

The Future of Energy: Revolution or Evolution?



“I don’t want you to be hopeful, I want you to panic”



“We are in the midst of a mass extinction of our own making”

Go to www.menti.com and use the code 90 57 71

 Mentimeter

What items in your daily lives are made from hydrocarbons?

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Morning

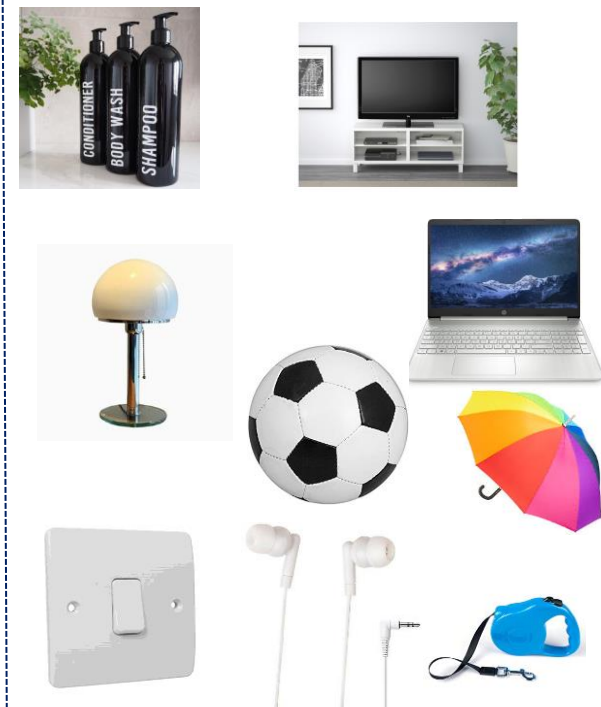


Afternoon



Headlights & roads

Evening

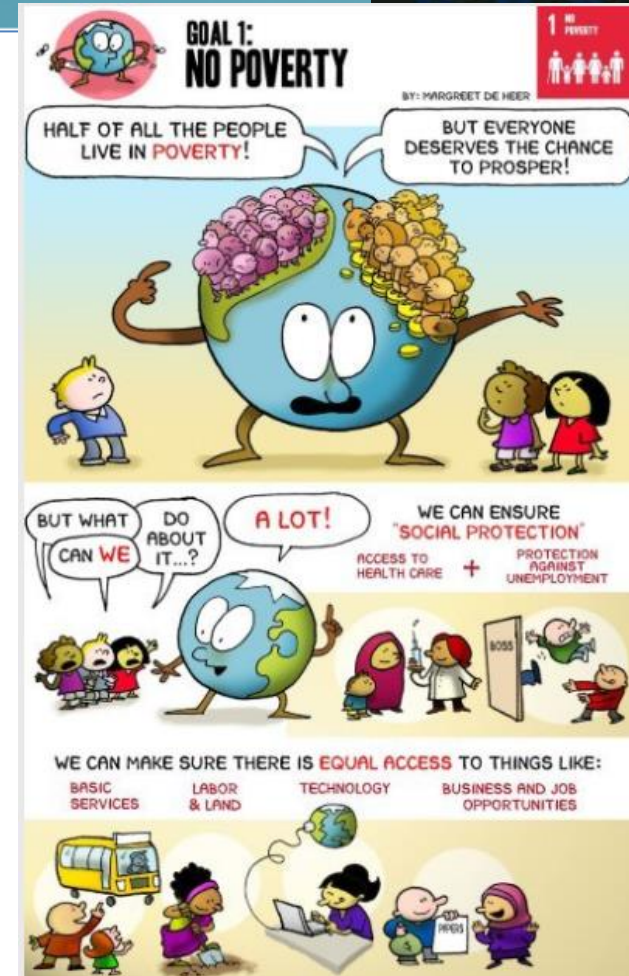


What does Sustainability mean?



- “Meeting the needs of the present without compromising the ability of future generations to meet their own needs”
- United Nations 17 Sustainable Development Goals (SDGs)
- Global framework for international cooperation (signed by 193 countries)

