Renewables subsidy schemes in Europe

Energy Economics Summer School, University of Auckland

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2014 - Trading Systems Analyst, European Power Exchange (EPEX Spot), Paris

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Why does NZ not have more solar & wind power plants?

- **NZ in 2016**: wind 5% & solar PV 0.1% power generation (MWh)
- **EU in 2016:** wind 10% & solar PV 4% power generation (MWh)

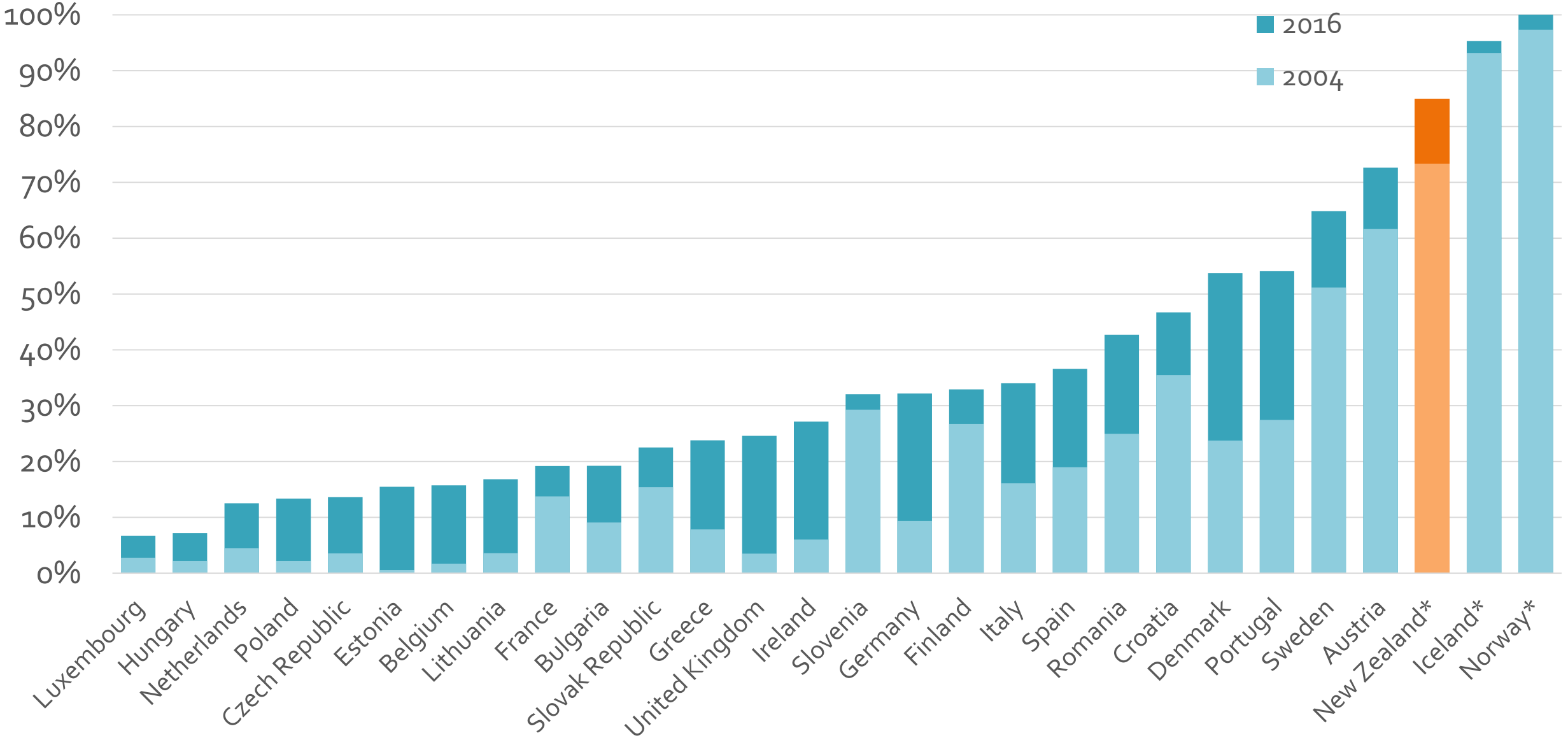
Wind 5%

Solar 0.1%

Why does NZ not have more solar & wind?

