Powered by Rock

Earth's Energy Systems

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Lecture 2

Class structure

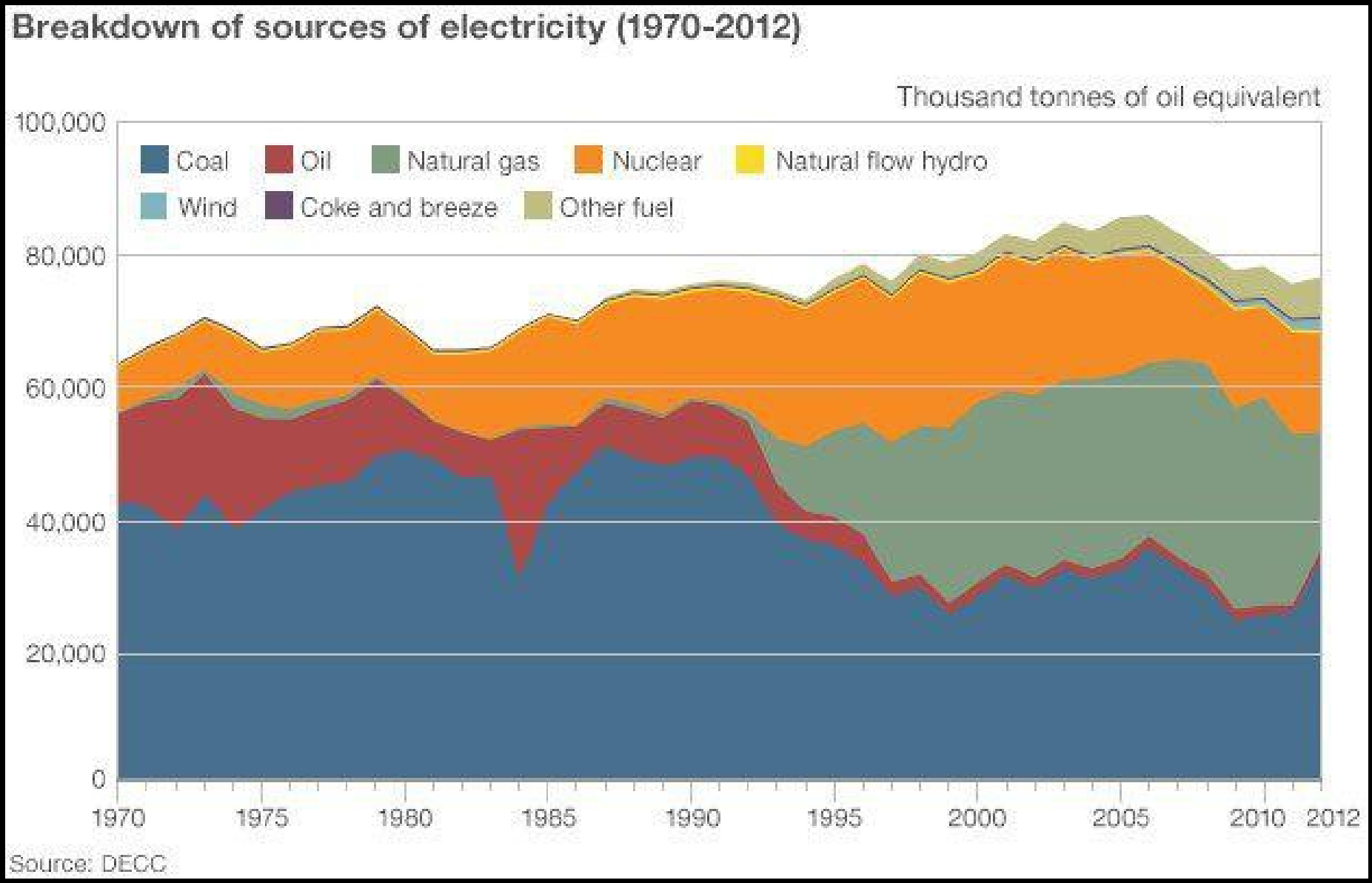
1) Opening statements

2) For v Against

3) My evidence

4) Jury decision

UK coal dependence



UK coal 2012

39% of UK electricity coal-powered

(up from 30% in 2011)

64 million tonnes (54.9m for electricity)