THE GLOBAL GOALS For Sustainable Development

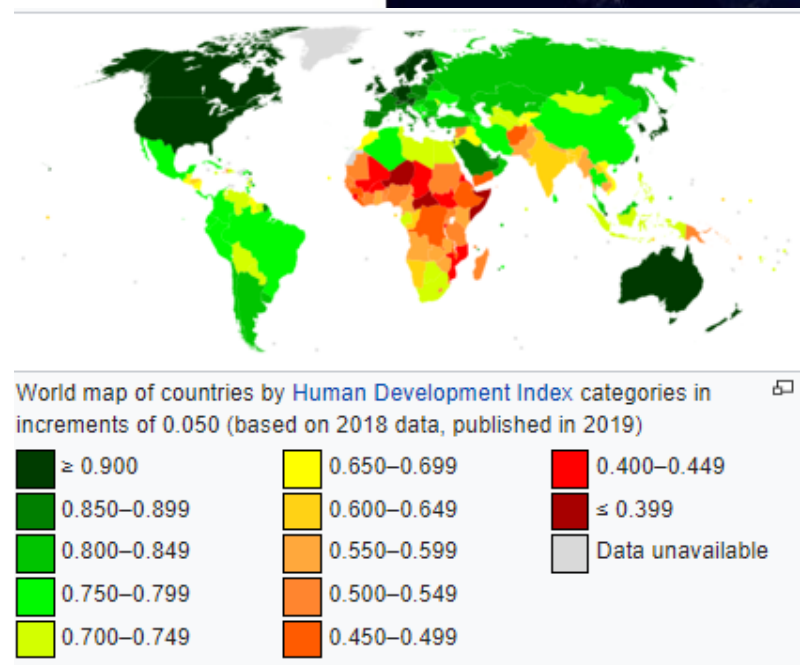
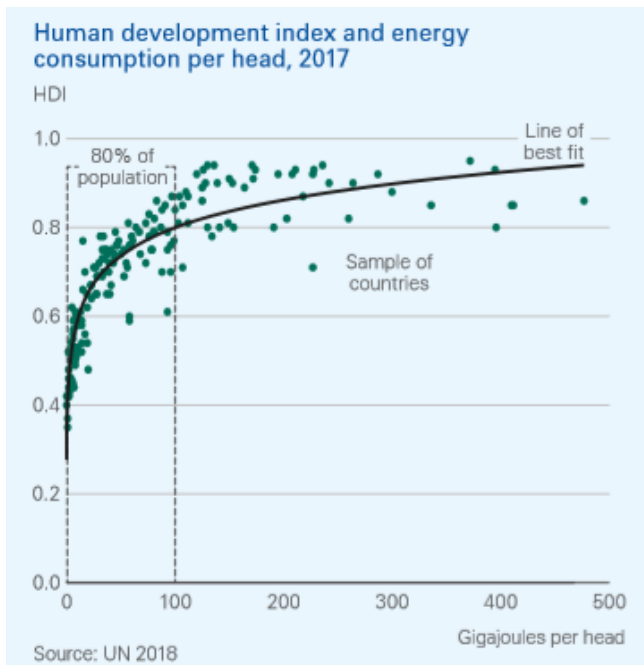
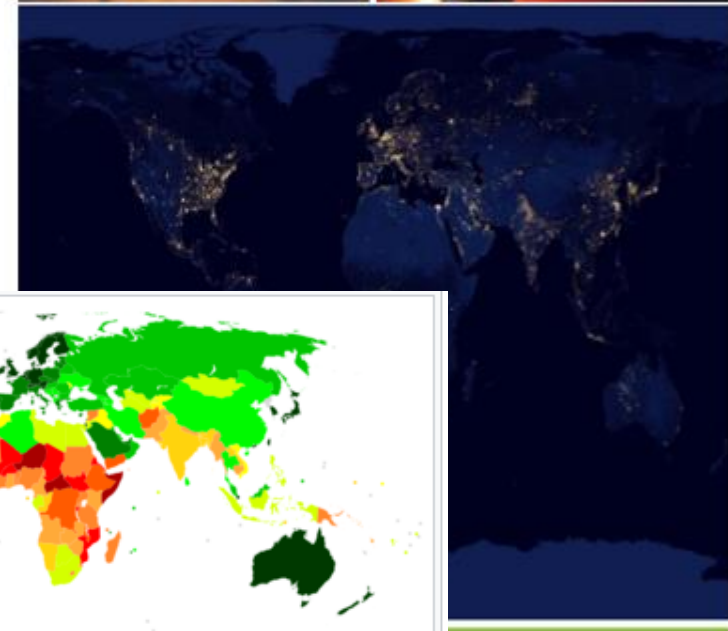


**END EXTREME POVERTY.
FIGHT INEQUALITY AND INJUSTICE.
TACKLE CLIMATE CHANGE.**

Energy Poverty



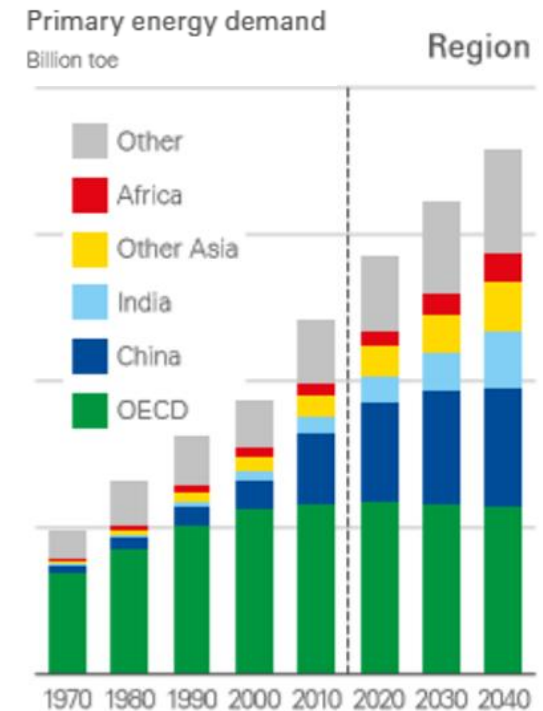
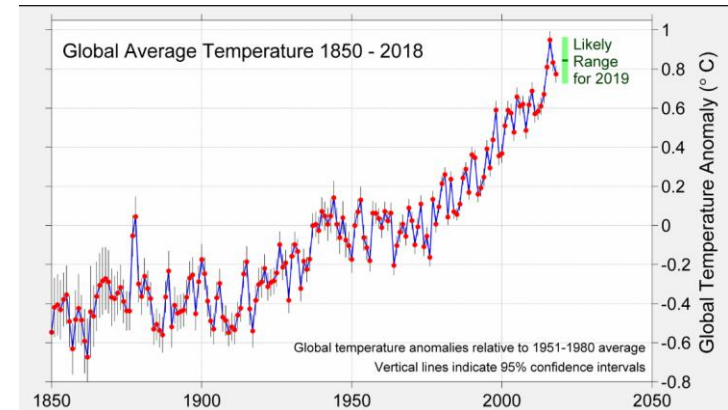
- “Energy is central to nearly every major challenge and opportunity the world faces today.” United Nations
- Energy poverty is a lack of access to modern energy services In 2018, 620 million people in Africa did not have access to electricity and 730 million relied on unclean fuel (e.g. wood, animal waste) for cooking



