Policies in the Age of Climate Change:

An Opportunity for Sustainable Energy Technologies

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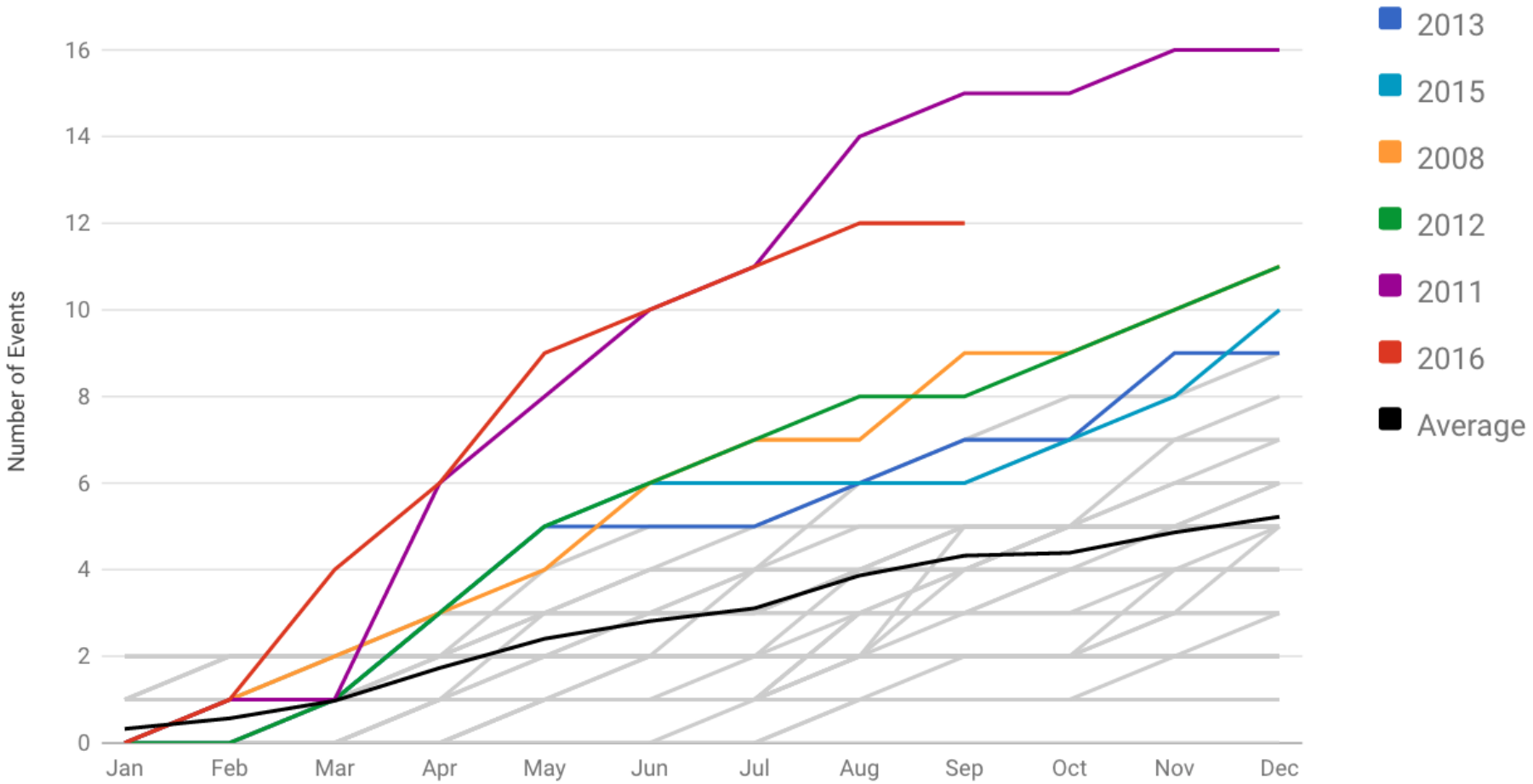
Introduction

Climate change can increase the risk of disasters, necessitating the integration of climate and clean energy policy into post-disaster construction to mitigate the risk of future disasters and to provide a more resilient, sustainable, and cost-saving energy system.

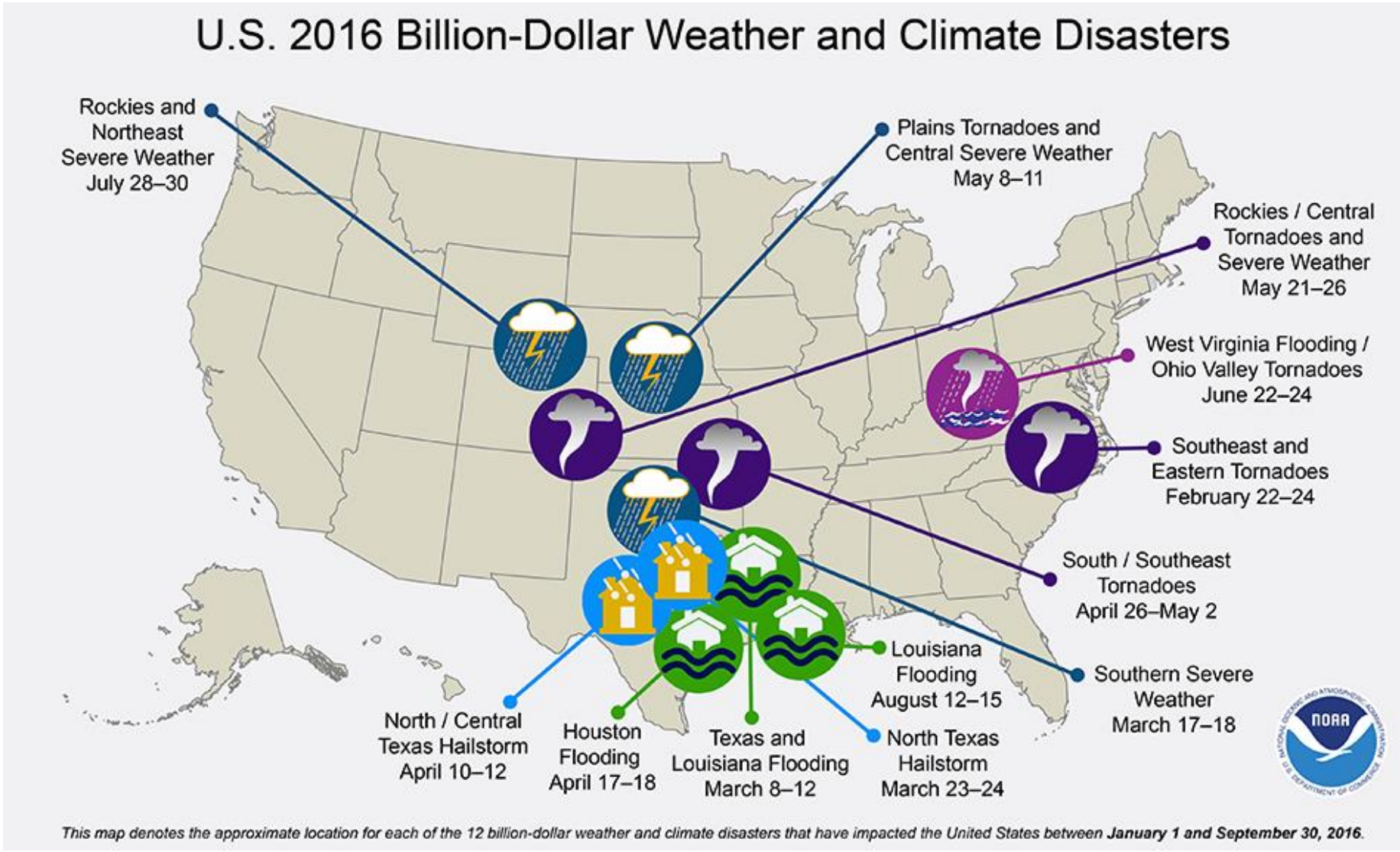
Aerial view of the vast destruction of the Indonesian coast caused by the Indian Ocean tsunami in 2004. UN Photo/E. Schneider

