

Low carbon technologies in the 21st century

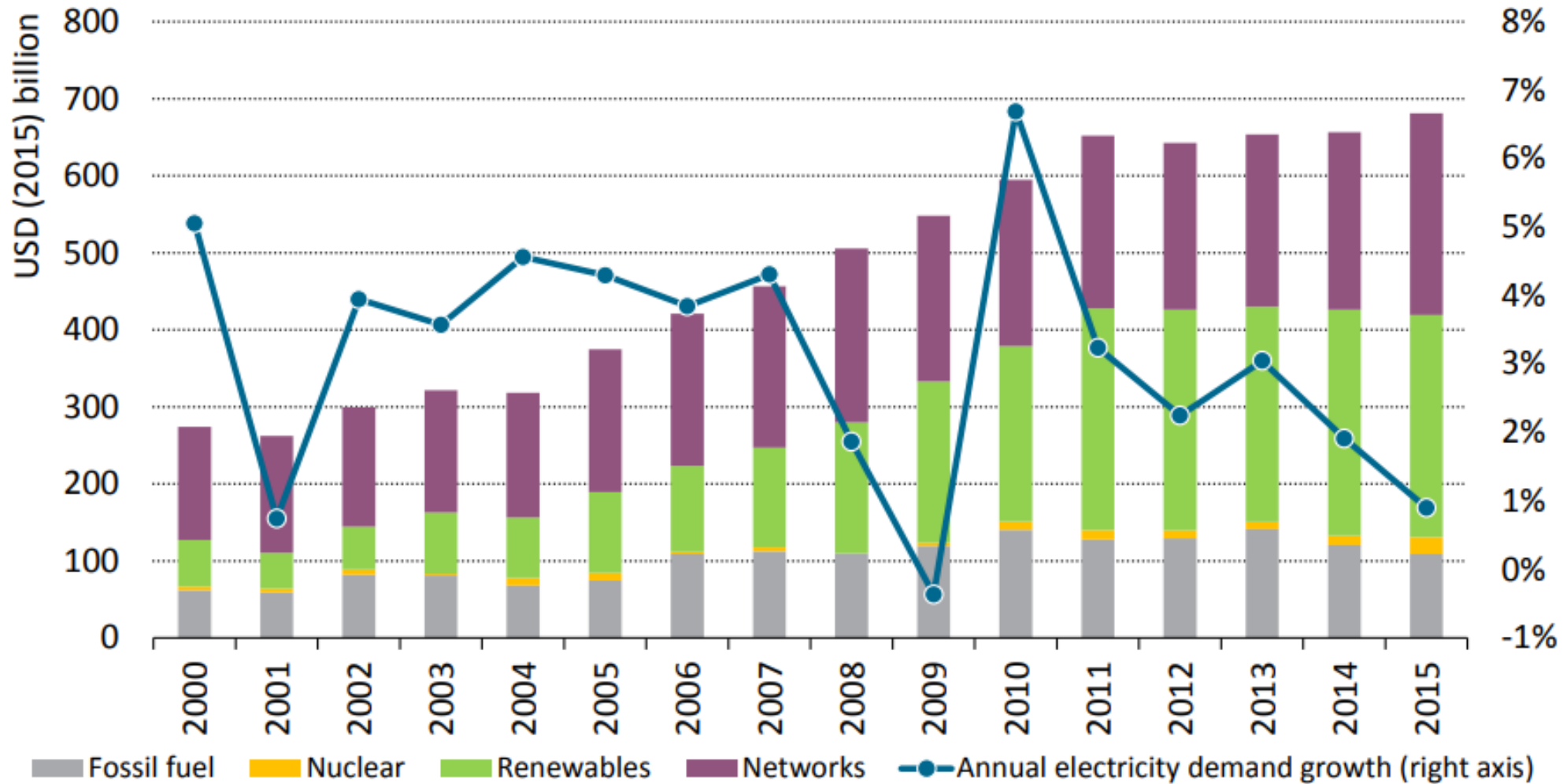
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Life cycle CO₂ equivalent of selected electricity supply technologies.

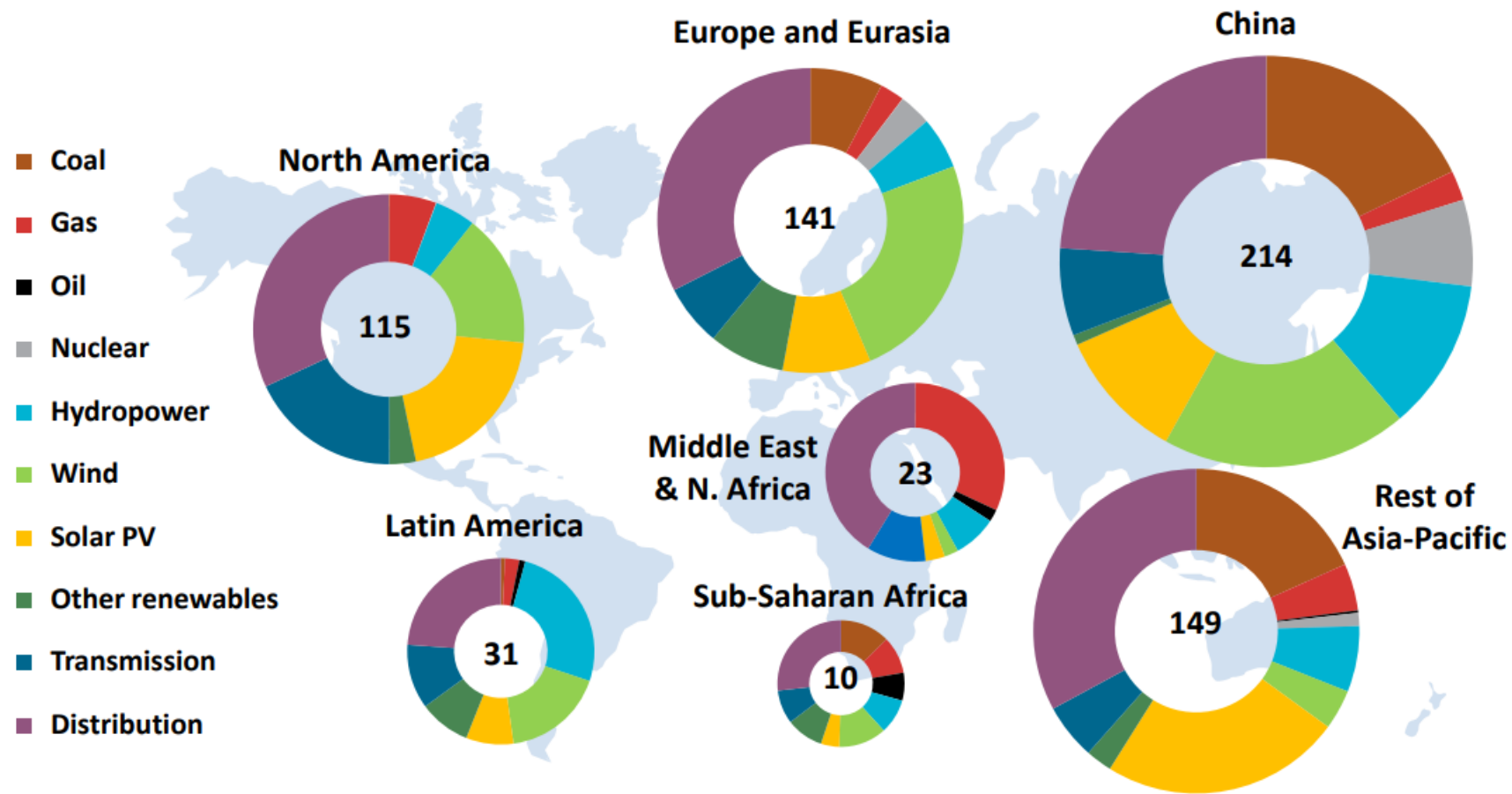
Technology	Median	Technology	Median
Coal	820	Geothermal	38
Biomass co-fired with coal	740	Concentrated solar power	27
Gas – combined cycle	490	Hydropower	24
Biomass – dedicated	230	Wind offshore	12
Solar PV – utility scale	48	Nuclear	12
Solar PV – rooftop	41	Wind onshore	11