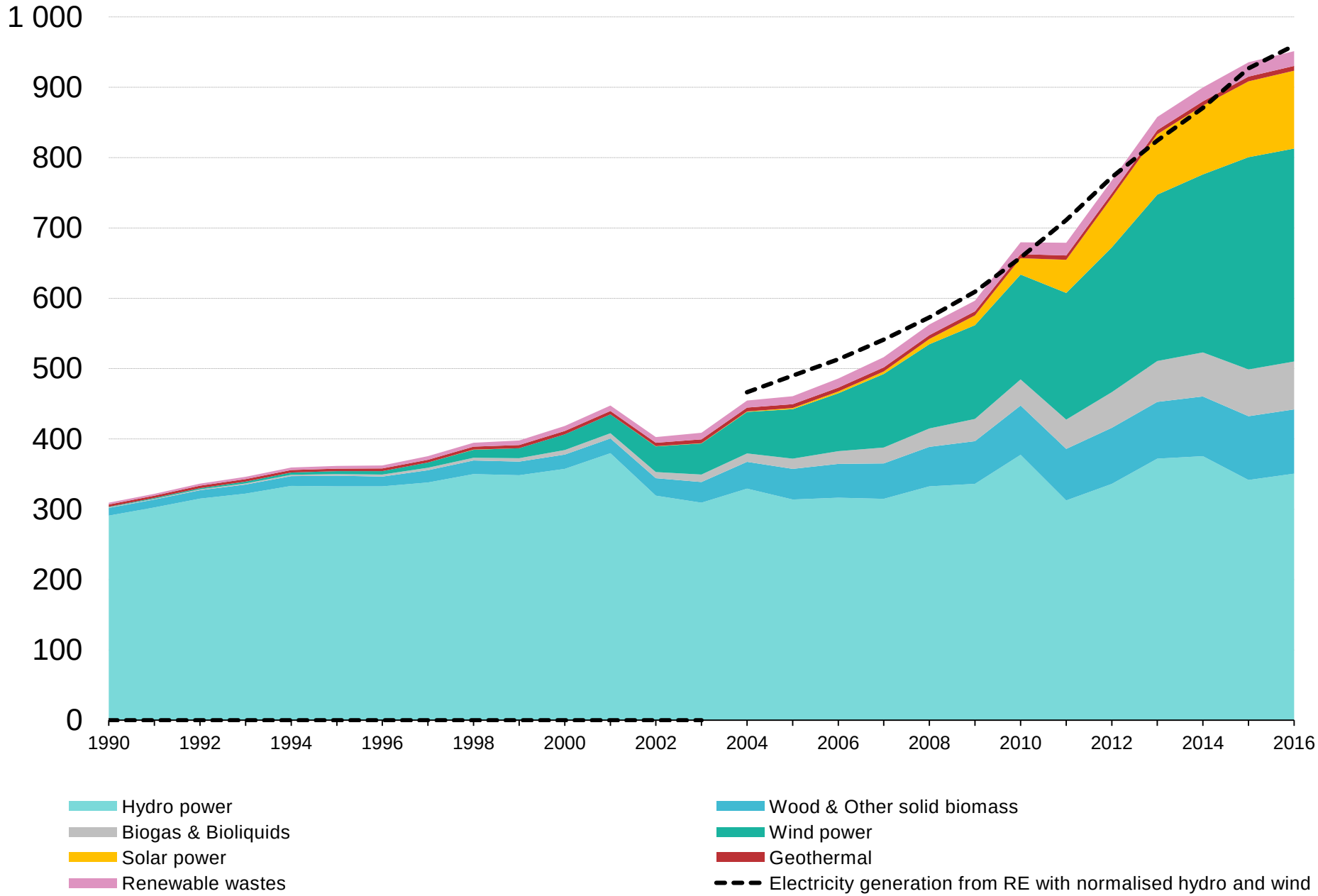
- Low national power demand growth
- Current generation capacity sufficient
- Share of hydropower & geothermal exceeds 80%

Share of renewables as % of electricity generation EU28 vs NZ, 2016



Source: Eurostat; MBIE

Renewable electricity production in EU-28 countries, TWh

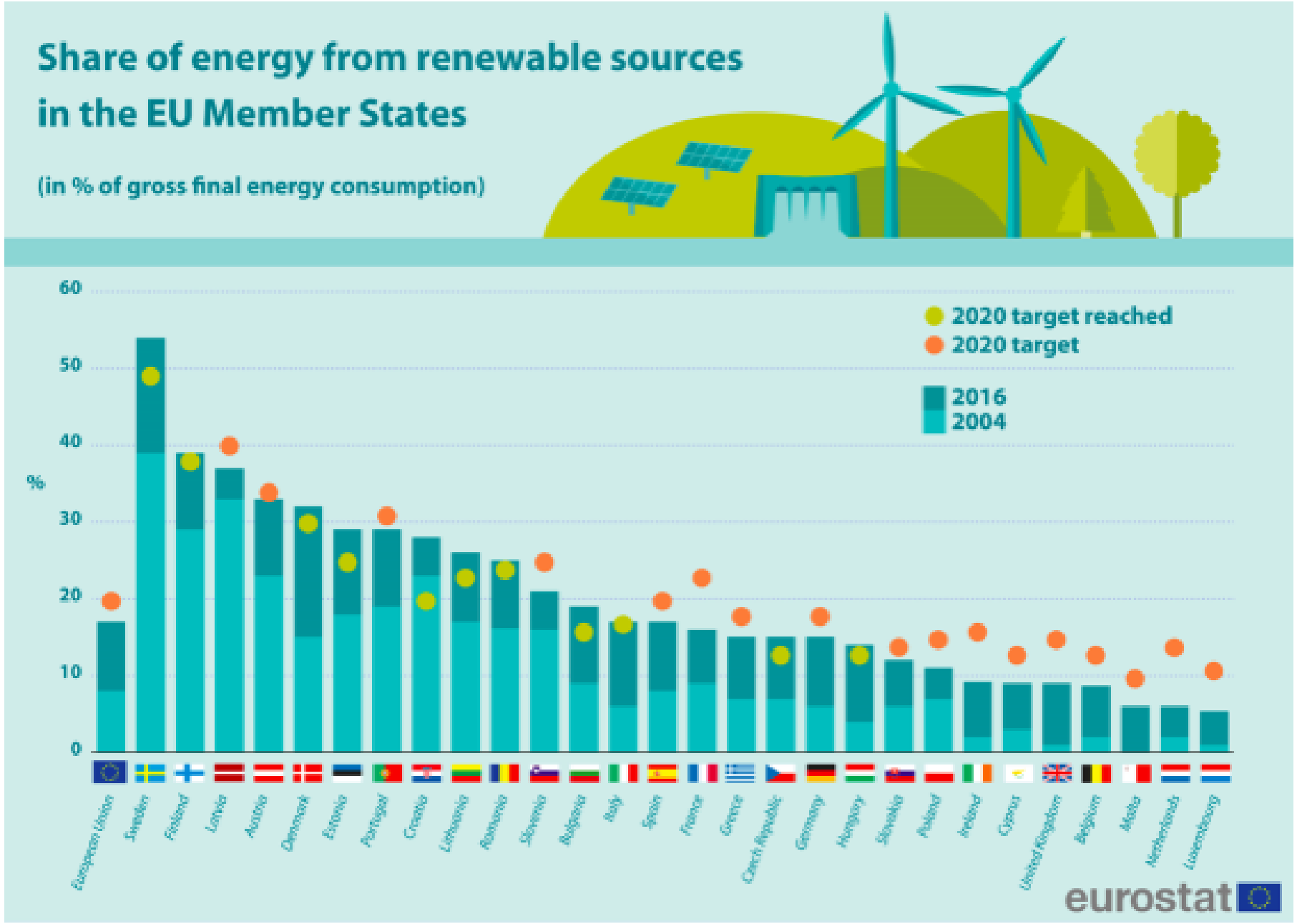


Growth since 2004:

- Wind 5-fold
- Solar 152-fold

Source: Eurostat

EU Renewable Energy Directive 2009



Renewables subsidy schemes

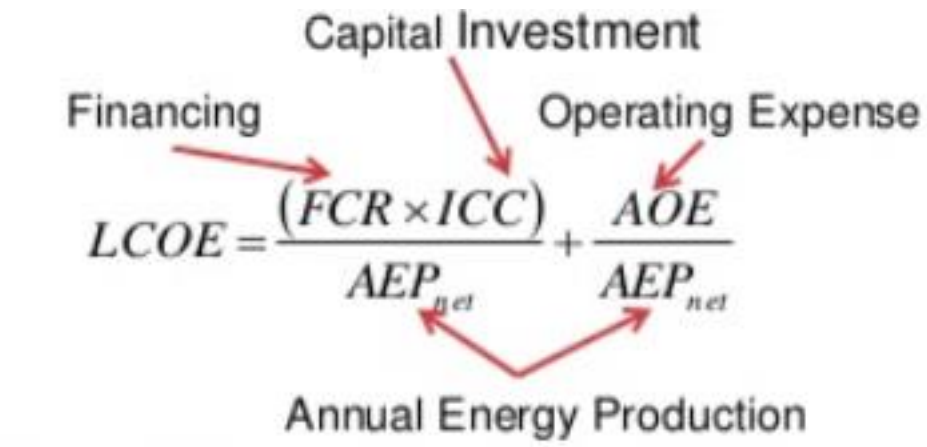
- Feed-in tariffs/premiums
- Priority grid-access
- Renewable/green certificates
- Reverse auctions/tenders
- *Corporate procurement (PPAs)*

Feed-in tariffs or premiums

- Policy mechanism offering a long-term fixed price contract to a renewable power project owner to cover costs of investment
- Price per MWh generated is generally higher than wholesale power price
- **Premium** is offered per MWh on top of wholesale power price
- EU schemes typically include **priority grid access / dispatch**
- Tariff structure may ratchet down over time to reflect technology cost reductions
- Indexed to inflation
- **Guarantees return on investment to facilitate financing**

Levelised cost of electricity

- *Levelised cost of electricity (LCOE) is net present value of a project's costs by production over its lifetime*
- *A proxy for wholesale power price required to break even*

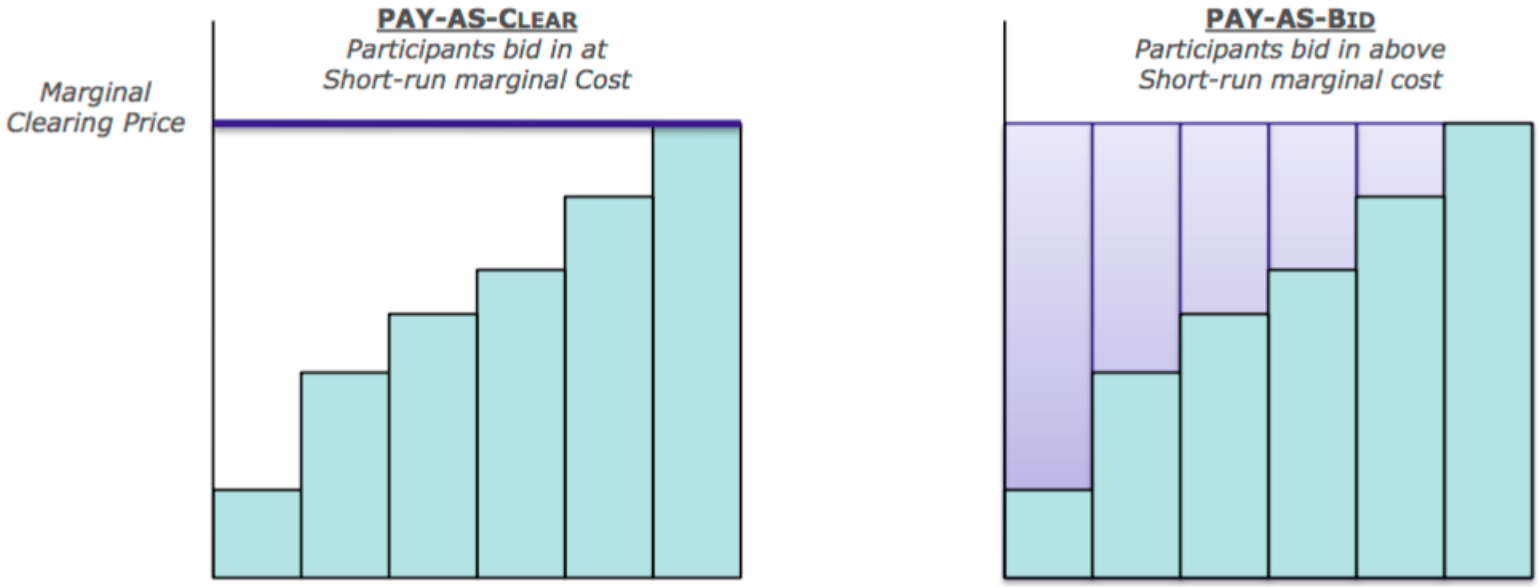


Renewable or green energy certificates

- United Kingdom (ROCs), Romania (GCs), Norway/Sweden joint scheme (RECs) etc.
- Suppliers obligated to procure of given % of renewable power annually
- Obligation quota (%) increased year-on-year
- Renewable energy producers allocated certificates for MWh generated

