Renewables – introduction and barriers to diffusion

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What are RES?

- renewable energy is energy derived from natural processes that is replenished at a higher rate than it is consumed
- Solar, wind, geothermal, hydropower, bioenergy, ocean power
- Variable (wind, solar) vs. dispatchable (hydro, biomass) RES

Drivers for deployment

- Energy security – RES are spread globally, in contrast to the conventional (fossil) fuels that are more geographically concentrated
- Environmental concerns - low environmental impact (vary according technology) – GHG emissions, local pollutants
- Strategic economic development (rural development, agriculture sector, high-tech manufacturing)
- Energy access through distributed or off-grid sollutions → de-centralized energy system
- Diversification of energy sources

Conventional	RES
Can be stored indefinitely in arbitrary quantities (left in the ground)	Only few RES technologies readily allow mass storage (hydro dams, biomass). Other cannot be stored at all or only in small quantities
Require extraction	Freely available
Finite reserves	Constantly replenished
Not strongly exposed to meteorological factors	Subject to meteorological and climate conditions
Key parts of the supply chain localised (ports, pipelines, refineries, plants)	Large potential for decentralisation
Exploation requires large, dedicated infrastructure at site of extraction	Exploation done at micro level (small PV panels) up to large scale (large hydro)
Long-distance transport of primary resource common	Long-distance transport of primary resource impossible (with exception of biomass)

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Global trends

- As a result of governments´supportive policies „*RES have been the driver of much of the growth in the global clean energy sector since the year 2000 … As global renewable elektricity generation expands in absolute terms, it is expected to … become the second most important global elektricity source, after coal* (by 2016)“ (IEA).
- In 2013 RES accounted for almost 22% of total power generation. Globally, renewable generation was on par with that of natural gas.

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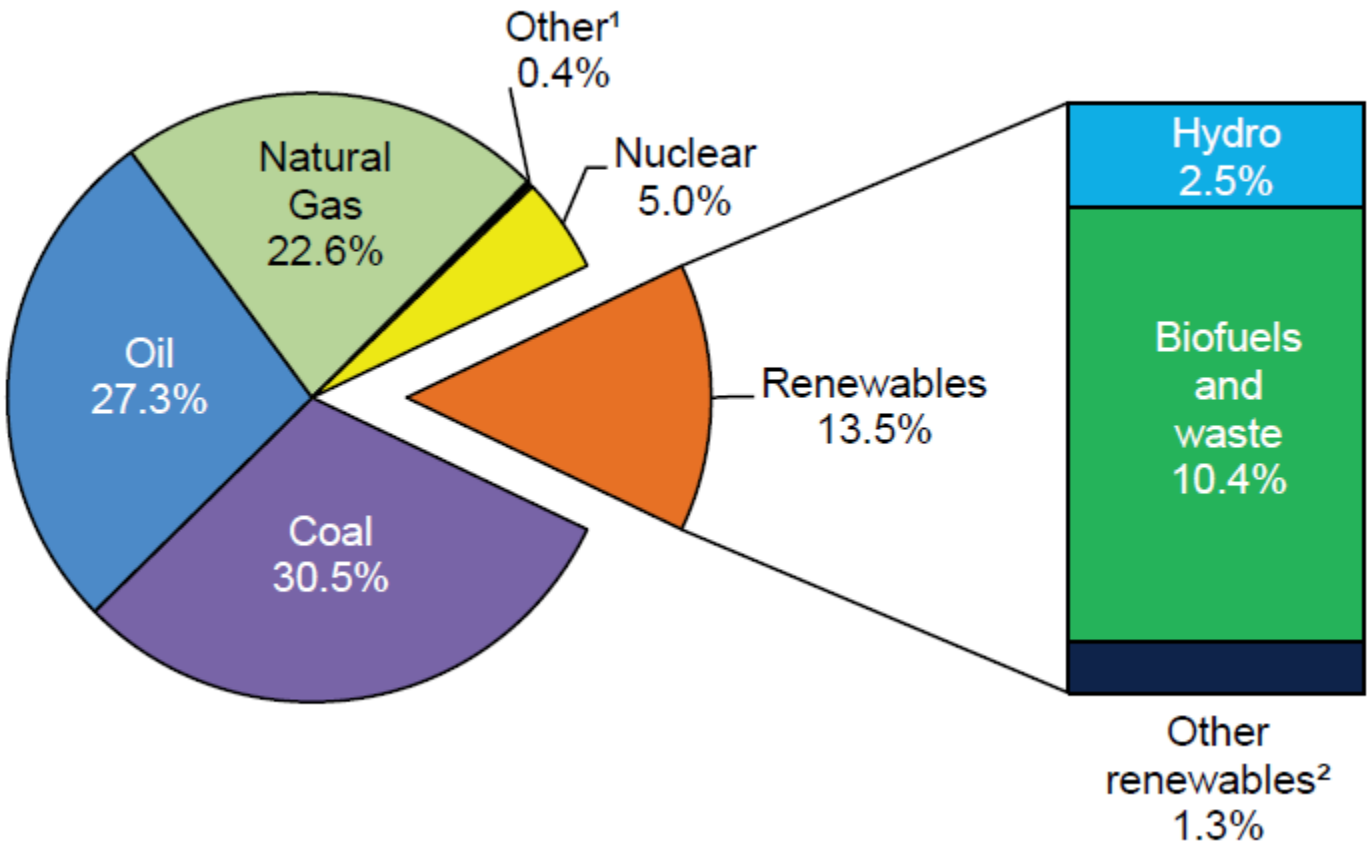
2013 fuel shares in word total primary energy supply



