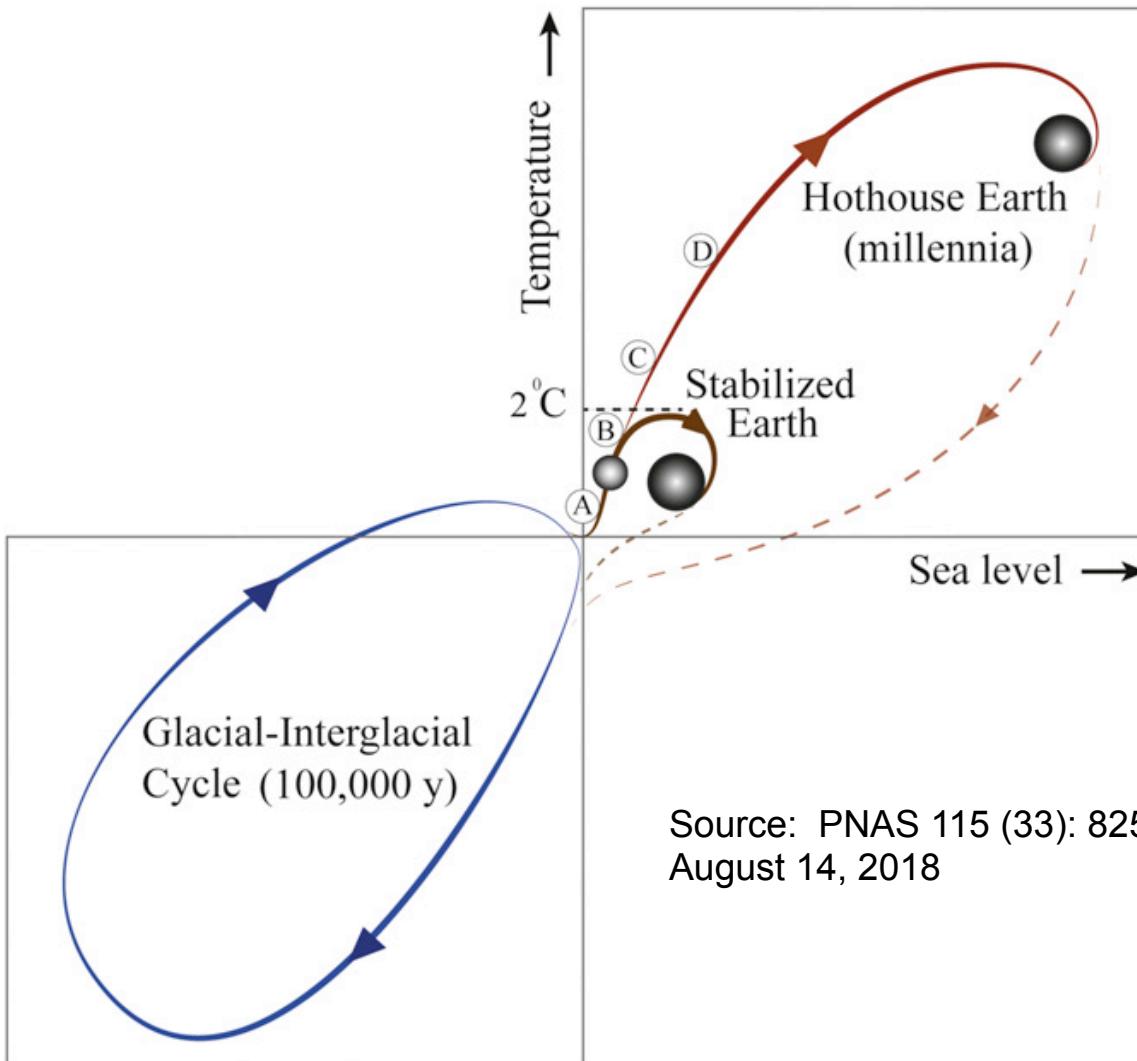
Change in electricity generation by source, 2017-2018



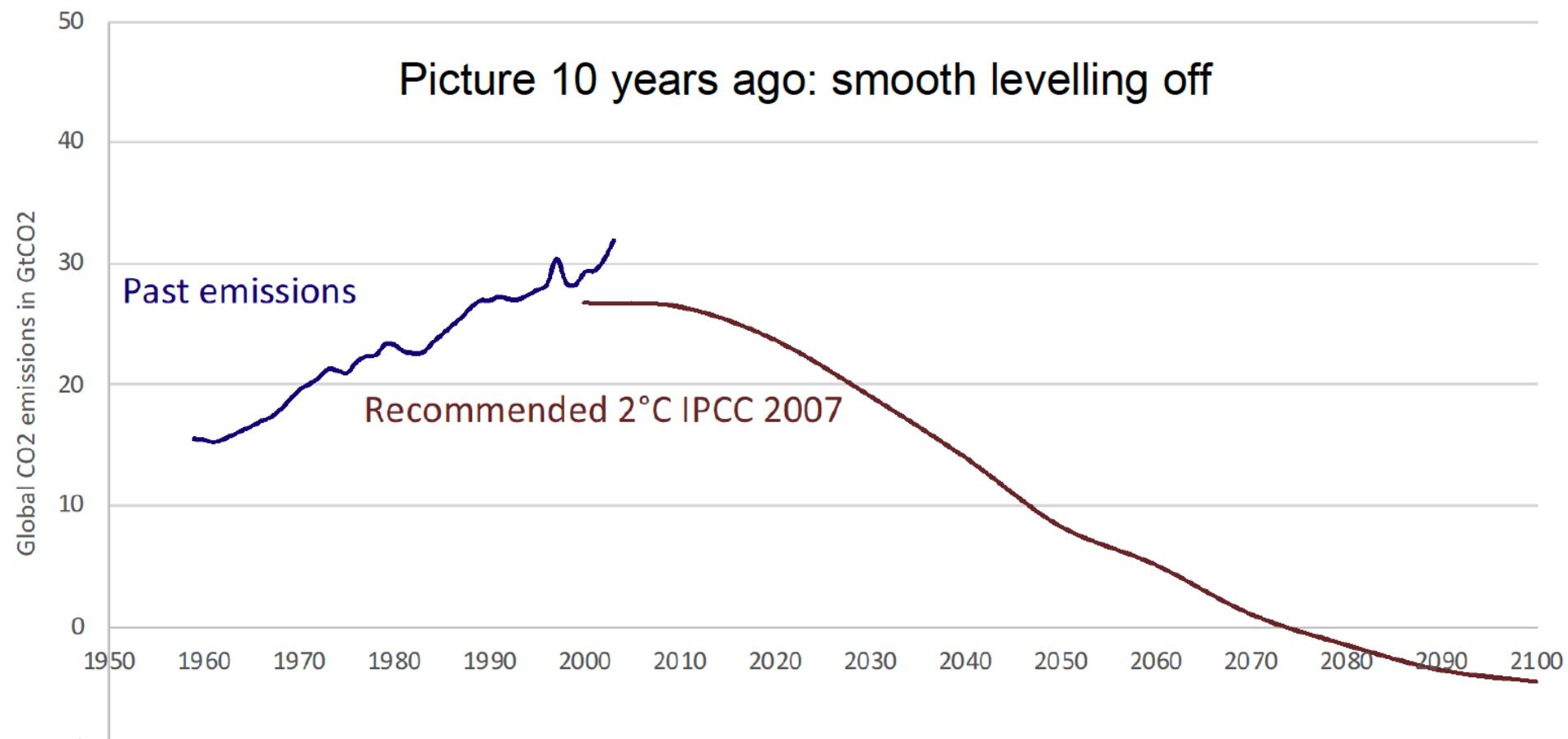
Avg. change in primary energy intensity (energy input/GDP)

