- How did climate change come about?
- Is carbon dioxide really rising; where does it come from and why is it a problem?
- Do we really need to worry about climate change?
- How are UK electricity and heating generated today?
- Are there effective low carbon alternatives and how much will they cost?
- What is holding up progress on climate change?
- What will the consequences of inaction be?
- What did COP 27 achieve?
- What are other countries doing?

Wrexham glyndŵr UNIVERSITY

Prifysgol Glyndŵr Wrecsam | Wrexham Glyndŵr University

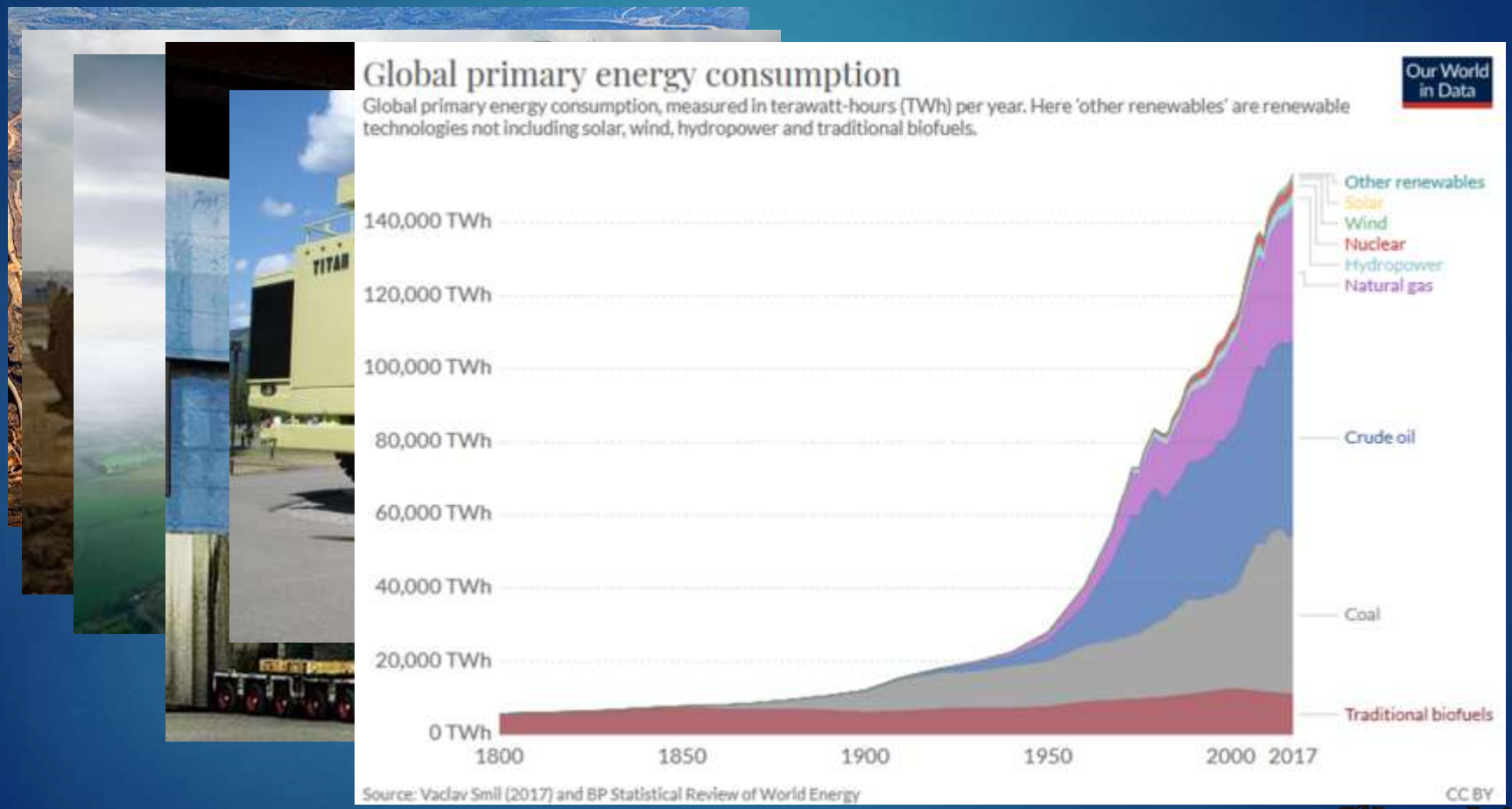
Climate change, Russian gas, and energy bills: A perfect Storm

Opportunity

David Sprake BEng(hons), CEng, MEI, FHEA, PGCE, Chartered Energy Engineer

Prifysgol Glyndŵr University

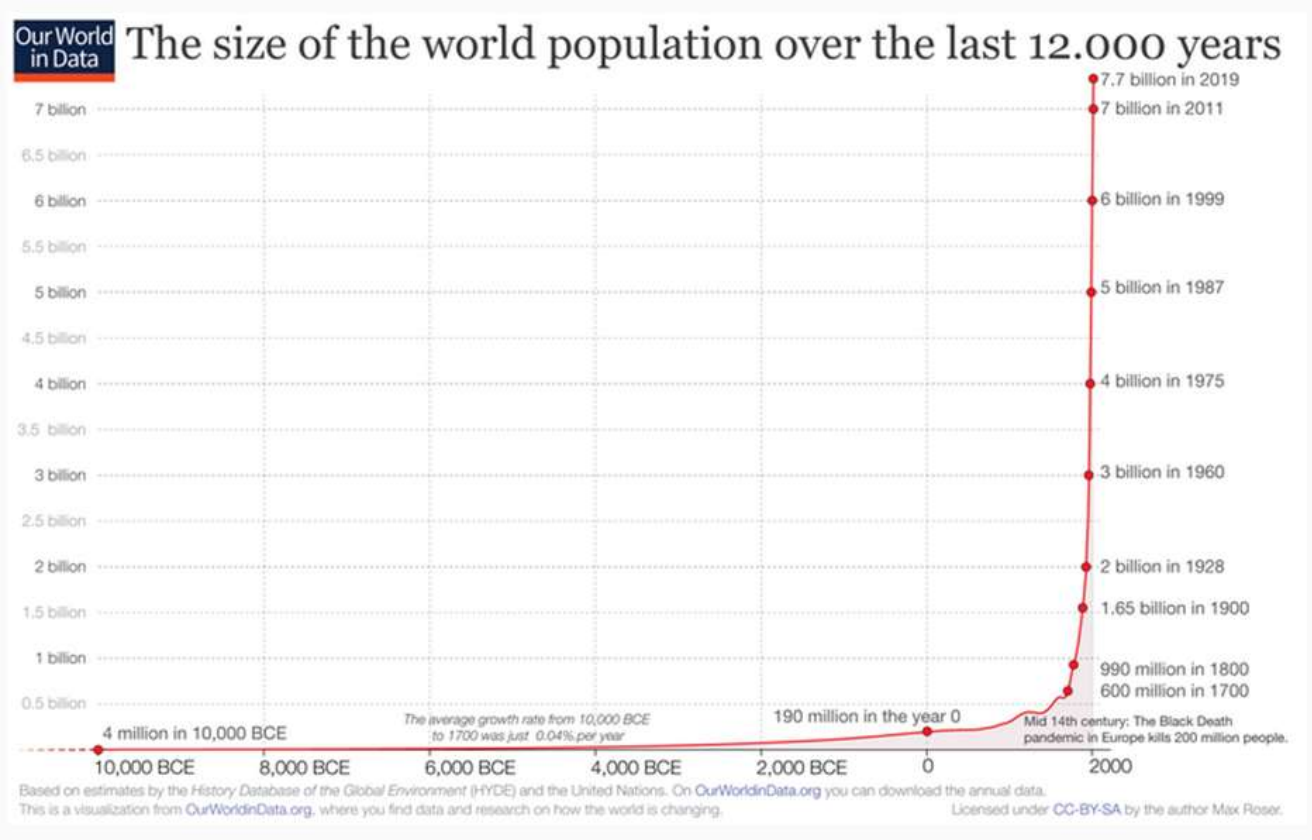
How did climate change come about?



Engineers have got (very) good at thinking big…

Images from google (various), https://ourworldindata.org/grapher/global-primary-energy