Arranged by decreasing median values. In gCO₂eq/kWh

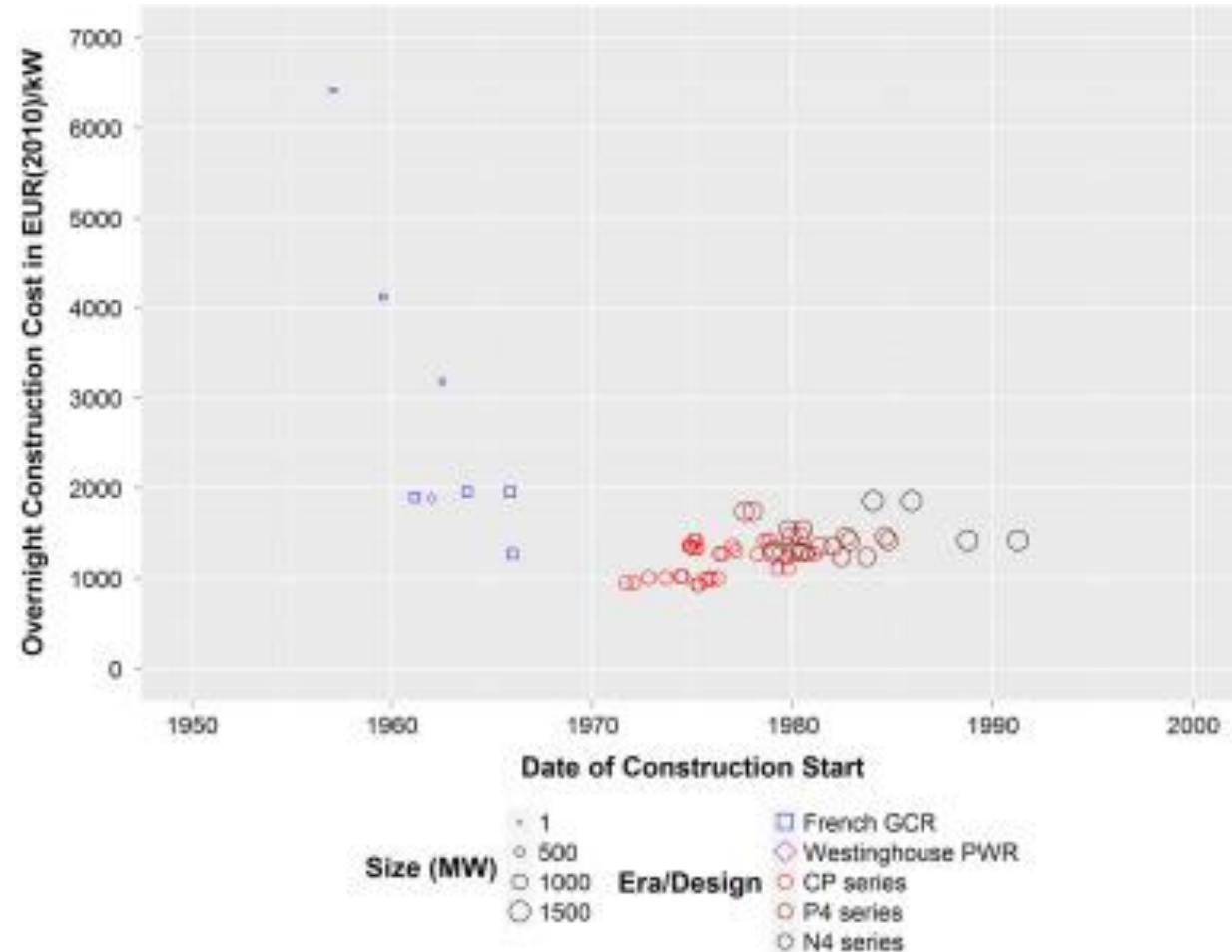
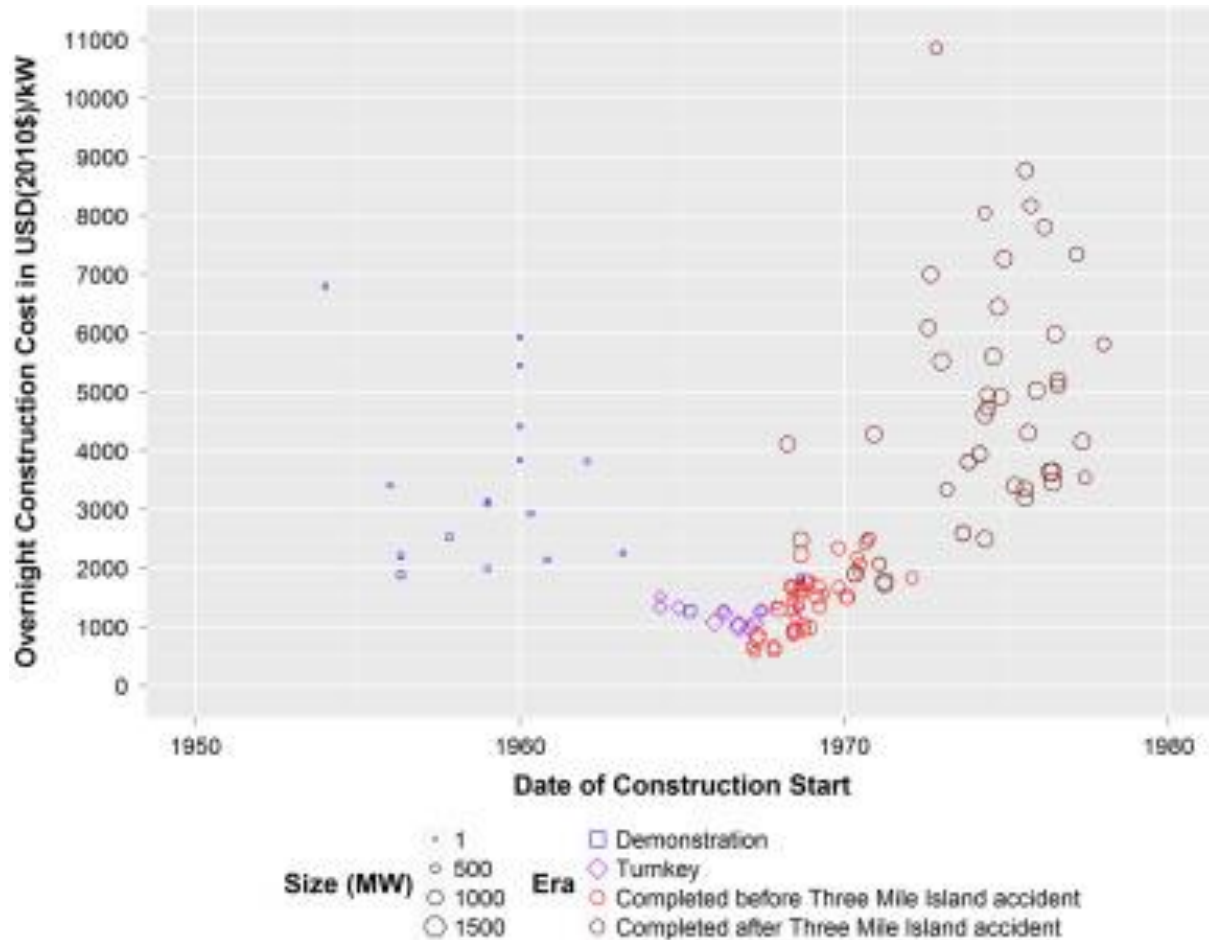
Global investments in power generation, electricity networks and demand growth



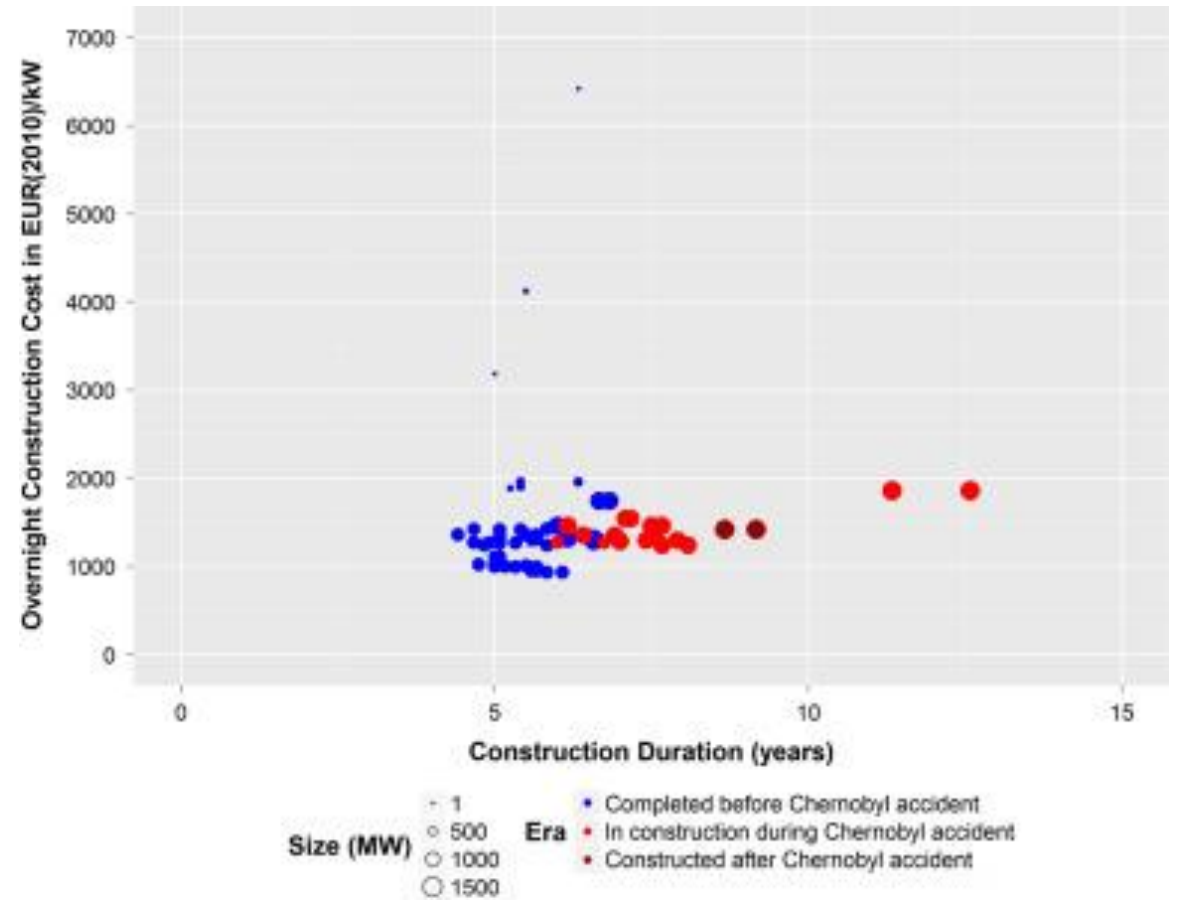
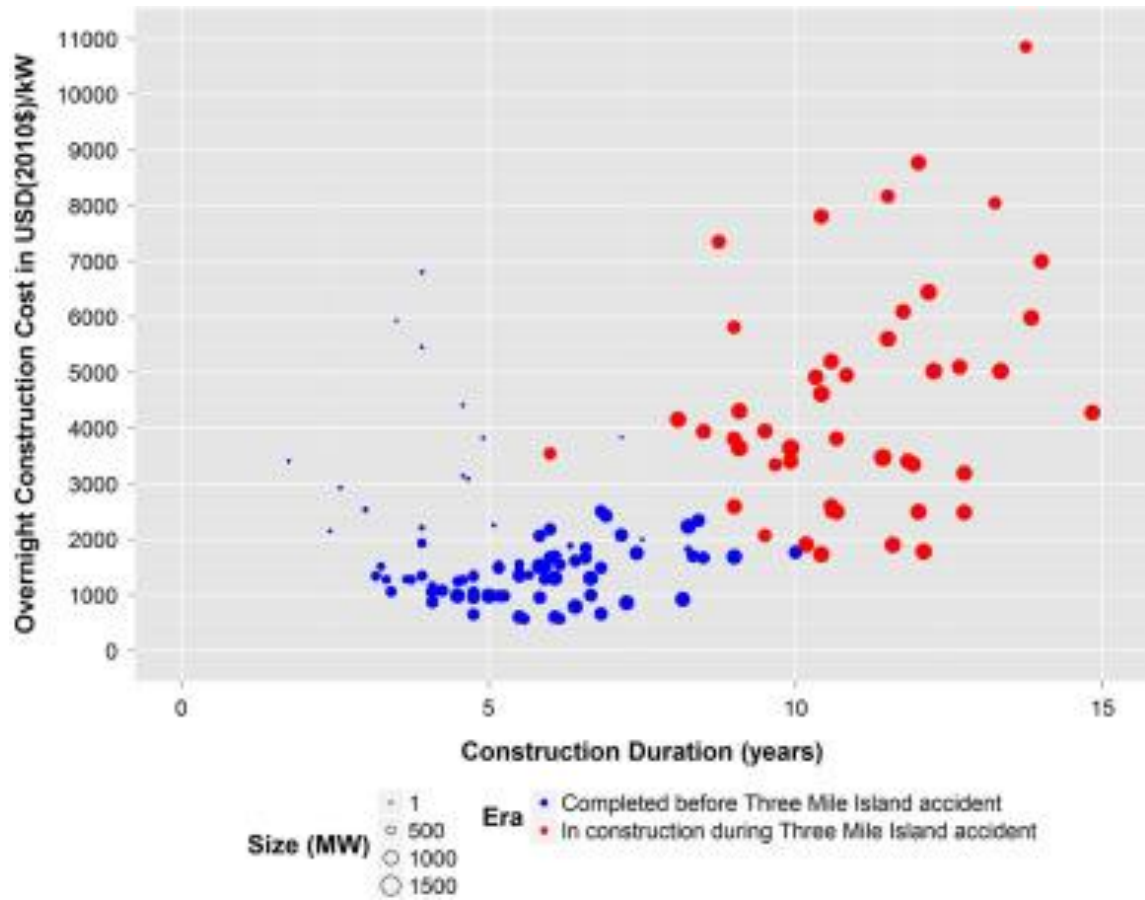
Investments in the electricity generation and networks, 2015 (in USD2015 billions)