Climate Change vs. Energy Demand



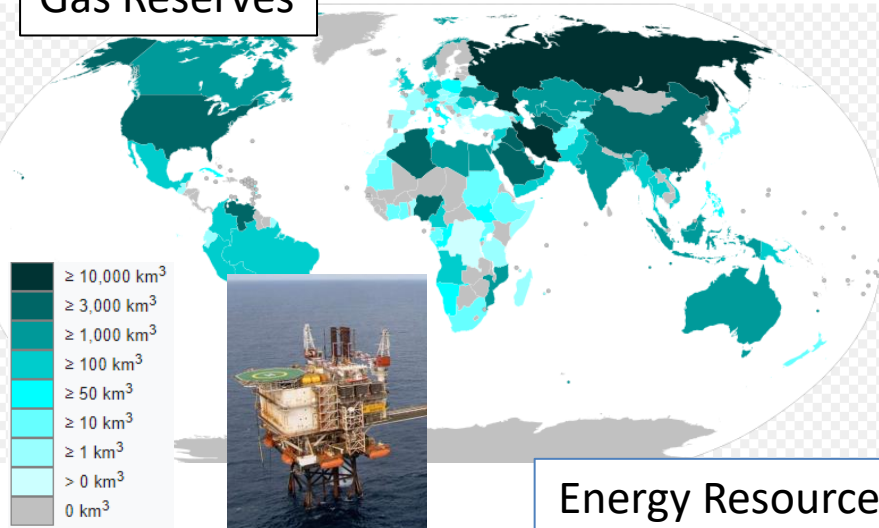
- UN SD Goals aim to limit climate change. 189 countries have now signed up to the Paris agreement, taking action to limit global temperature rises to below 2°C
- Global Energy demand continues to increase as poorer countries develop and population increases
- UN Sustainable Development Goals strive to increase the quality of living for many people in poverty around the world