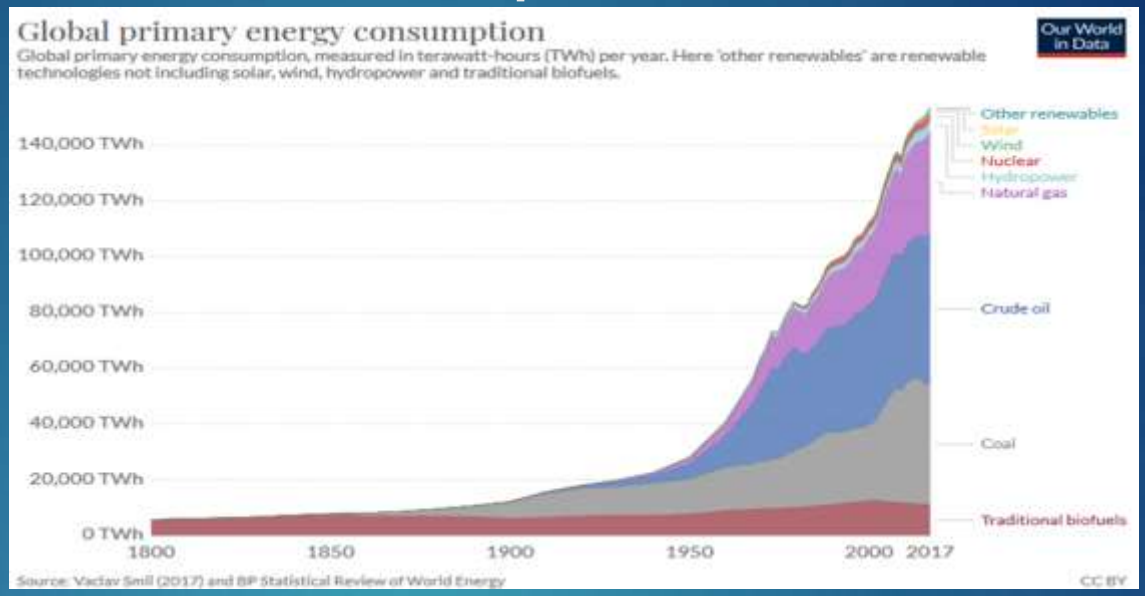
Population and industry expansion

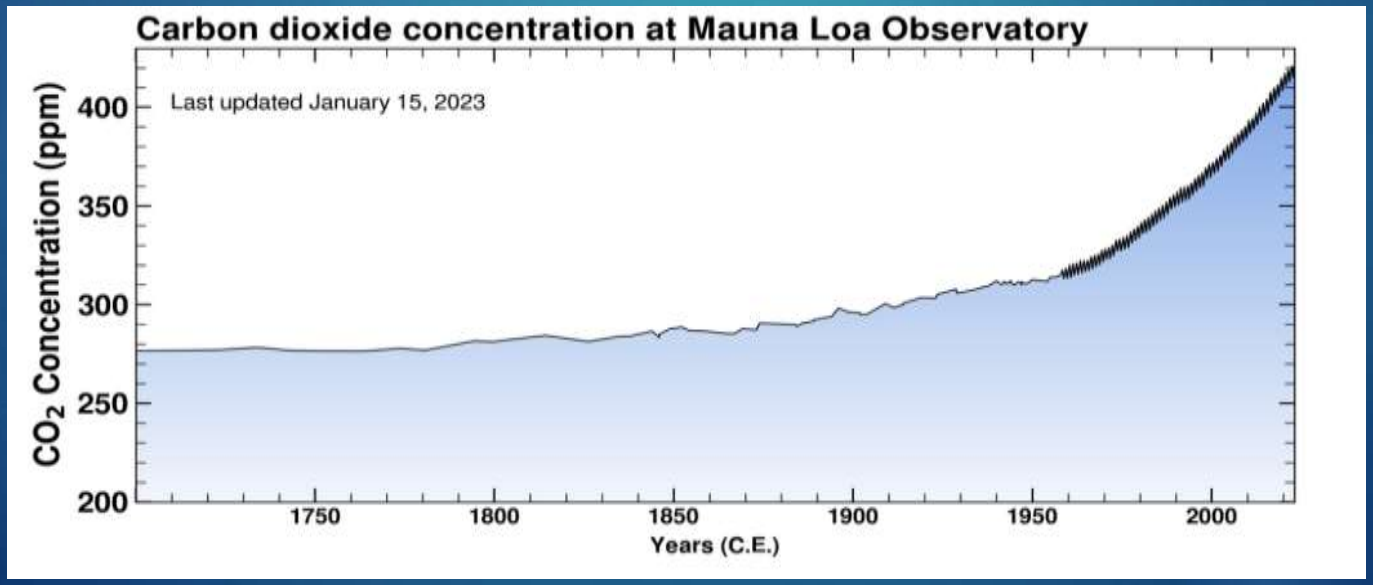


https://www.flightradar24.com/45,1.56/5
https://www.worldometers.info/
https://www.cbeci.org/

https://ourworldindata.org/grapher/global-primary-energy

Burning fossil fuels produces CO2

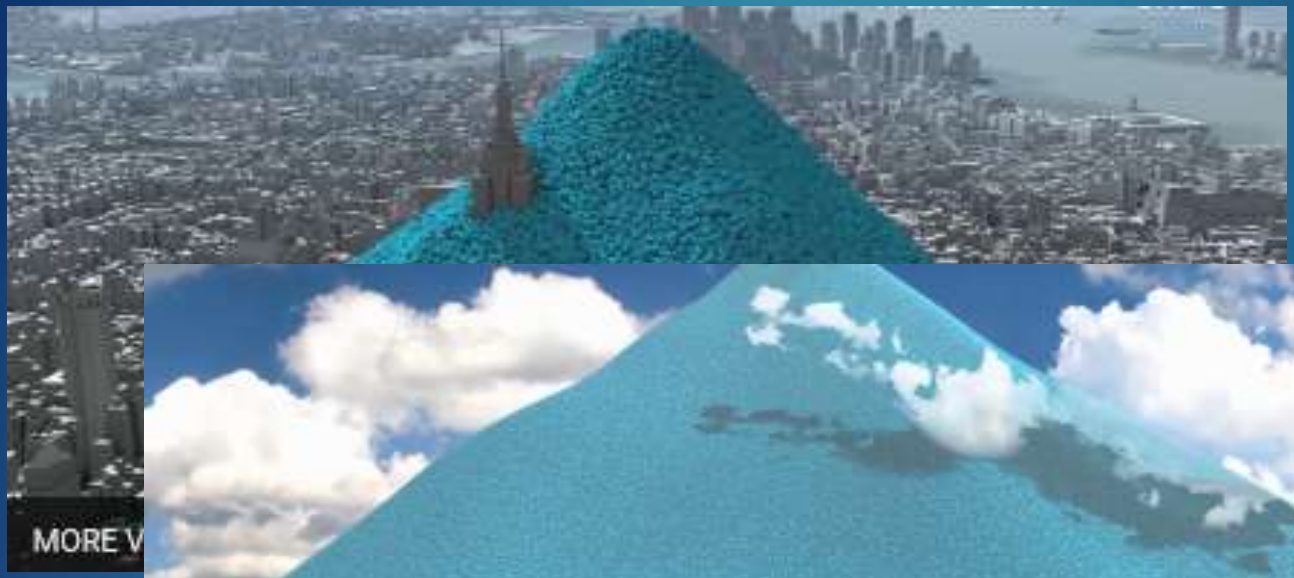




https://ourworldindata.org/grapher/global-primary-energy https://keelingcurve.ucsd.edu/

Visualising Carbon dioxide

One ton of CO2 = a spear 33 feet across



One day

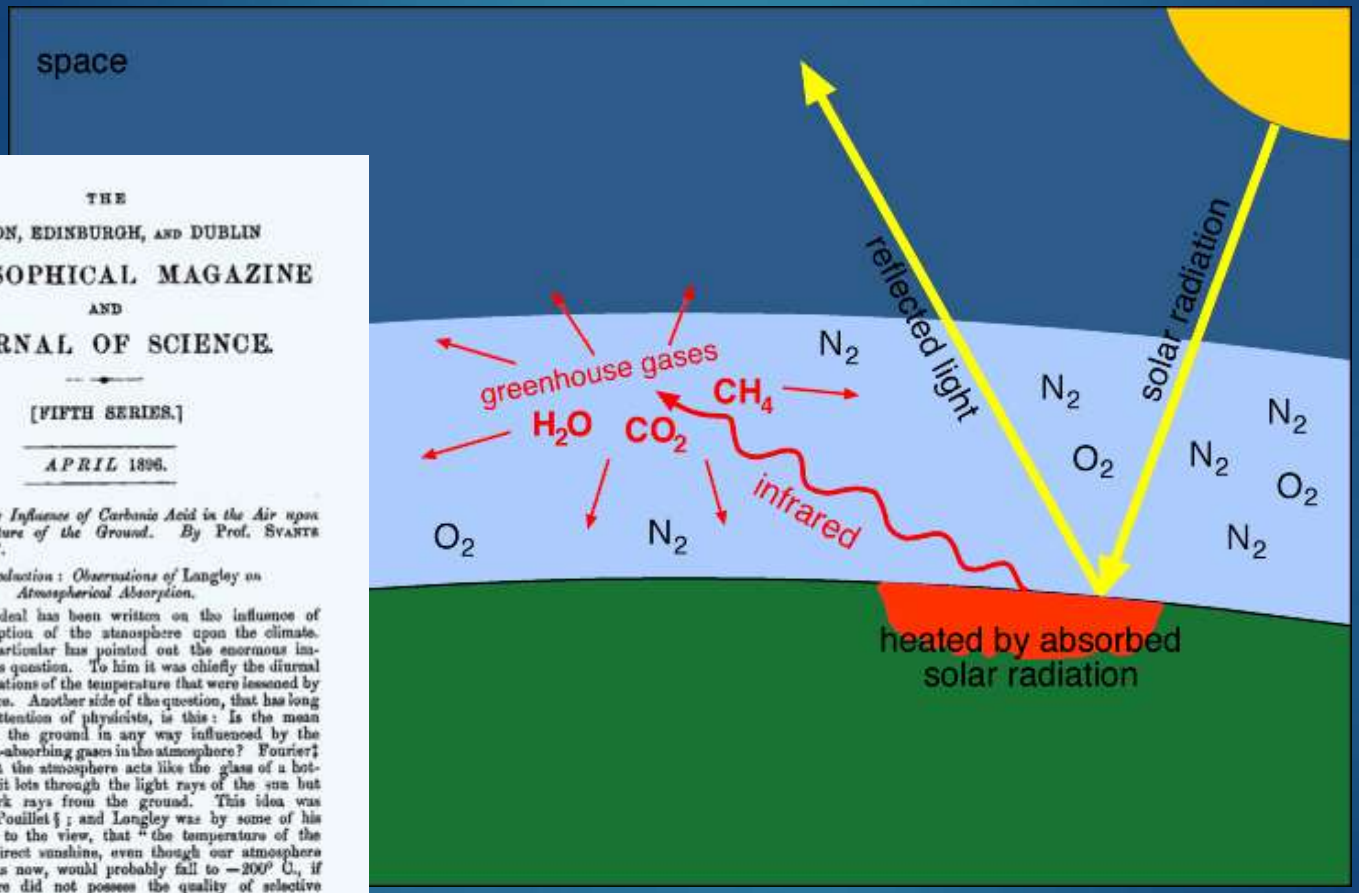
One year

https://www.anthropocenemagazine.org/2016/02/visualizing-carbon/

Taking carbon out of the atmosphere

- https://www.globalforestwatch.org/map/

Why is CO2 a problem?: It's a greenhouse gas



THE

LONDON, EDINBURGH, AND DUBLIN

PHILOSOPHICAL MAGAZINE

AND

JOURNAL OF SCIENCE.

[FIFTH SERIES.]

APRIL 1896.