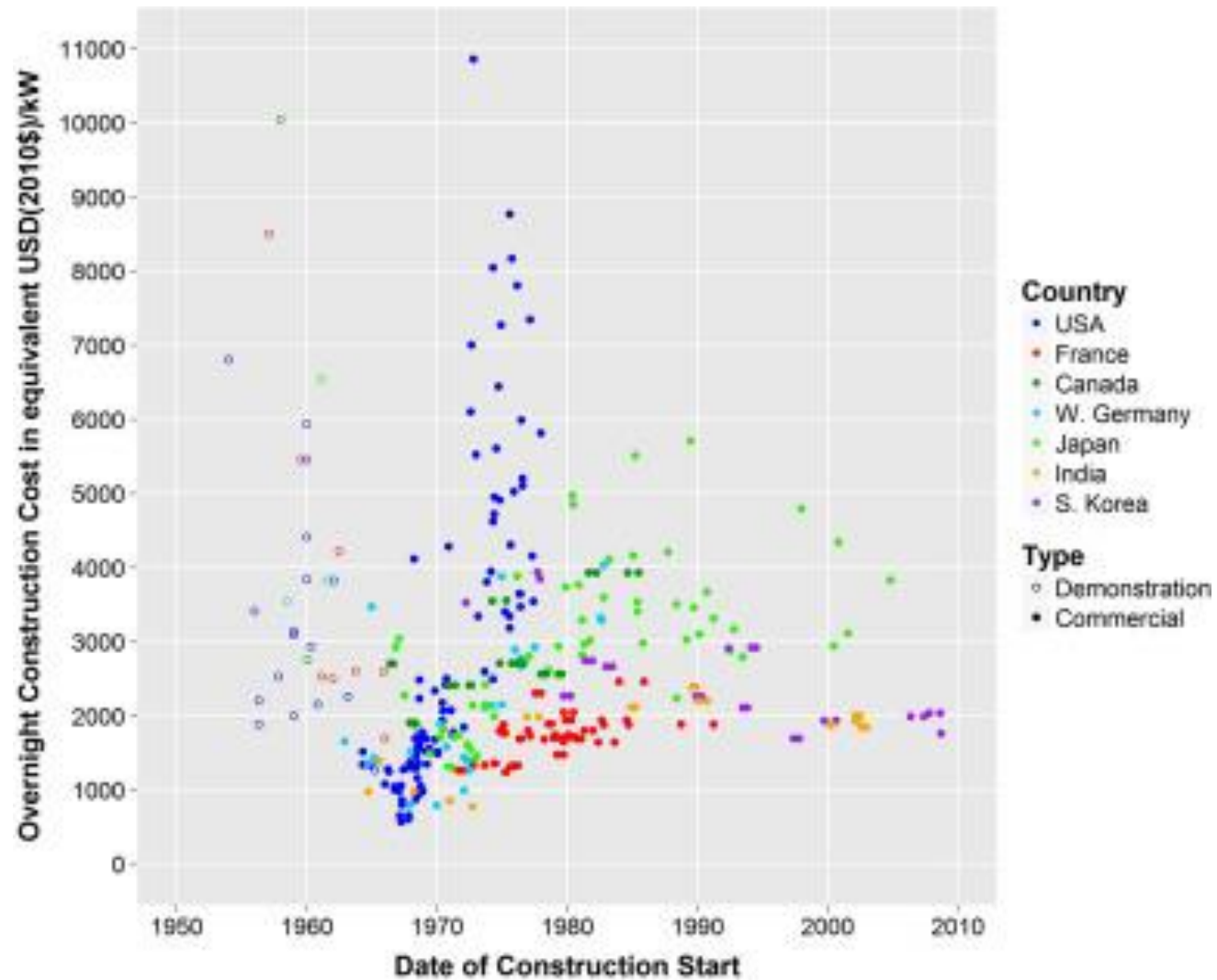
Overnight construction costs (OCC) in 2015USD/kW, USA and France



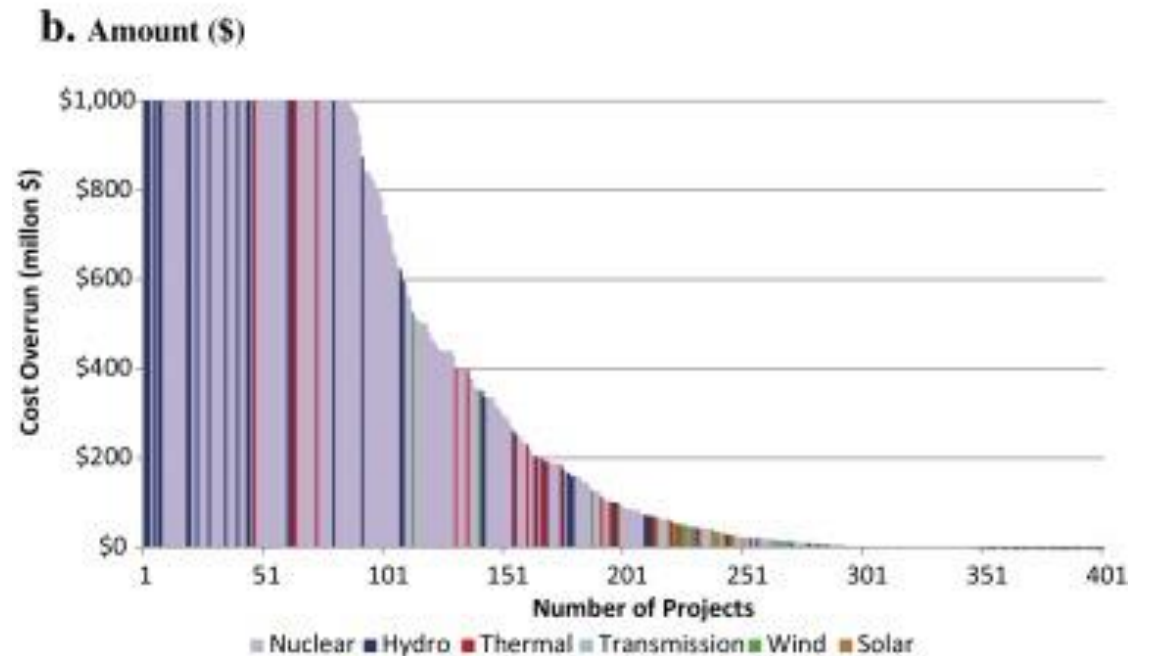
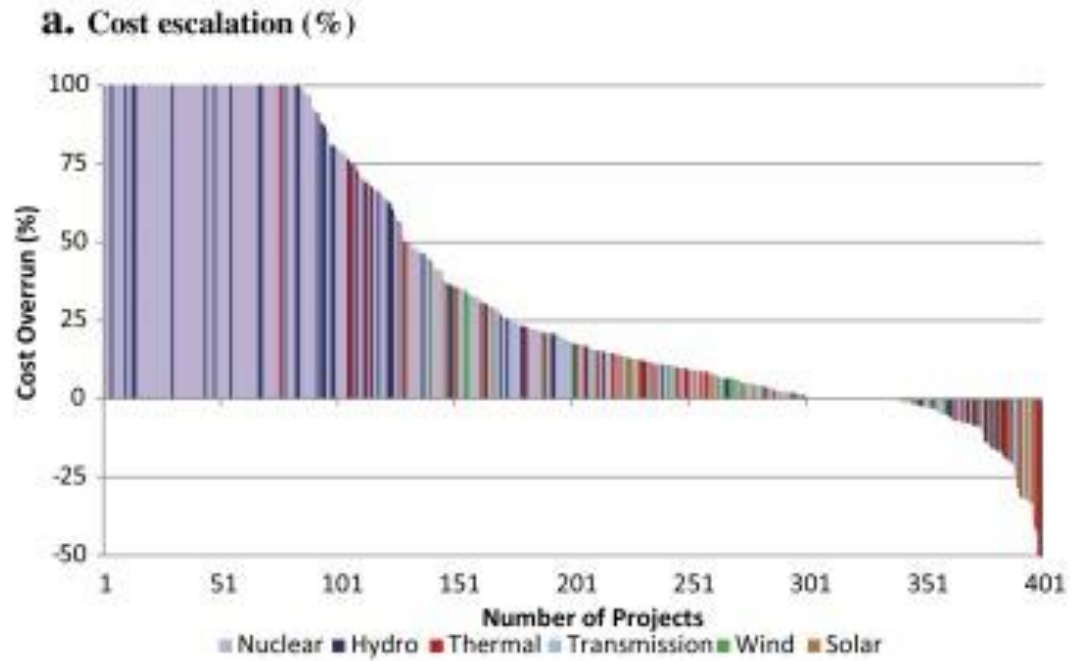
Construction duration, USA and France



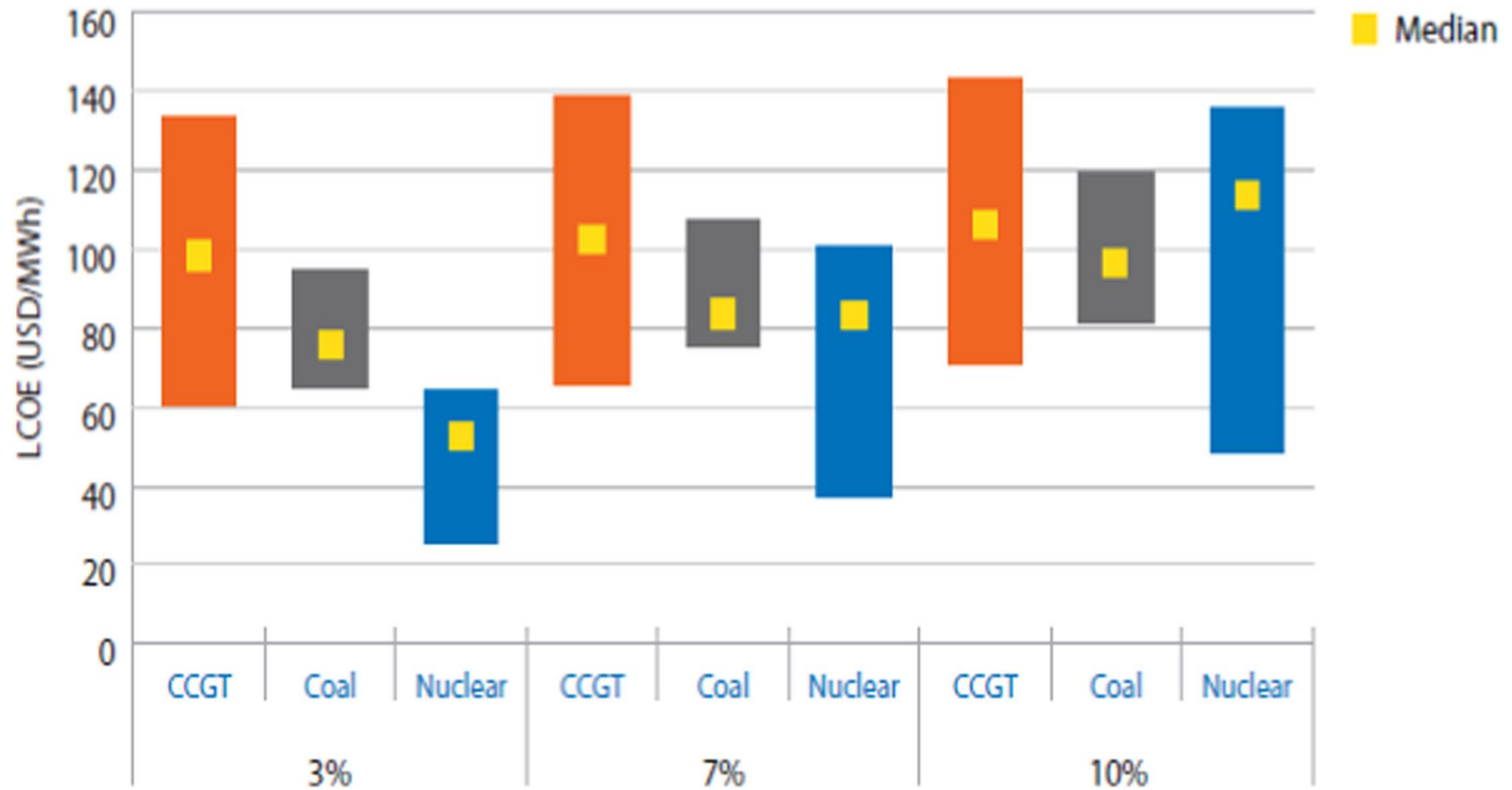
OCC of global nuclear reactors in USD2010



