



# Auctions for Renewable Electricity

Cambridge Energy Policy Research Group (EPRG)  
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Insight in Economics™

## **1. The spread of auctions for renewable subsidies**

- Map
- Key design decisions

## **2. The GB renewable CfD auctions**

- The first auctions – February 2015
- Modelling the auctions – results for 2015 and 2017

## **3. The future for renewable auctions**

- The UK
- Other EU – Germany, Poland

# 1 The spread of auctions for renewables

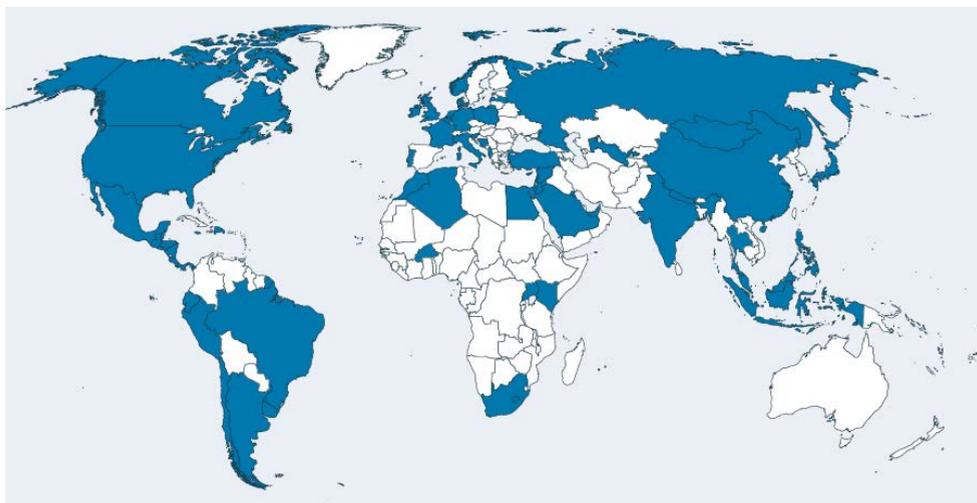
## Single technology

- Denmark (2005) Offshore
- Brazil (2009) Onshore wind, solar PV
- India (2010) Solar
- South Africa (2011) Solar, Onshore
- Middle East (2011) Solar
- US (2011) Solar
- Germany (2015) Solar (2016/17) Onshore and Offshore

## Multiple technologies

- Netherlands (2011)
- UK (2015) (Three “pots”)
- Poland (2016) (>1MW and < 1MW, low load factors maximum)
- California (2011)

## Countries with RES auctions



Source: IRENA, 2015

## Solar auction prices 2015



<http://renewables.seenews.com>

# 1 Key design choices

## Demand side

- Single technology/multiple technologies
- Single-year or Multi-year
- Budget: in TWh or \$
- Maxima or minima
- Reserve prices

## Supply side

- Cost of entry – e.g. planning permission, grid connection
- Bid bonds
- Non-delivery penalties

## Auction format, e.g.

- Sealed bid
- Descending clock

## Clearing mechanism

- Pay as bid (uniform price)
- Pay as clear

Tensions – e.g. maximise competition vs. maximise delivery

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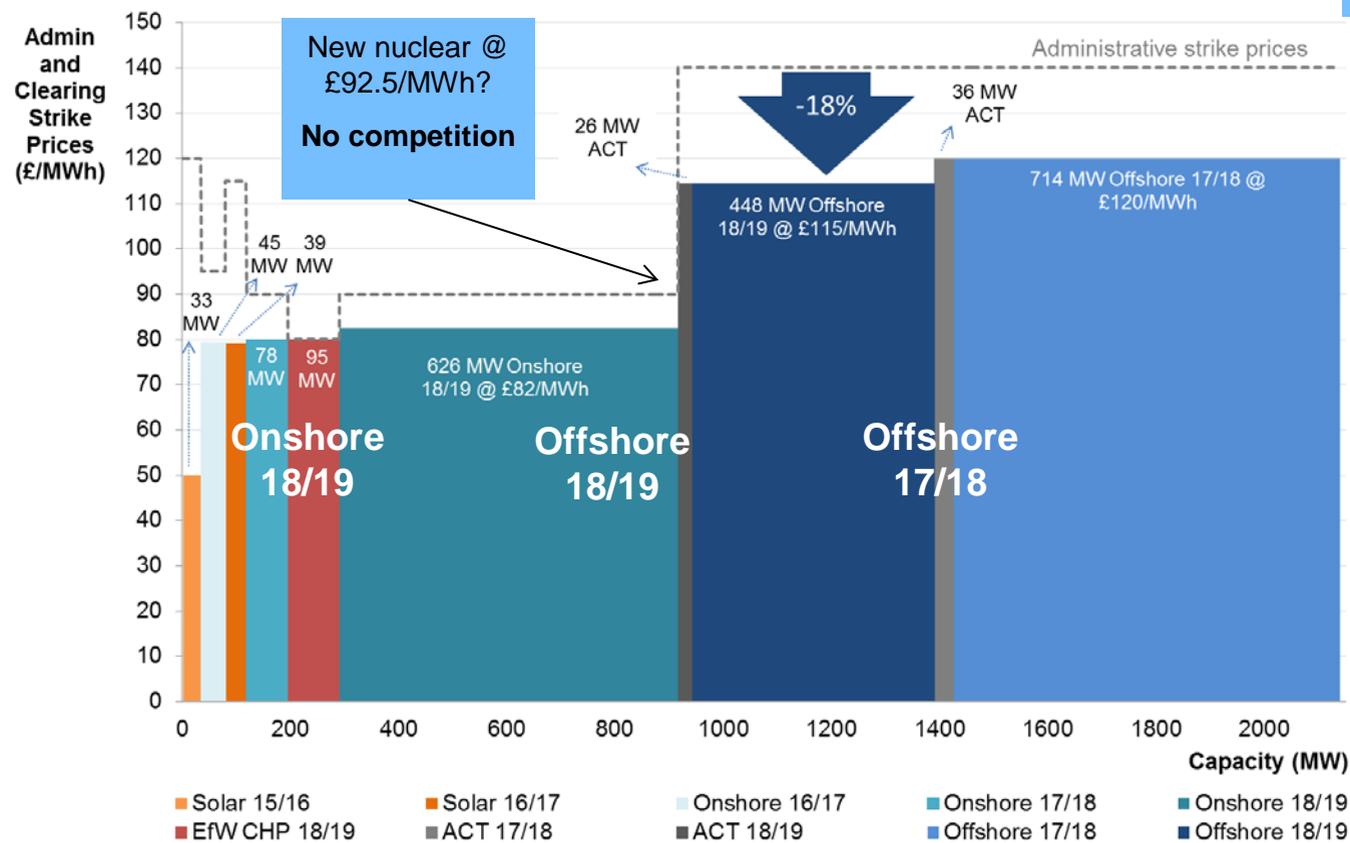
### Background and rules

