

*'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

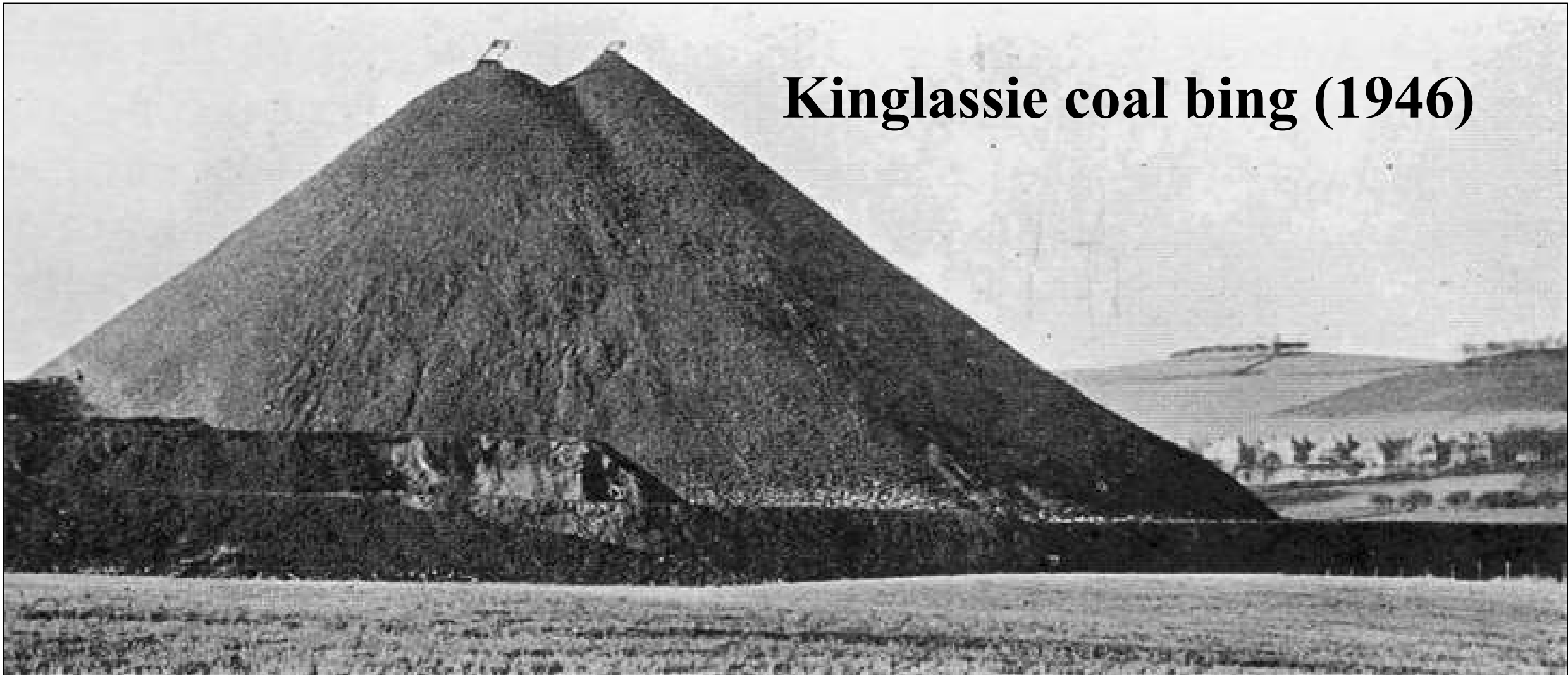


John Mander



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



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.



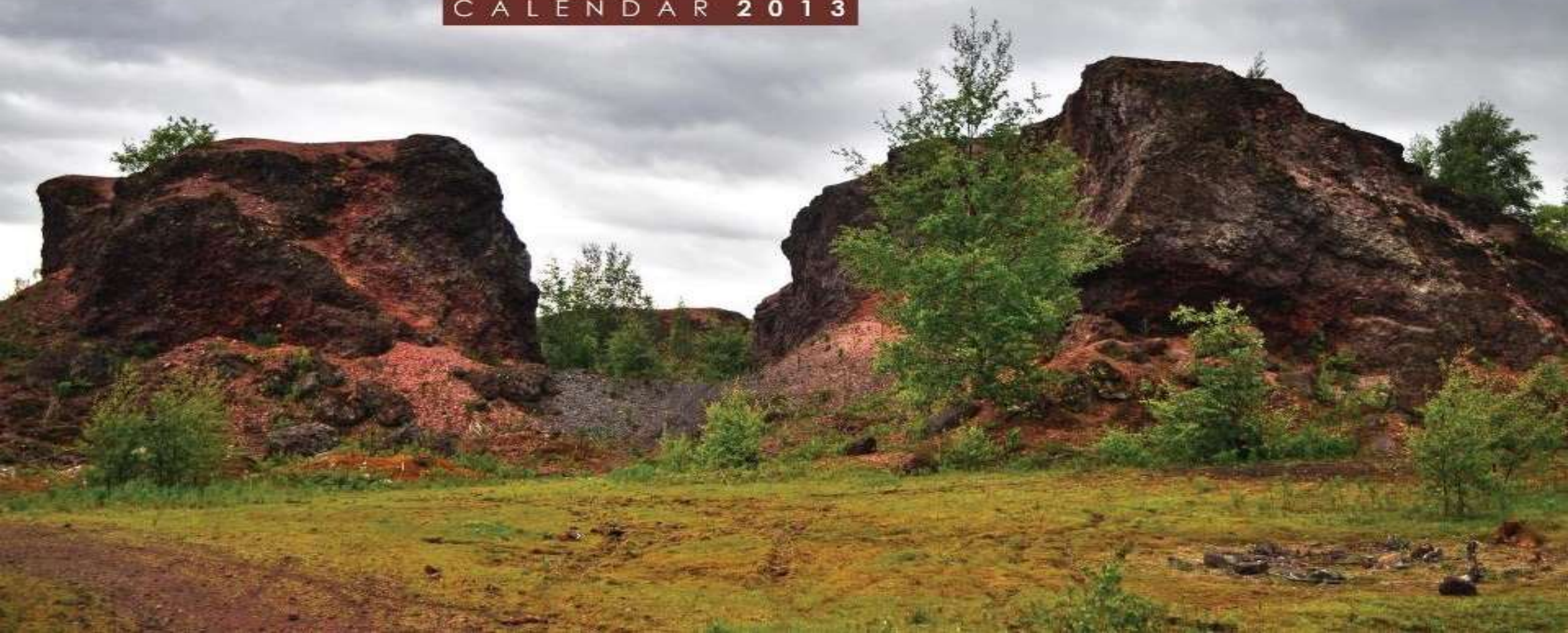
Good revegetation growth on reclaimed bing.

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

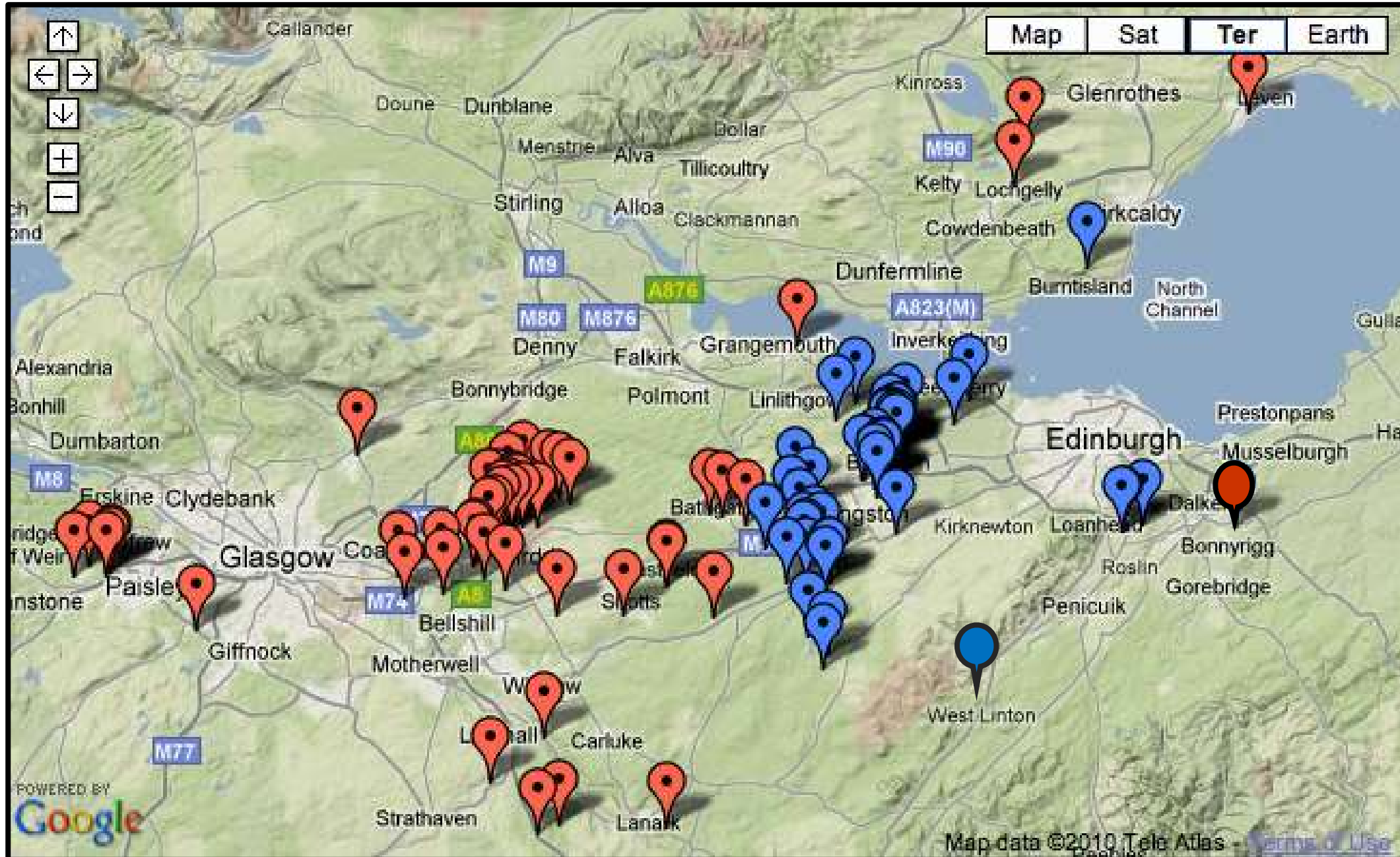


Scottish oil-shale industry

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.

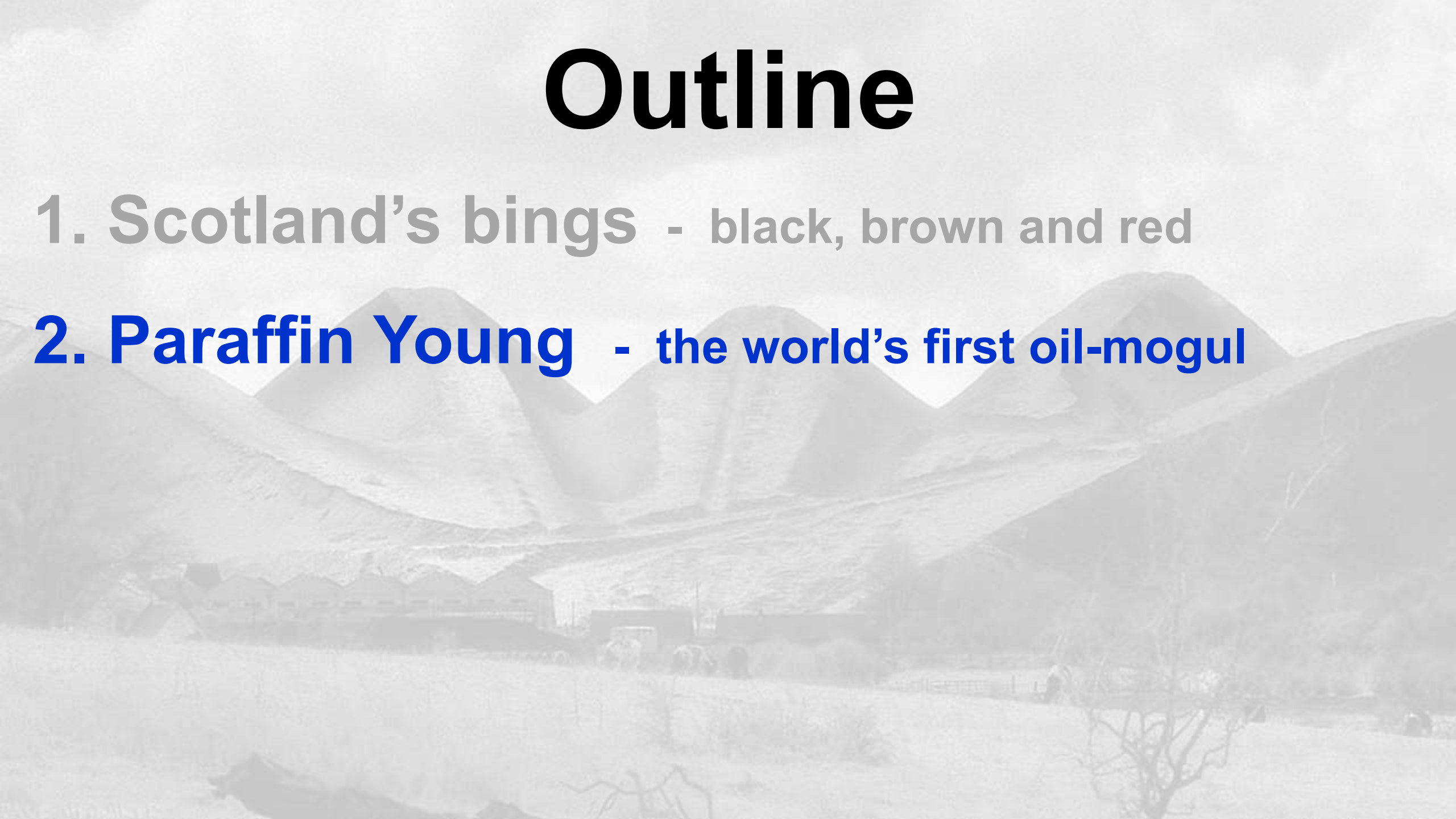
Problems have been caused by low quality, inappropriate engineering and poor land husbandry.”

