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# Exploration and Production in the Energy Trilemma

Adam Borushek, RISC

Introduction to Upstream Oil and Gas for the Net Zero World

4 November 2025, London Geological Society

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- Reservoir Engineer with 25+ years of global experience in the upstream hydrocarbon industry. Expertise in asset valuation, due diligence assessment for M&A and project finance requirements, and reserves assessment.
- Project manager of multidisciplinary teams with reports quoted on AIM, TSX, OSX, ASX, NYMEX.
- Experienced in a range of reservoirs including fractured carbonate reservoirs, tight gas, coal bed methane, and gas storage in depleted fields.
- Member of SPE, SPEE, GESGB.
- Chair of SPE London section 2024-25.
- Chair of Continuing Education for SPE London section, 2016-2024.
- SPE Regional Service Award, North Sea Region, 2019.
- Qualified Reserves Auditor (PRMS, COGEH) and Competent Person (AIM).

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- Why oil and gas matter in today's energy systems
  - The energy trilemma
  - The role of upstream oil and gas in the UK
  - The energy trilemma in the UK

# Why oil and gas matter in energy systems



- Energy is the lifeblood of modern society. It powers our homes, industries, and transportation systems.
- Currently oil and gas account for the majority of the UK's energy use.
- Why can't we just stop using all oil and gas immediately?
- We are here today to learn about upstream oil and gas, in the context of Net Zero.

- Global oil production is circa 100 million barrels per day<sup>1</sup> and consumption of natural gas is circa 400 billion cubic feet per day<sup>2</sup>.
  
- Oil and gas are important to every country's economy and industry, used for a wide range of products and services. Including:
  - Transportation:
    - Fuel for cars and trucks
    - Diesel fuel for trucks and machinery
    - Jet fuel for airplanes
    - Marine fuel for ships
  - Heating and Electricity:
    - Gas for heating homes and businesses
    - Gas for generating electricity
  - Manufacturing:
    - Petrochemicals for plastics, synthetic fibers
    - Lubricants for machinery
    - Asphalt for roads and roofing
    - Fertilizers
    - Pharmaceuticals
    - Steel and cement production

- There is global interdependence with many links.
  - For example, oil may be produced in Norway by a US-listed company. It may be sold via pipeline to the UK, with the oil exported and consumed in the Netherlands.
- Key industry players include:

## Government

### Finance

- HM Treasury

### Energy

- Department for Energy Security and Net Zero

### Regulators

- North Sea Transition Authority
- Health and Safety Executive

## Production Companies

### Integrated Majors

- Shell, BP, TotalEnergies

### Independents

- Serica, Harbour

### National Oil Companies

- Saudi Aramco, Equinor, CNOOC

## Service Companies + more

### Engineering and Construction

- Bechtel, Wood, Aker

### Drilling

- Noble, Diamond

### Oilfield Services

- Halliburton, SLB, Baker

### Finance

- Banks, private equity, traders

# Examples of global upstream industry companies

## Majors



## Independents



## NOCs



## Financial Institutions



## Service Companies

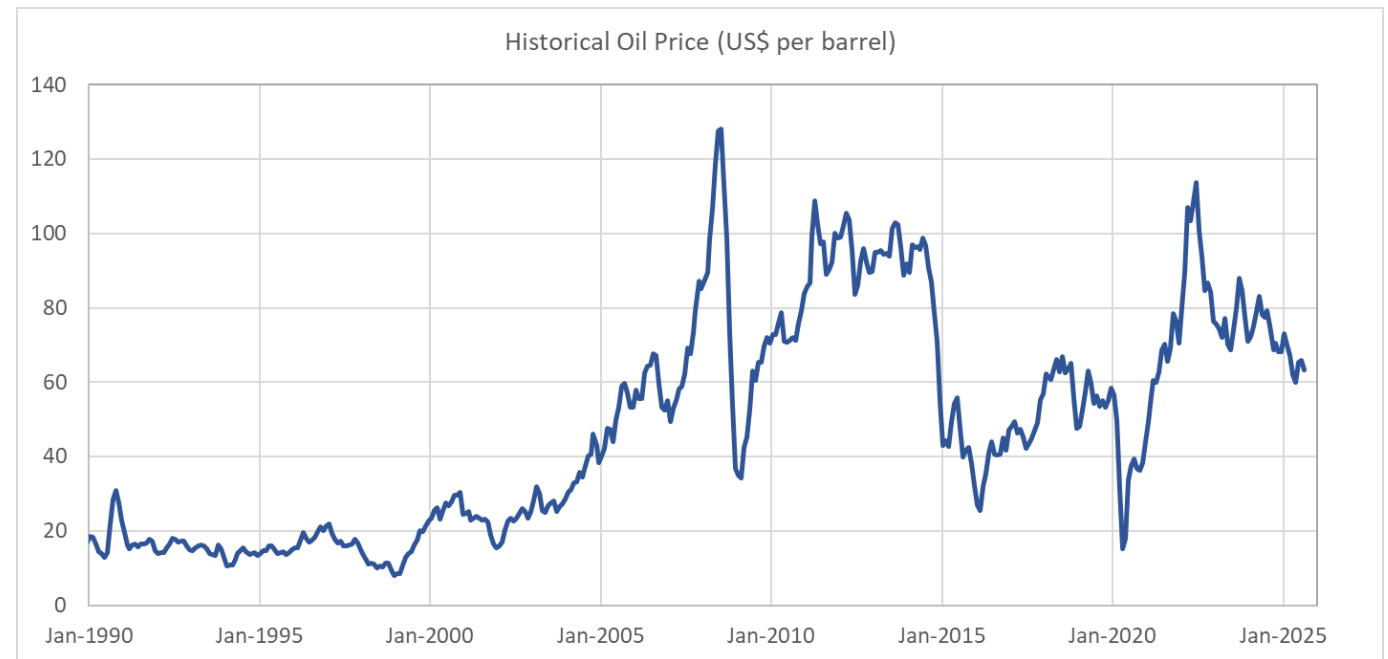


## Consultancies



# Instability in oil price

- The oil industry is interconnected, resulting in global oil prices
  - Local variations: Brent, WTI.
- Factors driving oil price instability include:
  - Geopolitical factors
  - Supply and demand dynamics
  - Economic cycles
  - OPEC decisions
  - Climate change policies
  - Technological advancements.