- Three technology pots
  - Pot 1 (established technologies): Onshore wind (>5MW), Solar Photovoltaic (PV) (>5MW), Energy from Waste with CHP, Hydro (>5MW and <50MW), Landfill Gas and Sewage Gas;
  - Pot 2 (less established technologies): Offshore Wind, Wave, Tidal Stream, Advanced Conversion Technologies, Anaerobic Digestion, Dedicated biomass with CHP, and Geothermal; and
  - Pot 3: Biomass conversion.
- Cost of entry – planning permission and grid connection agreement offer
- Bidders submit
  - Price £/MWh
  - Volume
  - Delivery year (auction covers 4 delivery years, e.g. 2015/16-2018/19)
- Sealed bid, pay as clear (uniform price). Bids stacked by price, across all delivery years.
- Budgets 2015 (cover the subsidy under a CfD, i.e. difference between the strike price and the reference price):
  - Pot 1: £65m/year
  - Pot 2: £260m/year

## 2 First auction outcome (Feb 2015)

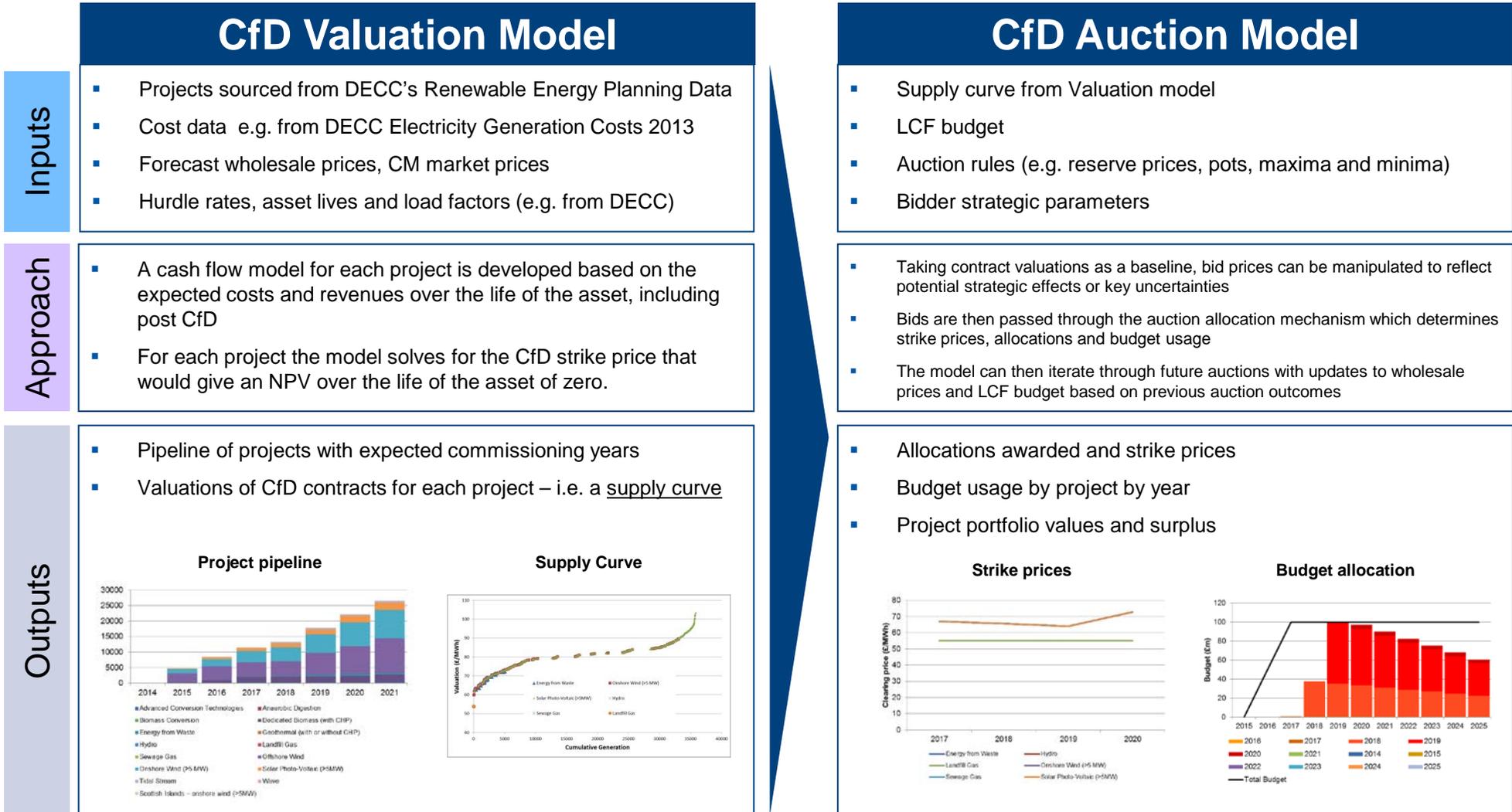
### Success! But questions remain...

