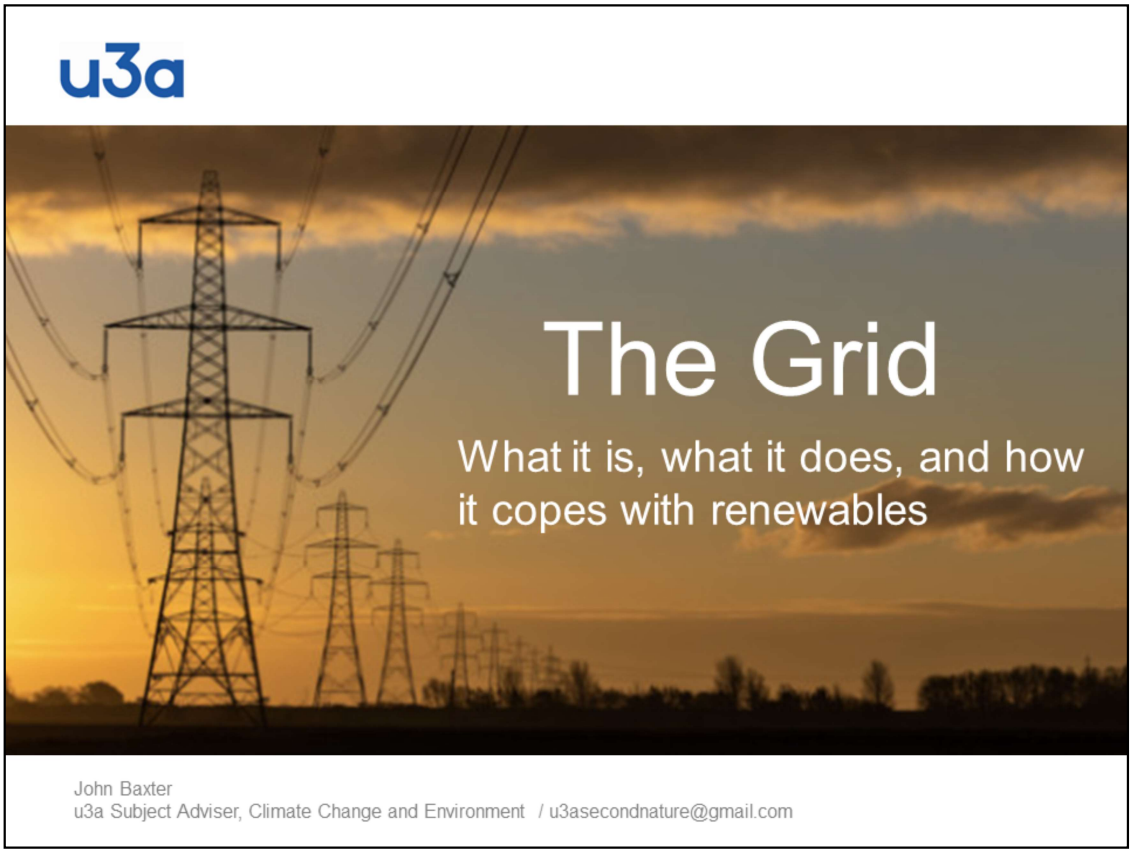
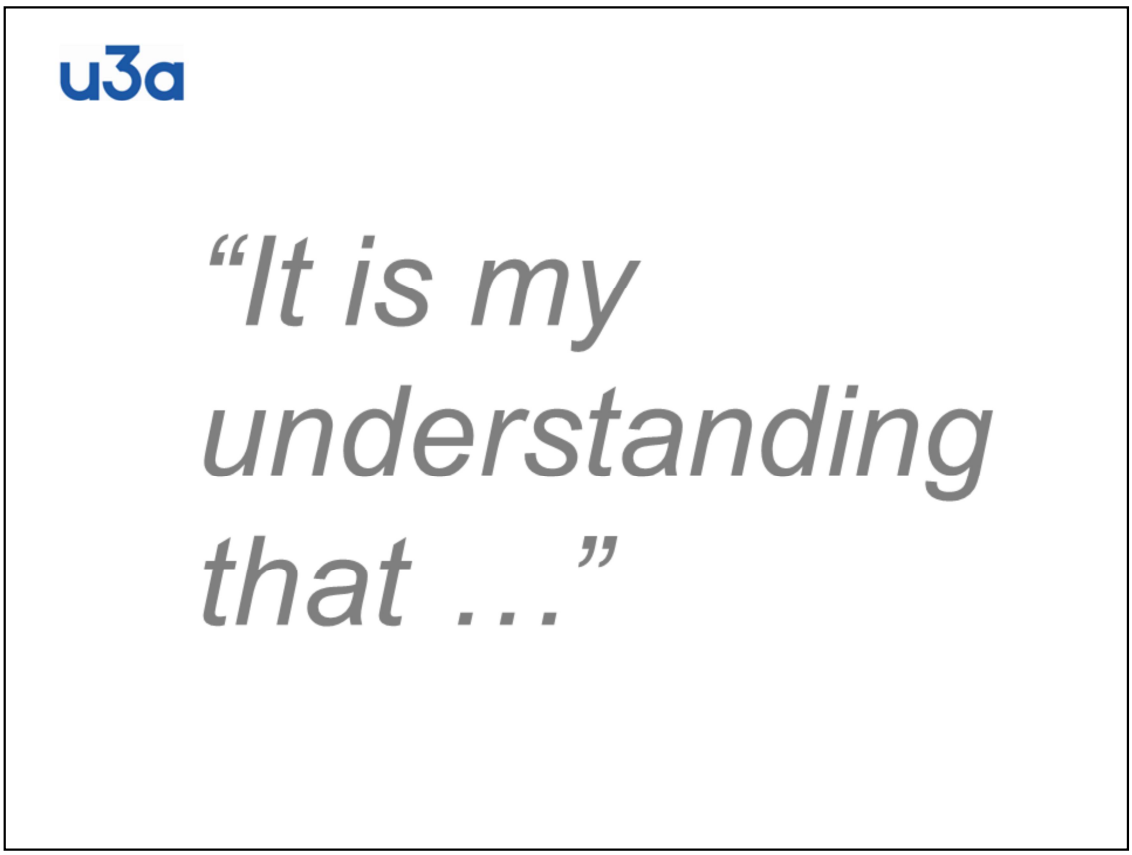
Synopsis