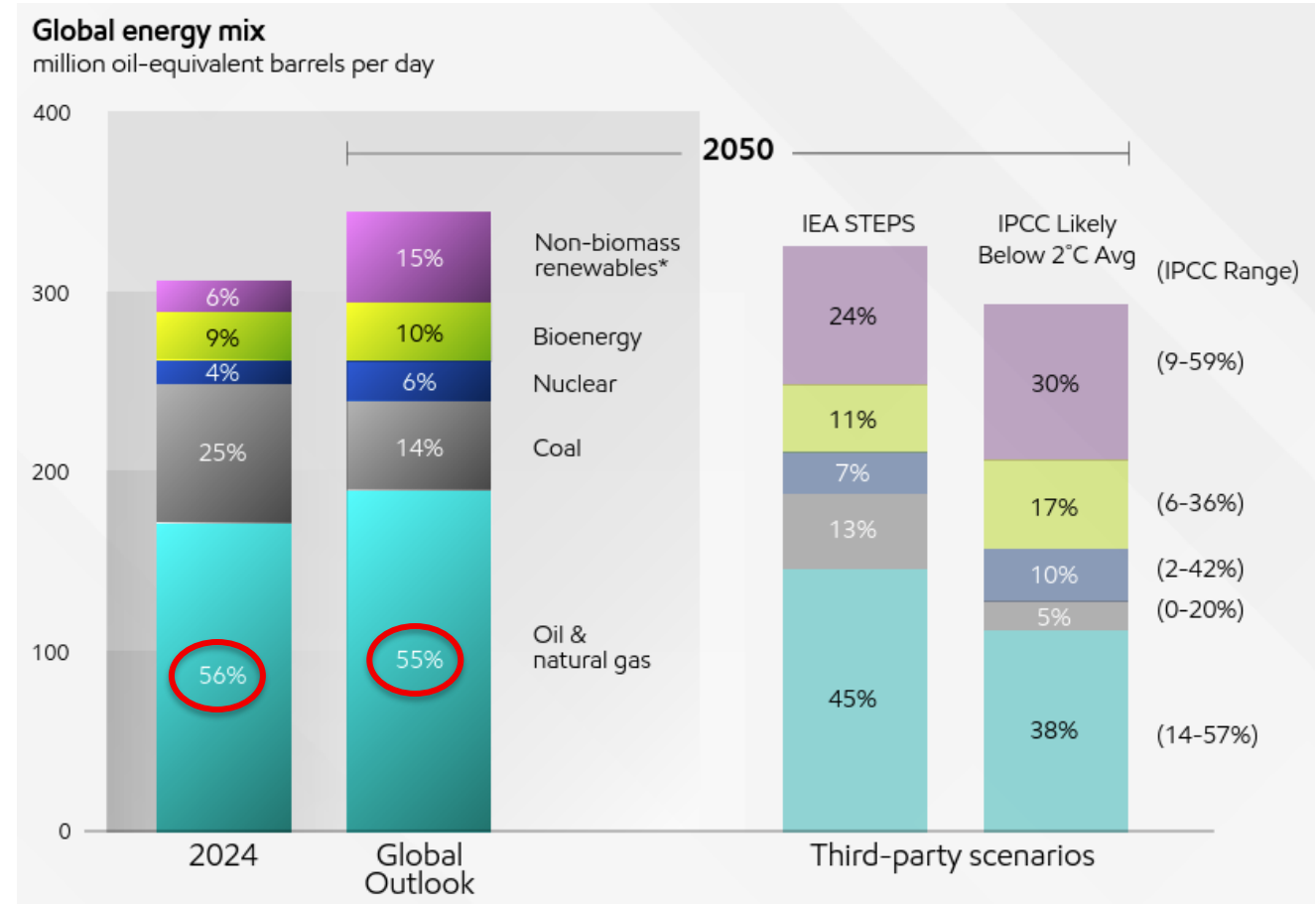
# Which countries produce the most oil?

- The USA has significant oil production due to shale wells, since 2005.
- Many of these are in OPEC or OPEC+.
- The UK's peak production was 3 million bopd in 1999. We now produce 0.6 million bopd.

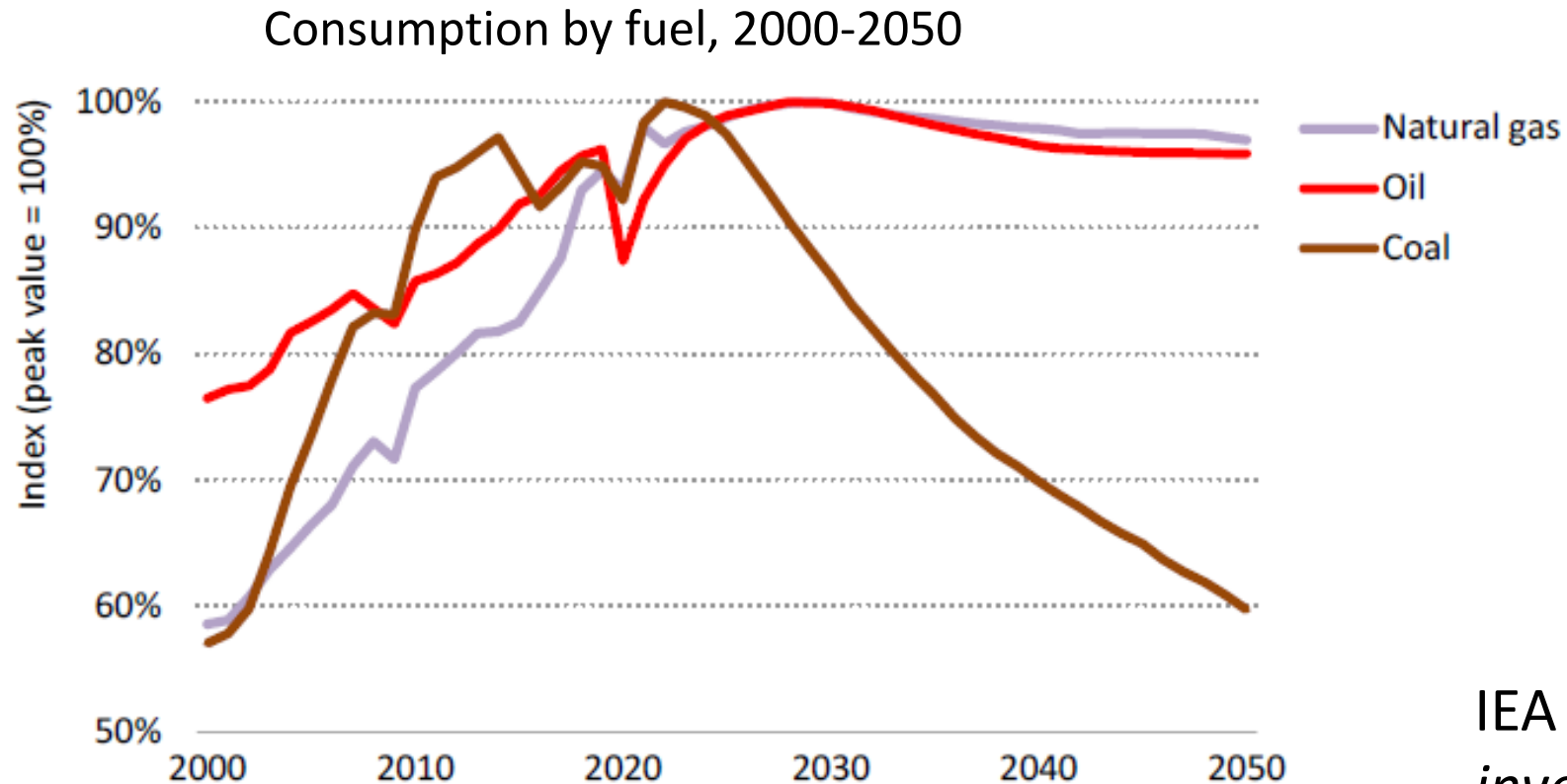
Country	Million barrels per day	Share of world total
United States	21.9	22%
Saudi Arabia	11.1	11%
Russia	10.8	11%
Canada	5.8	6%
China	5.3	5%
Iraq	4.4	4%
Brazil	4.3	4%
United Arab Emirates	4.2	4%
Iran	4.0	4%
Kuwait	2.9	3%
Total top 10	74.6	73%
<b>World total</b>	<b>101.8</b>	