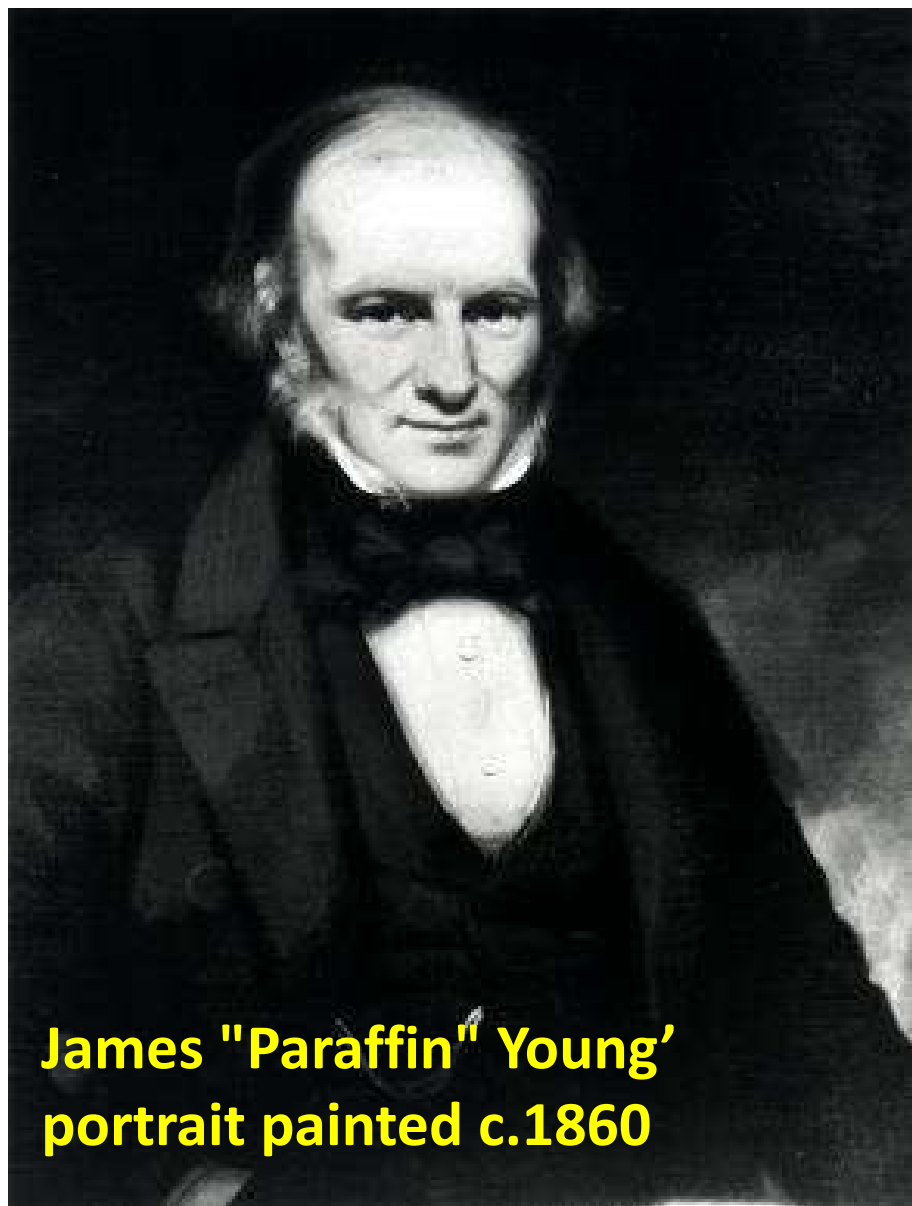
(Haigh et al., 2015)

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1. Scotland's bings - black, brown and red