- The components of the electricity system – generation, transmission, distribution, supply
- How generators contract with the system – Allocation Rounds, the role of the LCCC; what a CfD is
- How ESO buys electricity – Settlement, bid and offer prices
- Why the price of electricity tracks the gas price. The Marginal Generation Unit
- The Review of Electricity Market Arrangements (REMA)
- How ESO matches supply and demand – balancing
- Carbon intensity, and how it varies across regions and throughout the day
- Getting ready for net zero – black start, green inertia, and demand flexibility
- Green electricity and the REGO
- Questions.

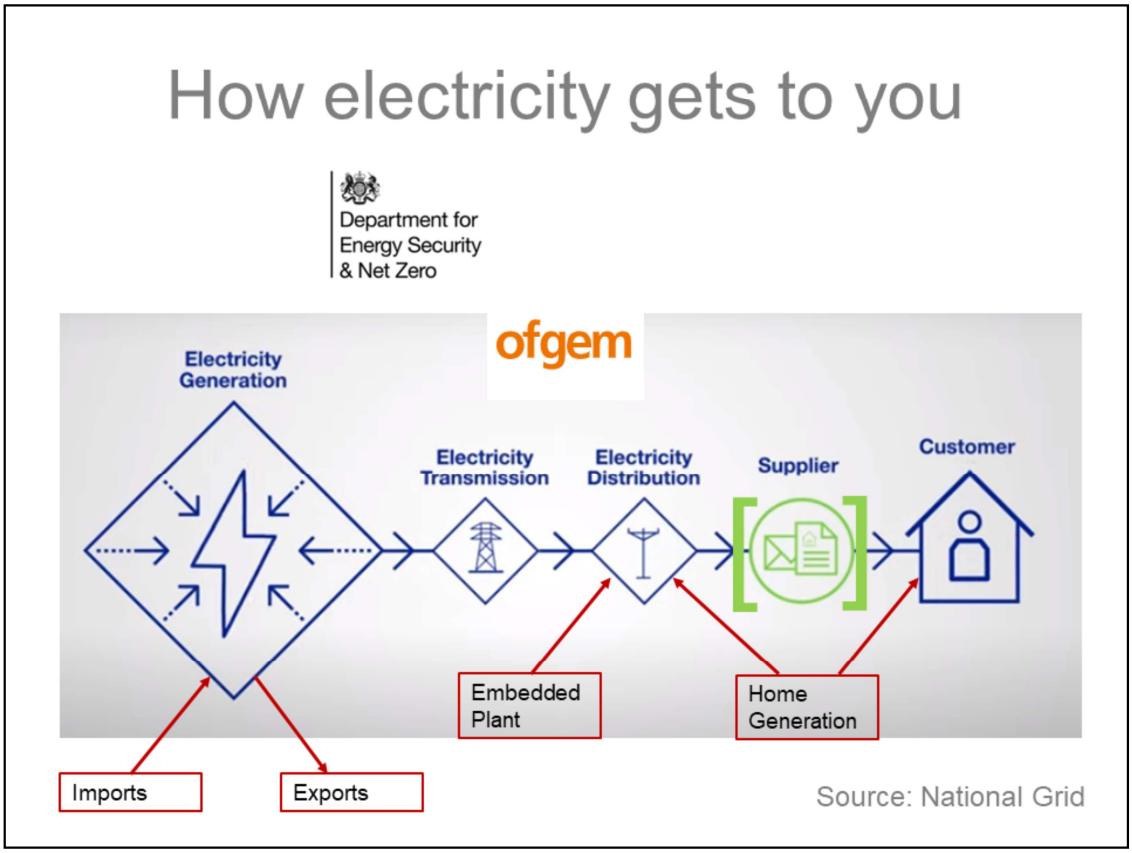
There are Notes Pages for many slides but they do not form a complete script. Contact me if you need more or if you want the original Powerpoint.