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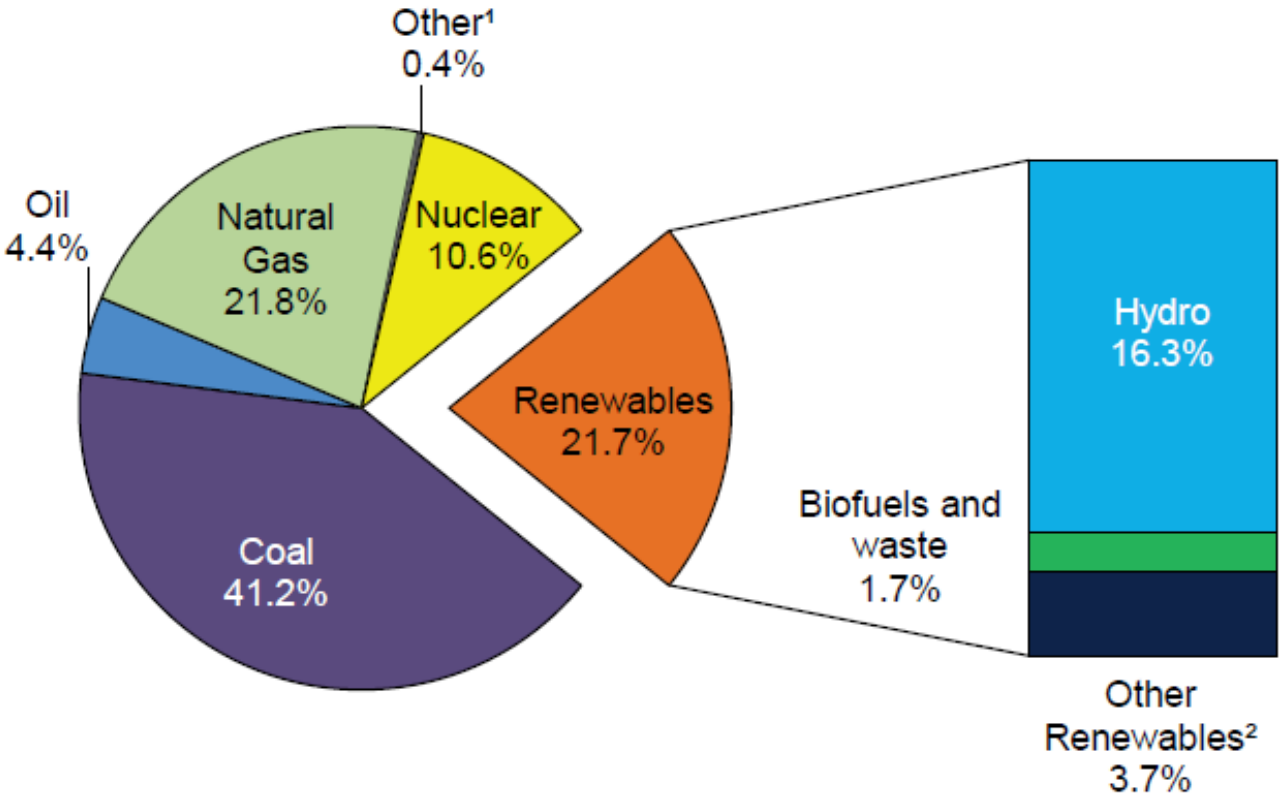
2013 fuel shares in word electricity production



