

UNDERGROUND COAL GASIFICATION

UCG versus SHALE GAS: CHALK and CHEESE

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OUTLINE OF PRESENTATION:

- **Cost of clean power in UK**
- **Opportunity for UCG**
- **Compare and contrast UCG and shale gas**
- **Public attitude to unconventional oil and gas in UK**
- **Debunking myths about renewables**
- **Prognosis for UCG in Britain**



FORECAST UK GENERATING COSTS

(including CCS for new fossil fuel stations)

- **OFFSHORE WIND £140 – 170/MWh**
- **ONSHORE WIND £80 – 100/MWh**
- **NEW NUCLEAR £93/MWh**
- **CLEAN COAL (combustion) £110/MWh**
- **COAL GASIFICATION (IGCC) £110/MWh**
- **EXISTING CCGT (no CCS) £60 – 100/MWh**
- **NEW CCGT + CCS £90 - 110/MWh**
- **UCG + CCS £70/MWh**

HOW ABOUT UCG IN 2015?

IN 2010, THE COST OF GENERATING POWER IN UK ON A CCGT FED WITH UCG GAS, INCLUDING CCS, WAS CALCULATED AS **£66/MWh** (using methodology of Mott Macdonald report for DECC, June 2010, comparing a wide range of power generation methods)

TODAY, THAT FIGURE MAY HAVE INFLATED TO AROUND

£70/MWh

N.B. NO COST OF COAL (ROYALTY) IS INCLUDED



CURRENT UK BULK POWER PRICES

- **WERE £40/MWh,**
- **THEN £50/MWh,**
- **SOON £60/MWh?**
- **BUT NONE OF THE FORECAST CLEAN GENERATION COSTS EXCEPT UCG COMES CLOSE TO MAINTAINING THIS**

SCOPE FOR UCG IN UK

In common with many European countries, UK is facing a crisis of shortage of generation capacity and increase in generation costs.

- Coal has been the lowest-cost source of power, but coal burning has been coming under increasing environmental pressure.
- Enormous resources of coal remain in Britain.
- No other generation method, not even prolific shale gas, can match the expected cost of power generated from UCG gas.

UCG vs. SHALE GAS (1) ANALYSIS

- **RAW SYNGAS IS TYPICALLY 20 – 40% CO₂, PLUS CH₄, CO AND H₂, WITH CV ABOUT ONE-THIRD THAT OF NATURAL GAS;**
- **BY SCRUBBING OUT THIS CO₂, CV INCREASES TO ABOUT HALF THAT OF NATURAL GAS;**
- **CH₄ AND CO CAN BE REFORMED TO CO₂ PLUS H₂;**
- **BY REMOVING ALL CO₂, RESIDUAL FUEL GAS IS ESSENTIALLY H₂;**
- **SYNGAS IS NOT READILY CONVERTIBLE TO PIPELINE-SPEC NATURAL GAS EQUIVALENT;**
- **SHALE GAS IN CONTRAST IS MARKETABLE AS CONVENTIONAL NATURAL GAS.**

UCG vs. SHALE GAS (2) CO2 REMOVAL

- NOT PERMISSIBLE TO BURN UCG SYNGAS IN UK WITHOUT CARBON CAPTURE;
- UCG WELLHEAD PRESSURE TYPICALLY ABOVE 30 BAR AND HIGH CO2 CONTENT ALLOWS PHYSICAL RATHER THAN CHEMICAL ABSORBENTS;
- COST OF CO2 CAPTURE AND STORAGE FROM UCG IS CALCULATED AT LESS THAN \$30/T CARBON (\$14/T CO2)
- COST OF FLUE GAS SCRUBBING FROM SHALE GAS CAN BE FIVE TIMES GREATER;
- SHALE GAS COULD BE REFORMED AND CO2-SCRUBBED BEFORE COMBUSTION - EXPENSIVE

