



# Auctions for Renewable Electricity

Cambridge Energy Policy Research Group (EPRG)  
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Alon Carmel  
Senior Consultant

Daniel Radov  
Associate Director

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

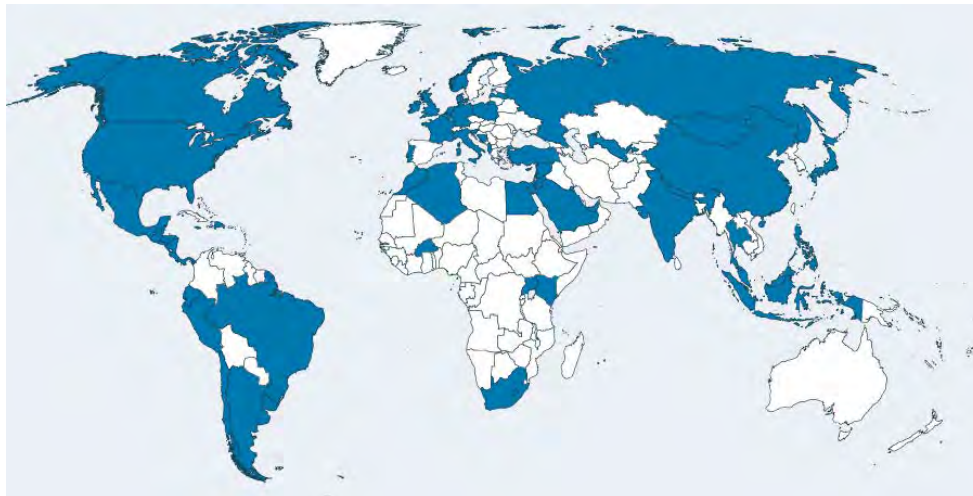
## Single technology

- 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



**OVERVIEW //** Lowest solar prices so far in 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

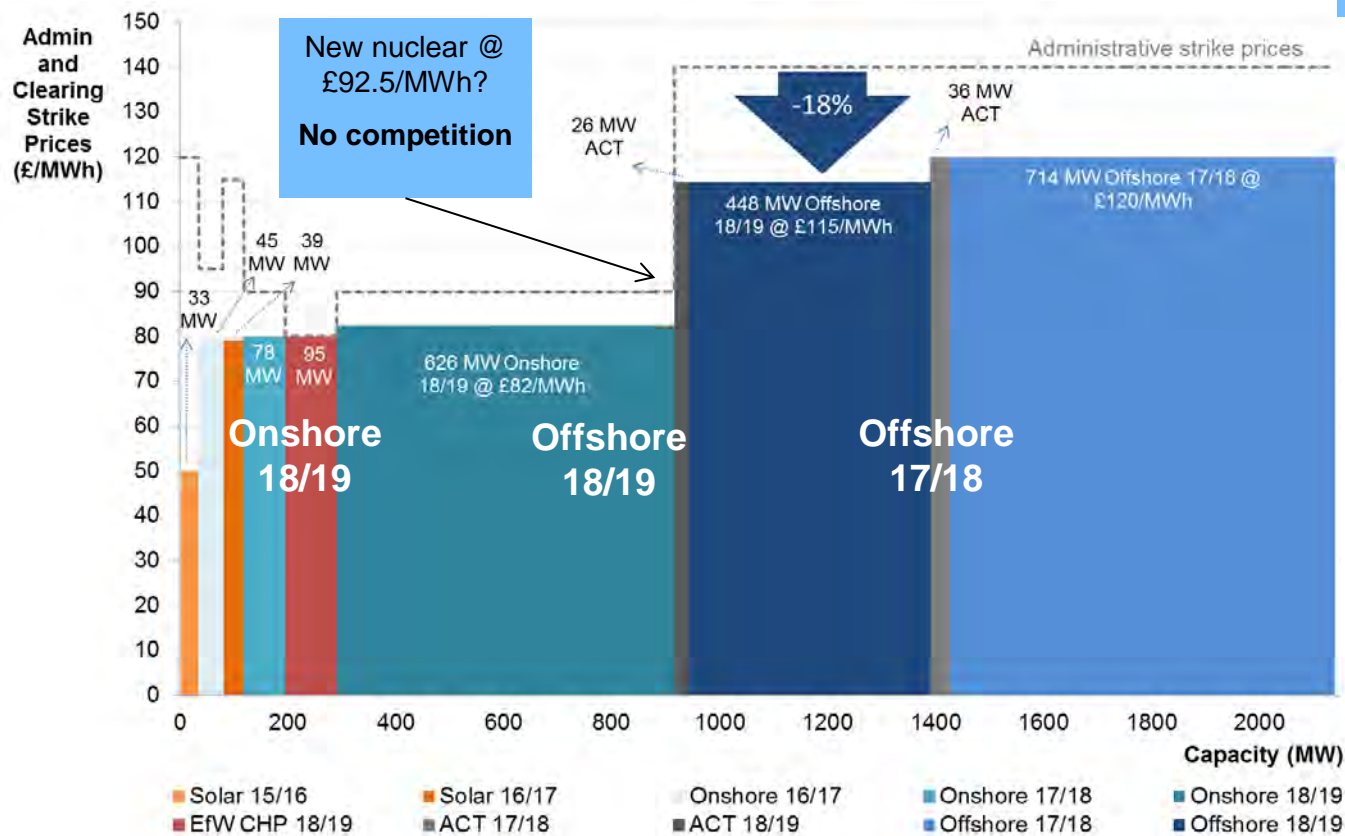
- Three technology pots
  - Pot 1 (established technologies): Onshore wind (>5MW), Solar Photovoltaic (PV) (>5MW), Energy from Waste with CHP, Hydro (>5MW and <50MW), Landfill Gas and Sewage Gas;
  - Pot 2 (less established technologies): Offshore Wind, Wave, Tidal Stream, Advanced Conversion Technologies, 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...