Source: <https://www.iea.org/k3k0/emissions/>

The Danger of the “Hothouse Earth” Pathway

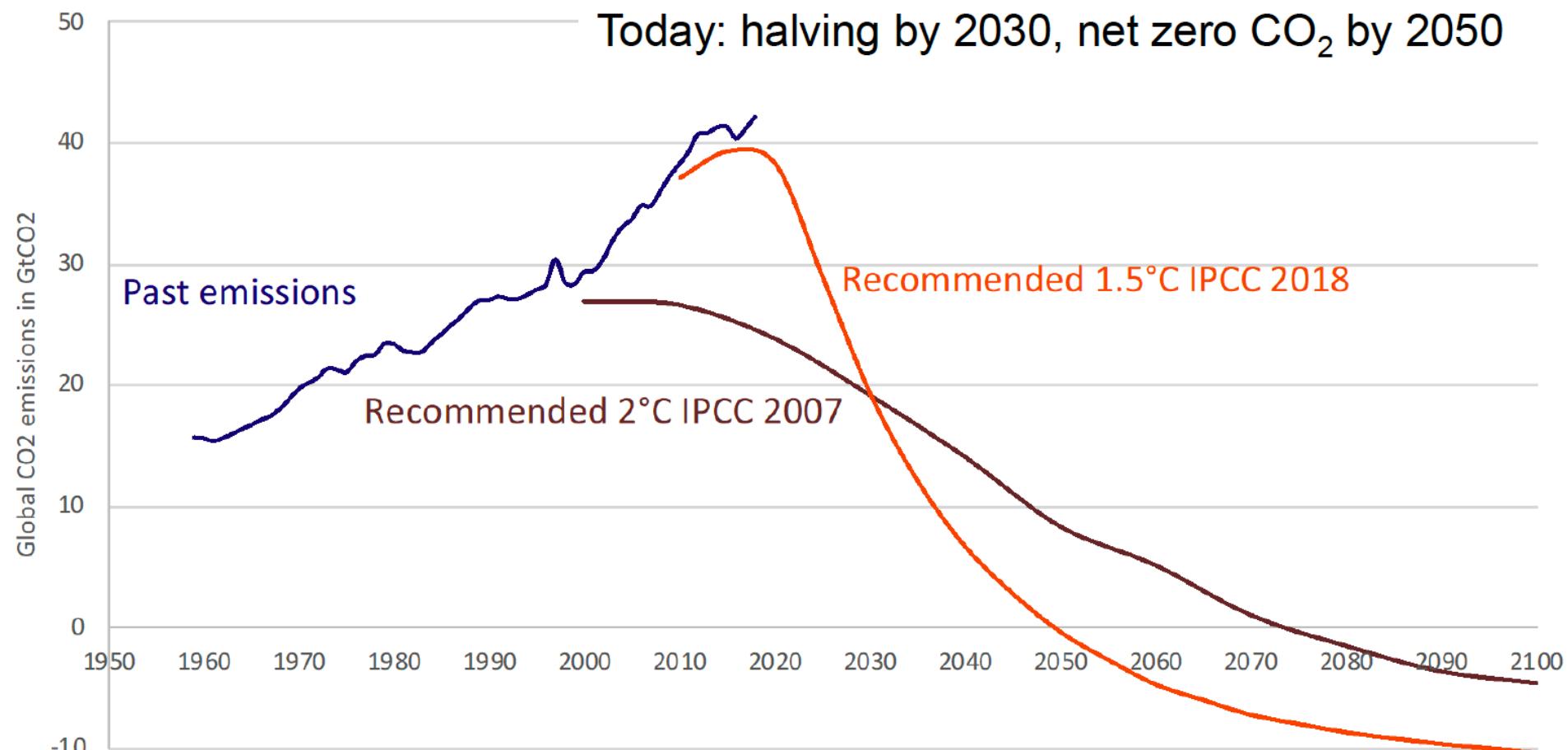


Urgency for Action



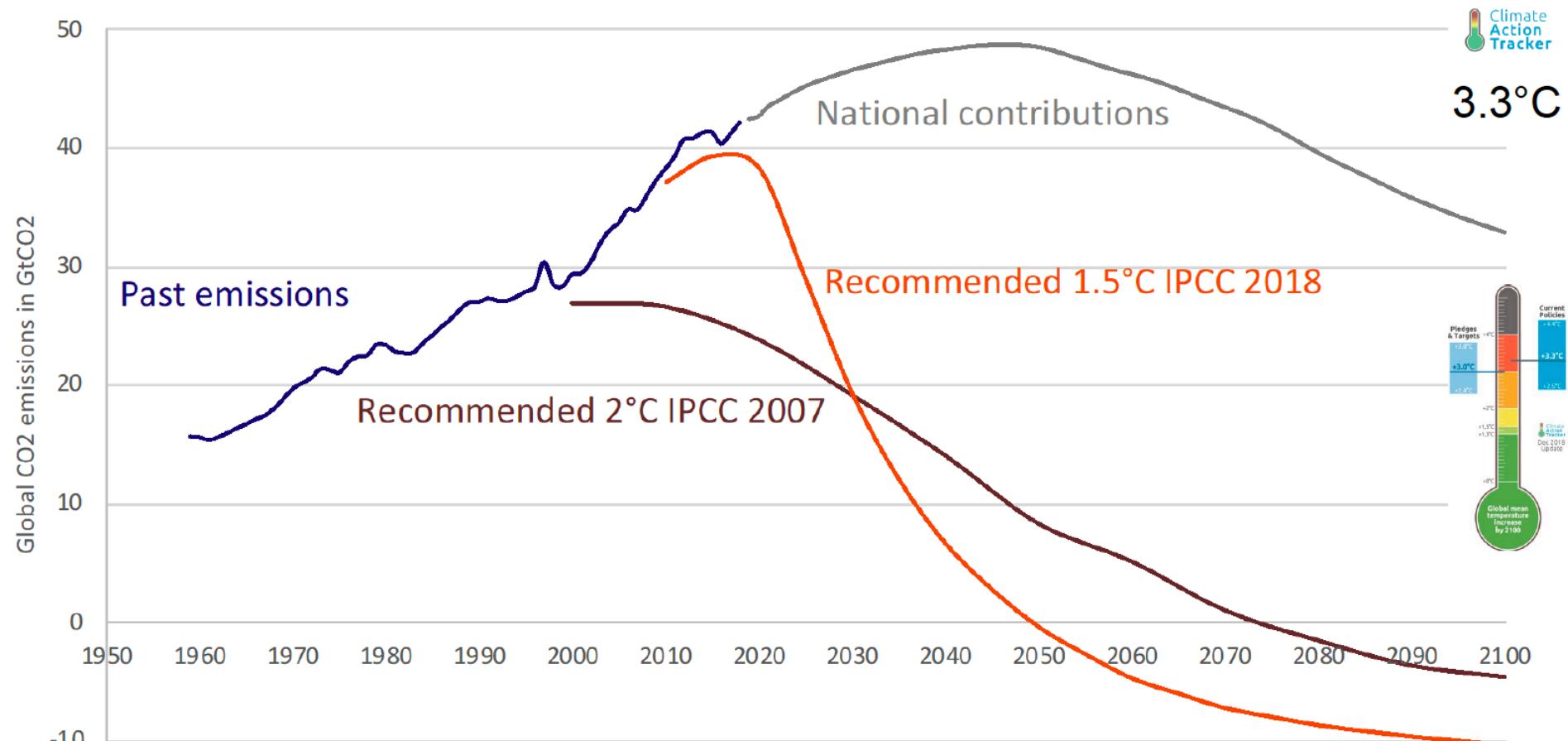
Source: New Climate Institute

Urgency for Action



Source: New Climate Institute

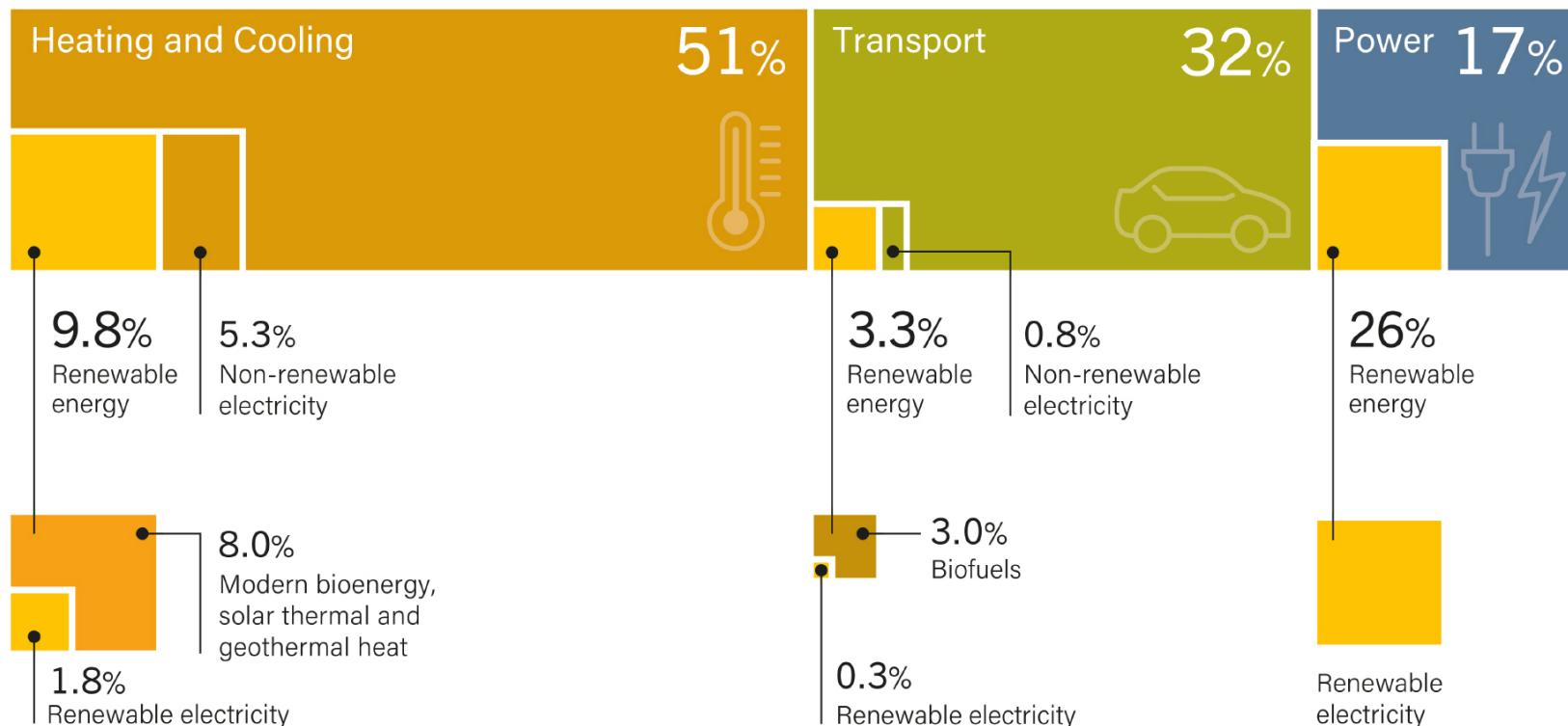
