

*'Bings Ain't What They Used to Be'
- Fracking for shale-gas*



Prof. Roy Thompson, FRSE

Outline

- 1. Scotland's bings - Black, brown and red**
- 2. Paraffin Young - The world's first oil-mogul**
- 3. Fracking - Scotland and England take different paths**
- 4. Scotland's energy trilemma**
- 5. The future of fossil fuels - Is it the end?**

The History of
**KELSICK GRAMMAR
SCHOOL, AMBLESIDE**
a way of life on the Lakeland Fells

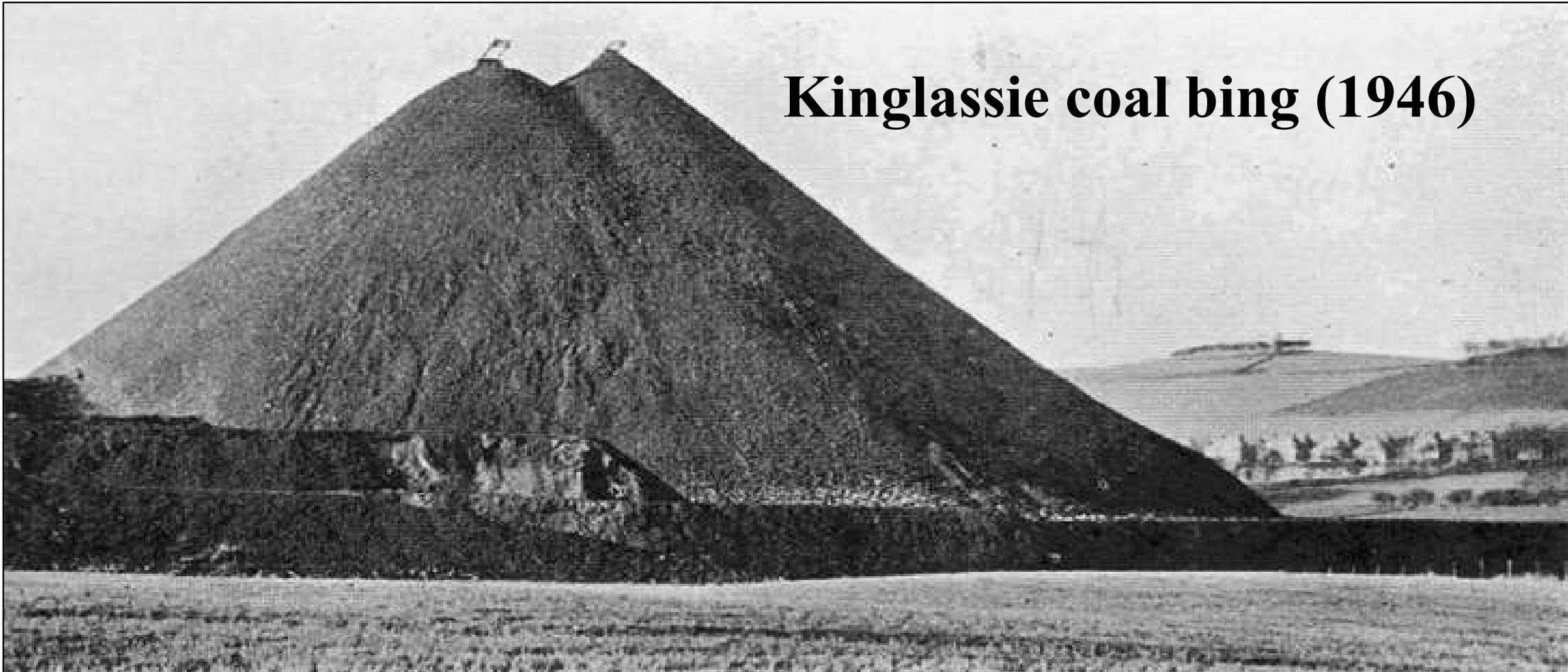


John Mander



THE HISTORY OF KELSICK GRAMMAR SCHOOL, AMBLESIDE

**Origin of the word bing – from Old Norse,
C12th, *‘bingr’* meaning a heap or pile.**



Kinglassie coal bing (1946)

**A few modest coal bings
endure near Sanquhar.**



Ironstone bings



Ironstone bings



Silver-Lead-Zinc

Oil-Shale

Coal

Torbanite

Mine

Deep-coal-mining

Open-cast
Mine

Bing

Polkemmet-
Burning-Bing

Reclaimed
coal-bing

Peden's
Stane

Shotts branch line

Explosives-factory

Ironstone bings



Benhar Bing before reclamation



A £90,000 project to restore the highly acidic and infertile spoil polluting the watercourse leading into the River Almond. The high acidity levels had totally inhibited plant growth.



Good revegetation growth on reclaimed bing.

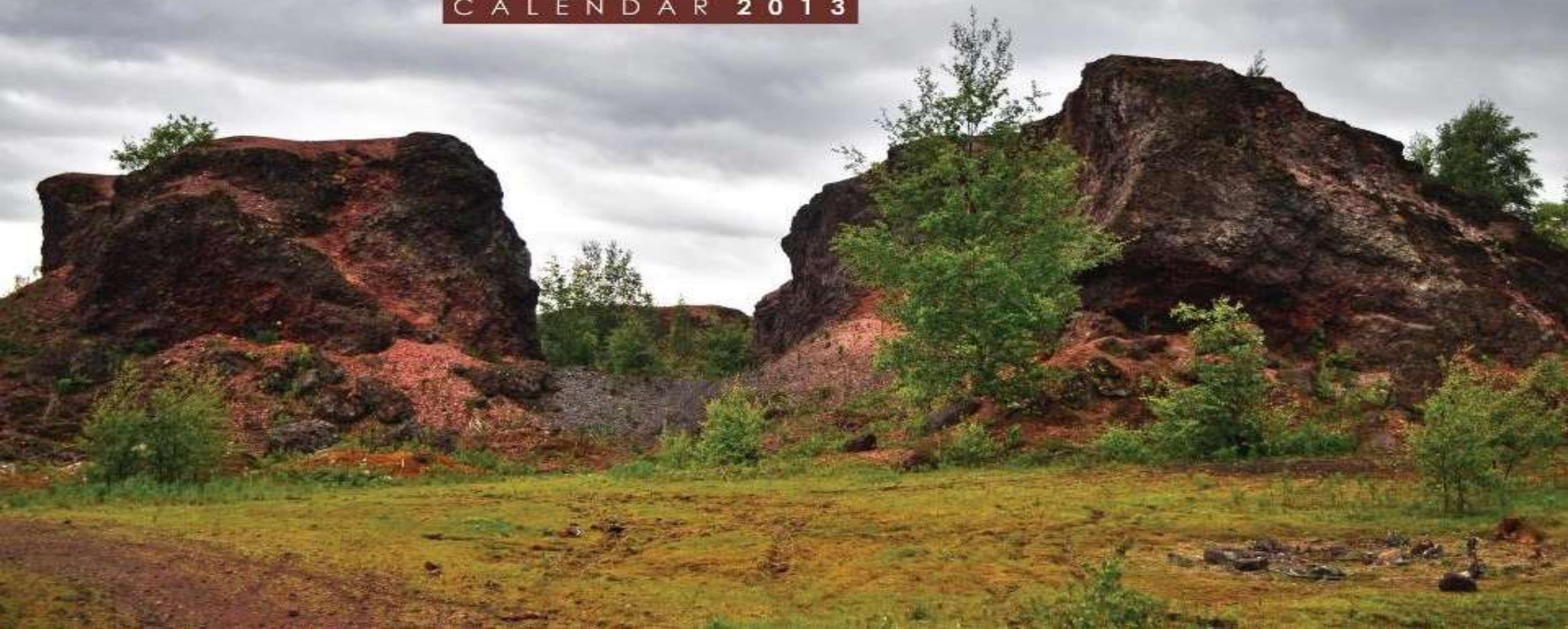
Long after mine abandonment siderite (FeCO_3) and pyrite (FeS_2) continued to cause detrimental impact on water quality.

Some orange sludge, $\text{Fe}(\text{OH})_3$ at outflow from Benhar ironstone bing. One of over 300 abandoned mine and mine-waste sites feeding into the Almond river.

The River Almond Angling Association has been a force for positive environmental change, helping recovery of fish stocks of Brown Trout, Sea Trout and Salmon and highlighting the problems of fish passage at weirs.

The
Beautiful Bings
OF BROXBURN

CALENDAR 2013

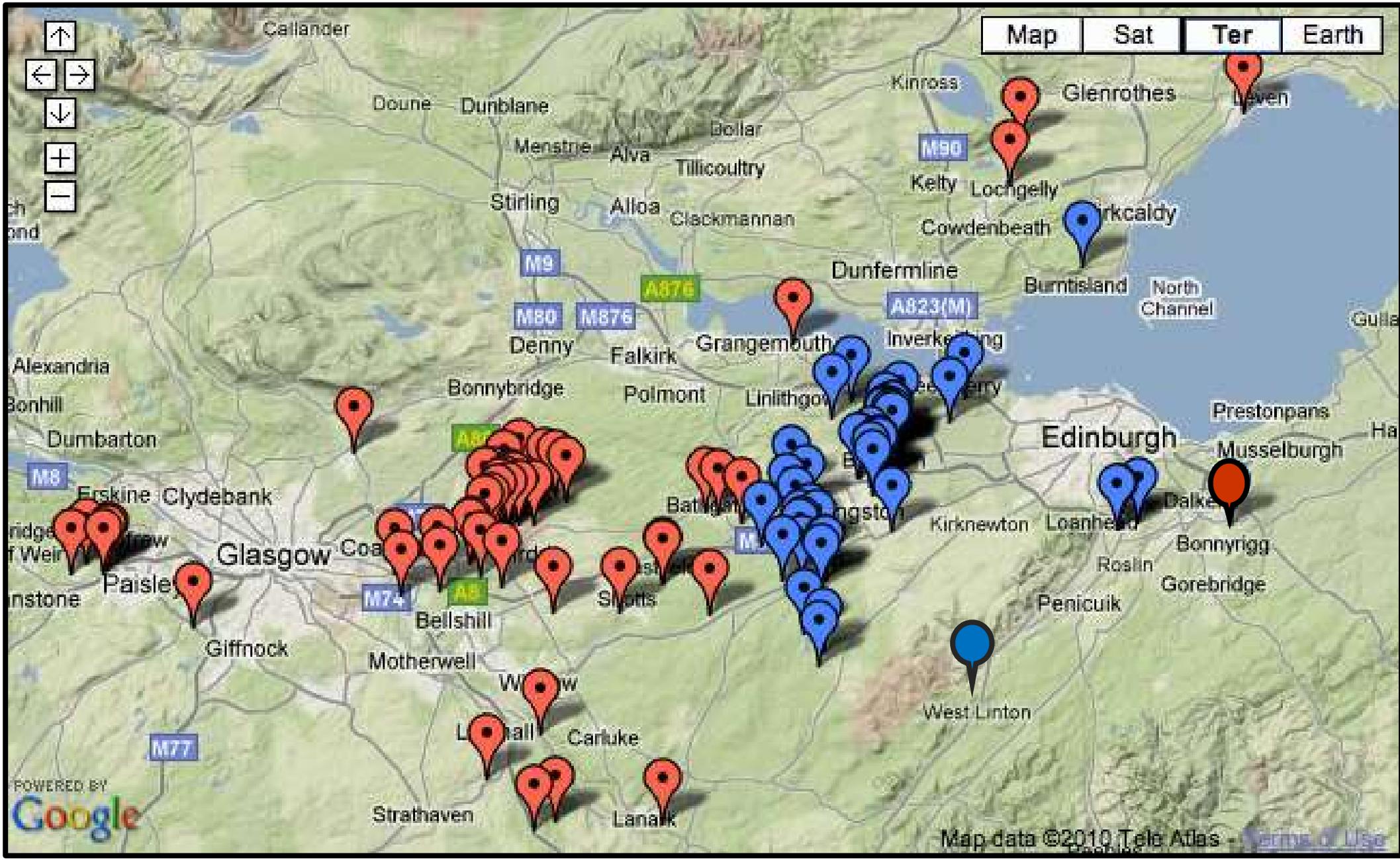


Scottish oil-shale industry

Crude oil-works, mines and pits

SHALE & COAL
OIL-SHALE

Deepest shale mine, Westwood 700ft



Bathgate: the World's first commercial-scale oil works (1852-1956)

"Great curiosity was manifested for miles around the Bathgate Oil Works."

"To prevent too inquisitive people from learning too much a massive stone wall was built around the works; and the two heavy wooden gates, which afforded the only means of ingress and egress, were constantly guarded."

(Redwood, 1897)





**Greendykes oil-shale
bings near Broxburn**



Local volunteers help plant 200 trees to create an area of native woodland for wildlife at Addiewell bing.