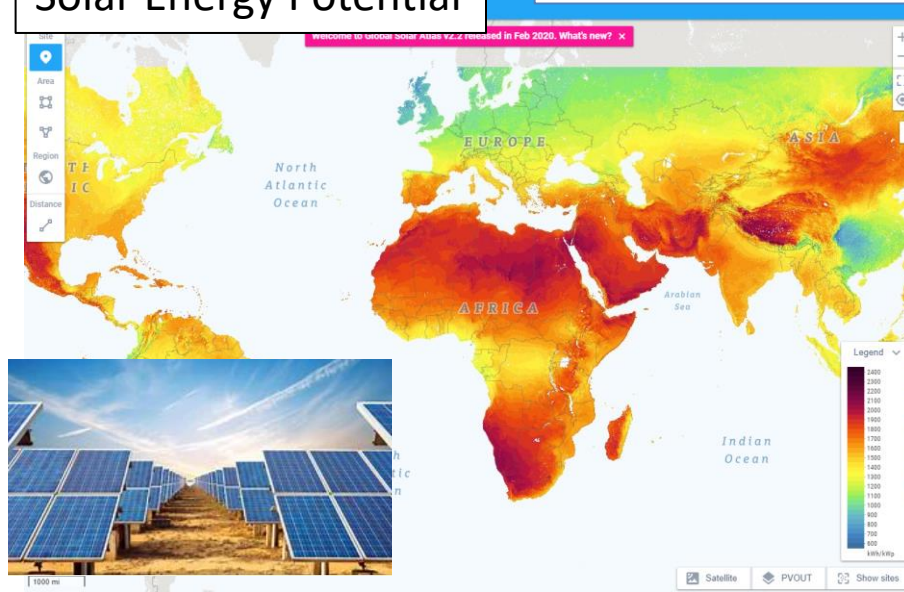
Energy Sources



Gas Reserves

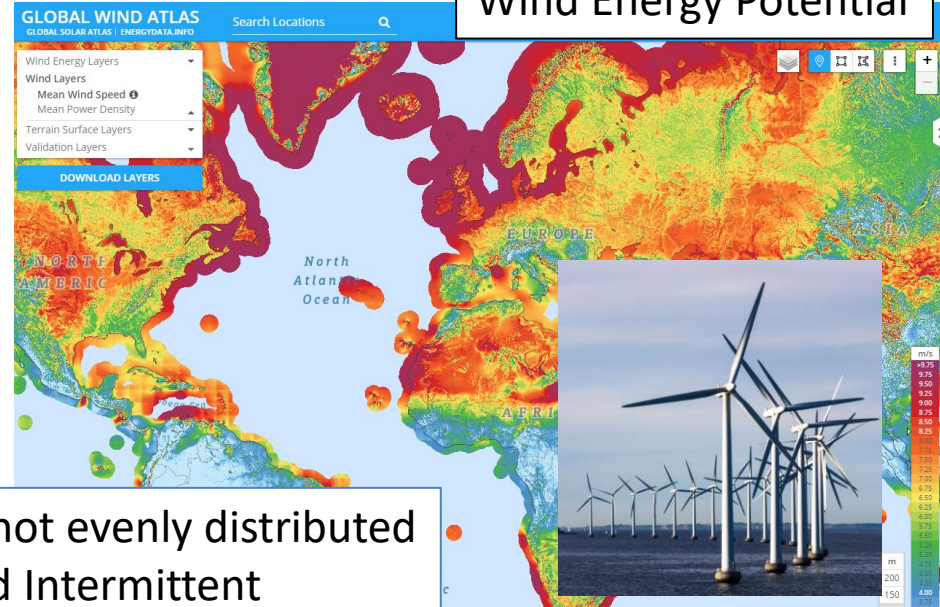


Solar Energy Potential

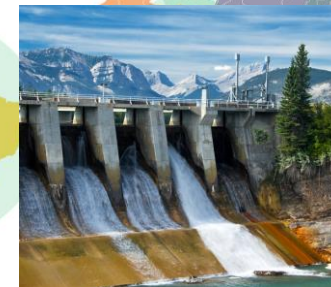
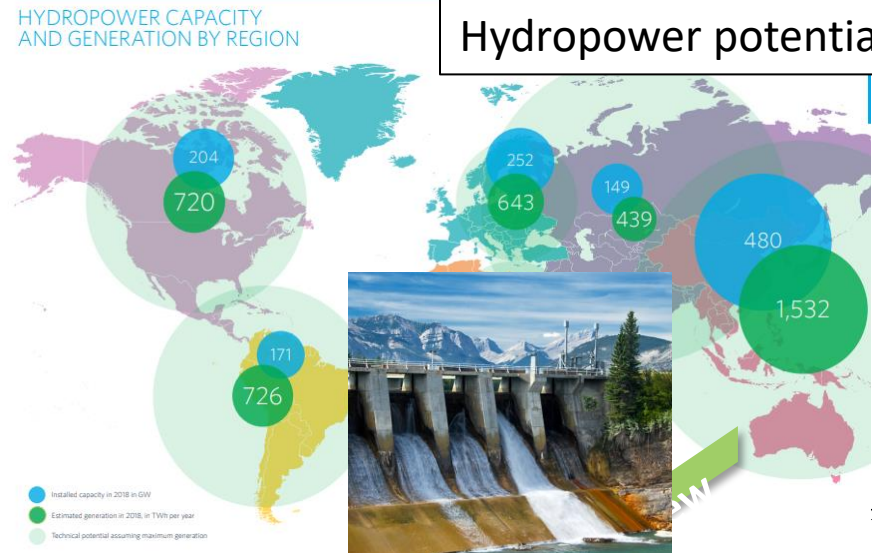


Energy Resources not evenly distributed
Solar/Wind Intermittent

Wind Energy Potential



Hydropower potential

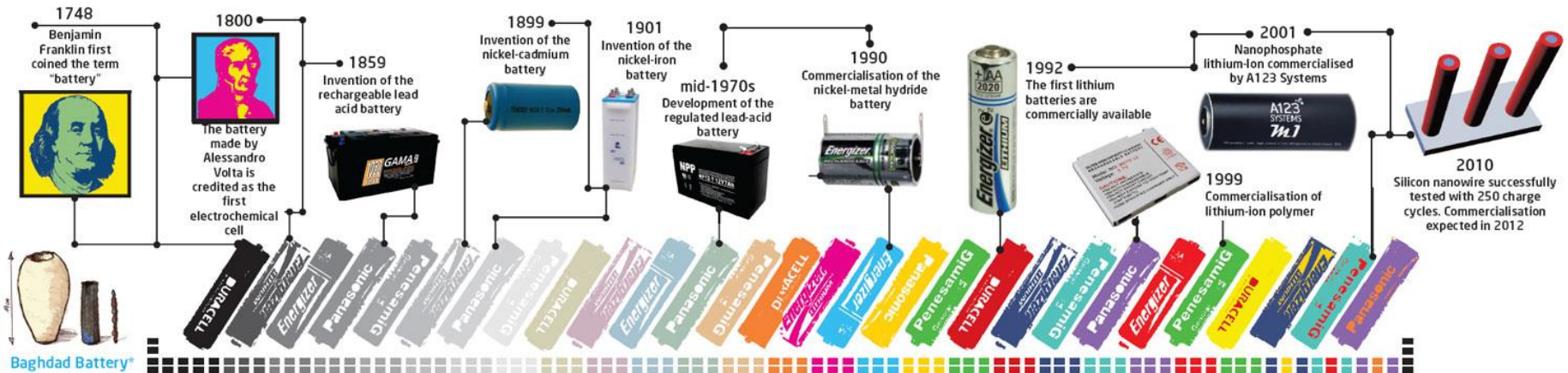


- UK Electricity requirement: ~100,000MW/day
- Require at least 25% storage capacity for reliable solar/wind power generation
- In 2019 biggest UK battery storage site 50MW (half size of a football pitch)
- Pumped hydropower also good storage

Tesla 129MW Battery storage, S. Australia



HISTORY OF THE BATTERY



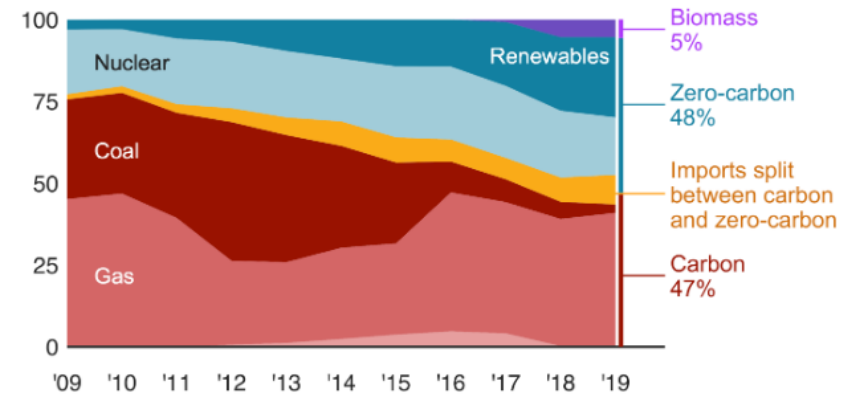
*There is a possibility that the battery was invented twice. Discovered by German archaeologist Wilhelm Konig on the outskirts of Baghdad, terracotta jars with a copper sheet inlay and an iron rod. These two combine to form an electrochemical couple in an electrolyte, the building blocks of a battery. The jars are believed to be 2000 years old.