Urgency for Action



Source: New Climate Institute

Final Energy Consumption, 2016

Renewable Energy in Total Final Energy Consumption, by Sector, 2016



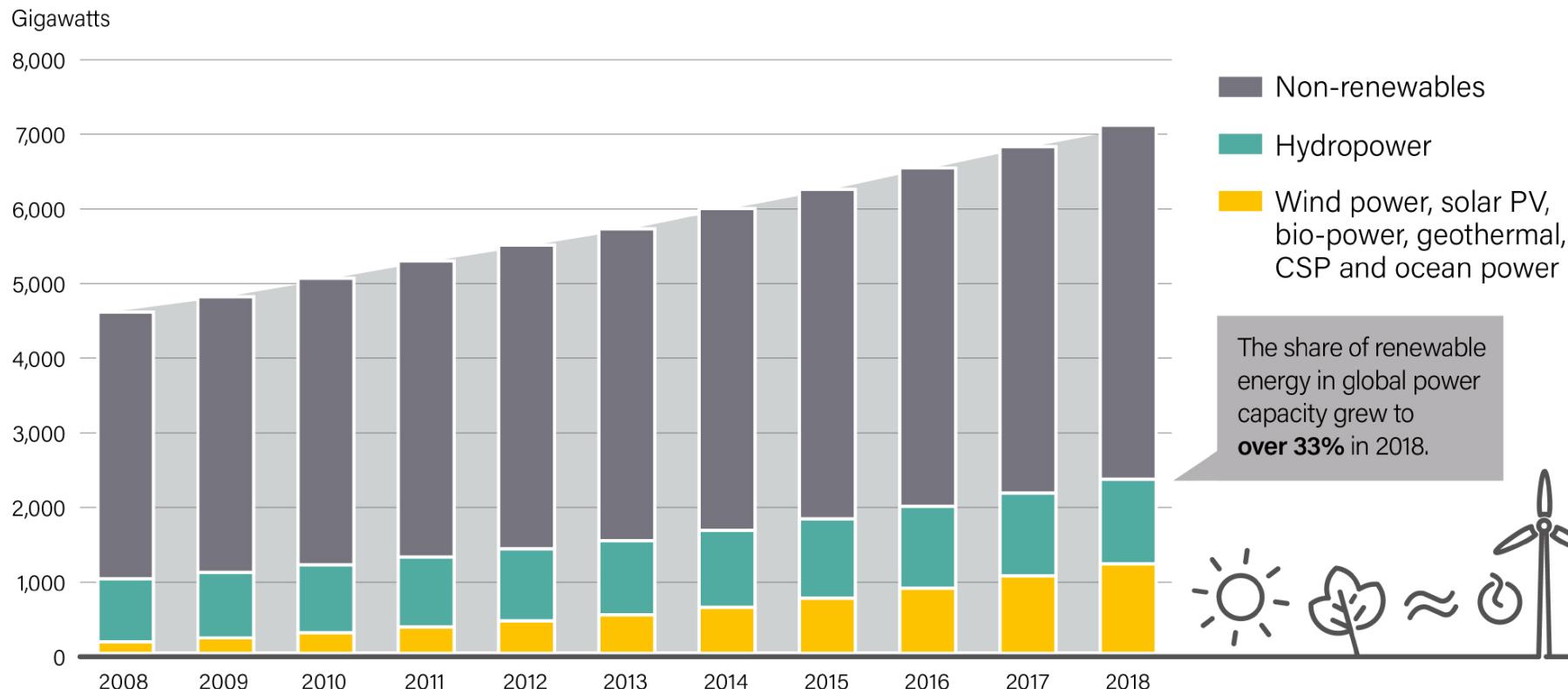
Note: Data should not be compared with previous years because of revisions due to improved or adjusted methodology.