The geology of coal

Coalification

Accumulation of plants + minerals in water

Compression = loss of water & volatiles

Types of coal

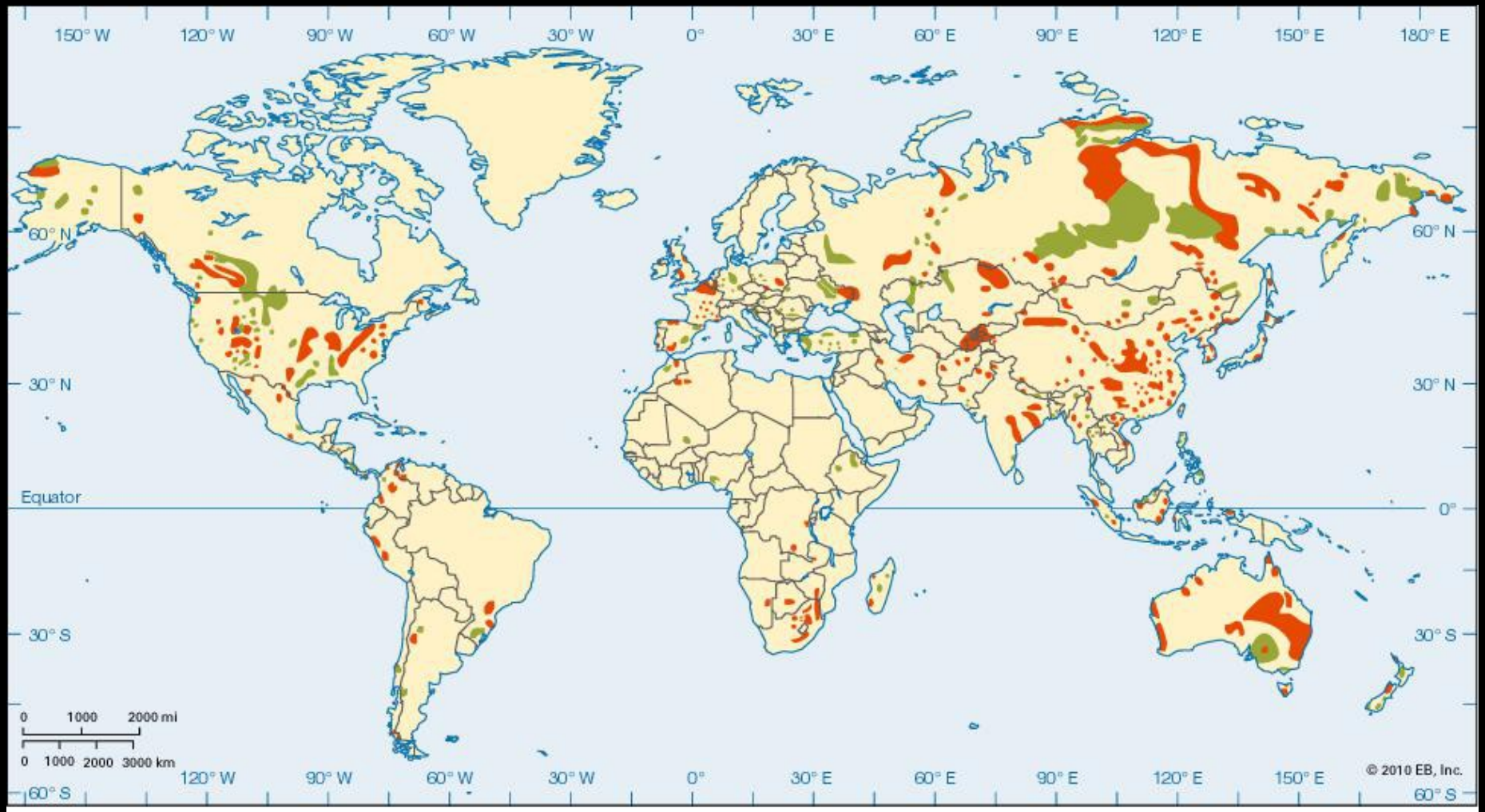
Lignite – bituminous coal – anthracite

Increasing Carbon content:

Peat ~60%

Anthracite 95% or more

A global resource

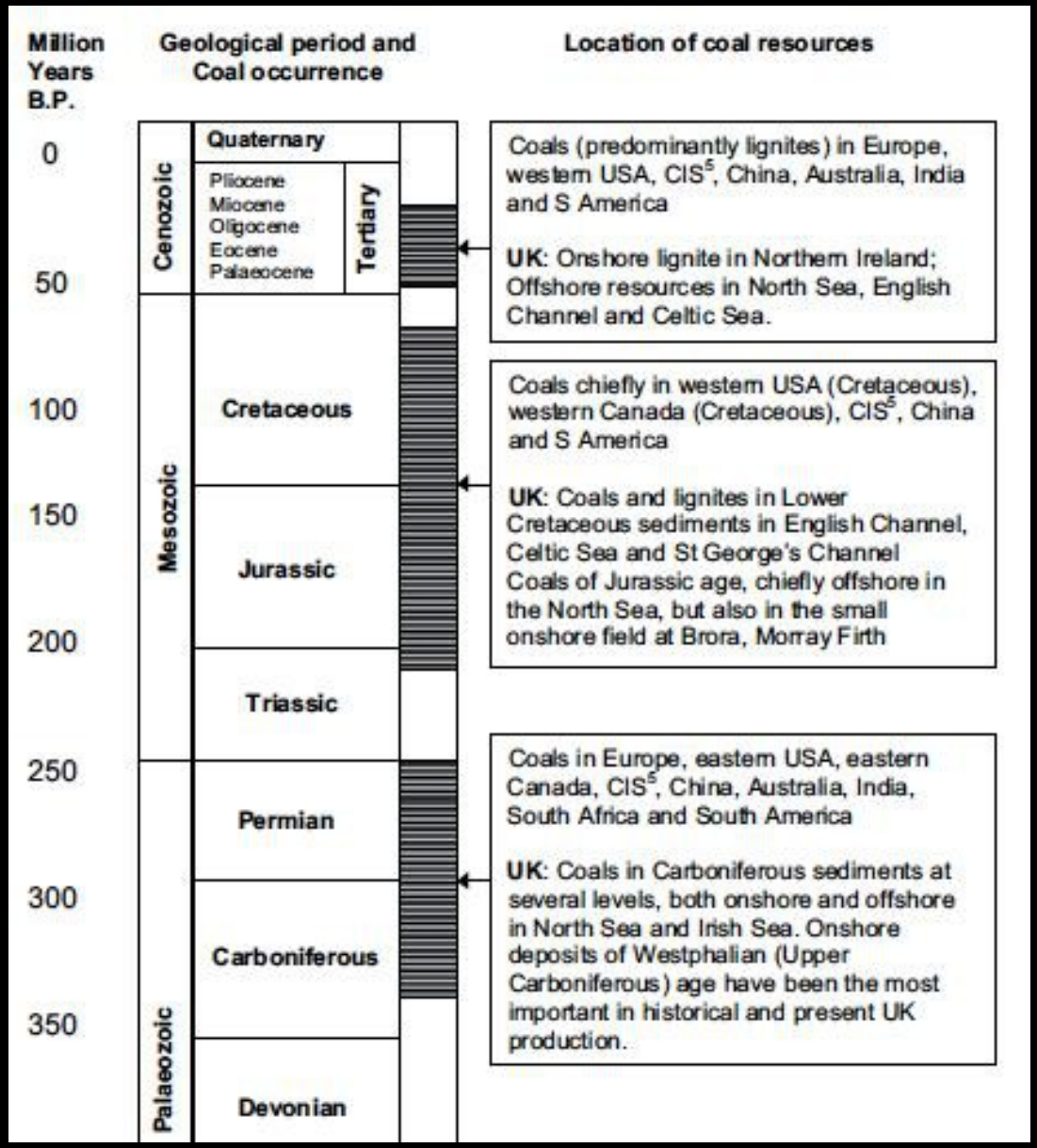


Major Coal Deposits of the World

Anthracite and Bituminous Coal

Lignite

Geological distribution



Land plants abundant since Devonian

Coal formation during warm, humid periods of Earth history

The Black Country

1709 – Abraham Darby's coke

1769 – James Watt's steam engine

The case for coal

Your arguments in favour
(with reference/s)

The case against coal

Your arguments in opposition
(with reference/s)

My evidence

Sending coals to Newcastle

64 million tonnes (54.9m for electricity)

44.8m tonnes imported:

Russia, Colombia, USA, Australia

DECC, 2013

How much coal in UK?