Distribution of construction overrun costs by technology (n = 401)



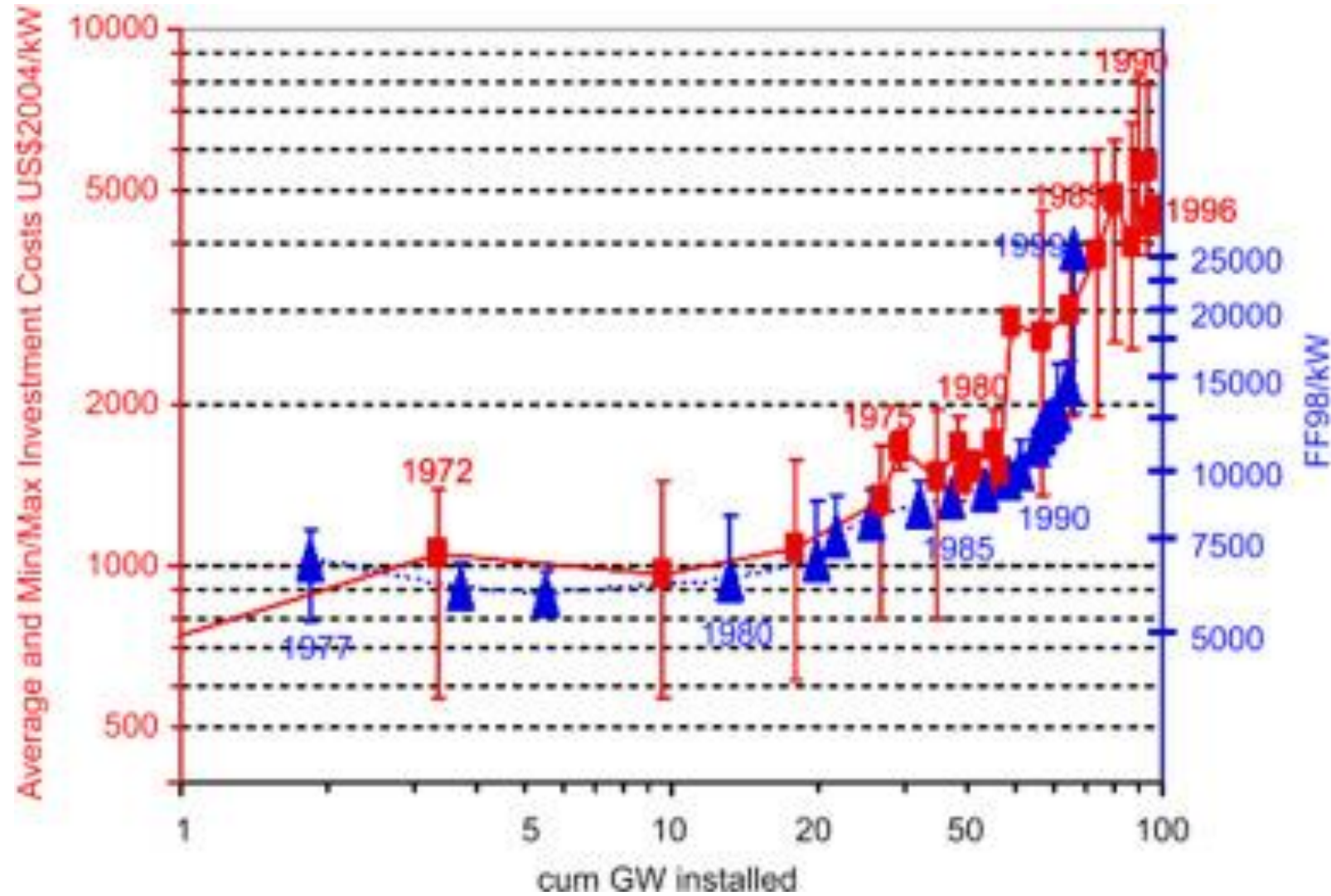
LCOE for base load technologies, at different discount rates



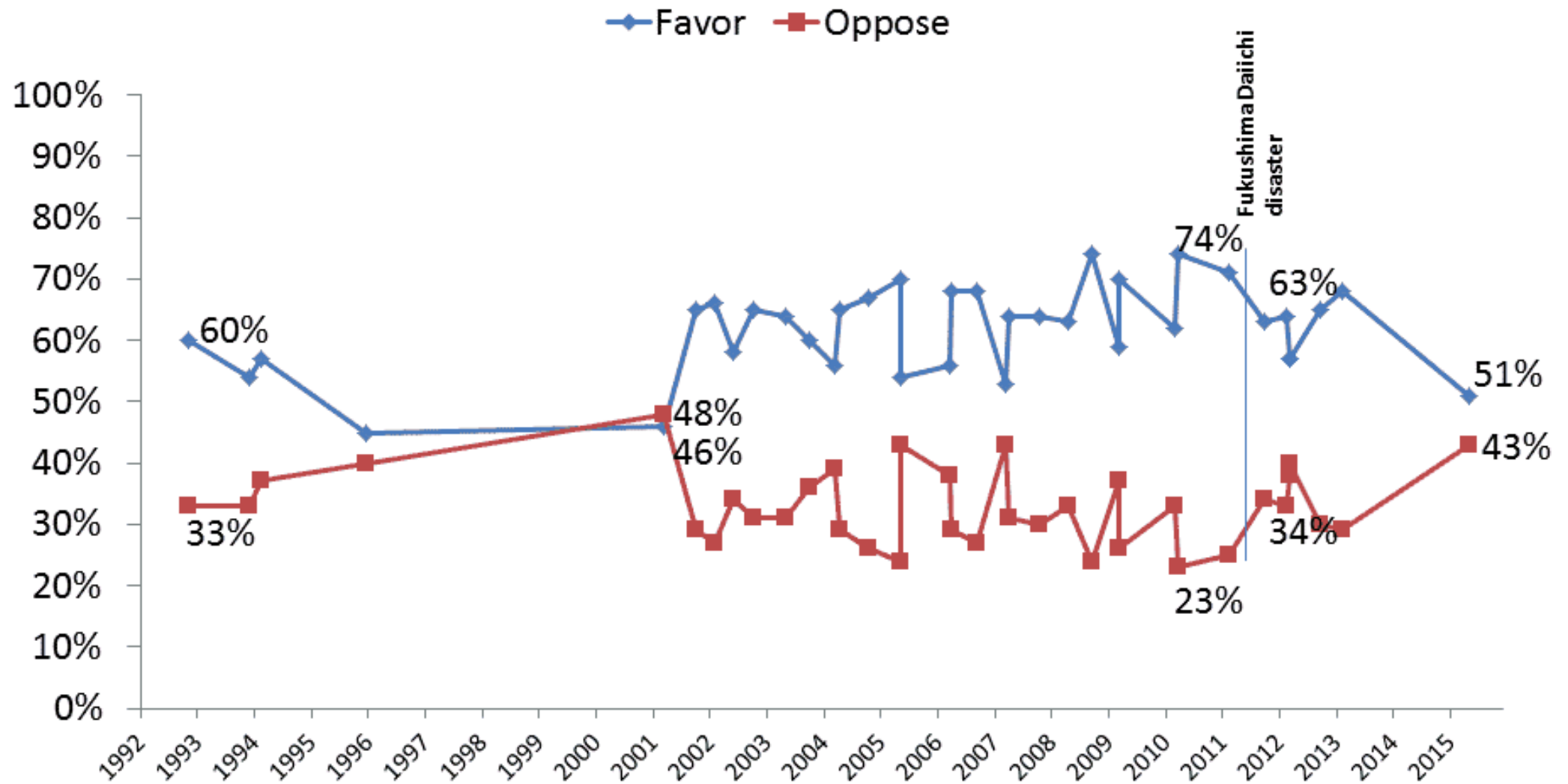
NPP in the EU in progress

- Flamanville NPP – construction started in 2007, with scheduled commissioning in 2012 and planned costs €3,3bn. Last information (from 2015) – commissioning in 2018 for €10,5bn.
- Olkiluoto NPP – construction started in 2005, with scheduled commissioning in 2010 and planned costs of €3bn. Last information (from 2017) – commissioning in 2018 for €8,5-10bn+.
- Mochovce NPP – construction re-started in 2009, with scheduled commissioning in 2012 and 2013 and planned costs of €2,775bn. . Last information (from 2017) – commissioning in 2018-2019 for €3,8bn.

Experience curve of USA/Fr NPPs



Favor or oppose the use of nuclear energy as one of the ways to provide electricity in the United States



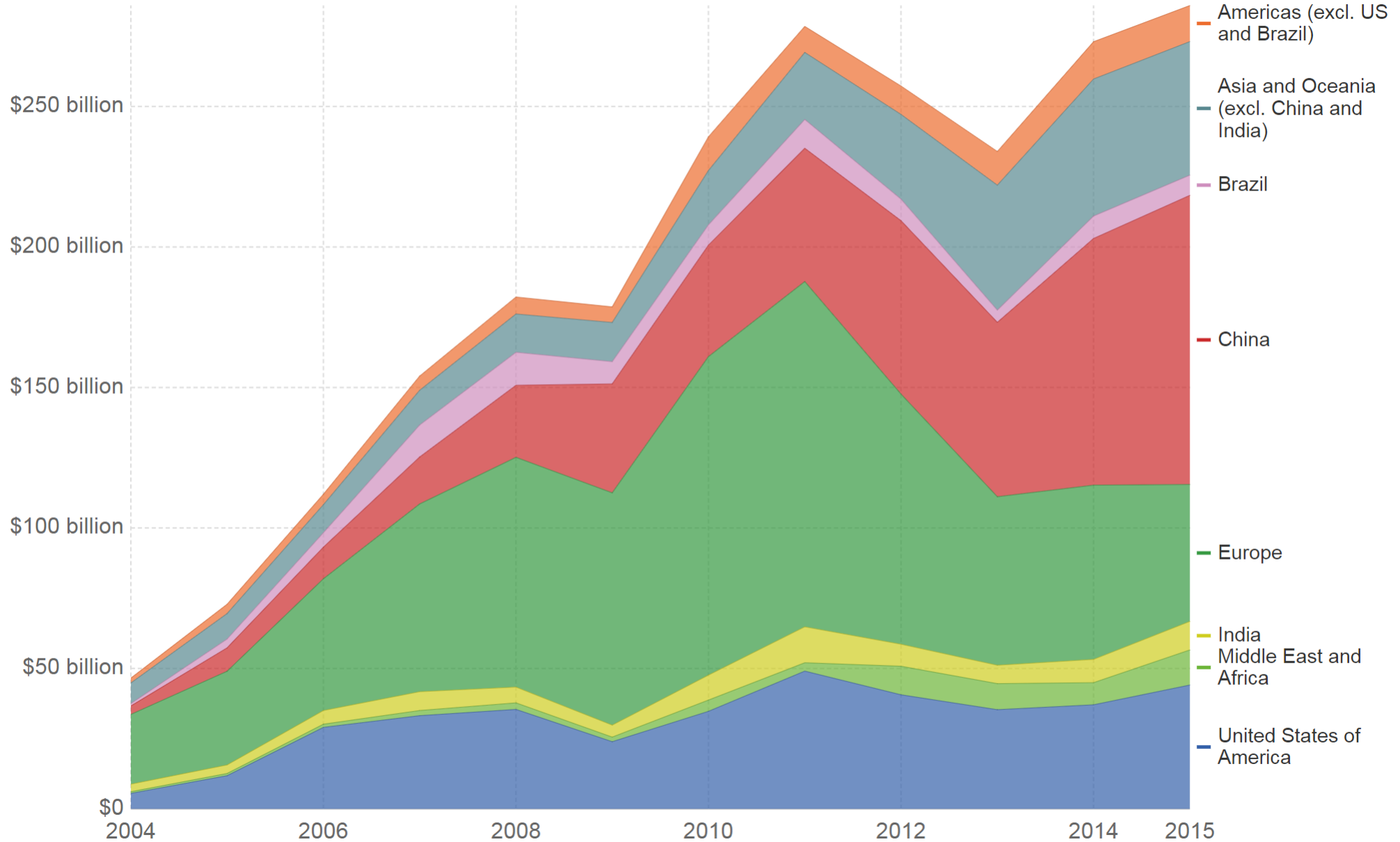
Strongly positive	Positive	Neutral	Rather negative	Strongly negative
Finland	UK	Luxemburg	Greece	Ireland
France	The Netherlands	Denmark	Sweden	Germany
Lithuania	Estonia	Malta	Belgium	Austria
Romania	Portugal	Cyprus		Italy
Bulgaria	Poland	-	Latvia	-
The Czech Republic	Slovenia	-	Lithuania	-
Hungary			Spain	-
Slovakia		-	-	-