- Clearing prices c.10-20% below administrative strike prices (£100m/year saved for consumers)
- Mainly after 1 April 2017 (post-RO)
- Winner's curse? Solar @ £50/MWh has withdrawn. Will offshore projects deliver?
- Why continue to award non-competed CfDs?



# 2 NERA's Renewables CfD Auction Model

We use a valuation model to build a supply curve and an auction model to analyse different design options – e.g. merging of pot 1 and pot 2



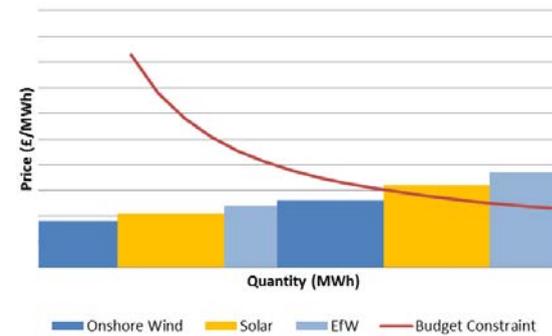
## 2 Analysis of different auction design

### Scenarios

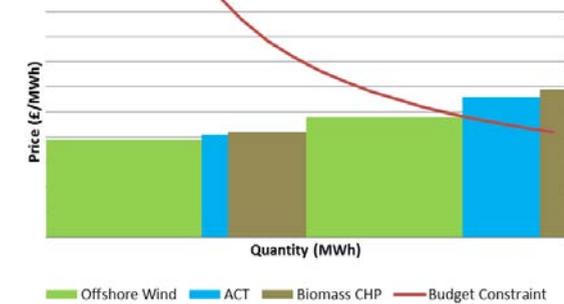
- **Baseline.** Two pots with budgets P1: £65m, P2: £260m (as for 2015 auction)
- **Merged pots.** Merging Pot 1 and Pot 2 with budget adjusted to achieve the same volume of renewable generation as in the Baseline
- **Excluding onshore wind.** Baseline, but with onshore wind excluded.
- **Excluding onshore wind merged pots.** Merged pots scenario, but with onshore wind excluded.
- Data - see Appendix.