# How much energy will the world need in future?

- As developing nations meet modern energy standards to enable economic growth, global energy use will increase by 25%.
- By contrast, energy use in developed nations will decline by 10% as efficiency improves.
- The net impact will increase global energy needs by 15% between now and 2050.
- Renewables will play an important role. So will the continued use of oil and natural gas.



# How much energy will the world need in future?



IEA stated *“Continued investment in fossil fuels is essential in all of our scenarios.”*

# The energy trilemma



- How should a nation handle these problems?
  - Drop in energy supply following sanctions after Russia's invasion of Ukraine
  - Globally rising CO<sub>2</sub> and the climate crisis
  - Changing energy demands during COVID and now with AI
  - Cost of living raising the cost of petrol, heating, electricity
  - Low investment returns on renewables projects
  - Increasing reliance on energy imports
  - Risks to economic growth
  - Instability in the Middle East.
  
- Can you see how many of these are interconnected?

- The UK government defines<sup>1</sup> a framework of three objectives that energy policymakers need to balance.
  
- The trilemma comprises:
  1. **Sustainability**: decarbonising energy
  2. **Security**: ensuring the security and reliability of energy supplies
  3. **Affordability**: minimising the cost of energy to consumers.
  
- There are no easy solutions. Balancing these objectives will involve trade-offs.

1: <https://commonslibrary.parliament.uk/research-briefings/cdp-2023-0074/>

- Each nation's circumstances will influence their energy choices:
  - **Geography:** Norway has hydropower, Iceland has geothermal energy
  - **Natural resources:** oil, gas, solar, wind
  - **Capital:** Strong economies can invest in diverse energy sources
  - **Development:** Countries in energy poverty focus on low-cost, reliable energy
  - **Leadership:** Some countries aim to take responsibility to lead industry
  - **Political factors:** Extent of public support for the energy transition

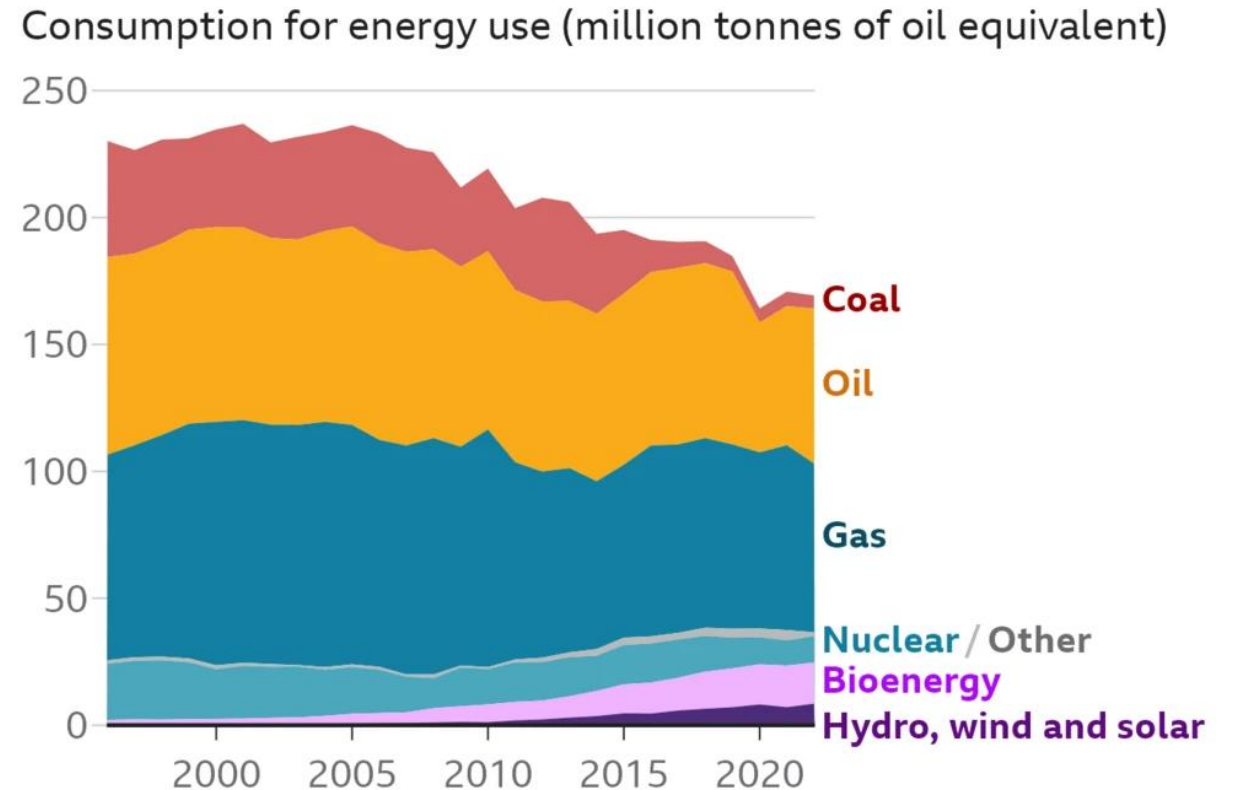


- A government's policy framework can speed up action by the private sector.
- Examples include:
  - **U.S. Inflation Reduction Act**, which focuses on an outcome of carbon intensity and does not pick winners and losers
  - **Canada's Clean Fuel Regulations**, which allows for co-processing of biofuels to achieve a lower carbon
  - European Union **coal phase-out commitments**: 25 member states will be coal-free by 2030
  - India's **subsidies for rooftop solar** installations commenced in 2024.
- National Oil Companies are also working towards this:
  - Eg ADNOC aims for Net Zero by 2045, Saudi Aramco by 2050.