Nuclear phase-outs

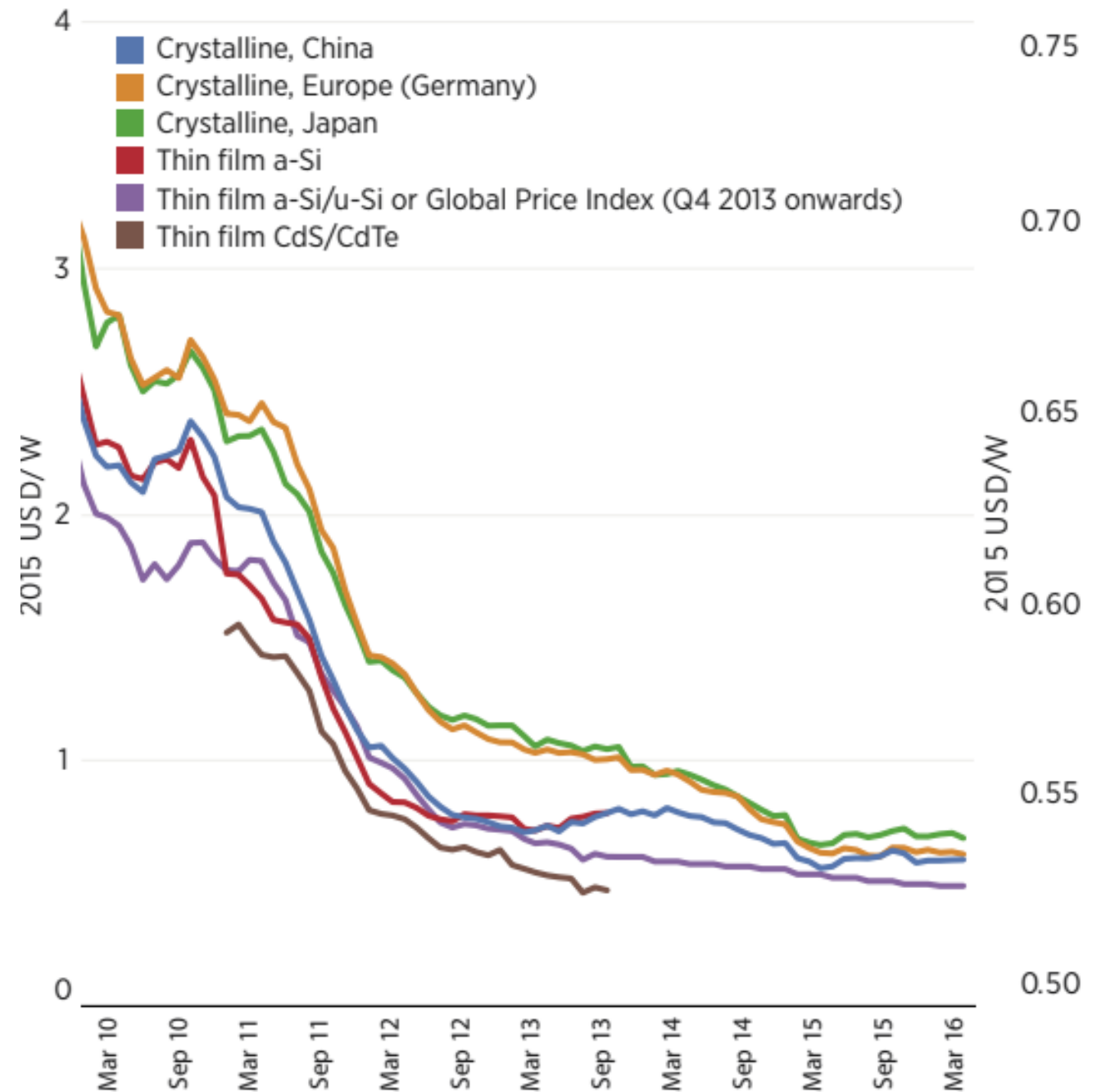
- Austria – 1997
- Germany – 2011
- Italy – 1987 (after Chernobyl)
- Sweden - 1980 (after Three Mile Island), renounced in 2010.
- New Zealand – 1987
- ...
- ...

Renewable Energy Investment

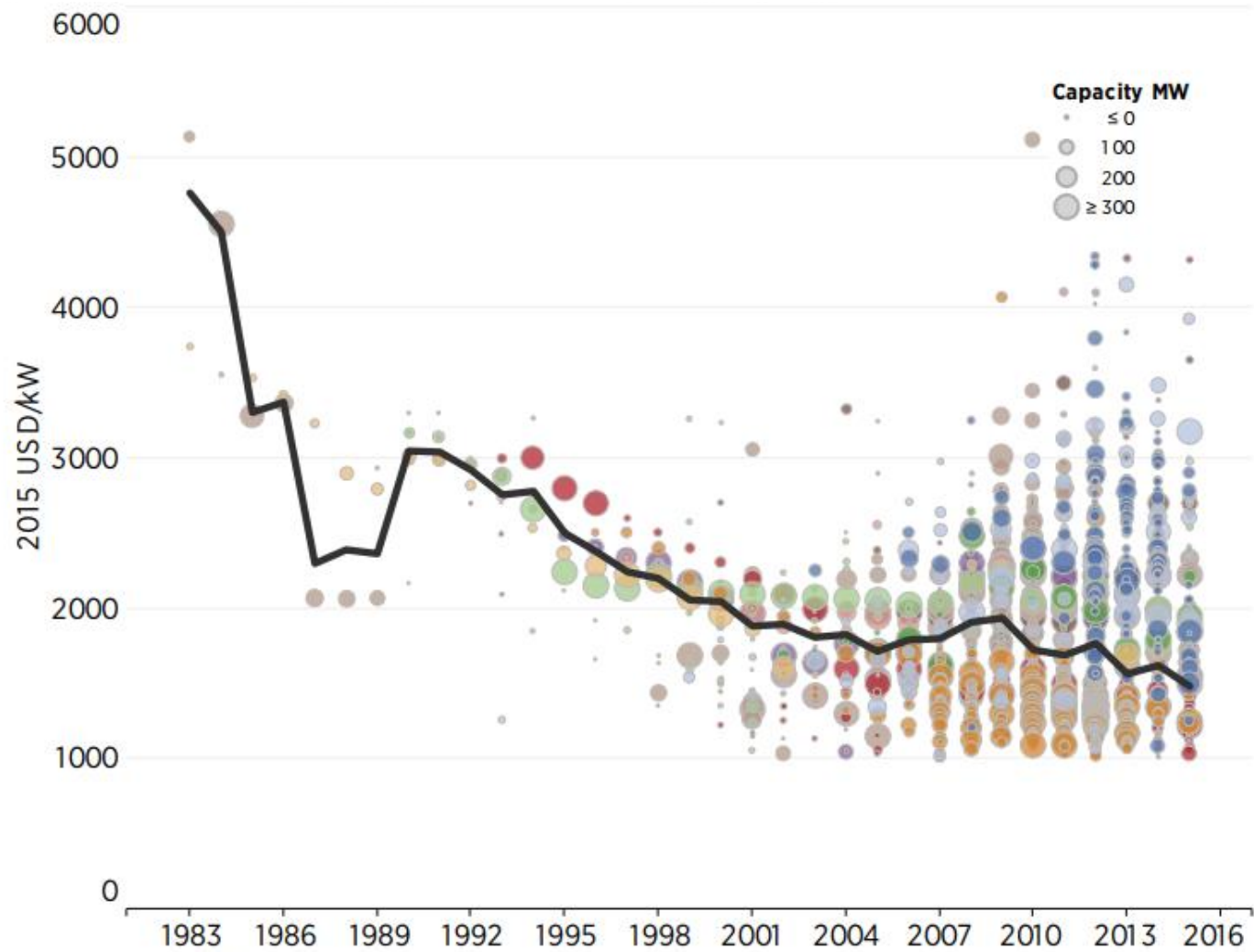
Investment in renewable energy technologies per year in billion US dollars by region.