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

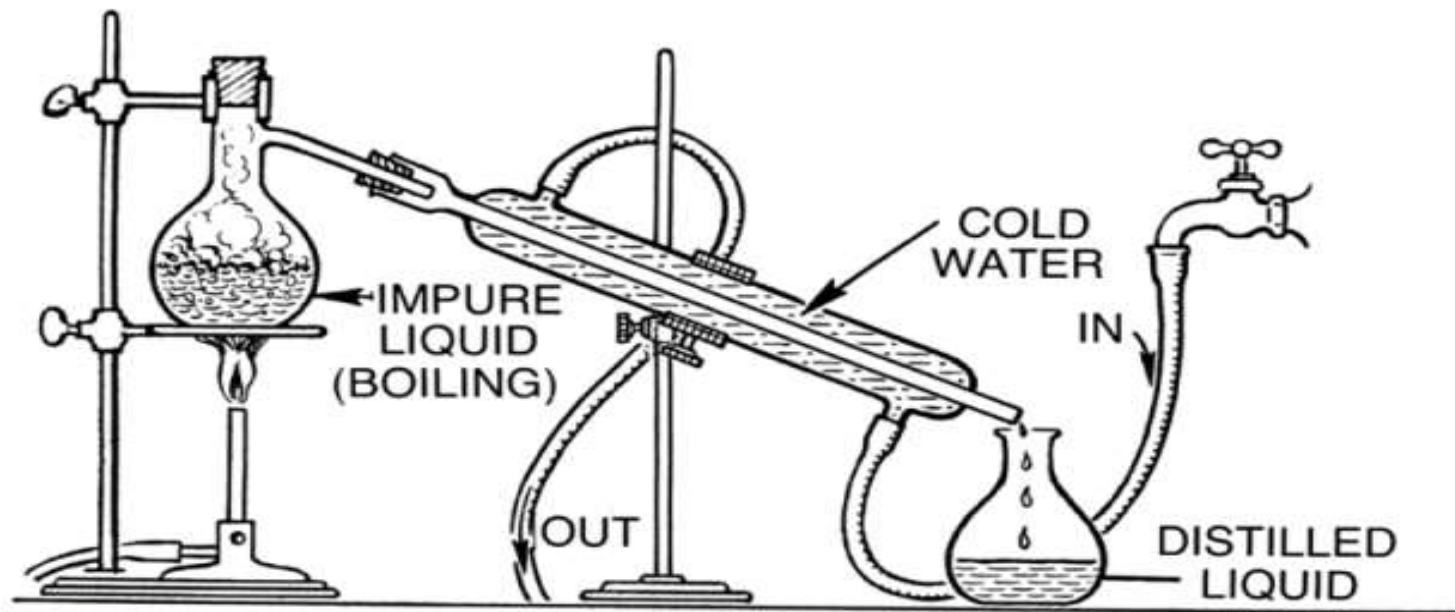




James "Paraffin" Young'
portrait painted c.1860

Oil distillation and cracking

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



**600m north of
Torbane Farm,
Aug 2019**



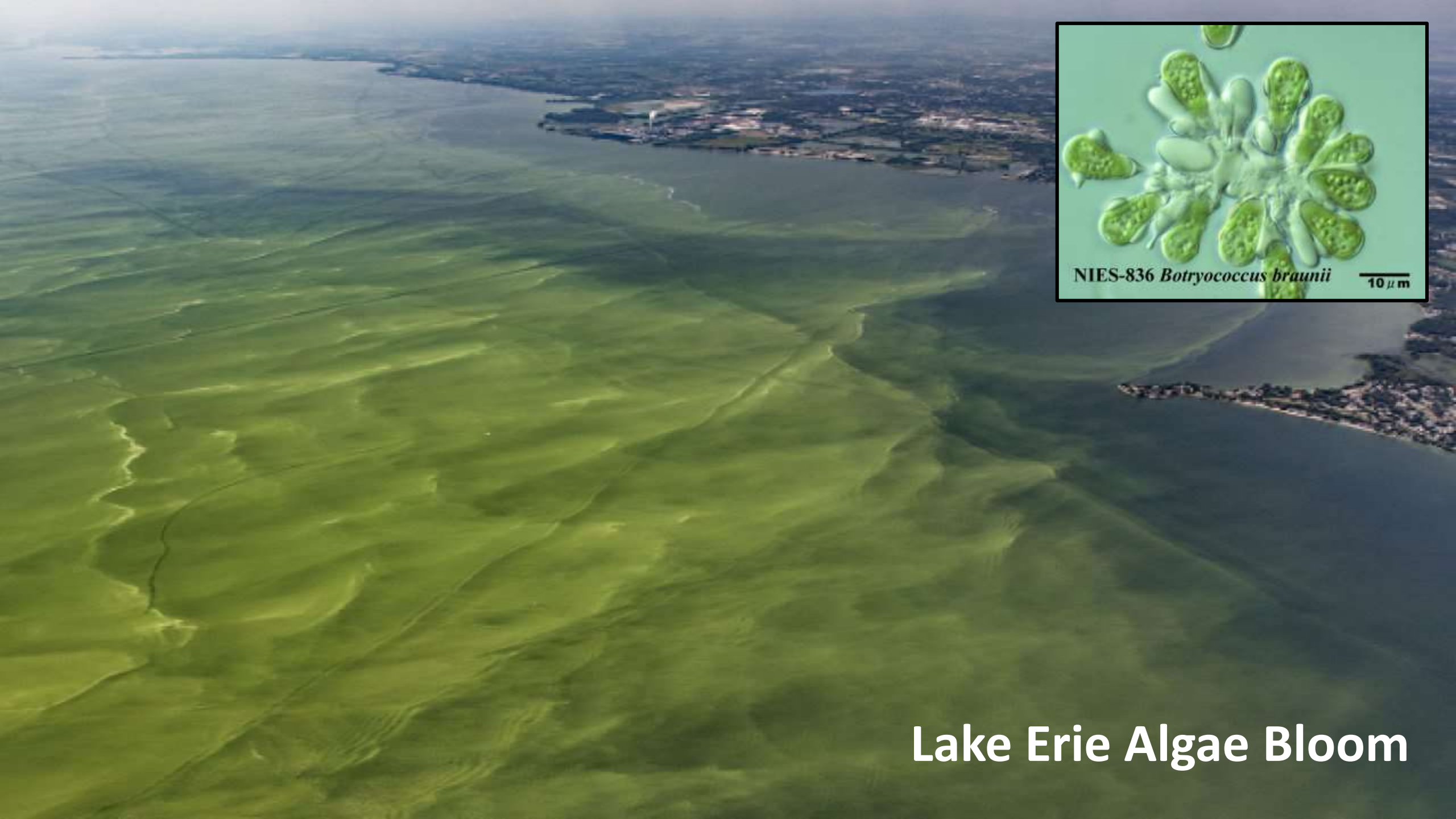
Torbanite and Young's Bathgate Works

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 >>>>>



Lake Erie Algae Bloom

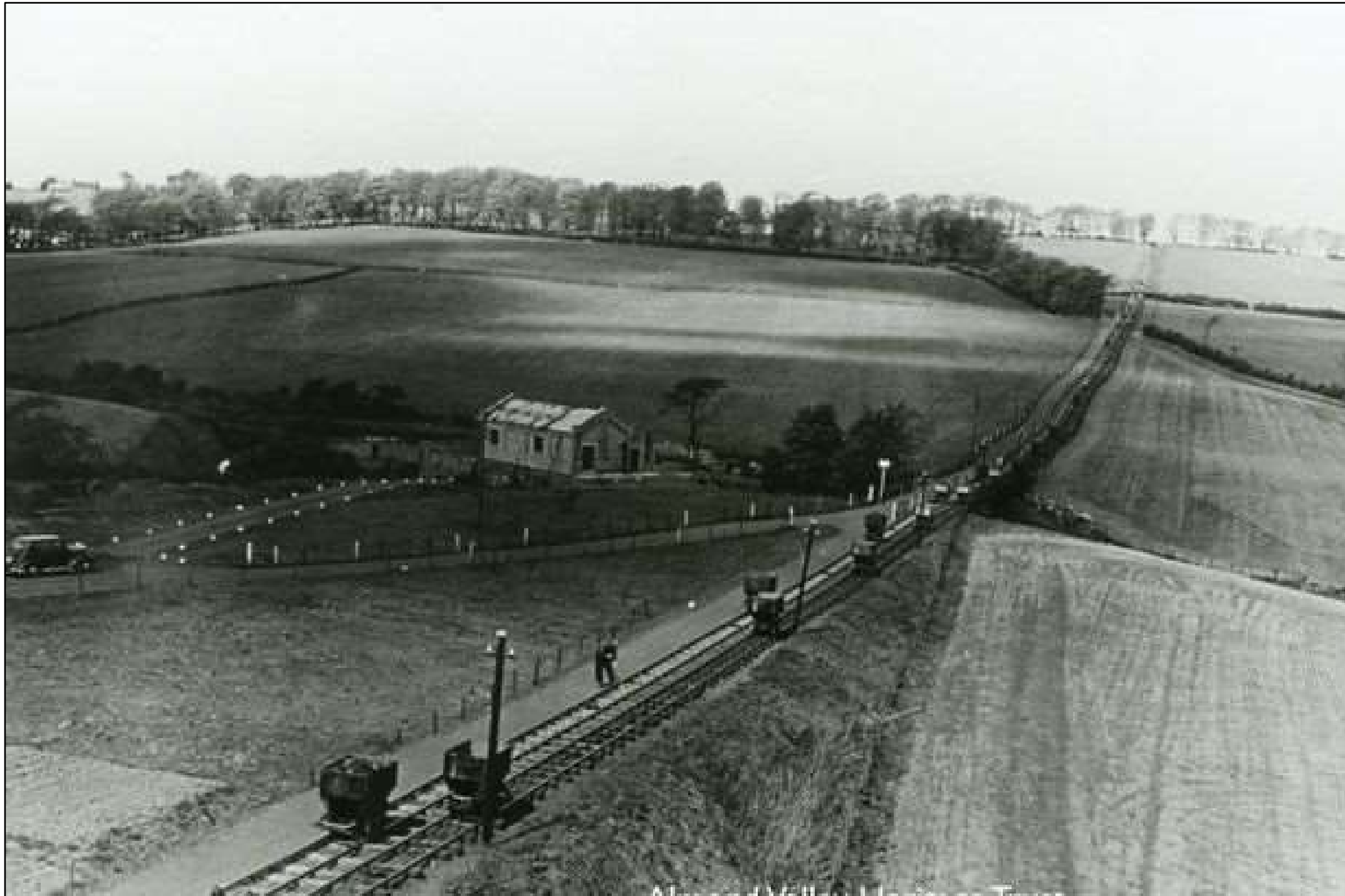
Oil shale mining in Dalmeny

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



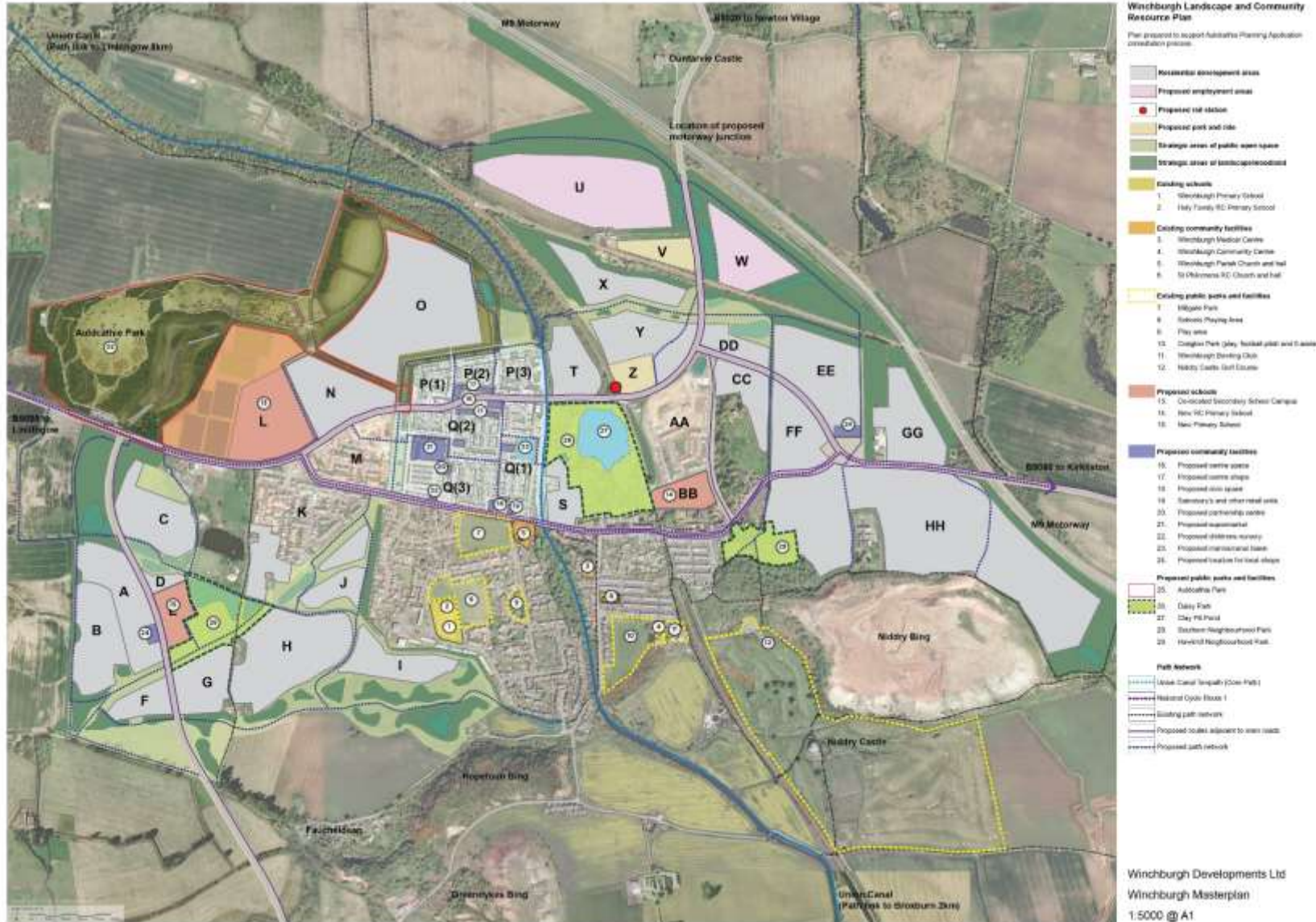
HM Prison Addiewell

Viewed from an Edinburgh bound flight from Prague.

Occupies the site of Young's former oil works.



Welcome to the new Winchburgh!



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

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- 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

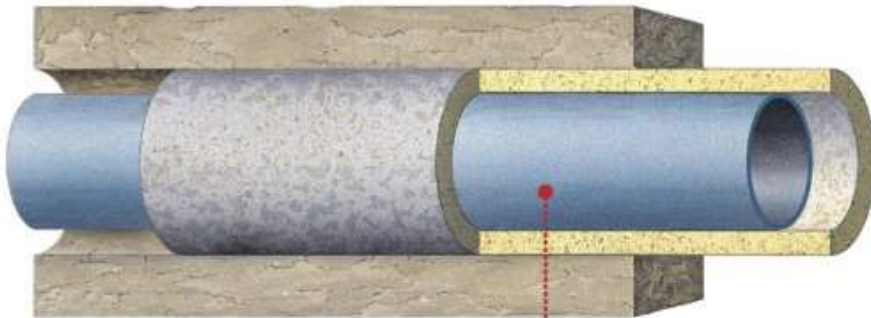
1. Drill

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.

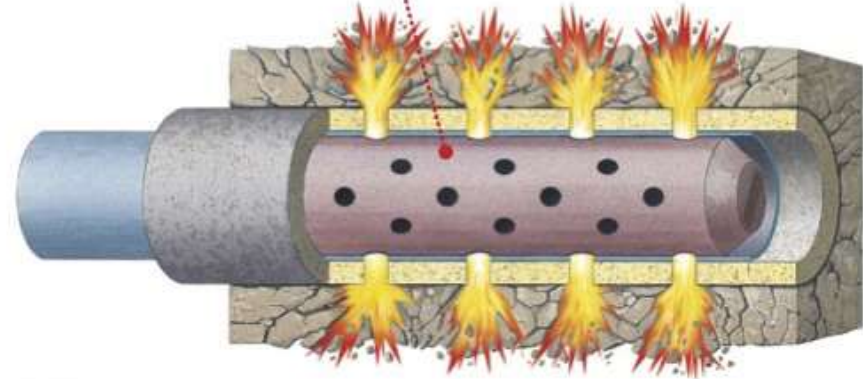


3. Casing

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

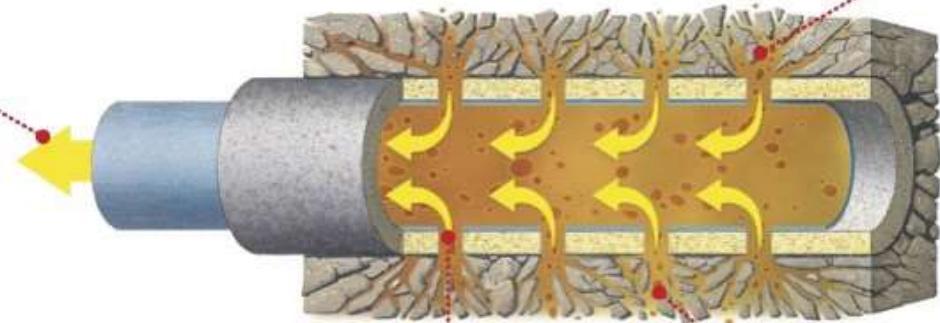
4. Perforation gun

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



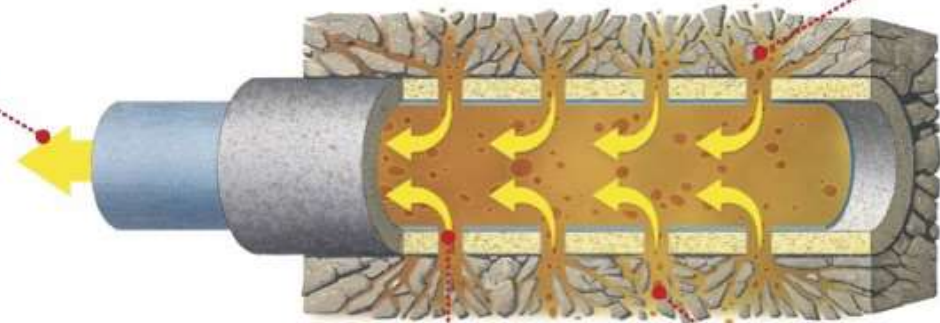
5. Fracturing

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.