I've been fascinated by the electricity system for some years now. After the road network, it's probably the biggest engineered system out there. I've used The Grid as the title here, but as you will see the electricity system is more than just the grid.

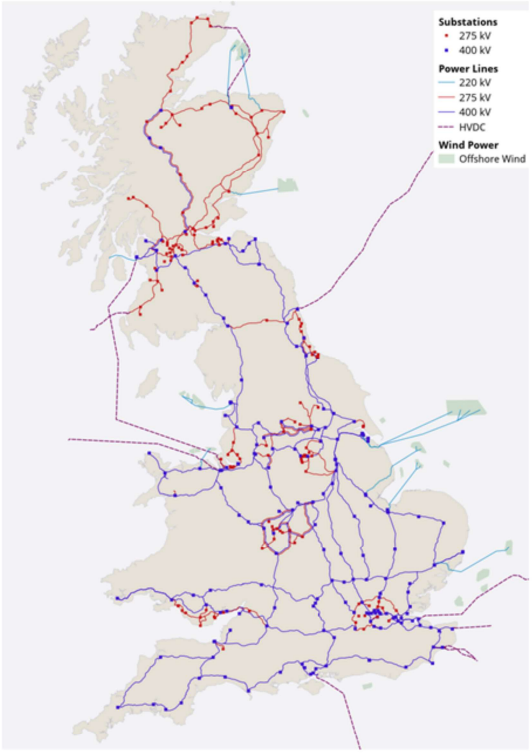


I’ve collected this information because I’m trying to understand the wholes electricity market; I hasn’t made me an expert. It will be tiresome if I have to prefix every statement with “it is my understanding that”, so I’ll ask you to add it yourself.