Global PV module price trends 2009-2016

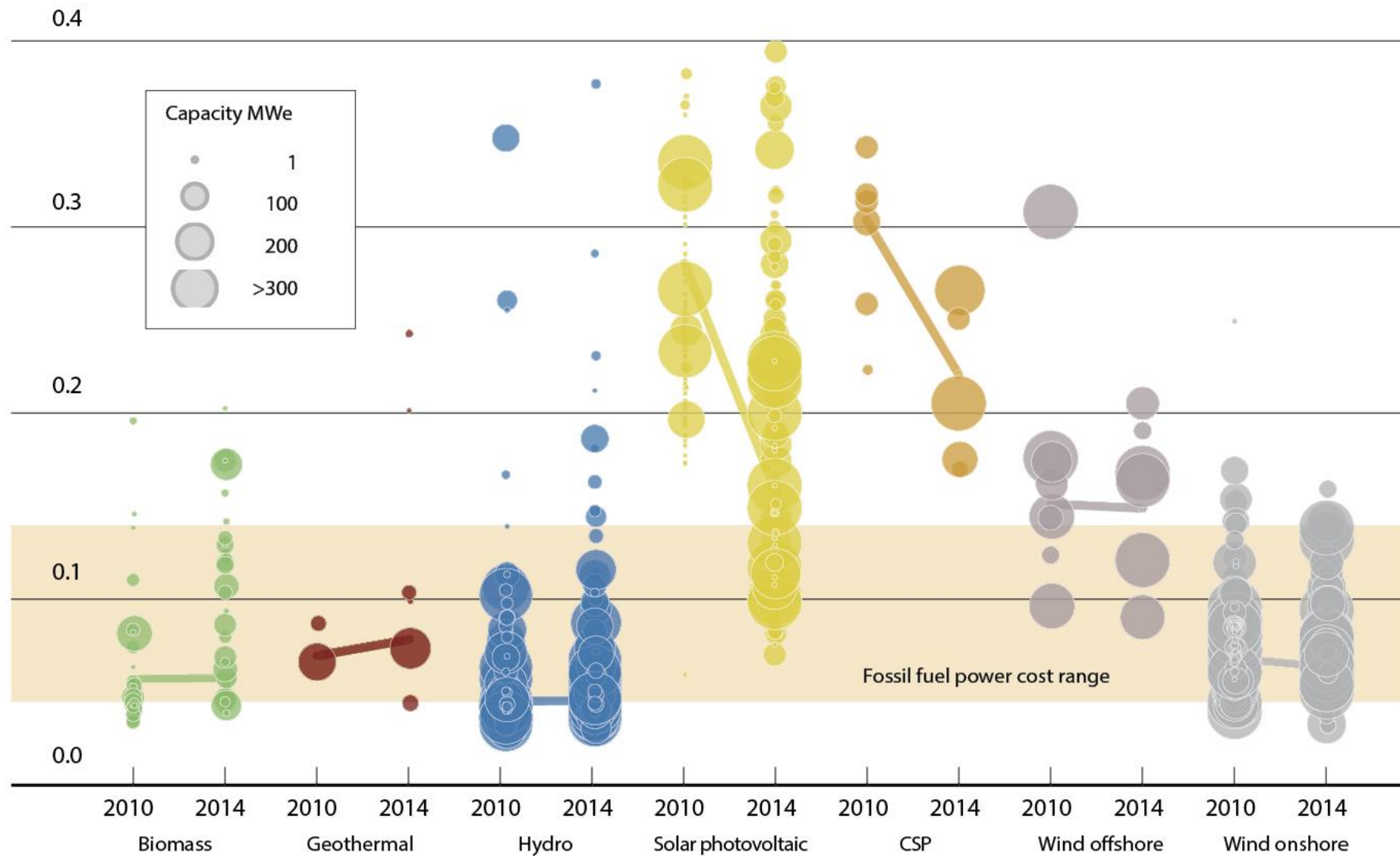


Total installed costs of onshore wind by country 1983-2014



E.S. 1: THE LEVELISED COST OF ELECTRICITY FROM UTILITY-SCALE RENEWABLE TECHNOLOGIES, 2010 AND 2014

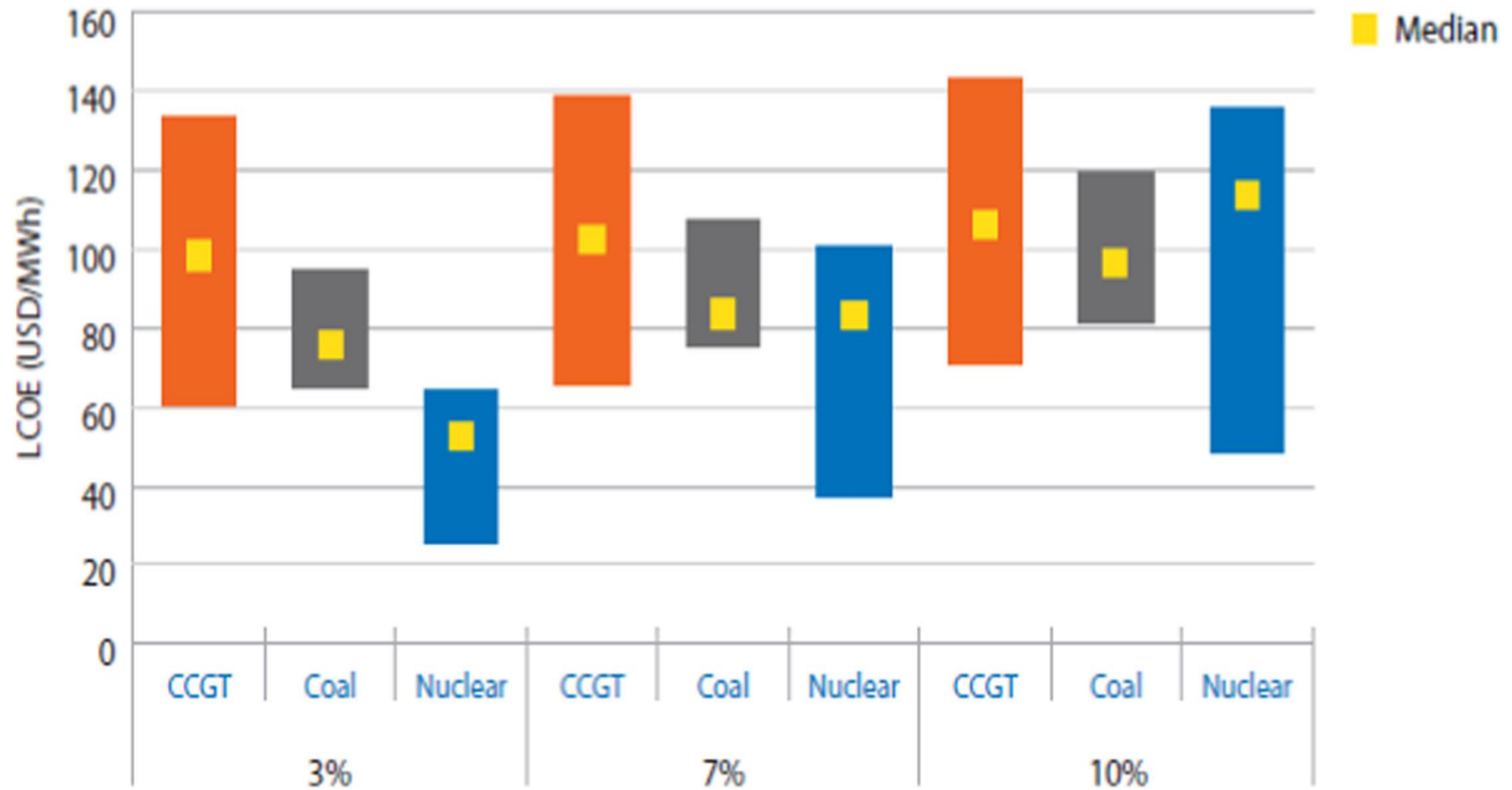
2014 USD/kWh



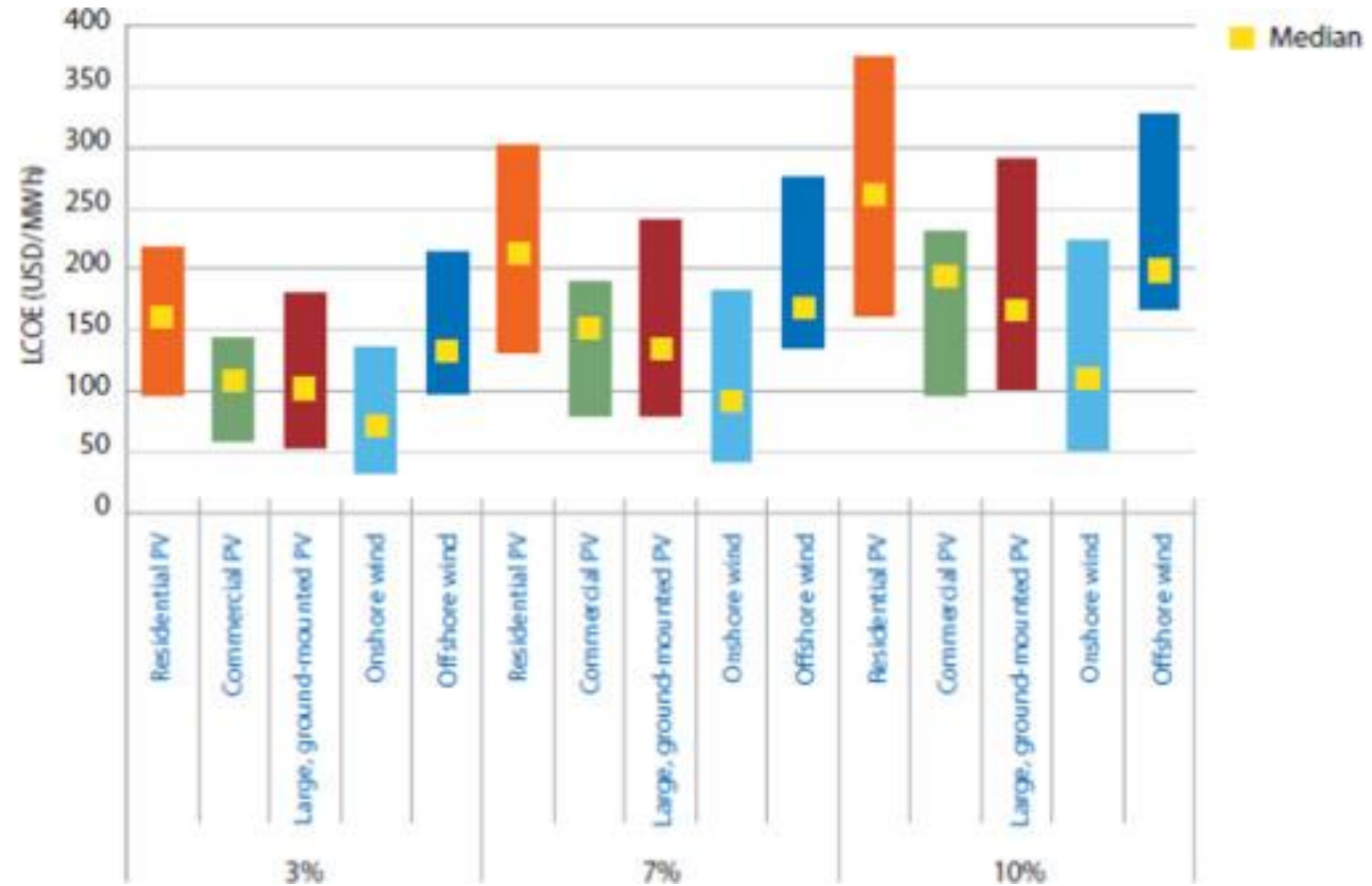
Source: IRENA Renewable Cost Database.

Note: Size of the diameter of the circle represents the size of the project. The centre of each circle is the value for the cost of each project on the Y axis. Real weighted average cost of capital is 7.5% in OECD countries and China; 10% in the rest of the world.

