



THE LEGACY ENERGY SYSTEM



Bloomberg NEW ENERGY FINANCE

THE EMERGING ENERGY SYSTEM



GLOBAL CLEAN ENERGY INVESTMENT & CAPACITY ADDITIONS





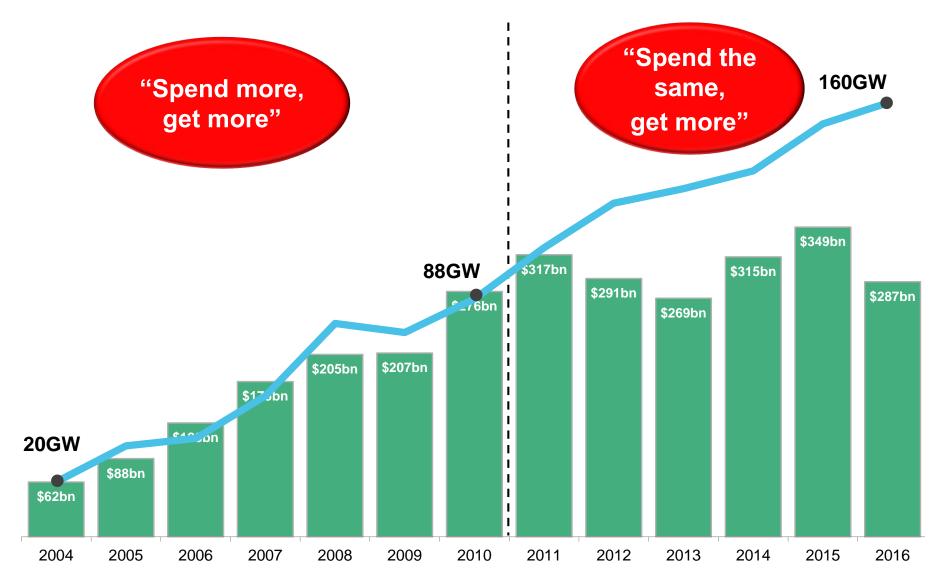
Note: Total values include estimates for undisclosed deals. Includes corporate and government R&D, and spending for digital energy and energy storage projects (not reported in quarterly statistics). Excludes large hydro.

Source: Bloomberg Intelligence, Bloomberg New Energy Finance

@MLiebreich

GLOBAL CLEAN ENERGY INVESTMENT & CAPACITY ADDITIONS



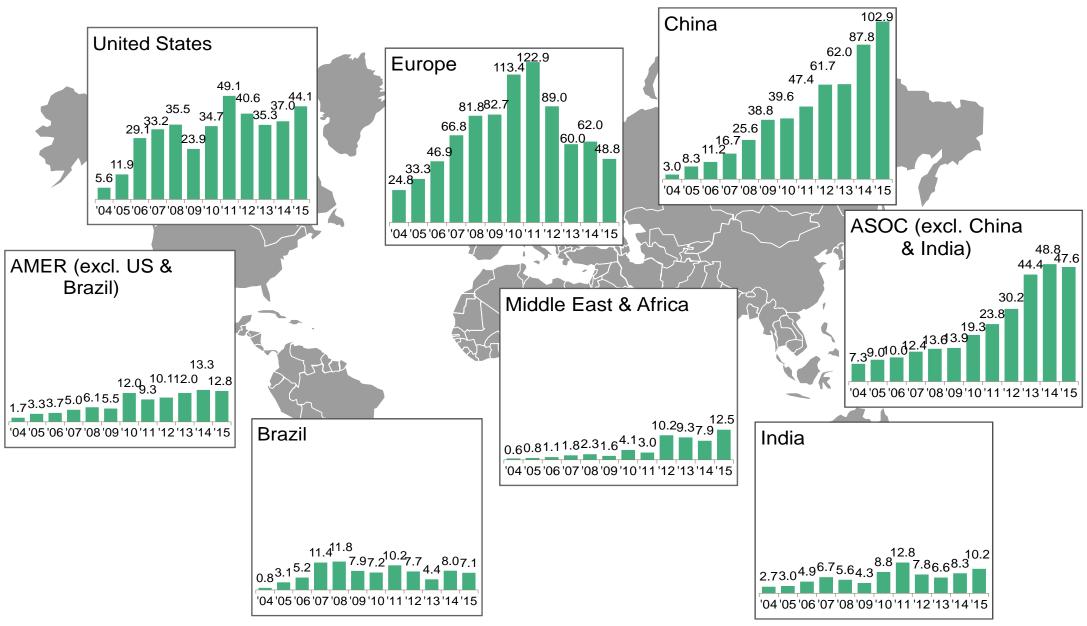


Note: Total values include estimates for undisclosed deals. Includes corporate and government R&D, and spending for digital energy and energy storage projects (not reported in quarterly statistics). Excludes large hydro.

Source: Bloomberg Intelligence, Bloomberg New Energy Finance

RENEWABLE ENERGY INVESTMENT BY REGION 2004-2015 (\$BN)



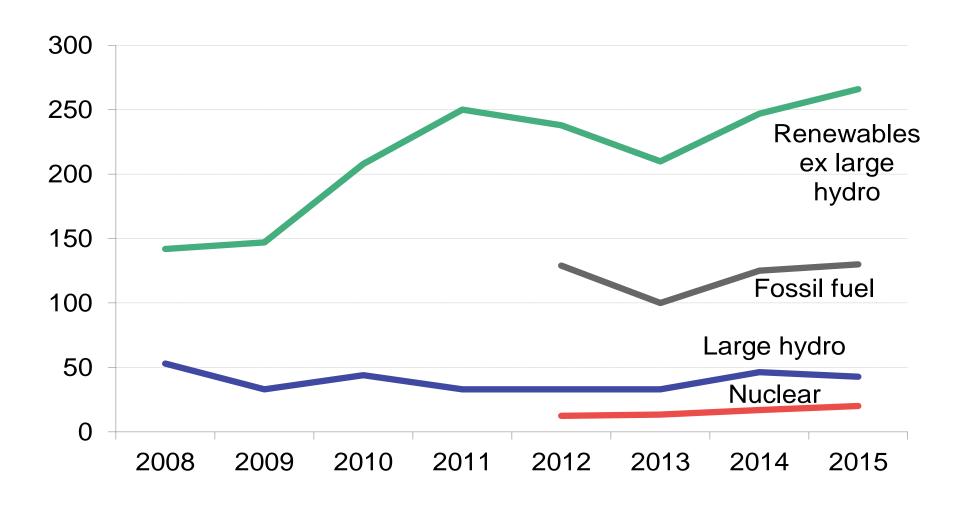


Note: New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals.

Source: Bloomberg New Energy Finance

INVESTMENT IN POWER CAPACITY, 2008–15 (\$BN)

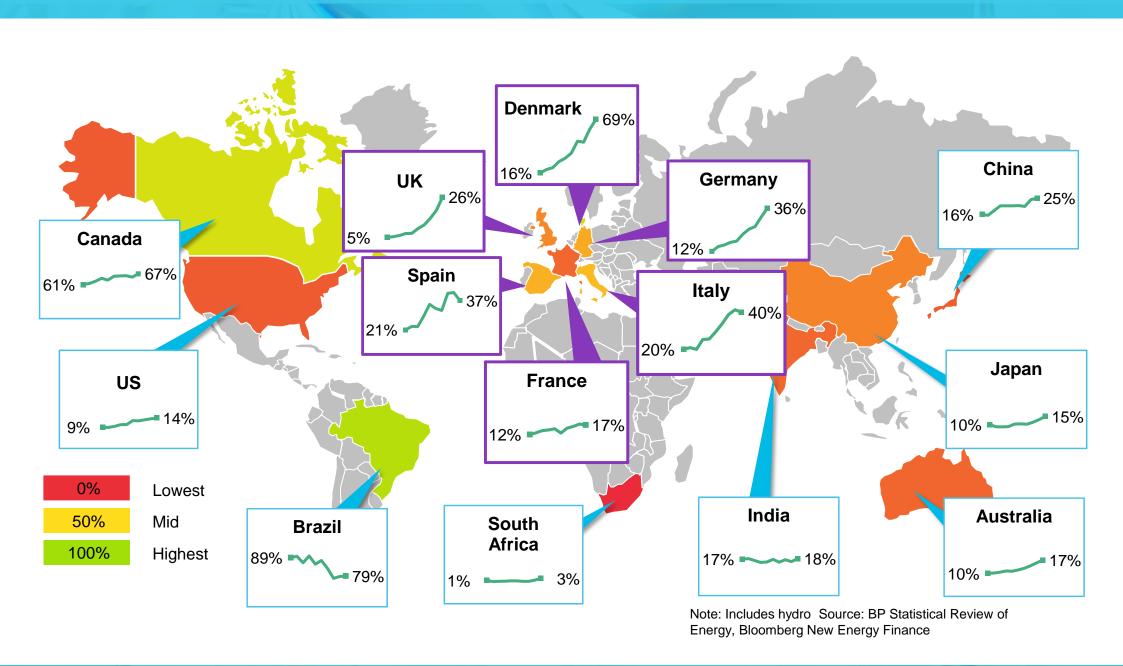




Source: UNEP, Bloomberg New Energy Finance

RENEWABLE ENERGY PROPORTION OF POWER GENERATION, 10 YEARS TO 2015 (%)