National Coal Board, 1977:

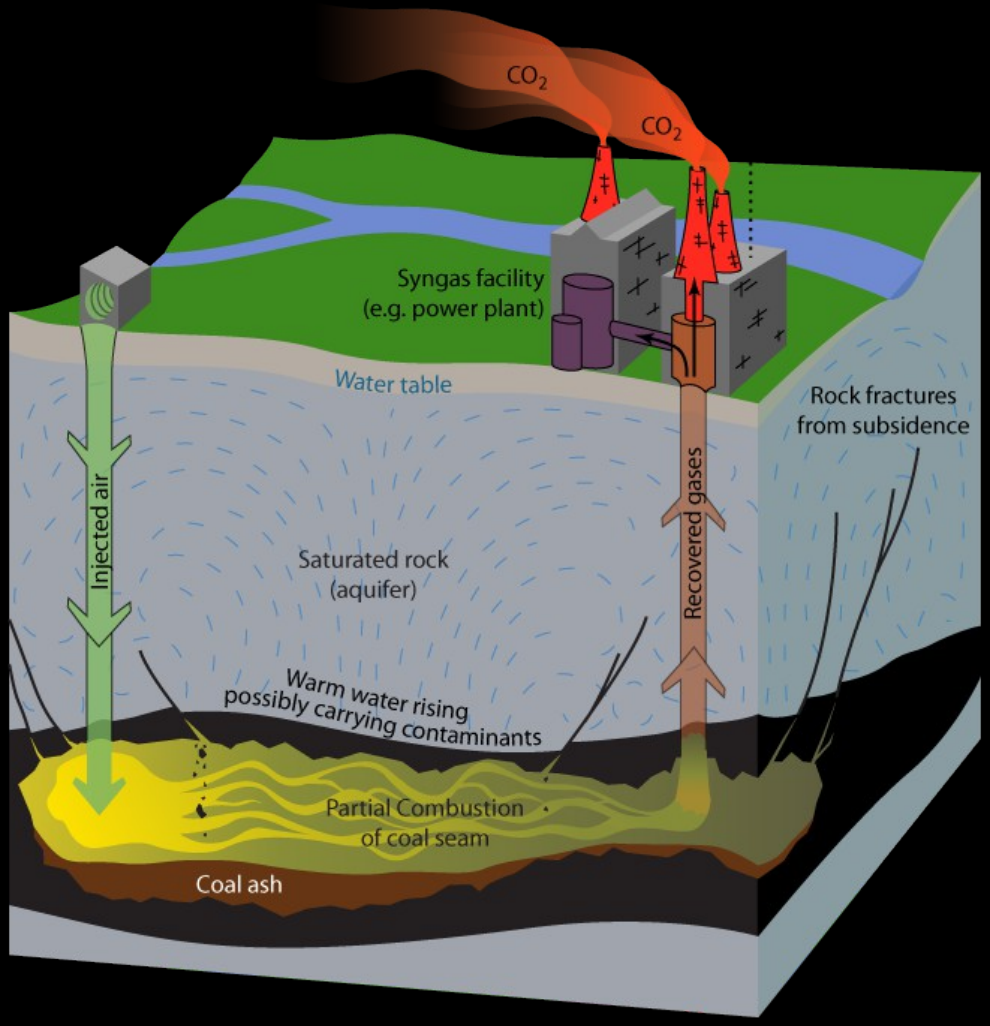
Resources: 190 bn tonnes

Reserves: 45 bn tonnes (700 years')

UK government, 2011:

Reserves: 3.2 bn tonnes (50 years')

New coal power



Underground Coal Gasification (UCG)

New coal power

Underground Coal Gasification (UCG)