### Baseline

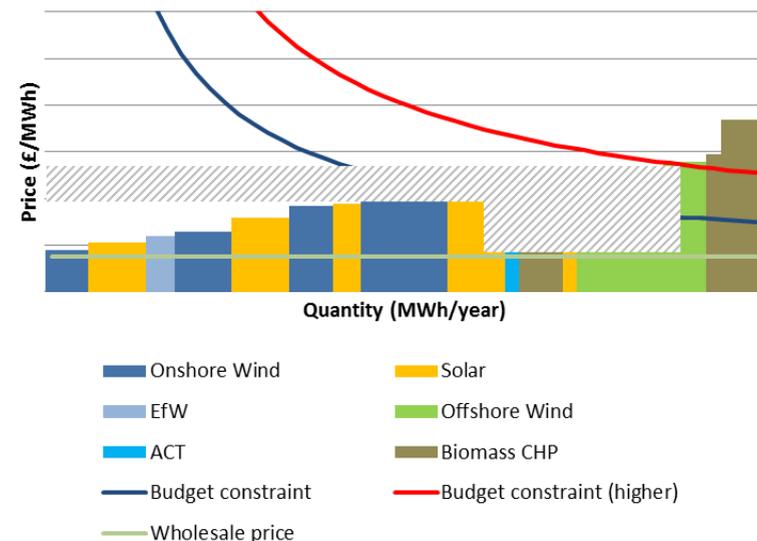
Pot 1 – Established technologies



Pot 2 – Less Established technologies



### Policy scenario – Merged pots

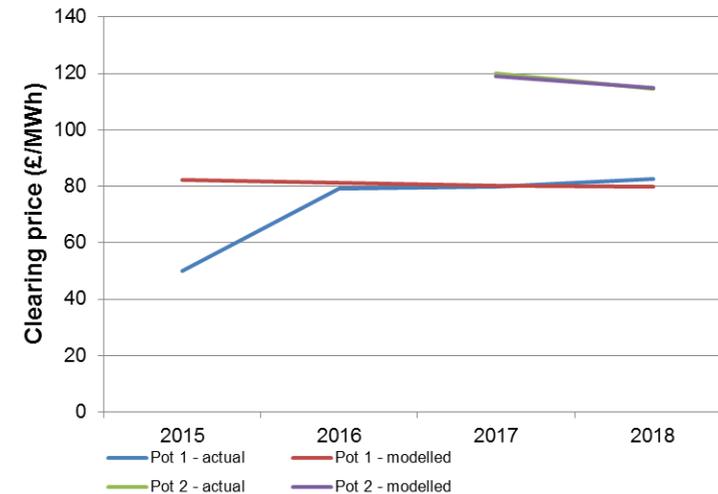


# 2015 Auction: Model Calibration

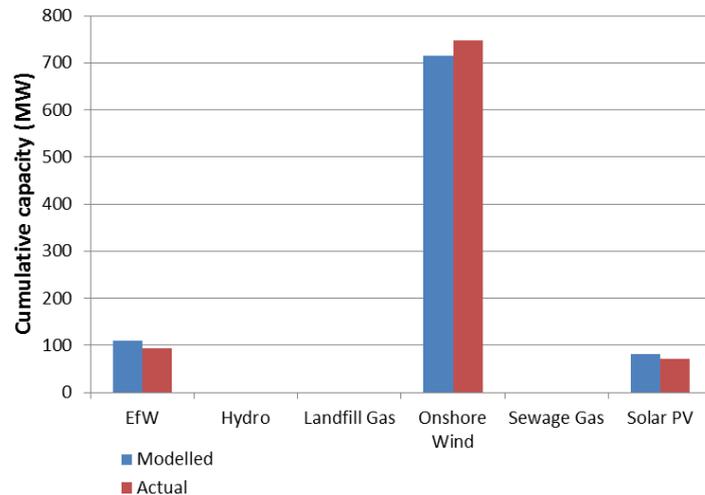
## Modelled vs. Actual

- Reduced the low end of cost distribution (DECC 2013) by 10% for solar and 20% for offshore
- Clearing prices within £1/MWh (apart from solar £50/MWh bid – withdrawn)
- Capacities within 10% of actual (apart from ACT).