Sources: Telegraph, reneweconomy.com.au, upsbatterycentre.com

- The UK has committed to reduce CO₂ emissions to zero by 2050, known as the “Net Zero” ambition.
- The UK already reduced its CO₂ emissions by 40% from 1990 to 2018
- The UK has started producing more electricity from “clean energy” than fossil fuels
- Rapid cost reduction has driven economic development of wind & solar power in UK.
- As part of Net Zero UK will need to be generating 75 GW offshore wind power by 2050 vs. just 8 GW today.
 - 7,500 turbines, 2% of seabed

Clean electricity is outstripping carbon-based

Percent of Britain's electricity generation by source

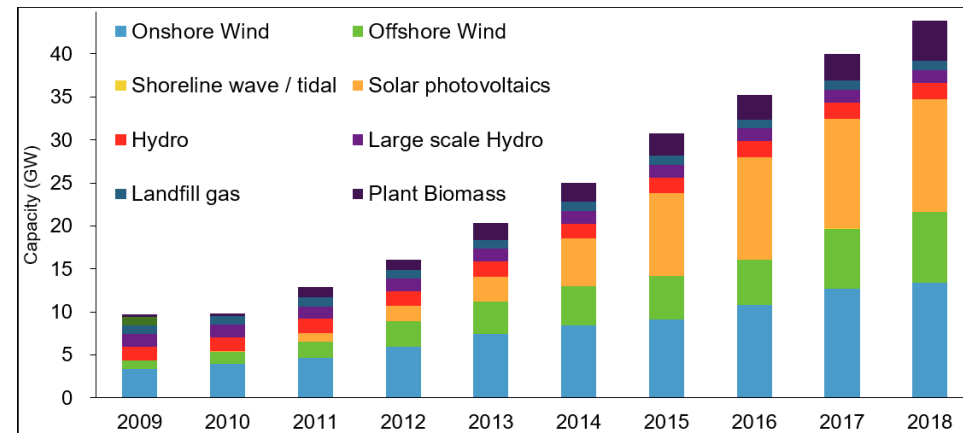


Data for 2019 is for the first five months of the year

Source: National Grid

BBC

GOV.UK Energy Trends



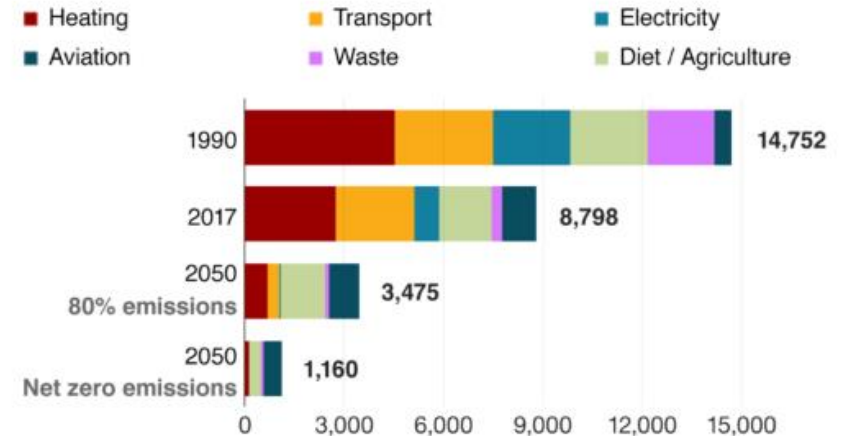
Net Zero UK -Why will it take to 2050?



- It requires many new government policies and individual change of habits. We need to become “Net Zero” ready
 - In 2019 only 7% car sales electric cars
 - Currently 80% of homes are heated by gas
 - 20,000 hectares/yr tree planting required (1/5 of UK agricultural land usage change)

Household emissions in 1990,2017 and 2050

Annual emissions, kilograms of CO₂



Source: Climate Change Committee/BEIS (2019)



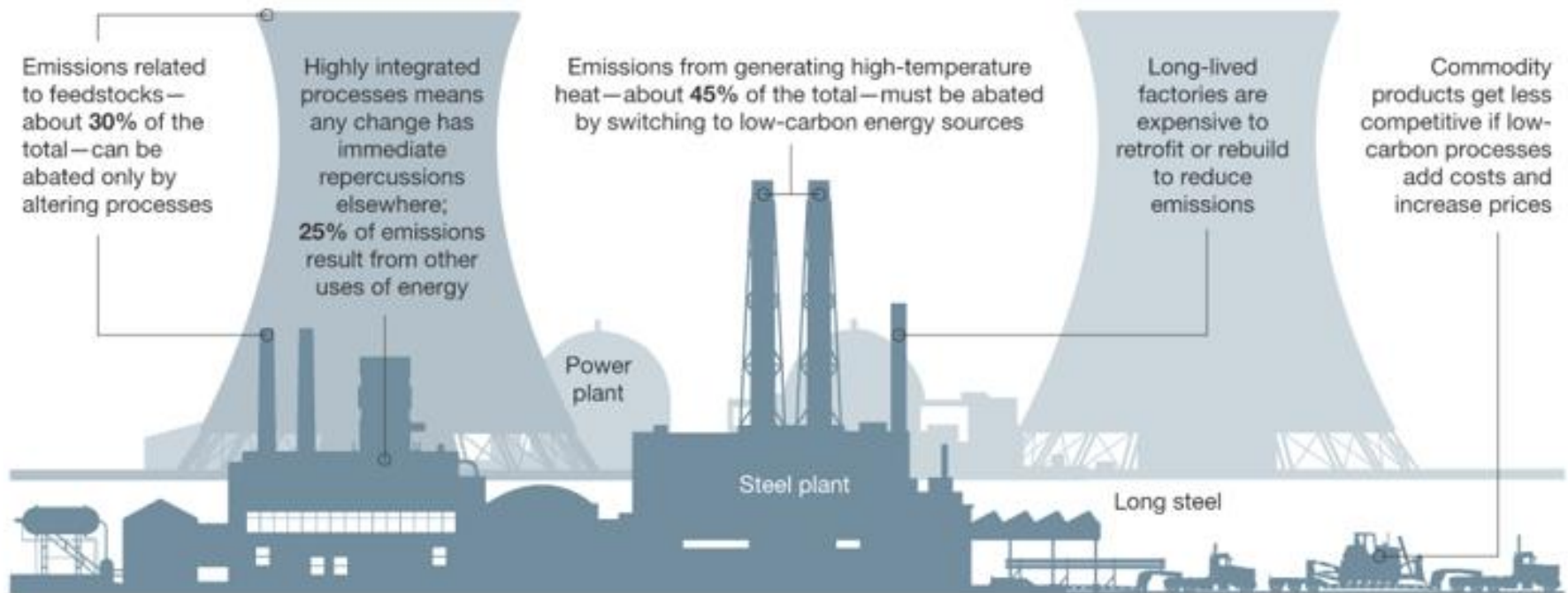
- The energy transition is expected to cost 1-2% of GDP per year (~£30bn/yr)
 - NHS 7% GDP per year, Education 4% GDP, Defence 2% GDP per year
- The UK “Climate Change Committee” agree some fossil fuels will still be needed even in 2050