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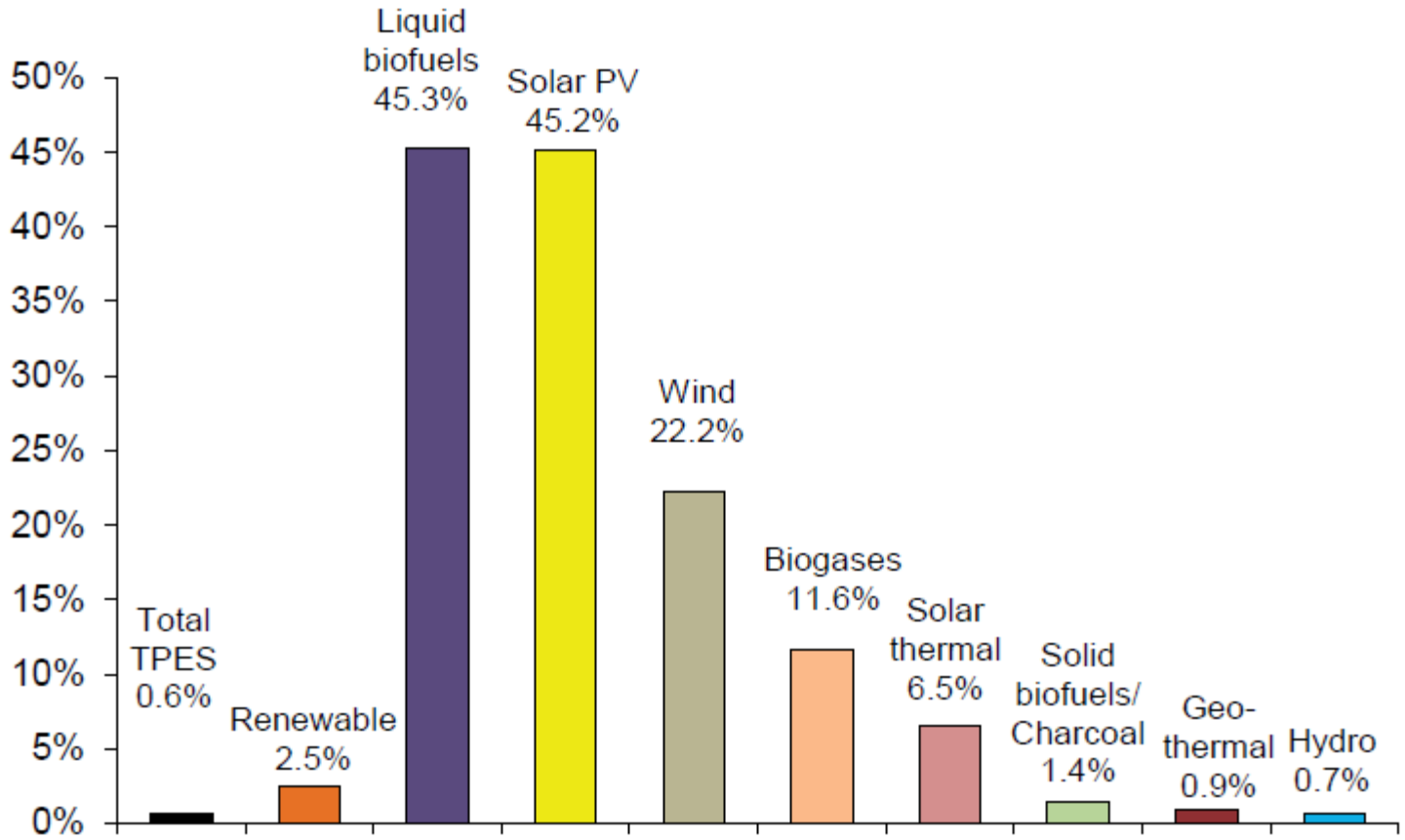
Annual growth rates of renewable supply from 1990 to 2014 in OECD total