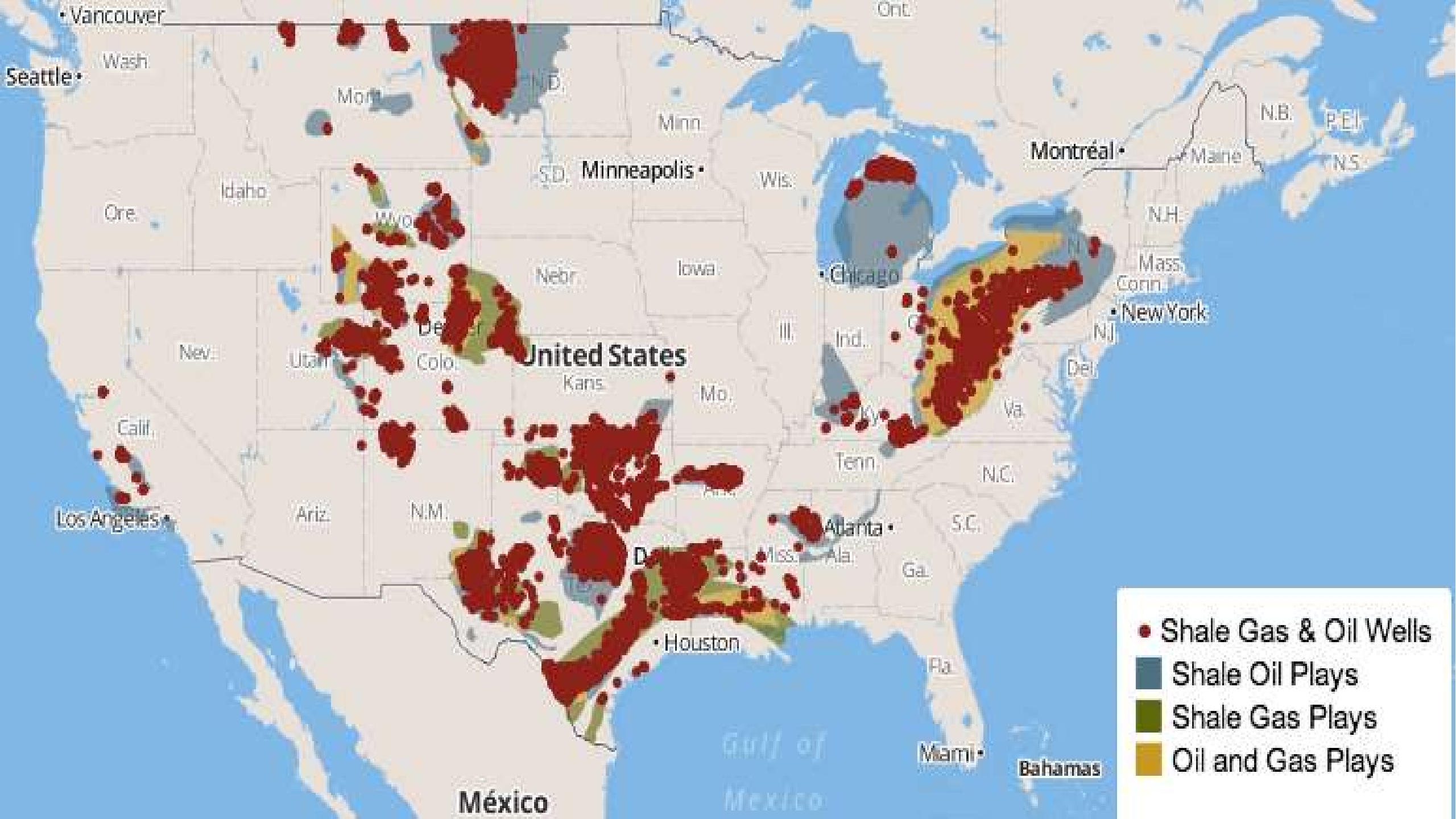


7. Freeing gas

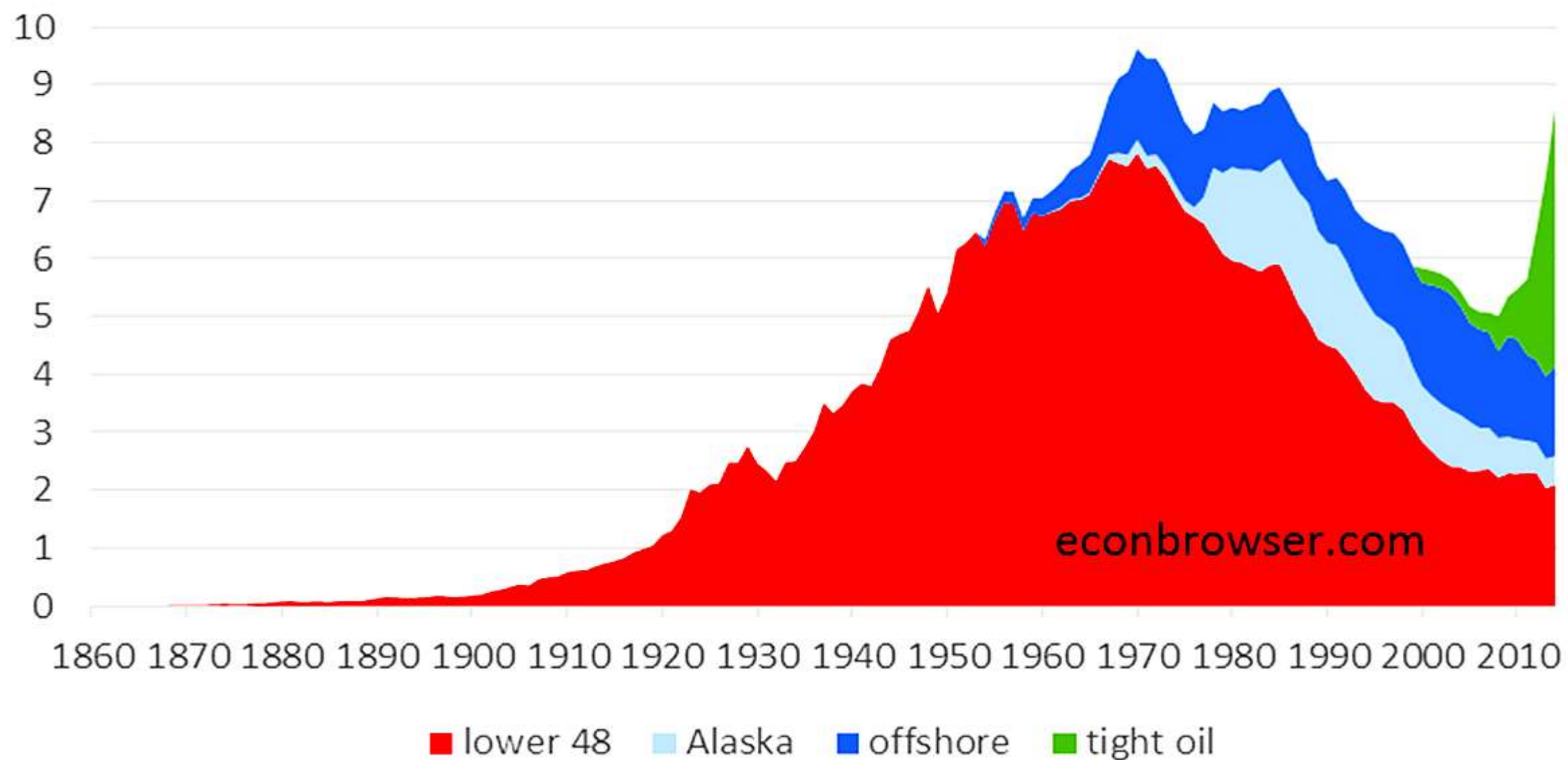
The fissures create pathways releasing gas from the impermeable shale rock.

6. Cracks

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

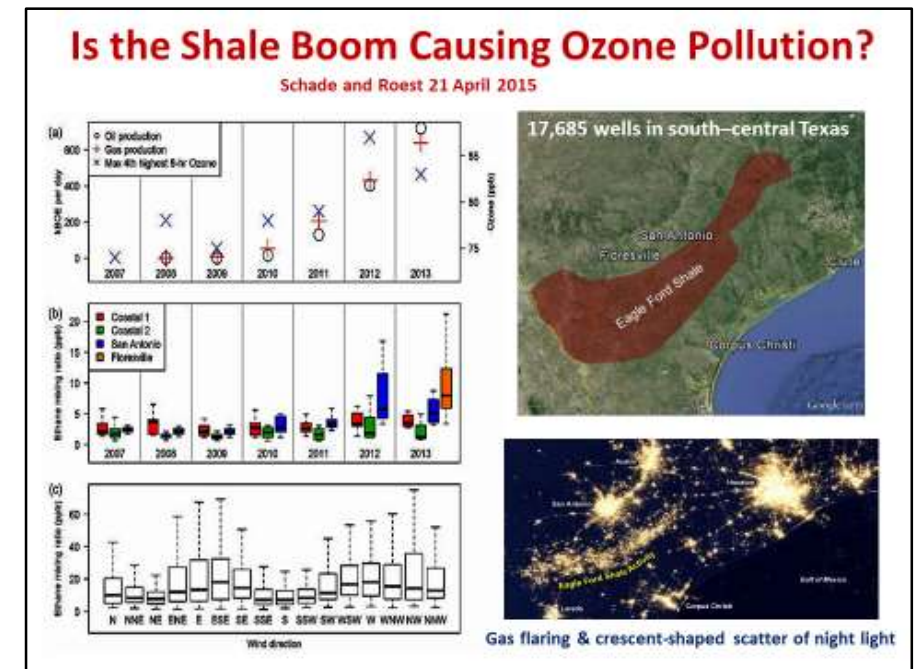
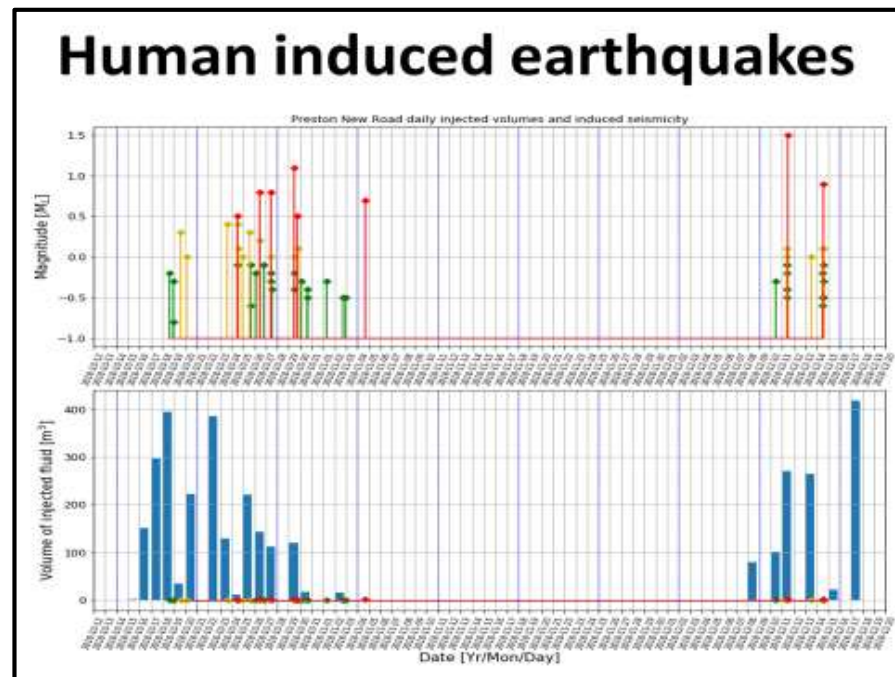