Hard to Decarbonize Industries



- Almost 45 percent of industry's CO₂ emissions result from the manufacturing of cement, steel, ammonia (cleaning products, fertilizer), and ethylene (plastics).
- “Carbon capture” has therefore been identified as an essential part of Net Zero

Steel process, example

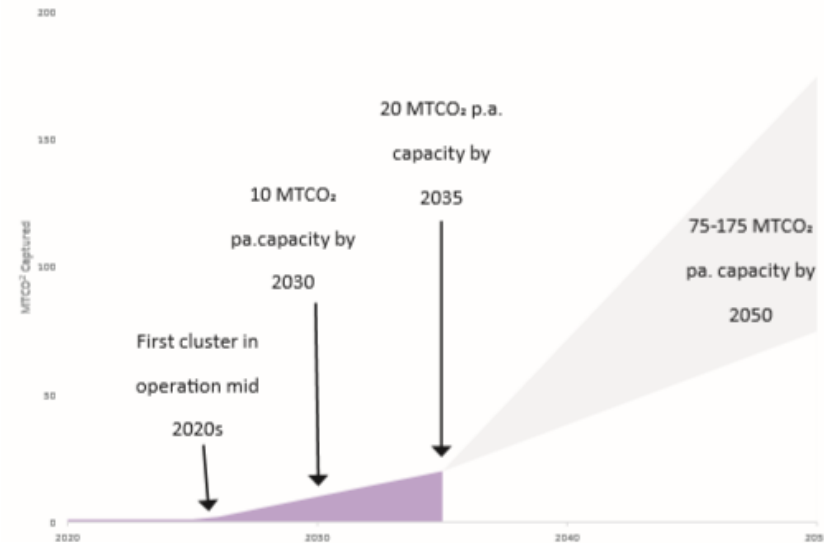


Carbon Capture and Storage (CCS)



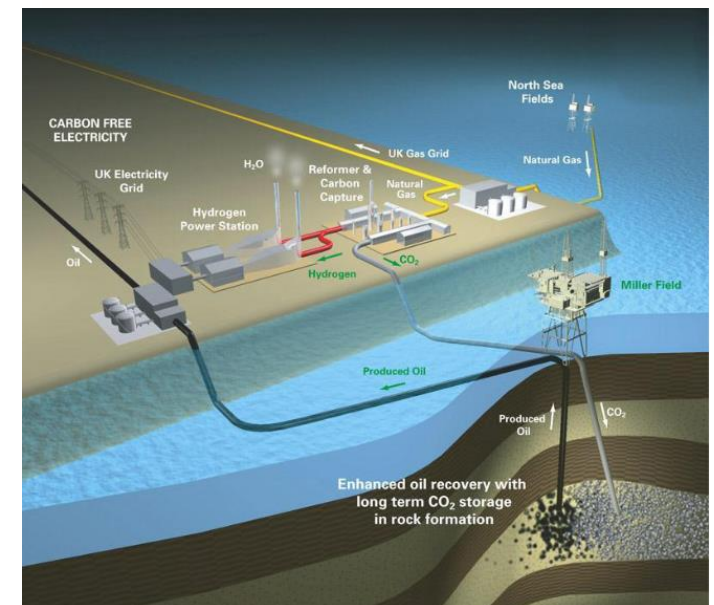
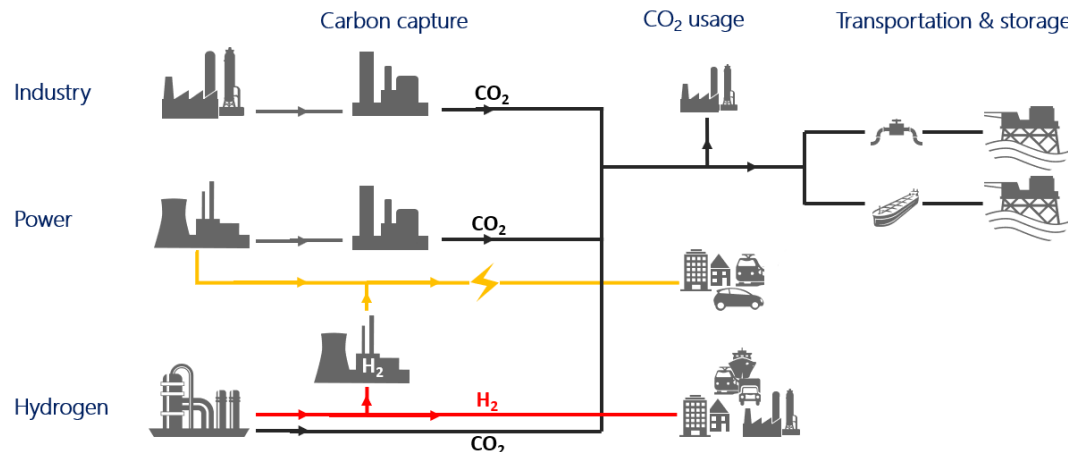
- CCS is the process of capturing waste carbon dioxide and transporting it to a storage site, where it cannot enter the atmosphere, normally underground
- This allows you to reach net zero even with some continued fossil fuel use where required
- UK has lots of storage potential in depleted North sea oil and gas reservoirs
- CCS needs to be developed very quickly