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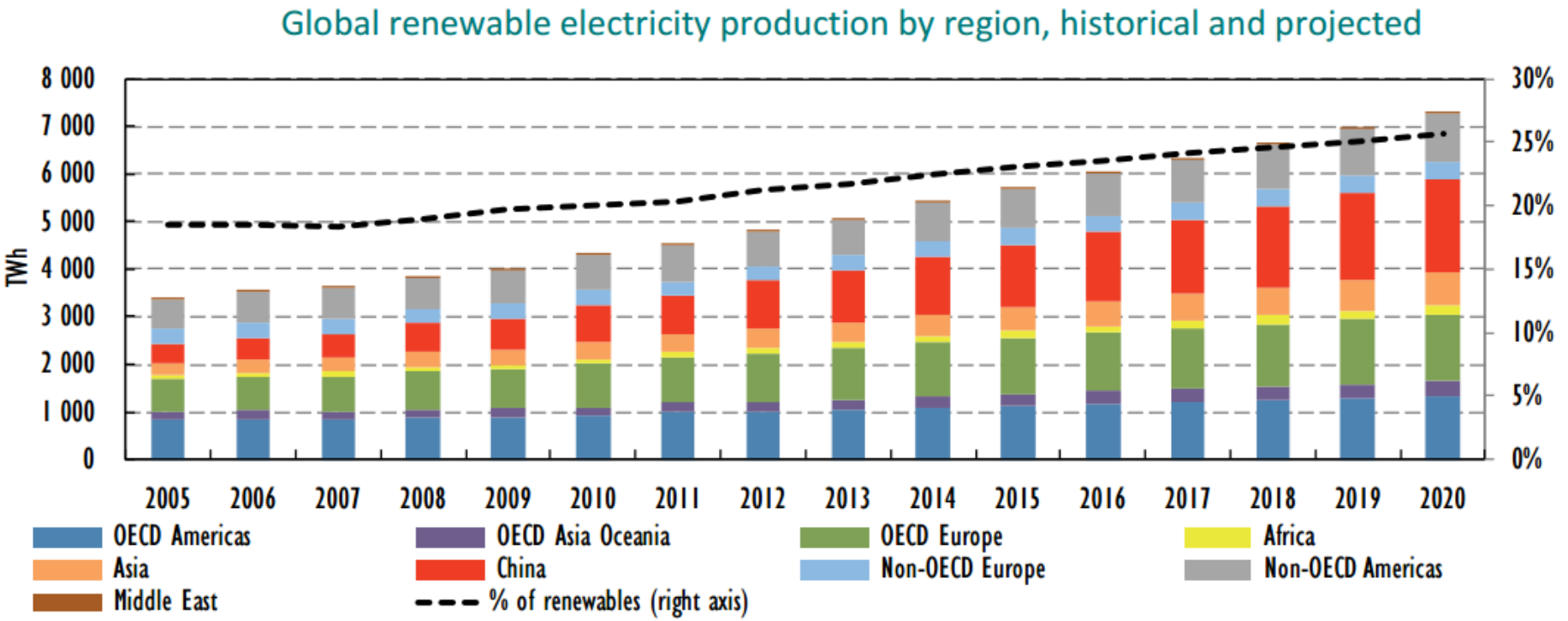
Global trends

- Global renewable elektricity generation projected to grow by almost 45% (+5,4% per year) by 2020
- 2 global trends driving the development of RES power capacity. 1) development should spread out geographically 2) RES technologies are becoming competitive on a cost basis with alternatives
- Annual growth in new capacity is expected to stabilise over 2013-2020, reflecting growing risks to deployment in some markets and remaining development barriers
- Non-OECD countries are expected to account for around 70% of new RES generation from 2013-2020. (Number of markets have adopted long-term policy framework)

Global trends

- China remains the anchor of RES capacity deployment, accounting for almost 40% of the global expansion and over 60% of non-OECD growth. RES should account for nearly 45% of incremental power generation over the medium term, ahead of coal.
- In 2013 global new investment in RES capacity estimated over USD 250 billion (plateued, slightly decreasing in last years).
- Reduction in investment costs have helped the LCOE. Closing gap between competitiveness of traditional sources and RES. Competitiveness depends heavily on market conditions and political framework (onshore wind in Brazil, South Africa, PV in Chile).

RES production by region



Notes: unless otherwise indicated, all material in figures and tables in this chapter derive from International Energy Agency (IEA) data and analysis. Hydropower includes pumped storage; the onshore and offshore wind split is estimated; total generation is gross power generation.