ONSHORE WIND



SOLAR PV



US\$ 6.2 cents/kWh

US\$ 17 cents/kWh

2016 UNSUBSIDISED CLEAN ENERGY WORLD RECORDS



ONSHORE WIND



SOLAR PV



Location: Morocco

Bidder: Enel Green Power

Signed: January 2016

Construction: 2018

Price: US\$ 3.0 c/kWh

Location: Peru

Bidder: Enel Green Power

Signed: February 2016

Construction: 2017

Price: US\$ 4.8 c/kWh

Source: Bloomberg New Energy Finance; ImagesSiemens; Wikimedia Commons

@MLiebreich

Bloomberg NEW ENERGY FINANCE

2016 UNSUBSIDISED CLEAN ENERGY WORLD RECORDS

ONSHORE WIND



SOLAR PV



Location: Morocco

Bidder: Enel Green Power

Signed: January 2016

Construction: 2018

Price: US\$ 3.0 c/kWh

Location: Coahuila, Mexico

Bidder: Enel Green Power

Signed: March 2016

Construction: 2018

Price: US\$ 3.6 c/kWh

2016 UNSUBSIDISED CLEAN ENERGY WORLD RECORDS



ONSHORE WIND



SOLAR PV



Location: Morocco

Bidder: Enel Green Power

Signed: January 2016

Construction: 2018

Price: US\$ 3.0 c/kWh

Location: Dubai

Bidder: Masdar Consortium

Signed: May 2016

Construction: 2019

Price: US\$ 2.99 c/kWh

2016 UNSUBSIDISED CLEAN ENERGY WORLD RECORDS



ONSHORE WIND



SOLAR PV



Location: Morocco

Bidder: Enel Green Power

Signed: January 2016

Construction: 2018

Price: US\$ 3.0 c/kWh

Location: Chile

Bidder: Solarpack Corporation

Signed: August 2016

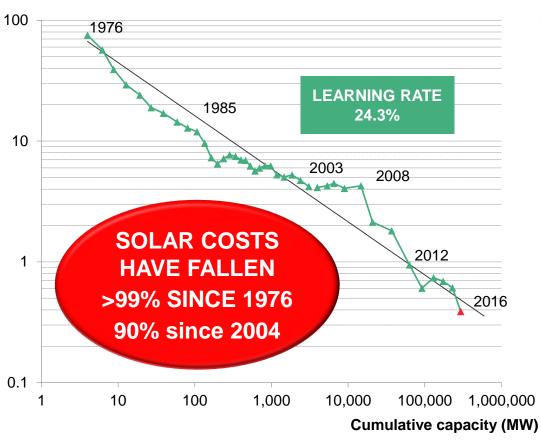
Construction: 2019

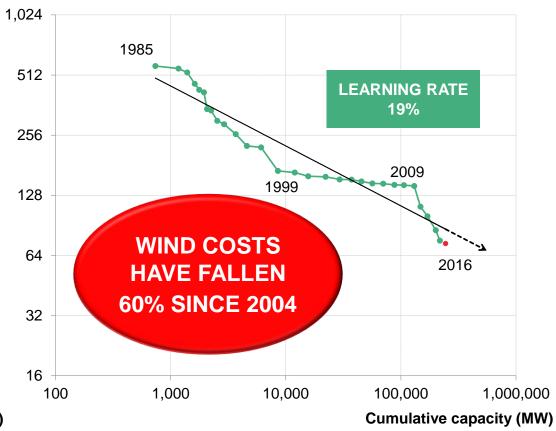
Price: US\$ 2.91 c/kWh

WIND AND SOLAR EXPERIENCE CURVES



ONSHORE WIND LEVELISED COST* SOLAR PV MODULE COST (\$/W) (\$/MWH) 1,024 1976





Note: Prices are in real (2015) USD. 'Current price' is \$0.4/W

Source: Bloomberg New Energy Finance, Maycock

Note: Pricing data has been inflation corrected to 2014. We assume the debt ratio of 70%, cost of debt (bps to LIBOR) of 175, cost of equity of 8%. *Data is for Northern Europe.