Source: OECD/IEA.

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Global Renewable Power Capacity

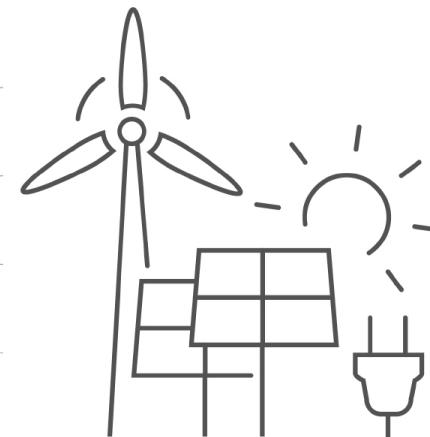
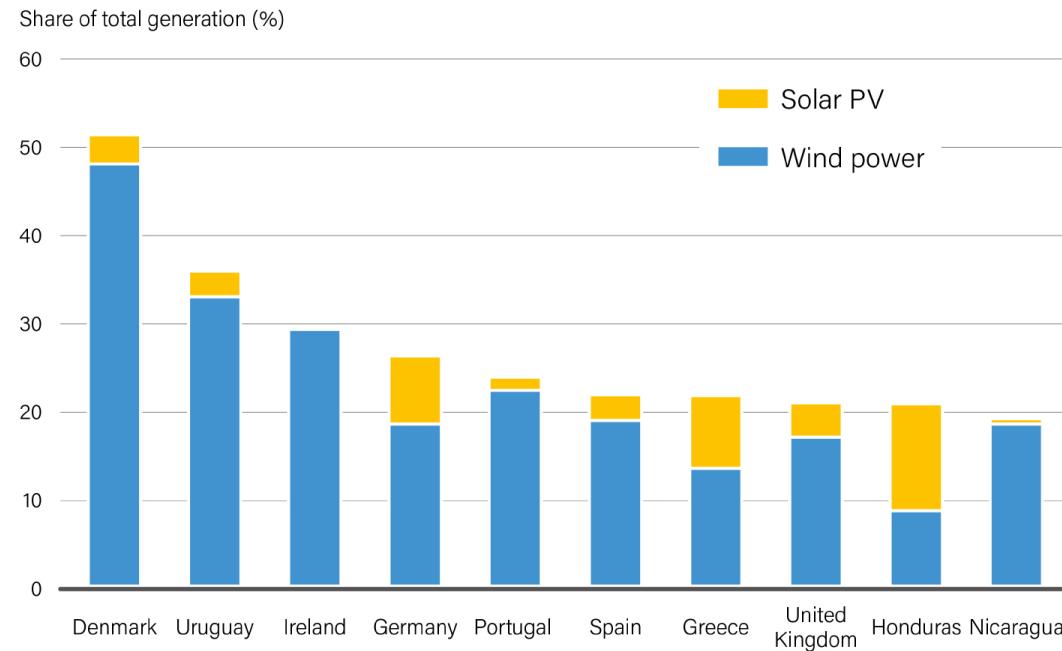
Global Power Generating Capacity, by Source, 2008-2018



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Share of Variable RE Generation

Share of Electricity Generation from Variable Renewable Energy, Top 10 Countries, 2018



Note: This figure includes the top 10 countries according to the best available data known to REN21 at the time of publication.

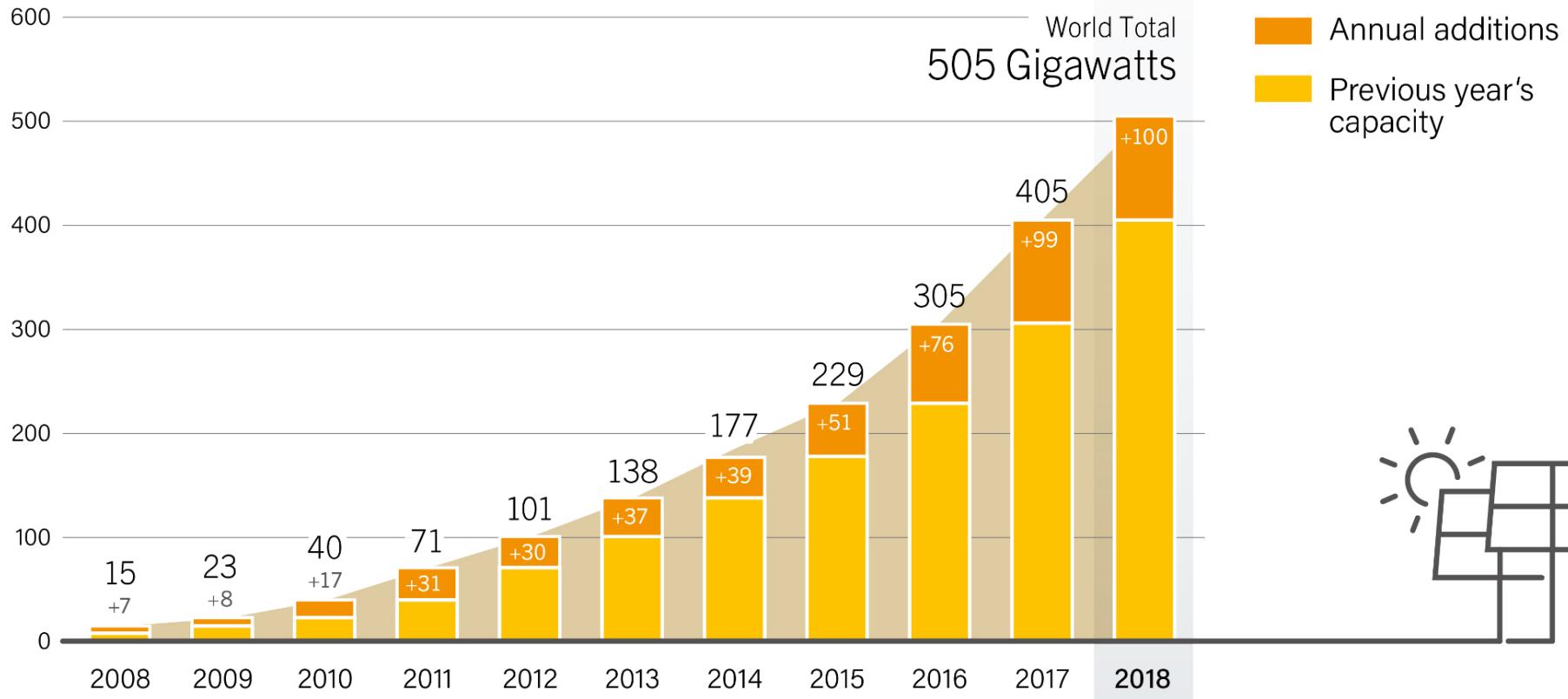
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Note that BNEF announced a 1 TW milestone on 30 June 2018