1980-2016 Year-to-Date U.S. Billion-Dollar Disaster Event Count (CPI-Adjusted)

Events are added according to the date on which they ended



Data Source: NOAA, Billion Dollar Weather/Climate Disasters, https://www.ncdc.noaa.gov/billions/overview

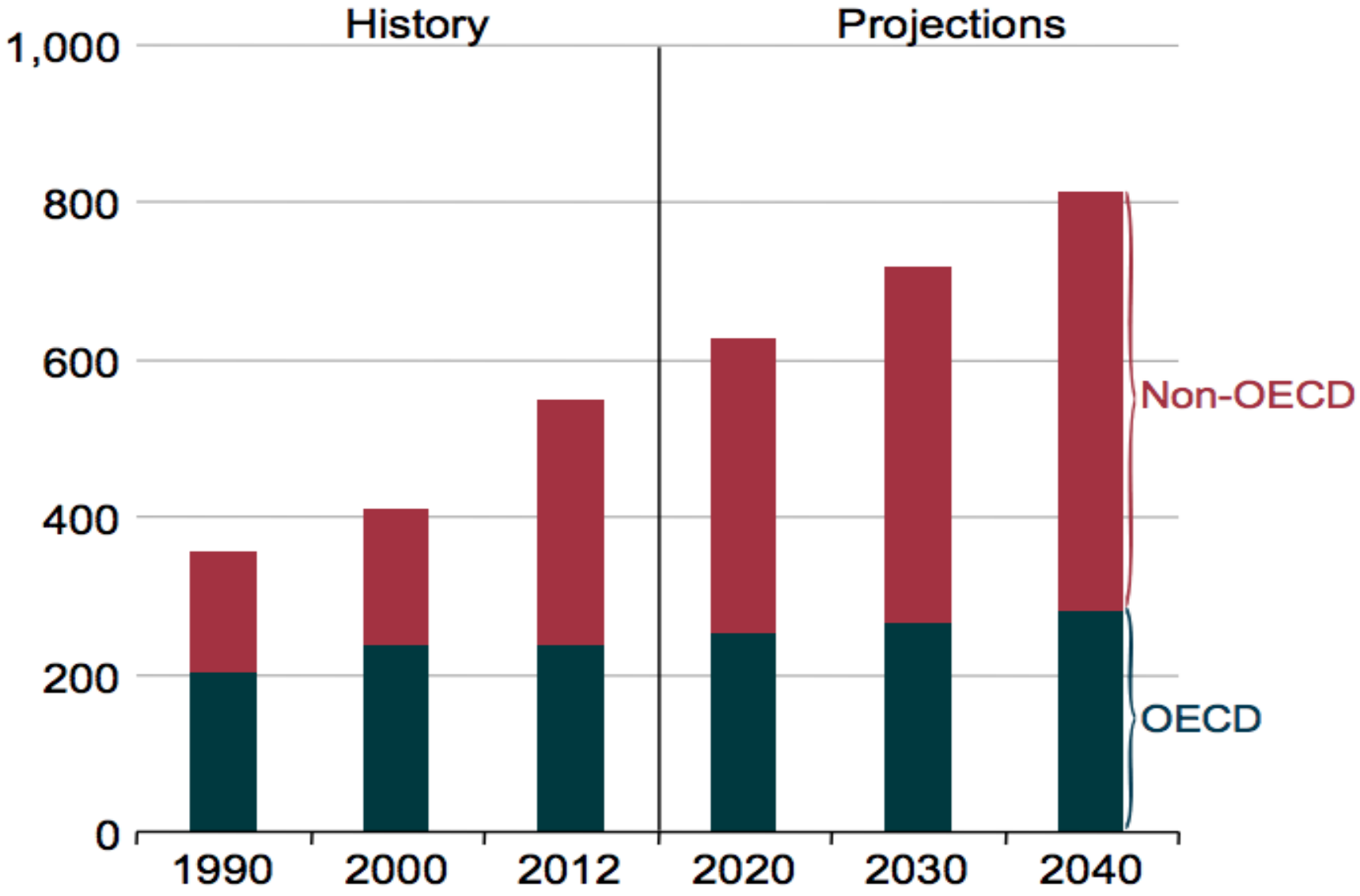


Data Source: NOAA, Billion Dollar Weather/Climate Disasters, https://www.ncdc.noaa.gov/billions/overview

Benefits of Rebuilding in a Resilient and Environmentally Safe Way

- **Climate change** increases the **vulnerability of conventional energy systems**, and clean reconstruction diminishes its negative impacts.
- Climate change is also the target of **environmental and energy regulations** through which clean reconstruction can emerge as a strong mitigation tool, especially as *world energy demand continues to rise.*
- **Energy diversity and security.** A diverse energy system is more secure and able to overcome challenges of renewable energy intermittency.
- **Energy finance and affordability.** Compared to fossil fuels, renewable energy is less susceptible to price shocks and fluctuations of energy markets. In many applications, renewable energy is less expensive.

World Energy Consumption, 2009-2040 (quadrillion Btu)



Source: EIA, World Energy Demand and Economic Outlook https://www.eia.gov/forecasts/ieo/pdf/world.pdf

The Goal: "Cleaner" Energy Matrix
Energy components of clean reconstruction

Table 2. Movement towards a greener energy mix*

Energy Source	Principles
Renewables	Resilient, **Clean**, Safe, Quick
Nuclear	Reliable, **Clean**, Safe, Affordable
Hydro	**Clean**, Safe, Affordable, Quick
Natural Gas	Resilient, Affordable
Coal/Oil	Reliable, Affordable