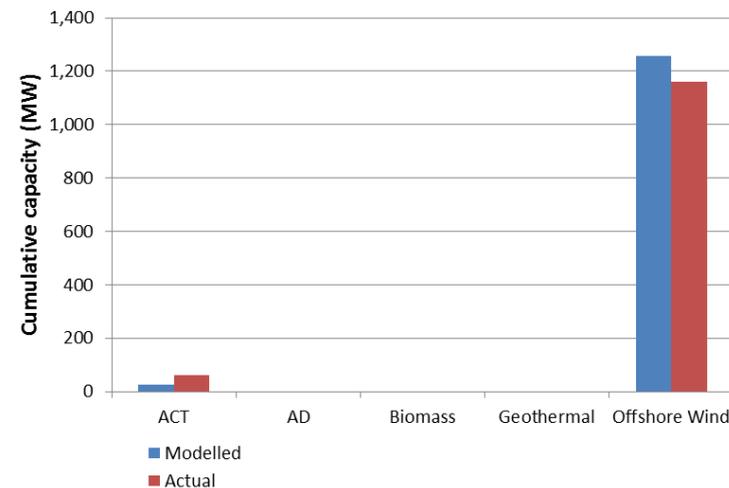
## Clearing prices



## Capacity – Pot 1

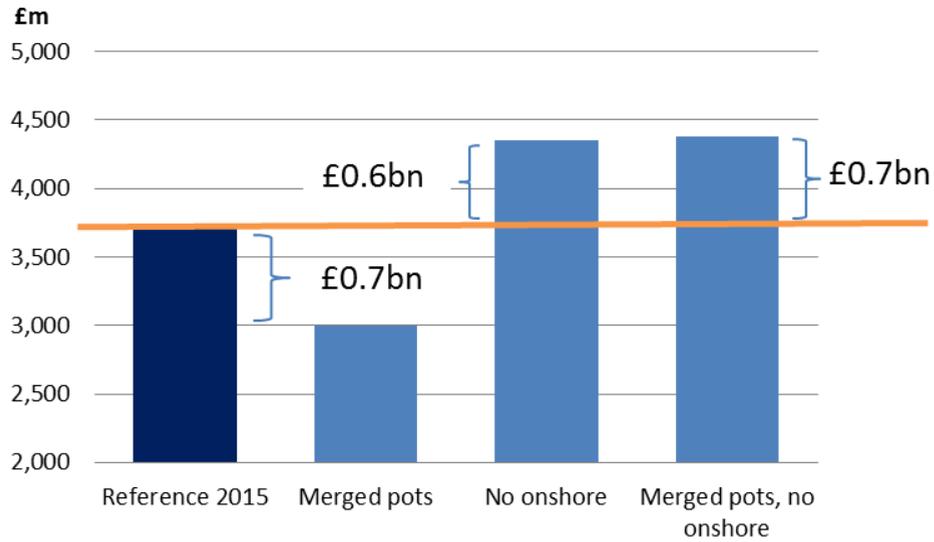


## Capacity – Pot 2

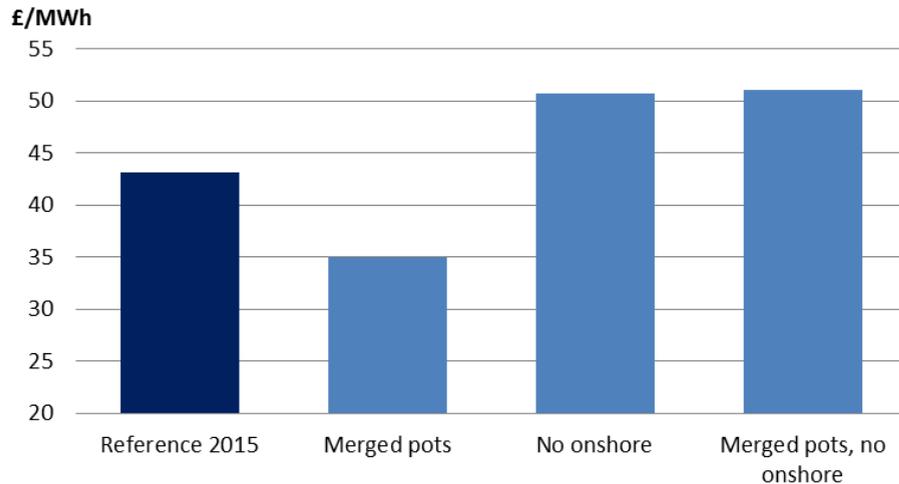


# Results: 2015 auction

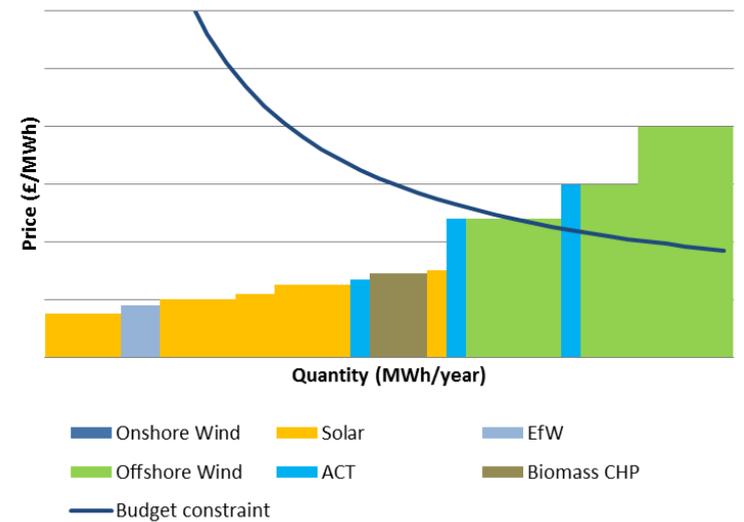
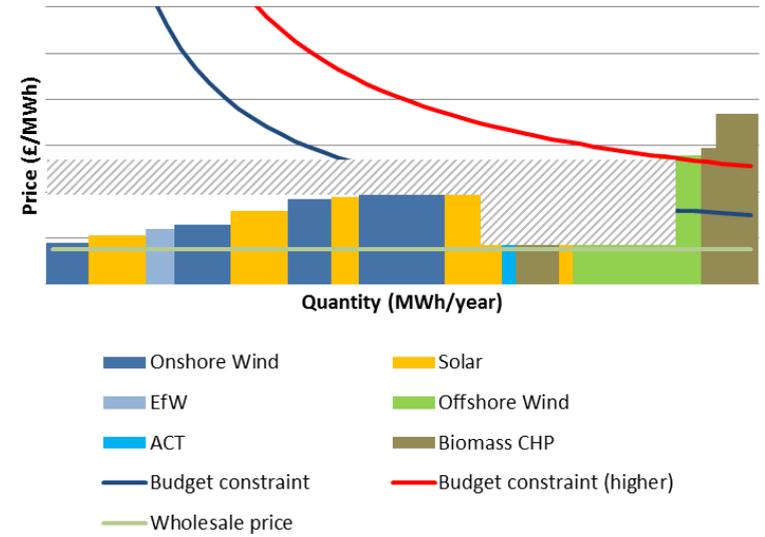
## Cost to consumers