Source: Bloomberg New Energy Finance

CAPACITY FACTOR IMPROVEMENTS





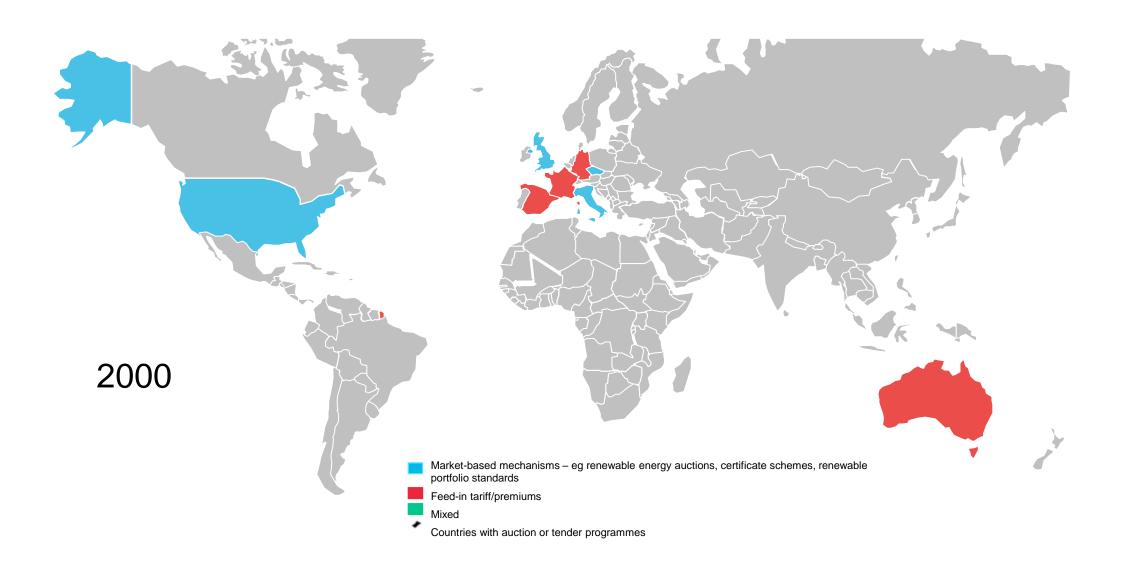




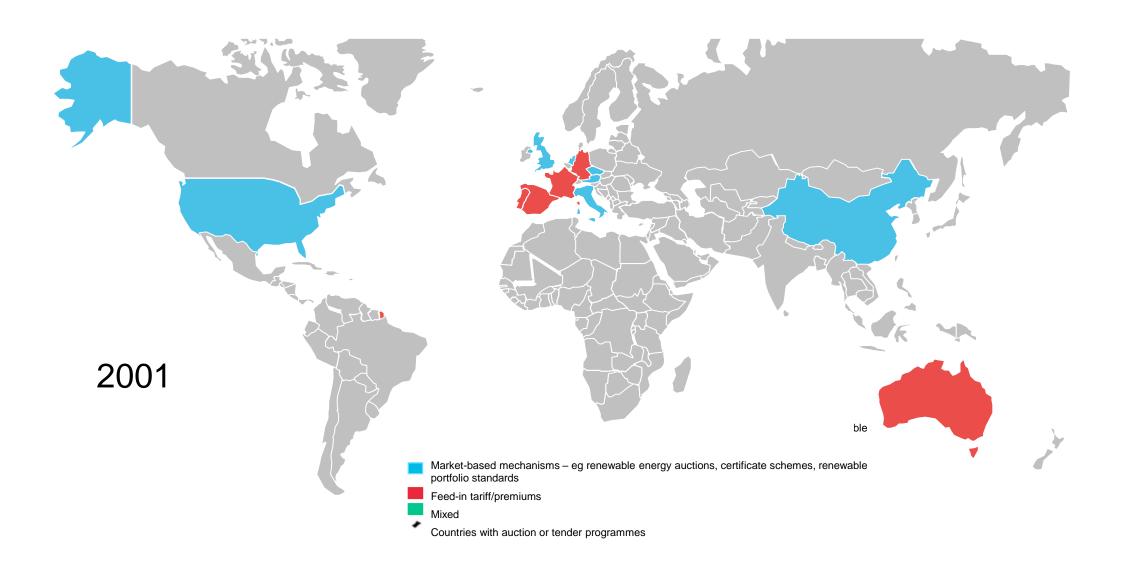


Source: Siemens, Nordex, GE, Vestas

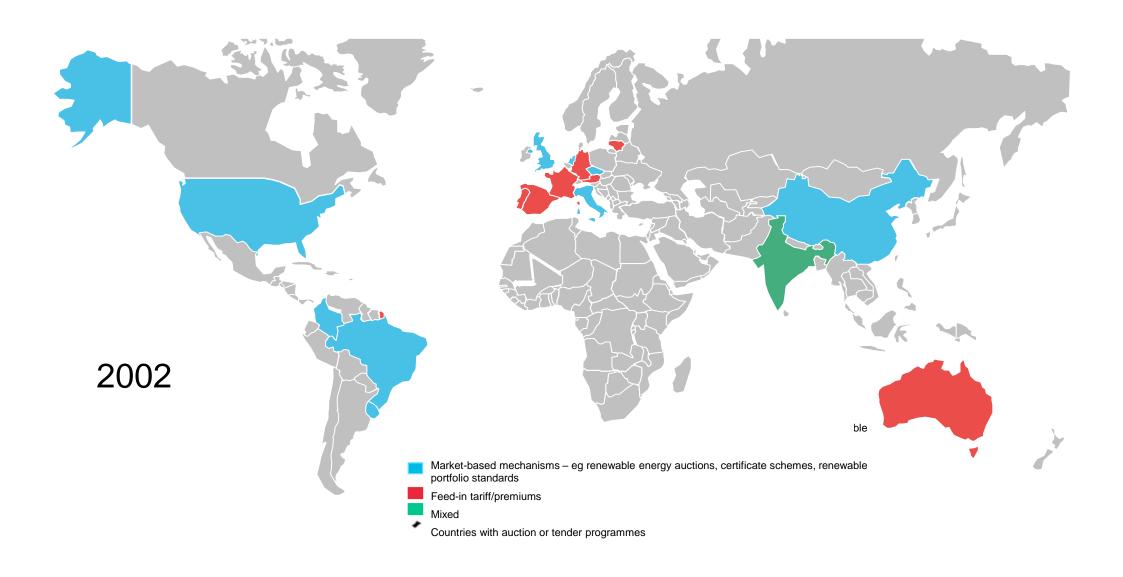




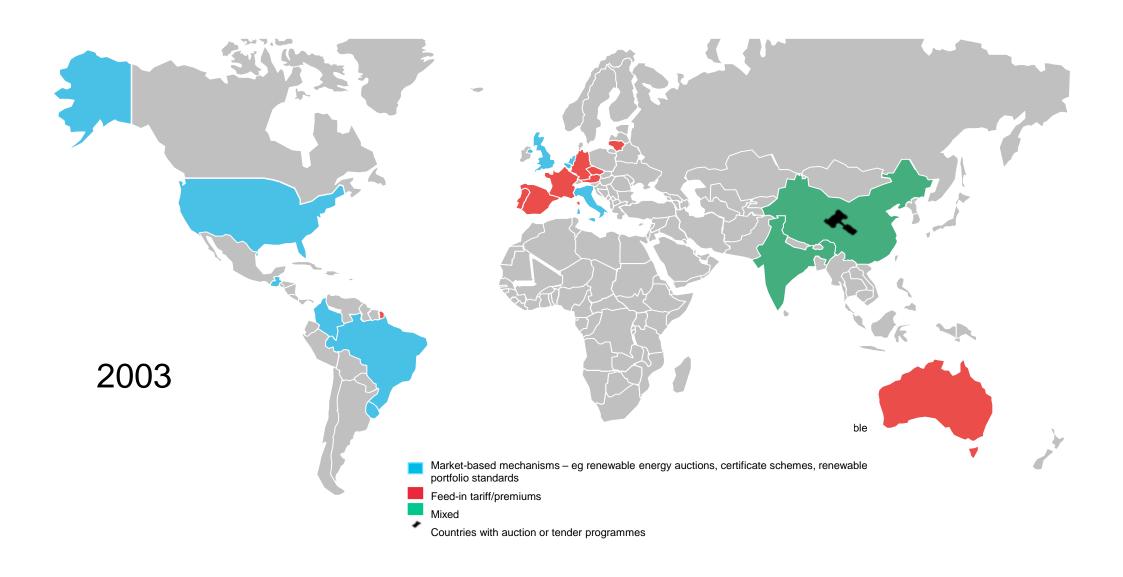




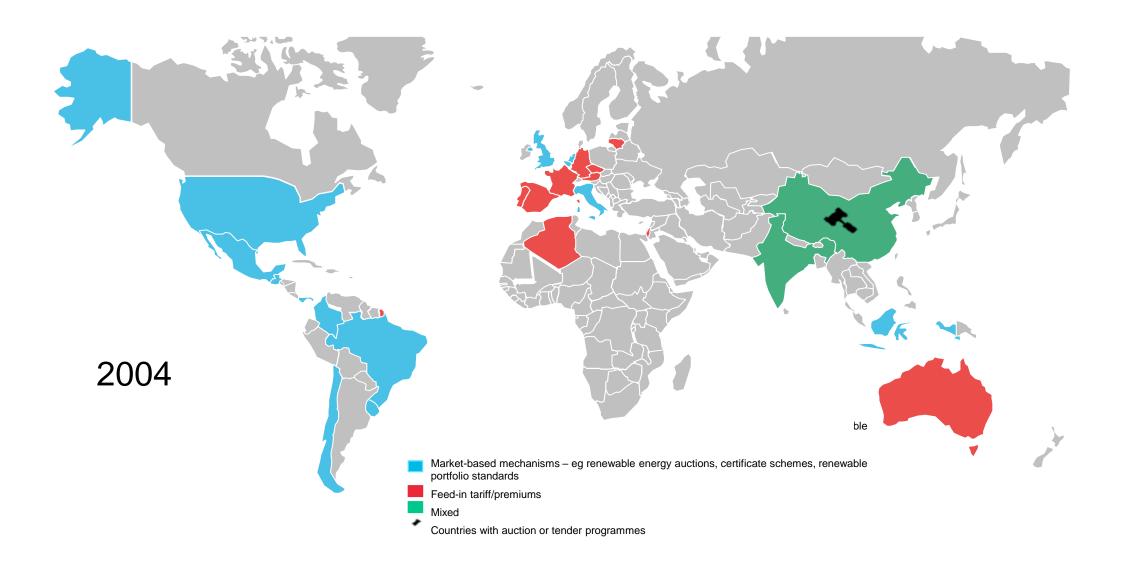




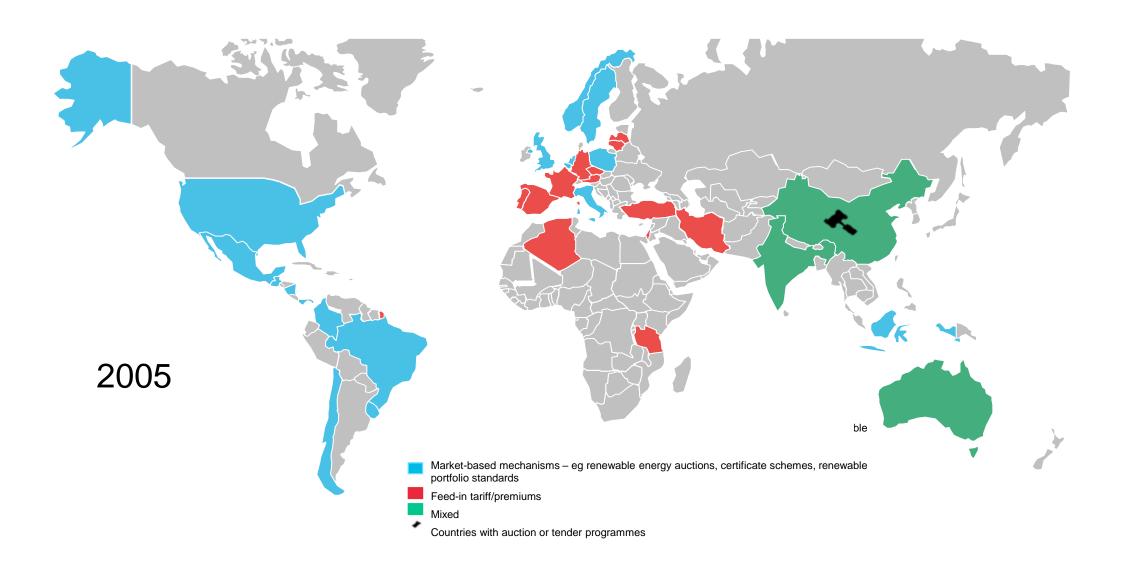




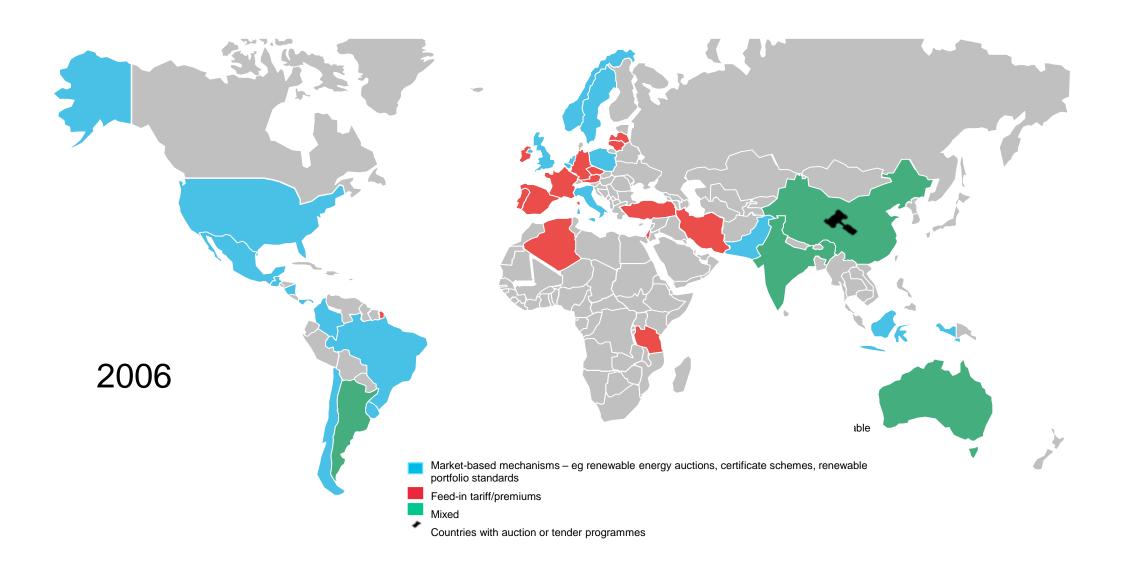




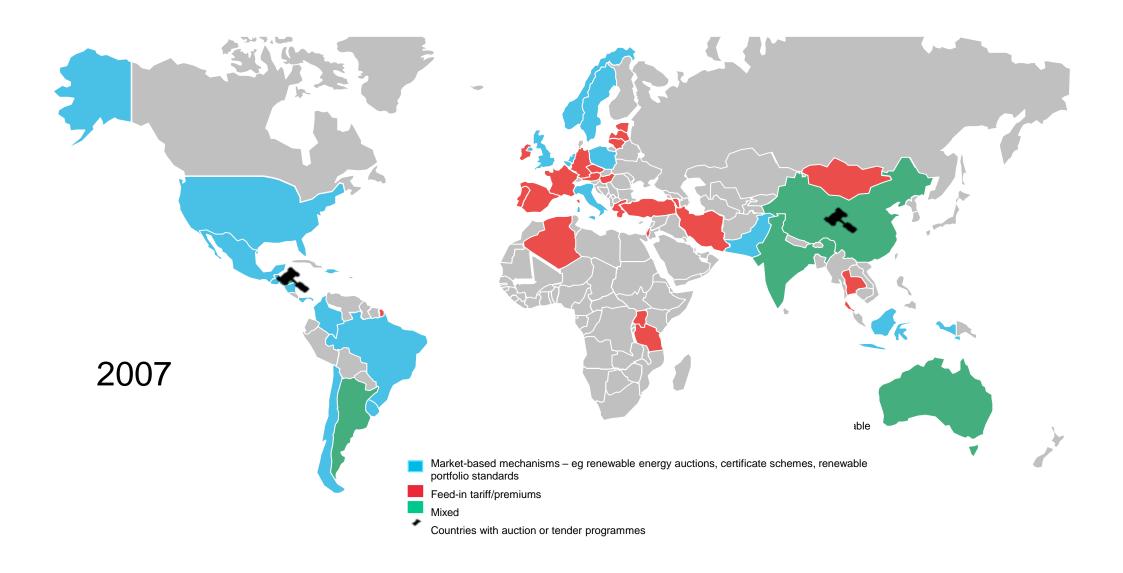




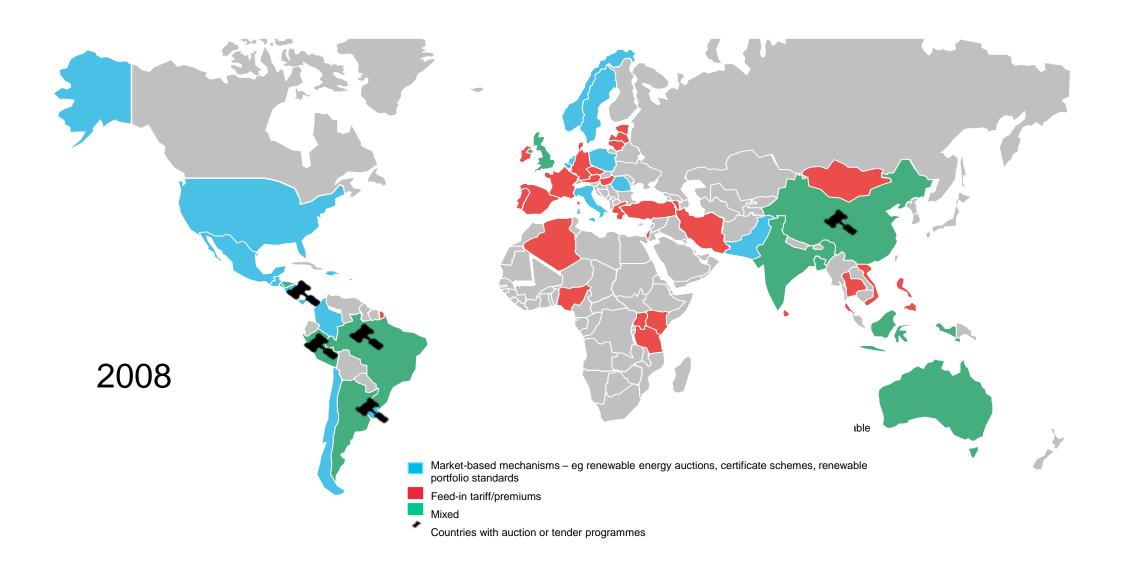




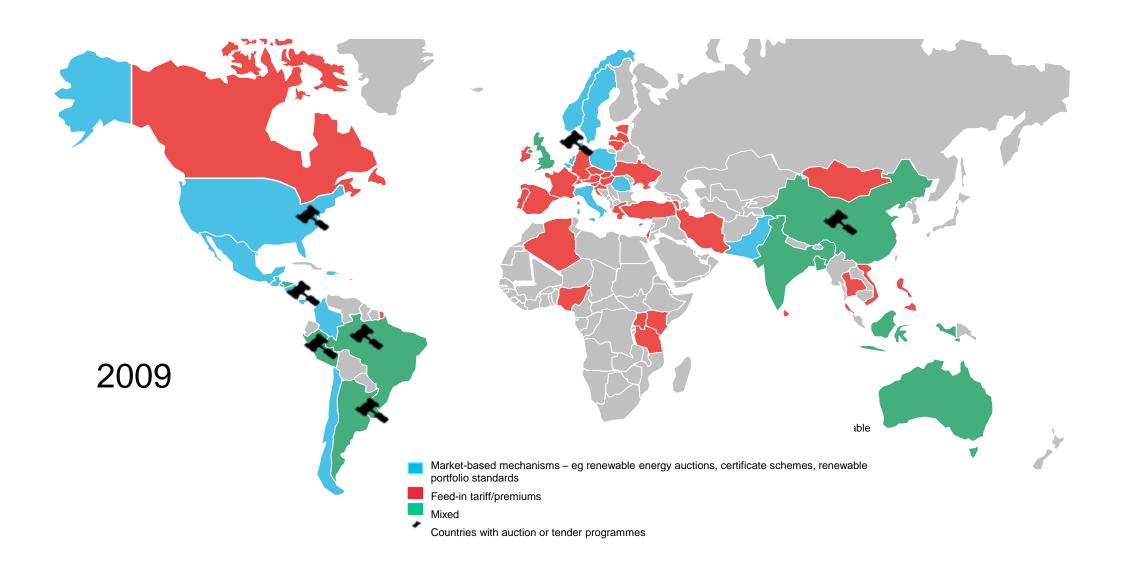




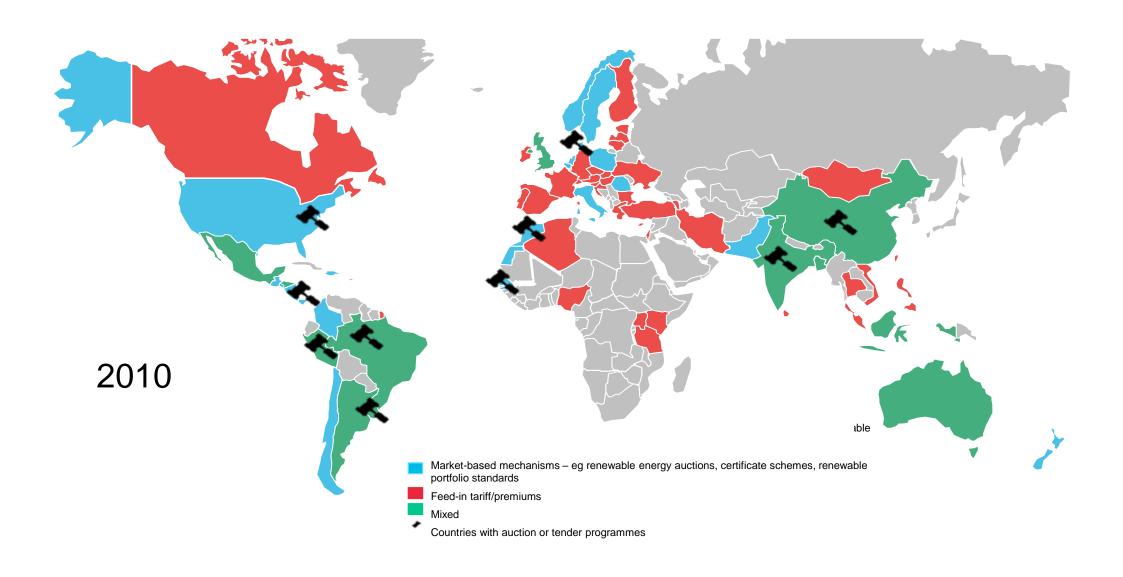




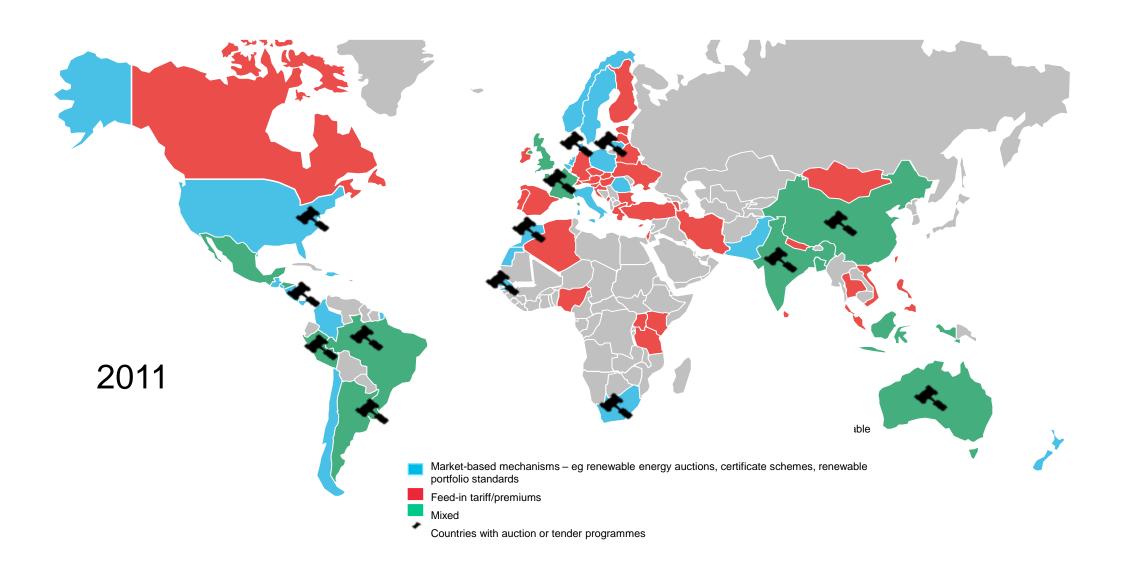




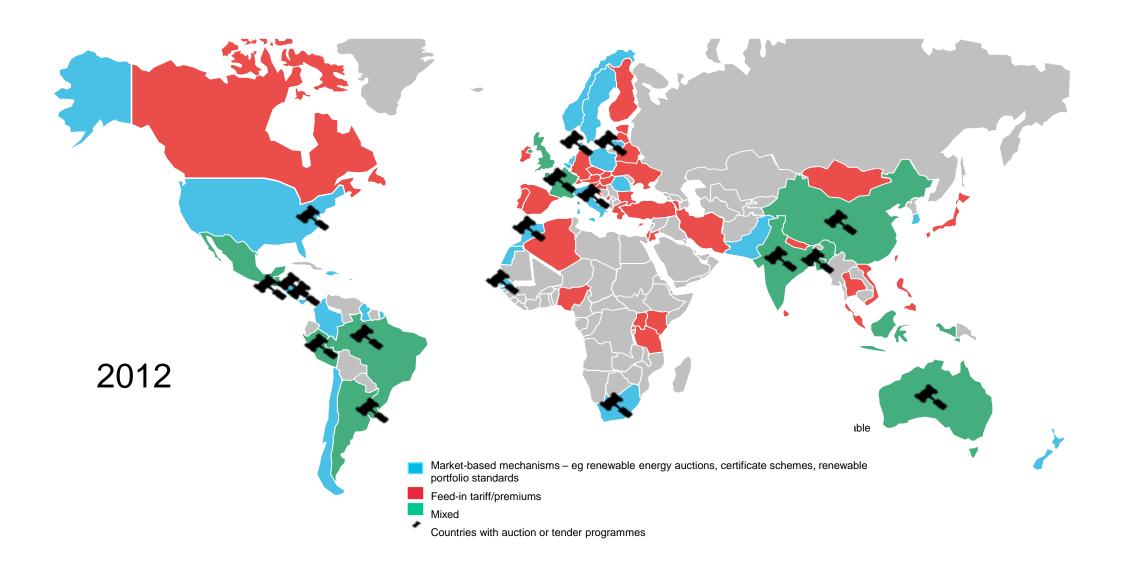