UCG vs. SHALE GAS (3) ECONOMICS

- **WILL COST OF SHALE GAS UNDERCUT UCG?**
- **PROBABLY NOT; SHALE GAS IN UK IS FORECAST TO COST AROUND PRESENT COST OF NATURAL GAS**
- **WILL SHALE GAS BE ABLE TO BE BURNT WITHOUT CCS?**
- **MAYBE INITIALLY, NOT IN MEDIUM / LONG TERM**

UCG vs. SHALE GAS (4) ENVIRONMENT

- **UCG REQUIRES THE STRATA AND GROUNDWATER TO BE UNDISTURBED AND GAS-TIGHT**
- **IT DOES NOT ENTAIL FRACTURING**
- **IT DOES NOT ENTAIL PUMPING OUT WATER**
- **IT DOES NOT ENTAIL PUMPING IN CHEMICALS**

“CHALK AND CHEESE”



UCG vs. SHALE GAS (5) LICENSING

- **SEPARATE LICENSING REGIMES APPLY IN UK FOR SHALE GAS AND FOR UCG**
- **BOTH CANNOT BE WORKED IN PRACTICE IN THE SAME LOCATION**
- **ARRANGEMENTS TO CO-ORDINATE AND PRIORITISE GIVE PRESUMPTION IN FAVOUR OF SHALE GAS**