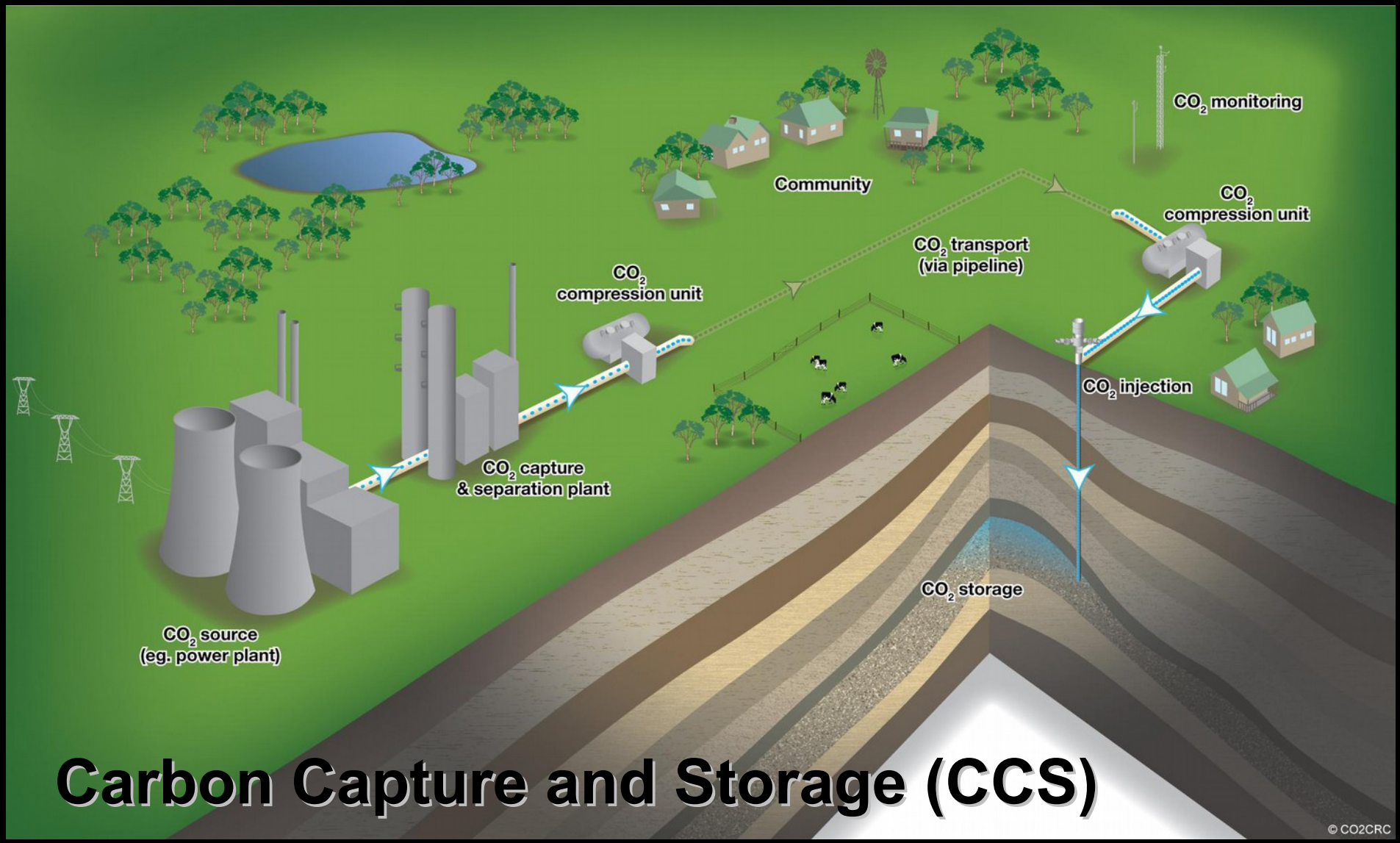
Controlled partial combustion

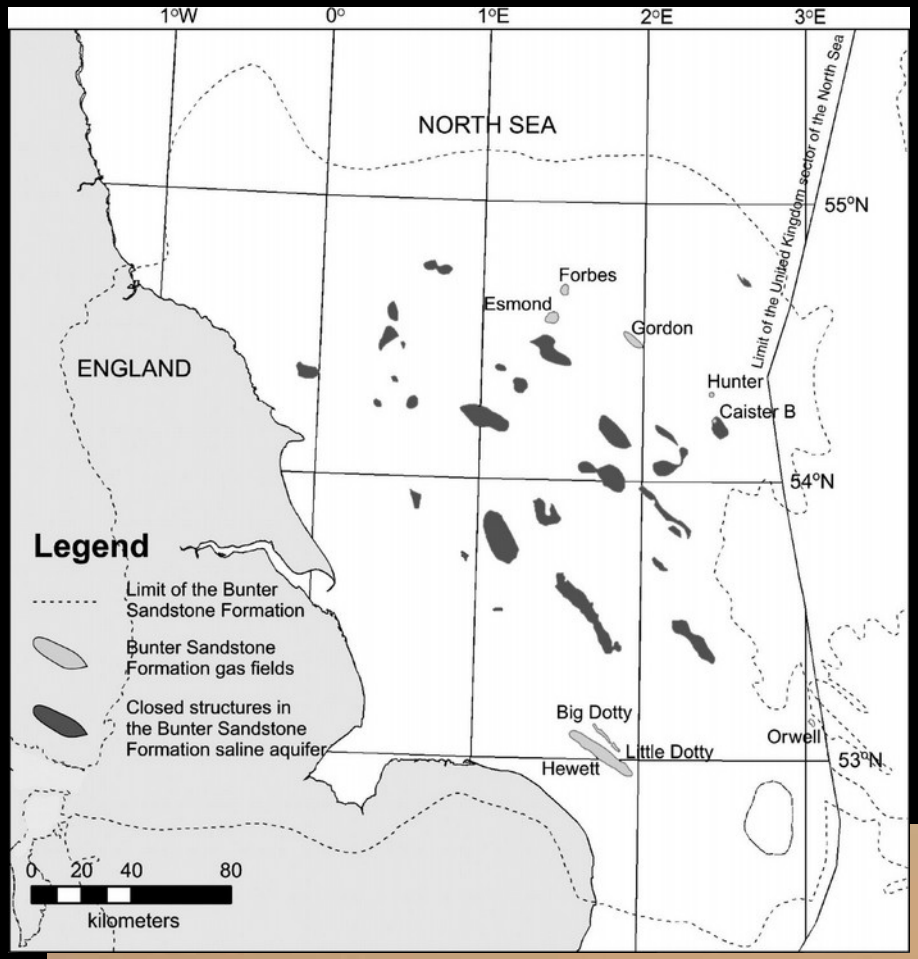
Produces synthetic gas

- Gas-fired power
- Can be converted to syn-diesel
  - Better/cleaner than oil diesel

UK resources: 17 bn tonnes (BGS)

Clean coal?


CO_2 monitoring
Community
CO_2 compression unit
CO_2 transport (via pipeline)
CO_2 compression unit
CO_2 injection
CO_2 capture & separation plant
CO_2 storage
CO_2 source (eg. power plant)
Carbon Capture and Storage (CCS)
© CO2CRC



White Rose CCS

http://www.whiteroseccs.co.uk/

Capture, transport & inject industrial CO2 into deep, brine-filled sandstone 70km off E. Yorks coast

Safe coal?

Deaths/cases per TWh
(Markandya & Wilkinson 2007)

	Deaths from accidents		Air pollution-related effects		
	Among the public	Occupational	Deaths*	Serious illness†	Minor illness‡
Lignite[30]	0·02 (0·005–0·08)	0·10 (0·025–0·4)	32·6 (8·2–130)	298 (74·6–1193)	17 676 (4419–70 704)
Coal[31]	0·02 (0·005–0·08)	0·10 (0·025–0·4)	24·5 (6·1–98·0)	225 (56·2–899)	13 288 (3322–53 150)
Gas[31]	0·02 (0·005–0·08)	0·001 (0·0003–0·004)	2·8 (0·70–11·2)	30 (7·48–120)	703 (176–2813)
Oil[31]	0·03 (0·008–0·12)	..	18·4 (4·6–73·6)	161 (40·4–645·6)	9551 (2388–38 204)
Biomass[31]	..	..	4·63 (1·16–18·5)	43 (10·8–172·6)	2276 (569–9104)
Nuclear[31,32]	0·003	0·019	0·052	0·22	..

Data are mean estimate (95% CI). *Includes acute and chronic effects. Chronic effect deaths are between 88% and 99% of total. For nuclear power, they include all cancer-related deaths. †Includes respiratory and cerebrovascular hospital admissions, congestive heart failure, and chronic bronchitis. For nuclear power, they include all non-fatal cancers and hereditary effects. ‡Includes restricted activity days, bronchodilator use cases, cough, and lower-respiratory symptom days in patients with asthma, and chronic cough episodes. TWh=10^{12} Watt hours.