U.S. oil production by source

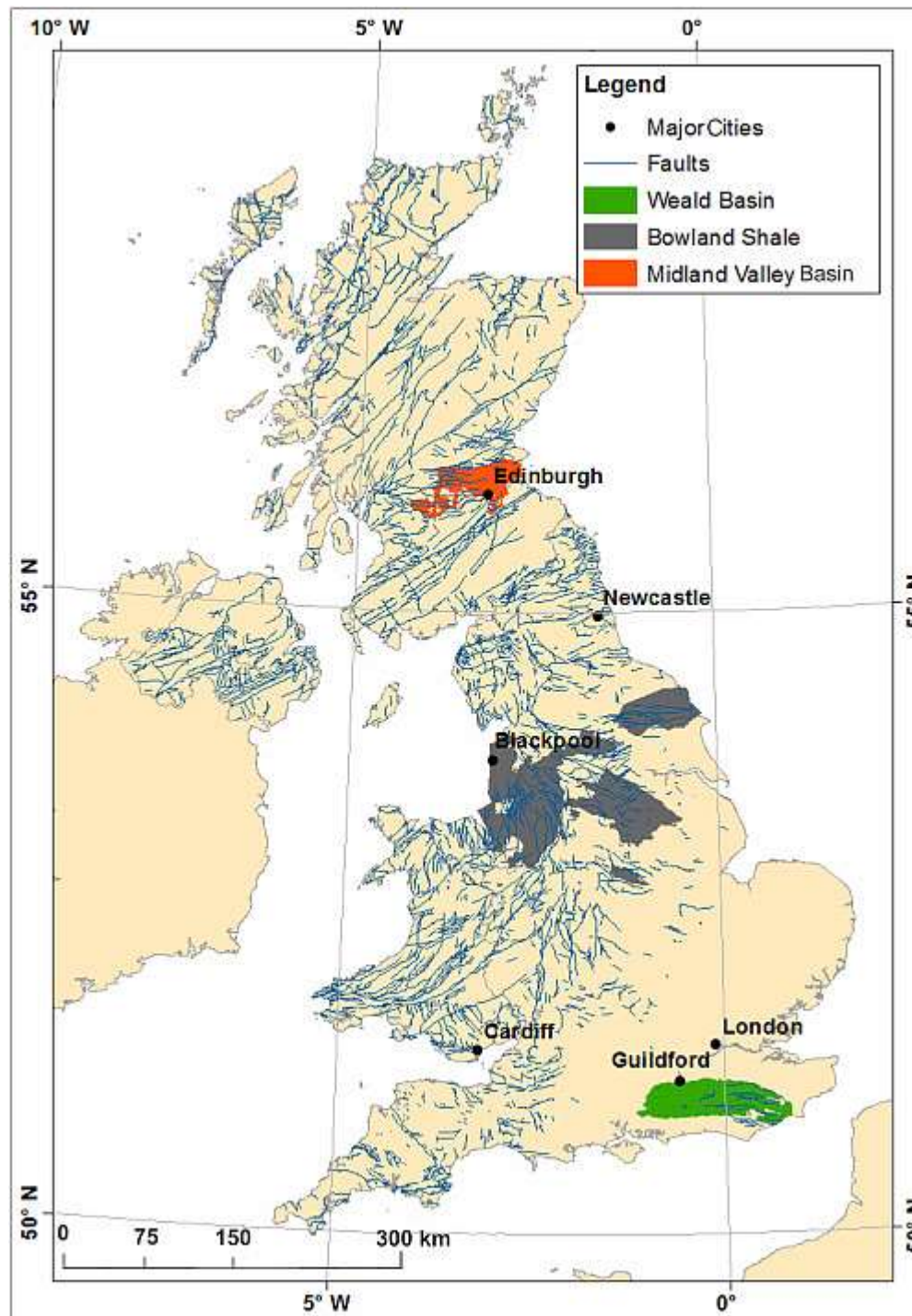


Fracking brings many local environmental problems

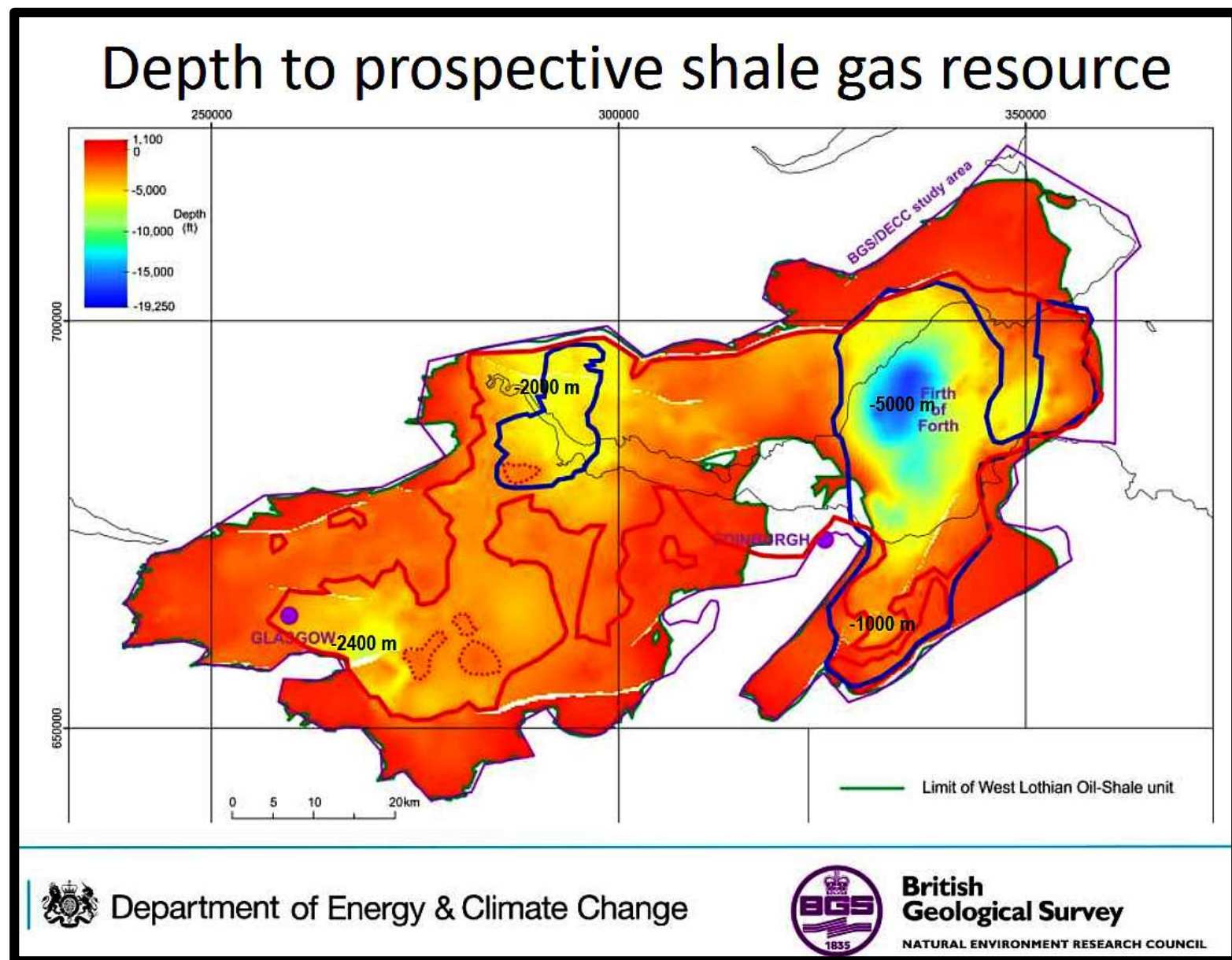
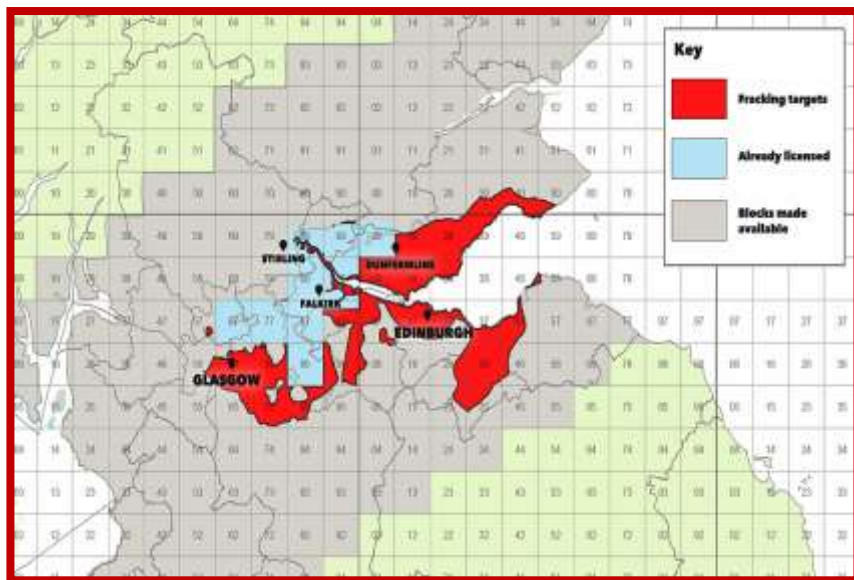
- Earthquakes
- Water quality
- Noise
- Ozone and air quality



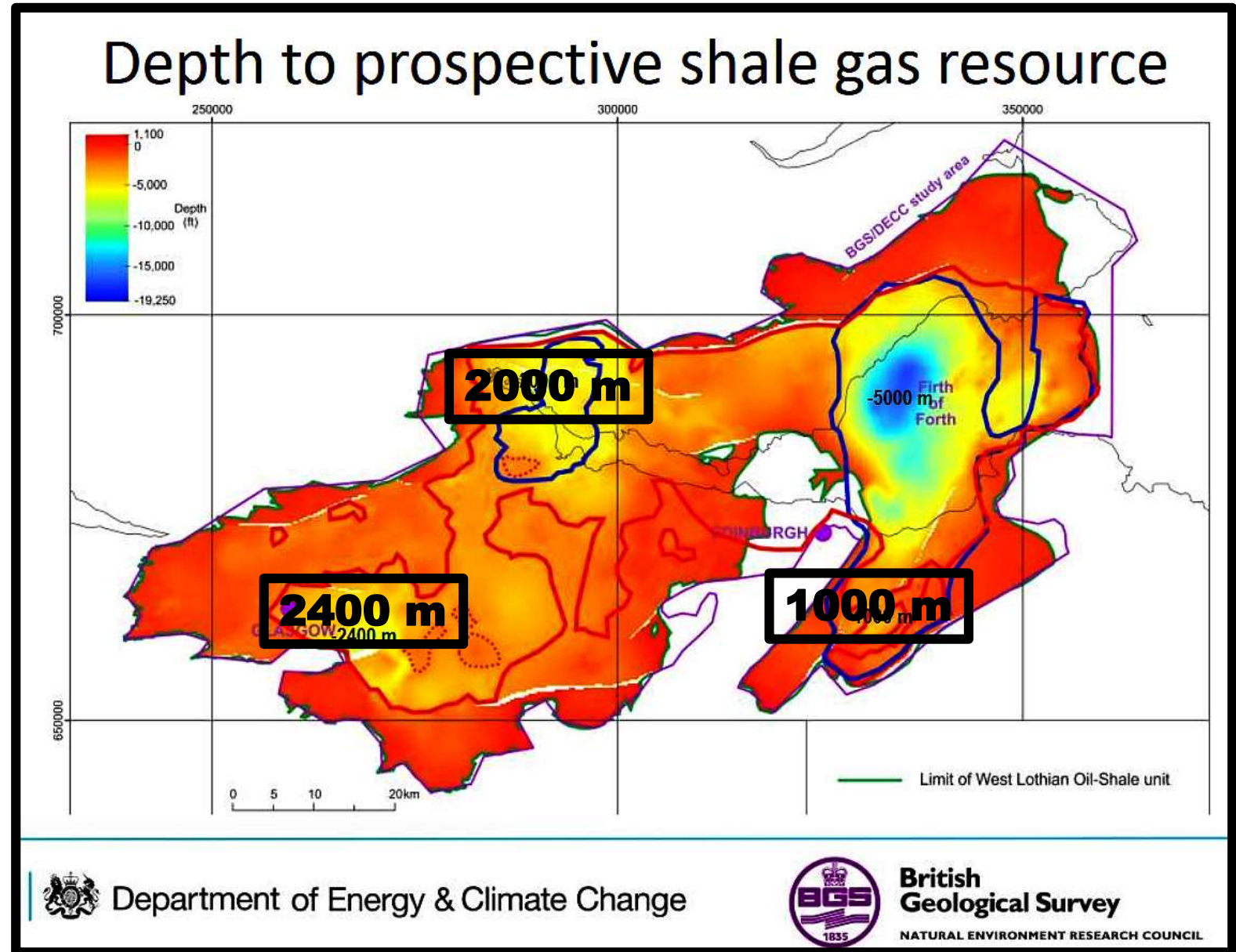
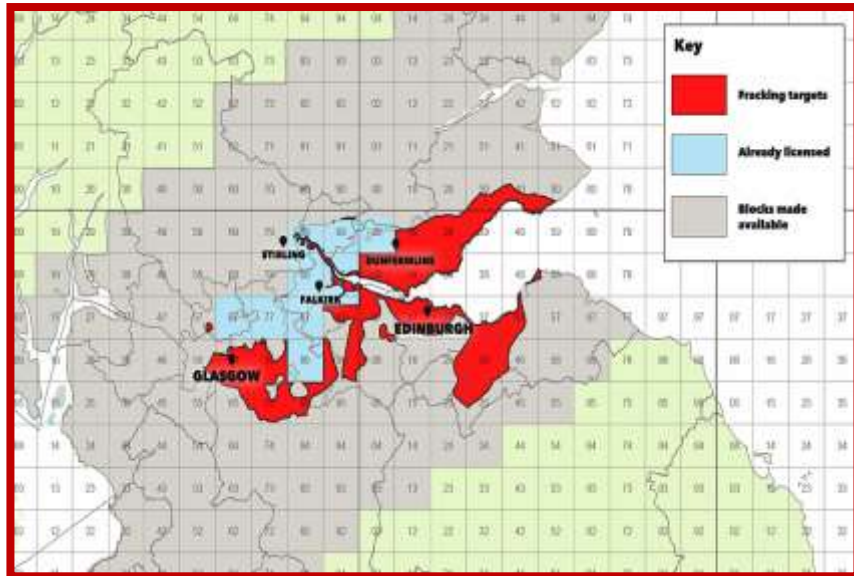
Major UK shale gas prospects and surface mapped faults