Required UK carbon capture rate p.a. (CCC)



Carbon Capture, Usage & Storage (CCUS)

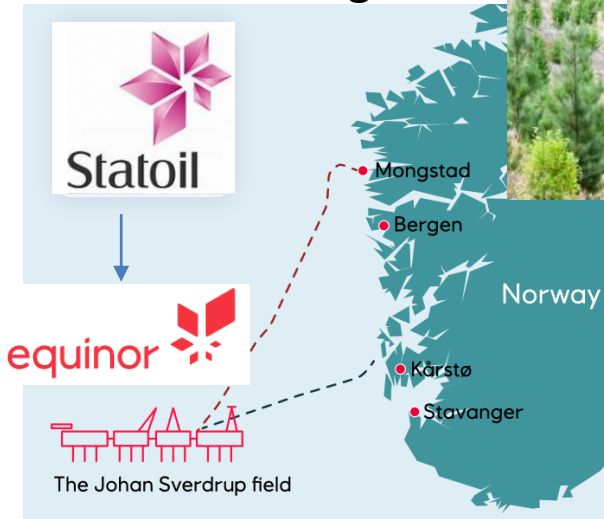
Key roles across industry, power and hydrogen



How will the Oil & Gas Industry adapt to Net Zero 2050?



Emission Reductions & Offsetting



Oil & Gas
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Energy

Electric/Hydrogen Vehicle Charging



Renewables & Battery Storage

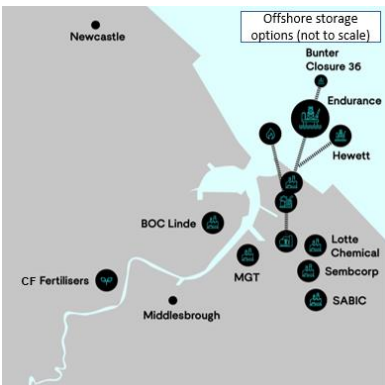


DONG
energy

↓
Ørsted

Carbon Capture & Storage

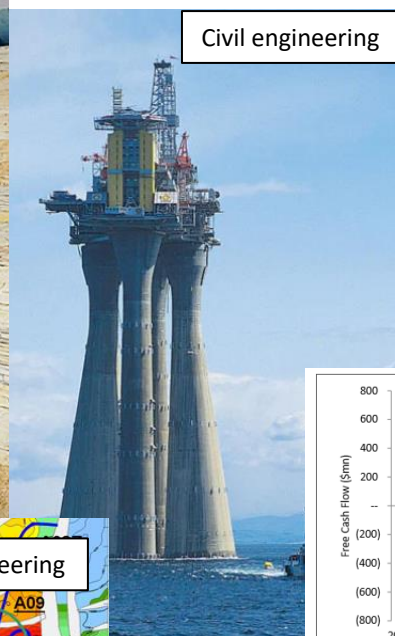
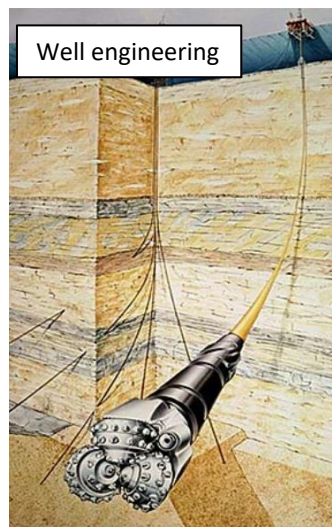
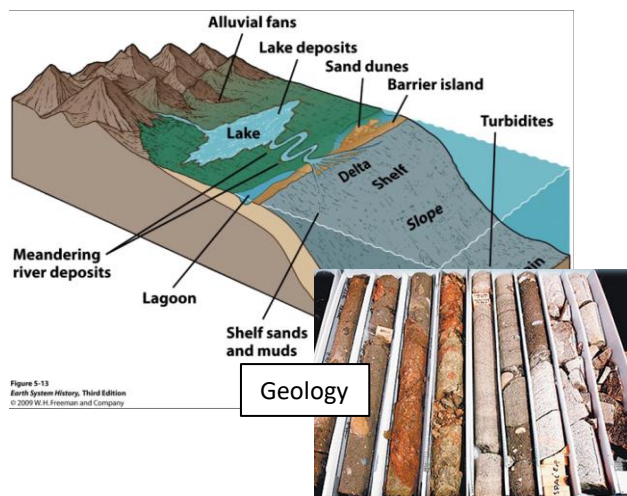
Net Zero Teesside