Global PV Capacity = 505 GW at end of 2018

Solar PV Global Capacity and Annual Additions, 2008-2018

Gigawatts



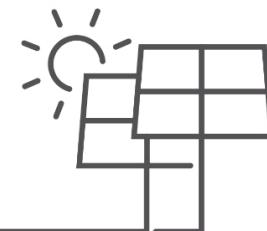
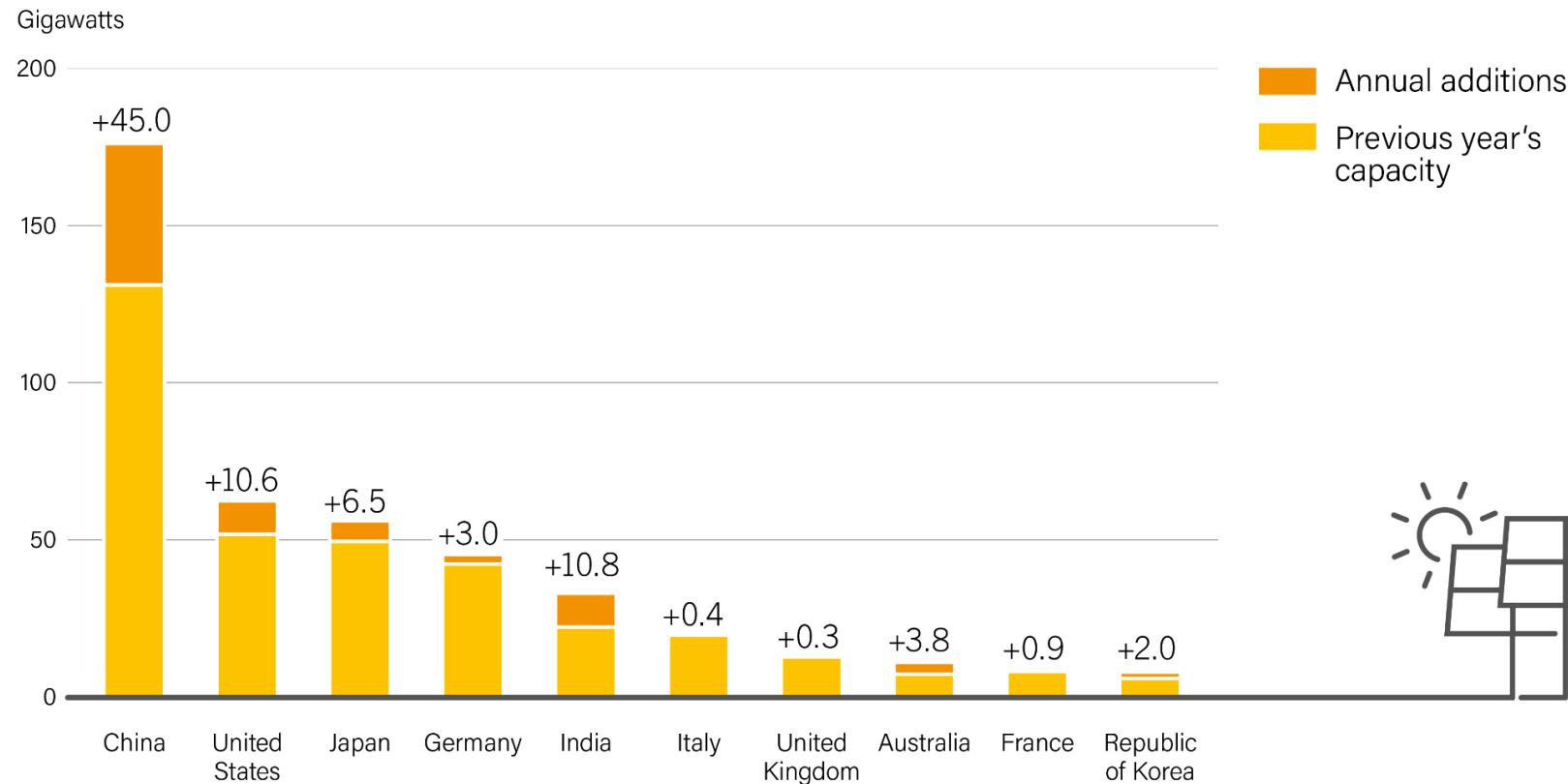
Note: Data are provided in direct current (DC).

Totals may not add up due to rounding.

Source: Becquerel Institute and IEA PVPS.

Global PV Capacity Additions: Top 10 Countries

Solar PV Capacity and Additions, Top 10 Countries, 2018



Note: Data are provided in direct current (DC).