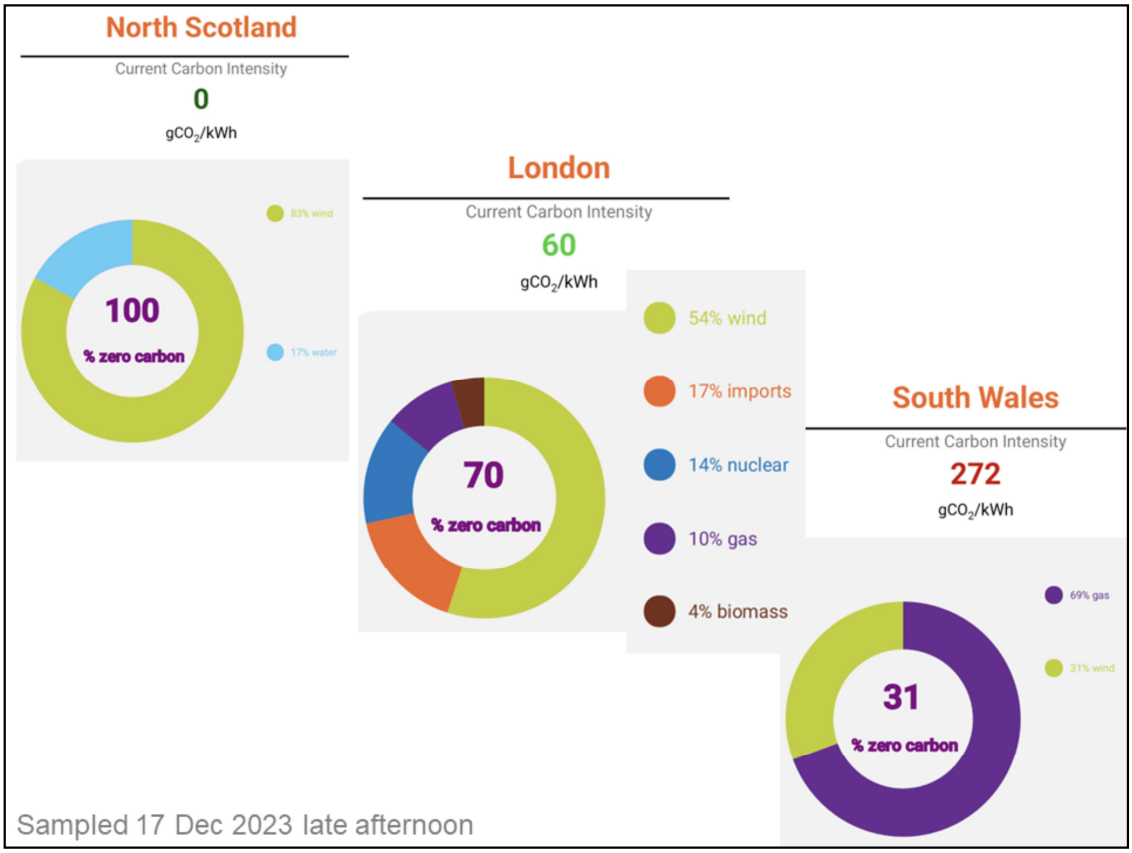


All of these are private companies.

You don't connect to the grid - you connect to a local distribution network. In London and SE that's managed by UK Power Networks.

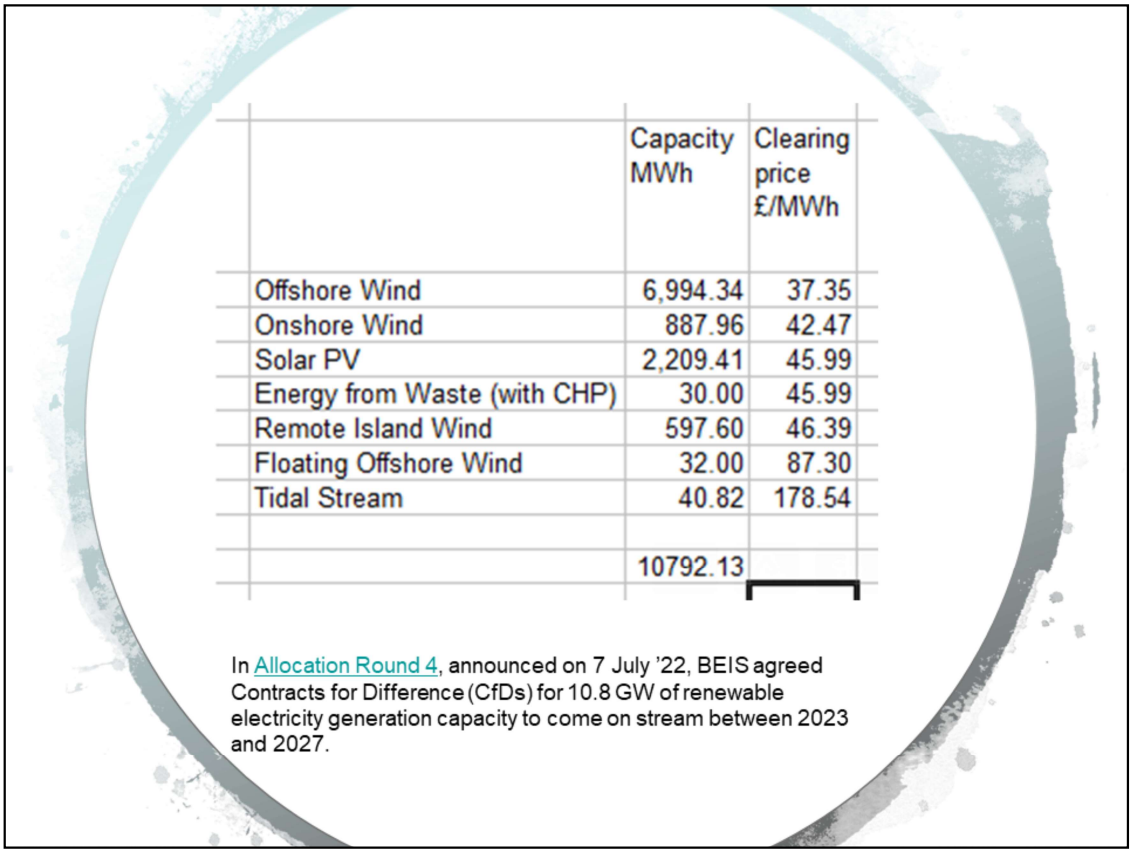


Source: Russss, OpenStreetMap contributors - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=128442884



The grid is divided into regions.