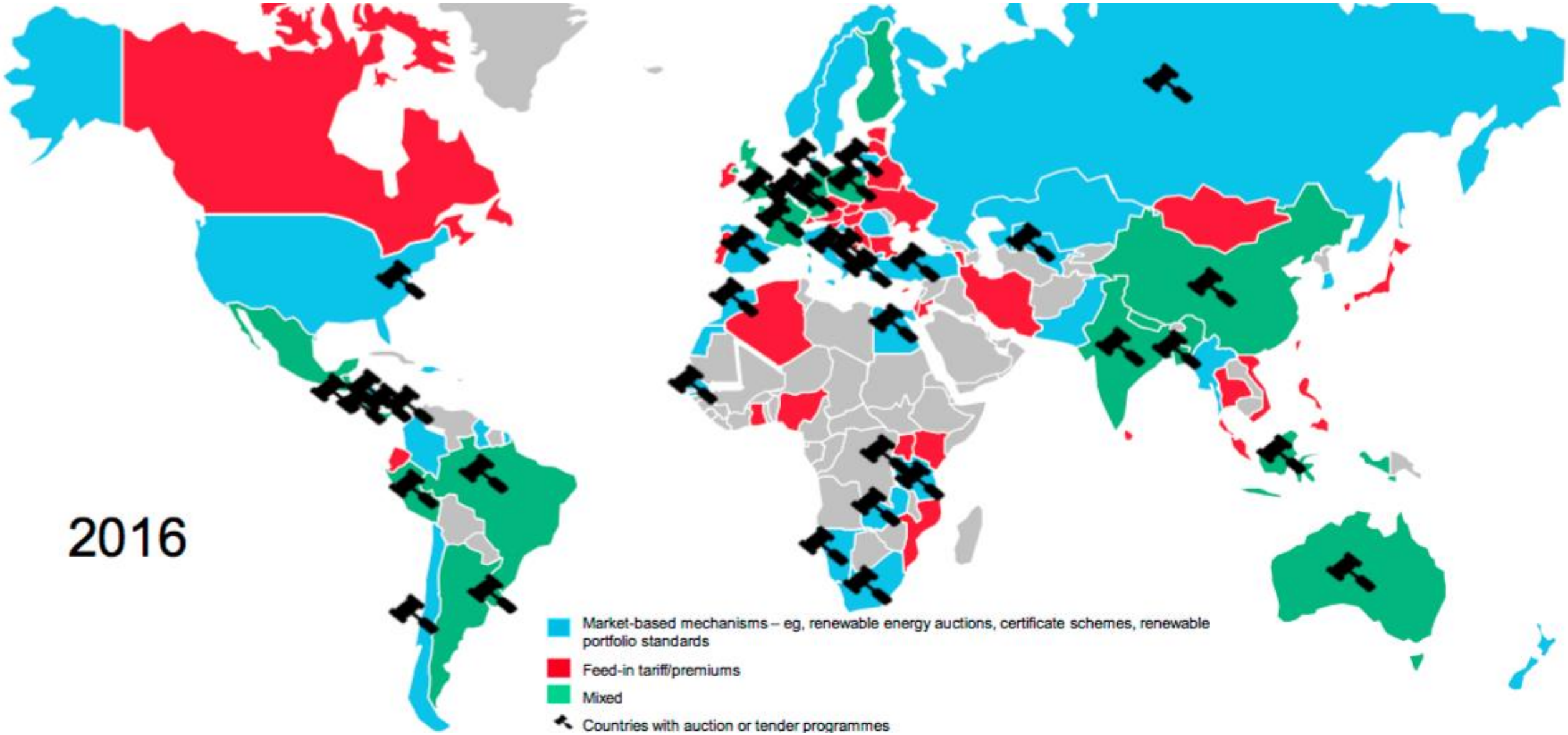
Renewables auctions

- Reverse auctions mean seller bids
- Capacity allocated to best bids up to a quota (MW); may differ by technology
- Winners obtain a power-purchase agreement for fixed period
- Price may be fixed (FiT or FiP)
- CfDs obligate buyer to pay difference between benchmark/index i.e. wholesale power price and a strike price set in auction