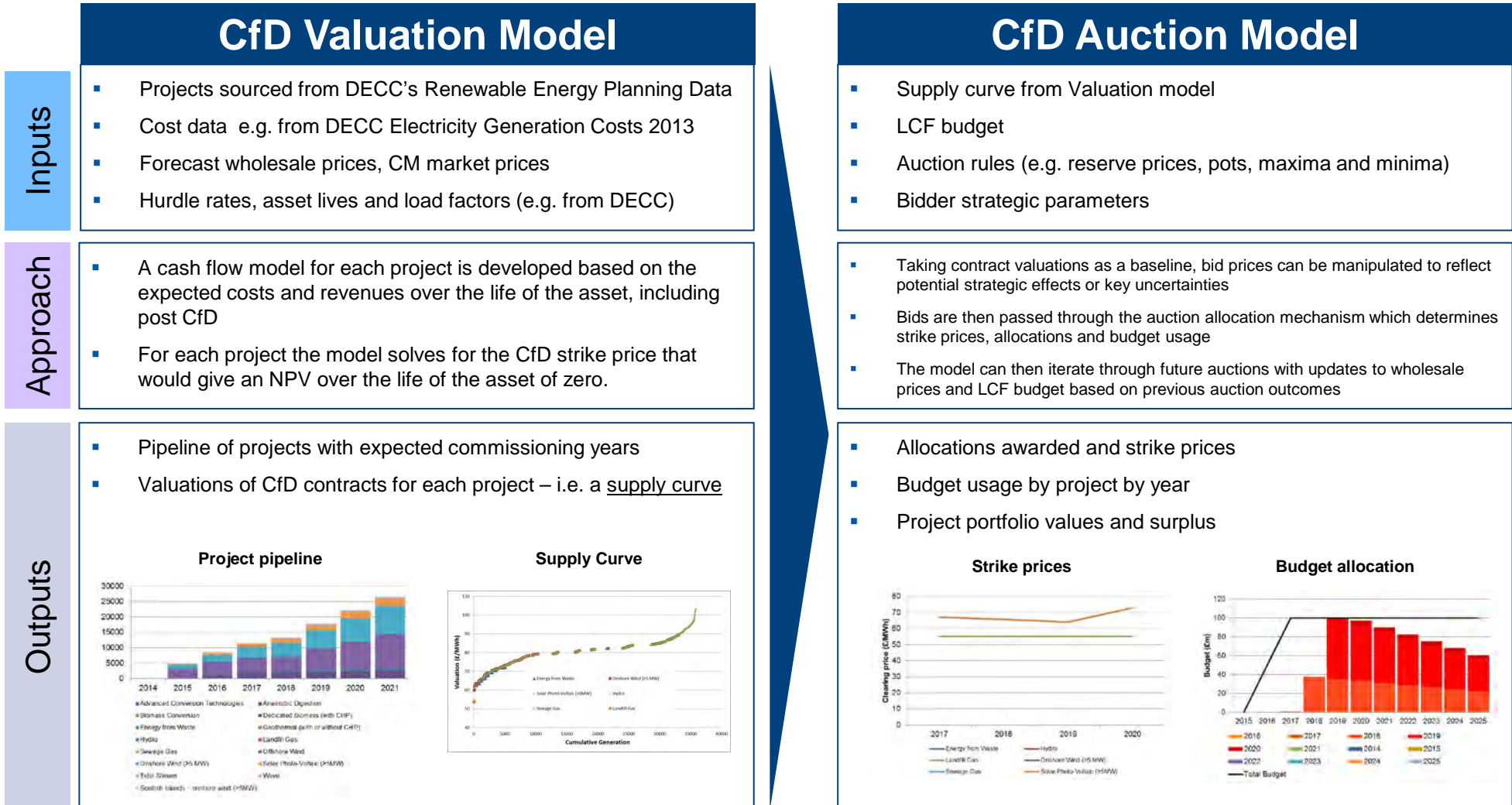
- Clearing prices c.10-20% below administrative strike prices (£100m/year saved for consumers)
- Mainly after 1 April 2017 (post-RO)
- Winner's curse? Solar @ £50/MWh has withdrawn. Will offshore projects deliver?
- Why continue to award non-competed CfDs?