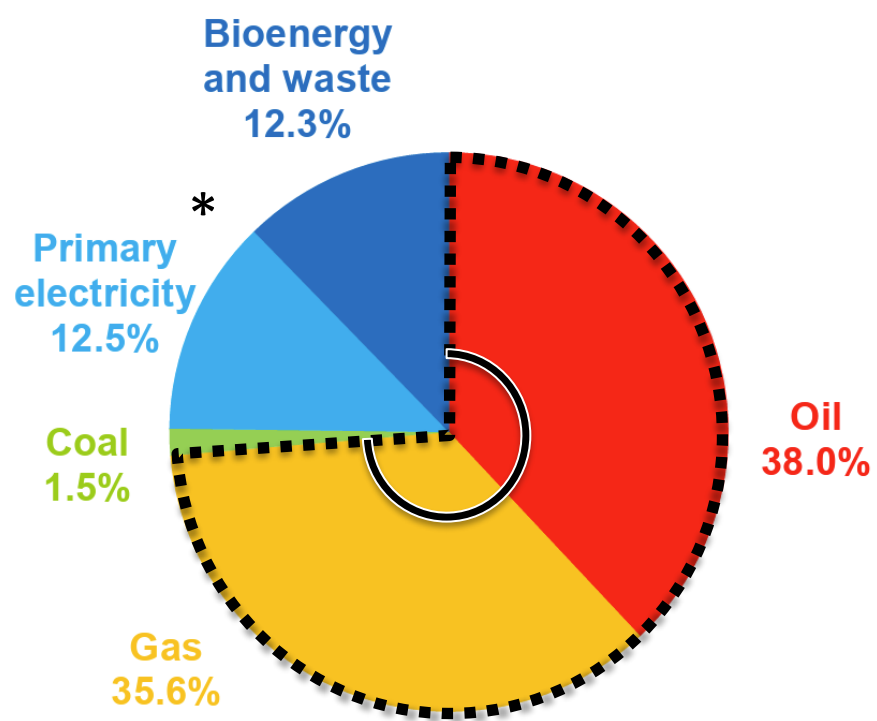
# The role of upstream oil and gas in the UK



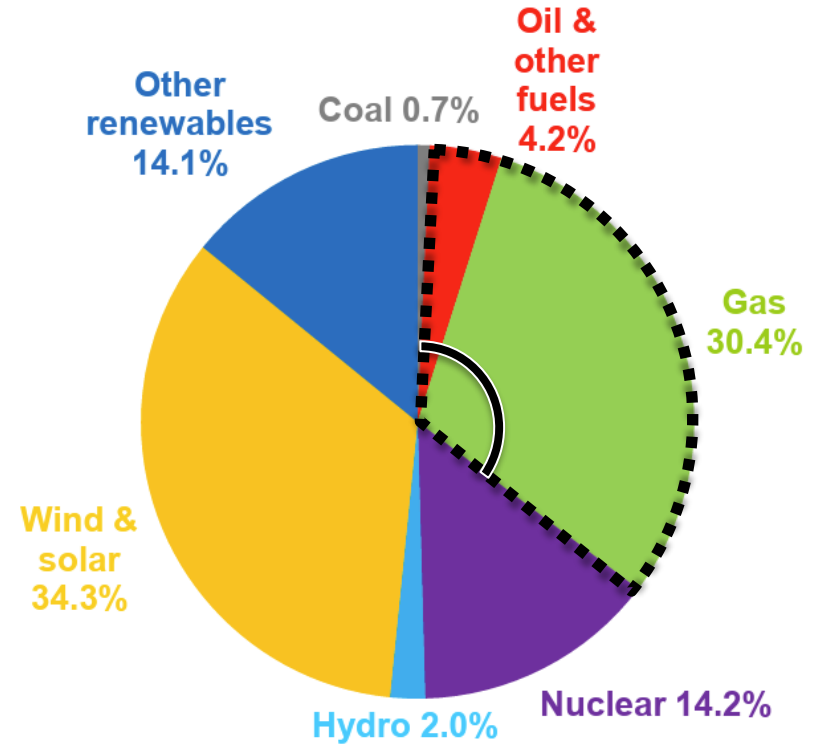
- The North Sea has been significant for the UK:
  - Historical reliance on fossil fuels.
  - The industry employs over 150,000 people, plus many more indirectly.
  - The oil and gas industry contributed contributes more than £25 billion of Gross Value Added annually to the UK economy.



# The UK's energy mix now



- Oil+Gas account for 74% of total UK energy use



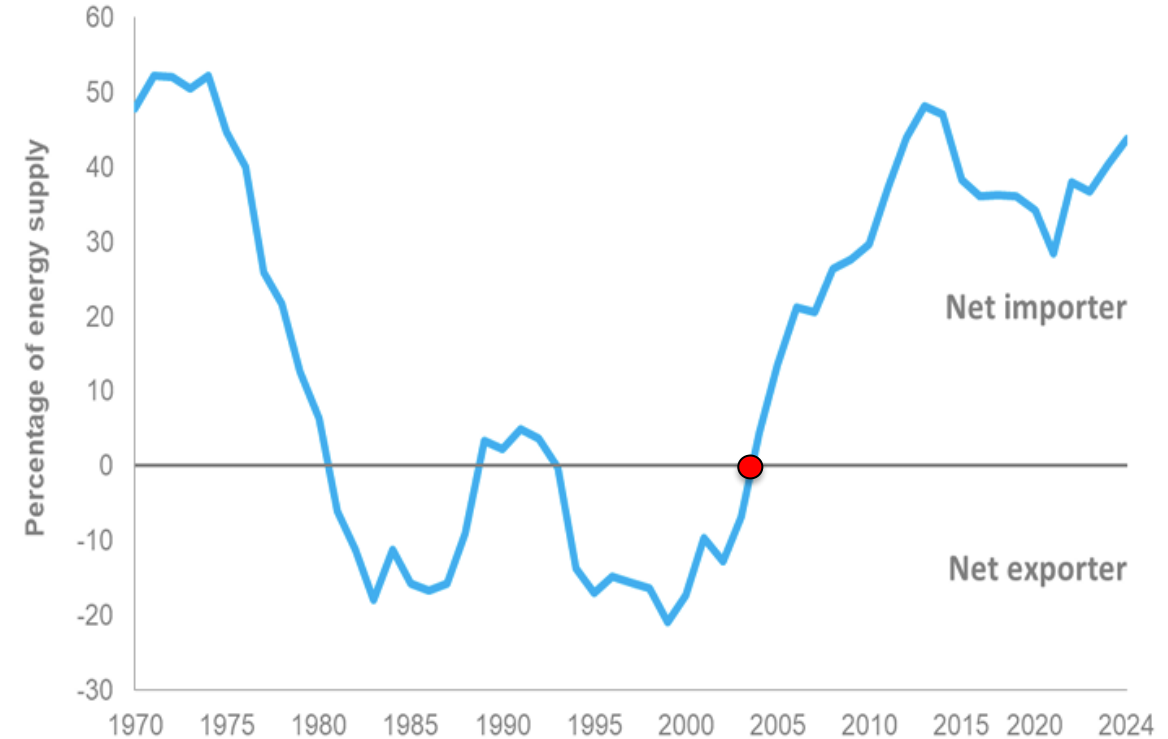
- Oil+Gas account for only 35% of UK electricity generation

\* Primary electricity includes nuclear, wind, solar, hydro and net imports.