Oakbank Bing: an extensive, well-planned restoration project with considerate woodland planting.





**Faucheldean
shale bing,
Winchburgh**

**Rare loose block
of pink/red,
congealed, spent
shale.**

Aberfan

with an image
of where the
tip used to be
superimposed
in black and
white





**Foreground
former site
of tip No.7**

**Aberfan
colliery and
village on
valley floor**

May 2019

Broken Promises and a Legacy of Distrust:

Restoration Failures Show Long-Term Impact of Coal Mines in South Wales



Figure 1 – ‘Officially reclaimed’ opencast land at Pwll Du, South Wales (Photo: M. Haigh).

“Large tracts of land, officially described as ‘reclaimed’ from former mineral workings, are in poor condition.

Problems include gullying, soil erosion, soil compaction, accelerated run-off and poor vegetation cover.

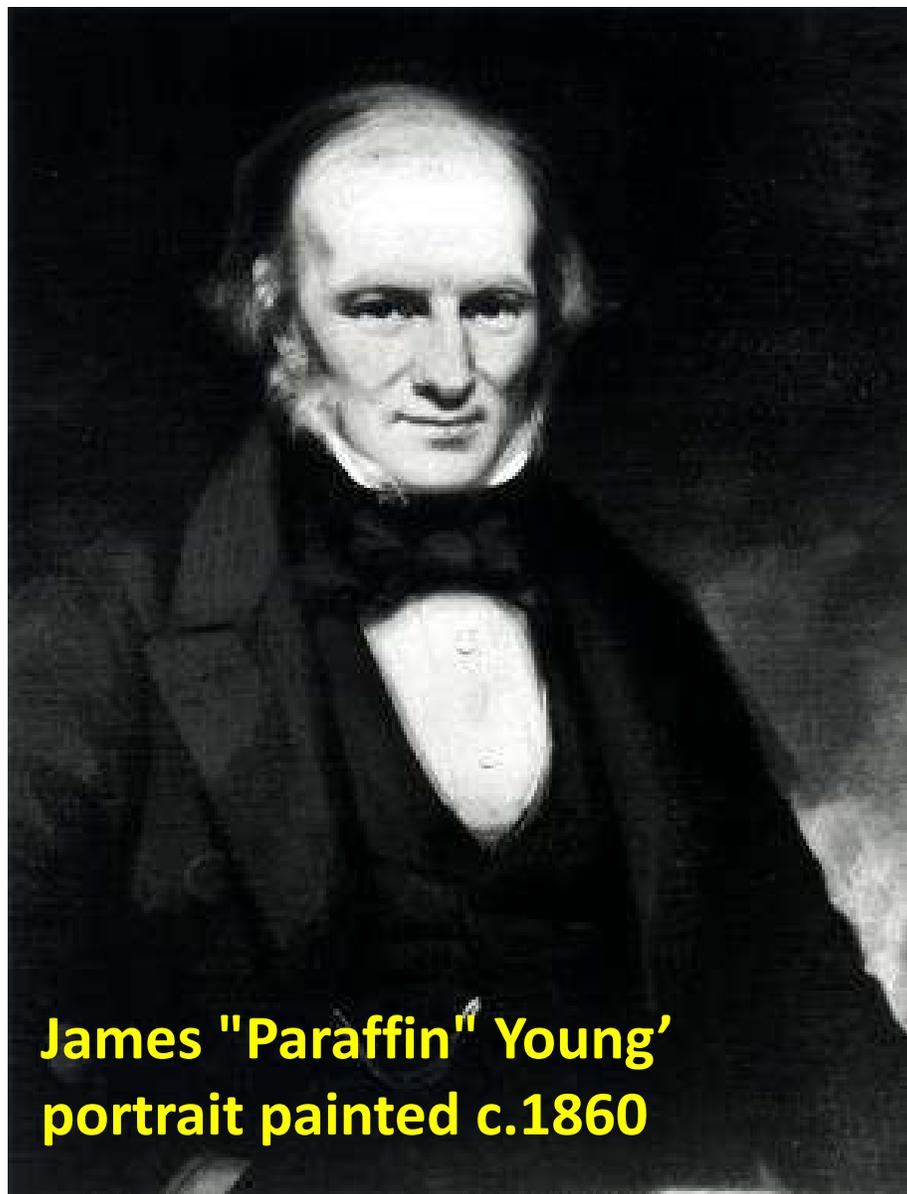
Problems have been caused by low quality, inappropriate engineering and poor land husbandry.”

(Haigh et al., 2015)

Outline

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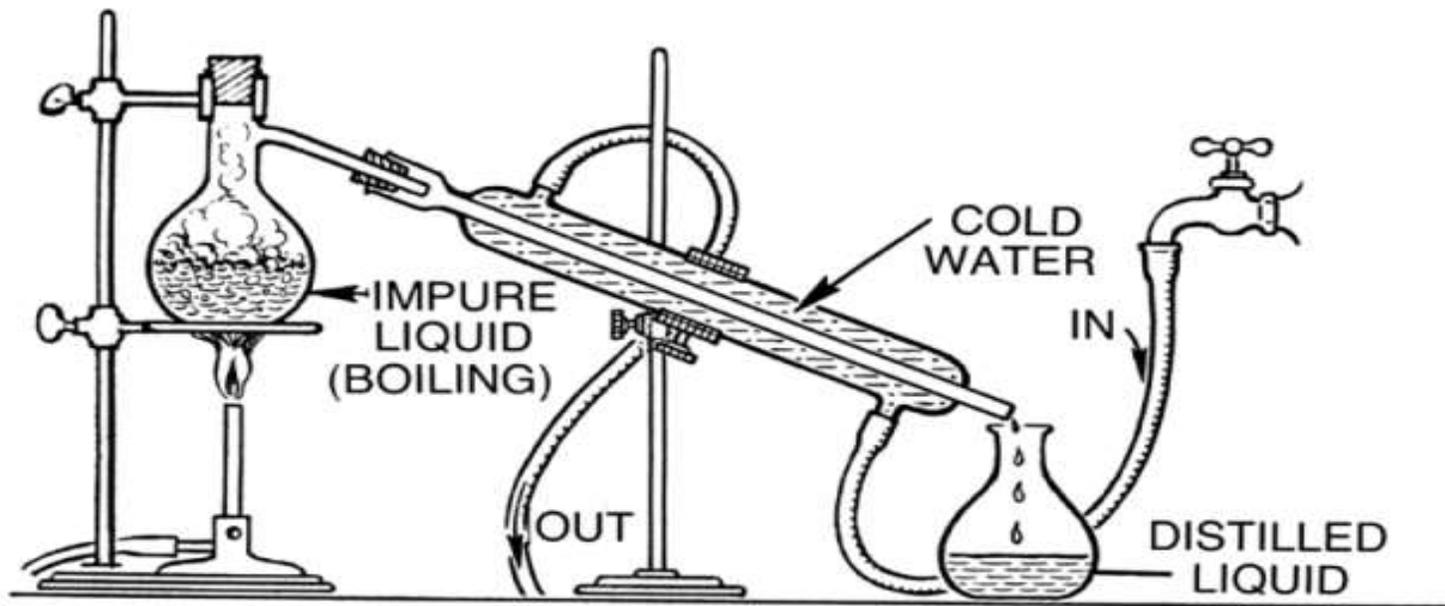
2. Paraffin Young - the world's first oil-mogul



James "Paraffin" Young'
portrait painted c.1860

Oil distillation and cracking

"Cracking" - breaking down large molecules of heavy oil into shorter, more useful molecules



600m north of
Torbane Farm,
Aug 2019



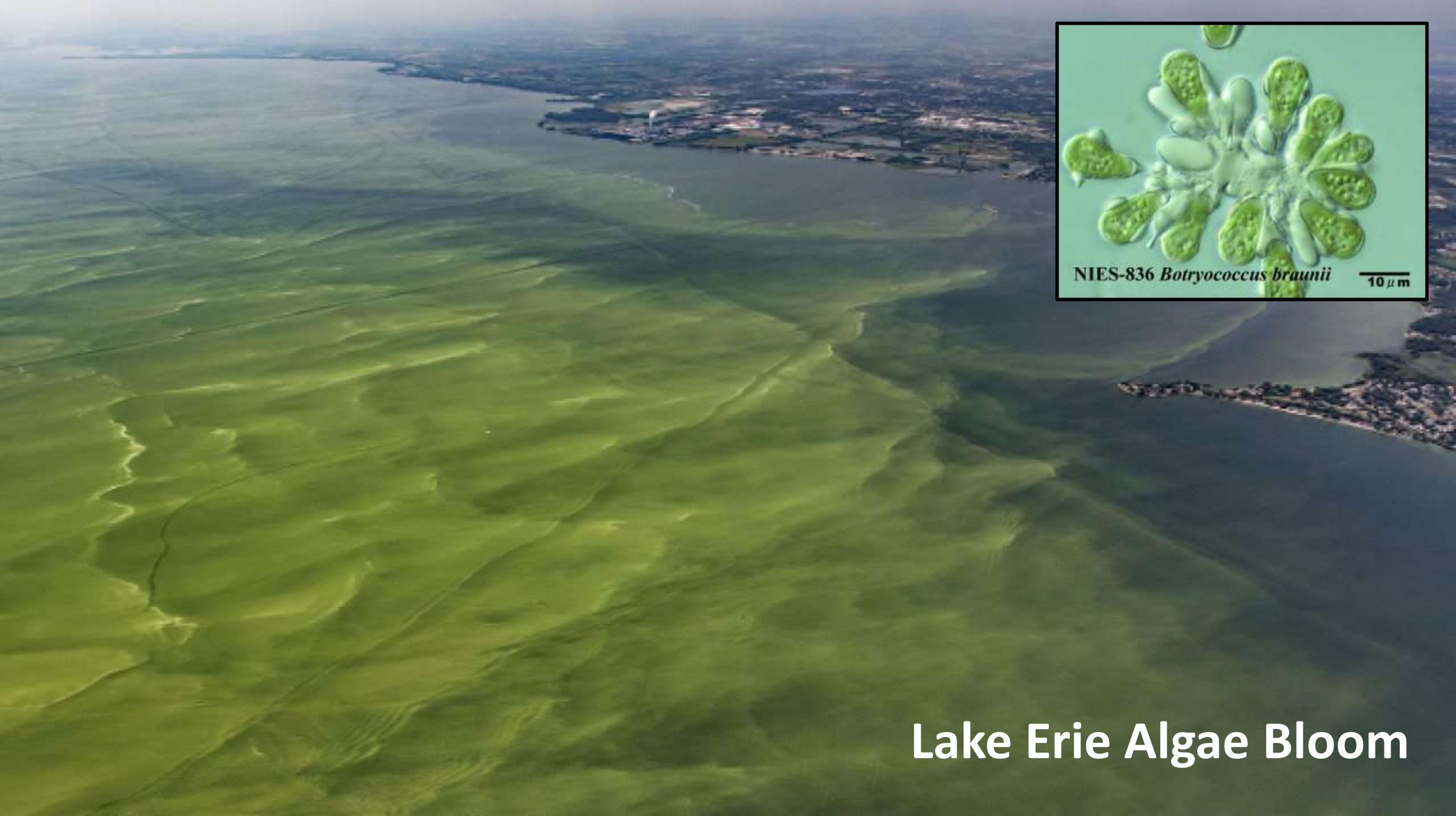
Torbanite and Young's Bathgate Works

In 1851 the works were warmly welcomed because they provided much needed employment - the local inhabitants were mostly hand-loom weavers with earnings barely sufficient to prevent starvation.





←←←← Pumpherstons oil-shale >>>>



NIES-836 *Botryococcus braunii* 10 μm

Lake Erie Algae Bloom

Oil shale mining in Dalmeny

A bold scheme to exploit shale reserves deep beneath South Queensferry and the River Forth.

The Rosshill workings extended $\frac{3}{4}$ mile under the sea. Shale-field opened 1911, abandoned 1921. Mined by inclined adit.

Many families, living in miners' rows took in boarders - often migrant workers - with up to 14 people living in one two-room cottage. There was open channel drainage and the surroundings were very dirty. Yet these properties were considered better than those in many coal-mining villages.





Breich

A rope-hauled tramway, built in about 1912, passed beneath the Seafield to Blackburn road, carrying oil-shale from pits to oil-works.



Aug, 2019

Nine shale bings in photo



Pumpherson Refinery, looking northeast, c.1962

HM Prison Addiewell

Viewed from
an Edinburgh
bound flight
from Prague.

Occupies the
site of Young's
former oil
works.



Welcome to the new Winchburgh!



Winchburgh Landscape and Community Resource Plan

Plan prepared to support Habitats Planning Application consultation process.