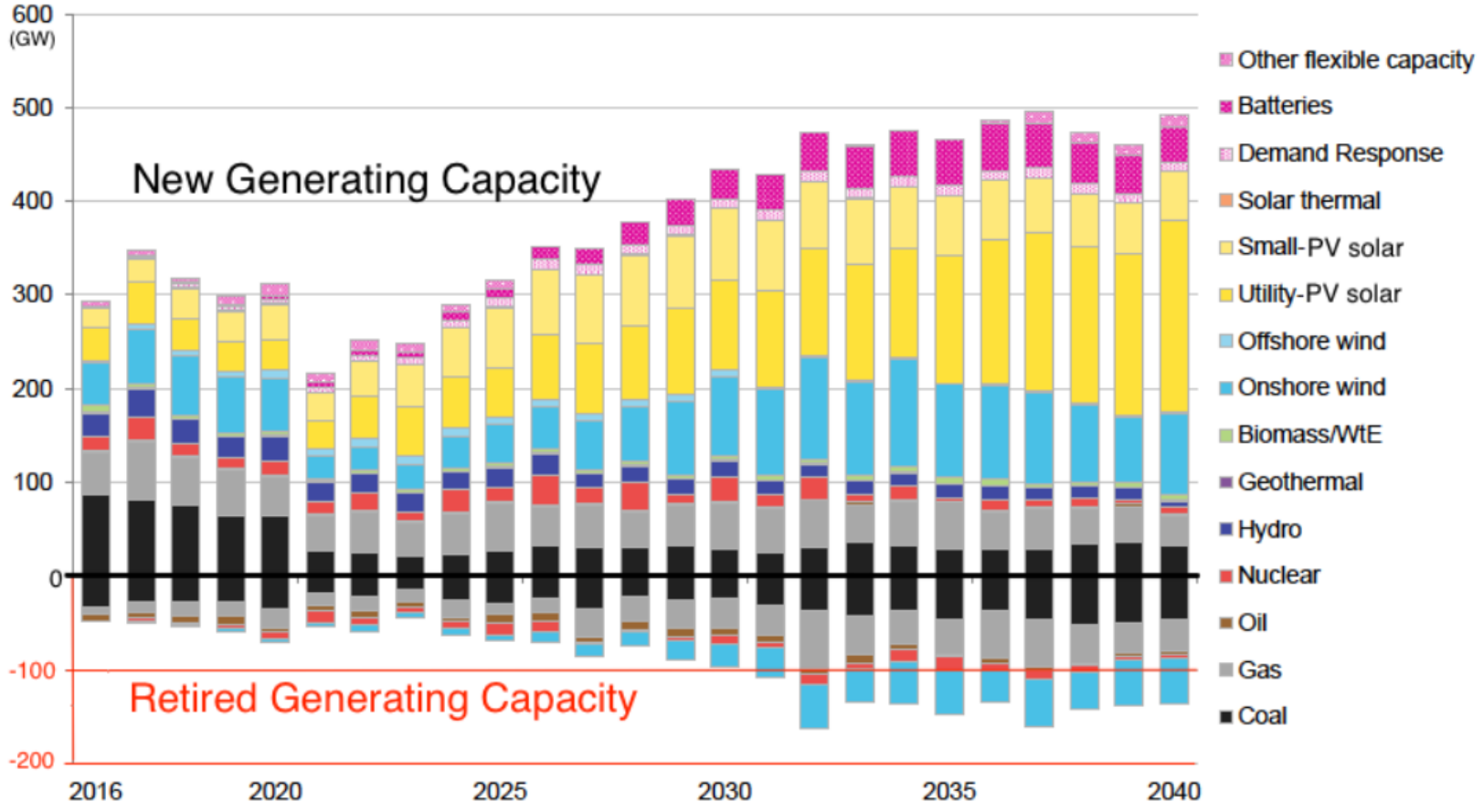
U.S. EPA Green Engineering definition: The design, commercialization, and use of processes and products, which are feasible and economical while minimizing 1) generation of pollution at the source and 2) risk to human health and the environment.