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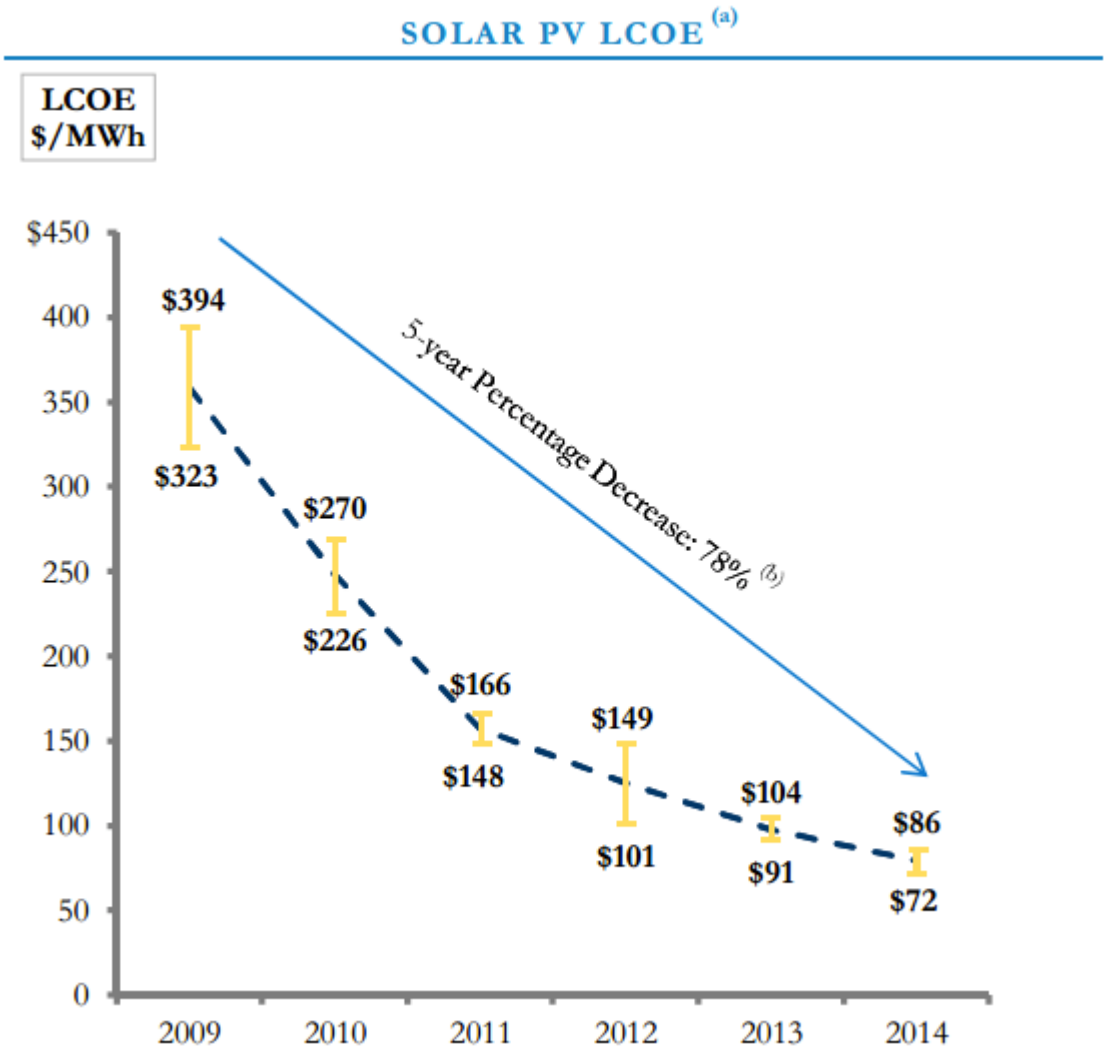
Costs of PV technology