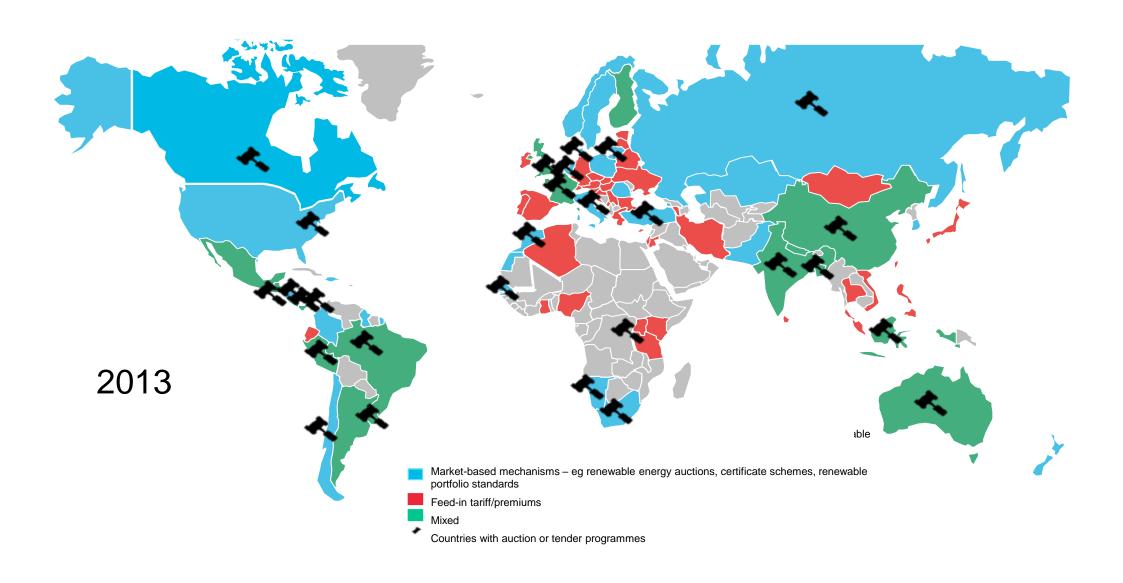




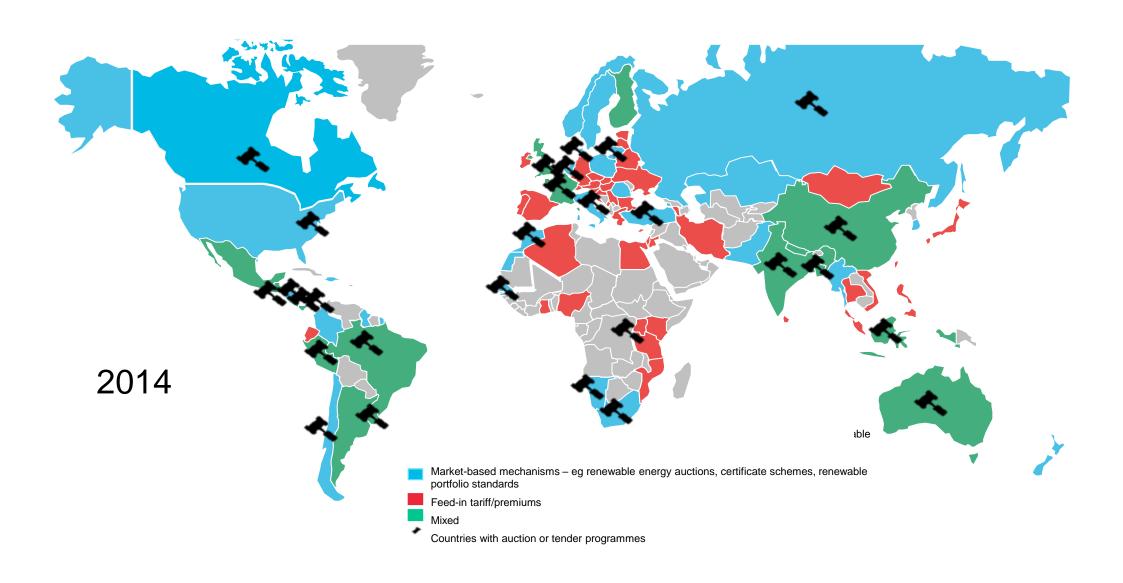




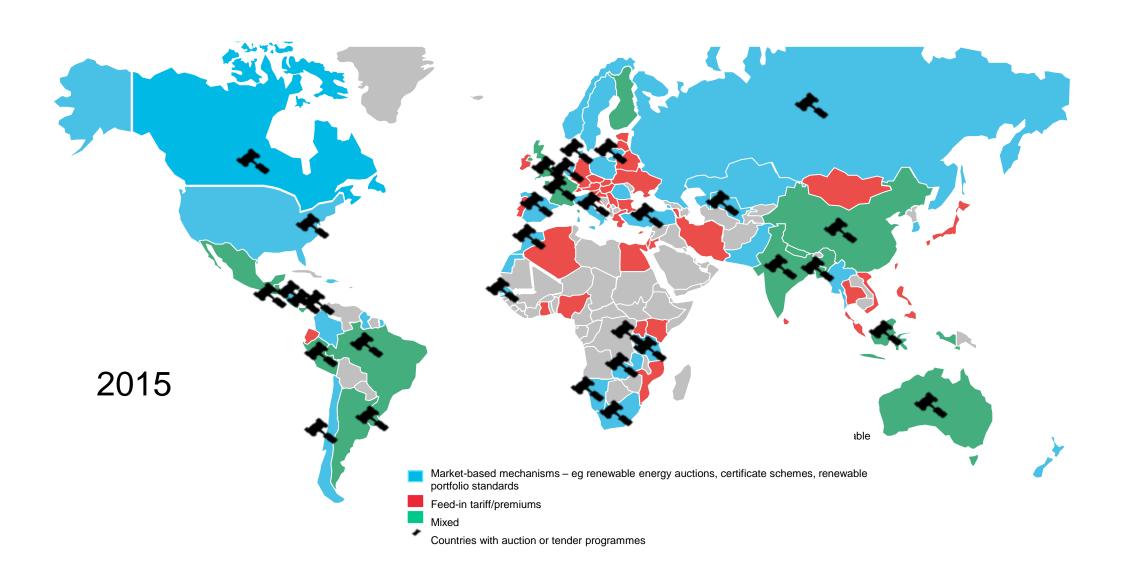




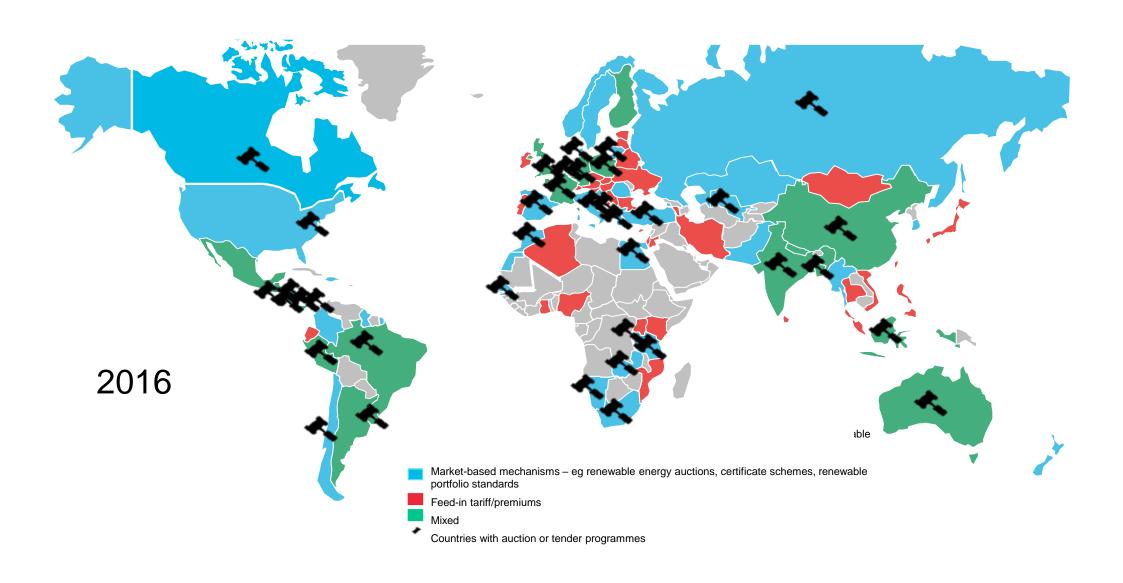












Michael Liebreich

ELECTRIC VEHICLES



CARS AND TRUCKS IN USE WORLDWIDE, 2016 1.3 billion



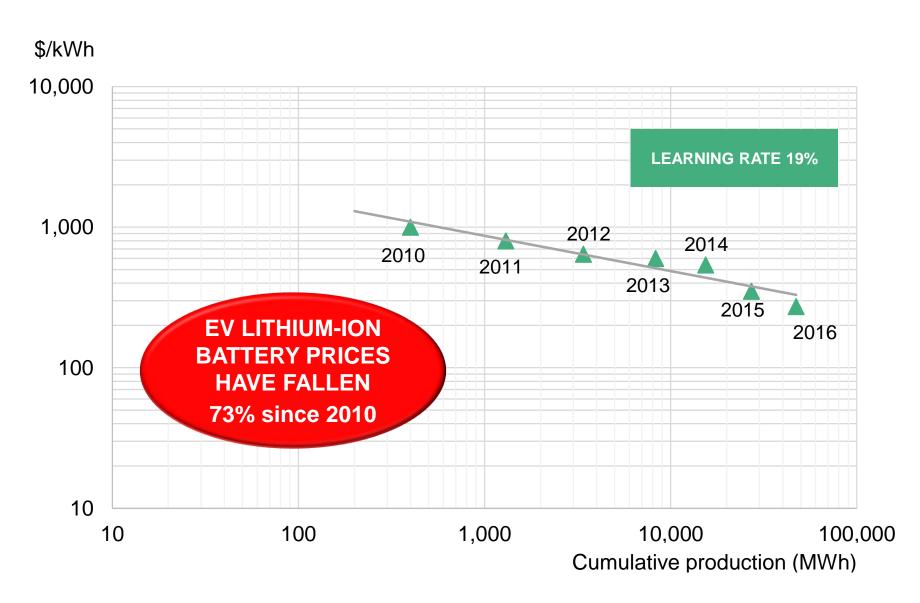


ELECTRIC VEHICLES IN USE WORLDWIDE, END 2016
1.8 million (to scale)

 $Source: Bloomberg\ New\ Energy\ Finance,\ International\ Organization\ of\ Motor\ Vehicle\ Manufacturers$

BNEF BATTERY PRICE LEARNING RATE 2013-2016 (\$ PER KWH)





Notes: This includes cells plus pack prices. For years where there were two surveys, the data in this chart is an average for the year. Prices are nominal.