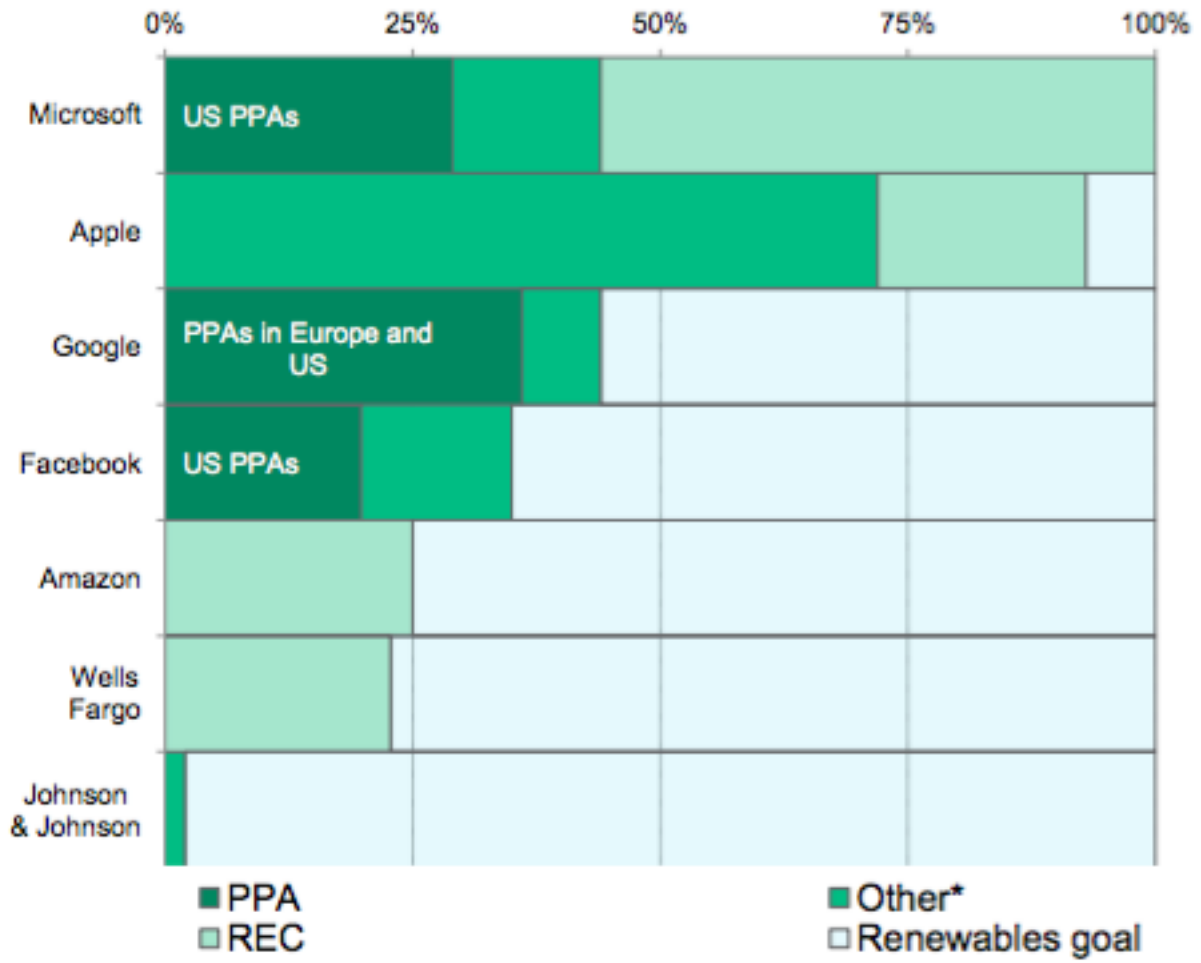
Source: Ofgem

Global renewables support schemes



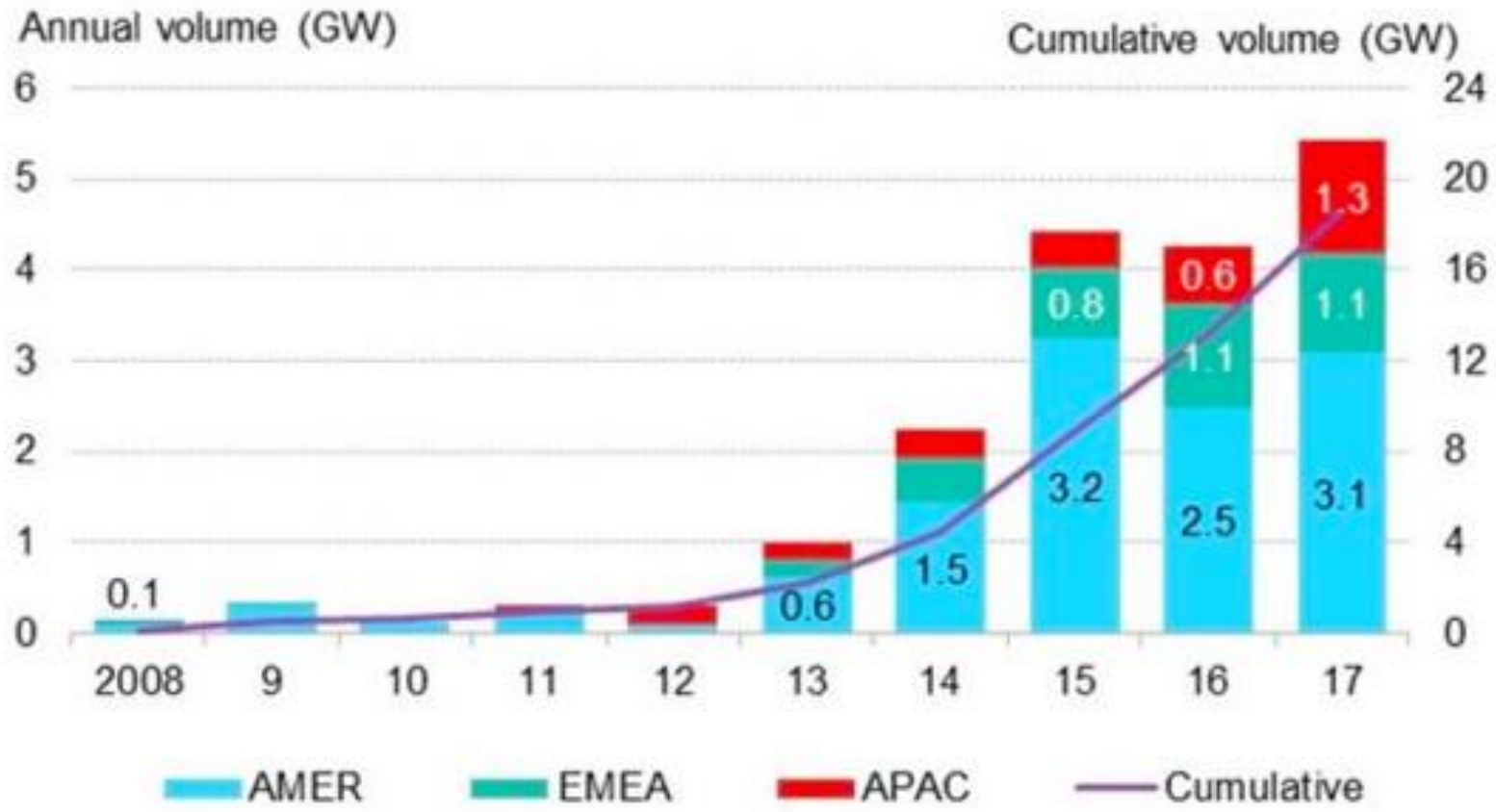
Source: Bloomberg New Energy Finance

Corporate renewables targets, 2015



Source: Bloomberg New Energy Finance. Note: Other includes renewables through on-site generation, owned projects, green tariffs and grid.*