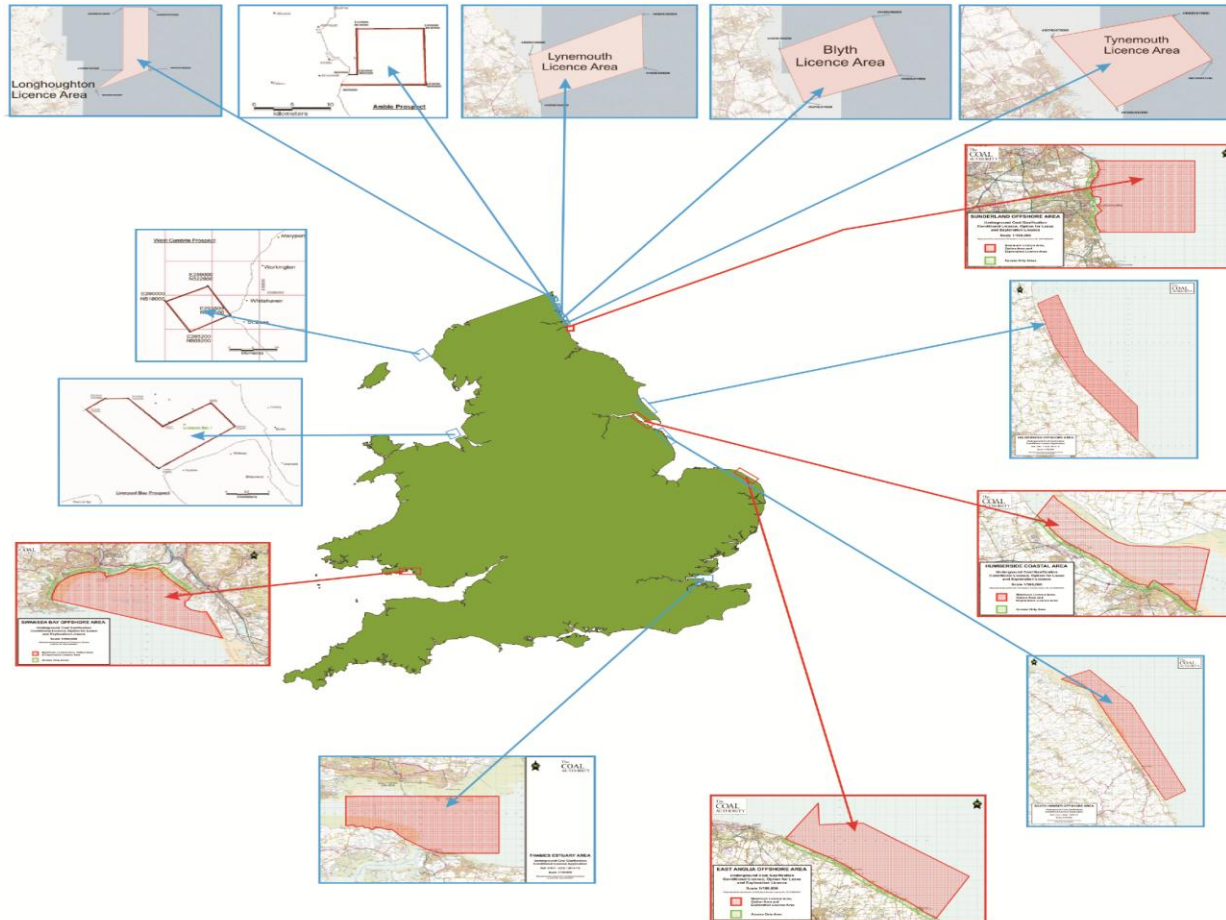
UCG vs. SHALE GAS (6) AREA REQUIRED

THE ENERGY PRODUCED BY UCG PER SQ KM OF LICENSED AREA IS AN ORDER OF MAGNITUDE, EVEN ORDERS OF MAGNITUDE, HIGHER WITH UCG THAN WITH SHALE GAS, DEPENDING ON THE NUMBER OF COAL SEAMS ACCESSIBLE

THE COMPARISON IS ANALOGOUS TO COALBED METHANE (CBM) WHERE A GIVEN BLOCK OF COAL WILL PRODUCE C. 20 TIMES AS MUCH ENERGY BY UCG COMPARED TO CBM



TYPICAL COASTAL SITES LICENSED FOR UCG ENGLAND AND WALES



CRF, LEEDS

15TH APRIL, 2015

DEBUNKING MYTHS ABOUT WIND FARMS

NEWS REVIEW & OPINION



THE GREAT WIND FARM FARCE

Ed Davey's plan for 400 turbines to be erected off the Yorkshire coast will be a heinous burden on the taxpayer that underlines the dangerous delusion over renewables, writes James Delingpole

Fewer there's a competition for the most spectacularly pointless and wasteful project in engineering history, you'd be hard pressed to find a more promising candidate than the one announced this week, with great fanfare, by Energy Secretary Ed Davey. Dogger Bank Croyke Beck is its name – and though it may seem a bit of an unfamiliar mouthful now, in future years it will trip off the tongue very nicely as the answer to any number of trivia questions.

As well as being the world's largest offshore wind farm (covering 430 square miles), it will be the most expensive to build (£6.2 billion), the most heavily subsidised (by as much as £900 million a year) and the one that does the most lasting damage to

homes; it is expected to support "up to 900 green jobs in Yorkshire and Humberside and millions of pounds' worth of investment to the UK's economy"; and it will, of course, make a key contribution to Britain's EU-mandated carbon emissions reduction target, whereby 32 per cent of all the electricity we need must come from renewable sources by 2020.

All this sounds superficially impressive. You can understand why a spokesman for industry lobbyist Renewable UK describes it as an "awesome" project. Each of its 400 turbines, when completed will be 600ft tall – one and a half times the height of Salisbury Cathedral spire. The area they cover, 80 miles off the Yorkshire coast, will be bigger than Dartmoor National Park. And on a

analysis the Renewable Energy Foundation, one of the project's most troubling aspect.

"Not since British Leyland has the government awarded this much public subsidy to a single industry – and look how badly that ended," he says. "It represents an experiment on such a scale that it could seriously disrupt the UK economy."

To appreciate his concerns, you first need to understand the fundamental flaw of wind energy: being intermittent and unreliable (obviously, because it's only available when the wind is blowing), it is a poor substitute for those other forms of energy (derived from fossil fuel or nuclear), which can be generated on demand according to consumer need.