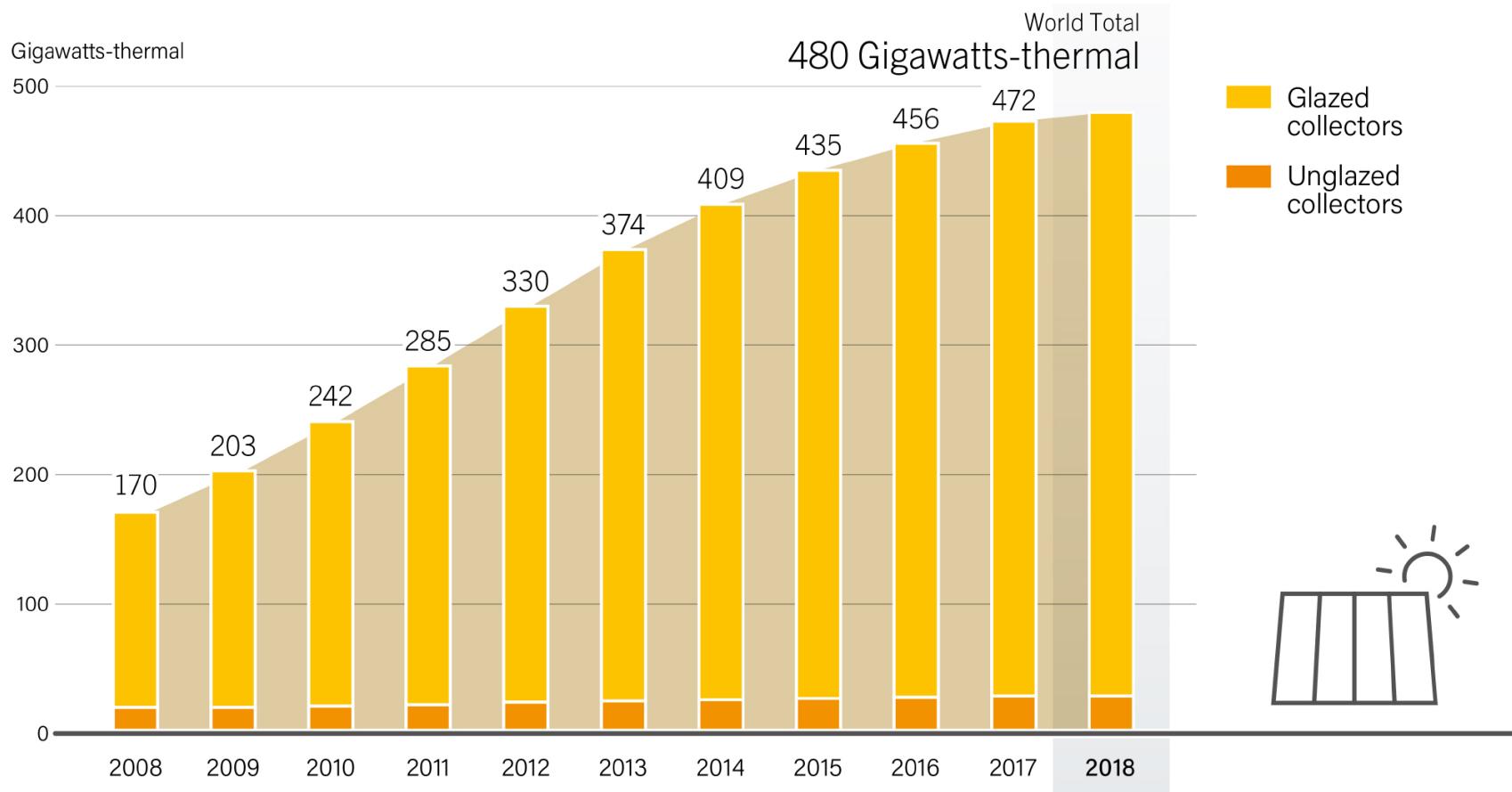
Data for India are highly uncertain.

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Global Solar Thermal Heating and Cooling

Capacity = 480 GW_{th} at end of 2018

Solar Water Heating Collectors Global Capacity, 2008-2018

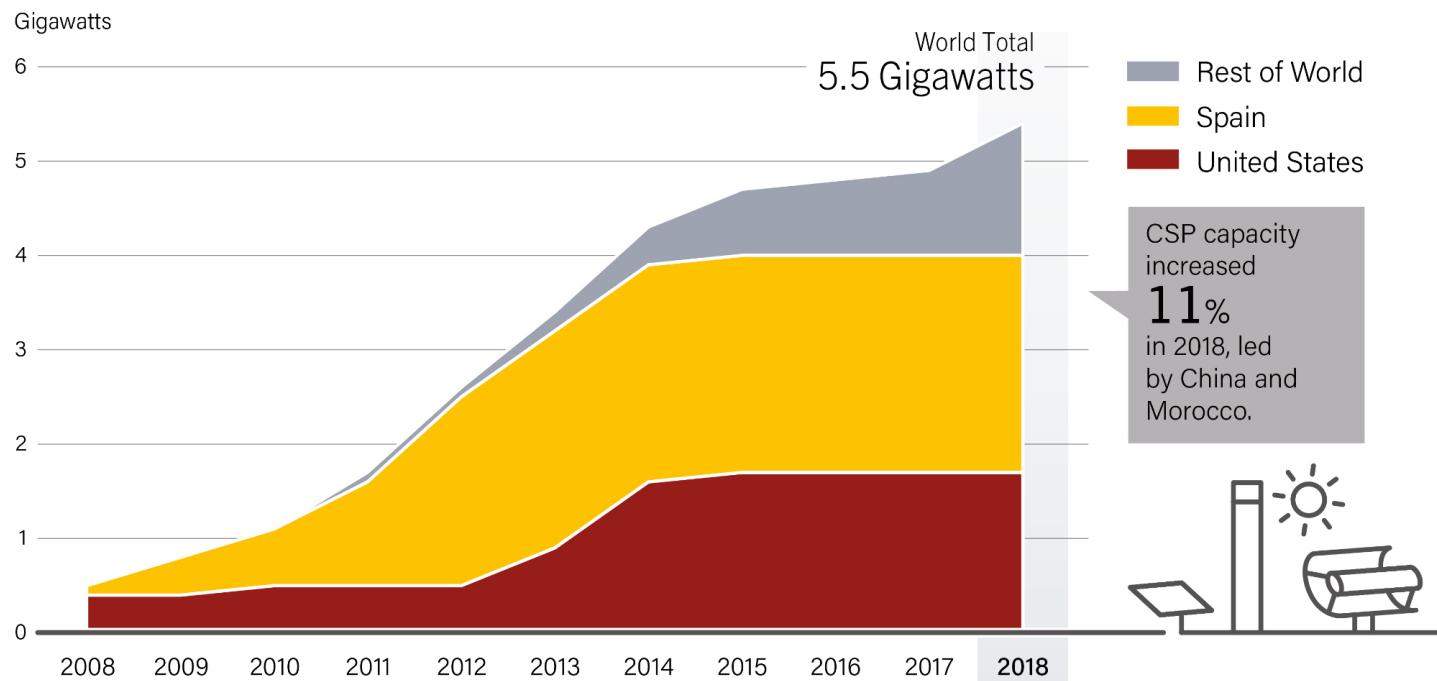


Note: Data are for glazed and unglazed solar water collectors
and do not include concentrating and air collectors.

Source: IEA SHC.