# Challenges facing the UK's oil and gas sector

- Declining North Sea production:
  - In 2024 the UK net imported £24 billion of petroleum
  - Net import dependency was 44%, up 3.4% compared to 2023
  - We import gas via pipeline from Norway, plus LNG from US and Qatar
  - The carbon intensity of UK North Sea gas is  $\frac{1}{4}$  of the imported LNG.
- Increasing climate change goals.
- Less finance and investment available.
  - No new oil wells drilled in the UK North Sea this year, for the first time since 1964.

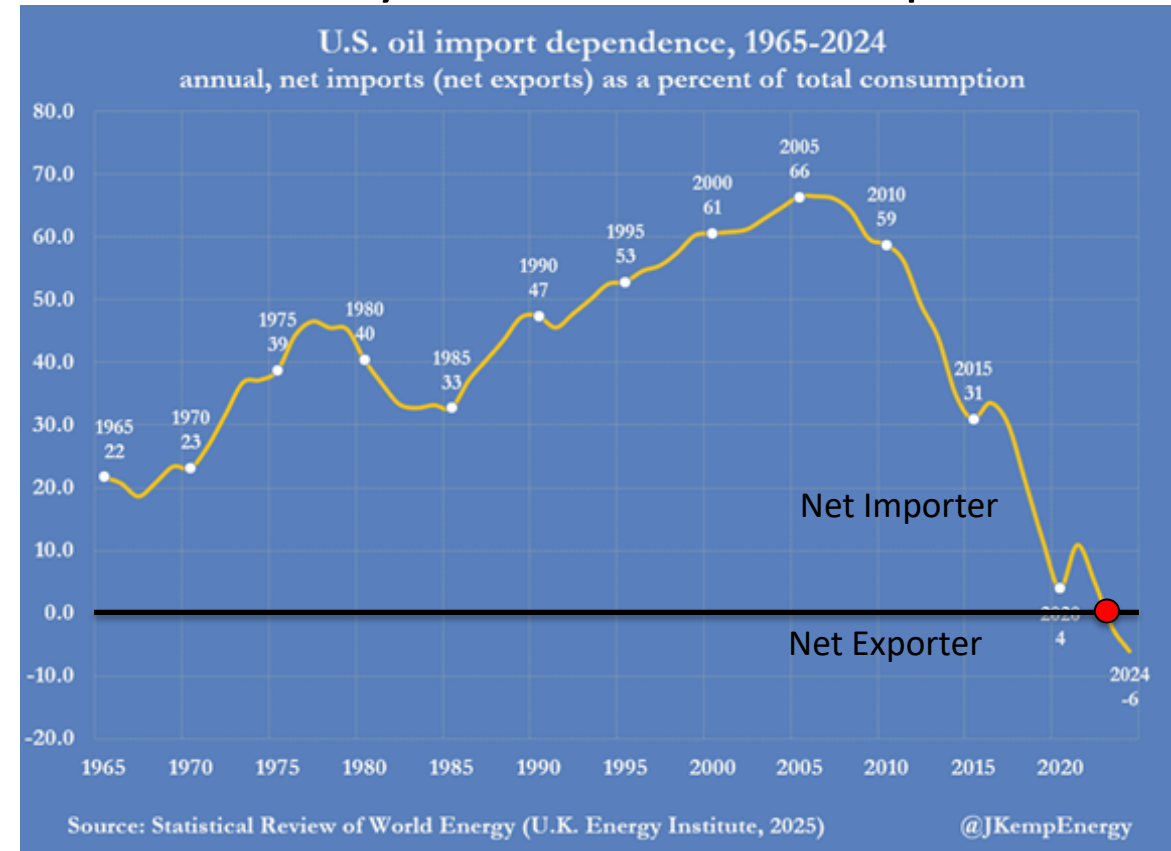
## The UK depends on energy imports



# USA has seen the opposite trend since 2005

- Increasing onshore shale oil production:
  - This started in 2005 and exploded since then.
  - Shale has contributed to their energy security.
- Different climate change goals
  - Cheap gas is replacing coal for electricity generation, reducing CO<sub>2</sub> emissions.
- More finance and investment available.