Tidal Range  
(Swansea Bay)  
@ £?/MWh  
**No competition**



# 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





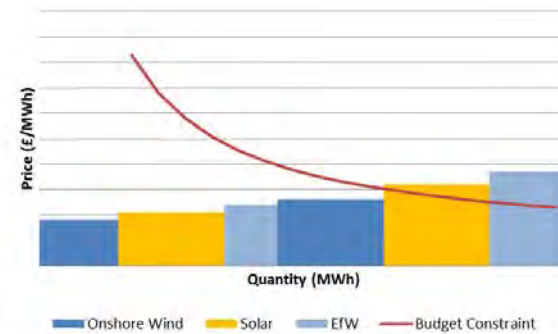
## 2 Analysis of different auction design

### Scenarios

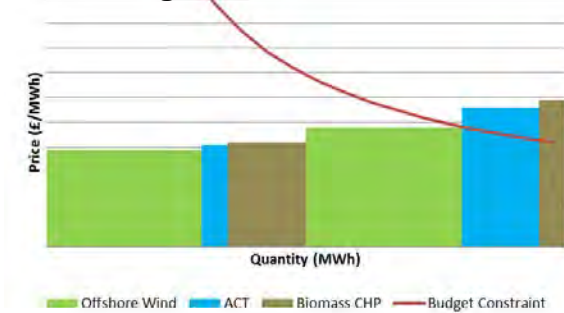
- Baseline. Two pots with budgets P1: £65m, P2: £260m (as for 2015 auction)
- Merged pots. Merging Pot 1 and Pot 2 with budget adjusted to achieve the same volume of renewable generation as in the Baseline
- Excluding onshore wind. Baseline, but with onshore wind excluded.
- Excluding onshore wind merged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