XXXI. *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.* By Prof. SVANTE ARRHENIUS *.

1. *Introduction: Observations of* Langley *on Atmospherical Absorption.*

A GREAT deal has been written on the influence of the absorption of the atmosphere upon the climate. Tyndall † in particular has pointed out the enormous importance of this question. To him it was chiefly the diurnal and annual variations of the temperature that were lessened by this circumstance. Another side of the question, that has long attracted the attention of physicists, is this: Is the mean temperature of the ground in any way influenced by the presence of heat-absorbing gases in the atmosphere? Fourier‡ maintained that the atmosphere acts like the glass of a hot-house, because it lets through the light rays of the sun but retains the dark rays from the ground. This idea was elaborated by Pouillet §; and Langley was by some of his researches led to the view, that "the temperature of the earth under direct sunshine, even though our atmosphere were present as now, would probably fall to −200° C., if that atmosphere did not possess the quality of selective

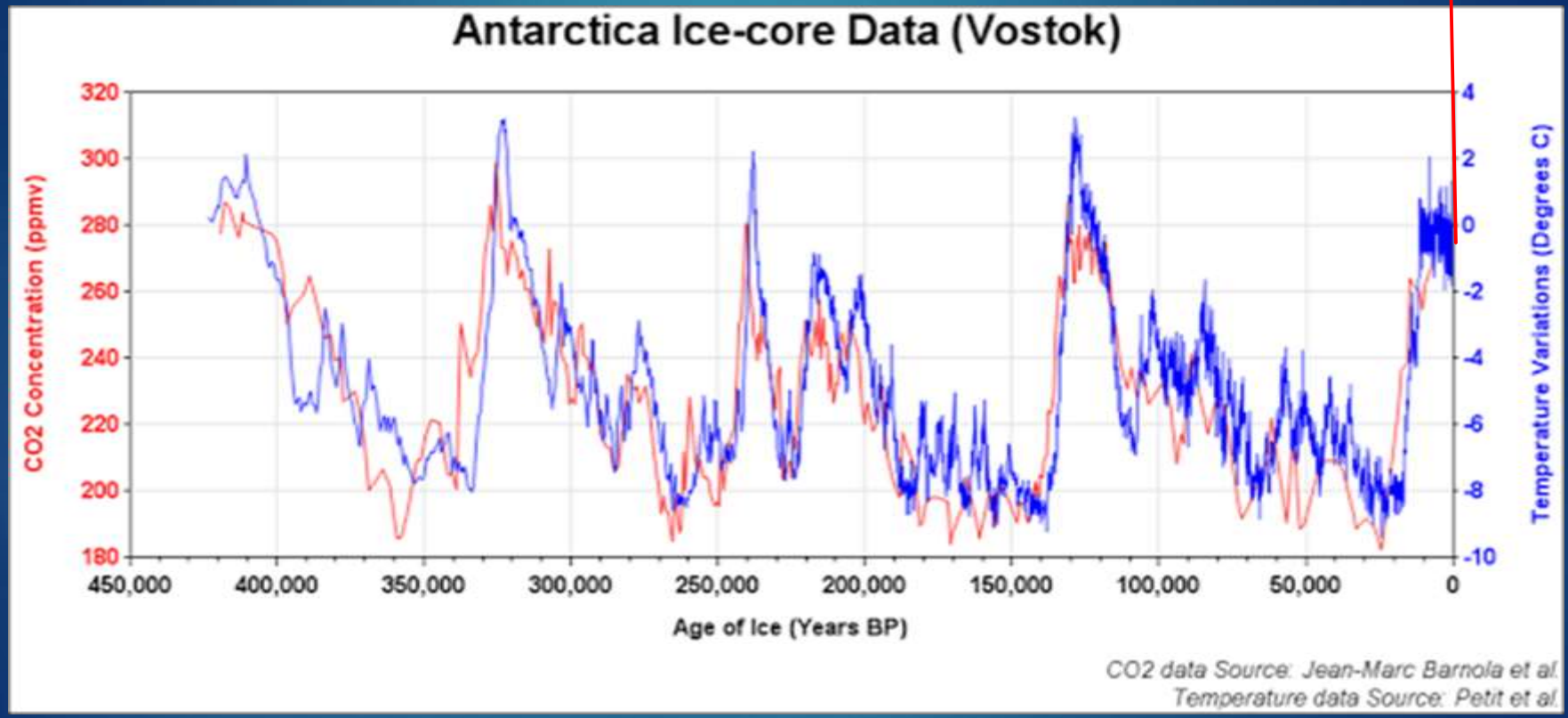
* Extract from a paper presented to the Royal Swedish Academy of Sciences, 11th December, 1895. Communicated by the Author.

† 'Heat a Mode of Motion,' 2nd ed. p. 406 (Lond., 1865).

‡ *Mém. de l'Ac. R. d. Sci. de l'Inst. de France*, t. vii. 1827.

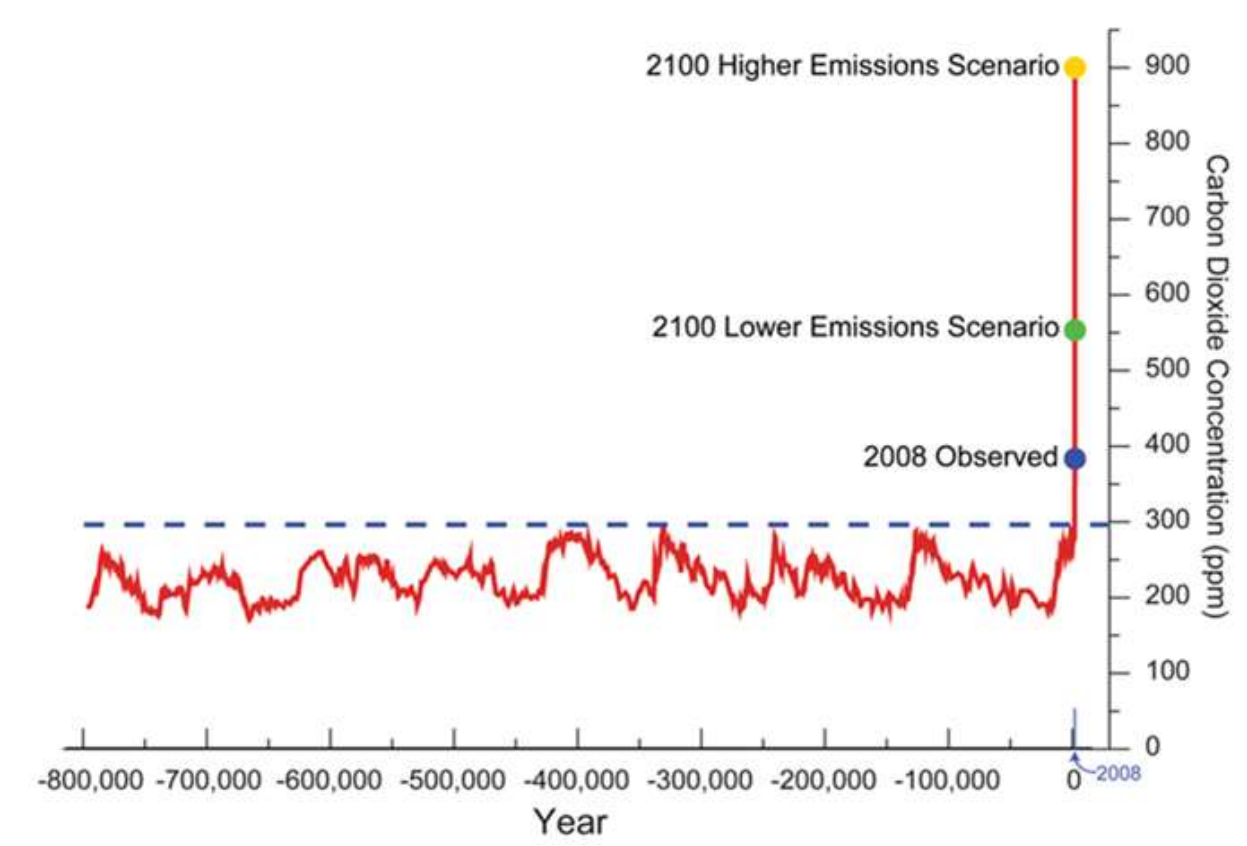
§ *Comptes rendus*, t. vii. p. 41 (1838).

Relationship between carbon dioxide and temperature



Vostok ice core records for carbon dioxide concentration and temperature change.

Do we really need to worry about climate change?



https://www.nasa.gov/press-release/nasa-says-2022-fifth-warmest-year-on-record-warming-trend-continues

1.30

https://nca2009.globalchange.gov/800000-year-record-co2-concentration/index.html

Arctic sea ice over 30 years

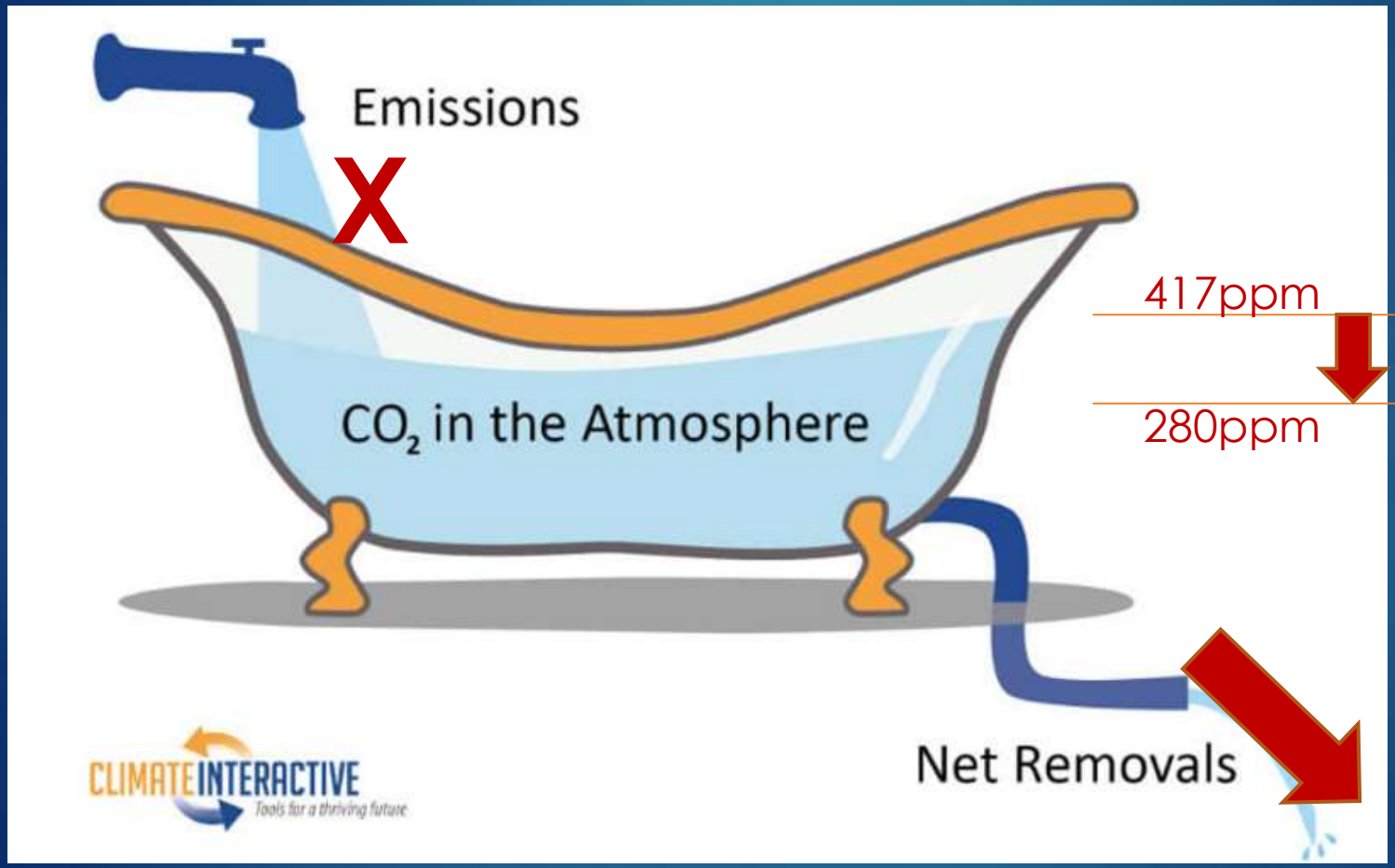
https://www.youtube.com/watch?v=JMQ21p93JZc&feature=related

Wrexham glyndŵr UNIVERSITY

The era of procrastination, of half-measures, of soothing and baffling expedients, of delays is coming to its close. In its place we are entering a period of consequences.