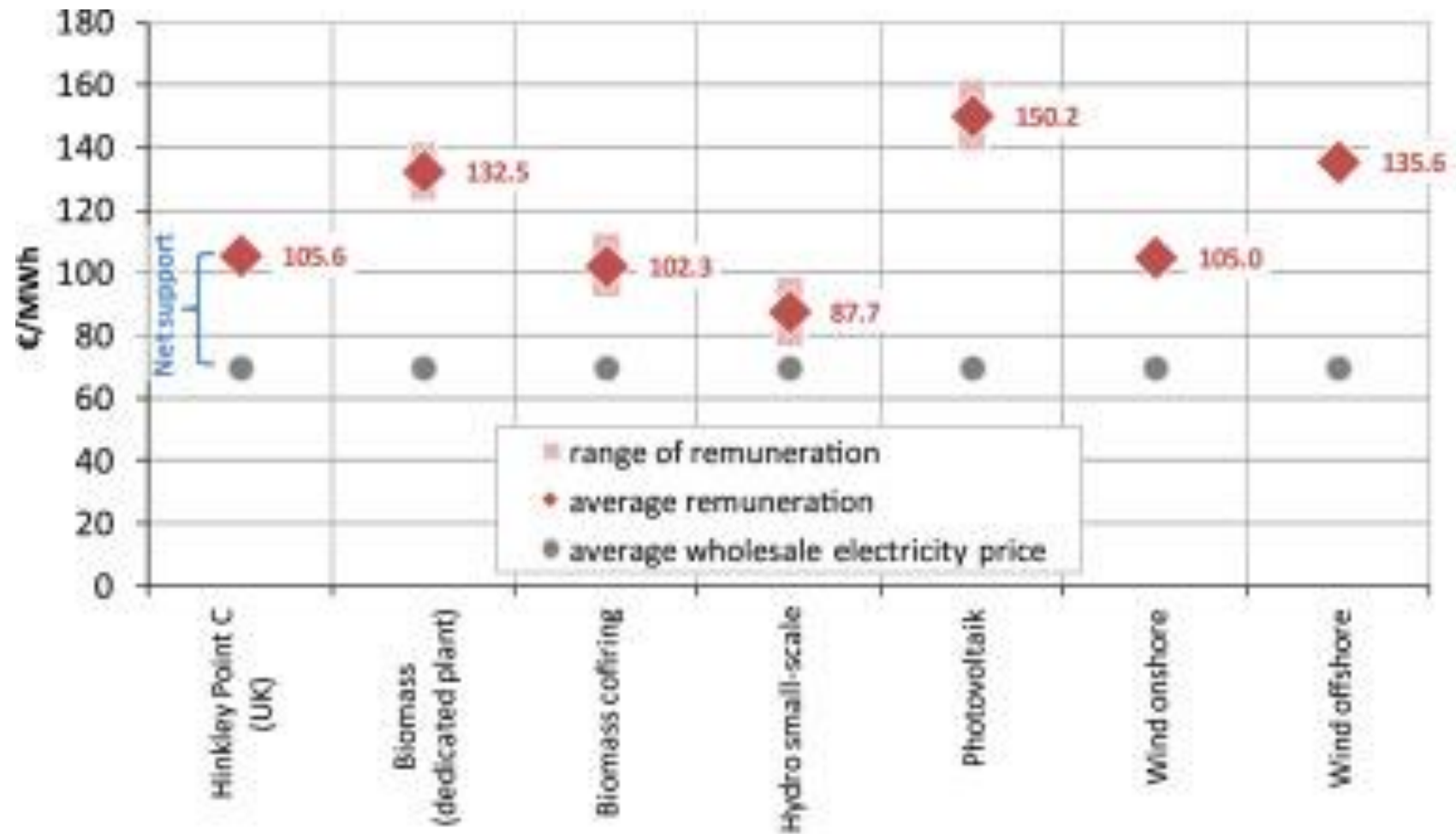
LCOE for base load technologies, at different discount rates



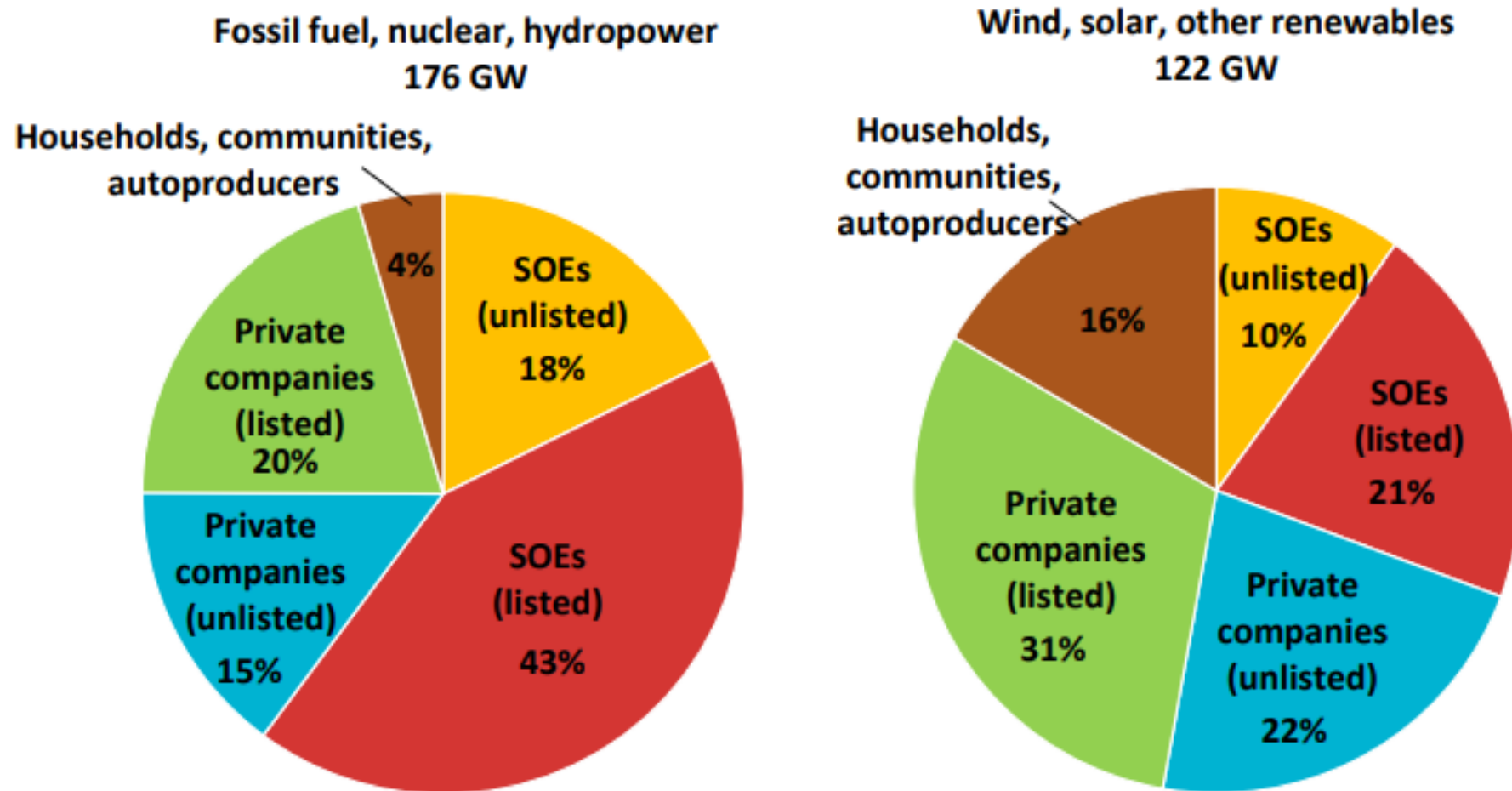
LCOE for RES technologies, at different discount rates



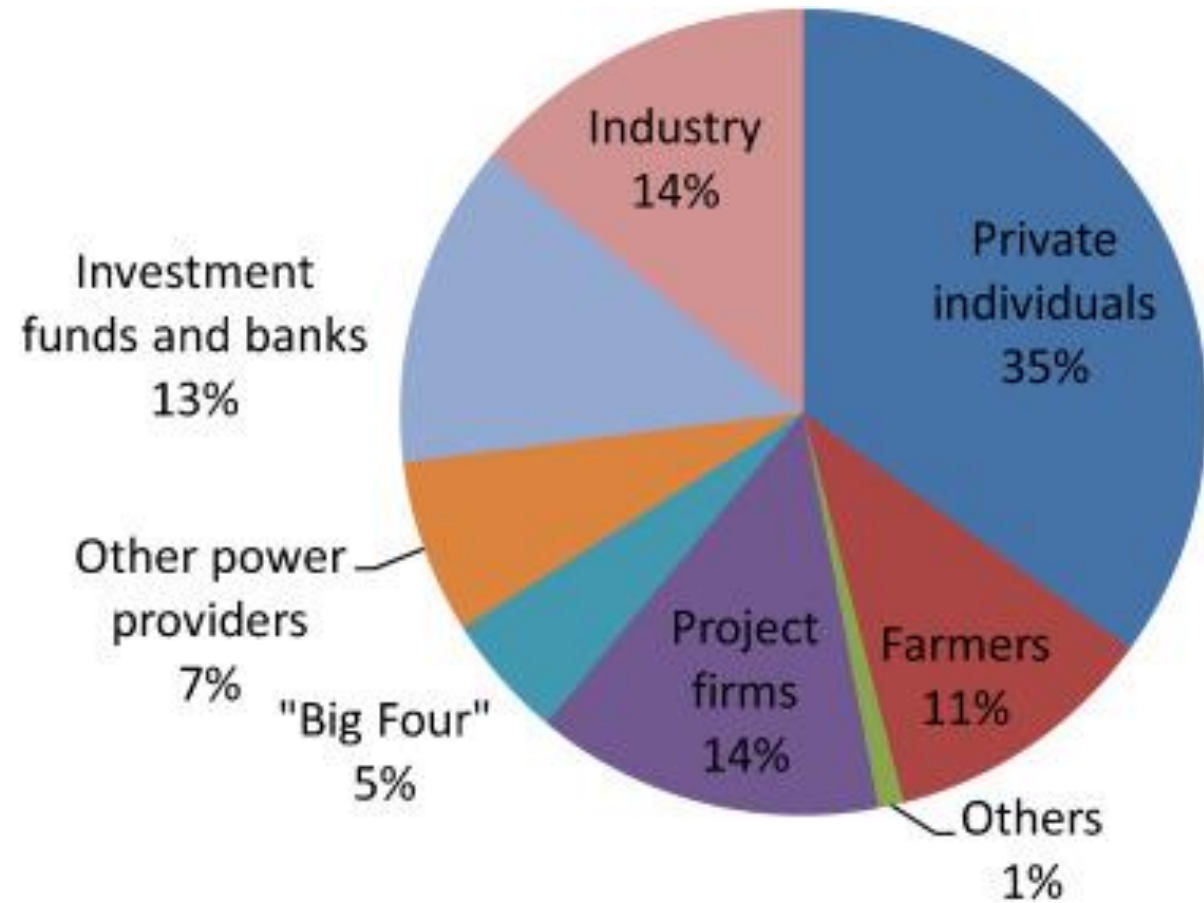
Remuneration levels for nuclear and RE technologies in the UK