**Deployment of RE serves as indicator in the PDGR Index (discussed later)*

U.S. EPA: http://www.epa.gov/oppt/greenengineering/pubs/whats_ge.html

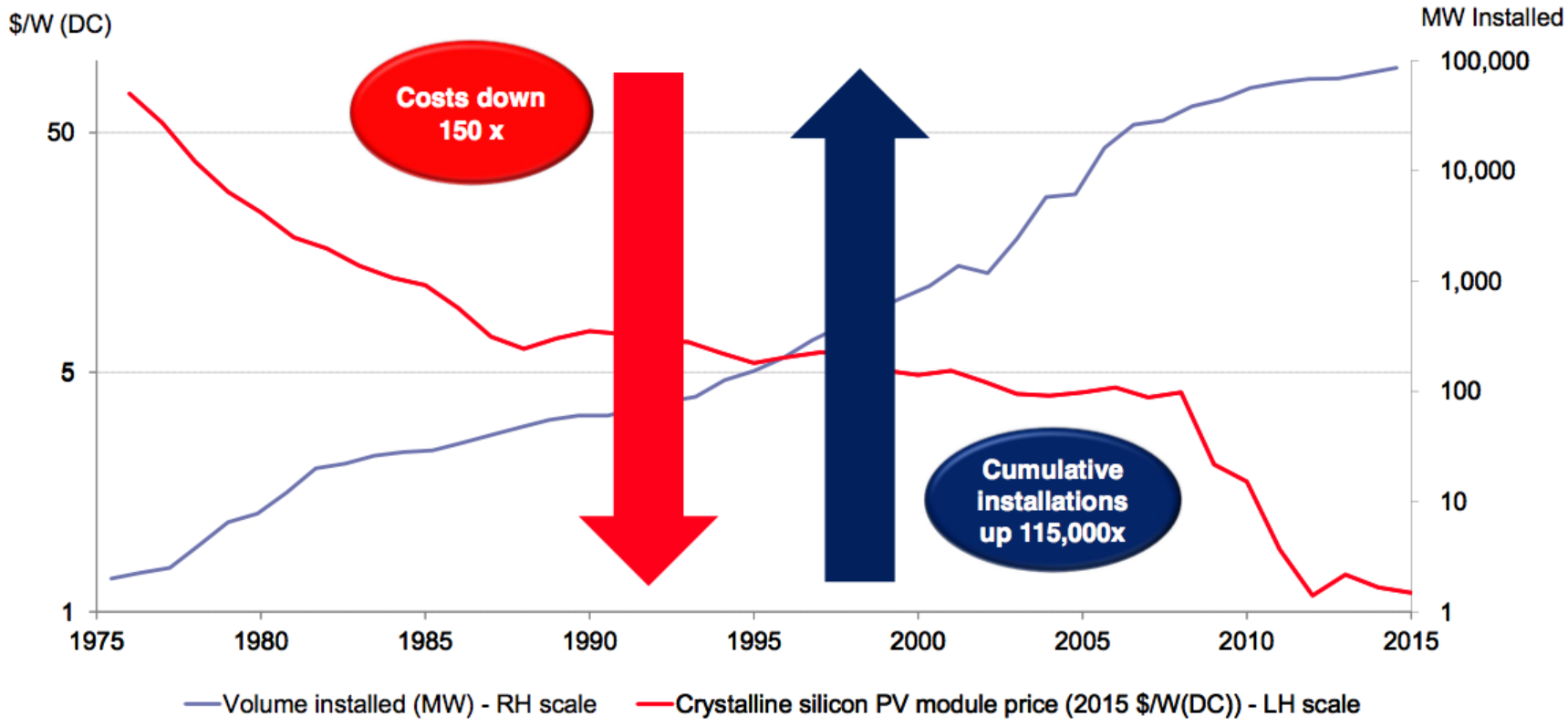
Solar Will Soon Dominate

Over the next 25 years, 68% of new electricity capacity will be renewable



Source: IEAGHG: 2016-IP17; Bloomberg NEO 2016, Bloomberg New Energy Finance

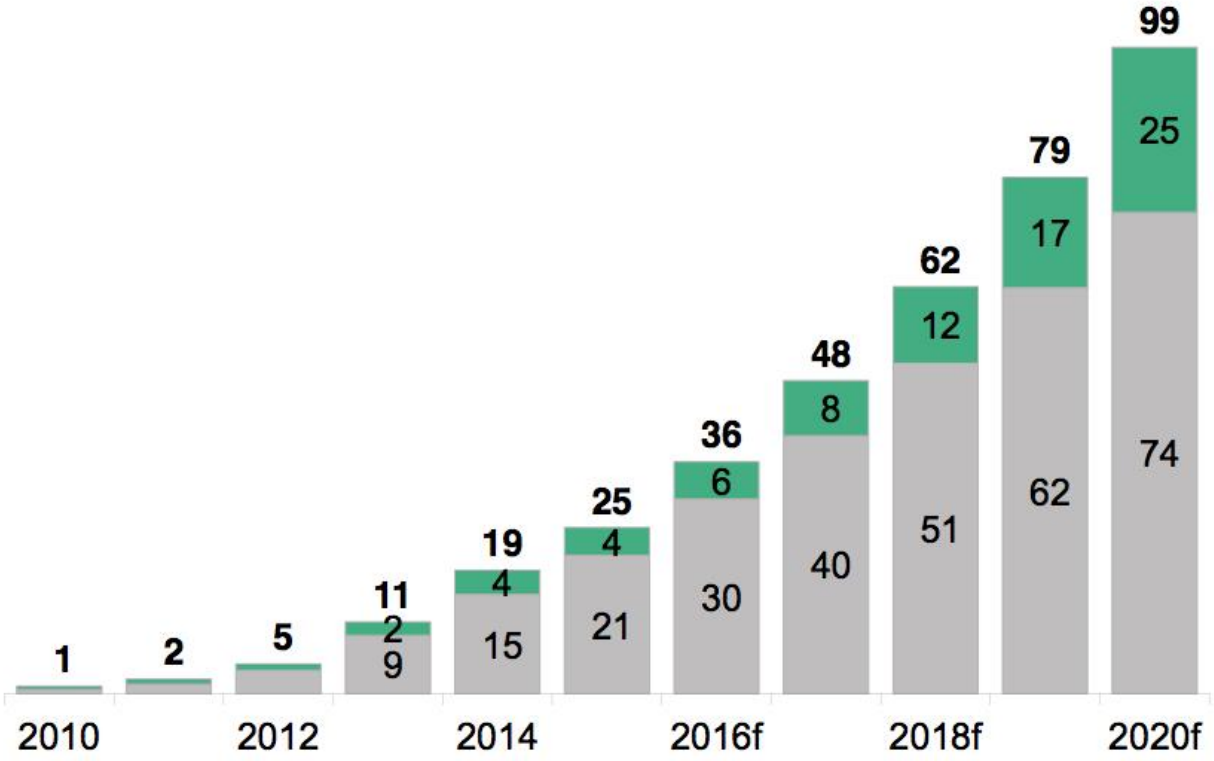
Expansion of Solar



Source: Maycock, Bloomberg New Energy Finance

Off-Grid Solar Users

(per millions of households)



Large solar home systems

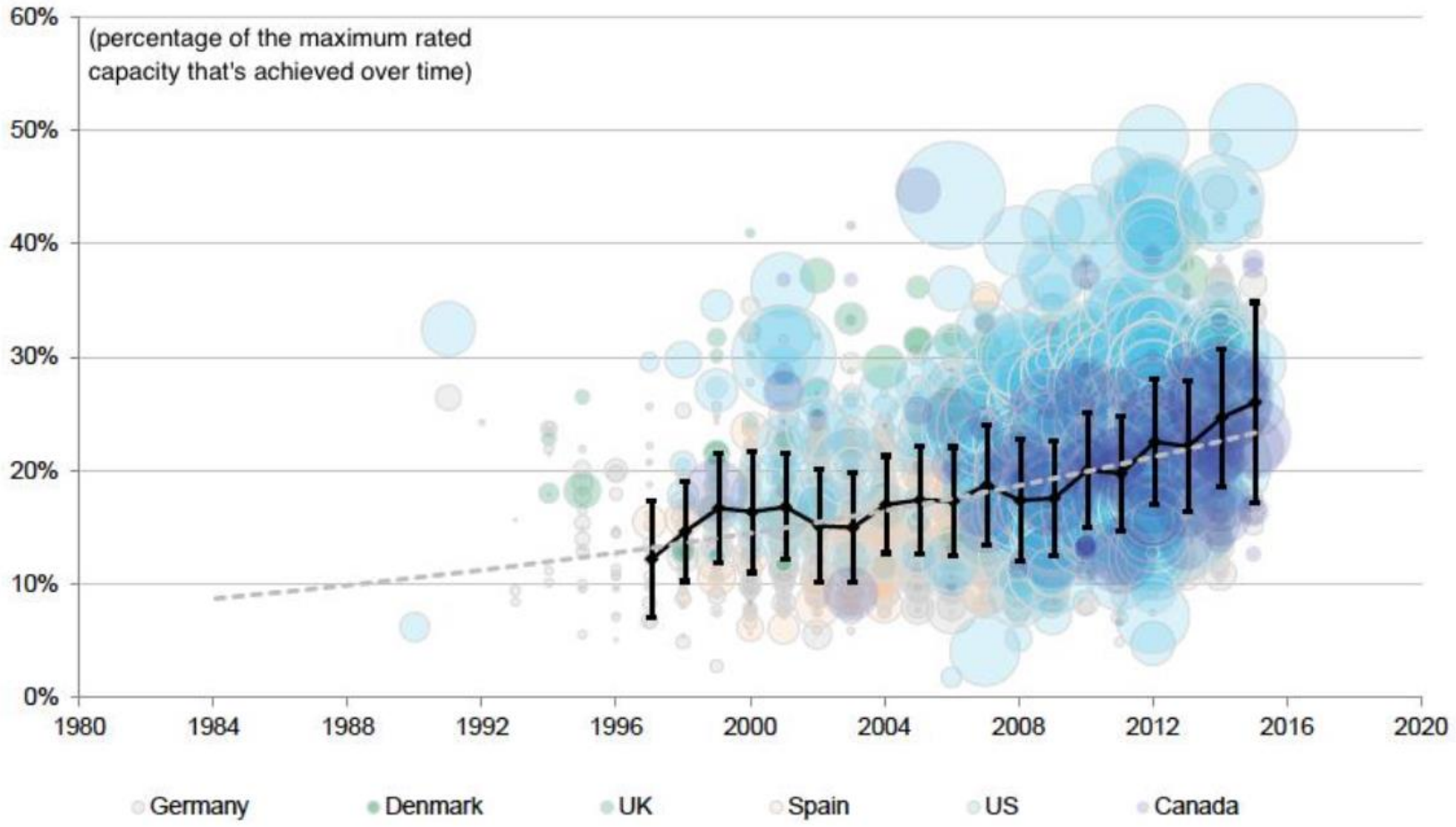
Portable solar lanterns and small home systems