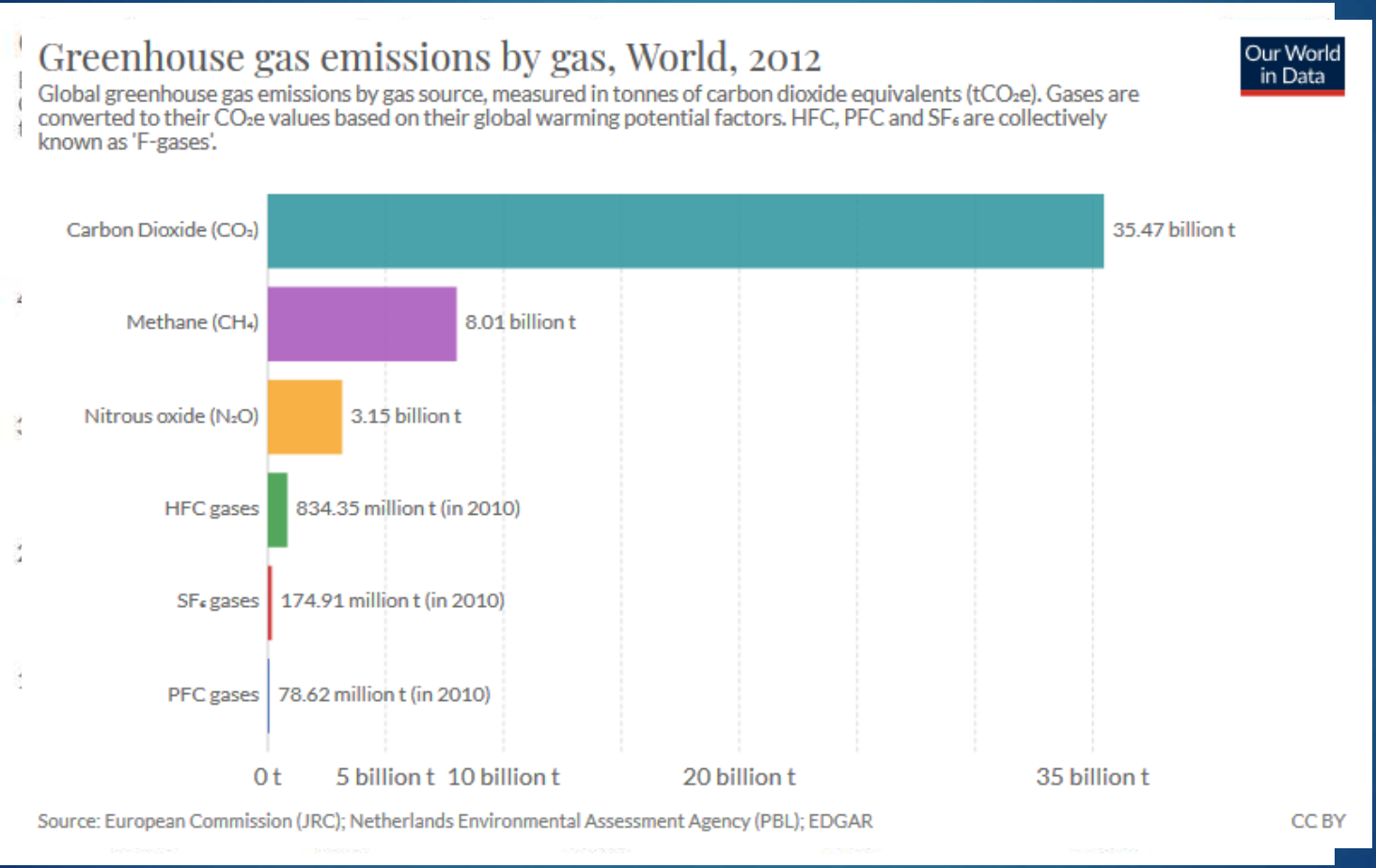
— Winston Churchill —

The solution to climate change



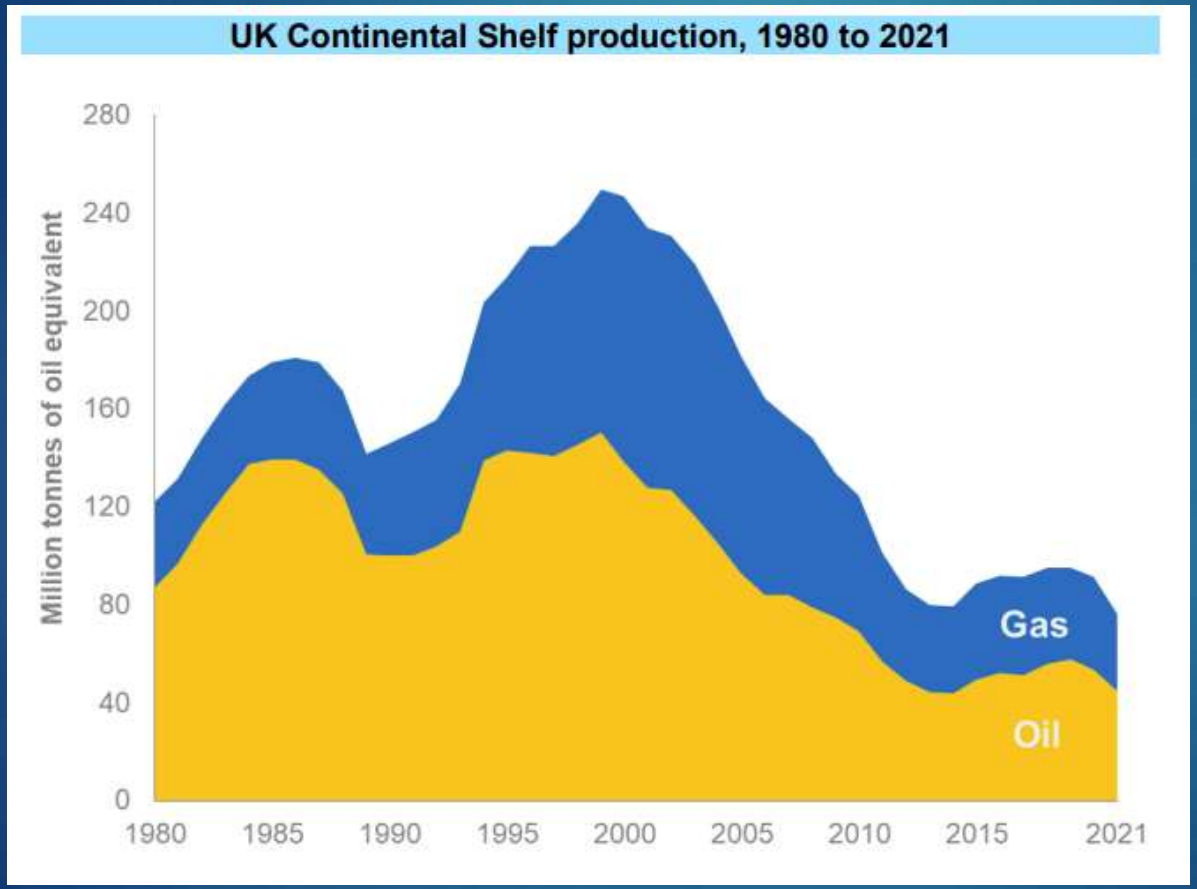
https://www.anthropocenemagazine.org/2016/02/visualizing-carbon/

Where do greenhouse gasses come from?



https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions

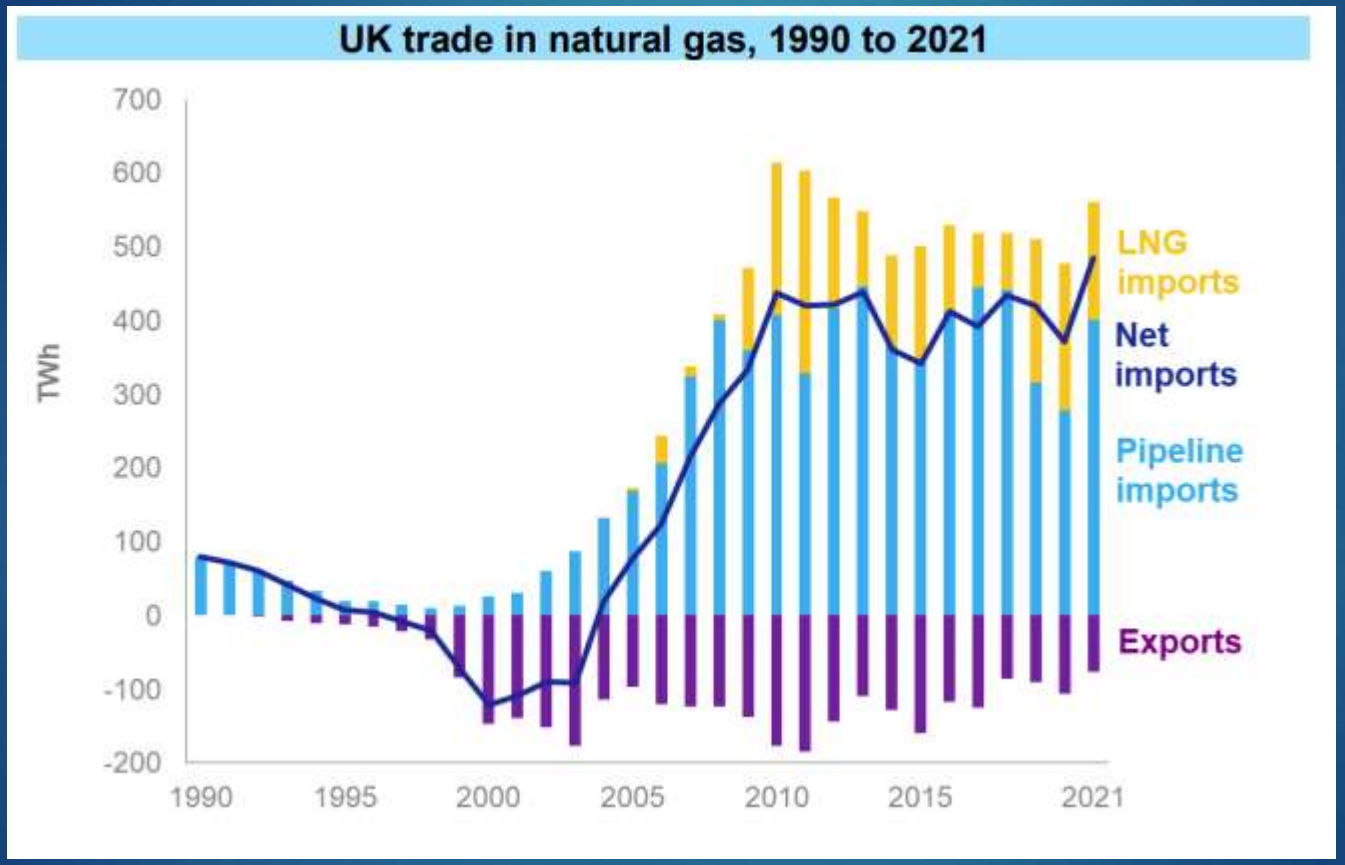
Where does the UK get its energy from? Gas