## Average subsidy

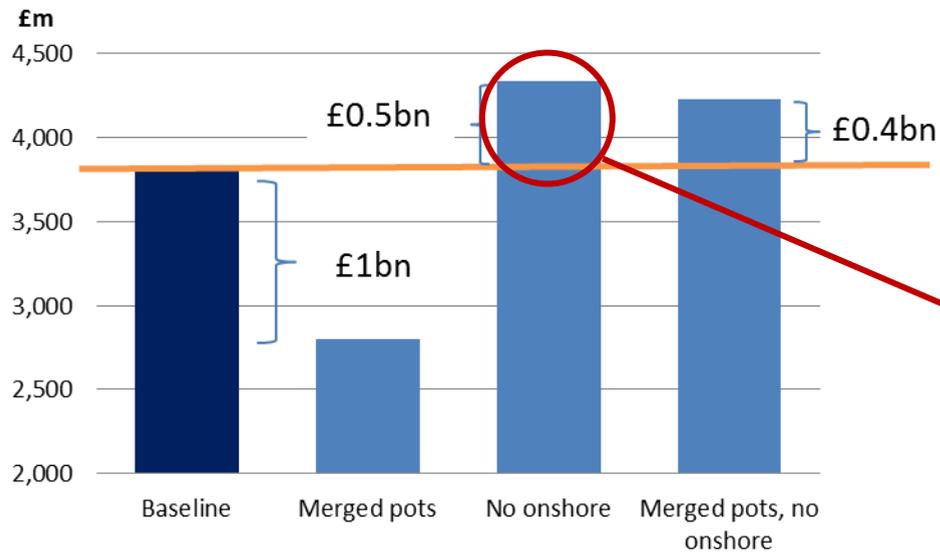


## Merging without onshore saves nothing...



# Results: 2017 auction

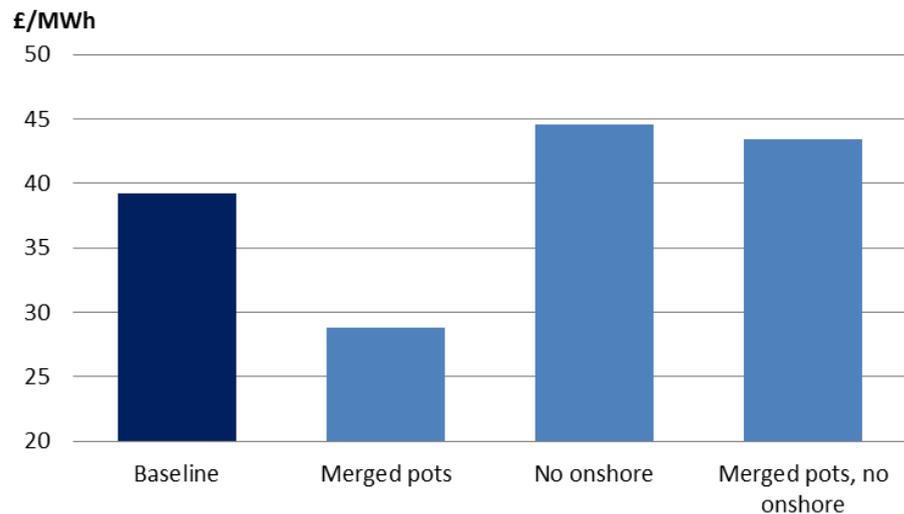
## Cost to consumers



## Sensitivity: Cost of excluding onshore wind



## Average subsidy



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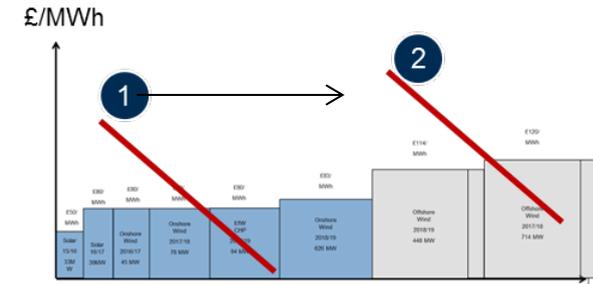
# 3 The future for auctions – UK

## The Government's plans...?

- Pot 1 (onshore and solar): “non-subsidy” CfDs?
- Pot 2 (Offshore): 3 auctions by 2020 – provided prices continue to come down...
- Pot 3 (Biomass conversion)?
- Technology neutral competition (merging pots)?
- Incorporating System Integration Costs? (CCC report for 5CB)
- Continue to try to control auction outcomes
  - technology pots,
  - maxima/minima
  - Excluding the lowest cost technology?