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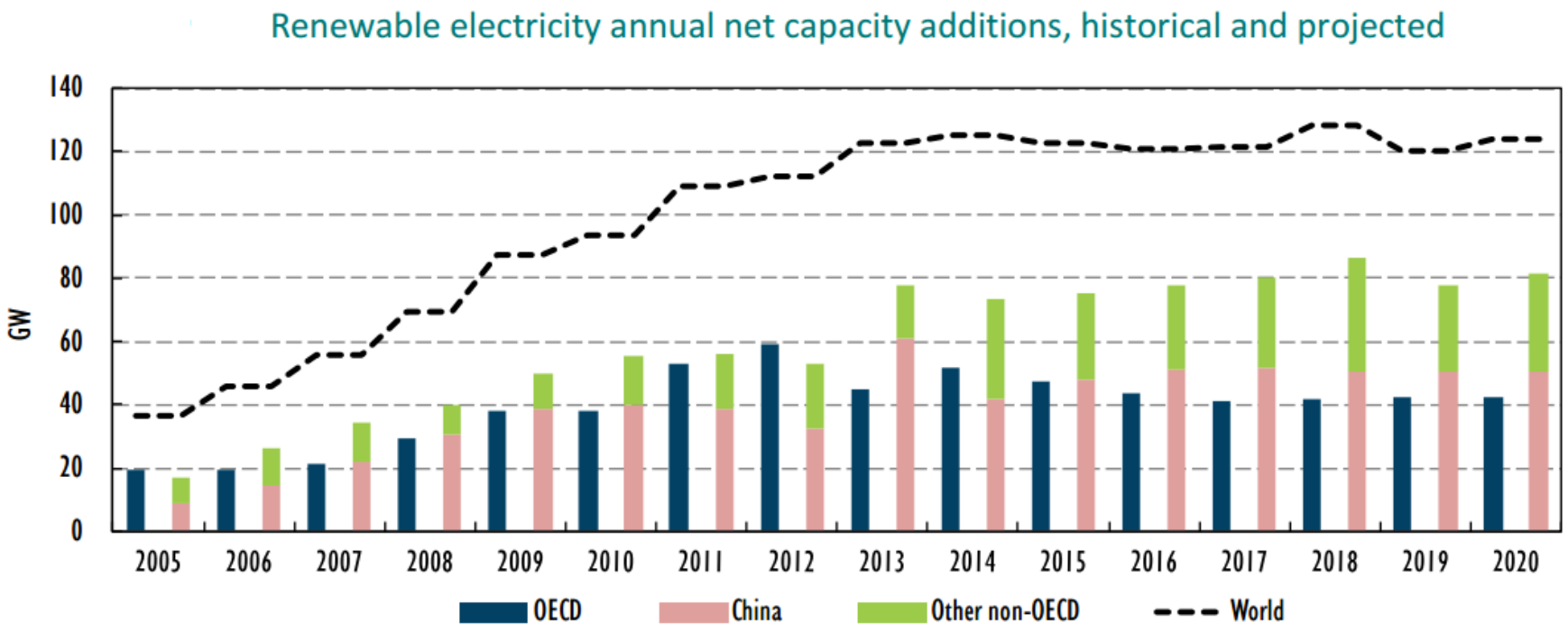
Global trends



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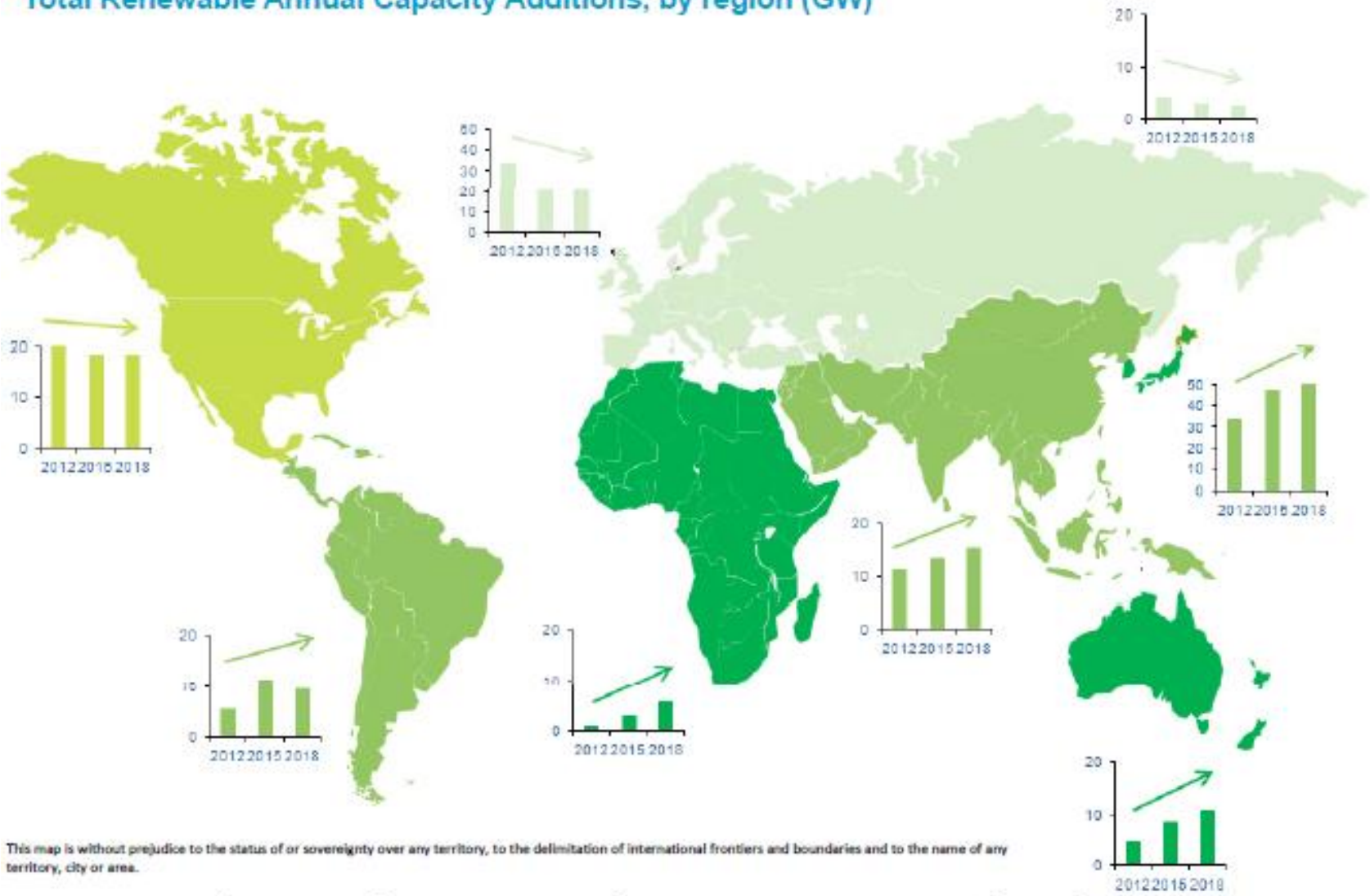
Renewable power spreading out everywhere