- Residential employment areas
- Proposed employment areas
- Proposed rail station
- Proposed park and ride
- Strategic areas of public open space
- Strategic areas of landscape/ecosystems
- Existing schools
 1. Winchburgh Primary School
 2. Holy Family RC Primary School
- Existing community facilities
 3. Winchburgh Medical Centre
 4. Winchburgh Community Centre
 5. Winchburgh Parish Church and hall
 6. St John's RC Church and hall
- Existing public parks and facilities
 7. Millgate Park
 8. Holywell Playing Area
 9. Play area
 10. Complex Park (play, football pitch and 6 water)
 11. Winchburgh Bowling Club
 12. Niddy Castle Golf Course
- Proposed schools
 15. De-located Secondary School Campus
 16. New RC Primary School
 18. New Primary School
- Proposed community facilities
 15. Proposed centre space
 17. Proposed centre shops
 18. Proposed play space
 19. Community and cultural centre
 20. Proposed community centre
 21. Proposed supermarket
 22. Proposed children's nursery
 23. Proposed international bank
 24. Proposed location for local shops
- Proposed public parks and facilities
 25. Addobathie Park
 26. Dairy Park
 27. Day Pit Farm
 28. Station Highground Park
 29. Winchburgh Highground Park
- Path Network
 - Usher Canal (equally 50m Path)
 - National Cycle Route 1
 - Existing path network
 - Proposed routes adjacent to main roads
 - Proposed path network

Winchburgh Developments Ltd
Winchburgh Masterplan
1:5000 @ A1

The development at Winchburgh is one of the largest and most exciting placemaking projects currently underway in the UK. When complete, the masterplan will bring **at least 3,450 new homes**, improved transport links, employment opportunities, state-of-the-art schools and stunning new outdoor spaces to this historic village.





Grangemouth
A904

Outline

1. Scotland's bings - black, brown and red
2. Paraffin Young - the world's first oil-mogul
3. **Fracking - Scotland and England take different paths**

Preston New Road, Lancashire:

The government has given Cuadrilla the green light to continue hydraulic fracturing.



George P. Mitchell, the father of fracking

Billionaire Texas oilman, developer and philanthropist



Fracking in action

Take a closer look at how fracking releases shale gas from rock

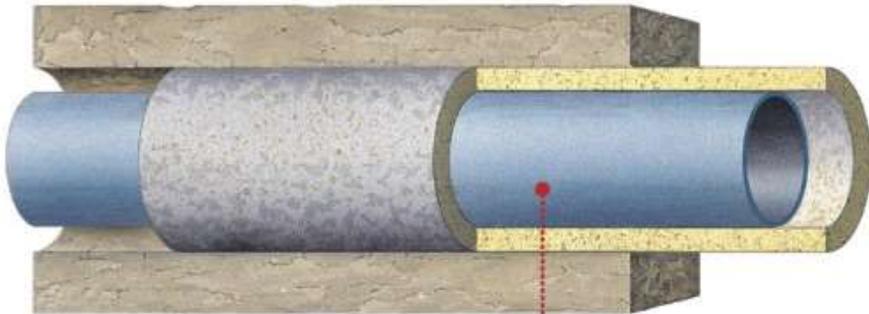
1. Drill

A drill bit creates a horizontal wellbore up to 3km (2mi) long.



2. Instruments

Instruments behind the drill make measurements so the drill's path can be steered to follow the shale formation.

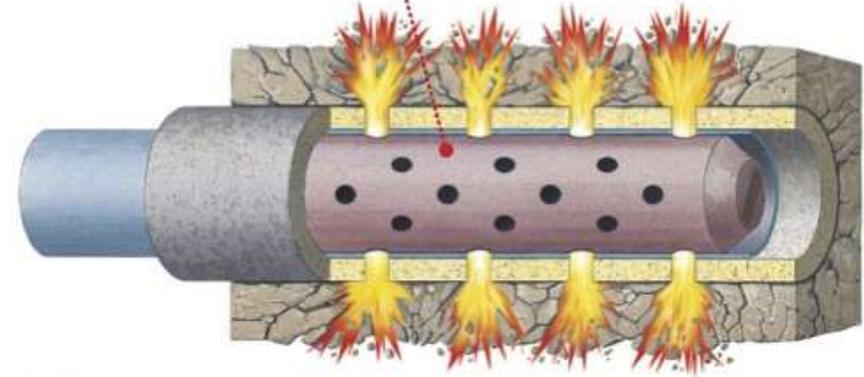


3. Casing

The wellbore is lined with steel piping, held in place with cement.

4. Perforation gun

A perforation gun then punches holes through the casing and into the rock.

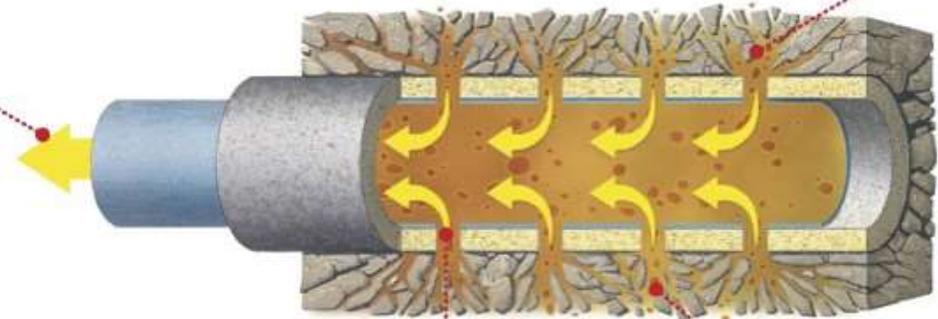


5. Fracturing

High-pressured fracking fluid - mostly water and sand - is injected into the well, opening up fissures in the shale rock.

8. Gas escapes

Gas flows into the wellbore and back up to the surface.



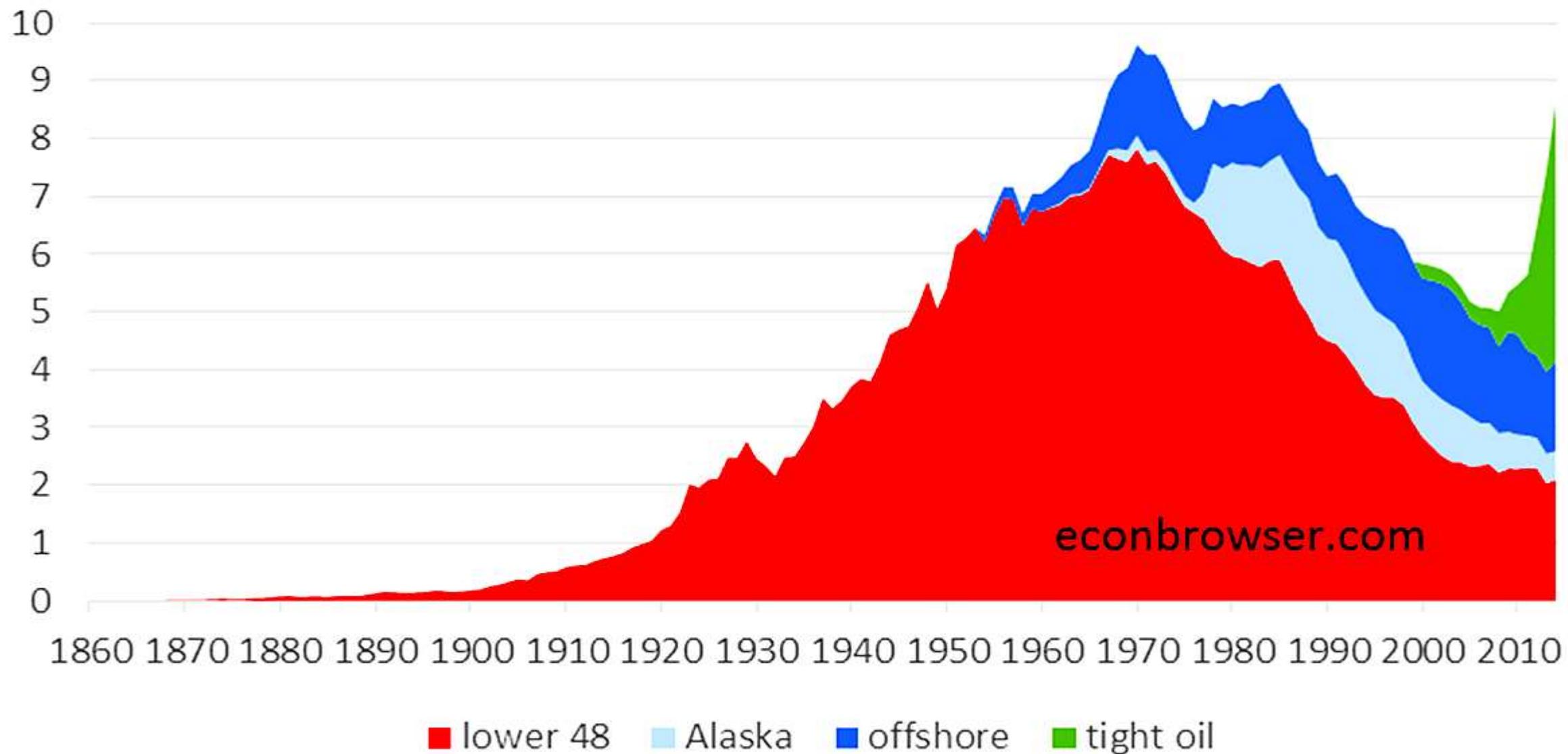
7. Freeing gas

The fissures create pathways releasing gas from the impermeable shale rock.

6. Cracks

Grains of sand lodged in the cracks keep them propped open.

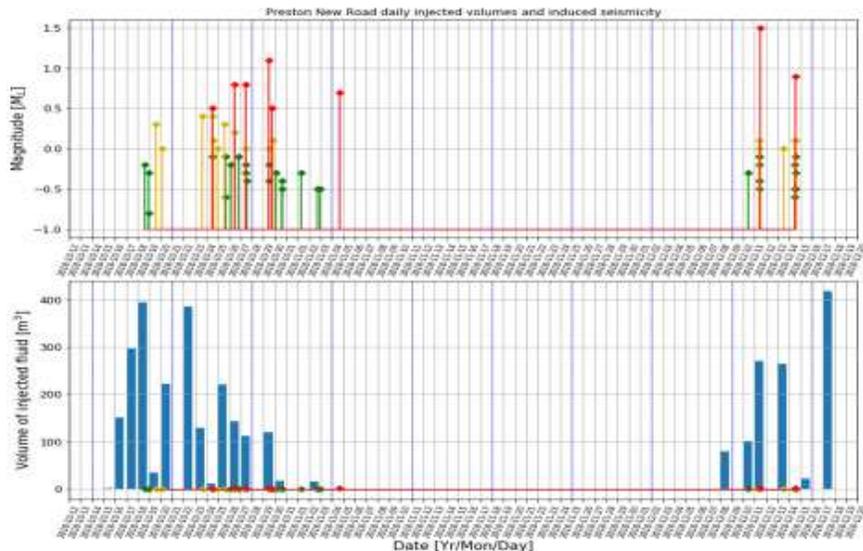
U.S. oil production by source



Fracking brings many local environmental problems

- Earthquakes
- Water quality
- Noise
- Ozone and air quality

Human induced earthquakes



Water from Carol French's well in Bradford Co. PA.



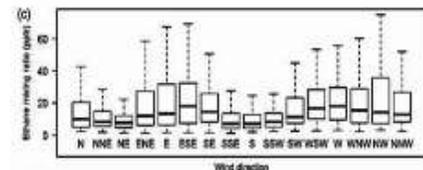
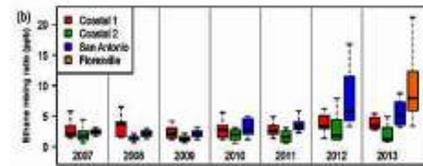
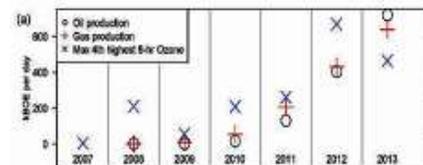
ECHO BARRIER
Environmentally Sound

How to **STOP** Fracking Noise



Is the Shale Boom Causing Ozone Pollution?