### Baseline

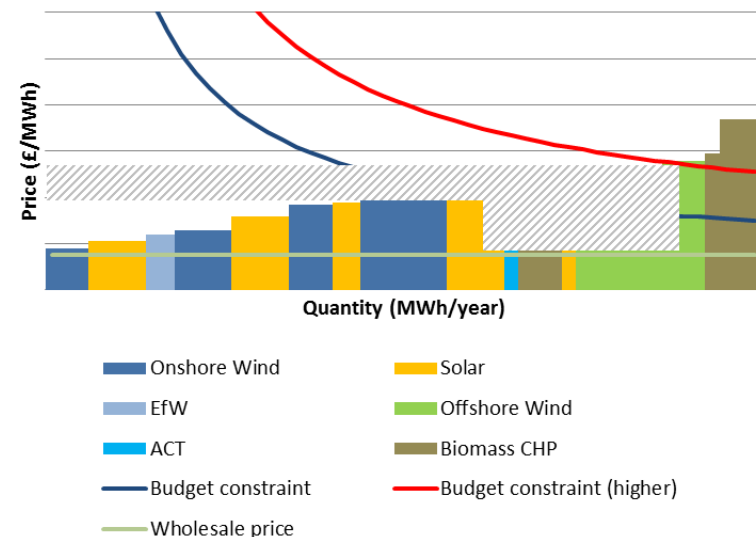
Pot 1 – Established technologies



Pot 2 – Less Established technologies



### Policy scenario – Merged pots

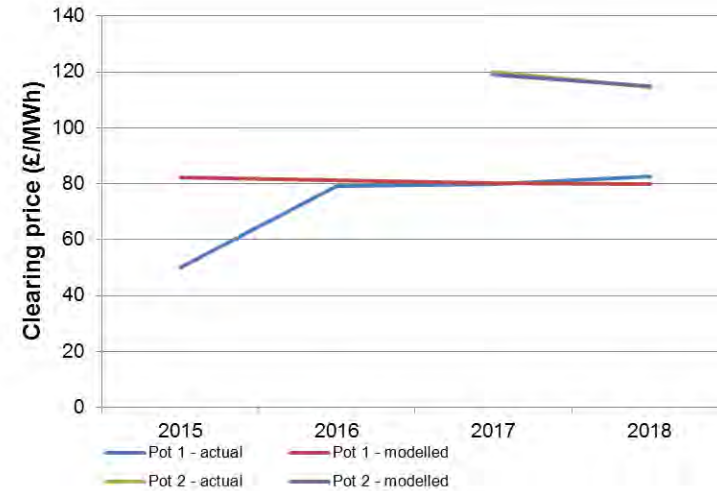


# 2015 Auction: Model Calibration

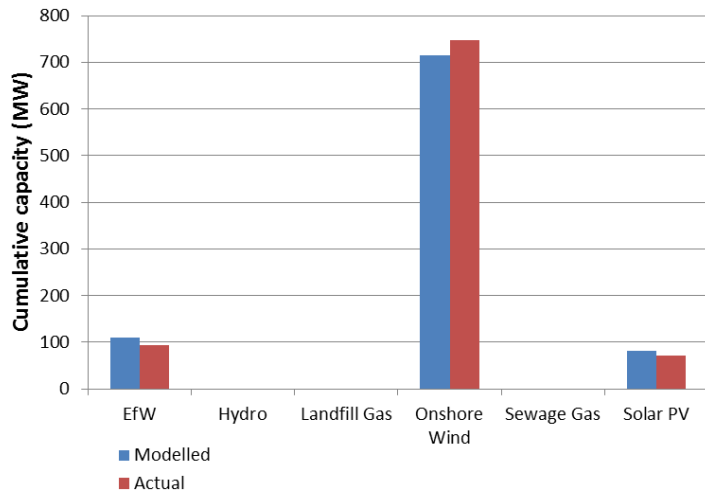
## Modelled vs. Actual

- 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).