Global Concentrating Solar Power Capacity = 5.5 GW at end of 2018

Concentrating Solar Thermal Power Global Capacity, by Country and Region, 2008-2018

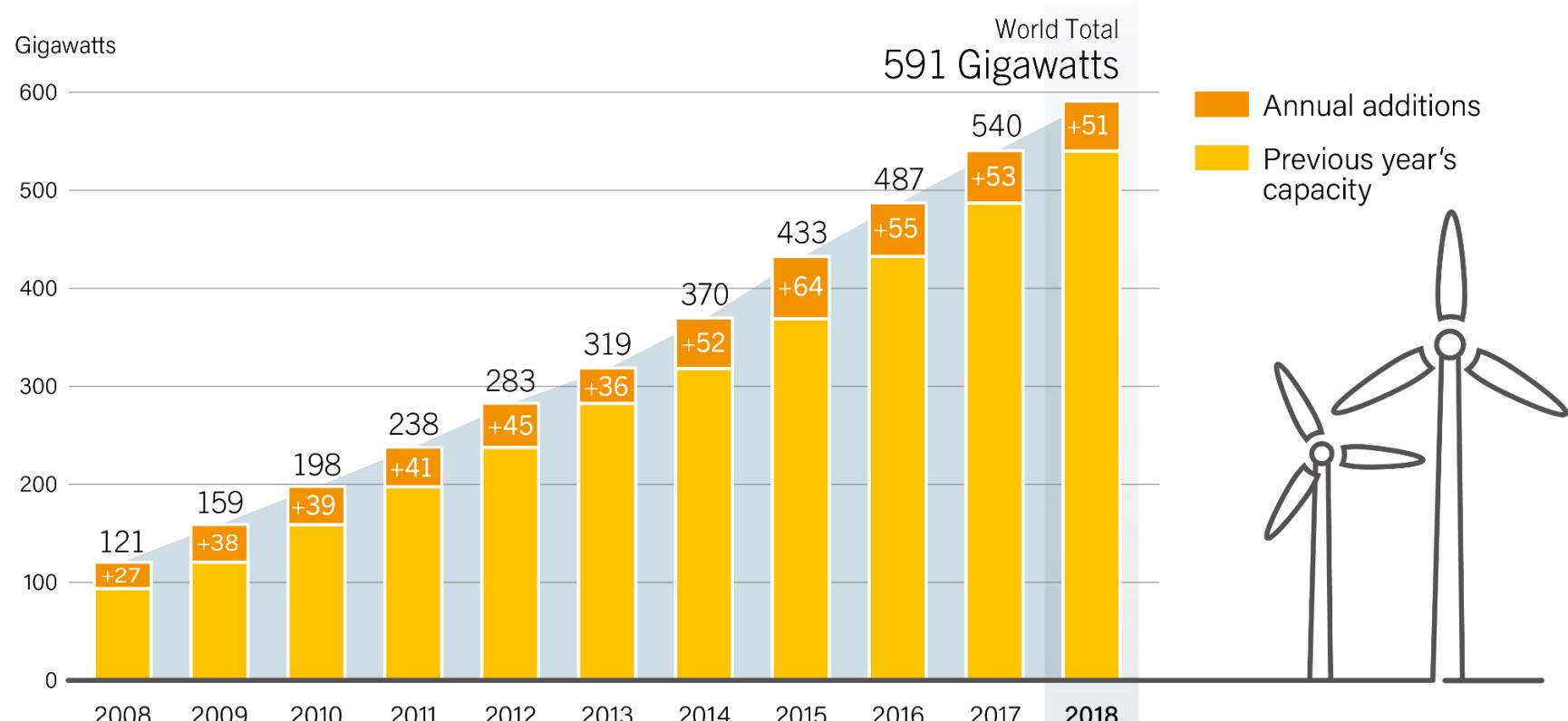


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Global thermal energy storage capacity = 16.6 GW-hr at end of 2018