This is why wind energy incentives. Not only are renewables companies paid significantly above the going rate for what little energy they manage to produce when the wind is blowing, but also customers are forced to buy their product whether they like it or not.

Hence the involvement of Forewind (an international consortium of energy companies SSE, RWE, Statkraft and Statoil) in this massive capital project. Like sharks to blood, they have been lured by the eye-wateringly generous sweetener being offered by the Government, for every megawatt (MW) of electricity their turbines produce, they will be paid the special offshore wind rate of £155 – more than three times what generators of fossil fuel electricity receive.

TOLL OF THE TURBINE



A substation for the massive wind farm in the Thames estuary

4,842	600ft
number of onshore turbines (source: RenewableUK)	the height of each turbine – one and a half times Salisbury Cathedral spire

inevitably, they will have to be expensively refitted much sooner than anticipated – or, more likely, left to rot.

Nor can supporters of Dogger Bank Croyke Beck draw much comfort from the experience of Germany where a similar but smaller offshore wind farm has been delayed for well over year with massive, unresolved technical difficulties which have cost it millions in lost revenue.

Given that these issues are in the public domain you might wonder why Davey gave the go-ahead to such a risky, costly and entirely unnecessary experiment. The answer is that for Davey – and the environmental zealots who dominate UKCC – the interests of energy users (ie all of us) must always take second place to

CAN WIND POWER BECOME VIABLE?

D. TEL. 27 FEB 2015

Wind farms win contracts in first competitive auction

By Emily Gosden

TWO offshore and 15 onshore wind farms have won subsidy contracts in the Government's first competitive green energy auction, significantly undercutting the prices that have been handed to other projects.

The results of the auction suggest consumers may be paying hundreds of millions of pounds a year too much on their energy bills because ministers previously allocated subsidies without competition, providing much higher returns to investors.

More generous subsidy schemes should now be shut down and excess subsidies clawed back, critics said.

In total, ministers gave the go-ahead to 27 green energy projects, with estimated lifetime subsidy costs totalling £4bn.

Energy companies were forced to bid against each other in "reverse auctions" with the cheapest proposed projects in each category being awarded subsidies.

As a result ScottishPower's East Anglia offshore wind farm, due to start generating in 2017-18, was awarded a contract guaranteeing it just under £120 per megawatt hour (MWh) of electricity, while Mainstream Renewable Power's

Fife offshore project, due to start generating in 2018-19, secured a contract at £114.39/MWh.

Until now the Government has not required companies to compete for green energy subsidies and has offered a blanket level of subsidy to each technology, irrespective of actual costs.

Last April £16.6bn of subsidy contracts were awarded on that basis. Three offshore wind farms due to start generating power in 2017 were guaranteed £150/MWh, while two others due to be running by 2018 or 2019 were guaranteed £140. The lack of competition in the process was heavily criticised by the National Audit Office.

Keith Anderson, chief executive of ScottishPower, said the East Anglia project had set a new "benchmark" for costs and would be "one the best value offshore wind farms ever developed anywhere in the world".

"It signals a major industry breakthrough in efforts to reduce the costs of offshore wind," he said.

Ed Davey, the energy secretary, said yesterday's projects were "a lot cheaper because we brought in competition" but denied the Government had overpaid previously, insisting it could not have introduced competition sooner.

PROGNOSIS FOR UCG IN UK

**COMPARED WITH OTHER AVAILABLE MEANS OF
POWER GENERATION, UCG OFFERS THE
LIKELIHOOD OF BEING A MAJOR,
AFFORDABLE, CLEAN, DOMESTIC ENERGY
SOURCE**

**UCG DOES NOT JUSTIFY THE “READING-
ACROSS” OF OBJECTIONS RAISED TO SHALE
GAS**



CRF, LEEDS

15TH APRIL, 2015



**A global alliance of knowledge, expertise,
training, networking & information for
Underground Coal Gasification**

(in dissolution, March 2015)

www.ucgassociation.org