Schade and Roest 21 April 2015

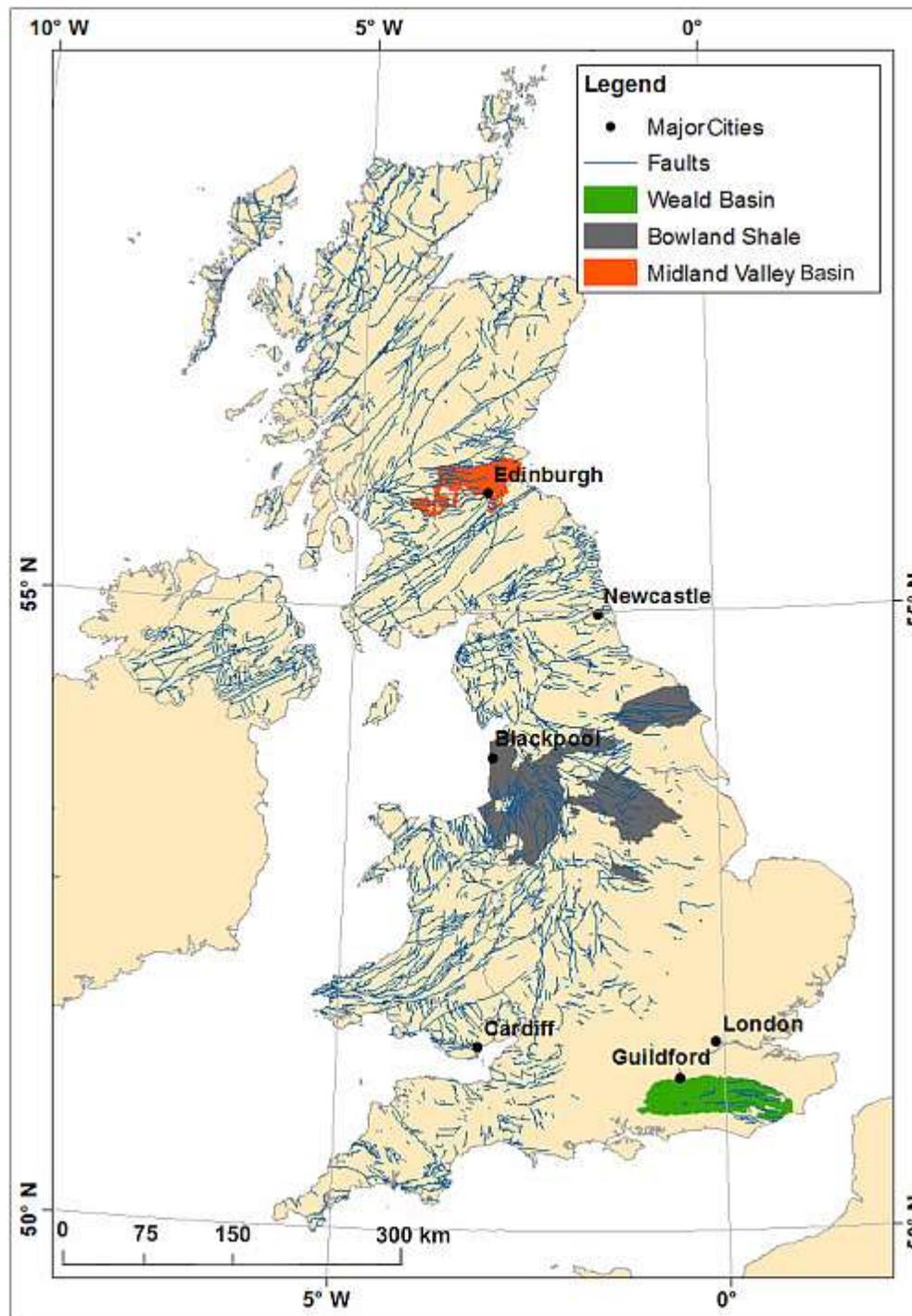


17,685 wells in south-central Texas

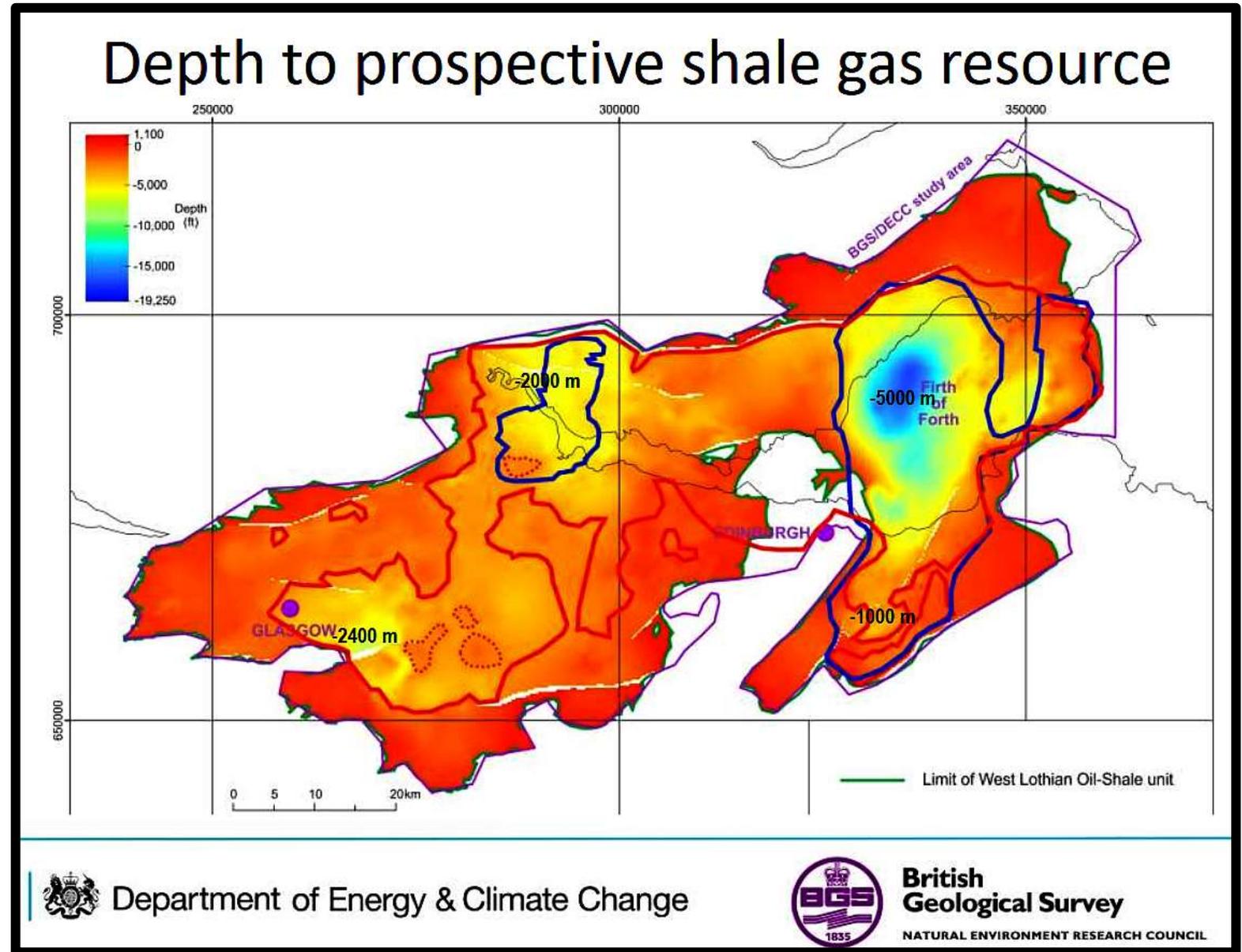
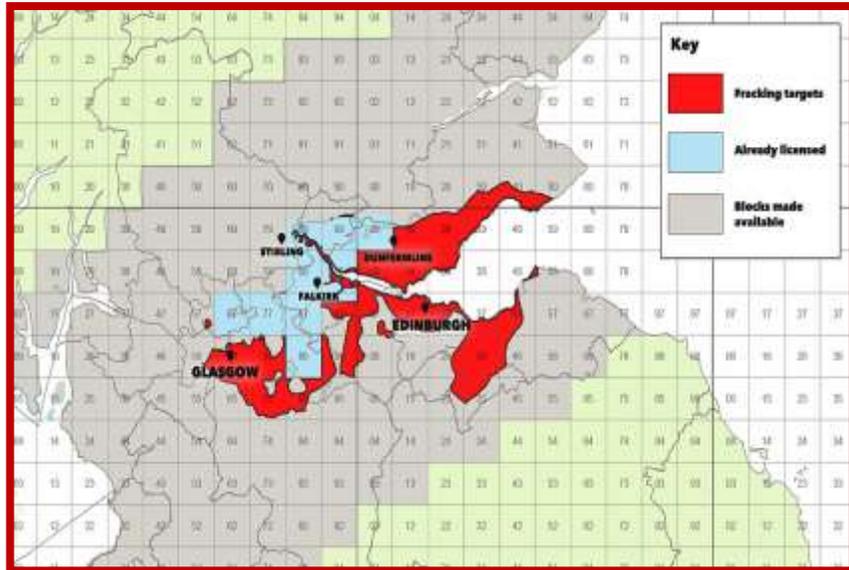


Gas flaring & crescent-shaped scatter of night light

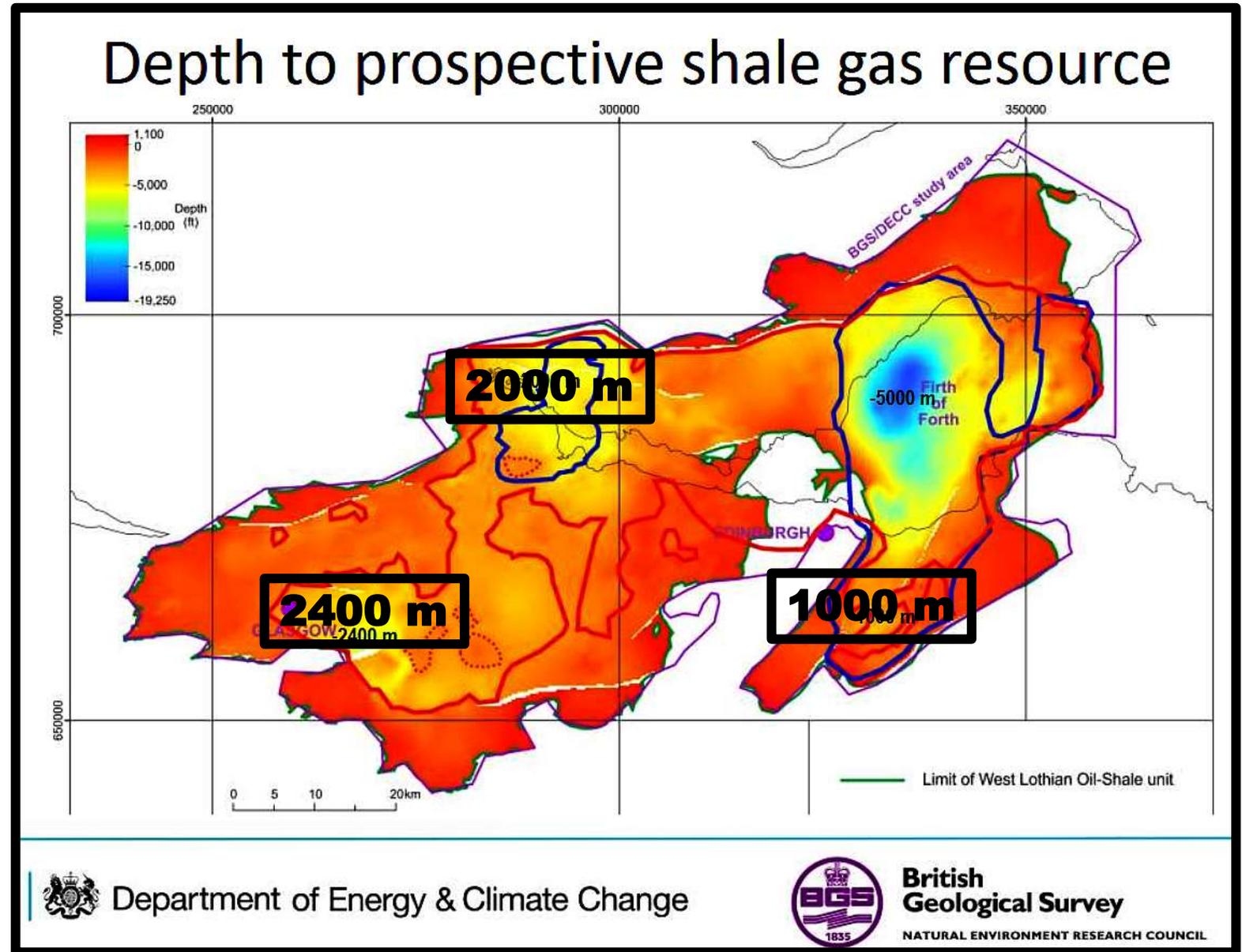
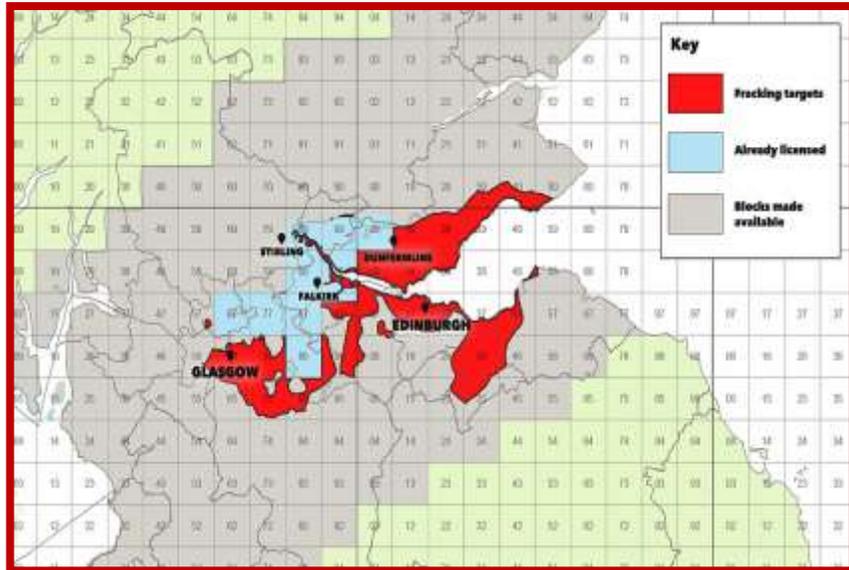
Major UK shale gas prospects and surface mapped faults