Total Renewable Annual Capacity Additions, by region (GW)



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

- Emerging markets more than compensate for slowing growth and volatility in markets such as Europe and the US

Progress tracked on different scales

Incremental TWh (2012-18)	
1. China	+ 750
2. USA	+ 150
3. Brazil	+ 130
4. India	+ 95
5. Germany	+ 70

Avg annual growth (2012-18)	
1. Morocco	+ 24.9%
2. South Africa	+ 20.1%
3. Korea	+ 14.1%
4. Australia	+ 14.0%
5. UK	+ 13.0%

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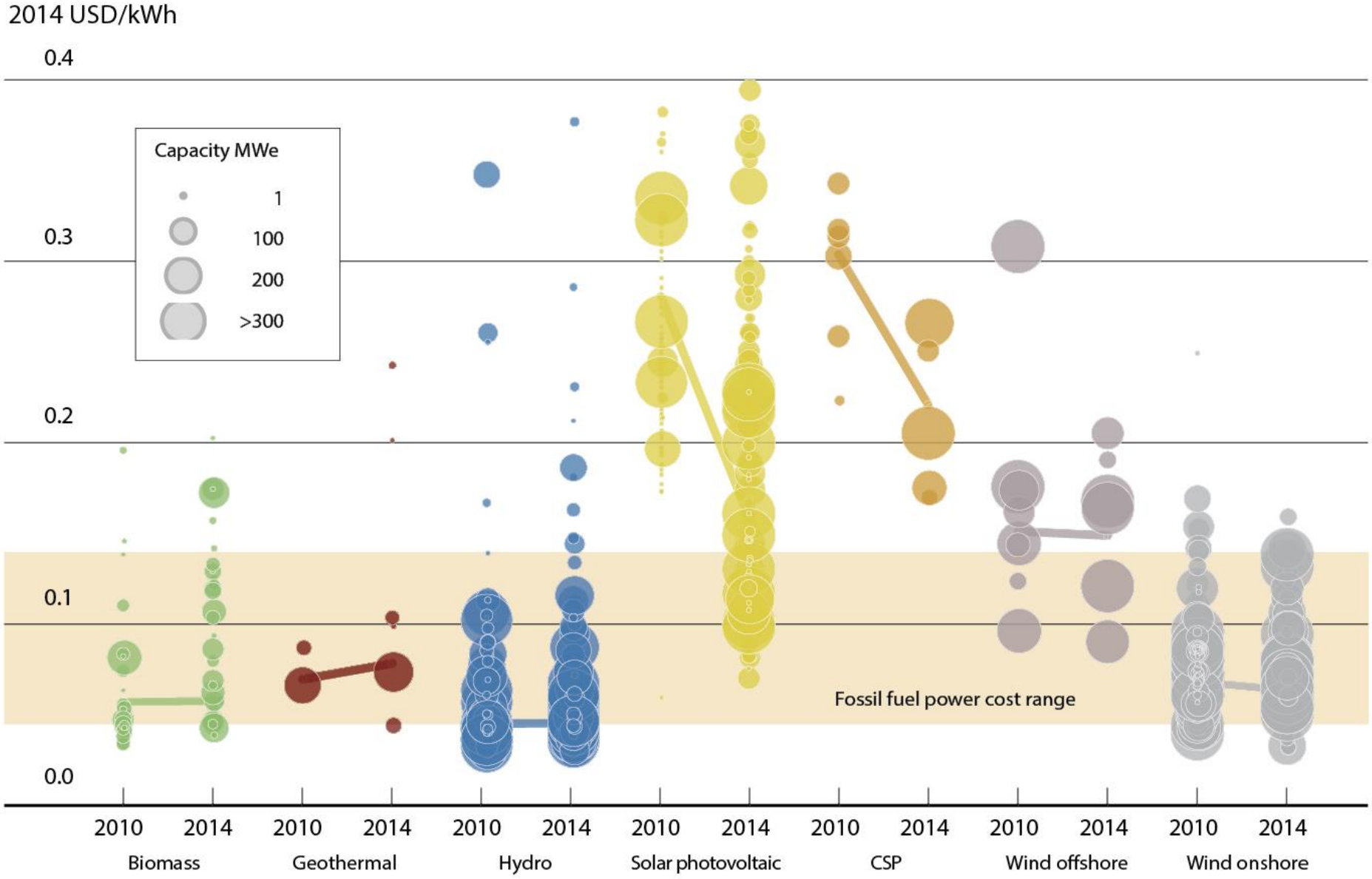
Techno-economic barriers