## Prices can go up as well as down...

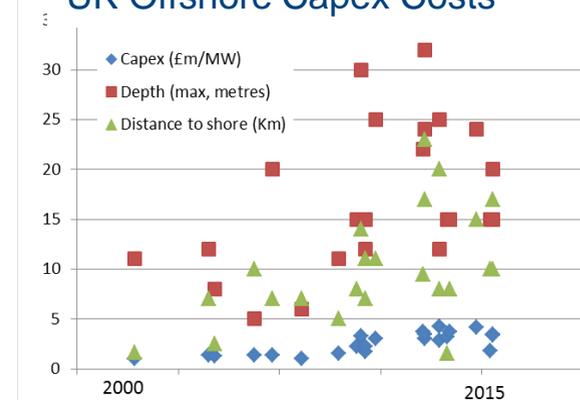
Moving up the supply curve vs. tech learning



## Brazil onshore wind



## UK Offshore Capex Costs

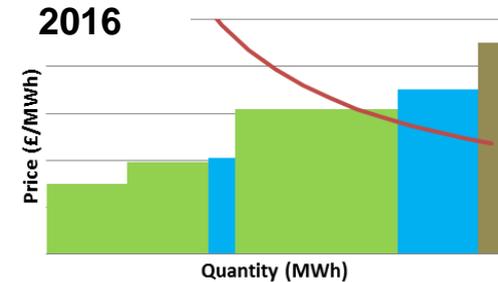


Source: 4COffshore, Analysis NERA

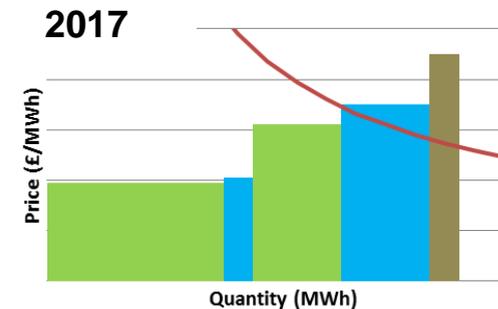
# 3 UK Pot 2 (Offshore) Auctions – Strategy

## Bid now or bid later?

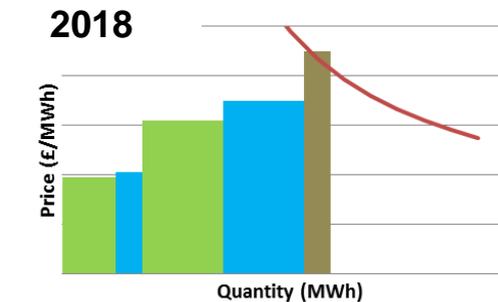
- Effectively a Pay As Bid auction
- What price to bid? What delivery year? What volume? Which auction?
- Real option value of bidding in later auction
  - + Competition may be lower (existing projects need to build and start earning revenues, and limited new entry?)
  - + Costs may be lower (learning?)
  - + Gearing levels may increase as banks become familiar with CfD projects
  - Cost of keeping project ticking over
  - Regulatory change (e.g. Govt could change budgets)
  - Yields and cost of debt will return to long term levels



Legend: Offshore Wind (green), ACT (blue), Biomass CHP (brown), Budget Constraint (red line)



Legend: Offshore Wind (green), ACT (blue), Biomass CHP (brown), Budget Constraint (red line)



Legend: Offshore Wind (green), ACT (blue), Biomass CHP (brown), Budget Constraint (red line)

### 3 The future for auctions – EU

- EC State Aid Guidelines – technology neutral competitions from 2017?

- Germany

- Solar, Onshore and Offshore – separate auctions
- Used 3 solar auctions as experiments in design
- Pay as clear produces lower prices, but Germany prefers Pay As Bid

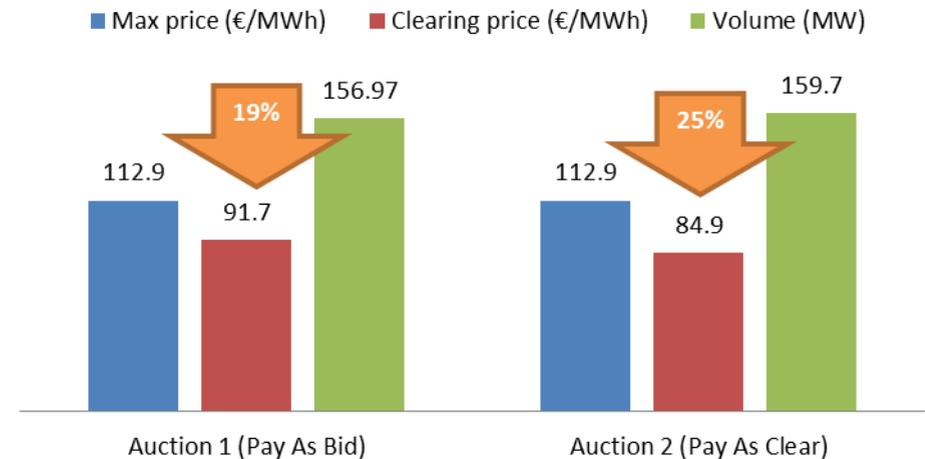
- Poland

- Tech neutral, but maximum for low load factor technologies (i.e. intermittent)