Source: Bloomberg New Energy Finance

EV MASS MARKET / SECOND CARS \$30,000 + 200 MILES RANGE





Images: Tesla, BMW, VW, GM, Nissan

Michael Liebreich





Picture: UNFCCC

@MLiebreich

PARIS



The Paris Agreement is a monumental triumph for people and our planet.

Together we have opened the door to a sustainable and climate-safe future for all.

Ban Ki Moon, former UN SG

Christiana Figueres, former head, UNFCCC

This is a turning point. This gives us the best possible shot to save the one planet we got.

Barack Obama. US President

The Paris Agreement has been an unprecedented historic success. >>

Miguel Arias Cañete, European Commissioner for Climate Action and Energy

66

It is a sign of hope. It can have a positive influence on the living conditions of billions of people.

Angela Merkel, Chancellor of Germany

66

Today's agreement signals nothing less than a renaissance for humankind.

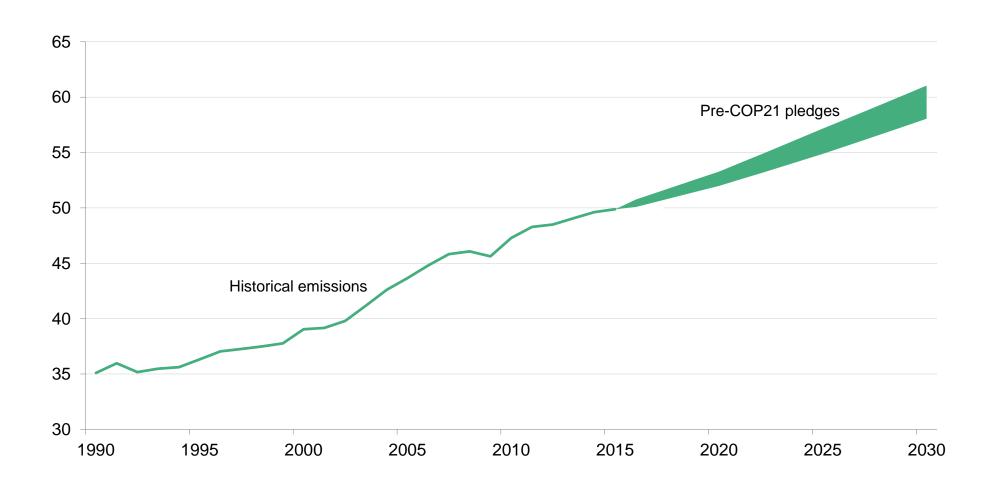
"

Mr. Mogens Lykketoft, President, UN General Assembly

GLOBAL GREENHOUSE GAS EMISSIONS



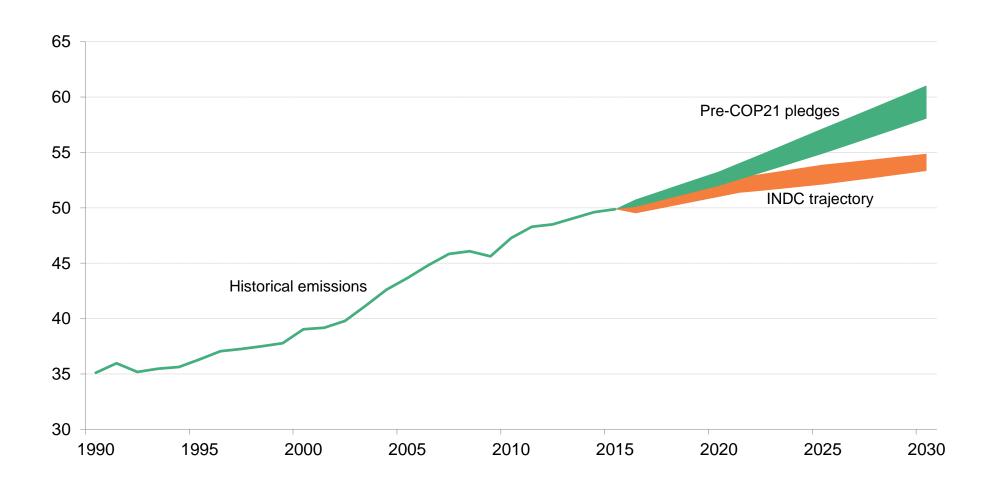
(GTCO2)



GLOBAL GREENHOUSE GAS EMISSIONS



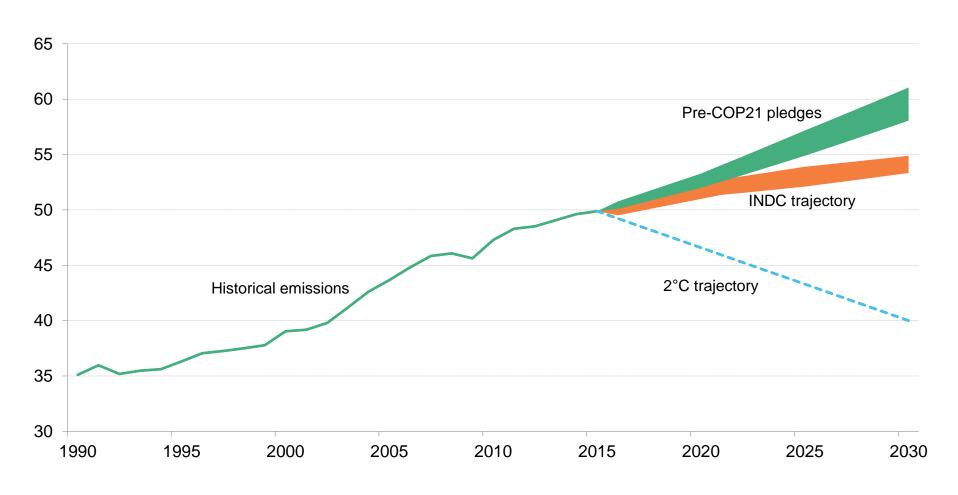
(GTCO2)



GLOBAL GREENHOUSE GAS EMISSIONS

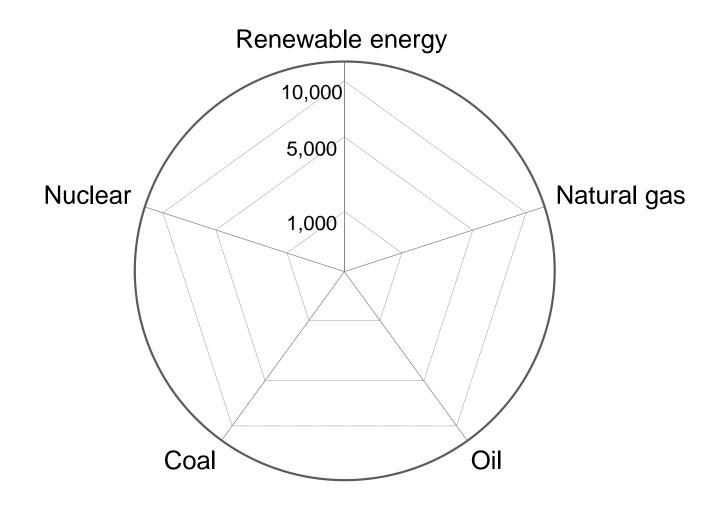


(GTCO2)