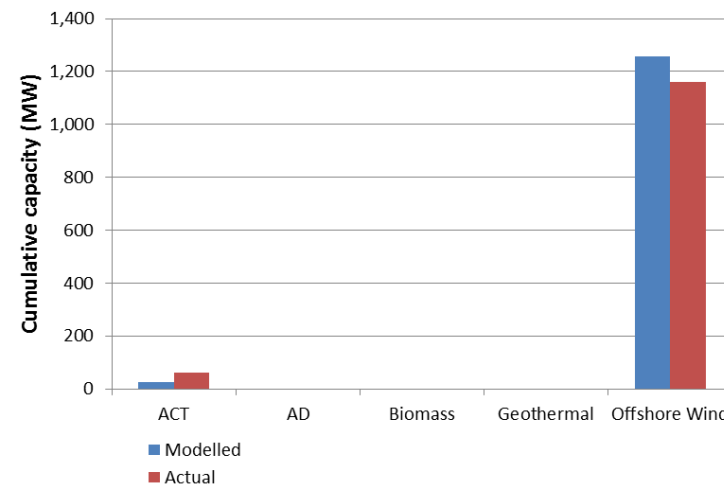
## Clearing prices



## Capacity – Pot 1

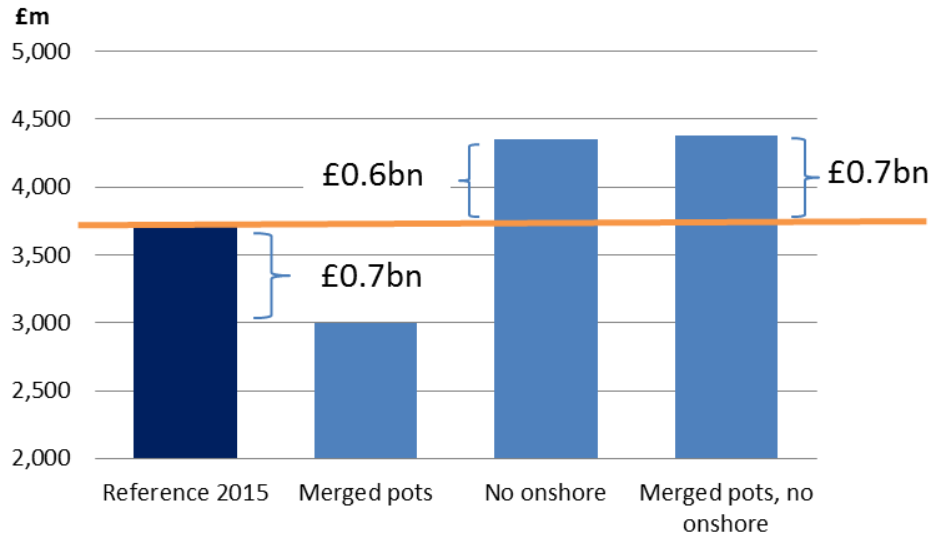


## Capacity – Pot 2

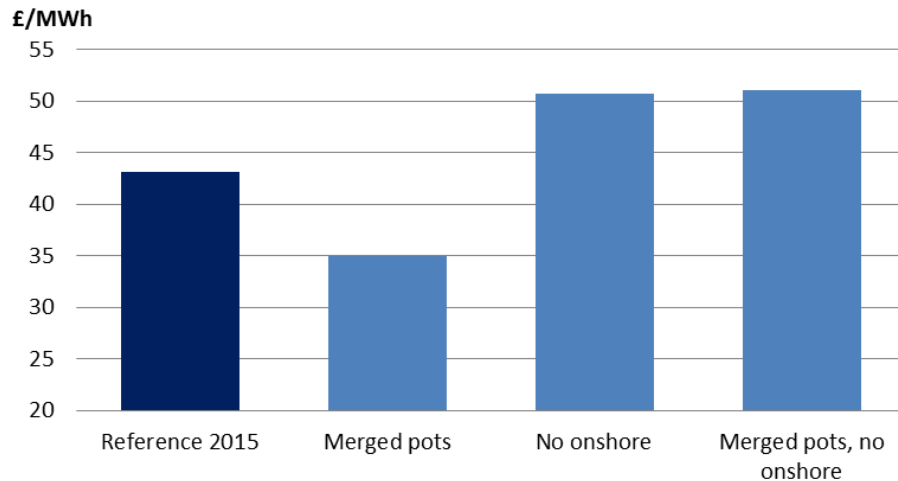


# Results: 2015 auction

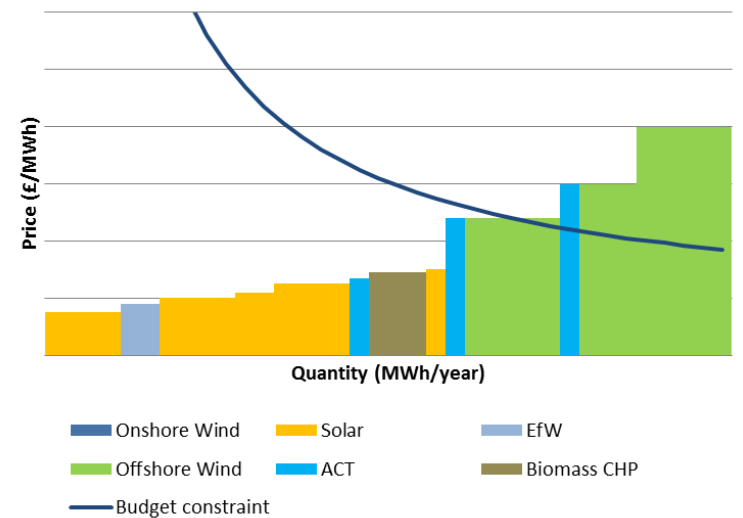
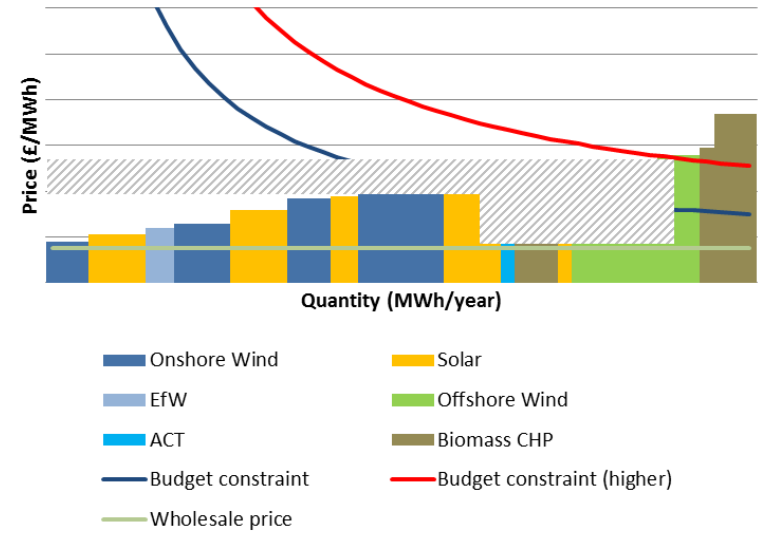
## Cost to consumers