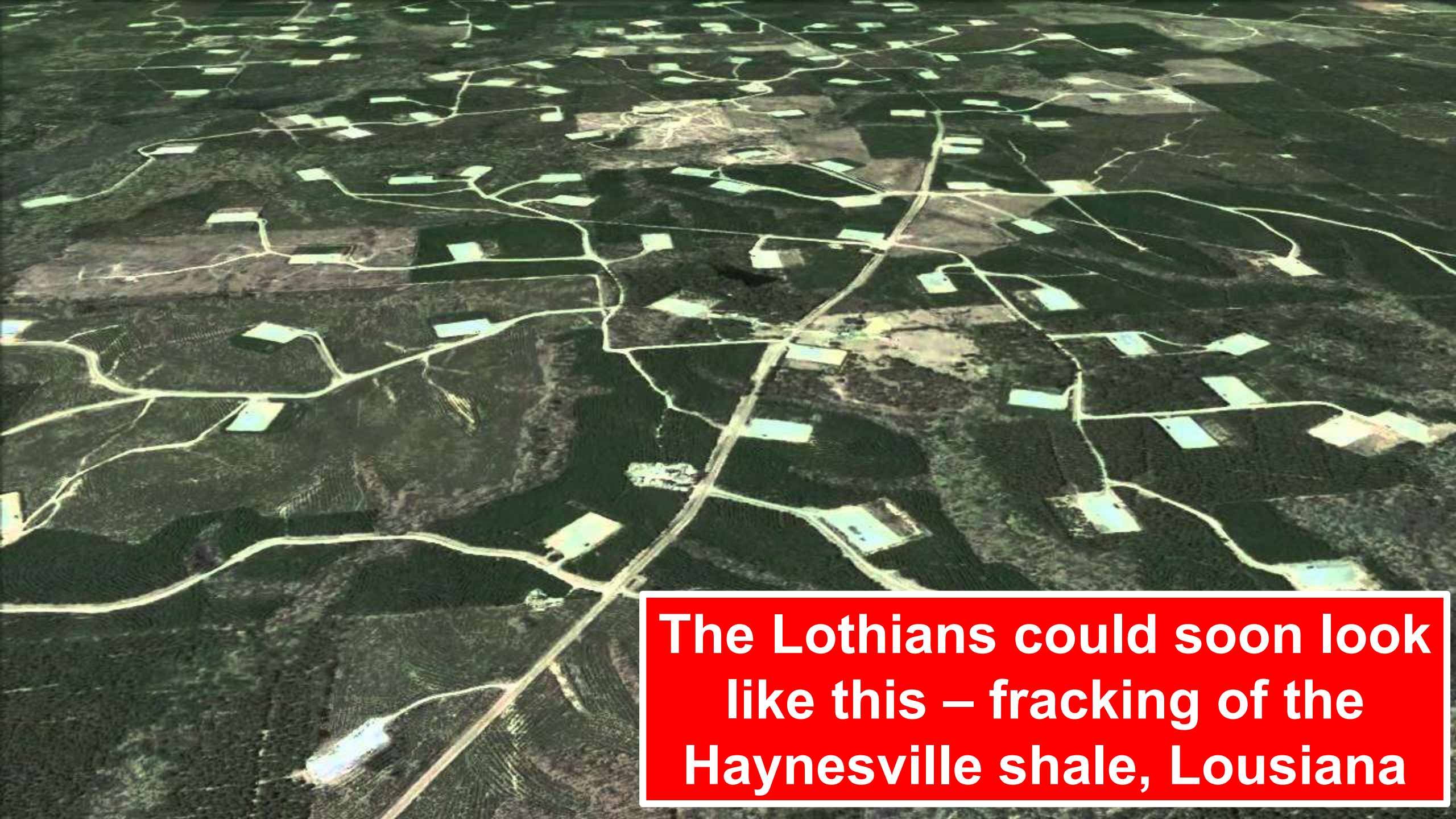


Where do companies want to frack in Scotland?

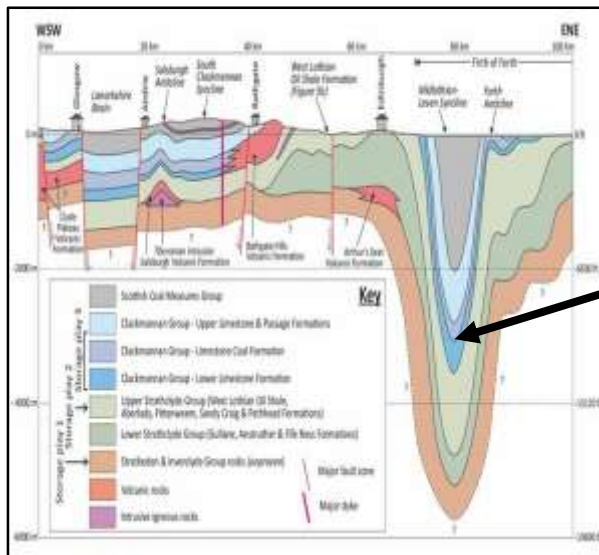


**Where do
companies
want to frack
in Scotland?**



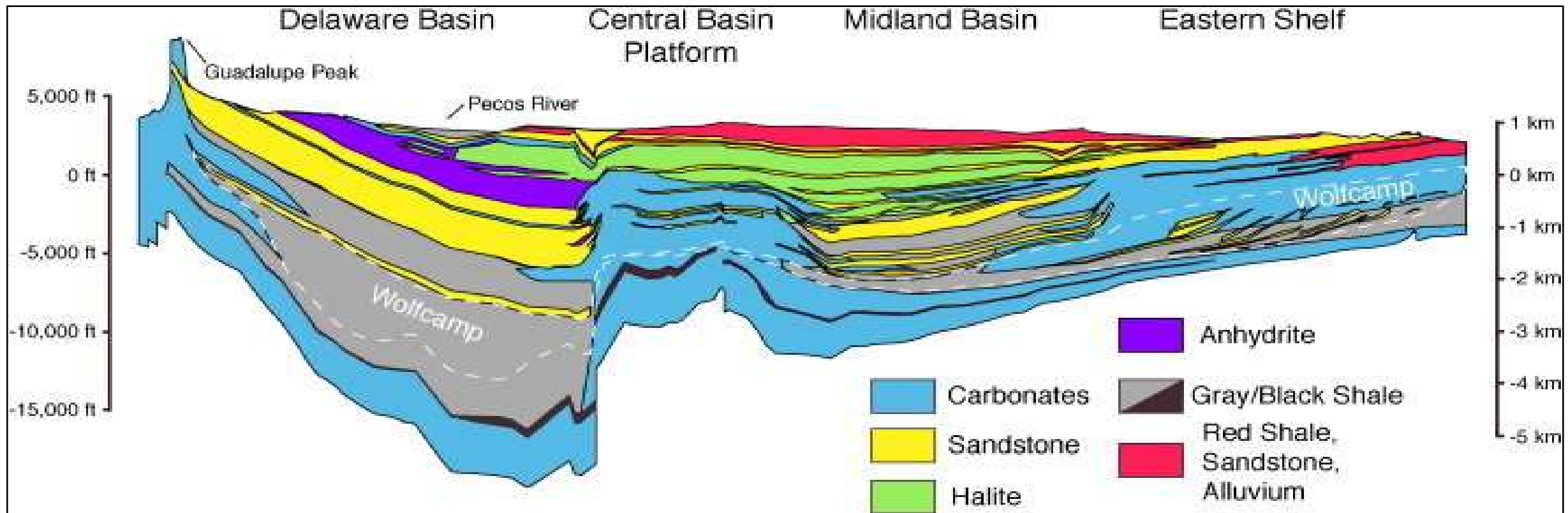


The Lothians could soon look like this – fracking of the Haynesville shale, Louisiana



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*'.

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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**