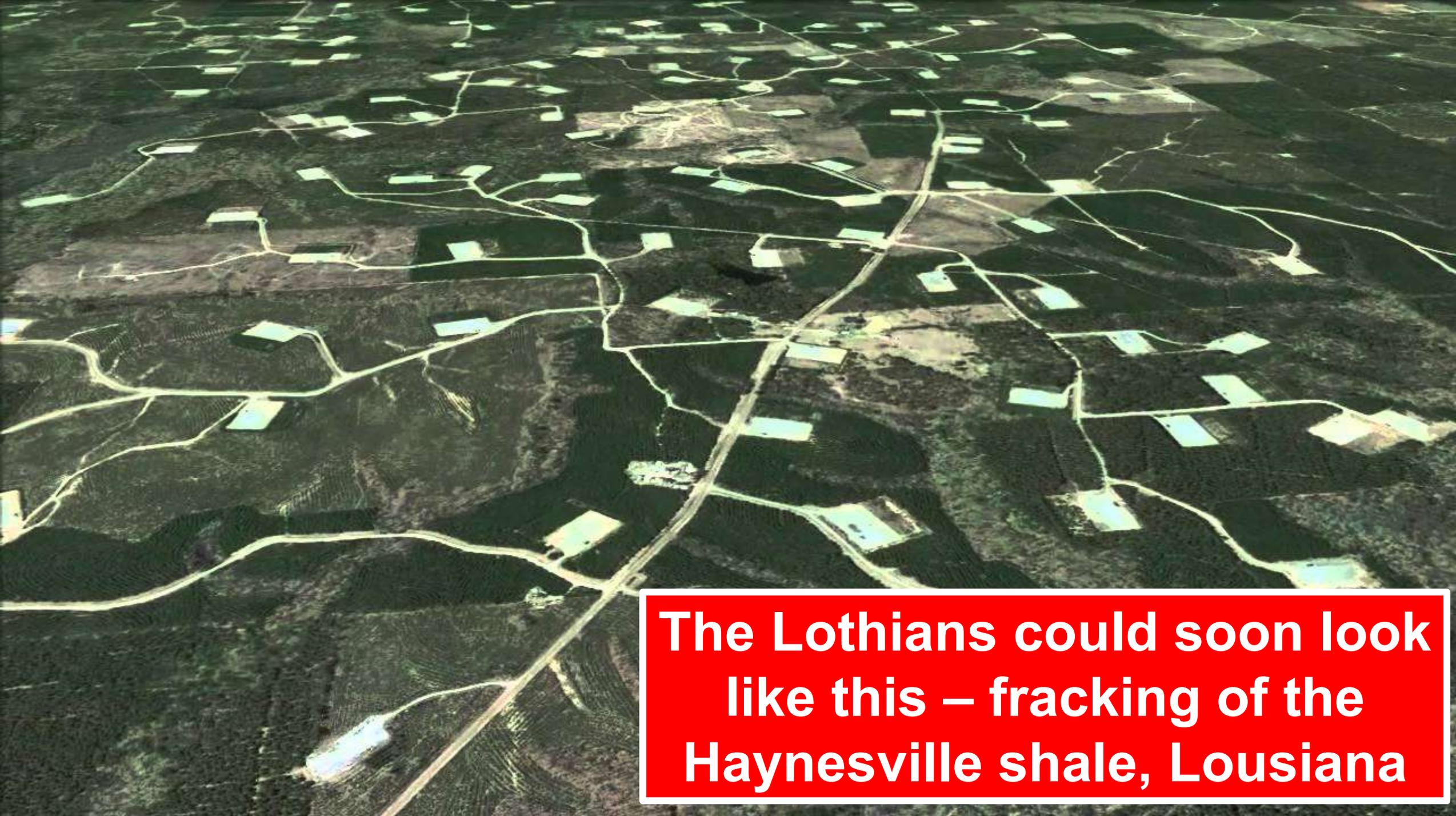


Where do companies want to frack in Scotland?

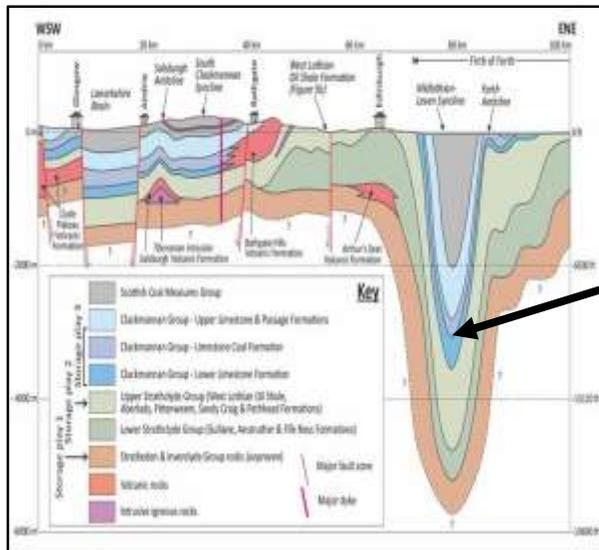


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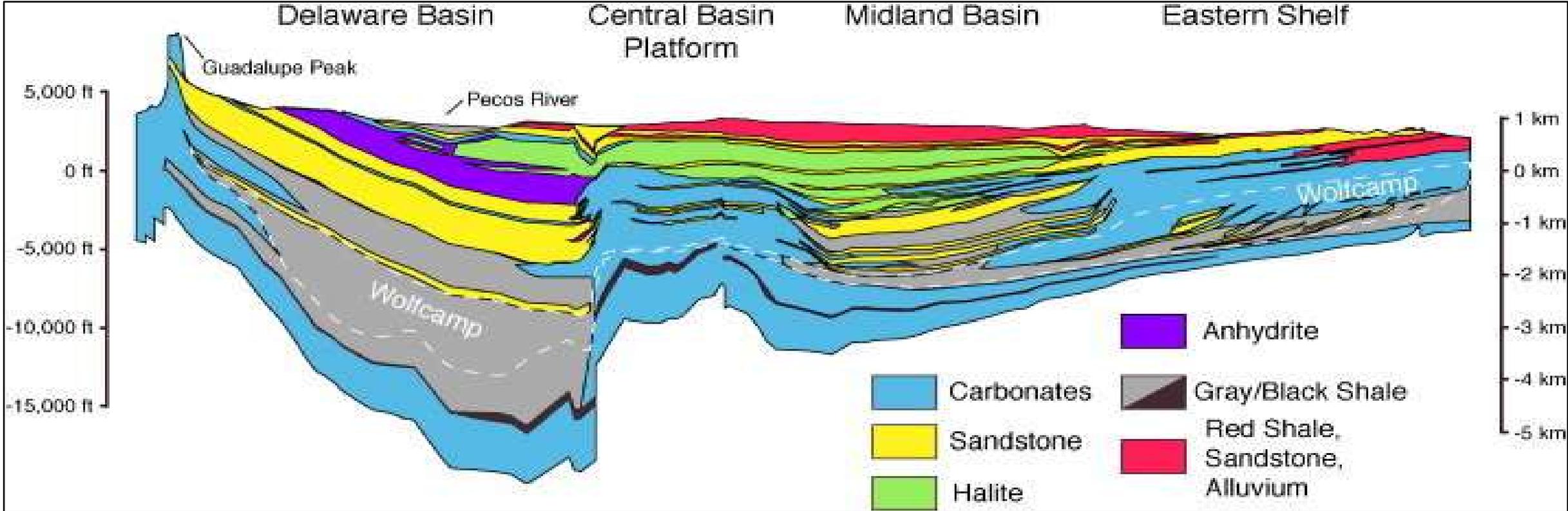


The Lothians could soon look like this – fracking of the Haynesville shale, Louisiana



Midlothian-Leven syncline beneath Firth of Forth

USA vs. Scotland same-scale comparison



The topic of fracking in Scotland remains a legal minefield, a political hot potato

Jan, 2015 **SNP ministers** announce an **indefinite ban on fracking** in Scotland. All local authorities were contacted making it clear they should not consider applications for unconventional oil or gas development.

Oct, 2017 **The Scottish Government** states its moratorium outlawing fracking will be permanently extended. Ms. Sturgeon declares: *“Fracking is being banned in Scotland, end of story. There will be no fracking in Scotland. I don’t think that position could be any clearer.”*

June, 2018 **The Court of Session’s judge - Lord Pentland** rules that as a matter of law **“there is no prohibition against fracking in force”** following INEOS’ claim that ministers had acted illegally in announcing a block in Oct 2017.

May, 2019 **The Scottish Government**, in response to a freedom of information request, revealed it **spent £173,928** on external legal advice and £1200 on court fees for the Court of Sessions’ judicial review.

June, 2019 **INEOS is granted an extension to its gas drilling licence** (for shale-gas and coal-bed-methane, at Airth) despite the SNP’s preferred policy position of a moratorium on fracking.

Summary - fracking in Scotland

- **No clear match is found between Scottish geology and that of North American shale-gas plays.**
- **Scotland's geology is too complex and heavily faulted.**
- **Scottish shales are too carbon poor, shallow, thermally immature, and ductile.**
- **If exploration in England continues to be unsuccessful or production proves to be costly, then a vibrant Scottish shale-gas industry is extremely unlikely.**
- **Holyrood should maintain its moratorium and await developments in England. Better still it should introduce primary legislation to clarify its position on fracking within a long-term energy policy that addresses the question of '*how is Scotland's future energy requirement to be met*'.**

Outline

1. **Scotland's bings** - black, brown and red
2. **Paraffin Young** - the world's first oil-mogul
3. **Fracking** - Scotland and England take different paths
4. **Scotland's energy trilemma**

Affordability

Power mix has high level of intermittent renewables, with little balancing or backup capacity

Lots of coal and gas power generation with some level of diversification, and political efforts to either secure imports, or increase domestic production

