

UK energy system: Solving the trilemma

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Energy Bill and Electricity Market Reform (EMR)

"The Government has three objectives for energy policy:

- to keep the lights on,
- to keep energy bills affordable
- and to decarbonise energy generation.

The Energy Bill is central to meeting all of these objectives."

Electricity Market Reform: Policy Overview 09/2012

Security

Margins Shrinking

"Demand will continue to decline in the next five winters"

Electricity Capacity Assessment Report 2014, OFGEM



Margins Shrinking



"... But this is cancelled by deteriorations on the supply side as a result of further plant closures and mothballing"

> Electricity Capacity Assessment Report 2014, OFGEM



Britain passes a historic milestone with first days of coal-free power

Renewable energy and cheap gas hasten end of an era as UK aims to scuttle coal within decade

FT 16/05/2016



Generation (MW) by technology type for the first week in May each year

Breakdowns force National Grid to issue power supply crunch alert





National Grid issued the alert on Monday evening calling for more power plants to fire up. credit: PETER LAWSON/REX

Low Carbon

Large Offshore Wind potential

"The UK has been the world leader in offshore wind since October 2008, with as much capacity already installed as the rest of the world combined"

RenewableUK



Gone Green Scenario (NG, FES 2015)

A Solar Surprise!

Total solar capacity installed in the UK has broken through the 10GW barrier. (6 GW in France)



Intermittency poses operability issues









PV typical GB Capacity factor



Non-intermittent low carbon generation

"A significant proportion of the existing nuclear fleet will reach the end of its expected operational life time towards the end of the decade "

> "GB electricity Capacity margin" Royal Academy of Engineering, October 2013

"Energy companies are currently planning to build up to 16GW of new nuclear power capacity in the UK"



Non-intermittent low carbon installed

Gone Green Scenario (NG, FES 2015)

Nuclear AMRC

Affordability

The lights will stay on, but at a cost



¹² March 2015

The Government has managed to "keep the lights on", but buying in extra 'safety net' capacity at short notice has brought costs for the taxpayer and the environment, concludes a Lords report out today.

CfD and Capacity Market: backbone of the EMR

Capacity Market

•"Its goal is to ensure **adequate capacity** within an electricity system that in future will rely increasingly on intermittent wind and inflexible nuclear generation."

•"The Capacity Market is designed to ensure sufficient reliable capacity is available by **providing payments to encourage investment** in new capacity or for existing capacity to remain open."

•A **reverse clock auction** to provide a targeted capacity for each delivery year.

Contract for Difference (CfD)

•"A Contract for Difference (CFD) is a **private law contract** between a low carbon electricity generator and the Low Carbon Contracts Company (LCCC), a government-owned company"

•"CFDs **provide long-term price stabilisation** to low carbon plant, allowing investment to come forward at a lower cost of capital and therefore at a lower cost to consumers."

•"A generator party to a CFD is paid the difference between the 'strike price' – a price for electricity reflecting the cost of investing in a particular low carbon technology – and the 'reference price' – a measure of the average market price for electricity in the GB market"





A Plunge in the Wholesale Market

Wholesale UK gas and electricity prices have averaged at least nine-year lows over Q1 2016

Increasing non-energy costs pushed retail prices but recent competition among supplier started to bring the prices down









UK power prices go negative as renewables boom distorts market

Power stations start paying for some of their electricity to be taken off their hands on sunny days



A boat passes between turbines at the London Array, the world's largest consented wind farm, off southeast England @ Bloomberg



APX Half Hourly Prices (£/MWh) 02/05/2016



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Affordability

•We need to **minimise** the power system **1.Operations 2.Maintenance 3.Investments**

With an uncertain future:
1.Commodity prices
2.Technology cost evolution subject to the investment level
3.Other energy sectors evolution (transport, heat, etc.)



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Security

•Constraints to be met in probability to insure that supply and demand are equal

•A reliability measure is defined as the Loss of Load Expectation (LOLE)

•This LOLE represents the hours for which The system operator (SO) would call exceptional measure to insure supply meets demand.

•This Loss of Load expectation need to be less than 3 hours by year. To achieve that the SO will leverage: 1.Investments in **capacity** 2.Investments in **flexibility 3.Reserve** allocation

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Low Carbon

•Constraints to be met in all scenarios to achieve a fully decarbonised power sector for 2050

•This constraints need to be met by insuring that investments will go into low carbon technologies: **1.Generation**: Nuclear and Renewable **2.Demand**: energy efficiency measures and demand response **3.Storage**: Bulk and residential that would be linked to the transport sector decarbonisation through EV



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