Global corporate power-purchase agreements



Source: Bloomberg New Energy Finance. Note: Excludes on-site projects

Corporate procurement

- Total of 5.4GW of PPAs were signed by 43 corporations in 10 different countries in 2017
- Mostly in United States: 2.8GW
- Largest agreement ever signed by a corporation and utility was Apple's 200MW PPA with NV Energy
- Europe over 1GW signed with 95% of volume coming from projects in the Netherlands, Norway and Sweden.
- Big players: Apple, Microsoft, Google, Amazon…

Subsidies drive deployment

- De-risks investment so developers can raise debt & secure equity
- Facilitates permitting

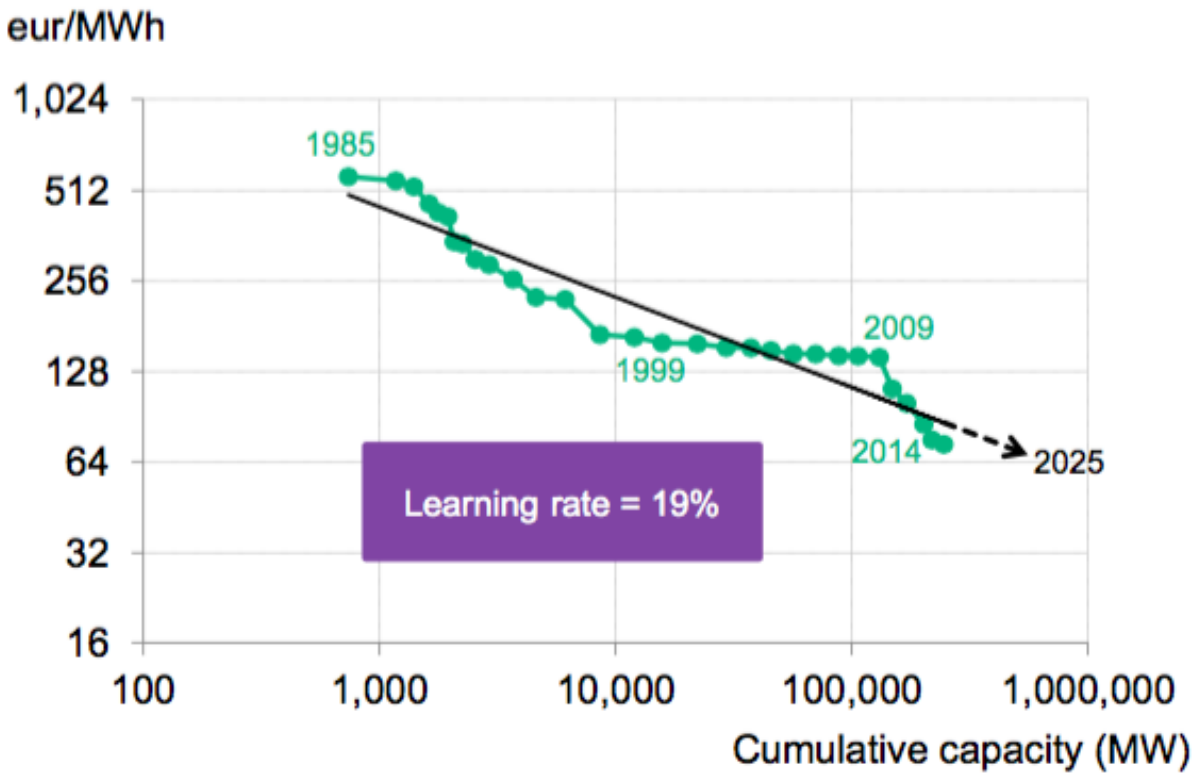
Positive feedback loops:

- Technology improvements
- Investment cost reductions

Wind & solar learning rates

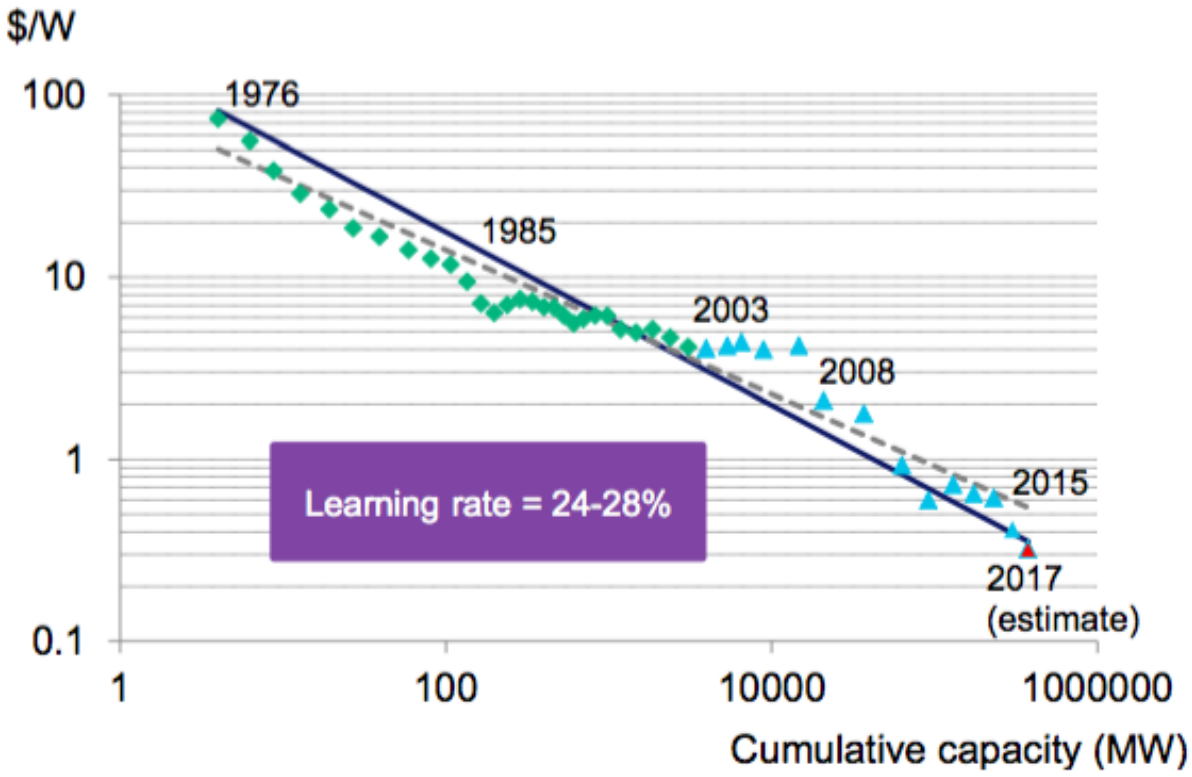
Investment cost reduction for each doubling of installed capacity