or

Source: Bloomberg New Energy Finance, Lighting Global

The Technology Keeps Getting Better

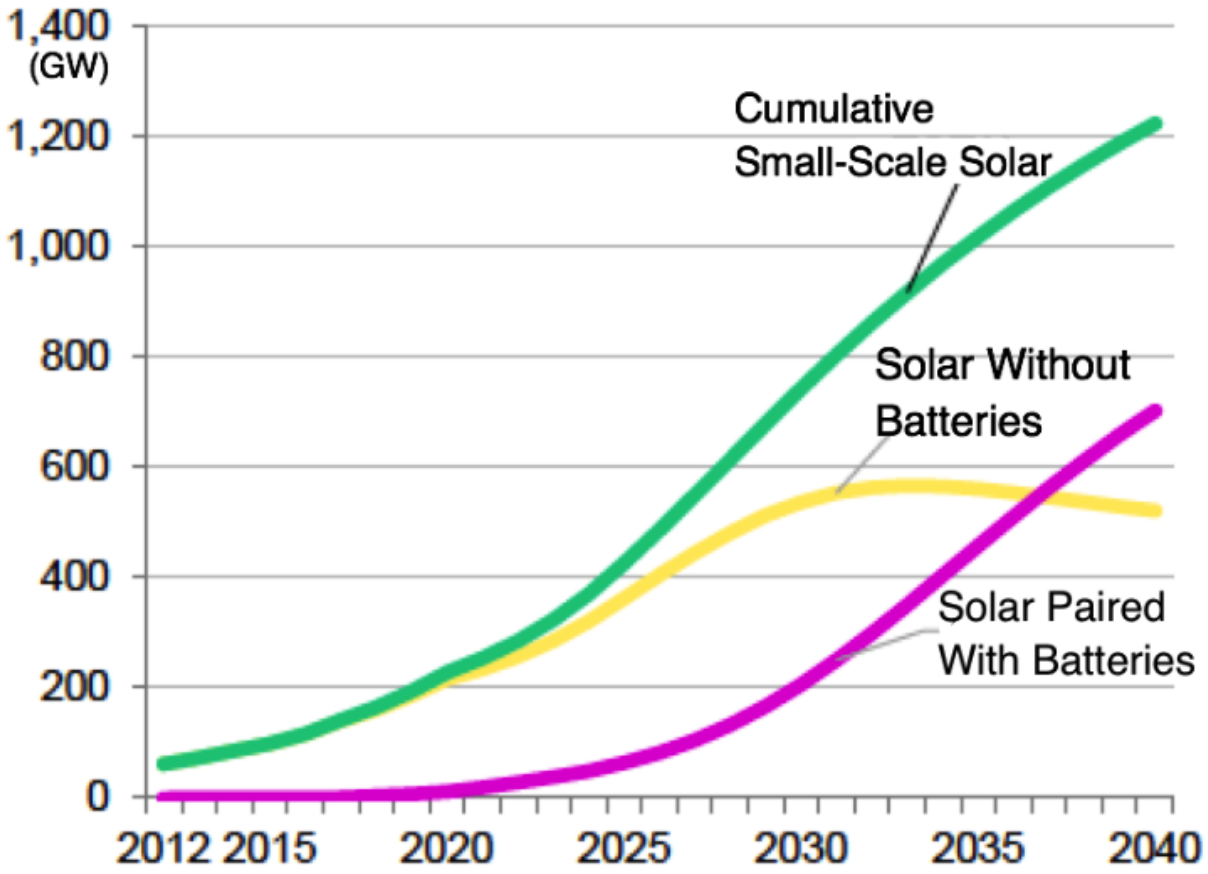
Newer wind turbines are better at catching the breeze



Source: IEAGHG: 2016-IP17; Bloomberg NEO 2016, Bloomberg New Energy Finance

Here Come the Batteries

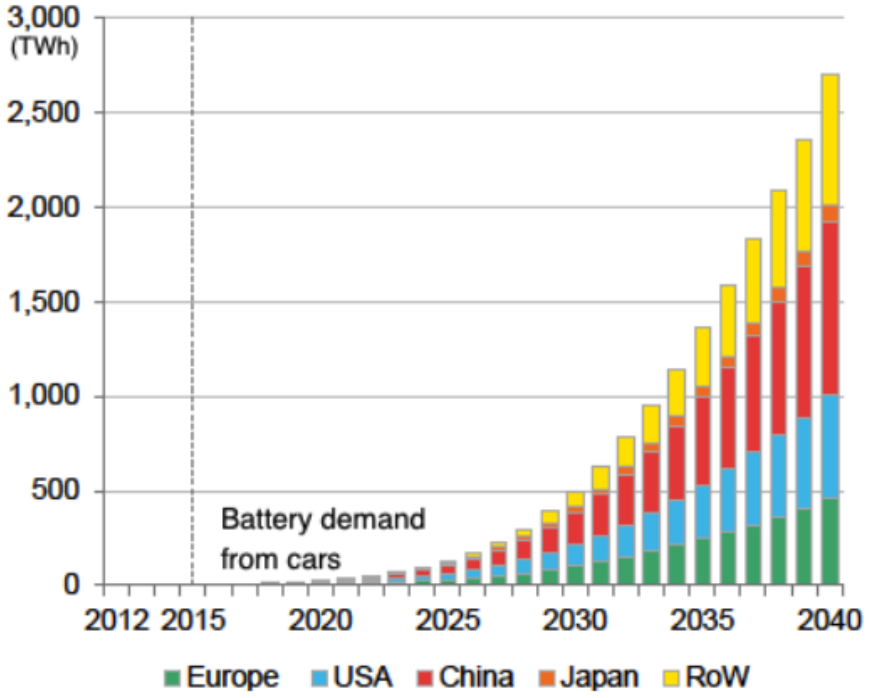
Electricity storage will come standard with rooftop solar by the 2030s



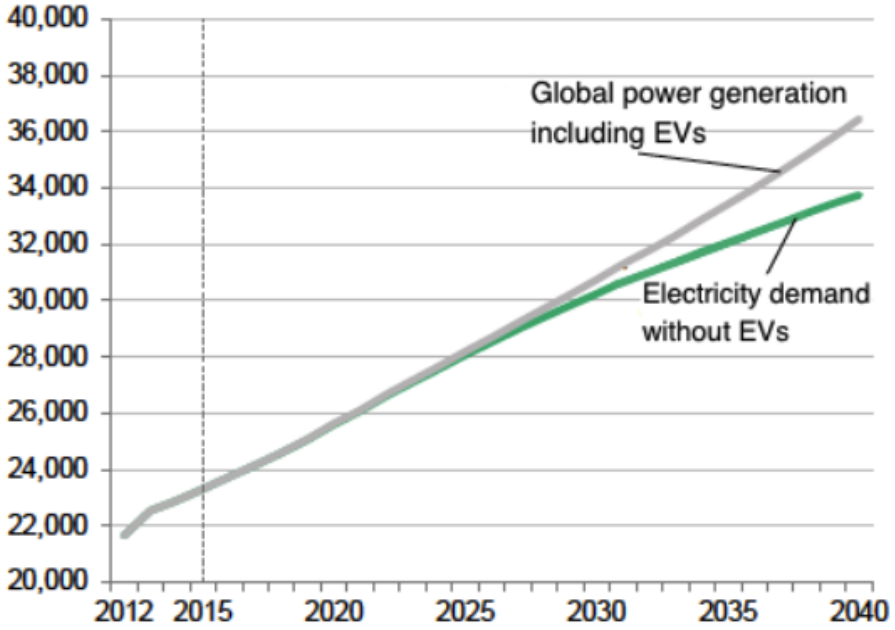
Source: IEAGHG: 2016-IP17; Bloomberg NEO 2016, Bloomberg New Energy Finance