About 50% of total UK gas consumption self-sufficient (2022)

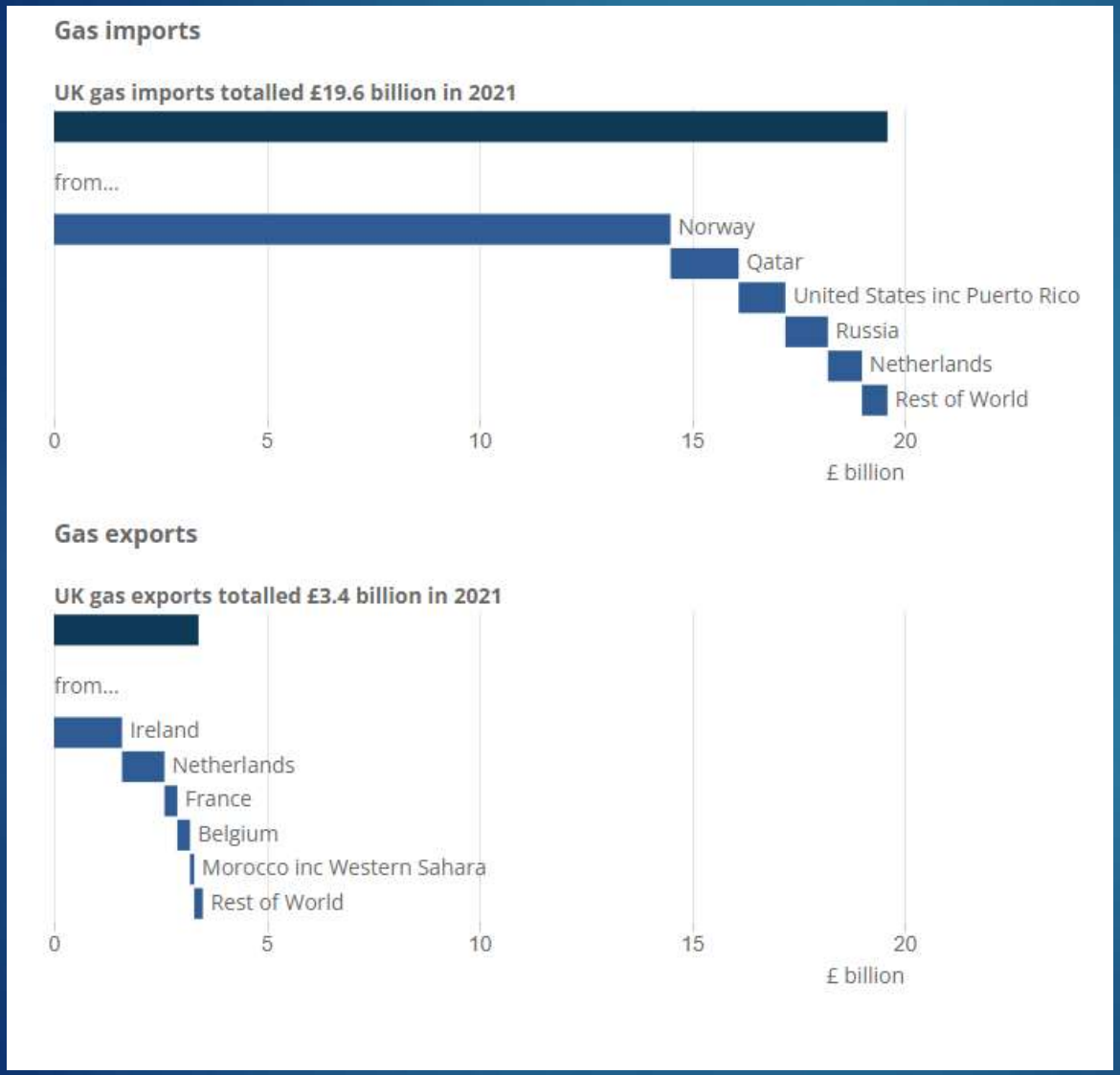
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1094025/UK_Energy_in_Brief_2022.pdf

Where does the UK get its energy from? Gas



https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1094025/UK_Energy_in_Brief_2022.pdf

Russian gas in context:



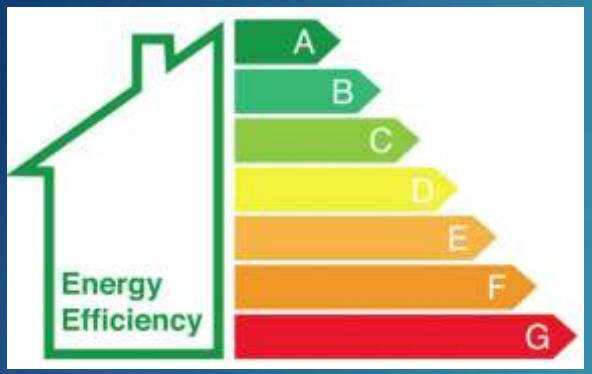
https://www.ons.gov.uk/economy/nationalaccounts/balanceofpayments/articles/trendsinukimportsandexportsoffuels/2022-06-29

Where does the UK get its energy from? Electricity

- https://www.carbonbrief.org/mapped-how-the-uk-generates-its-electricity/
- https://www.gridwatch.templar.co.uk/

Are there low carbon alternatives?

Lower demand:



In perpetuity…

Images from Google (various)

Wind Energy

https://www.gridwatch.templar.co.uk/

https://www.vestas.com/en/products/offshore/V236-15MW

Solar energy

https://www.gridwatch.templar.co.uk/

The energy from the sun that strikes the Earth per hour is more than the entire world consumes in a year.

Images from Google (various)

Hydro (River/ tidal/ wave) Energy

Putting it all together

Hydrogen
1
H

Electrified or Hydrogen Heating and Transport

Smart grid

Images from Google (various)

How much land will be needed?

- https://landartgenerator.org/infographics.html

Co2 footprints of electricity production (gCO2eq/kWh)

Fig 1. International Carbon Footprints of Fossil-Fuel Electricity

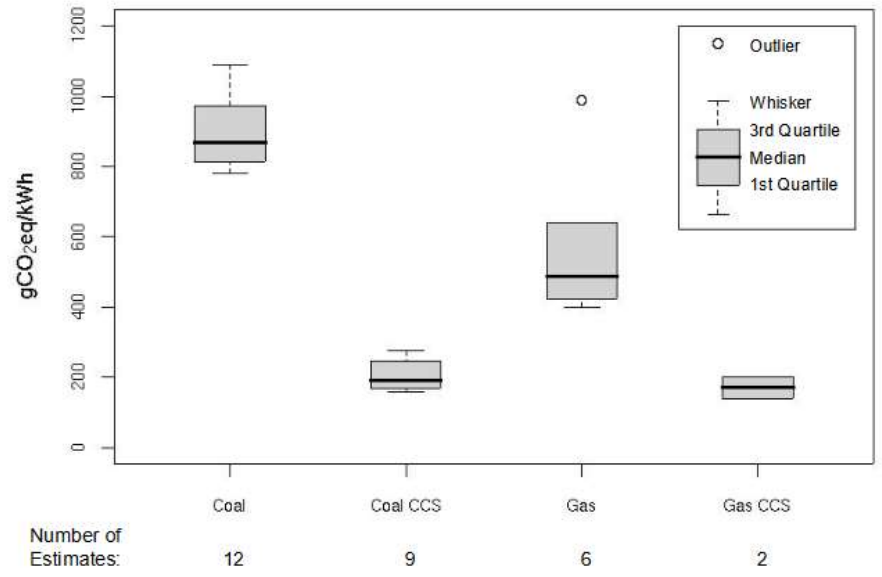
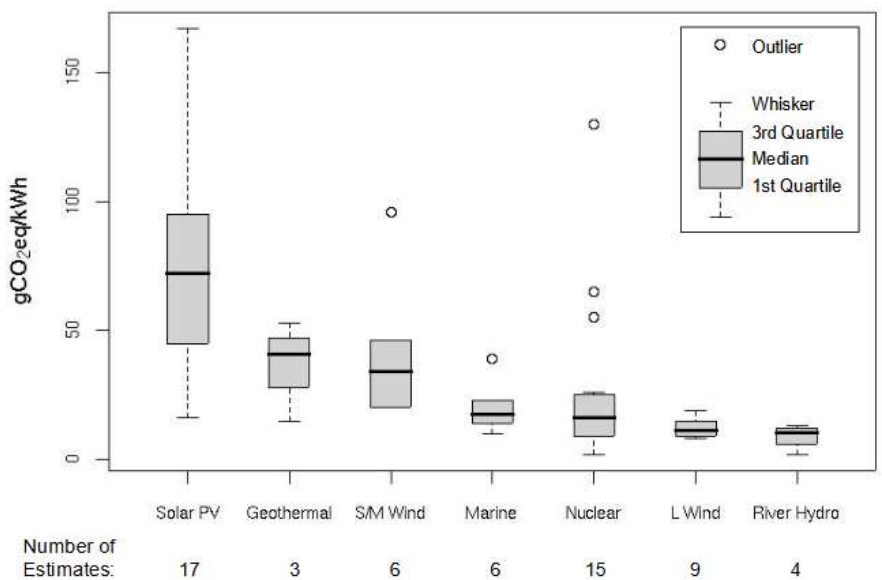