Wind



Source: Bloomberg New Energy Finance

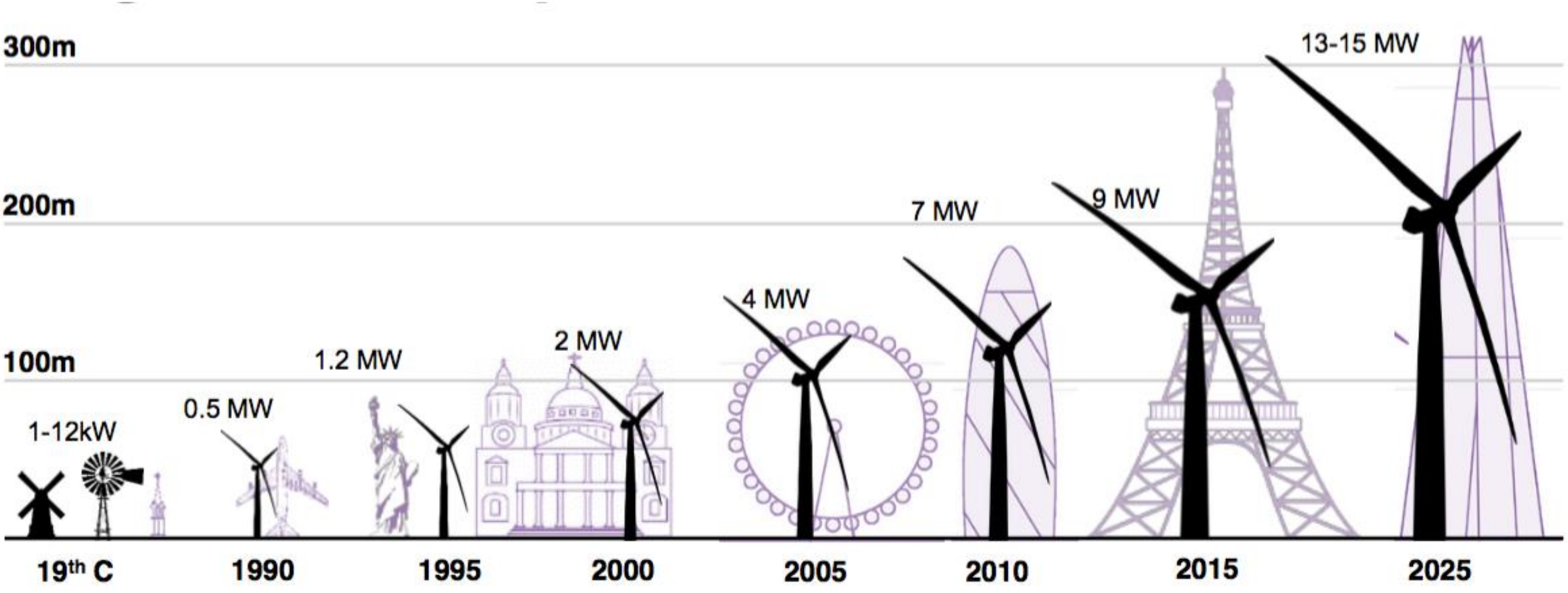
Solar



Source: Bloomberg New Energy Finance

Wind turbine evolution

MHI Vestas 9MW offshore wind turbine is already installed at Burbo Bank in the UK



Sources: Various; Bloomberg New Energy Finance

Renewables auction price records

Solar PV
Country: Chile
Developer: Enel
Bid: **$US 21.48/MWh**

Records set in Dubai, Mexico, Peru, Chile, Abu Dhabi and Saudi Arabia in 2016 & 2017