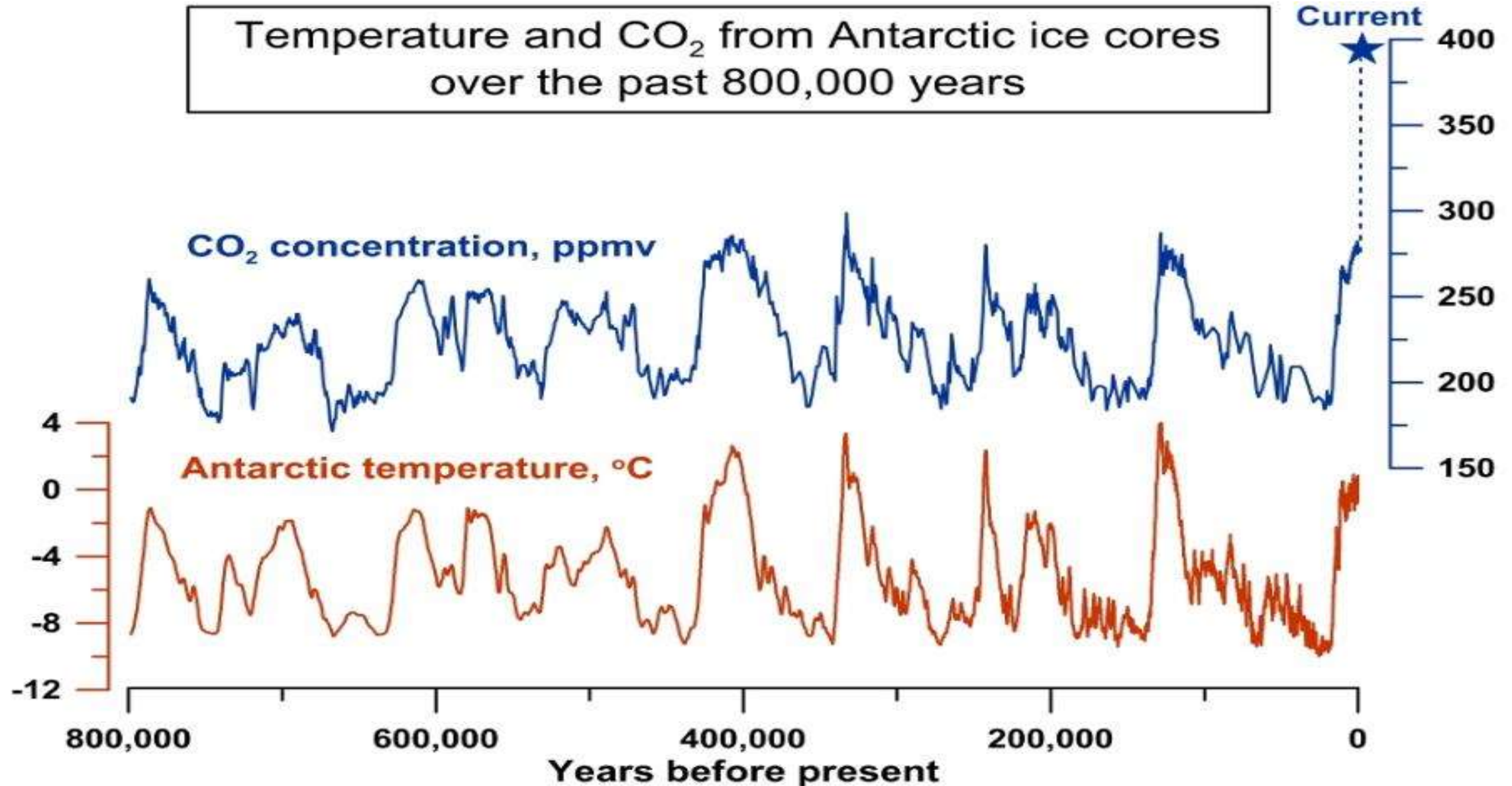
**Environmental
impact**

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

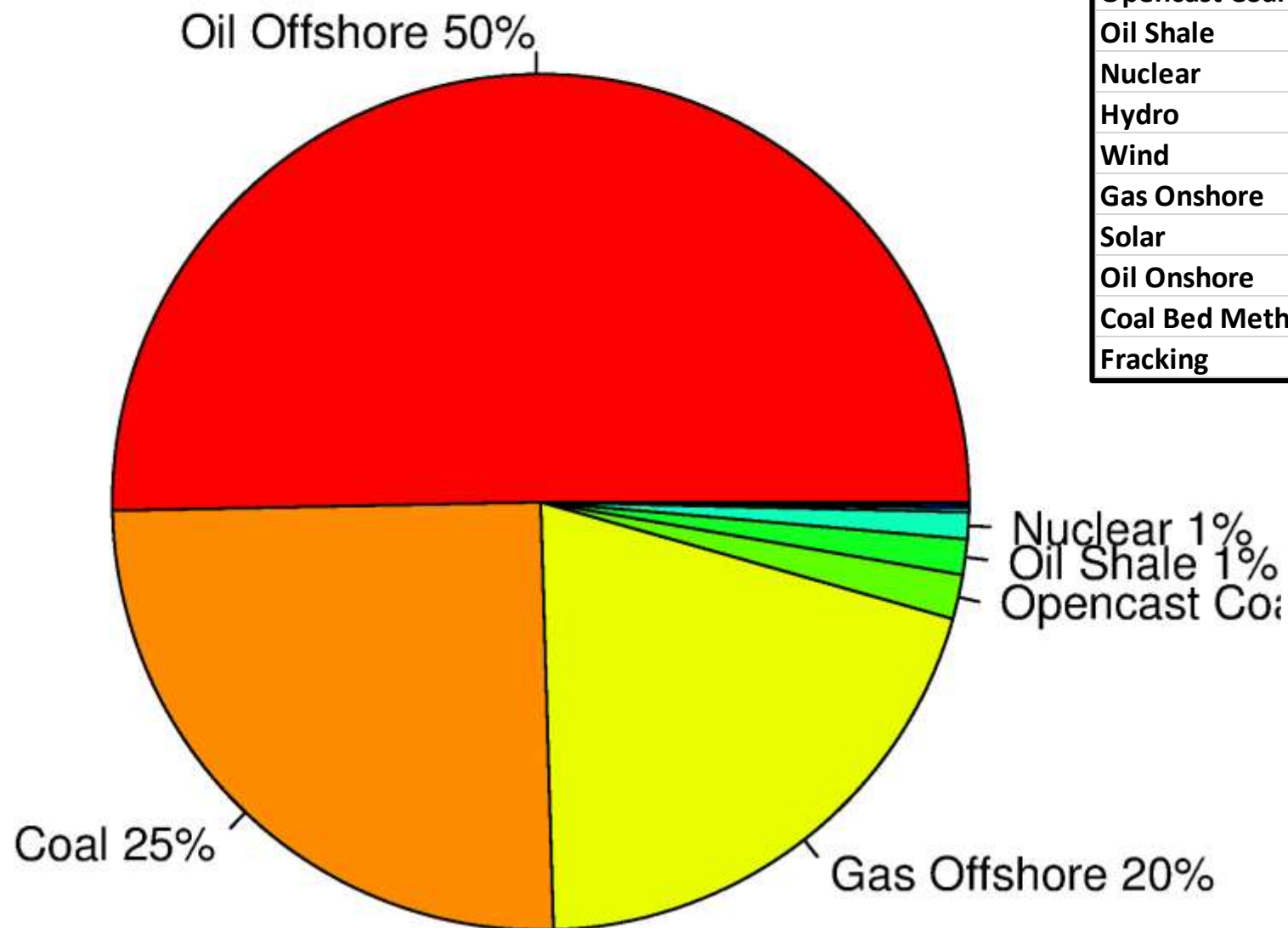
The basic climate-change problem



Antarctic ice: the world's air museum

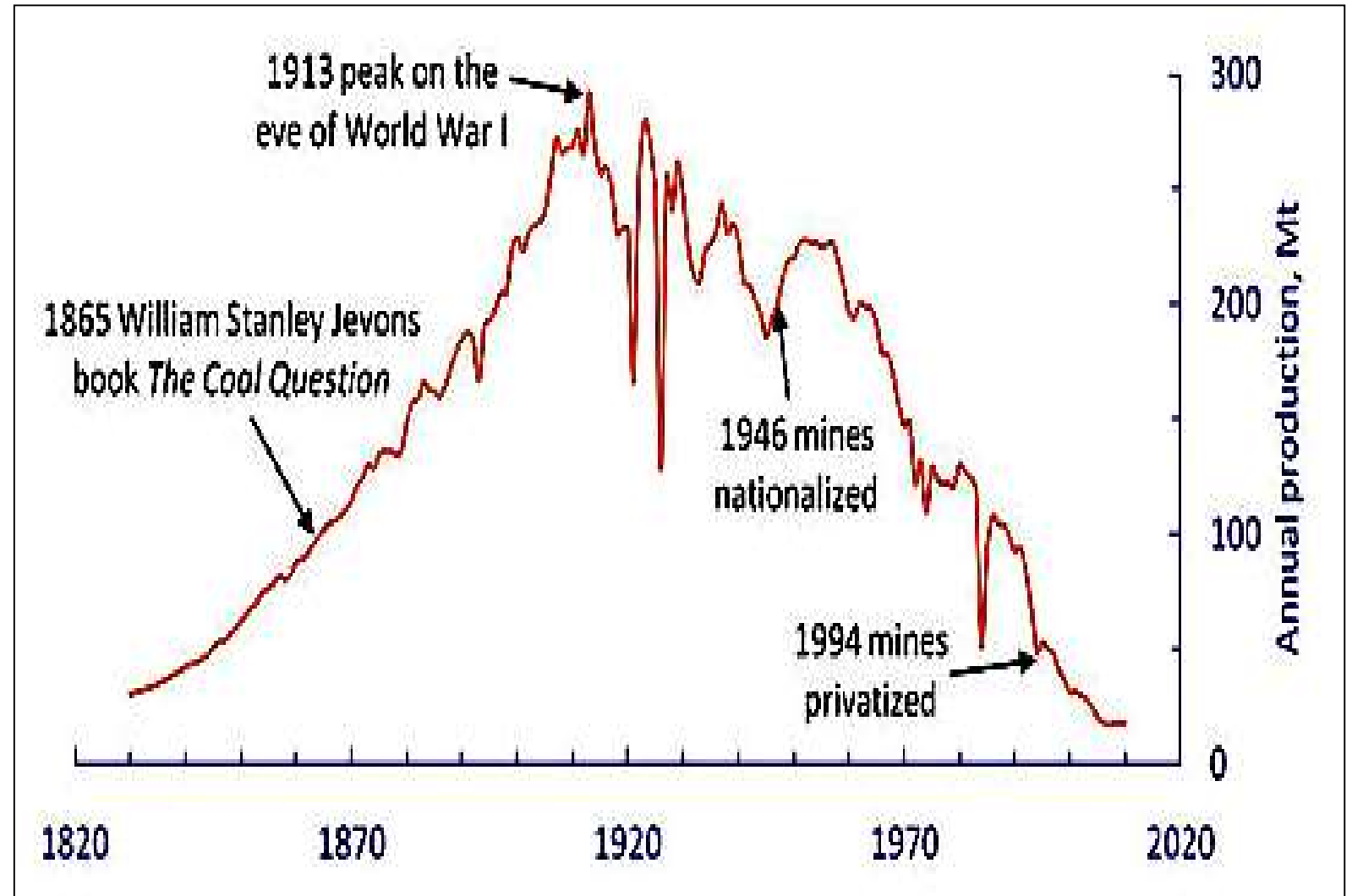


Scotland's energy 1850–2020

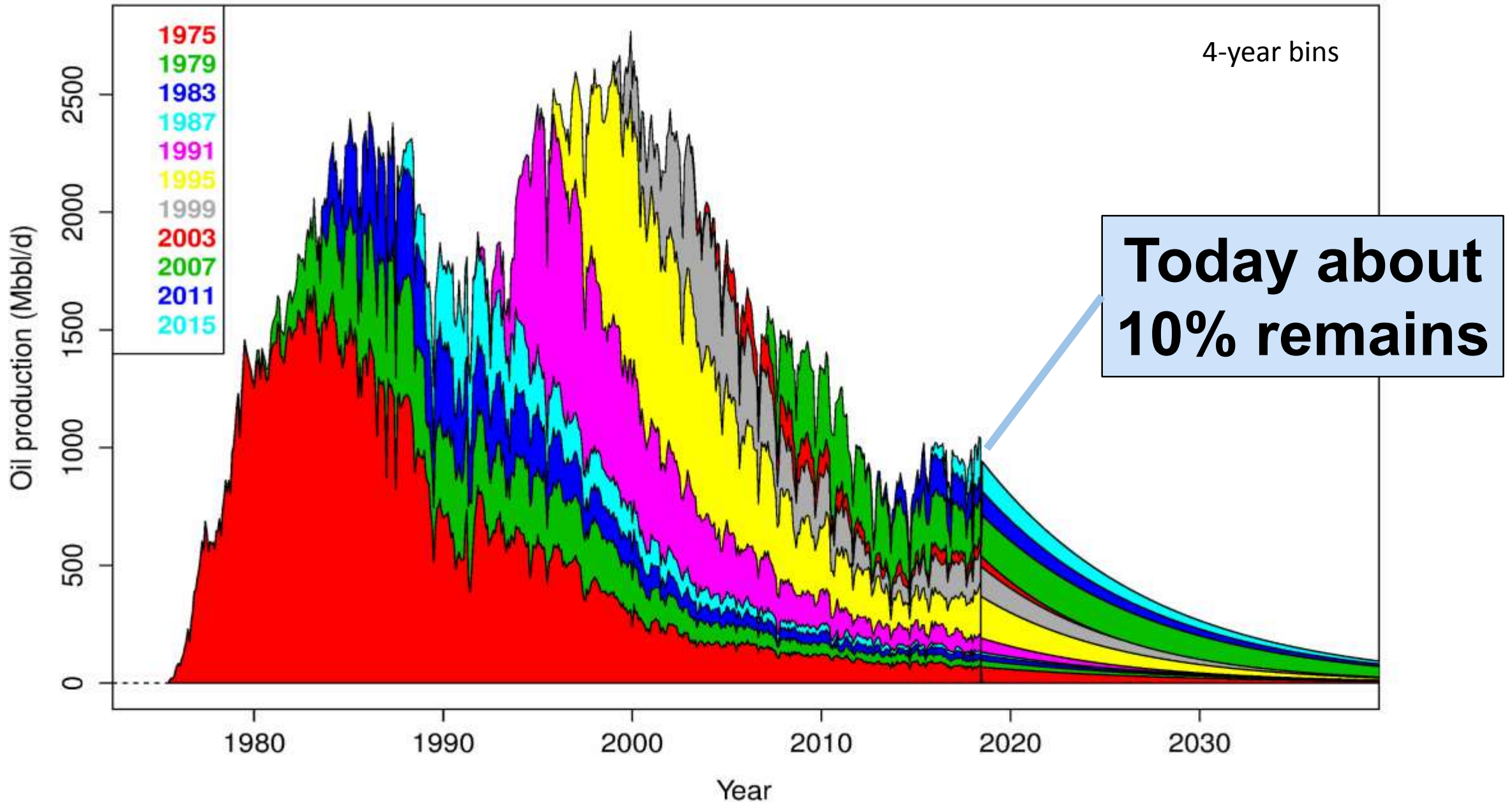


Source	BllionBarrelsOil
Oil Offshore	30
Coal	15
Gas Offshore	12
Opencast Coal	1
Oil Shale	0.8
Nuclear	0.6
Hydro	0.1
Wind	0.08
Gas Onshore	0.04
Solar	0.002
Oil Onshore	0.00003
Coal Bed Methane	0.000011
Fracking	0

UK coal production (1820-2010)



UK oil production



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



Dounreay





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.