Ownership of global power generation capacity commissioned in 2015

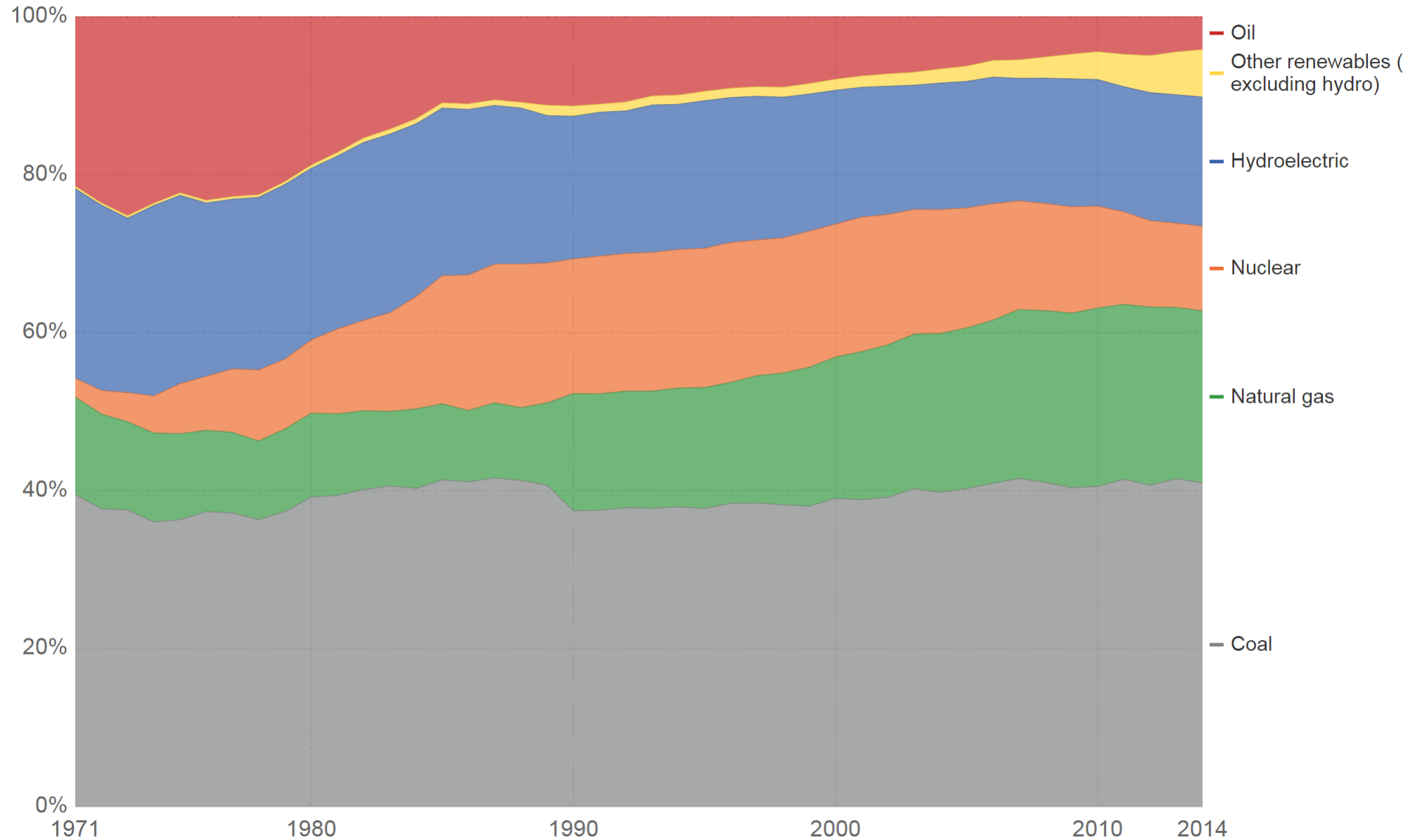


Ownership of installed RE capacity in Germany (2012)



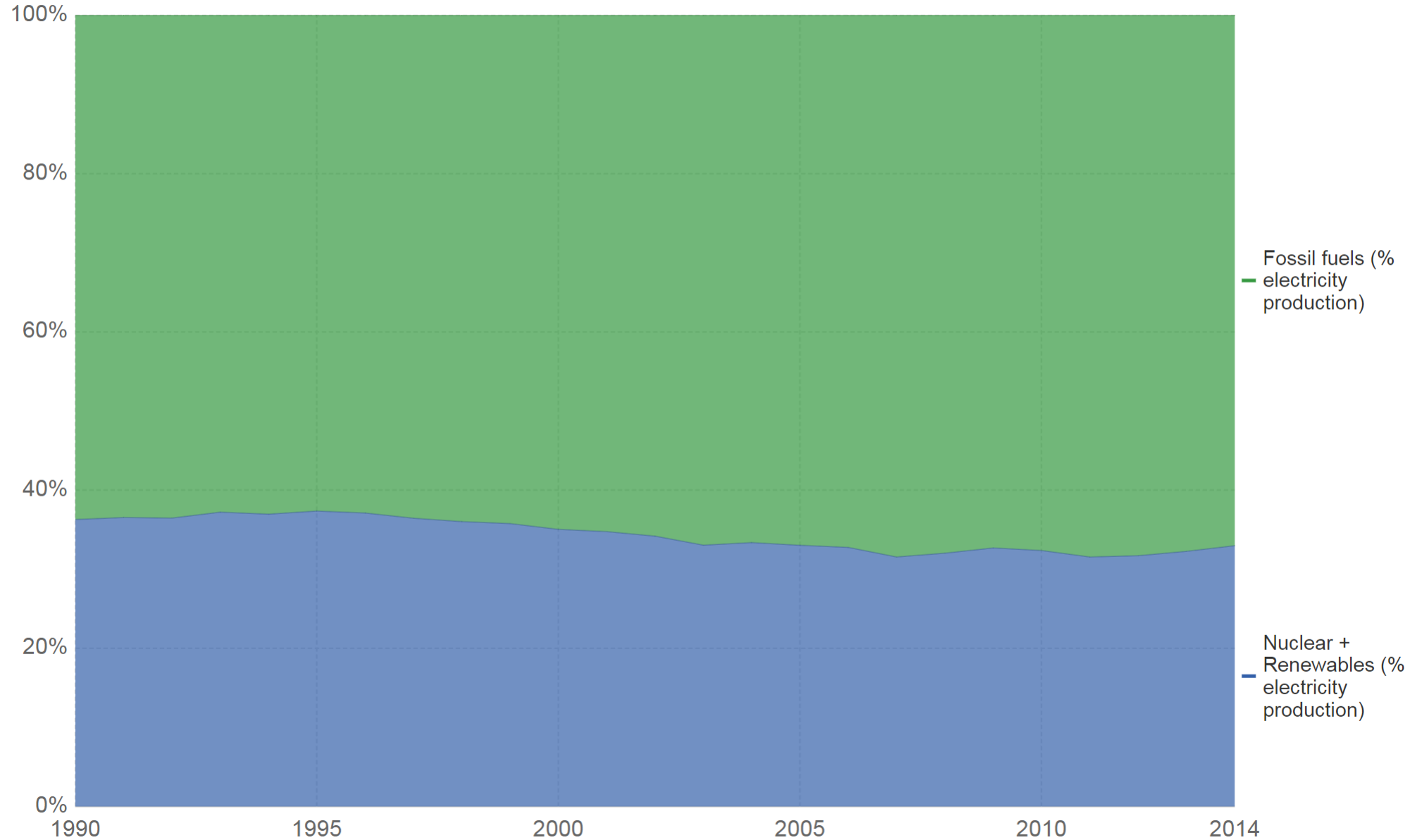
Electricity share by fuel source, World

Electricity production (measured as the percentage of total electricity production) by source (coal, oil, gas, nuclear, hydroelectric power and other renewables). Other renewables in this definition includes biomass, wind, solar, geothermal, and marine power.



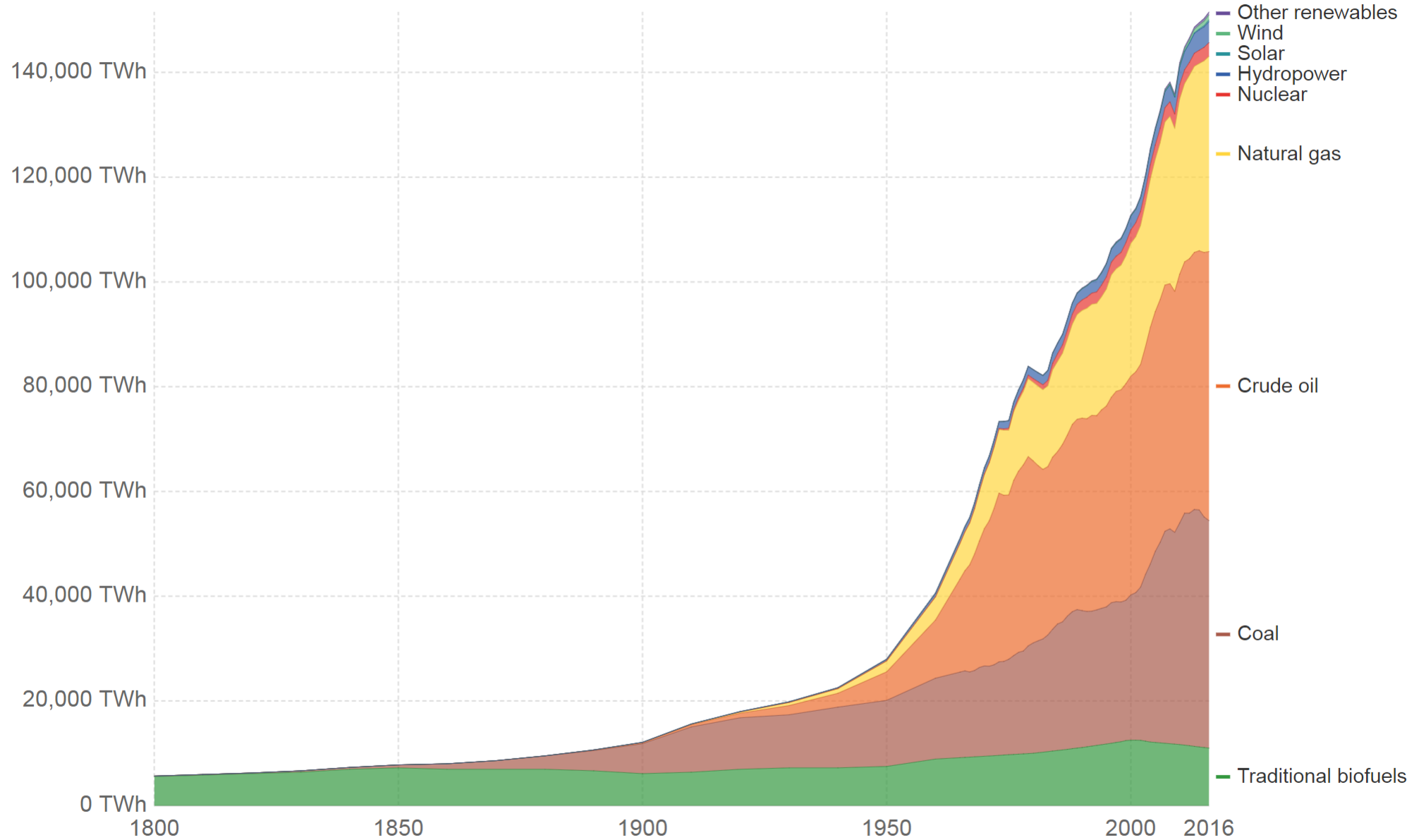
Global electricity production by source

Global electricity production, measured as the percentage contribution from fossil fuels (coal, oil and gas) and low-carbon sources (nuclear, hydropower, biomass, wind, solar, geothermal and marine power)



Global primary energy consumption

Global primary energy consumption by source, measured in terawatt-hours (TWh).



Source: Vaclav Smil (2017), Energy Transitions: Global and National Perspectives and BP Statistical Review of World Energy
OurWorldInData.org/energy-production-and-changing-energy-sources/ • CC BY-SA

Sources

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- Lovering, J.R.; Yip, A.; Nordhaus, T.(2016): Historical construction costs of global nuclear power reactors.
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