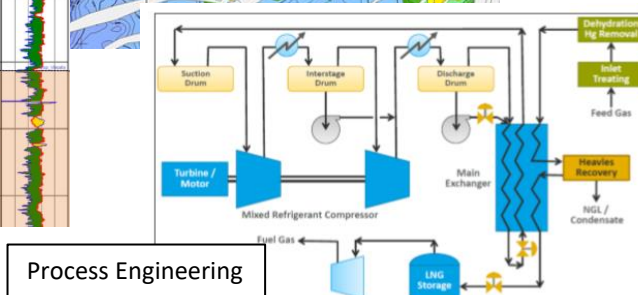
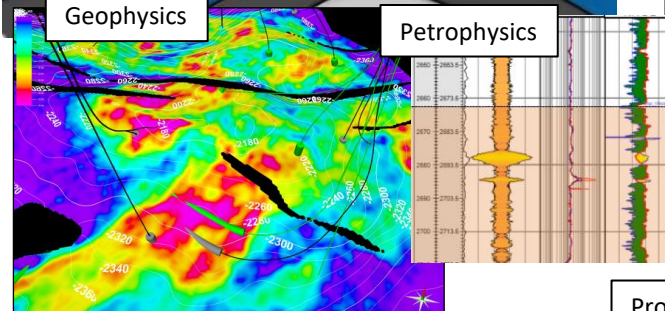
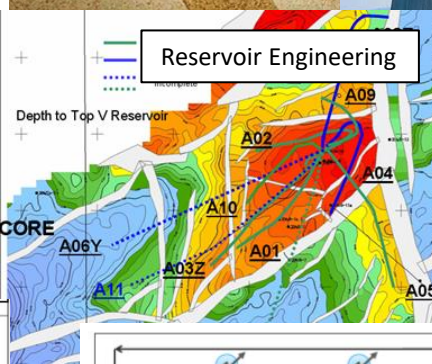
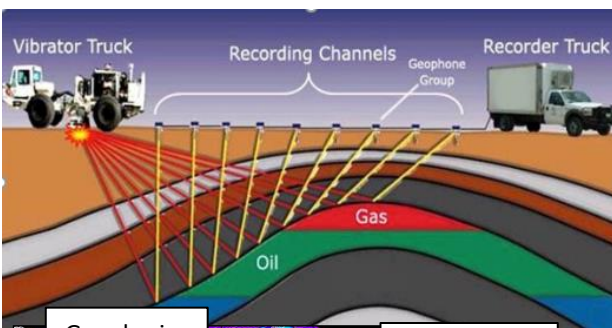
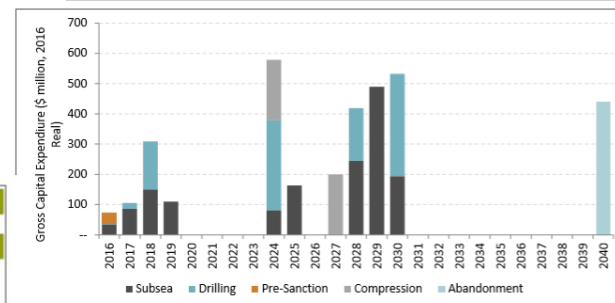
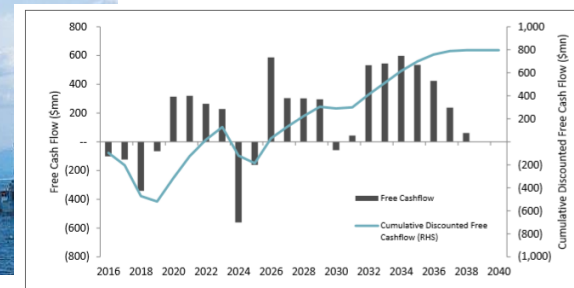
Energy Industry: Traditional Jobs (only 3-4% offshore)



Skill requirements: Maths, physics, chemistry, geography, economics, statistics, computer science



Health & Safety
Environmental Impact
Accounting
Economics
Commercial
Law



Energy Industry: Developing Technical Areas



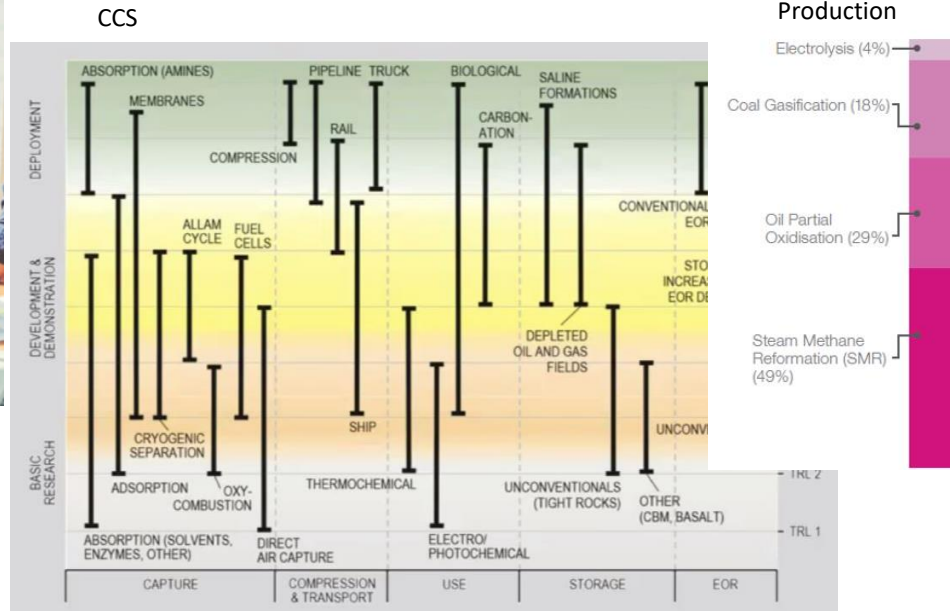
Augmented Reality



Big Data, Coding, Artificial Intelligence



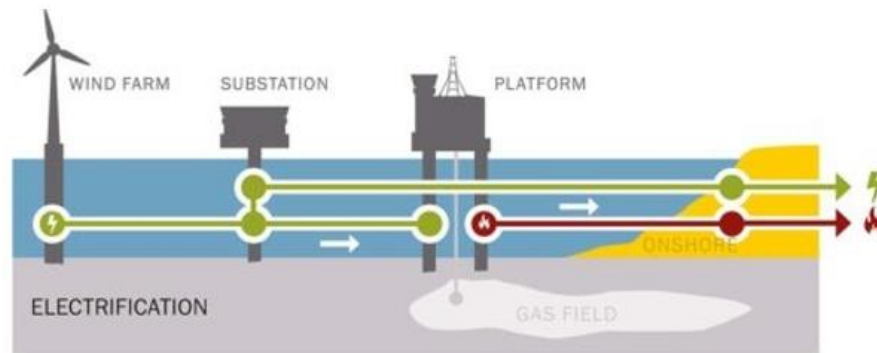
Carbon Capture & Storage & Hydrogen Technology



Wind Technology



Electrification



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