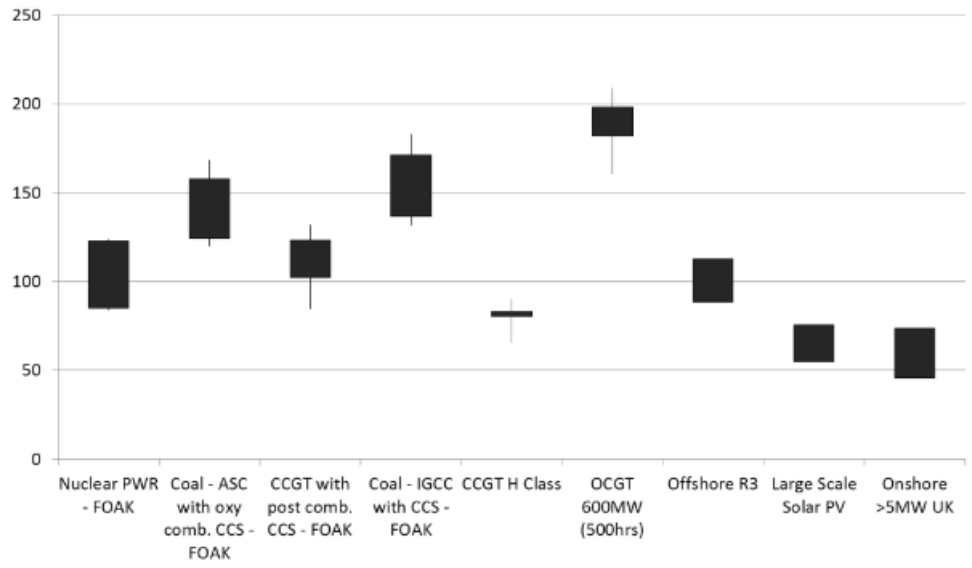
Fig 2. International Carbon Footprints for Low-Carbon Electricity



https://www.parliament.uk/documents/post/postpn_383-carbon-footprint-electricity-generation.pdf

UK Cost of Electricity generation predicted 2025

Chart 7: Levelised Cost Estimates for Projects Commissioning in 2025, Technology-specific Hurdle Rates, Sensitivities, £/MWh



Not included:

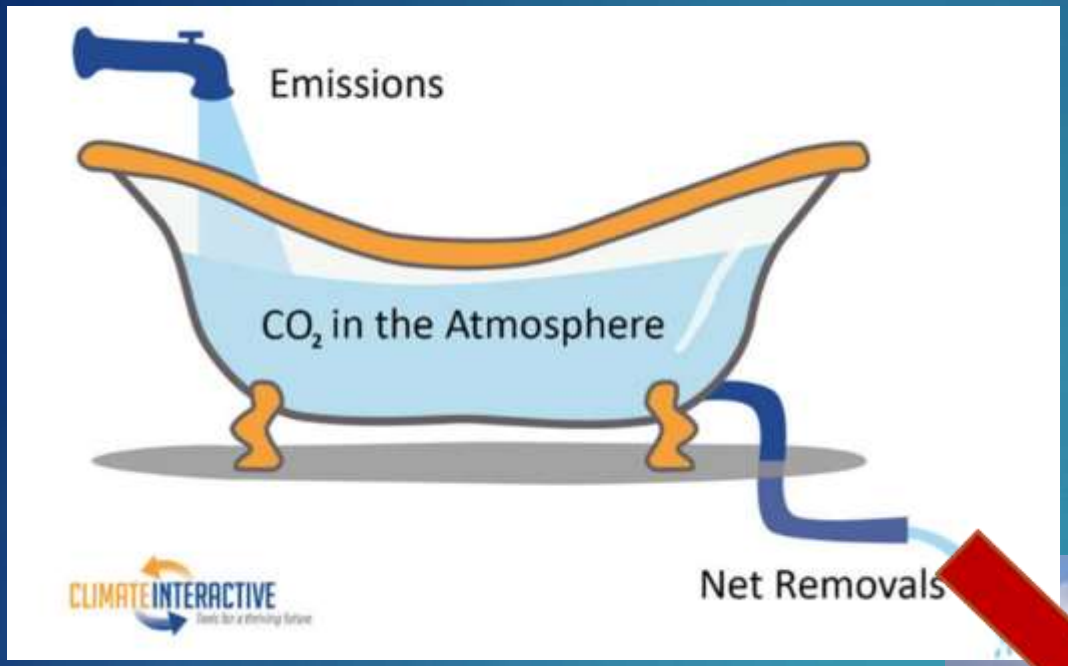
- Future costs of climate change
- Air pollution
- Possible large swings in price of oil and gas

https://www.ofgem.gov.uk/energy-data-and-research/data-portal/wholesale-market-indicators

https://www.carbonbrief.org/analysis-record-low-price-for-uk-offshore-wind-is-four-times-cheaper-than-gas/

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/566567/BEIS_Electricity_Generation_Cost_Report.pdf

Carbon capture and storage



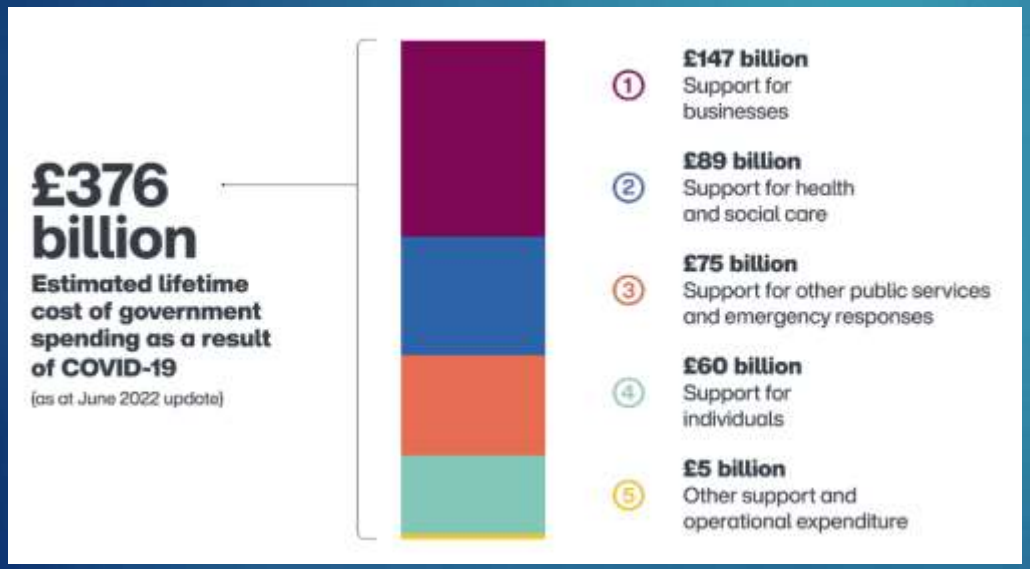
Carbon Engineering

PRIFYSGOL glyndŵr UNIVERSITY

https://carbonengineering.com/our-technology/ https://www.climateinteractive.org/

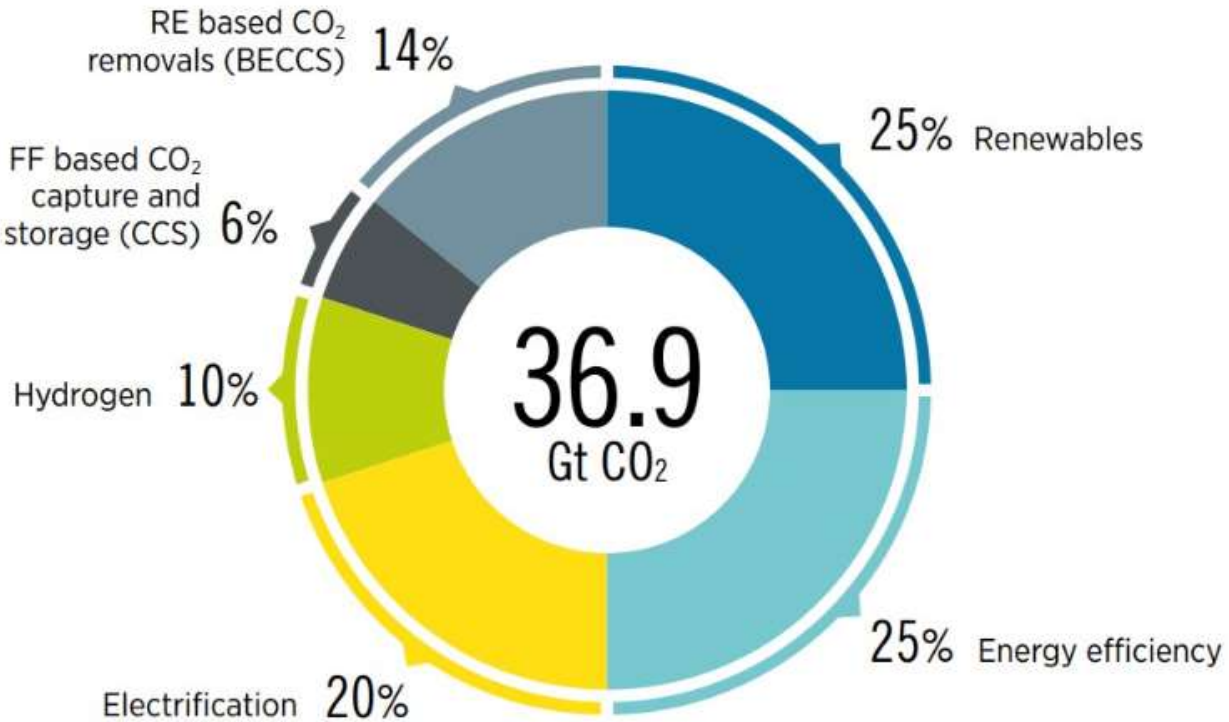
Converting to low carbon costs

A net cost of the UK reaching net zero by 2050 to be £321bn, or just over £10bn per year. (*Office for Budget Responsibility (OBR), July 2021) The value of UK support to fossil fuels amounted to about £12bn annually on average (OECD,2021)*