Electric Cars Go Mainstream

Plug-in vehicles hit the accelerator



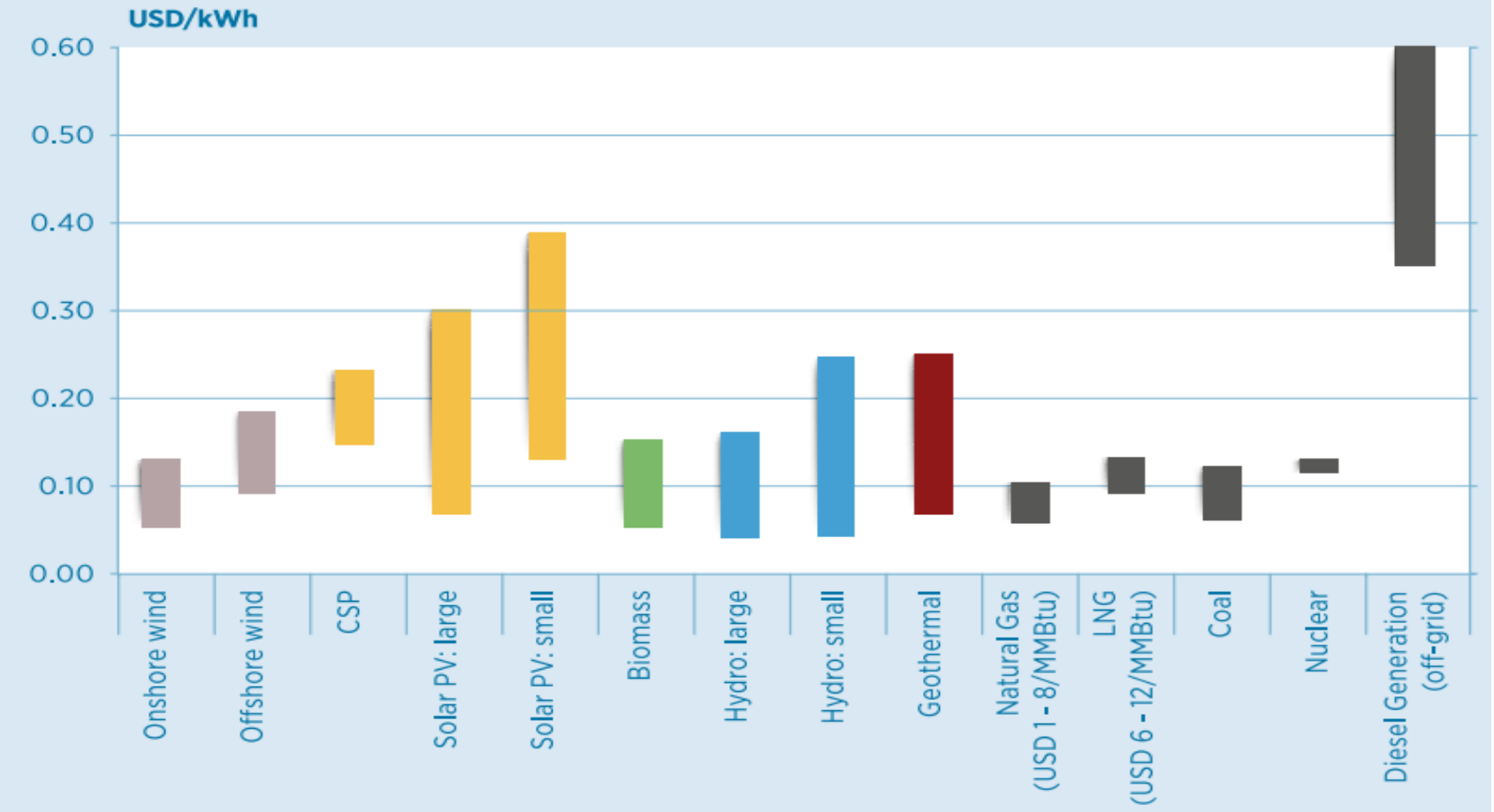
EVs boost electricity demand by 8%



Source: IEAGHG: 2016-IP17; Bloomberg NEO 2016, Bloomberg New Energy Finance

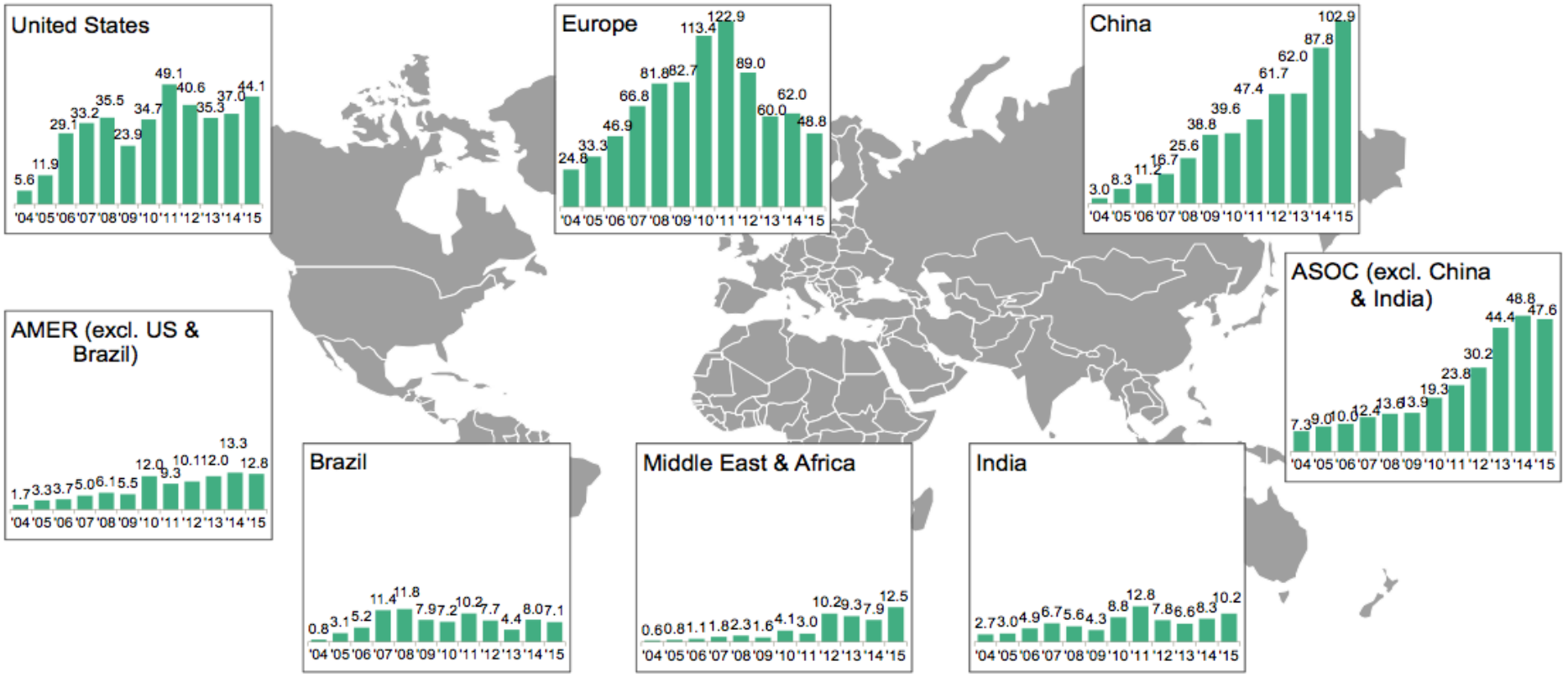
Falling Cost, Increasing Competitiveness