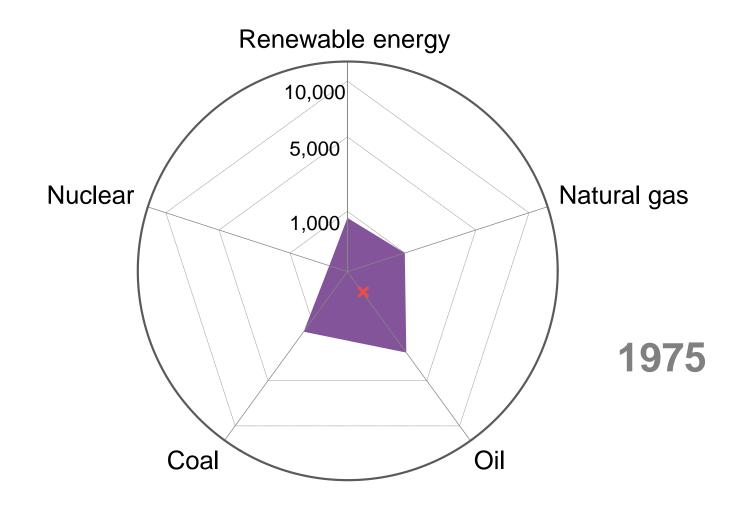
 $Source: \, \mathsf{UNFCCC}, \, \mathsf{UNEP}, \, \mathsf{Climate} \, \, \mathsf{Action} \, \, \mathsf{Tracker}, \, \mathsf{Bloomberg} \, \, \mathsf{New} \, \, \mathsf{Energy} \, \, \mathsf{Finance}$