The US can rely more on domestic production

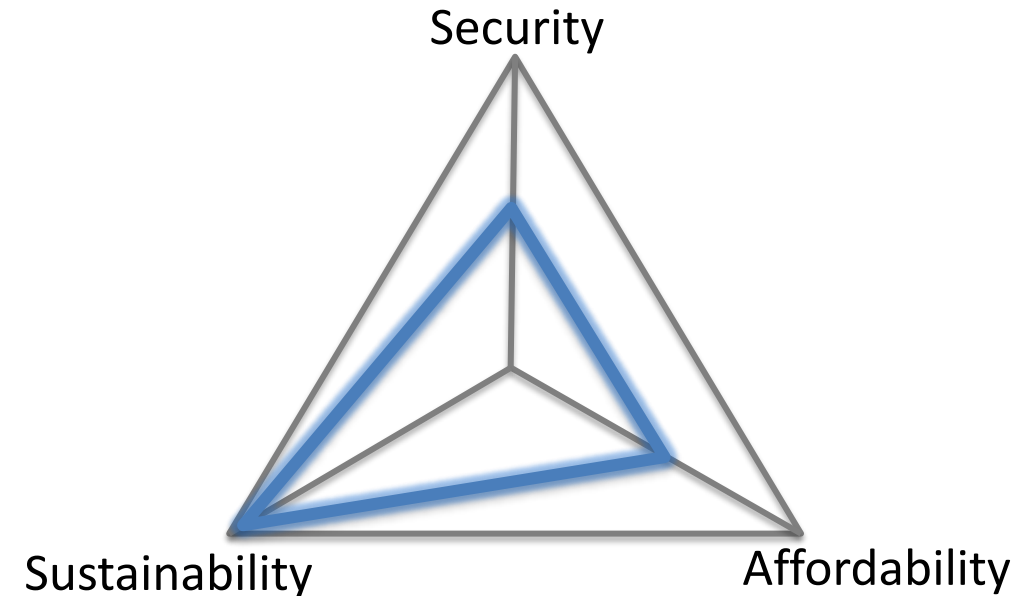


# The energy trilemma in the UK

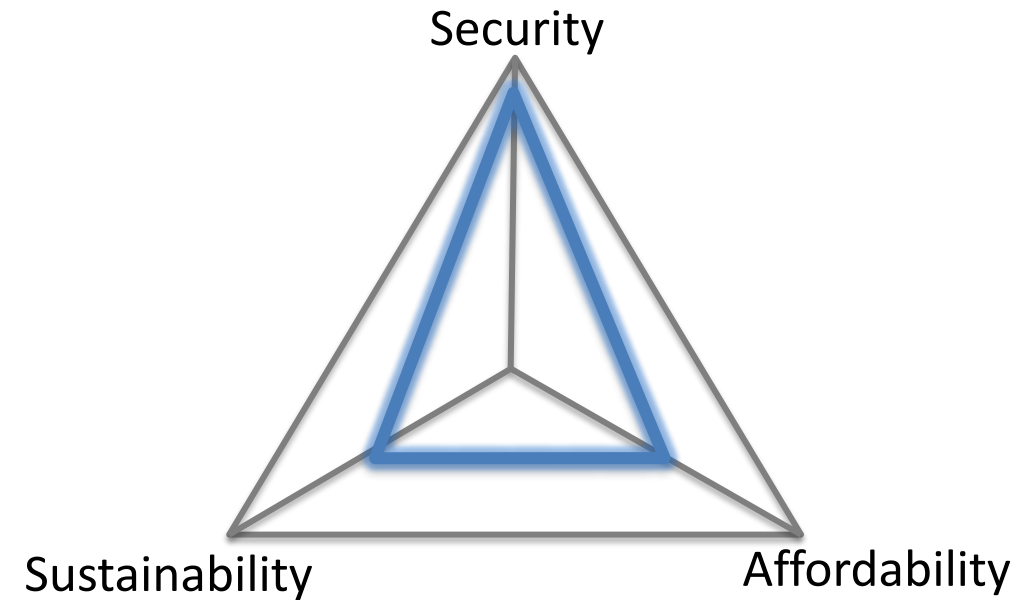
The background of the slide is a monochromatic blue-toned landscape. It features a wide, flat expanse in the foreground, possibly a plain or a large body of water, with several mountain ranges and hills in the distance. The sky is a uniform, dark blue, and the overall scene is rendered in a soft, ethereal light.

- Let's now combine these issues:
  - The global energy system
  - Changing energy sources in the UK
  - The energy trilemma

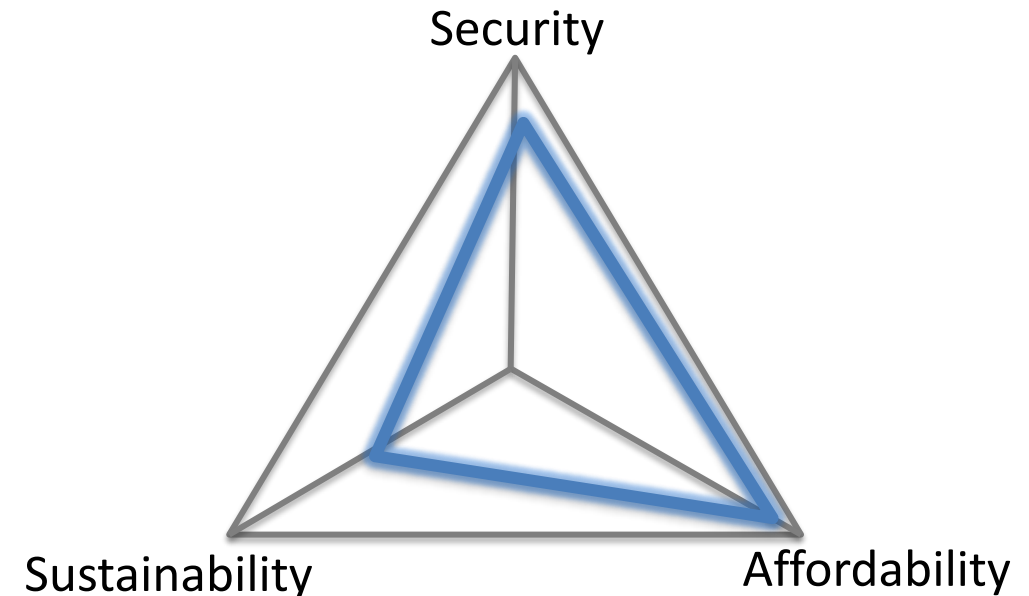
- The UK's focus within the energy trilemma has shifted significantly.
- Until 2020: the emphasis was strongly weighted on sustainability.
- Regulators assumed energy would remain affordable and the global market would supply as required.



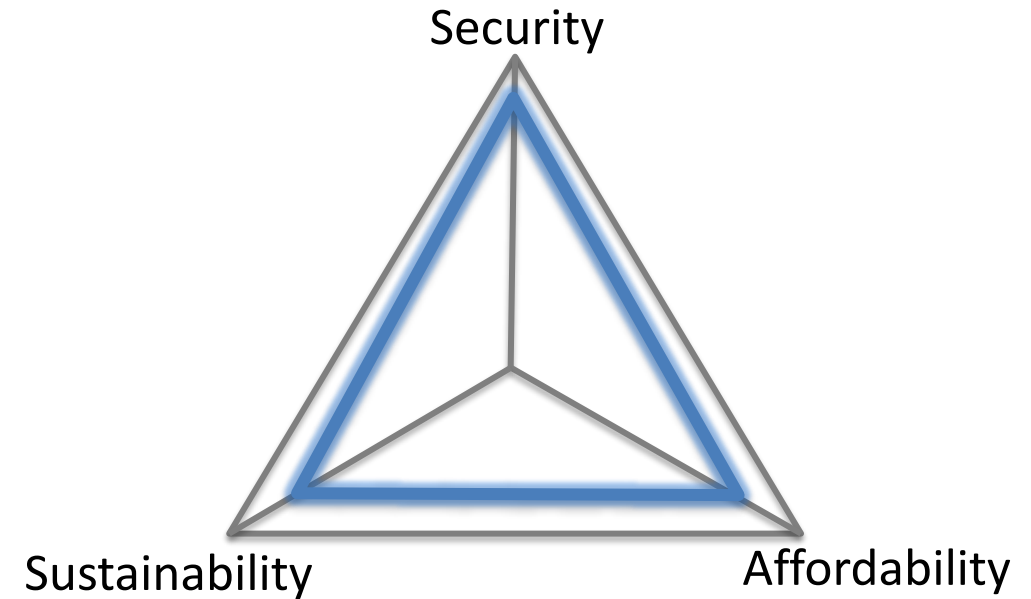
- 2022: Russia invaded Ukraine, followed by sanctions on Russian exports of gas to Europe.
- Russia supplied 30% of EU's gas at that time, so supply was required from other sources. This challenged the UK's energy security.