The Levelised Cost of Electricity from Renewable, Fossil and Nuclear Technologies (2014)



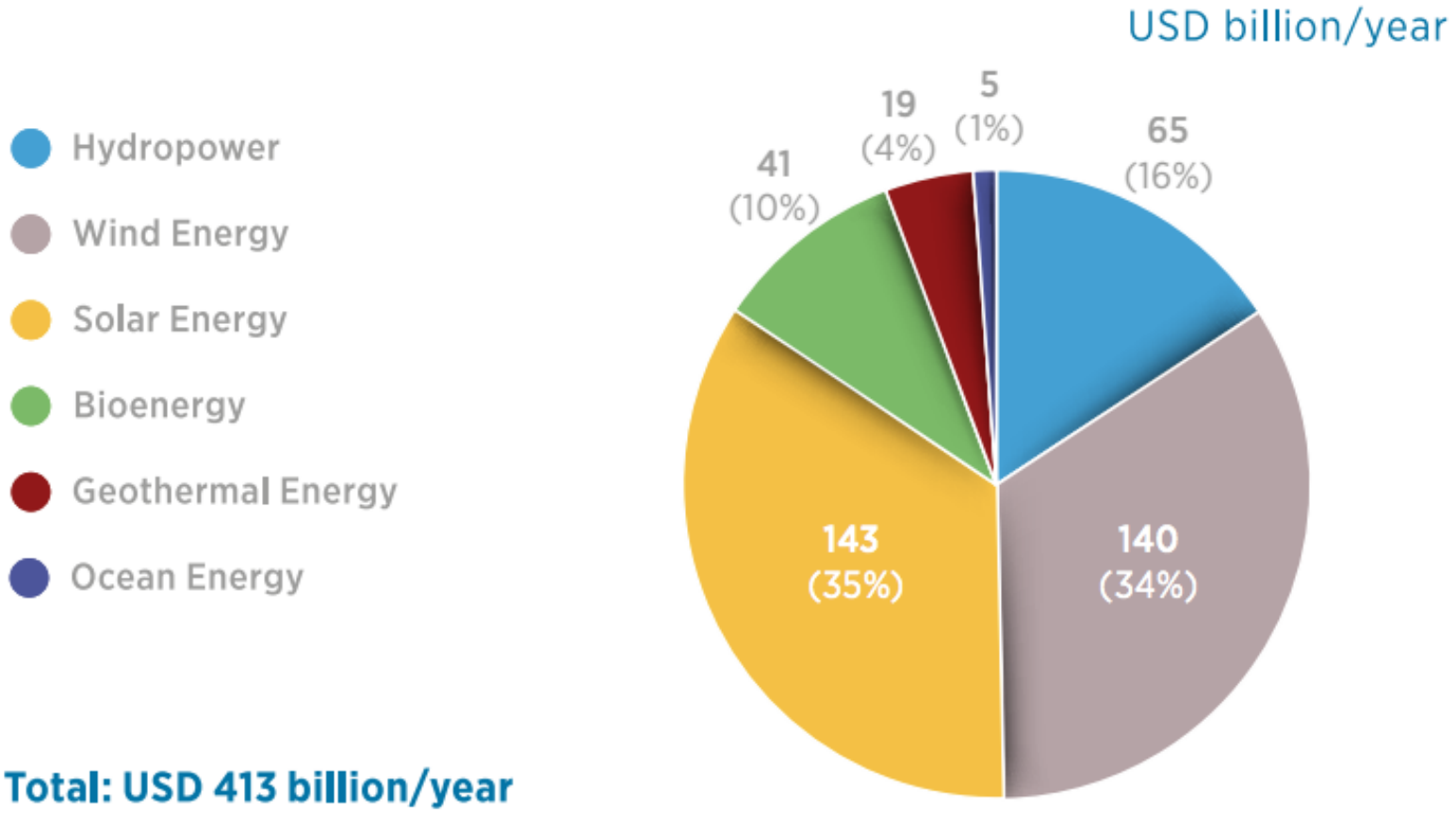
Source: IRENA, Rethinking Energy: Renewable Energy 2015,
http://www.irena.org/rethinking/IRENA%20_REthinking_Energy_2nd_report_2015.pdf

Renewable Energy Investment, 2004-2015 by Region



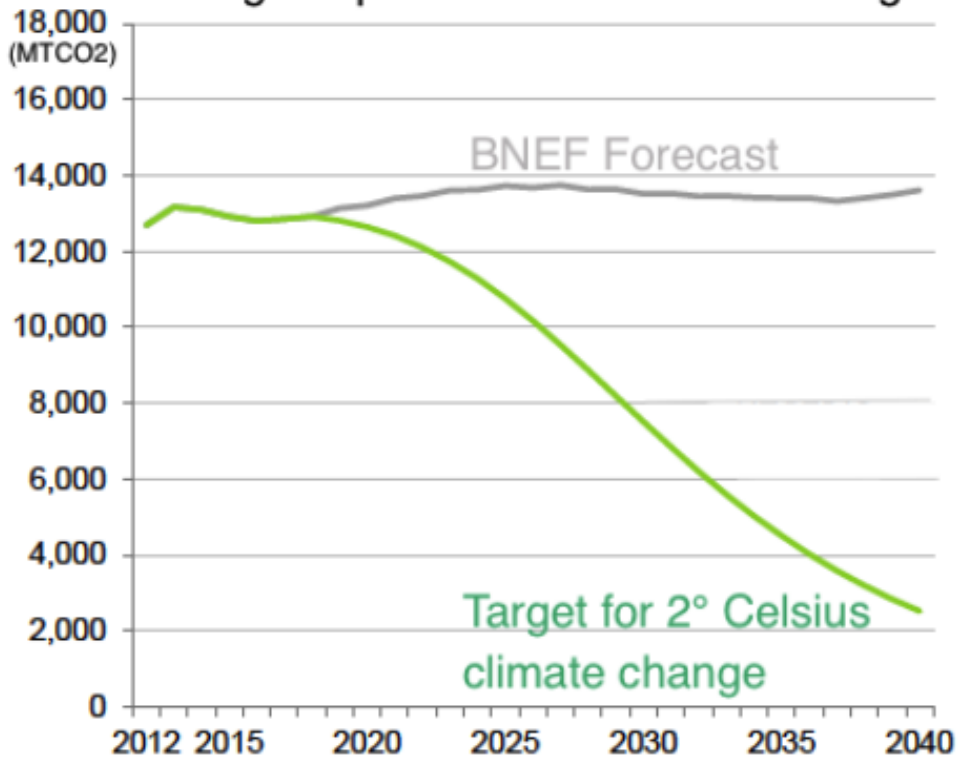
Source: Bloomberg New Energy Finance

Renewable Power investment by technology (2015-2020)