## Average subsidy

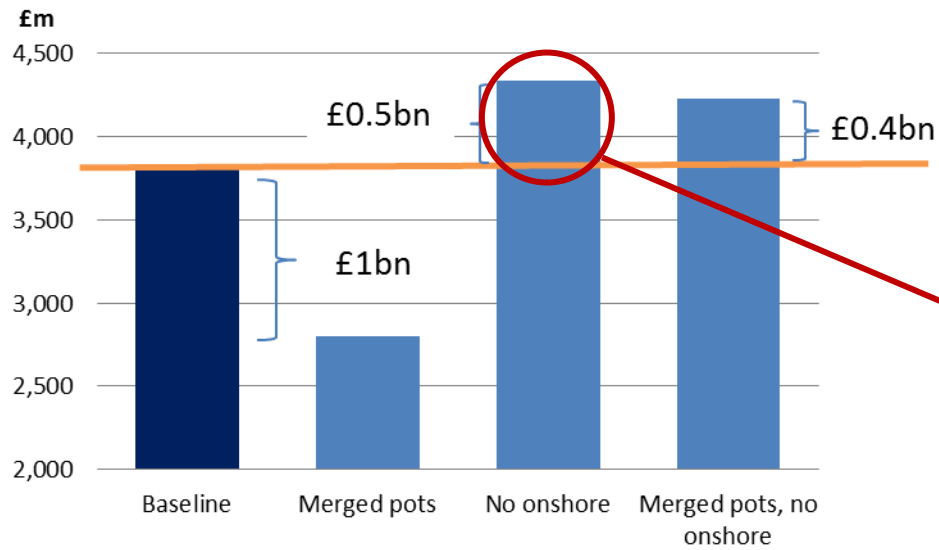


## Merging without onshore saves nothing...



# Results: 2017 auction

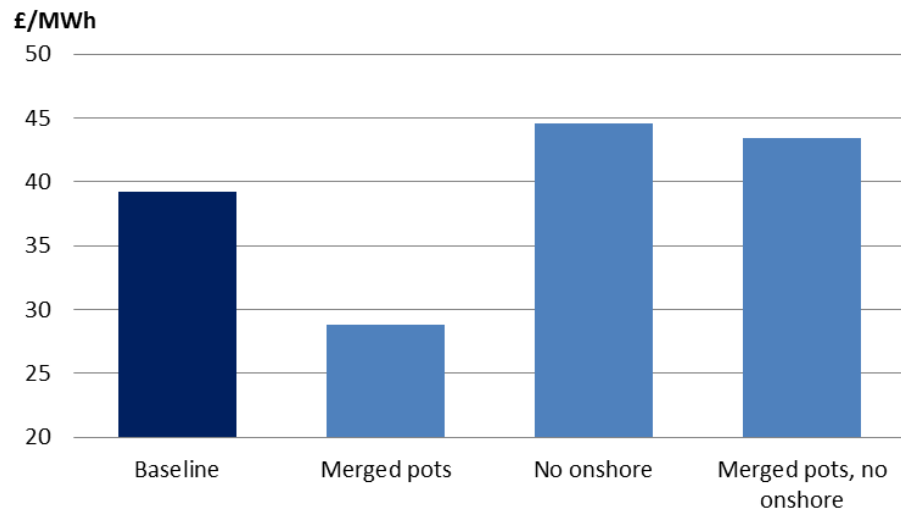
## Cost to consumers



## Sensitivity: Cost of excluding onshore wind



## Average subsidy



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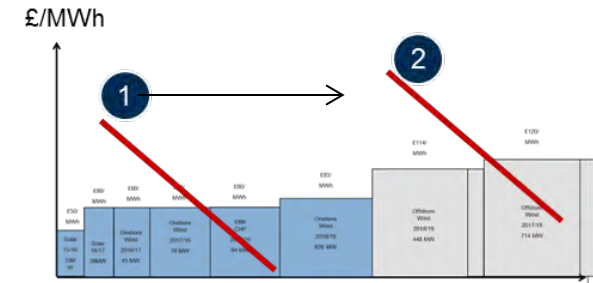
# 3 The future for auctions – UK

## The Government's plans...?

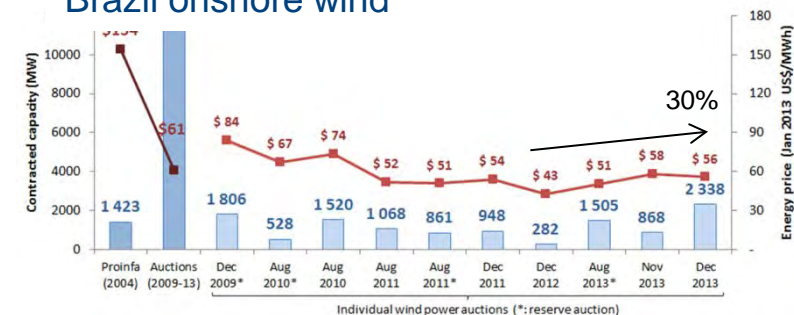
- Pot 1 (onshore and solar): “non-subsidy” CfDs?
- Pot 2 (Offshore): 3 auctions by 2020 – provided prices continue to come down...