ENERGY TRILEMMA

Energy security

Environmental impact

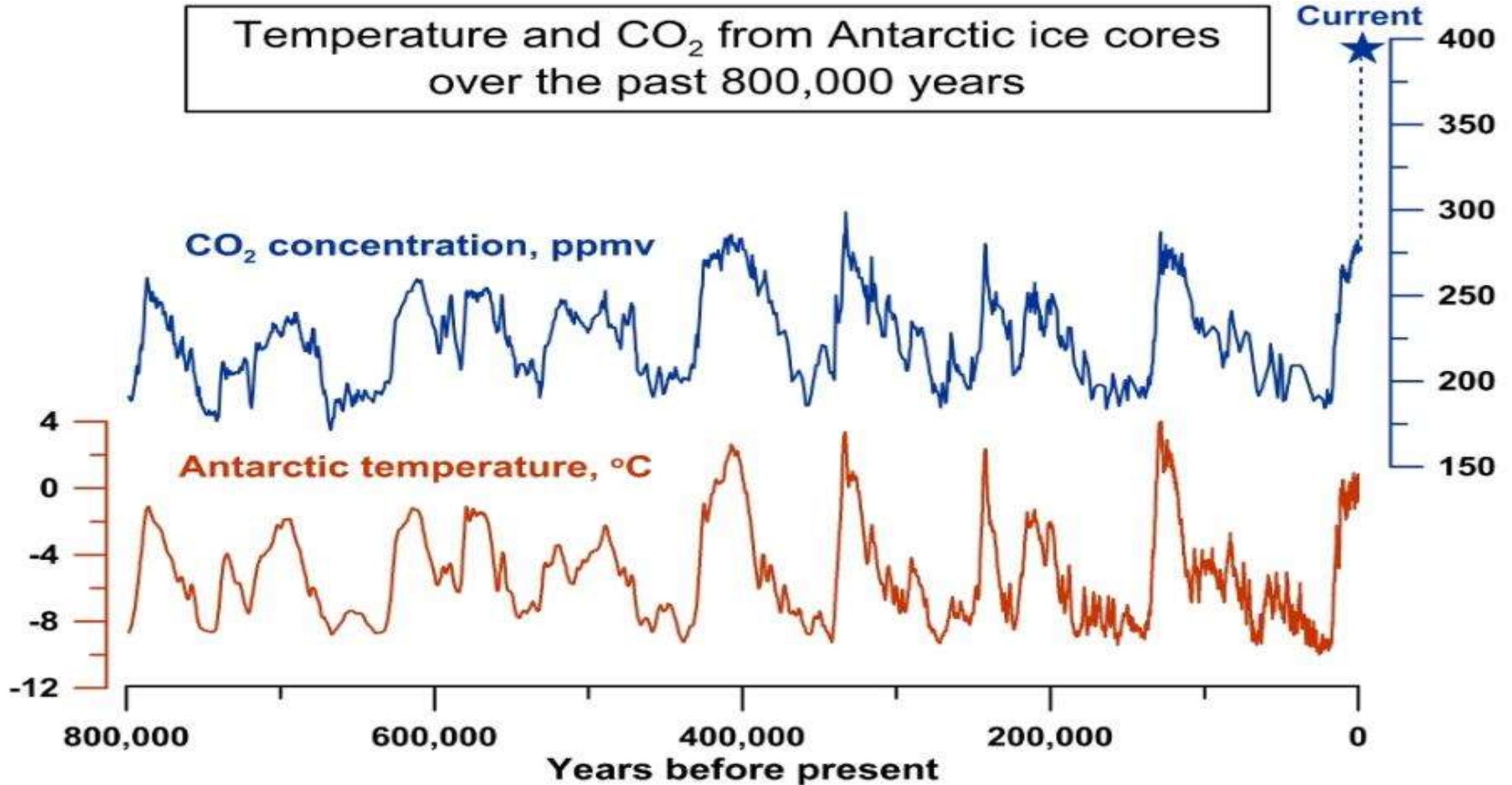
No fossil fuels. Hydro and tidal sites exploited where there is minimal damage to ecosystems. Biomass, bioliquids, & hydro used for peaking. Minimal fuel imports

The basic climate-change problem

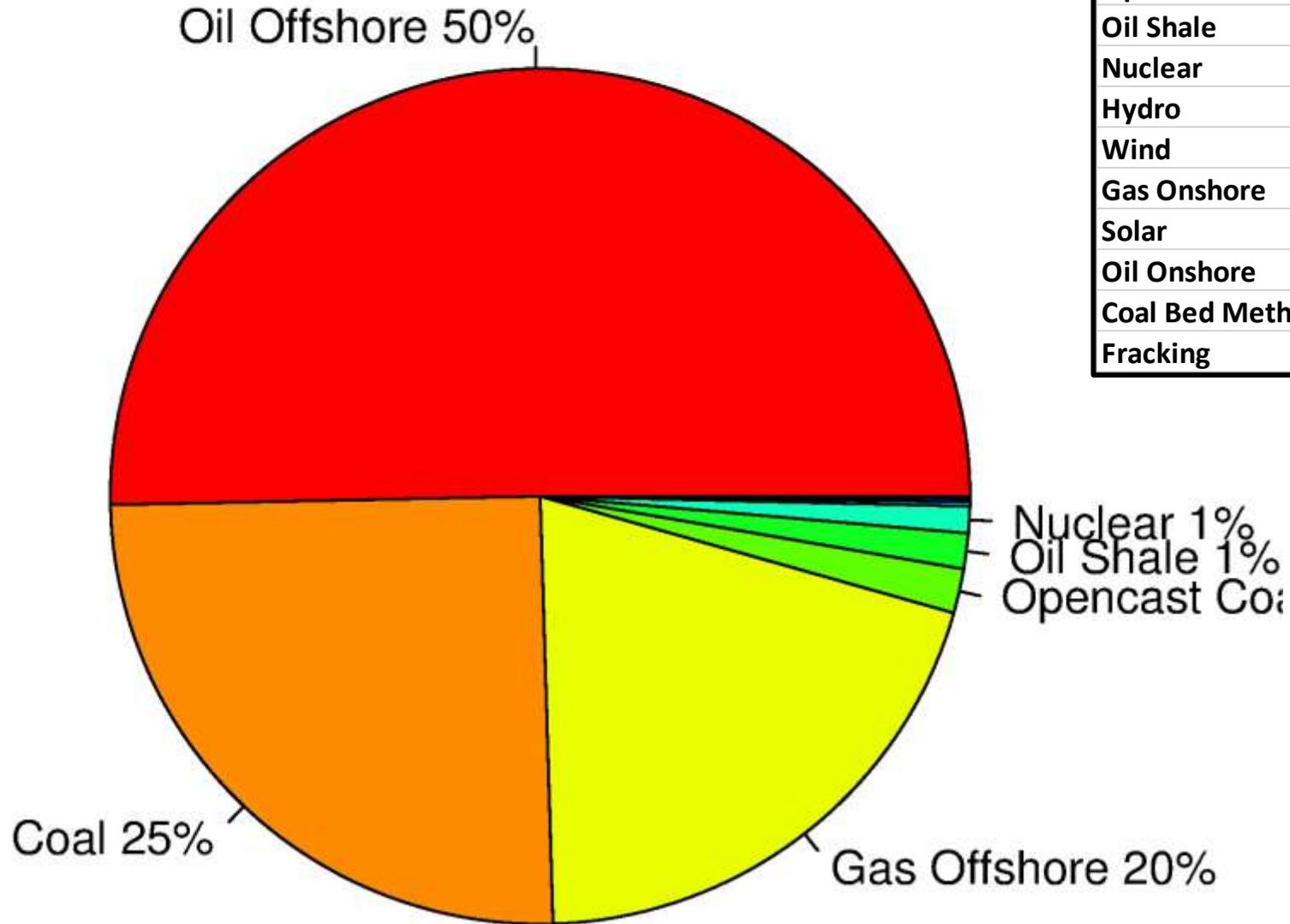


Antarctic ice: the world's air museum

Temperature and CO₂ from Antarctic ice cores over the past 800,000 years

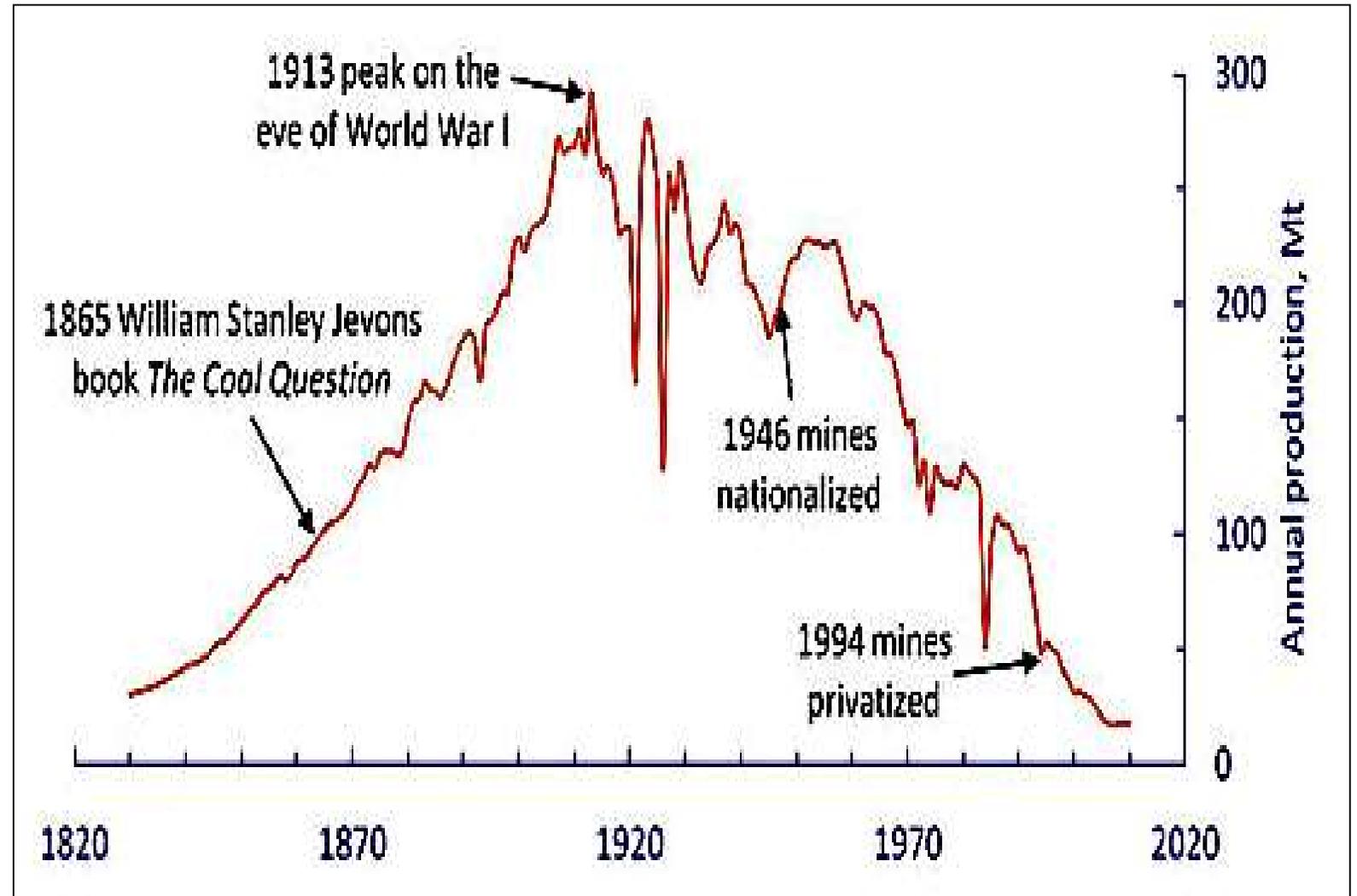


Scotland's energy 1850–2020

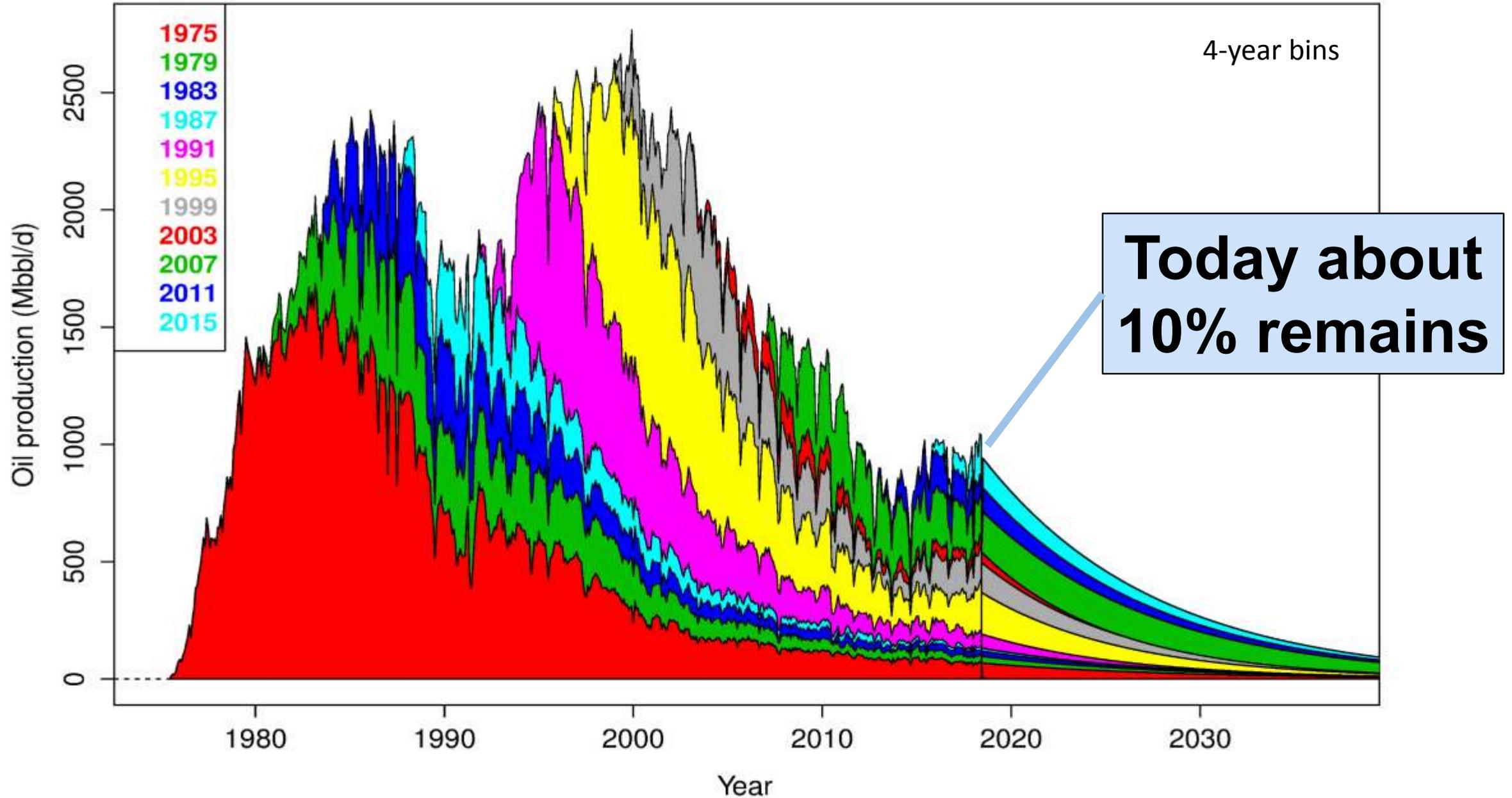


Source	BllionBarrelsOil
Oil Offshore	30
Coal	15
Gas Offshore	12
Opencast Coal	1
Oil Shale	0.8
Nuclear	0.6
Hydro	0.1
Wind	0.08
Gas Onshore	0.04
Solar	0.002
Oil Onshore	0.00003
Coal Bed Methane	0.000011
Fracking	0