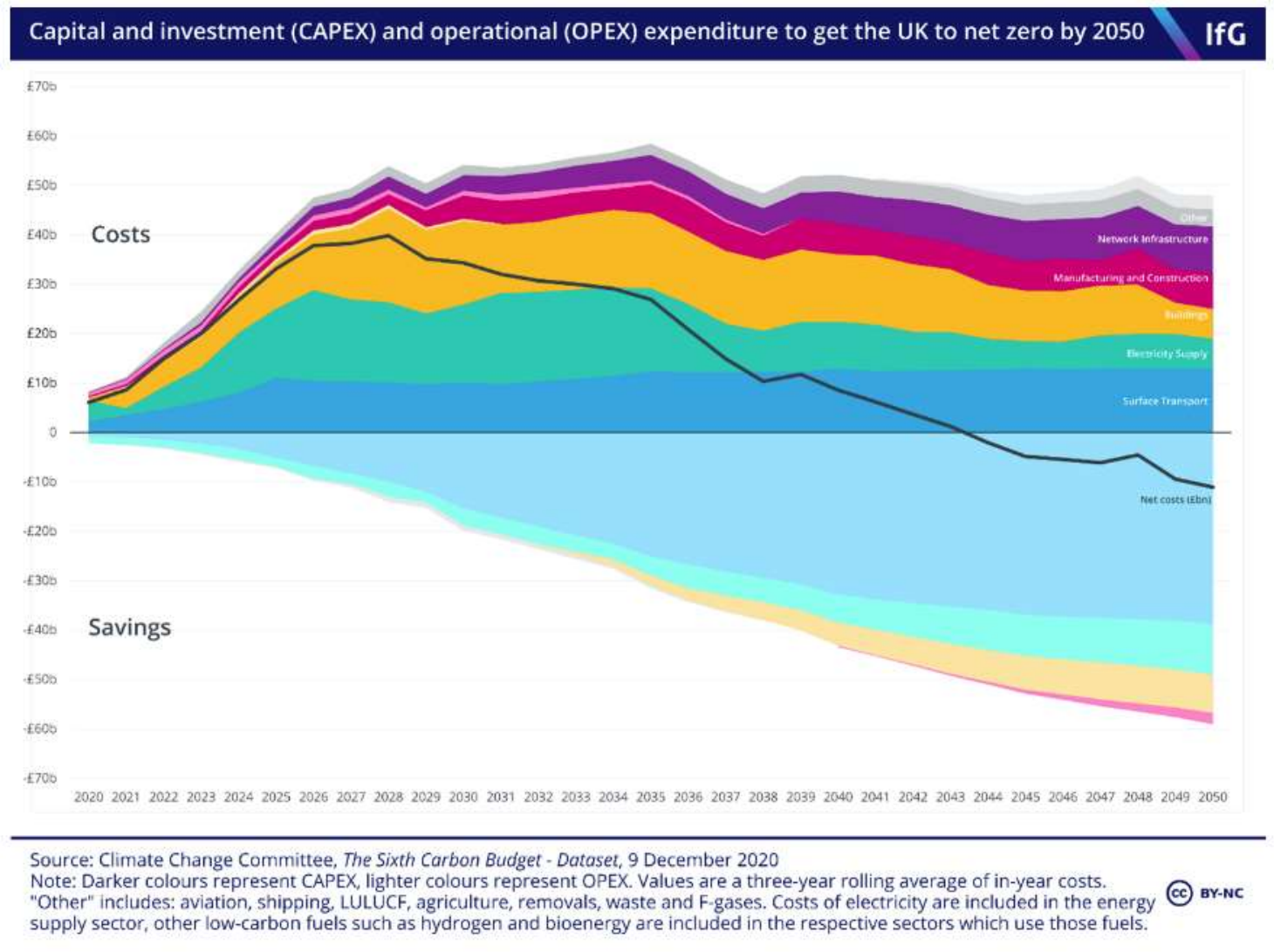
https://stats.oecd.org/Index.aspx?DataSetCode=FFS_GBR https://www.nao.org.uk/overviews/covid-19-cost-tracker/

Reducing emissions by 2050 through six technological avenues



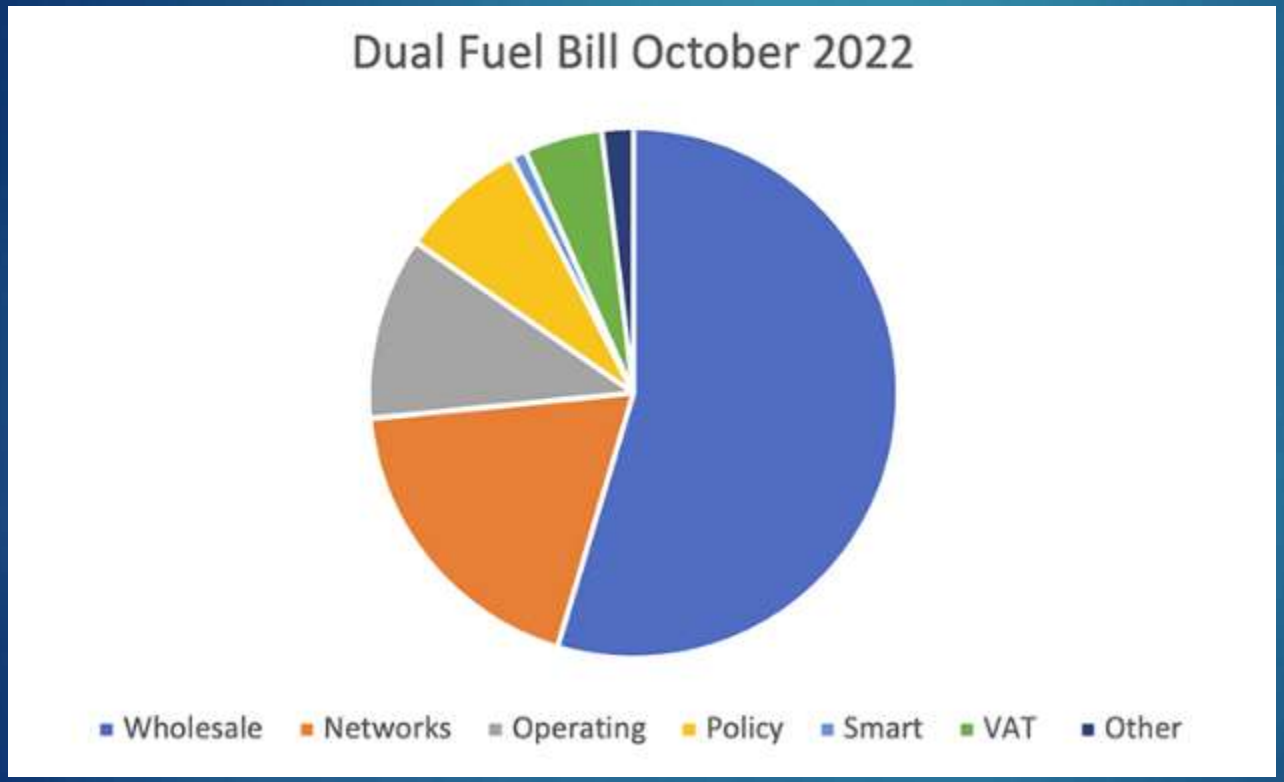
https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2022#page-1

How much will it cost ?



https://www.instituteforgovernment.org.uk/explainers/paying-net-zero#:~:text=In%20a%20July%202021%20report,%C2%A31.1trn%20in%20savings.

UK breakdown of Energy bills, and how the cost is worked out



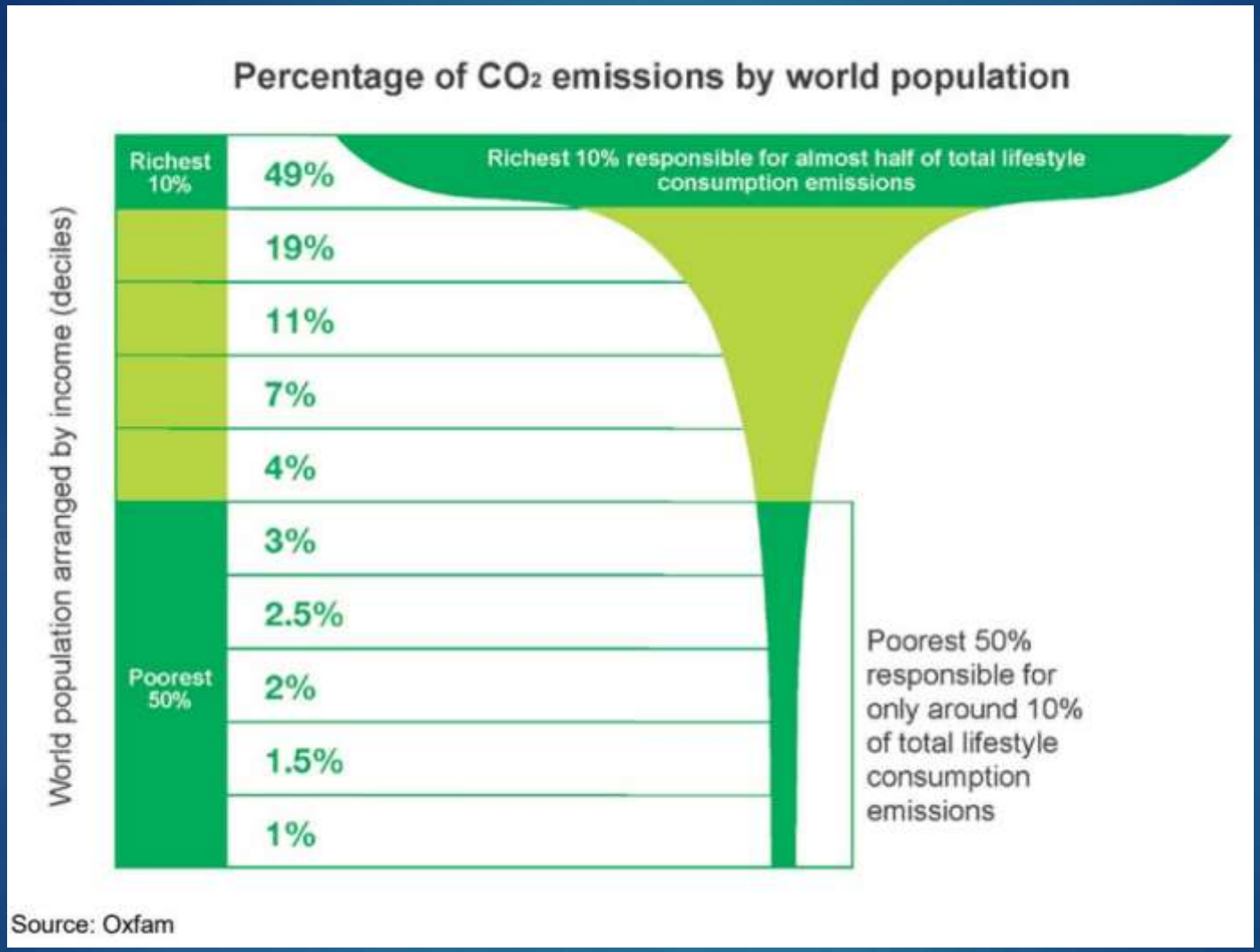
https://www.gridwatch.templar.co.uk/

Data from Ofgem

What are other counties doing ?