- Pot 3 (Biomass conversion)?
- Technology neutral competition (merging pots)?
- Incorporating System Integration Costs? (CCC report for 5CB)
- Continue to try to control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

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

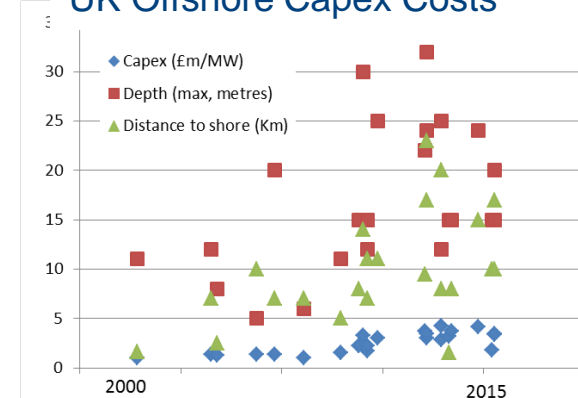
Moving up the supply curve vs. tech learning



### Brazil onshore wind



### UK Offshore Capex Costs

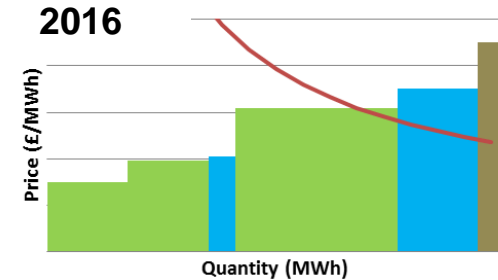


Source: 4COffshore, Analysis NERA

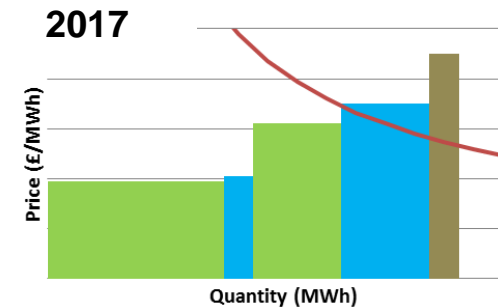
# 3 UK Pot 2 (Offshore) Auctions – Strategy