UK coal production (1820-2010)



UK oil production



Scotland's SNP government has a *'no new nuclear power strategy'*



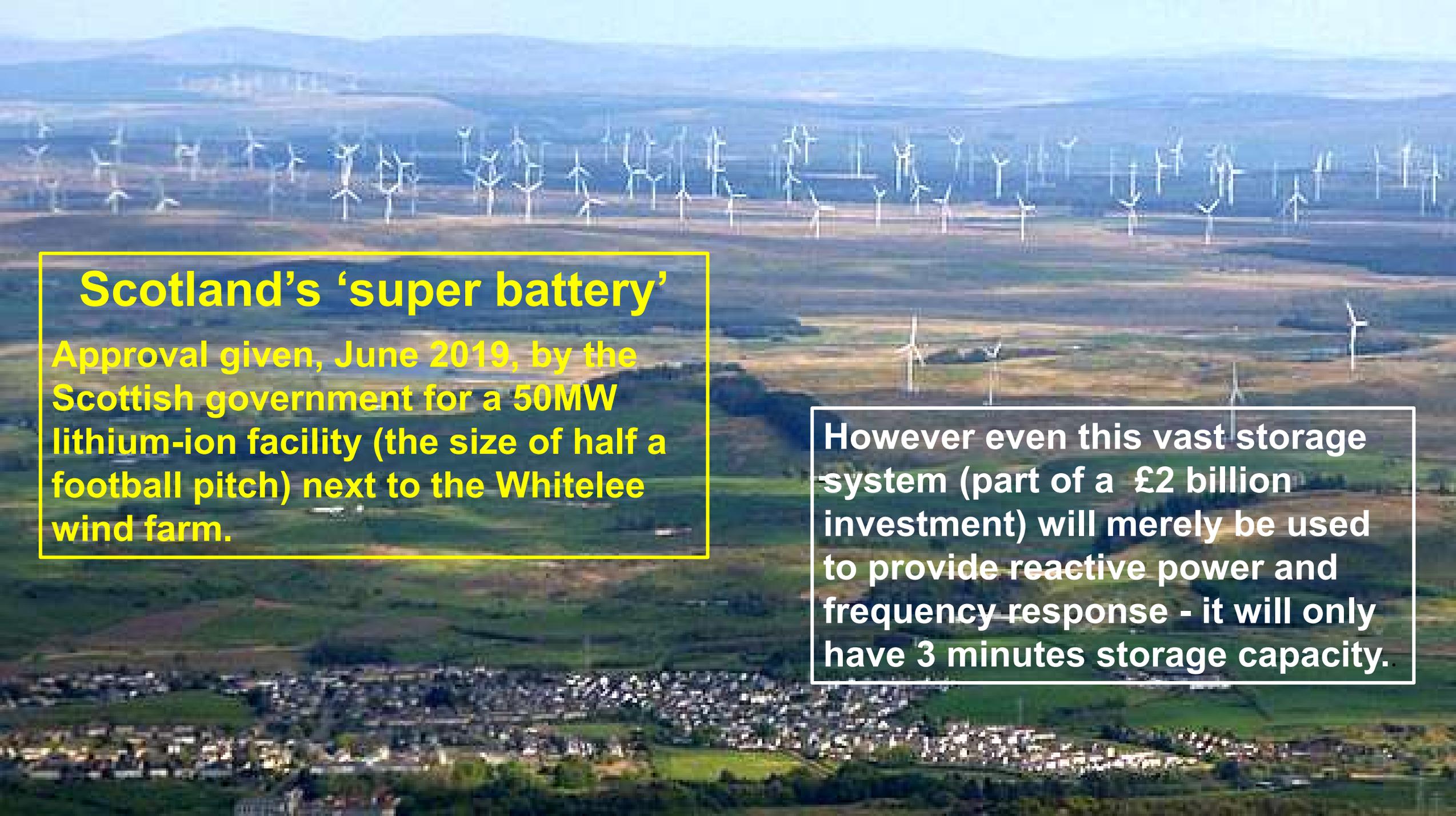
Dounreay



An aerial photograph of a large-scale wind farm in Scotland. The landscape is a mix of green fields and brownish hills. In the foreground, a small town or village is visible. The middle ground is dominated by hundreds of white wind turbines stretching across the terrain. The background shows rolling hills under a clear blue sky.

Scotland's 'super battery'

Approval given, June 2019, by the Scottish government for a 50MW lithium-ion facility (the size of half a football pitch) next to the Whitelee wind farm.

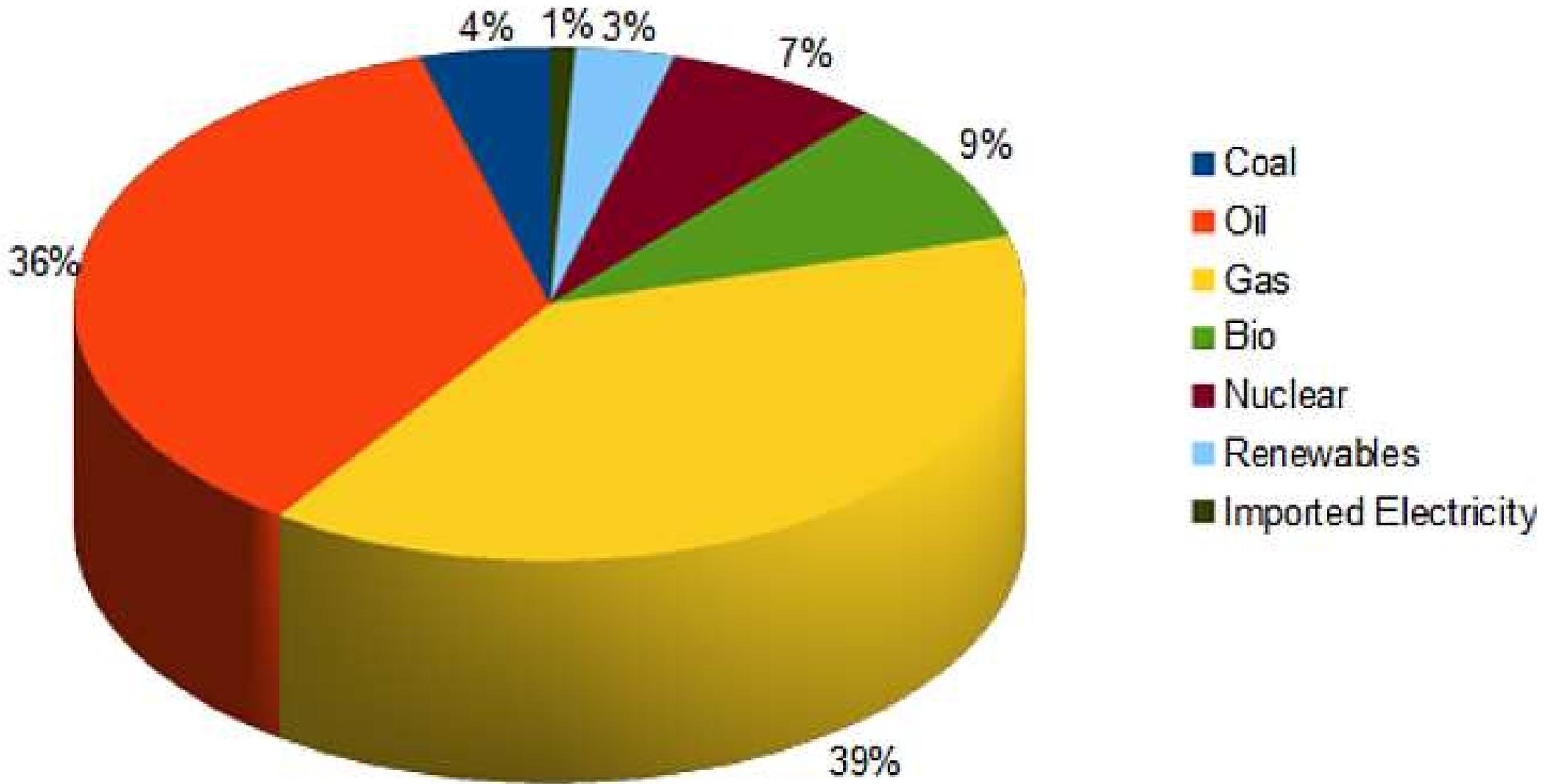


Scotland's 'super battery'

Approval given, June 2019, by the Scottish government for a 50MW lithium-ion facility (the size of half a football pitch) next to the Whitelee wind farm.

However even this vast storage system (part of a £2 billion investment) will merely be used to provide reactive power and frequency response - it will only have 3 minutes storage capacity.

UK Primary Energy Consumption 2018

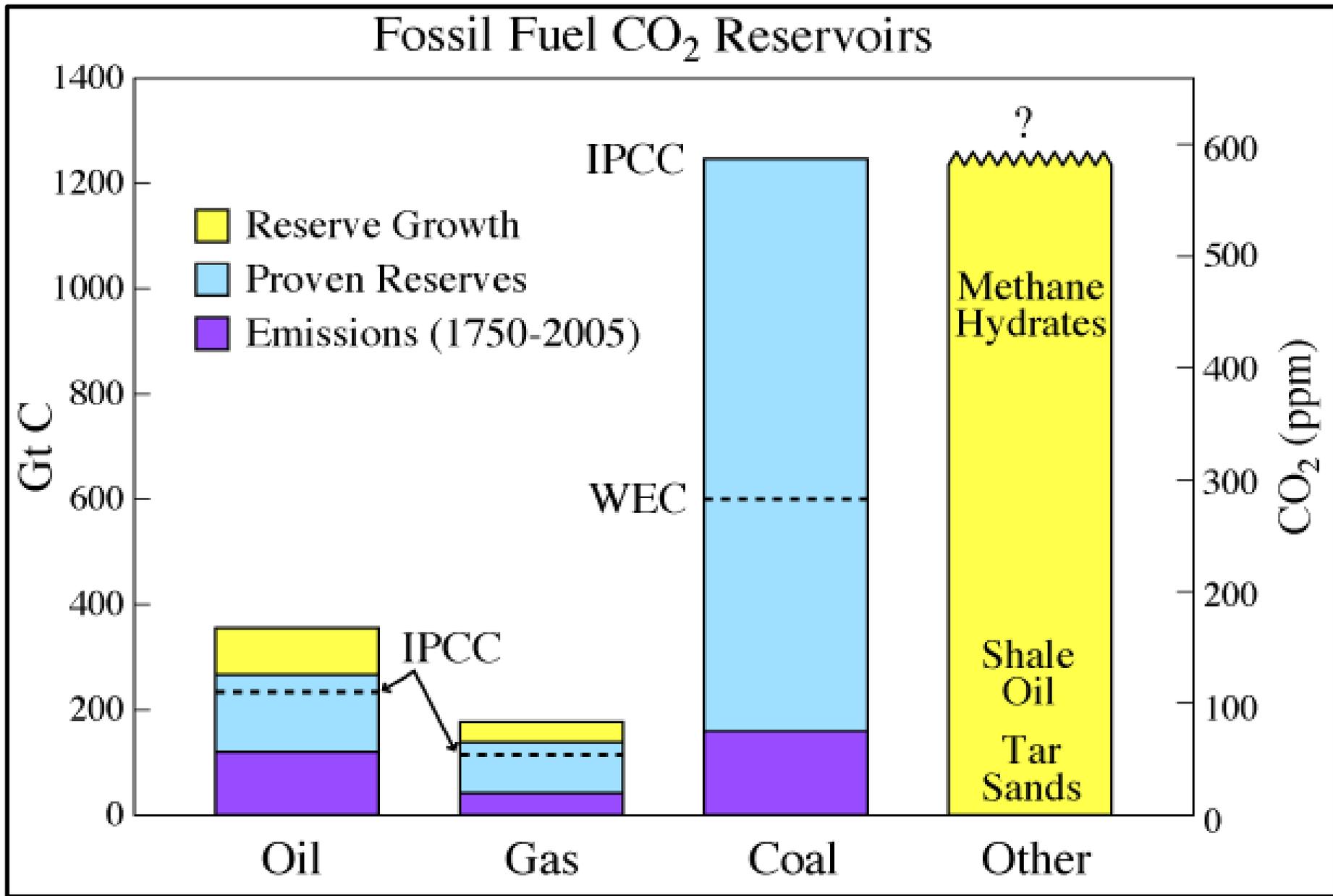


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Dozens arrested in Extinction Rebellion protest as climate change protesters block main roads in Edinburgh's city centre. 16 April 2019.