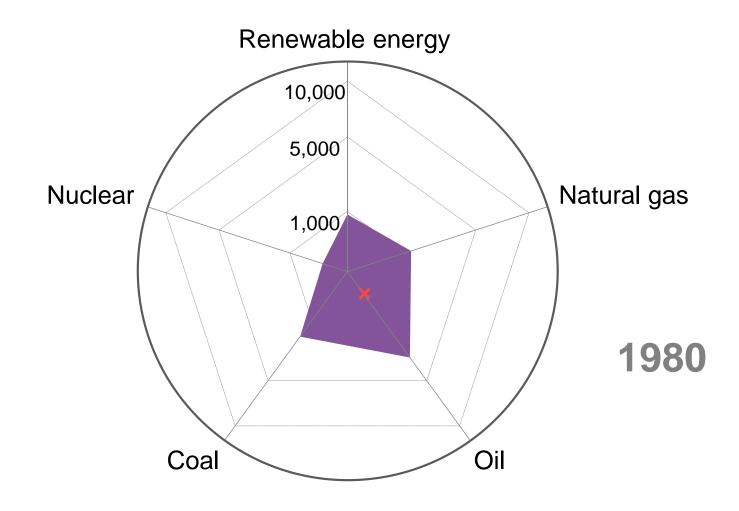










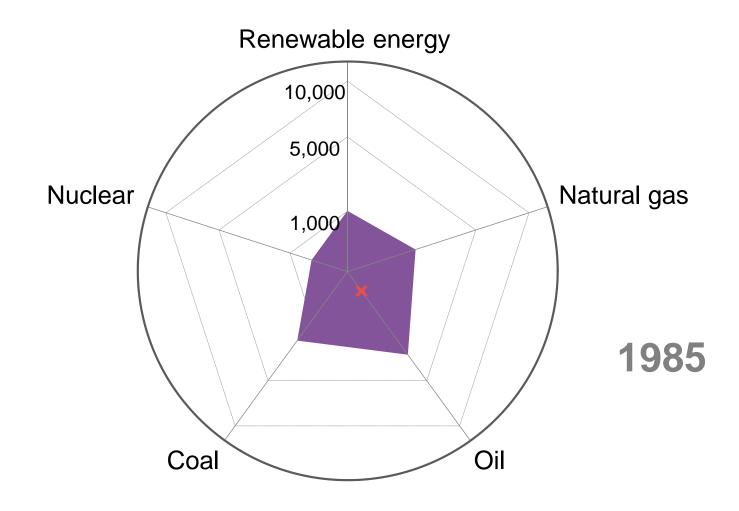


Source: Bloomberg New Energy Finance, IEA

Michael Liebreich







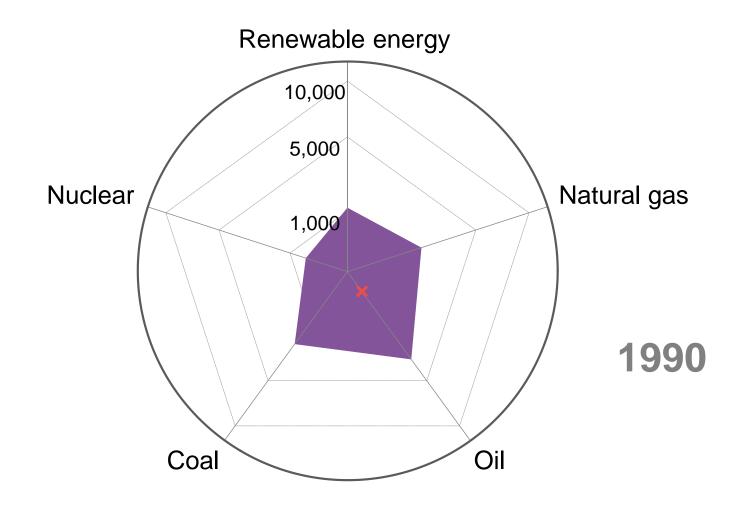
Michael Liebreich

Source: Bloomberg New Energy Finance, IEA

@MLiebreich







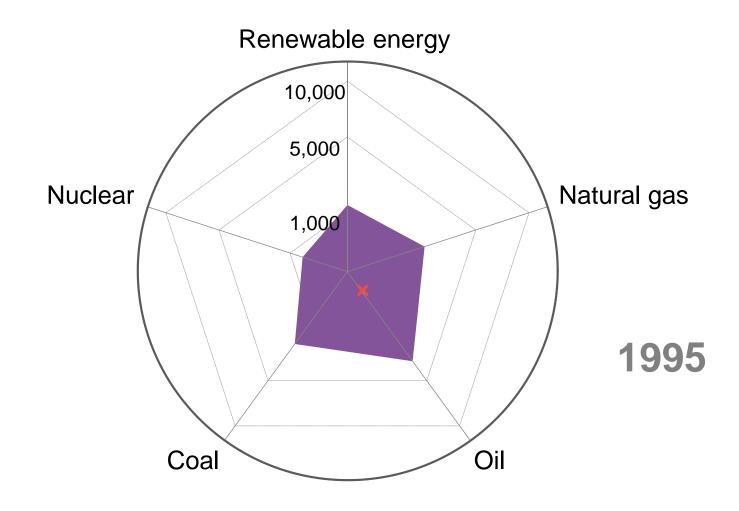
Michael Liebreich

Source: Bloomberg New Energy Finance, IEA

@MLiebreich





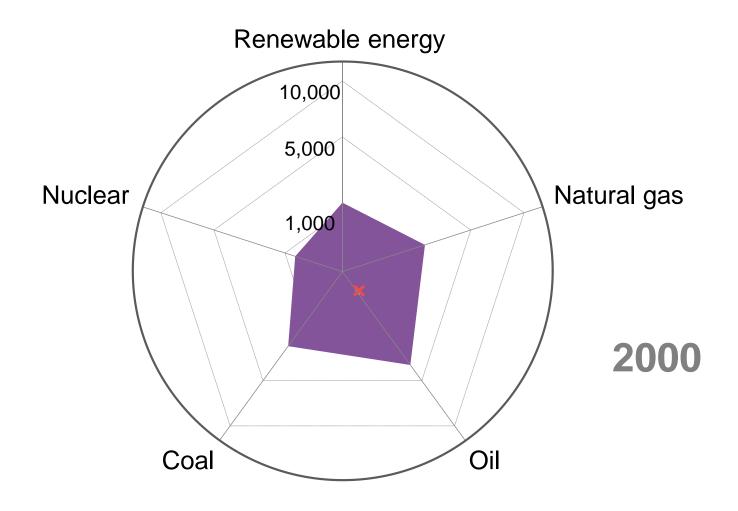


Source: Bloomberg New Energy Finance, IEA

Michael Liebreich

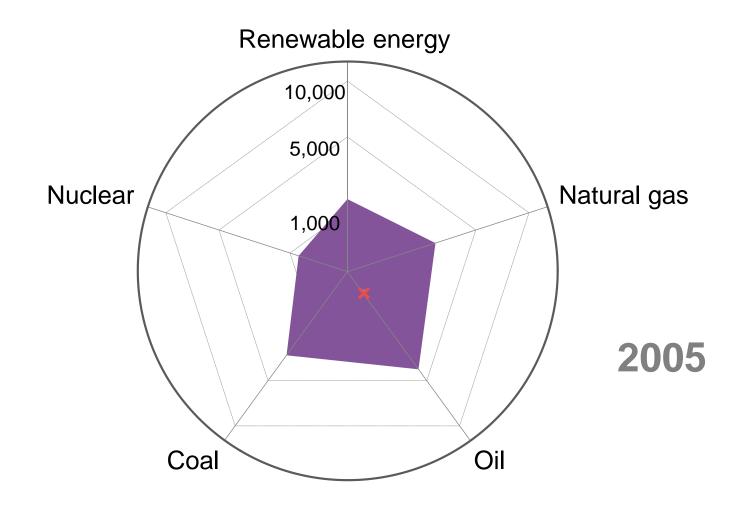






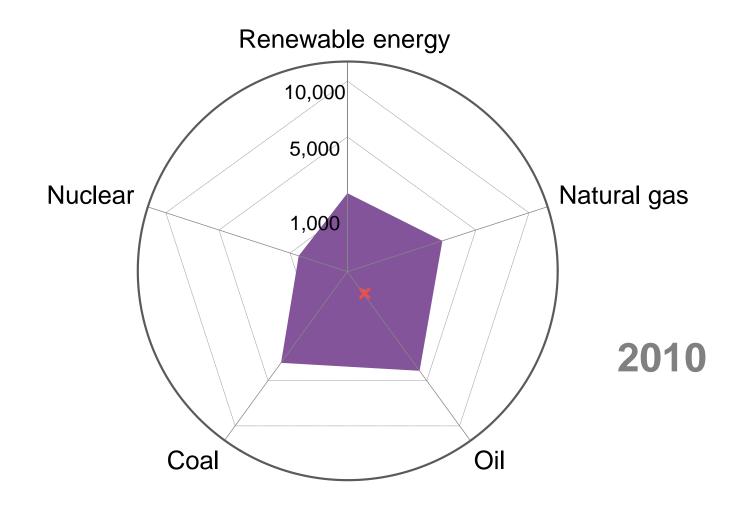










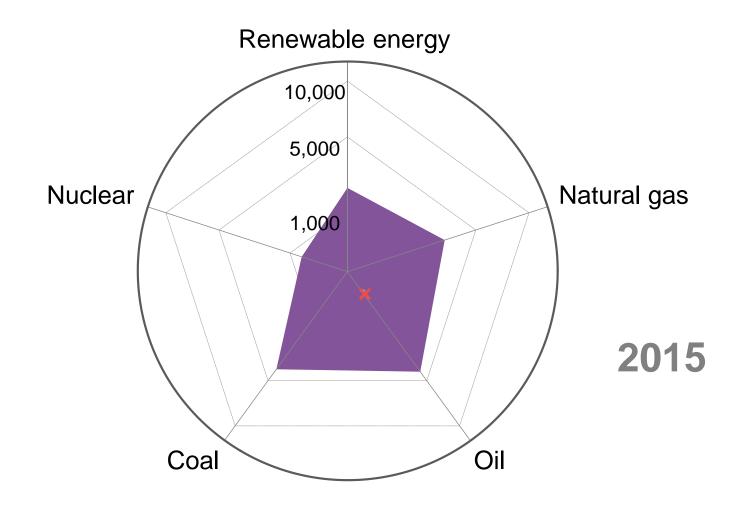


Source: Bloomberg New Energy Finance, IEA

Michael Liebreich



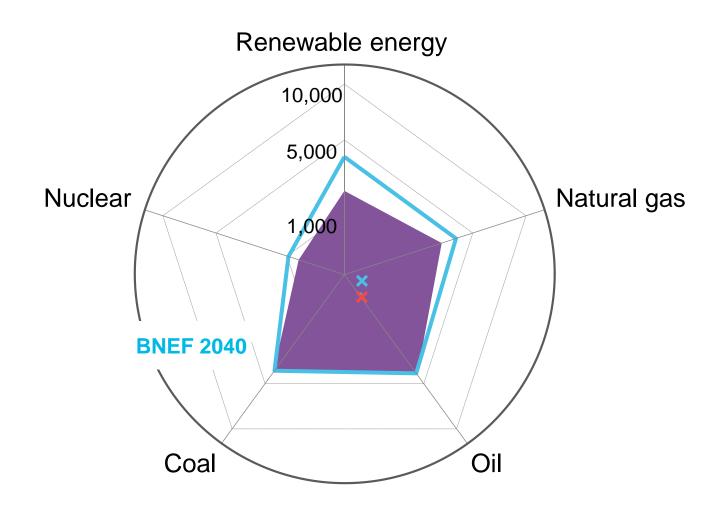




Source: Bloomberg New Energy Finance, IEA

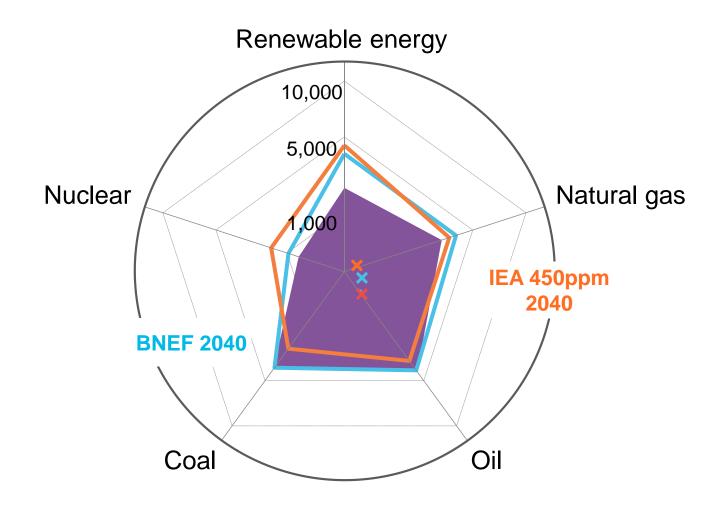
Michael Liebreich





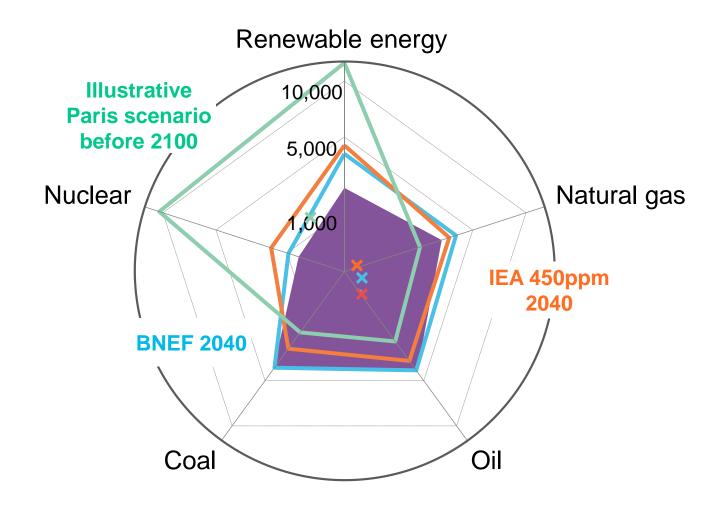
Note: BNEF adjusted IEA NPS forecast using its own electricity generation and EV demand forecast. Renewables total includes bioenergy and hydro.





Note: BNEF adjusted IEA NPS forecast using its own electricity generation and EV demand forecast. Renewables total includes bioenergy and hydro.

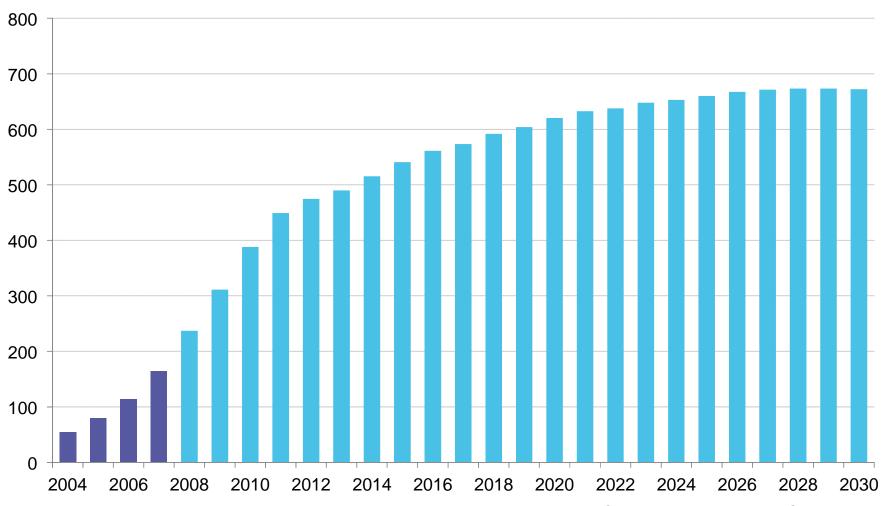




Note: BNEF adjusted IEA NPS forecast using its own electricity generation and EV demand forecast. Renewables total includes bioenergy and hydro. Paris illustrative scenario assumes some carbon capture.

CLEAN ENERGY CAPITAL REQUIREMENT TO 2030 (\$BN)



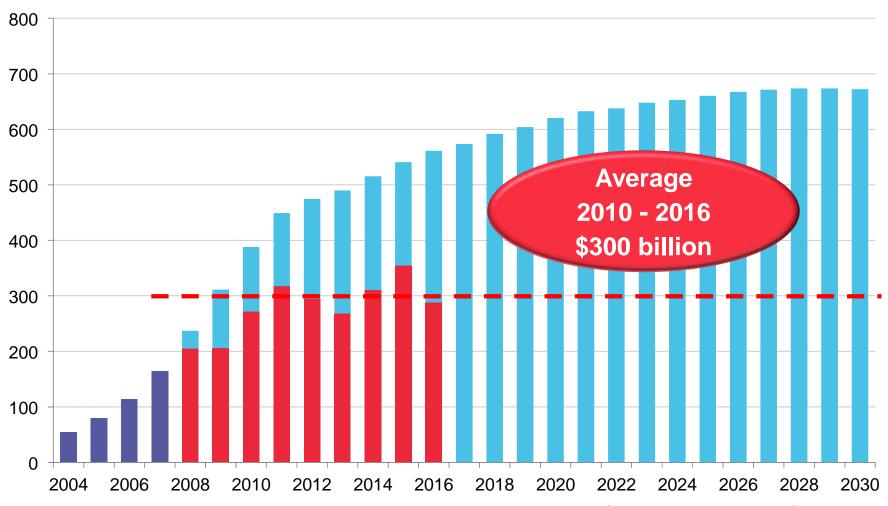


Note: Global Futures figures from 2008 restated to reflect current investment calculation methodology

Source: New Energy Finance Global Futures 2008, Bloomberg New Energy Finance

CLEAN ENERGY CAPITAL REQUIREMENT TO 2030 (\$BN)





Note: Global Futures figures from 2008 restated to reflect current investment calculation methodology

Source: New Energy Finance Global Futures 2008, Bloomberg New Energy Finance

WHY IS ALL THIS SO HARD?



- 1. Challenge of information (technology, engineering, human behaviour, economics etc)
- 2. Challenge of strategy(decision-making in uncertainty, poverty reduction vs growth)
- 3. Challenge of leadership (political, business, civic society)
- 4. Challenge of implementation (unintended consequences, agenda creep)
- 5. Challenge of inertia (social, physical, financial, incumbency)

Thanks!

MARKETS

Renewable Energy
Energy Smart Technologies
Advanced Transport
Gas
Carbon and RECs

SERVICES

Americas Service Asia Pacific Service EMEA Service Applied Research Events and Workshops Michael Liebreich
Twitter: @MLiebreich

Unique analysis, tools and data for decision-makers driving change in the energy system