Global Wind Capacity = 591 GW at end of 2018

Wind Power Global Capacity and Annual Additions, 2008-2018

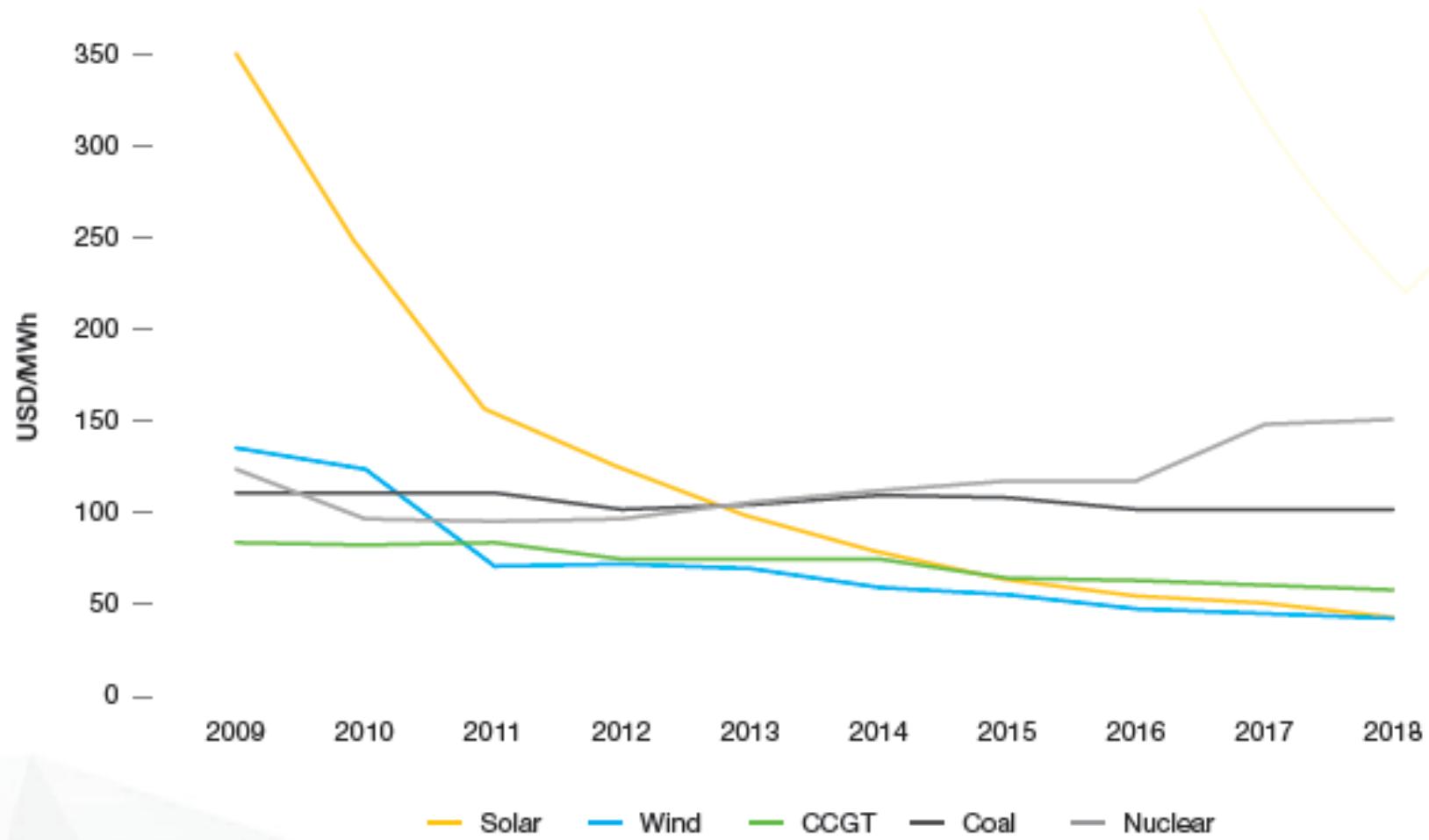


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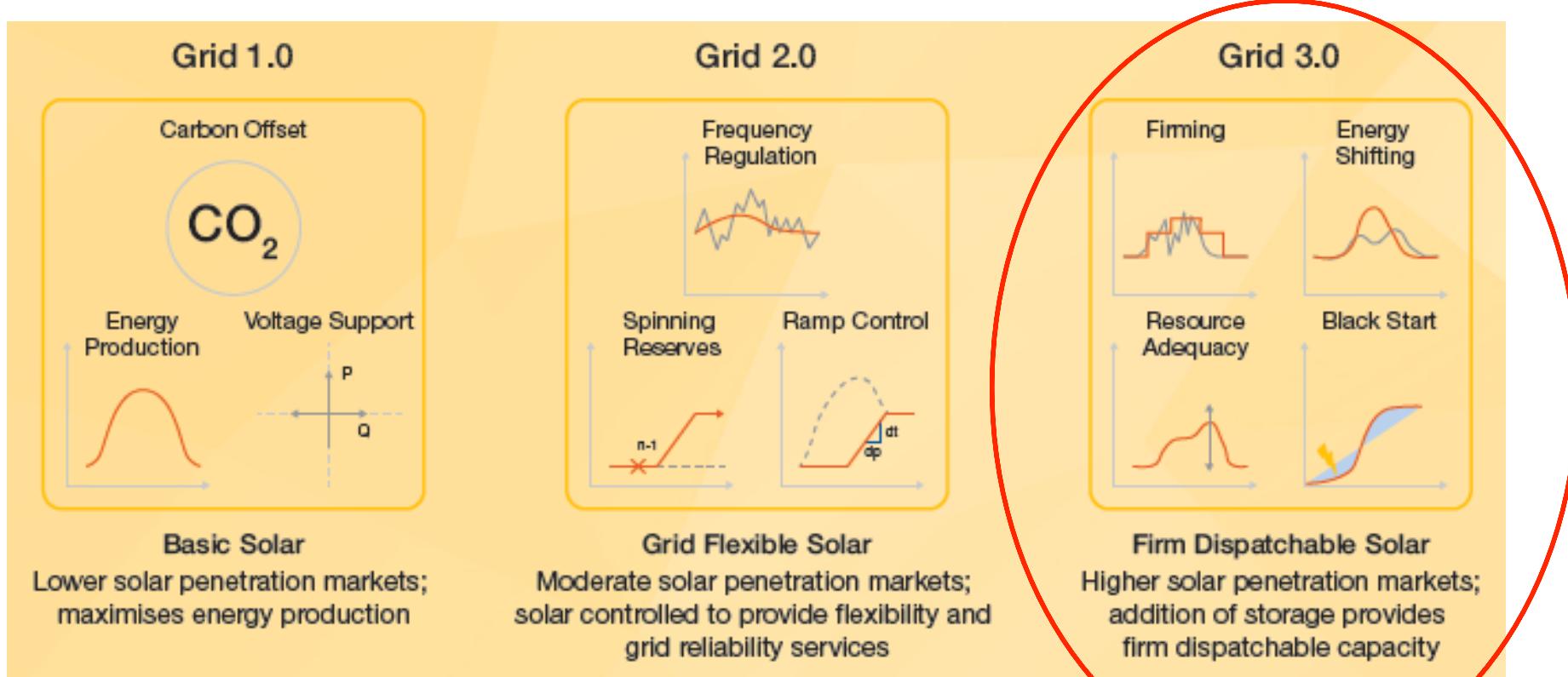
Source: GWEC.

...and RE Generation Costs Continue to Drop



Source: SPE GMO 2019

Evolution of the Grid in the Energy Transformation



Source: SPE GMO 2019

Transforming VRE to firm generators is necessary for very high penetrations

Storage will Play a Key Role in the Power System of the Future

- Total global installed capacity, 2018: 9 GW/17 GW-hr
- Projected to grow to 1,095 GW/2,850 GW-hr by 2040
- Will require \$662B investment over next two decades
- Lithium-ion battery costs to drop by half by 2030
- Majority of new capacity will be utility-scale, rather than behind-the-meter and businesses
- 10 countries (especially U.S. and China) will represent $\frac{3}{4}$ of global market in terms of GW

Source: BloombergNEF “Energy Storage Outlook 2019”

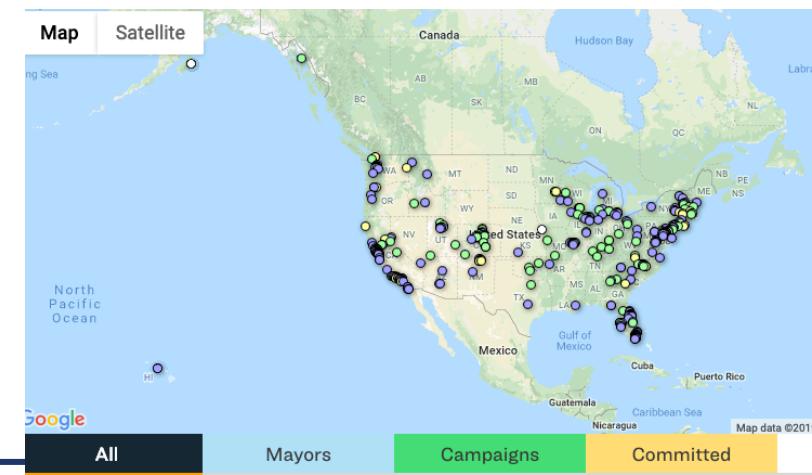


NEC ES 18 MW 7.5 MW-hr Grid-Scale Storage Plant near Zurich, Switzerland (source: PV-Magazine)

What About those 100% Clean and Renewable Energy Targets?

- Denmark has a national 100% RE Target (See: “*Towards 100% Renewable Energy*” by the IRENA Coalition for Action, 2019)
- Several states (e.g. Hawaii, California, New Mexico) have 100% Clean Energy Targets (Source: *Environment America*)
- >166 Companies have committed to 100% Renewable Power (Source: <http://there100.org/companies>)
- Sierra Club’s Ready for 100 has signed up over 100 Cities with a 2050 target for 100% clean RE (Source: <https://www.sierraclub.org/ready-for-100>)

Sierra Club’s Ready for 100 Committed Cities



Hawaii – 100% Renewable Electricity by 2045

- First state in U.S. to legislate a 100% target (2015)
- Managed under Hawaii Clean Energy Initiative (HCEI)
- Strong stakeholder engagement: Hawaii Utilities, state and local governments, civil society, USDOE/NREL
- Technologies include wind, solar, hydro, geothermal, ocean energy, biofuels, and H₂ produced from RE
- Modernization of electricity grid is underway
- HCEI also provides roadmaps for other end-use sectors (e.g. EV's)

Key Take-Away Messages

Renewables making real progress, but urgency of climate change means the transformation has to be accelerated

- The energy transformation is driving, and being driven by, massive renewable energy deployments; much due to local, regional, and private-sector initiatives, and stakeholder engagement
- Renewable electricity alone will not solve the problem; must decarbonize all end use energy
- There must be more political will, especially at national and international levels
- All new major carbon-based investments need to be phased out; otherwise we are locked in to significant GHG emissions for years to come
- Continued R&D and project success stories will unleash much more private finance by lowering risk and improving investor confidence

Thank You!

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