I want to build a windfarm



	Capacity MWh	Clearing price £/MWh
Offshore Wind	6,994.34	37.35
Onshore Wind	887.96	42.47
Solar PV	2,209.41	45.99
Energy from Waste (with CHP)	30.00	45.99
Remote Island Wind	597.60	46.39
Floating Offshore Wind	32.00	87.30
Tidal Stream	40.82	178.54
	10792.13	

In Allocation Round 4, announced on 7 July '22, BEIS agreed Contracts for Difference (CfDs) for 10.8 GW of renewable electricity generation capacity to come on stream between 2023 and 2027.

Almost all generators of low-carbon electricity are contracted with the Electricity System Operator ESO indirectly via the Low Carbon Contracts Company (LCCC), a company wholly owned by UK government. LCCC uses a financial instrument called a Contract for Difference (CfD). Under a CfD a buyer and a seller agree on a strike price and the buyer pays the seller the difference between the current wholesale price and the clearing price The generators get the wholesale price from ESO and if it is below the clearing price then they get a top-up from LCCC, and if it is above the clearing price then they pay back. The mechanism is designed to de-risk generation and so bring private capital into the electricity market,

CfDs are offered in an auction-like process called an Allocation Round, managed (now) by DESNZ. The table shows the outcome of AR4, which closed in July 2022.

In AR4:

- Offshore Wind is cheaper than onshore. I don't know why this should be (maybe it reflects economies of scale)
- All the Onshore Wind projects are in Scotland
- Energy from Waste (EfW) only qualifies for AR4 if it includes Combined Heat and Power (CHP). There is only one such project in the mix
- Some money was specifically set aside for Floating Offshore Wind, presumably

to encourage its development. It has a high clearing price.

• The highest clearing price is for Tidal Stream. There are 4 projects, the largest 28 MW.

CfDs by type of generation

Source: LCCC, retrieved Sept '23

	No. CFDs	Highest Price	Lowest Price	Biggest (MW)	Smallest (MW)	Total (MW)
Offshore Wind	51	£209.32	£45.37	2,852.00	12.00	20,002.34
Nuclear	1	£128.09	£128.09	3,277.20	3,277.20	3,277.20
Solar PV	69	£105.98	£56.99	112.00	6.00	2,248.08
Onshore Wind	25	£110.35	£52.25	212.00	6.15	1,636.51
Biomass Conversion	2	£139.08	£132.47	645.00	420.00	1,065.00
Remote Island Wind	10	£62.05	£49.77	220.00	16.32	872.82
Dedicated Biomass with CHP	3	£165.97	£82.58	299.00	0.64	384.64
Advanced Conversion Technology	10	£160.36	£45.40	27.50	0.05	151.91
EfW with CHP	3	£107.01	£45.99	49.75	30.00	124.75
Tidal Stream	4	£238.81	£235.24	28.00	2.40	40.82
Floating Offshore Wind	1	£116.77	£116.77	32.00	32.00	32.00
	179					29,836.07

No bids for offshore wind in government auction

8 September · Comments

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By Michael Race

Business reporter, BBC News

But AR5 flopped …

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Blow to UK renewable plans after Vattenfall halts wind farm project

Swedish group suspends work on Norfolk Boreas offshore site after surging costs

The UK government has been trying to get more wind power projects off the ground to meet net zero targets © Chris Ratcliffe/Bloomberg

Rachel Millard in London JULY 20 2023

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… and there are signs that the AR4 prices were too low. Vattenfall's Norfolk Boreas windfarm was planned to have three phases of 416 MW, 505 MW, and 475 MW respectively. The clearing price was £45.37. In July Vattenfall decided not to complete the windfarm at this price, saying that it was no longer profitable because of rising interest rates and the impact of inflation on its supply chain.

Generators and suppliers contract for every half hour of every day – a time slot known as a Settlement Period. Contracts can be years in advance. Non-physical traders such as investment banks can also participate in trading)I don't know what they do, but they presumably make money doing it). The market closes one hour before the Settlement Period opens. Generators offer an amount of power at a price, plus a bid price (how much they want if during the Settlement Period ESO asks them to go up) and an offer price (how much they will pay back if they are asked to go down). ESO reviews the contract data and takes the lowest price offered until demand is met, then issues its Bid Offer Acceptances.

In the winter some coal stations such as West Burton A and the coal units at Drax may be paid by ESO to stand by. They are outside the wholesale market adn only fire up if requested by ESO.