Table 2: **Health effects of electricity generation in Europe by primary energy source (deaths/cases per TWh)**

Direct deaths (2008)

China: 1 per 0.7m tonnes mined

USA: 1 per 25m tonnes mined

Chinese smog

>250,000 deaths in 2011

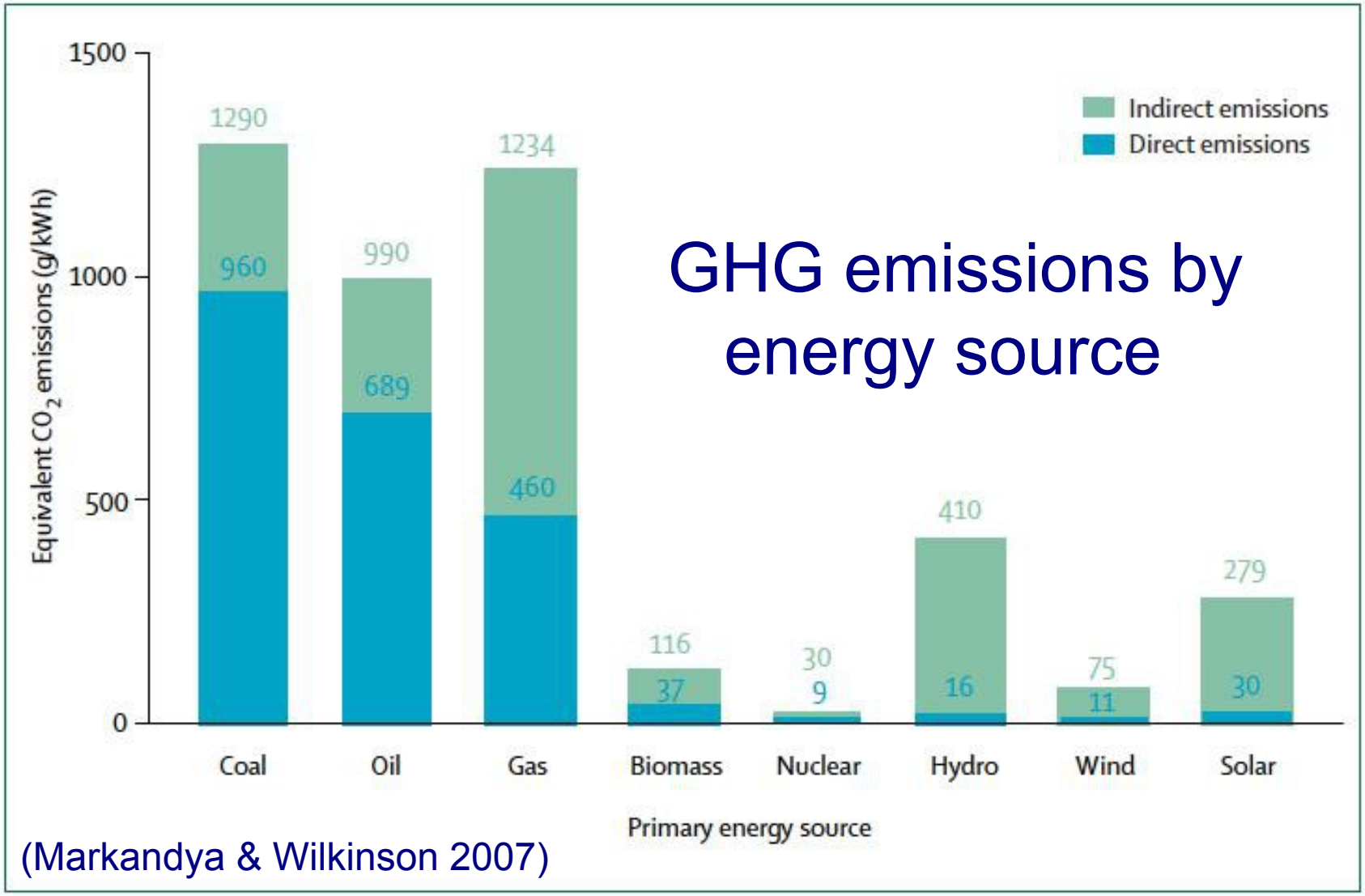
UK health burden

	Cases	Percentage due to coal
Accident-related deaths		
Among the public	6	44%
Occupational	13	99%
Air pollution		
Deaths	3778	85%
Serious illness	35186	84%
Minor illness	1853152	94%

Table 3: Health burdens from electricity generation in the UK, 2001

(Markandya & Wilkinson 2007)

Environmental impact



(Markandya & Wilkinson 2007)

Environmental impact

2008 – 14 million m3 of methane emitted from abandoned UK coal mines (UN, 2010)

Not included in UK greenhouse gas emissions data

But:

Abandoned Mine Methane (AMM)

Coal Mine Methane (CMM)

Coal Bed Methane (CBM)

Jury decision

Should coal be part of the future UK energy mix?