https://app.electricitymaps.com/map

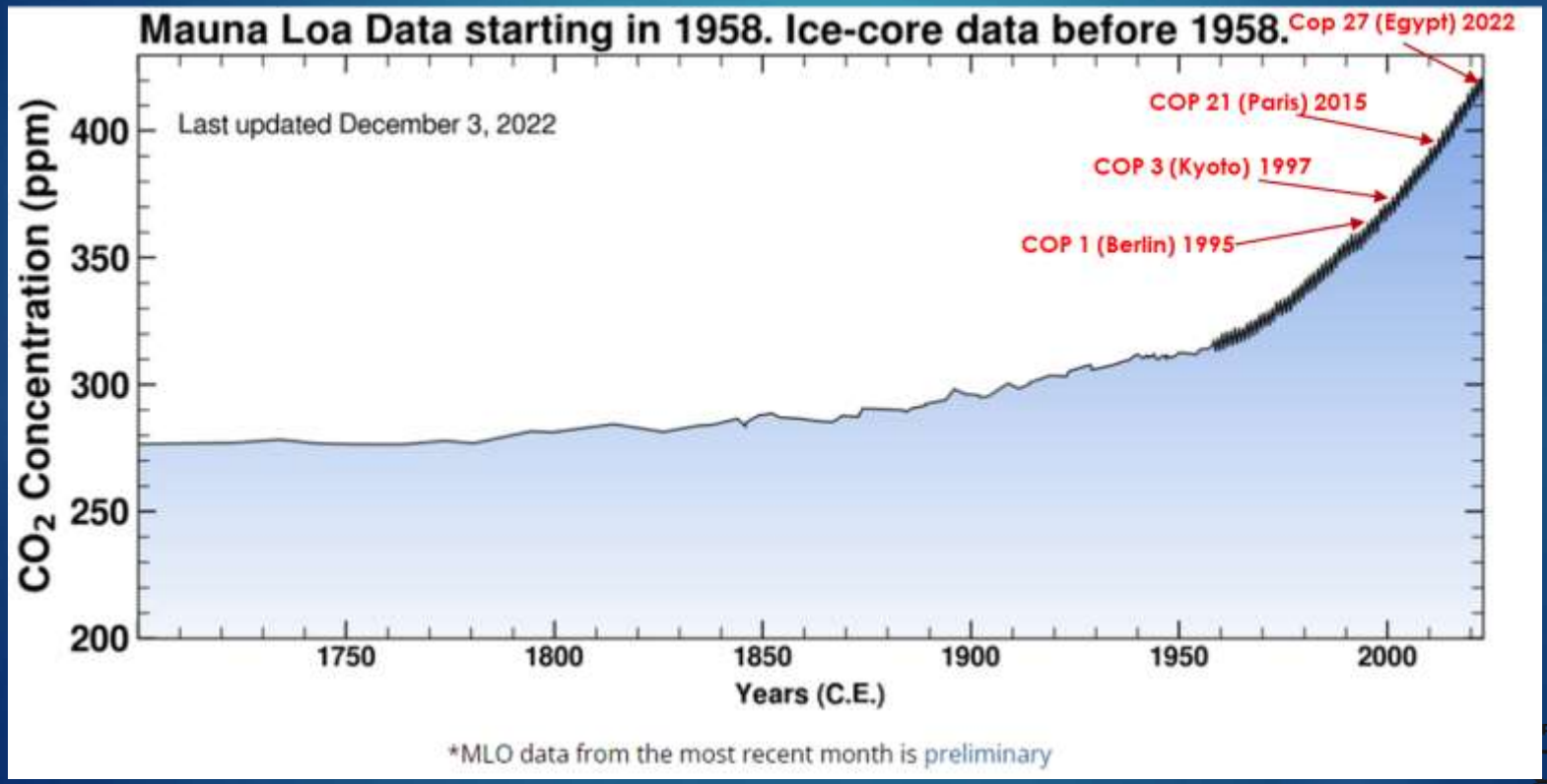
https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions



https://oi-files-d8-prod.s3.eu-west-2.amazonaws.com/s3fs-public/file_attachments/mb-extreme-carbon-inequality-021215-en.pdf

What did COP 27 achieve

- No real progress of keep global warming under 1.5 degrees, and to phase out the use of fossil fuels.
- The creation of a loss and damage fund



https://keelingcurve.ucsd.edu (Overlayed with Cop dates DS)

What's holding up action on climate change ?

UK fracking and oil drilling good for environment, claims climate minister

Graham Stuart tells MPs that awarding more than 100 licences for North Sea drilling is a green policy

A production platform in the North Sea. Photograph: Bluegreen Pictures/Alamy

Fracking and drilling for new oil and gas in the North Sea is green and good for the environment, Liz Truss's new climate minister said on Wednesday.

https://www.opensecrets.org/federal-lobbying/industries/summary?cycle=2022&id=E01

https://www.theguardian.com/environment/2022/oct/12/uk-fracking-and-oil-drilling-good-for-environment-says-climate-minister-graham-stuart

Crisis + "a crucial point, when something begins to change."

Often misconstrued as opportunity

Image taken from Google

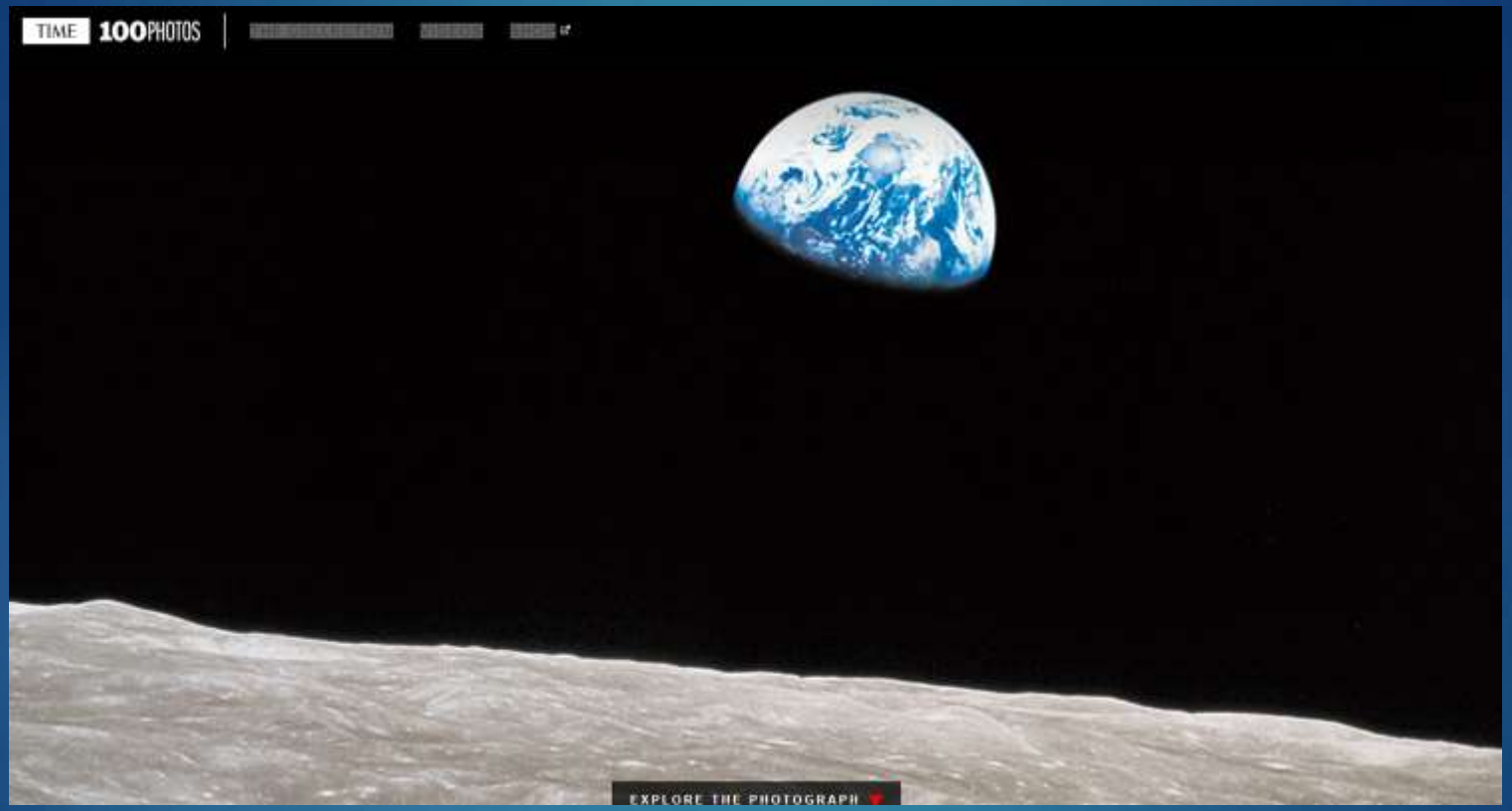
Prifysgol Glyndŵr Wrecsam | Wrexham Glyndŵr University

Climate change, Russian gas, and energy bills: A perfect Storm

Opportunity

David Sprake BEng(hons), CEng, MEI, FHEA, PGCE, Chartered Energy Engineer

Prifysgol Glyndŵr University



https://time.com/5479821/earthrise-picture-history-apollo-8/

Wrexham glyndŵr UNIVERSITY

Learn more…

- Introduction to climate change (short course)

Renewable and sustainable Engineering

- BEng(hons)+ Msc +PhD (full+ part time):
- Low carbon degree apprentices
- Electrical, mechanical, automotive and aeronautical engineering degrees.

David Sprake.

d.sprake@glyndwr.ac.uk

Questions?

Filed trip photo DS

Temperature anomalies

Temperature anomalies
https://youtu.be/K4Ra2HR27pQ

Antti Lipponen climatecentral.org

Cause of previous climate change

http://profhorn.meteor.wisc.edu/wxwise/climate/milankovich.html

Wrexham glyndŵr UNIVERSITY

Wind vs Nuclear

Nuclear: Hinckley point c, 2027, = 3,260MW, £26 Billion

Wind energy 3,260MW = (Approx. £1M/MW) = 3.2 Billion
Wind only blows approx. 35% of the time (capacity factor)
so $9.1 Billion + 17 Billion to spend on energy storage.