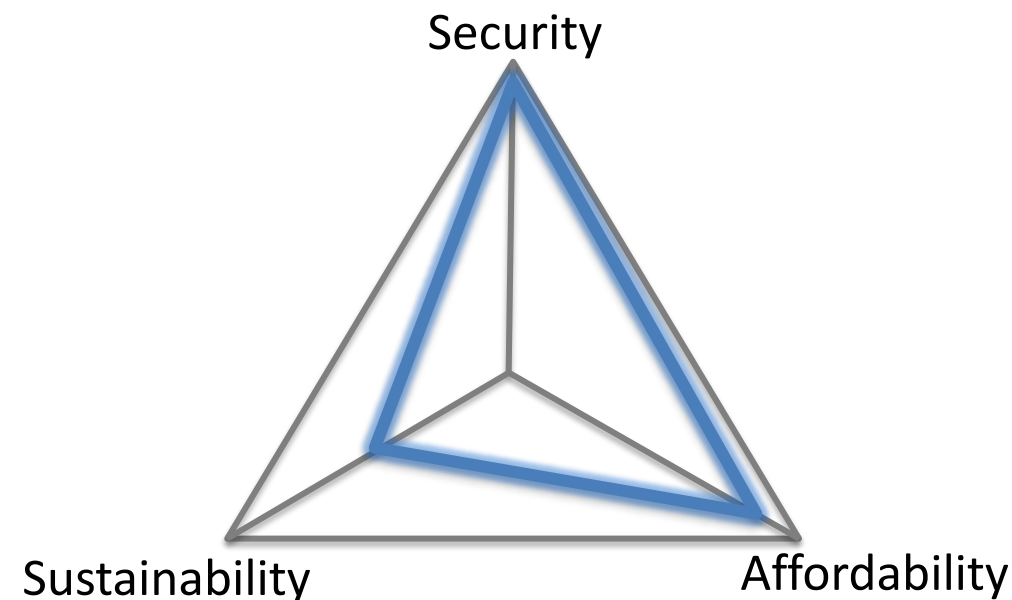
- In 2022/23 the cost of living increased significantly, including energy prices.
  - Goods and energy prices were the main contributors to the rise in inflation<sup>1</sup>.
- The UK government responded with:
  - Energy Price Guarantee limiting energy costs to households.
  - Financial support for energy bills.



- Then as energy prices decreased, the UK seemed to be moving towards a balanced approach.



- Are we still in a balanced position in late 2025?
- Or are energy security and energy affordability going to influence policy and investment again?
  - In 2024, UK energy production fell by 6.5% while energy consumption rose by 2.6%.
  - That means importing more LNG, at higher CO2 emissions than the UK's North Sea gas.
- Energy security goals are overtaking global collaboration on decarbonisation.



- The UK's path to net zero depends less on technology and more on politics.
- Businesses, finance and the energy industry must plan for two very different futures.

## UK unveils 'carbon budget delivery plan' to get back on track for net zero targets

Ed Miliband says pushing for renewable energy and lower emissions will reduce household bills and boost economy



Ed Miliband has unveiled the government's plan to meet the UK's legally binding net zero targets. Photograph: Hollie Adams/Reuters

The UK government will go "all in" on clean energy and climate policy, the energy secretary has said, as he unveiled plans to put the UK back on track to reach its **net zero commitments**.

## Tories pledge to scrap landmark climate legislation



Becky Morton

Political reporter

2 October 2025 · 986 Comments

**The Conservatives have pledged to scrap the UK's landmark climate change legislation and replace it with a strategy for "cheap and reliable" energy.**

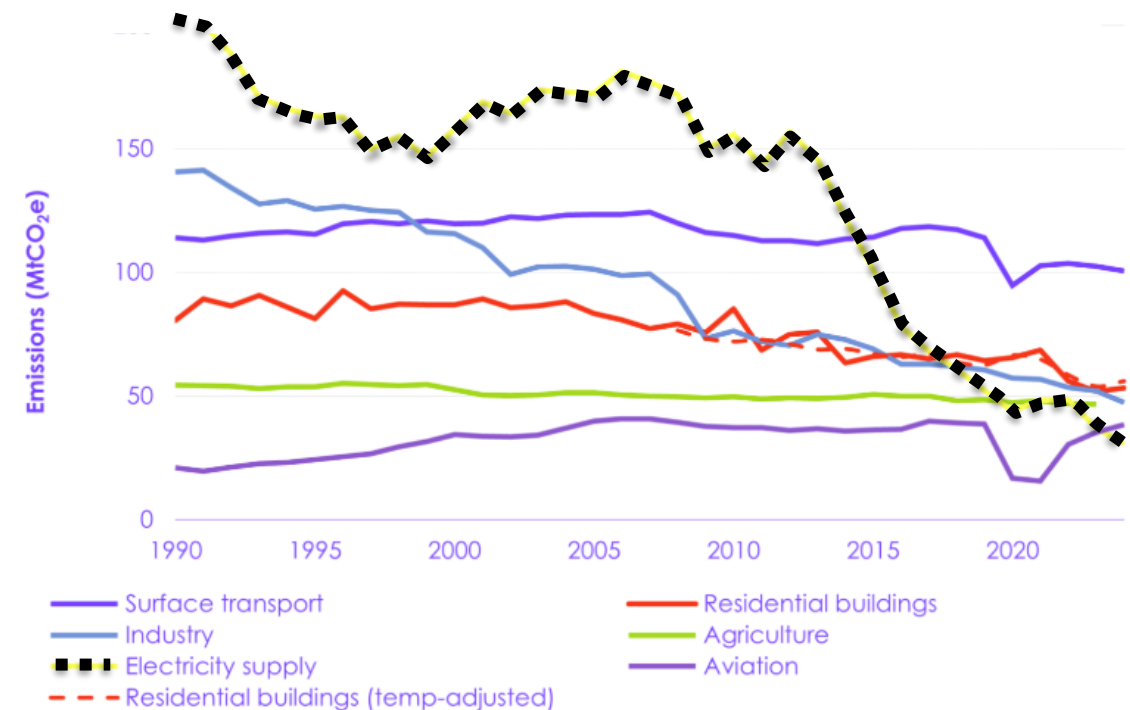
The Climate Change Act 2008, which put targets for cutting emissions into law, was introduced by the last Labour government and strengthened under Tory PM Theresa May.

Tory leader Kemi Badenoch said her party wanted to leave "a cleaner environment for our children" but argued "Labour's laws tied us in red tape, loaded us with costs, and did nothing to cut global emissions".