Onshore wind
Country: Morocco
Developer: Enel
Bid: **$US 30/MWh**

Records set Brazil, Canada, Germany, India and Mexico in 2016 & 2017

Offshore wind
Country: UK
Developers:
- EDPR/ENGIE
- DONG

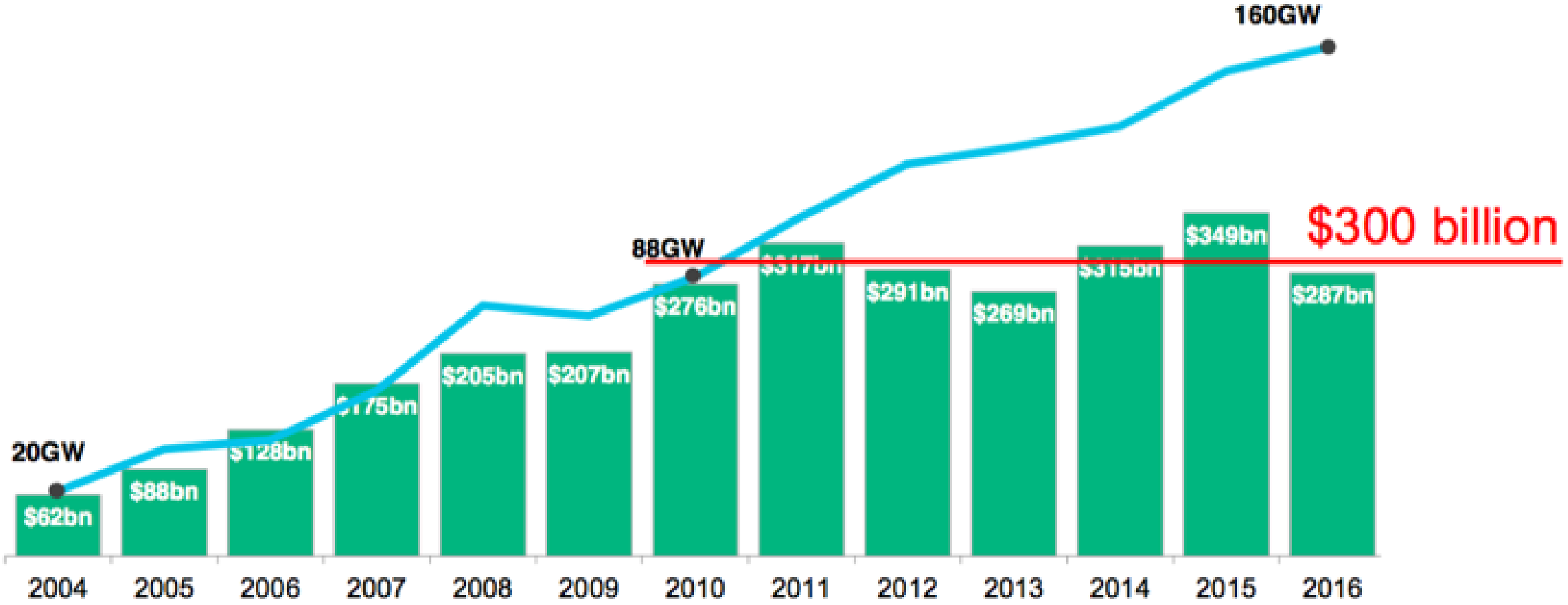
Bid: **$US 81/MWh**

Records set in Germany, the Netherlands, Denmark, UK in 2016 & 2017

Renewables in Europe today

- Subsidies facilitated tech improvements & cost-reductions
- Cost-competitiveness
- Transition to market-based mechanisms i.e. auctions
- Corporate procurement to play greater role

Market reaches maturity: global clean energy investment and installations



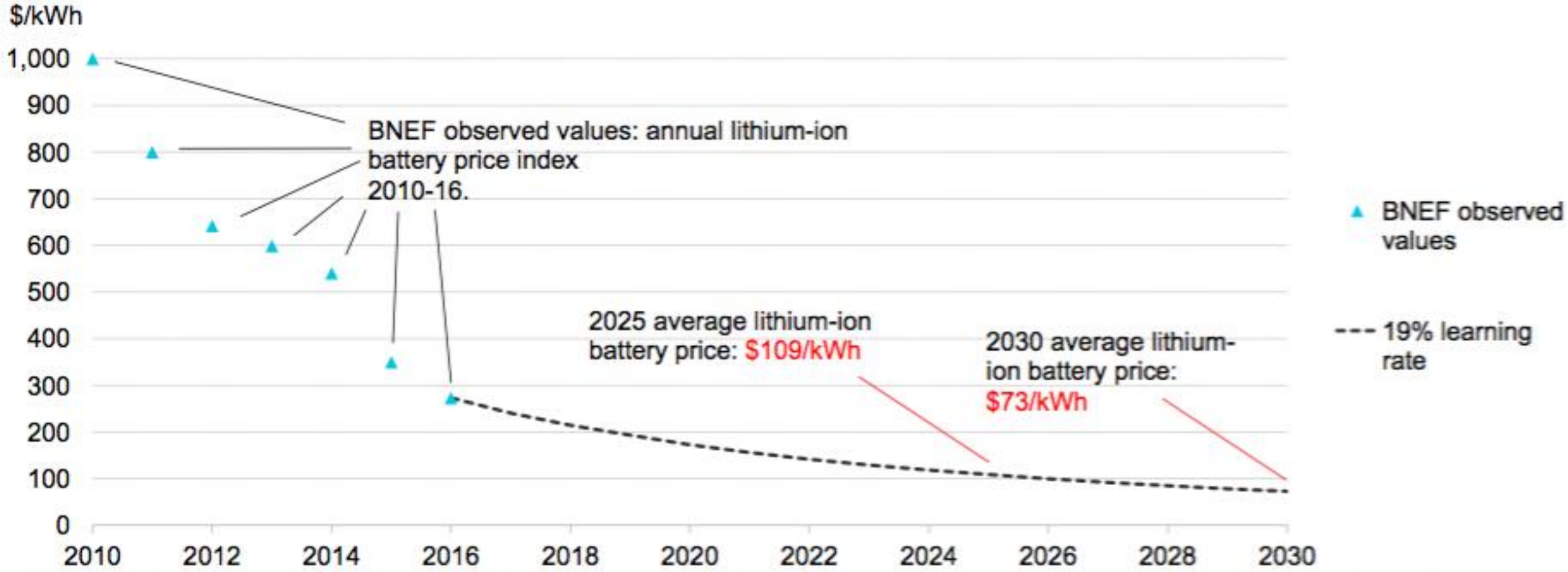
Total values include estimates for undisclosed deals. Includes corporate and government R&D, and spending for digital energy and energy storage projects (not reported in quarterly statistics). Excludes large hydro.

Source: Bloomberg New Energy Finance

Why does NZ not have more solar & wind power plants?

- Australia: ¼ households have invested in solar PV
- BNEF forecasts distributed solar to power more than 50% of Australia's needs by 2040
- Lack of incentives caps NZ residential solar (& EV uptake)
- NZ electricity usage peaks in winter when solar generation lowest
- No utility-scale solar without subsidies
- Wind investment muted without subsidies
- Falling costs in global PV, wind & batteries will reach NZ

Lithium-ion battery prices - historical and forecast



Source: Bloomberg New Energy Finance EVO 2017; Note: Prices are an average of BEV and PHEV batteries and include both cell and pack costs. Cell costs alone will be lower. Historical prices are nominal, future ones are in real 2016 U.S. dollars.

Questions