- Are present when the cost of a technology is above the cost of competing alternatives. Mainly related to
  - the level of technology maturity
  - the extent to which external benefits and costs are internalised
- „Real“ costs are difficult to assess
  - Public subsidies – in 2011 renewables received roughly €30 billion in subsidies, nuclear power €35 billion and fossil fuels took €26 billion. (EEA 2013).
  - Limited responsibility of NPP – in CR up to €300 million, estimated damages of Fukushima up to €170 billion.
  - Coal industry social programmes.

E.S. 1: The levelised cost of electricity from utility-scale renewable technologies, 2010 and 2014



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.

Techno-economic barriers

- High initial capital costs – lower fuel and operating cost make RES cost competitive on a life-cycle basis, but higher initial capital costs results in less installed capacity per initial euro invested. RES generally require higher amounts of financing for the same capacity. Capital markets may demand a premium in lending rates for financing RES because more capital is being risked up front than in conventional projects.

Techno-economic barriers

- Transaction costs – RES instalations typically smaller than conventional energy projects. That makes transaction costs (eg. resource assessment, sitting, permitting, planning…) higher
- Unfavourable power pricing rules – RES may not receive full credit for the value of their power. On one hand, they are close to the consumer, on the other hand those sources are intermitent

Techno-economic barriers

- Difficulty of fuel price risk assessment – risk associated with fluctuations in future fossil fuel prices may not be quantitatively considered in decisions about new power generation capacity because these risks are inherently difficult to access
  - Price volatility – loss of 0,5% in GDP for 10% oil price increase for the United States and the European Union. Over the past year oil prices increased by app. 45% resultin in a 2,25% loss in GDP (USD 774 bn). In comparison with total support payment for all RES globally in 2009 (57 bn)
  - Price uncertainty

Legal and regulatory barriers

- Lack of legal framework for independent power producers – in many countries power utilities still control a monopoly on production and distribution → absence of a legal framework for independent producers investing in RES facilites and selling their electricity
- Restriction on siting and construction – based on height, aesthetics, noise, safety. Permiting authorities may not be familiar with the technologies
- Transmission access – utilities may not allow favorable transmission access to RES or may charge high prices for transmission access

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Legal and regulatory barriers

- Utility interconnection requirements – individual home or commercial systems connected to utility grids can face inconsistent or unclear utility interconnection requirements. Lack of uniform requriements add to transaction costs
- Liability insurance requirement – problem for small power generators that may face excessive requirements for liability insurance

Market performance barriers

- Lack of access to credit – small investors may lack access to credit to invest in RES (esp. when state support policy is unstable)
- Percieved technology performance uncertainty and risk – even proven and cost effective technologies may be percieved as risky if there is little experience with them in region. Wrong perception (or missing experience) may increase required rates of return, resultin in less capital availability. „Lack of utility acceptance“

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Market performance barriers

- Lack of technical or commercial skills and information – markets function best when everyone has low-cost access to information and skills. But in specific markets, skilled personnel who can install, operate and maintain RES technologies may not exist in sufficient numbers

Barriers to renewable energy

= Policy remains vital to the competitiveness of RES. Policy uncertainty remains a key challenge to the RES deployment

= Non-economic barriers, integration challenges, grid connection risks … can all increase financing costs and prevent investments

= In markets based on short-term marginal cost pricing RES can often require policy incentives

= in some areas RES are competitive without financial suppport

Sources

- IEA (2011): Renewable energy: Policy considerations for deploying renewables
- IEA (2015): Renewable energy: Medium-term market report
- IEA (2016): Key renewable trends 2015

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