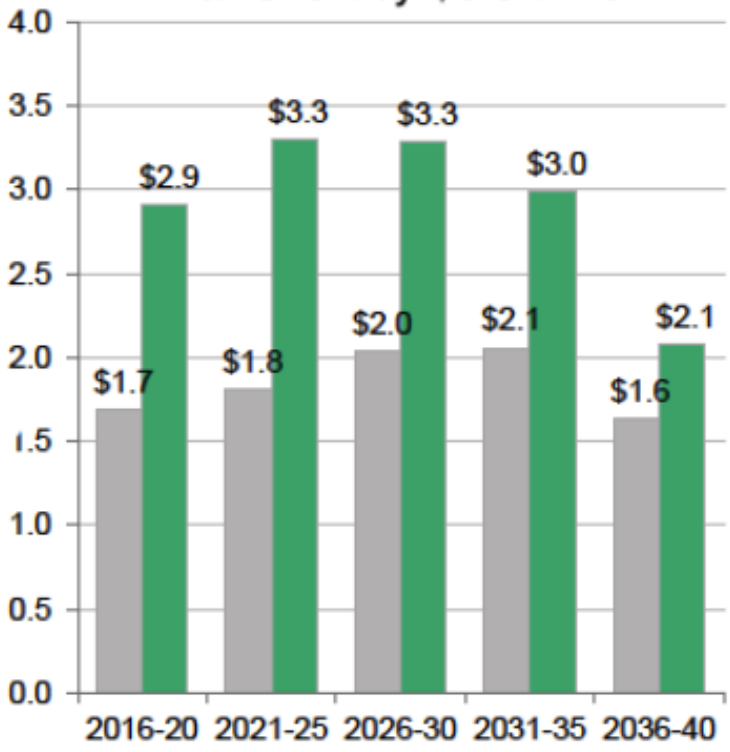


The Climate Is Still In Trouble

Global power emissions will remain far too high to prevent excessive warming...



...and clean-energy investment will fall short by $5.3 trillion



Source: IEAGHG: 2016-IP17; Bloomberg NEO 2016, Bloomberg New Energy Finance

Moving Forward

1. Renewable energy technology has become increasingly innovative and price points are improving.

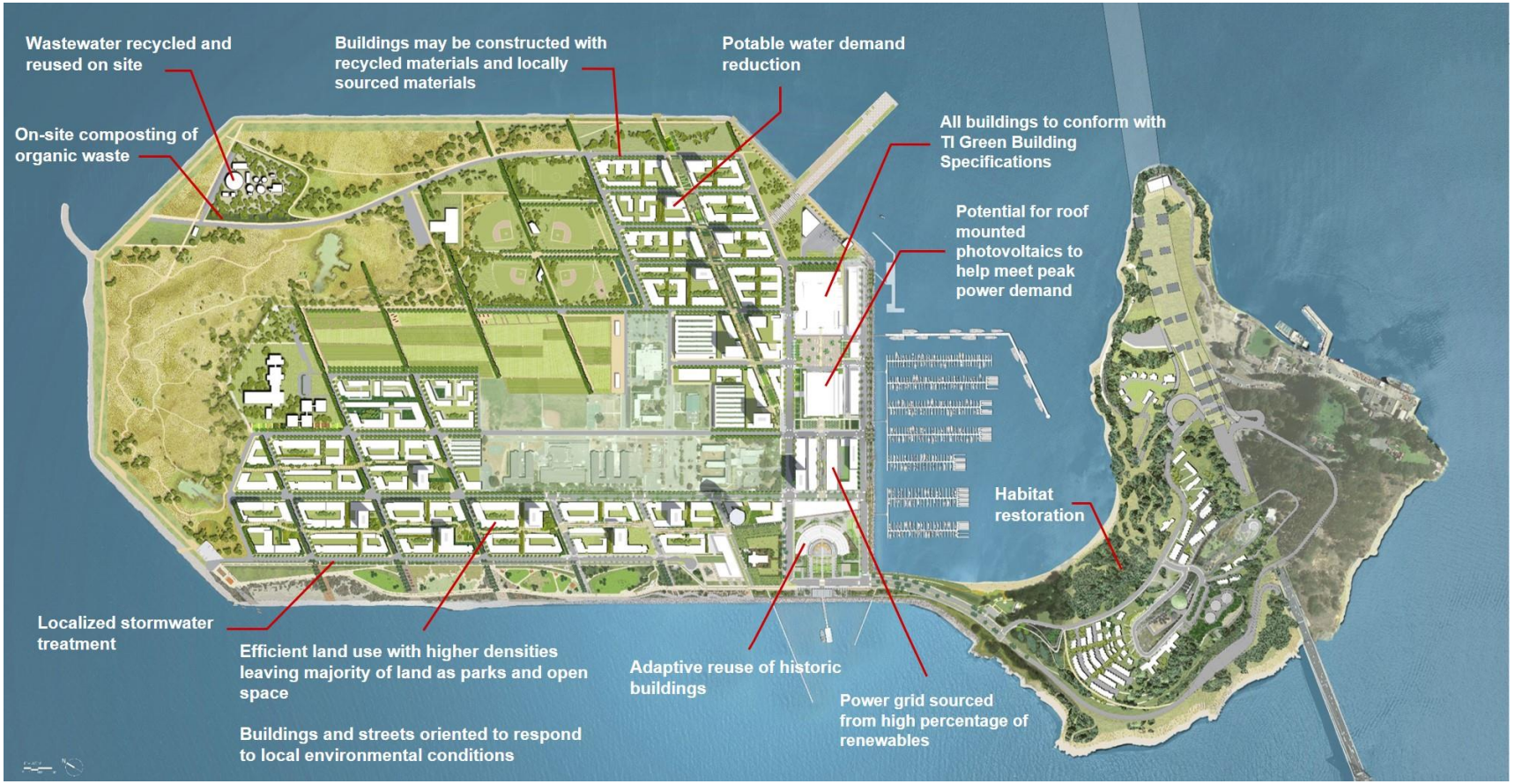
2. Governments have begun incorporating clean energy and climate policy into their infrastructure investment.

3. There is still work to be done…

Inspiration for the Future: Smart Cities and Eco-Towns

http://www.transsolar.com/content/2-projects/17-masdar-city/cover.jpg

California: Eco-Village



Credit: skidmore owings & merrill

China: Smart City

Credit: Sino-Singapore Tianjin Eco-city Development and Investment

Call to Action

- Can we change our energy usage to address climate change?
- Rebuilding with clean energy in mind will result in resilience and save costs, while helping the environment
- Current eco-town and smart city projects demonstrate the way forward
- The future is now!

Thank you! Questions?