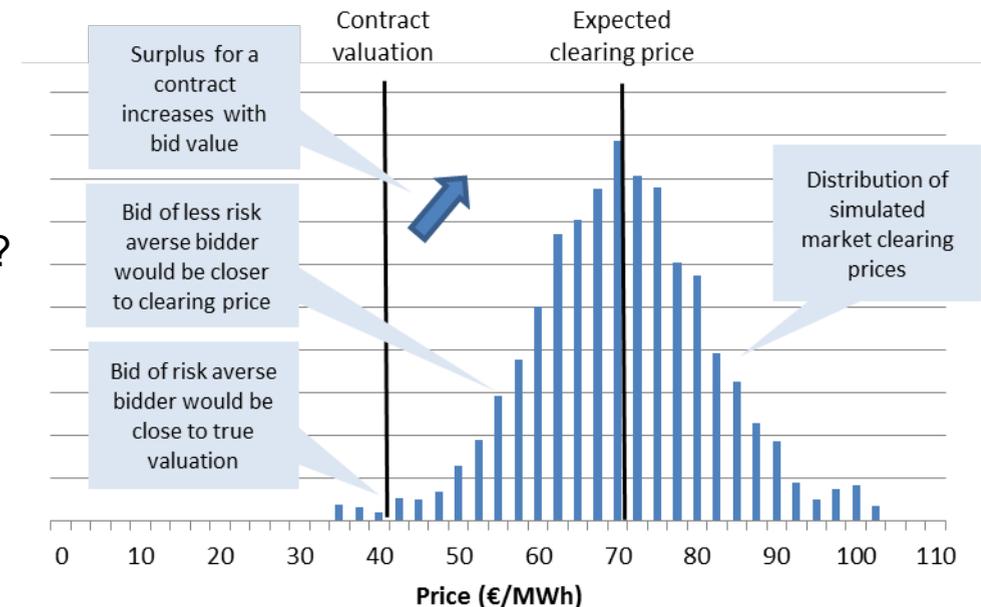
- How can different technologies compete fairly?

- How take Whole System Costs into account?
- Should intermittent generation have to provide firm capacity?

#### German PV Auctions 2015



Source: NERA analysis



# Appendix: Assumptions and data sources



# Key assumptions

- Technology costs
  - Base: DECC 2013 Generation costs (and fuel costs from consultation on the RO 2012)
  - Offshore and solar calibrated to 2015 auction results (lower end of cost distribution adjusted by a factor)
  - Sensitivities:
    - Low technology costs: 30% lower for less established technologies and solar, 20% lower for other established technologies.
    - High technology costs: 50% of DECC learning rate
- Rates of return required (hurdle rates) and build limits, load factors and asset lifetimes also aligned with DECC 2013 Generation costs report
- Wholesale prices
  - Base: DECC 2014 UEP and CfD allocation framework (c. £53/MWh in 2020, 2012 prices)
  - Sensitivities:
    - DECC 2014 UEP High (£70/MWh in 2020)
    - DECC 2014 UEP Low (£41/MWh in 2020)
- Supply curve
  - 2015: REPD database (exclude “under construction” or those without planning permission). Allow limited new entrants.
  - 2017: mainly new entrants similar to the REPD database.
  - Projects draw costs from a distribution defined using the DECC 2013 technology costs
  - Strike price bids are generated via a discounted cash flow project model

<https://www.gov.uk/government/collections/renewable-energy-planning-data>

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/223940/DECC\\_Electricity\\_Generation\\_Costs\\_for\\_publication\\_-\\_24\\_07\\_13.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223940/DECC_Electricity_Generation_Costs_for_publication_-_24_07_13.pdf)

<https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2014>

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/42852/5936-renewables-obligation-consultation-the-government.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42852/5936-renewables-obligation-consultation-the-government.pdf)

## Background and rules

- The GB auctions for renewable CfD contracts were introduced in 2014 and the first auction was held in February 2015
- There are separate **auction pots**\* or budgets for established technologies (like onshore and solar), less established technologies (like offshore wind) and biomass conversion.
  - This means there are up to 3 separate auctions (as budgets are kept separate). There has been no budget for Pot 3 yet.
- The auction design is a **sealed bid, second price** format where bidders receive the clearing price (**pay-as-clear**) rather than the price they have bid, as long as the clearing price is below their (technology-specific) maximum price (administrative strike price).
  - If the clearing price is above the maximum price for a technology, then successful bidders from that technology receive their maximum price.
- Projects can submit up to 10 separate bids with different capacities, prices and commissioning years.
- Auctions cover multiple future delivery years – e.g. in the 2015 auction projects could bid in capacity to be commissioned in any of the **four subsequent years 2015/16-2018/19** (and for offshore wind this extends out to 2020/21 as such projects can phase their projects over 3 years)
- Budgets pay for subsidies: the difference between the strike price (clearing price in the auction) and the reference price (defined *separately* for intermittent and baseload technologies) for all the successful contracts.
- The auctioneer (National Grid) **stacks all bids according to bid price** (irrespective of delivery year) and in each pot clears the auction using the lowest cost energy that fits in the budget

\* The pots are: Pot 1 (established technologies): Onshore wind (>5MW), Solar Photovoltaic (PV) (>5MW), Energy from Waste with CHP, Hydro (>5MW and <50MW), Landfill Gas and Sewage Gas; Pot 2 (less established technologies): Offshore Wind, Wave, Tidal Stream, Advanced Conversion Technologies, Anaerobic Digestion, Dedicated biomass with CHP, and Geothermal; and Pot 3: Biomass conversion.



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