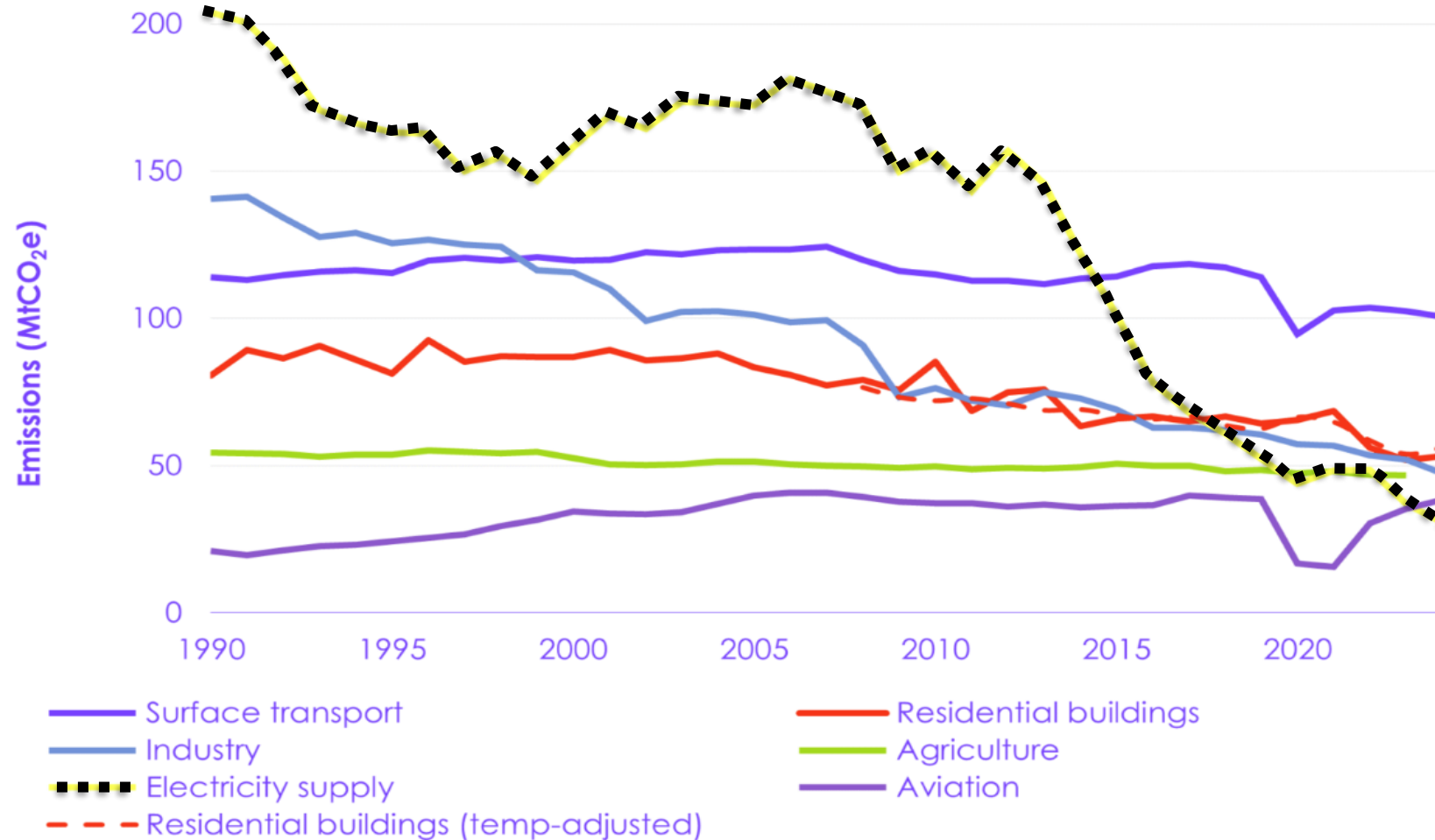
- The UK is still formally committed to reaching net zero by 2050:
  - Reducing greenhouse gas emissions
  - Decarbonising our energy systems.
  
- Plus ongoing investment in:
  - Renewable energy like solar, wind
  - Carbon capture and storage
  - Hydrogen as a fuel
  - Research and development for new technologies.

- The UK has made excellent progress.
- UK greenhouse gas emissions in 2024 were 50.4% lower than in 1990
  - Increased electricity imports and less production in the UK.
- UK shut its last coal power plant in September 2024.
- The UK is the first major economy to halve its emissions.

## UK emissions by sector since 1990



## UK emissions by sector since 1990



- We need to address concerns about the rapid pace of change:
  - Job losses in oil and gas, and manufacturing
  - Will the UK be less competitive than countries with less strict standards?
  - Are we losing industries without their replacements being ready?
  - Are renewables a good long-term investment, at high interest rates?
  - Are we becoming too reliant on the US, Norway, China, Qatar?
  - Will our lifestyle change: flying to holidays? Our cars? Our food?
  
- A ‘just transition’ approach ensures that the affected people are considered by those making decisions
  - Lessons from another transition: the end of the UK coal industry in the 1980s.

- The UK needs a diverse energy mix to secure a supply to homes and industries.
  - Imports: electricity from Europe; gas from Norway and outside our region
  - Solar, wind, plus gas with carbon capture and storage
  - Even with clean electricity, we need similar backup gas-powered generation in 2030, compared with today.
  
- Physical security is also essential:
  - Gas pipelines sabotaged
  - Cyber-security threats from nations, criminal organisations, and hackers
  - Supply chain security, ensuring access to spares/repairs of critical infrastructure.



- As we import gas and LNG, changes in global energy prices affect UK consumers
  - Reducing our reliance on volatile gas markets could lower energy costs.
- However, removing oil and gas from the UK's energy system will be expensive:
  - Levies to support renewable energy will be £10-15 billion each year to 2030
  - This can be increases to electricity bills, gas bills, and/or taxes.
- In the second half of 2024, UK gas prices were 34% below the EU average and electricity prices were 19% above the EU average.
- In the Autumn Budget, will the government remove the Energy Profits Levy early, aiming to promote more UK gas production and less LNG importing?

- Examples of policies in place:
  - A clean electricity system by 2030
  - A Net Zero target of 2050
  - North Sea Transition Deal
  - A National Energy System Operator - upgrading the electricity and gas networks
  - Great British Energy - a publicly owned clean power company
  - The UK Emissions Trading Scheme - a price on carbon emissions.
  
- And under consideration:
  - Phasing out new fossil-fuel cars and vans by 2030
  - Phasing out new gas-fired boilers for new homes.

- Consider the world's energy future:
  - All energy types will remain in the mix
  - Renewables will grow the fastest
  - Coal will decline the most
  - Under any credible scenario, oil and natural gas remain essential
  - Can we supply a 'just energy transition' to the UK? Also to less developed nations?
  
- From the IEA: **“No country is an energy island, and no country is insulated from the risks of climate change.”**



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