## Bid now or bid later?

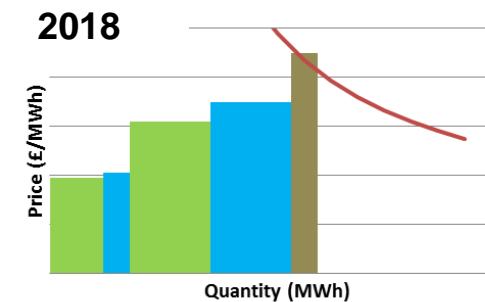
- Effectively a Pay As Bid auction
- What price to bid? What delivery year? What volume? Which auction?
- Real option value of bidding in later auction
  - + Competition may be lower (existing projects need to build and start earning revenues, and limited new entry?)
  - + Costs may be lower (learning?)
  - + 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



Offshore Wind    ACT  
Biomass CHP    Budget Constraint



Offshore Wind    ACT  
Biomass CHP    Budget Constraint



Offshore Wind    ACT  
Biomass CHP    Budget Constraint

### 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

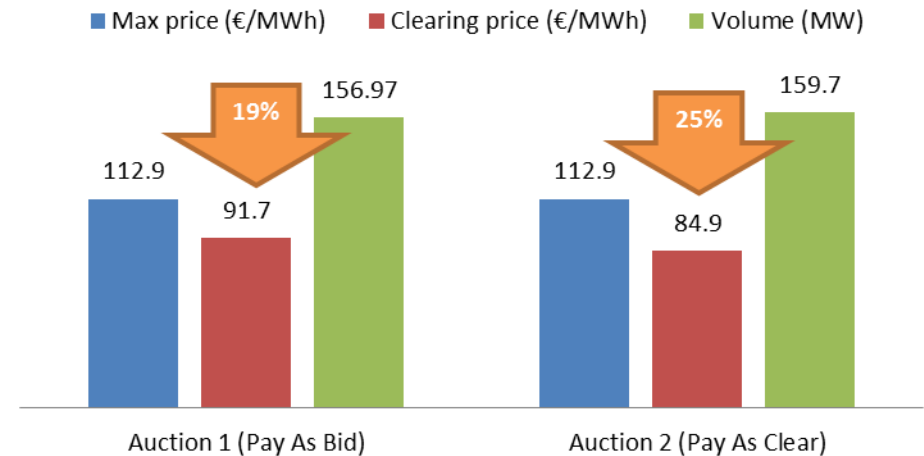
- Poland

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

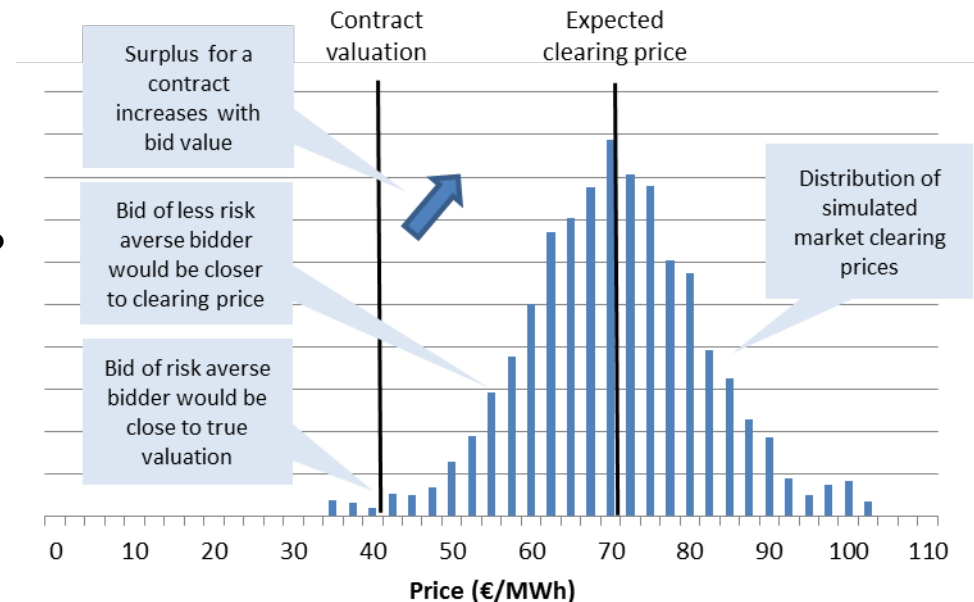
- How can different technologies compete fairly?

- 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.



# Contact Us

Daniel Radov  
Associate Director  
NERA London  
+44 20 7659 8744  
daniel.radov@nera.com

Alon Carmel  
Senior Consultant  
NERA London  
+44 20 7659 8628  
alon.carmel@nera.com