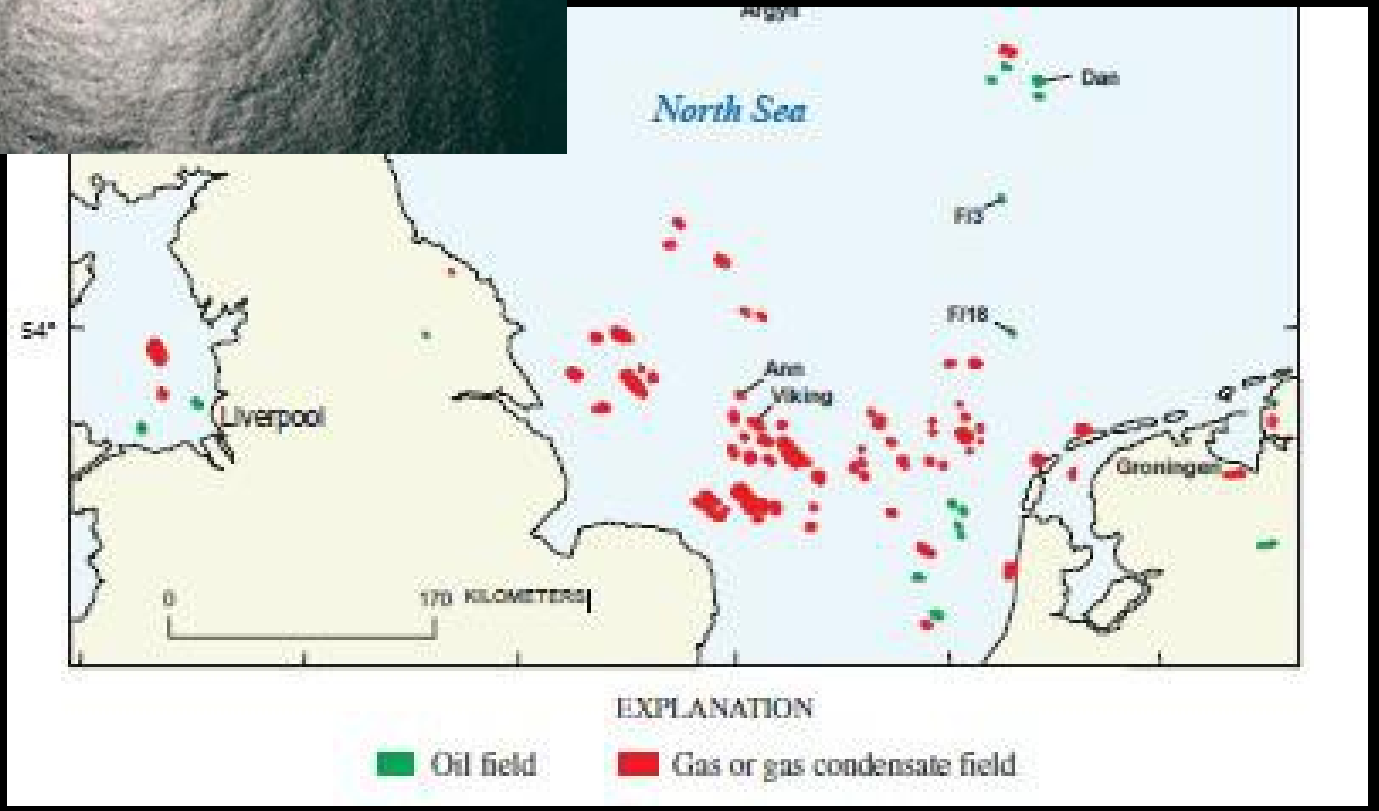
Consider:

- Cost & availability
- Health & safety
- Energy security
- Environmental impact

Next week

Oil & Gas

(incl. fracking)



The Hat of Random Energy Judgement

5 x FOR

5 x AGAINST

6 x NEUTRAL (jury)

Next week: Oil & Gas

FOR – make an argument in favour of hydrocarbons

AGAINST – make an argument against

Are they part of our future energy mix?

Another decision!

Extra class after final week?
(would be March 17th)

Or two 3-hour classes?

Resources

www.fossilhub.org / lgh865@hotmail.com

IEA: http://www.iea.org/

USGS: www.usgs.gov

BGS: www.bgs.ac.uk

DECC: www.gov.uk