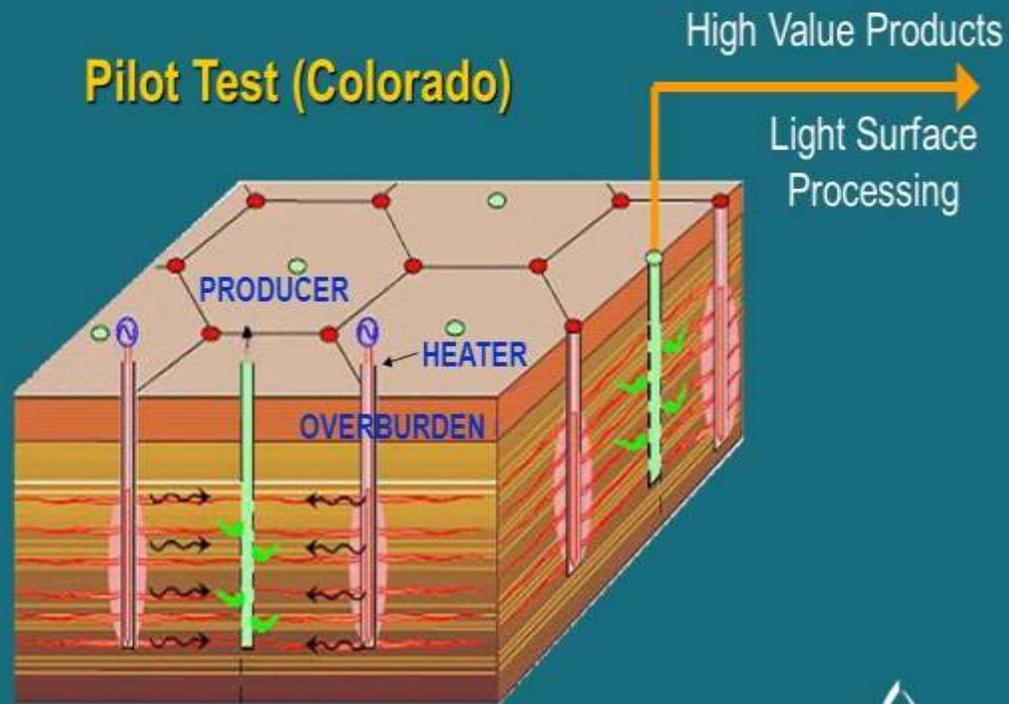
Historical emissions shown in purple, remaining reserves in blue, and potential near-term additions to reserves in yellow.

A new £165m coal mine has been unanimously approved by councillors in Cumbria – the first deep-level, UK, mine in 30 years.

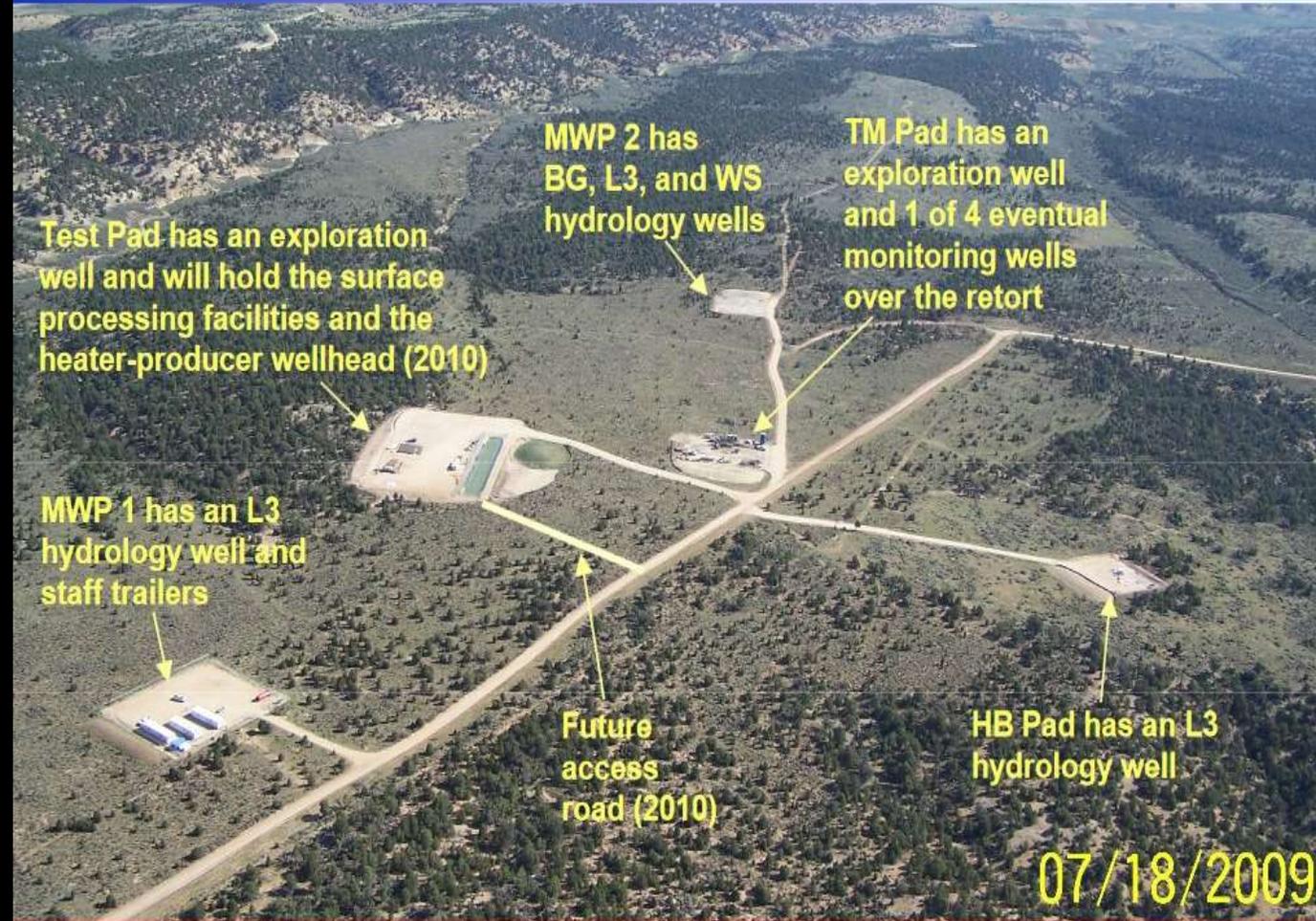


**Artist's impression of
Whitehaven venture**

In-situ oil shale-oil?



Most of our site preparation and all of our hydrology wells are in place



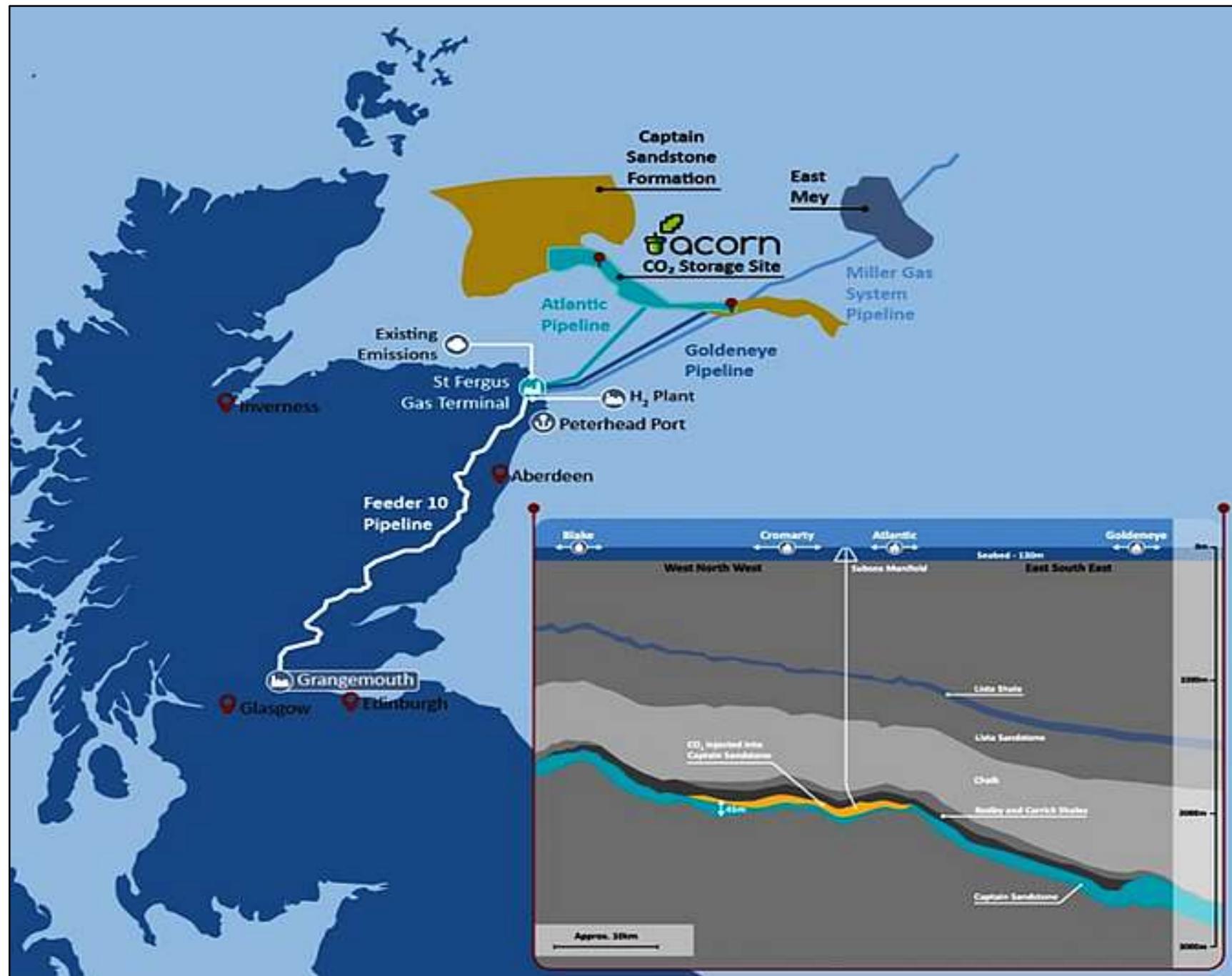
07/18/2009

Carbon capture projects get UK funding boost

(27/06/2019)

£26 million allocated to nine projects to accelerate the rollout of carbon capture technology as the UK strives for net zero emissions by 2050.

Potential to hold 100 years of Scotland's industrial CO₂ output.



Summary

1. **The past 300 years have seen miraculous advances in civilization and the quality of life, largely brought about by extracting the prodigious energy resources of fossil fuels.**
2. **Paraffin Young: a truly remarkable Scottish genius – created the world's first petro-chemical industry in the early 1850s.**
3. **Scotland's coal and shale bings have largely been removed or transformed from ugly blots on the landscape into scenic, community sites.**
4. **Fracking for gas: Scotland's geology will not allow economic viability.**
5. **Scotland's energy trilemma: a major headache – our governments show no signs of having a coherent, long-term vision.**
6. **In global terms - the end of fossil fuels is not about to happen anytime soon.**