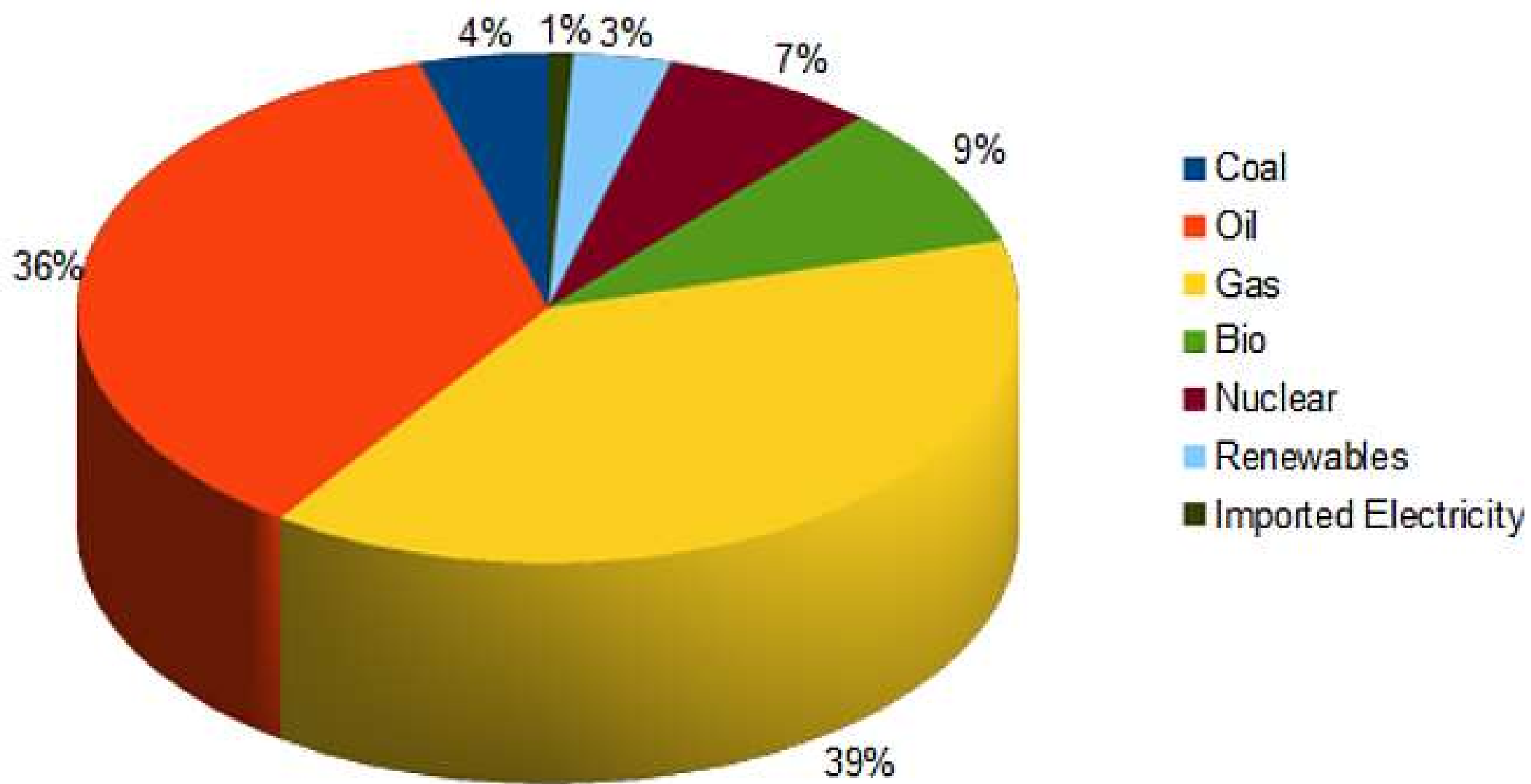


Scotland's 'super battery'

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

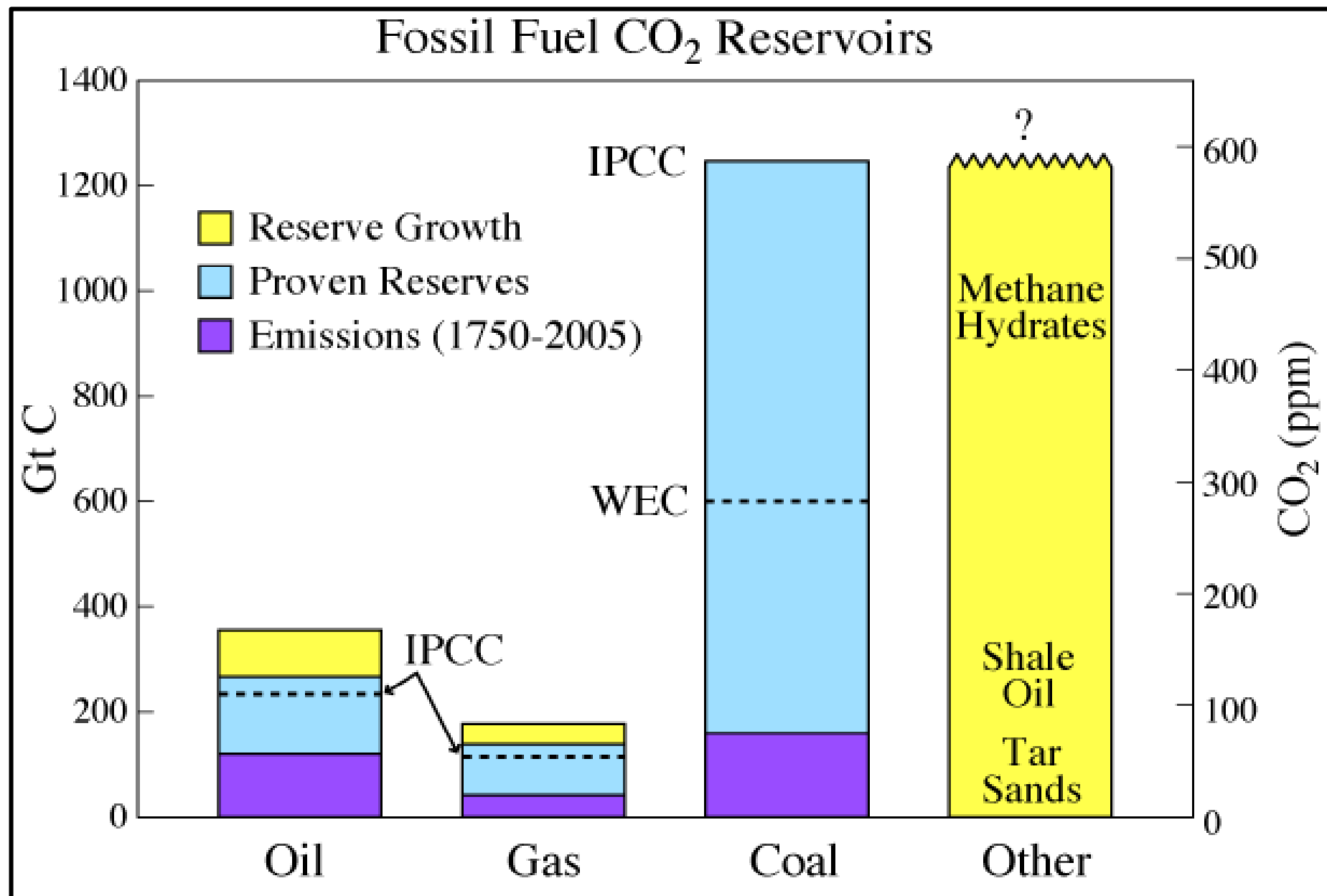


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Dozens arrested in Extinction Rebellion protest as climate change protesters block main roads in Edinburgh's city centre. 16 April 2019.



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

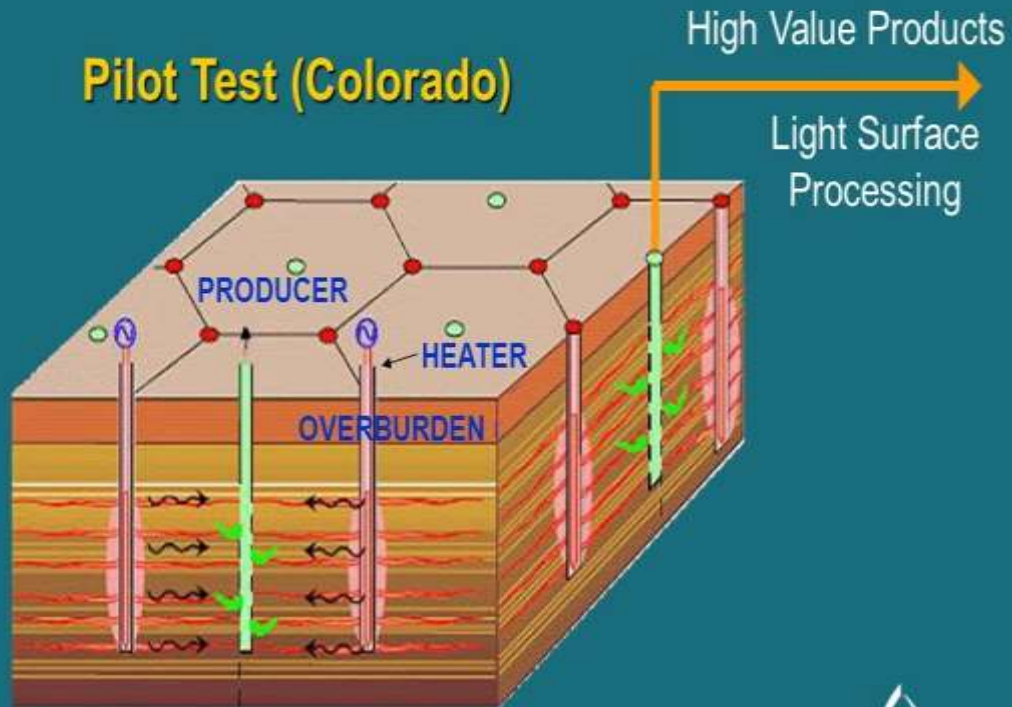
A new £165m coal mine has been unanimously approved by councillors in Cumbria – the first deep-level, UK, mine in 30 years.



**Artist's impression of
Whitehaven venture**

In-situ oil shale-oil?

Pilot Test (Colorado)



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



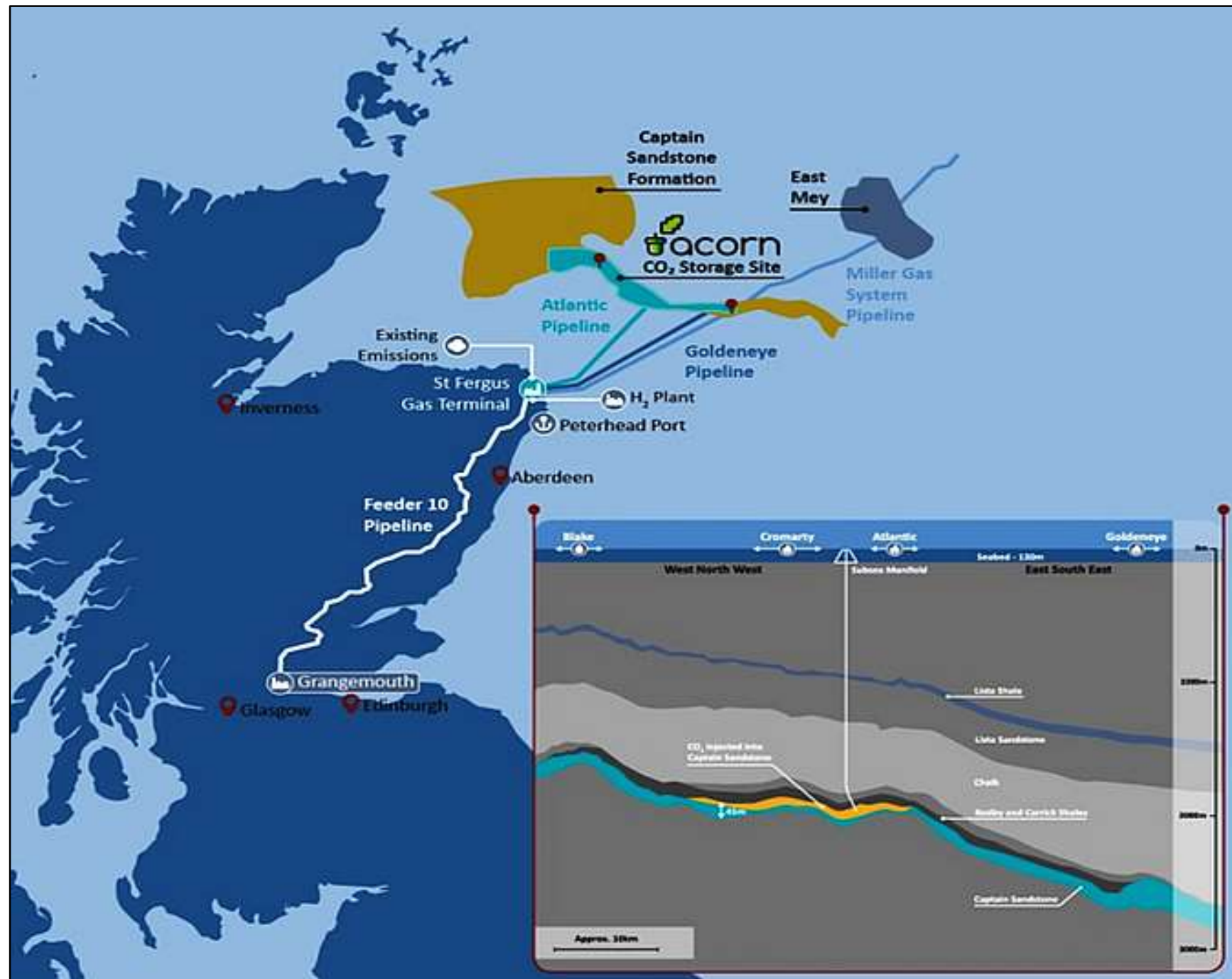
07/18/2009

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.