NERC Hackathon Two – Recovery

1 Introduction

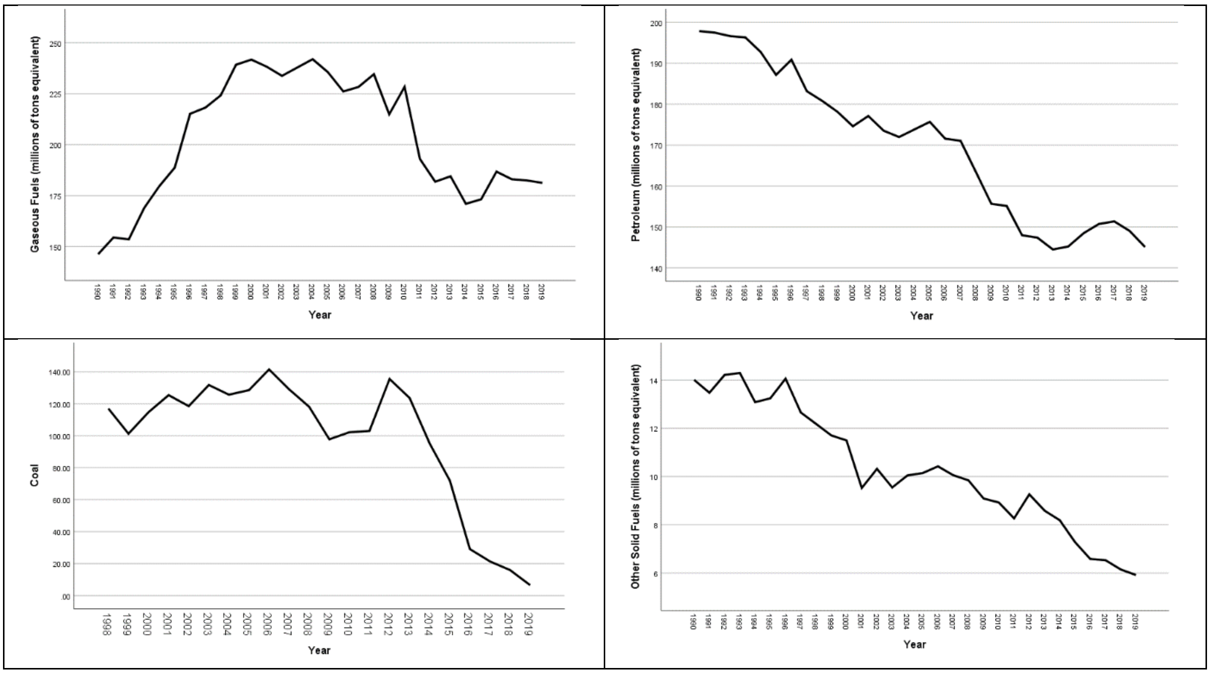
In the description of Hackathon Two it states that “lockdown restrictions have currently delivered both a 5% reduction in emissions, and a 14% reduction in GDP”. Clearly if we wish to drastically reduce our emissions then following a lockdown strategy would be catastrophic to our economy and in the long term to our wellbeing. It follows that another approach needs to be found. One solution might be the **mass production of floating wind turbines and storing any excess energy produced in the form of hydrogen**.

2 Methodology

This is both a literature review and some thoughts.

3 Results

Emissions come from many sources; the main sources being industry, electricity generation and traffic. An example of industries contribution to CO_2 emissions is the creation of cement where $CaCO_3$ is heated giving CaO (cement) and CO_2, it is usual for the heat required in this process to be generated through the burning of coal, oil or gas which in turn generates more CO_2. With electricity generation coal, oil and gas are burnt creating electricity and CO_2 and similarly with traffic oil (petrol and diesel) is burnt generating movement and CO_2. CO_2 helps heat up the planet in what is known as the greenhouse effect. If this continues ice locked up in the Arctic and Antarctic will melt leading to the rise in sea levels and the flooding of low-lying cities and land. Table 1 shows the sources of CO_2 emissions in the UK.



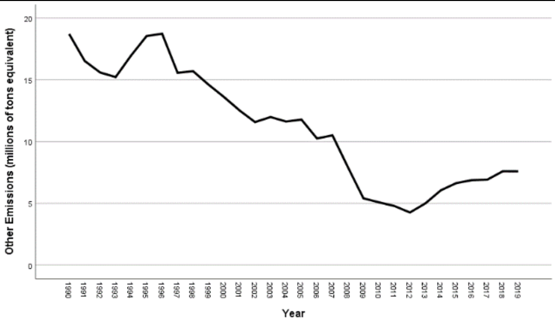
 	

Table 1: Sources of CO2 emissions; Gaseous Fuels, Petroleum, Coal, Other Solid Fuels and Other Emissions by year

CO_2 is not the only emission that has a negative impact on humanity. Traffic creates a vast array of pollutants that have been shown to be harmful to human health. Whereas people's quality of life [1] and mental health [2] are not negatively impacted by moderate levels of traffic pollution, there is however evidence that high levels of pollution can lead to death [3][4]. A week association has been found between childhood cancers and early exposure to traffic pollution [5]. Many studies have linked traffic pollution to heart problems [6] [8][10][11][12][13] and that this might be more severe in people with diabetes [7] [9]. It has been shown that long term exposure to traffic pollution harms lung function [15] [16] [17] and that this might be worse in children [14] [19]. It has been estimated that exposure to high levels of traffic pollution could bring forward death by 2.5 years [18]. The increasing incidence of childhood Asthma have been linked to traffic pollution [20] [21] [22], though good air-conditioning systems in the home can lessen this problem [23]. There is no evidence that adults are affected in a simpler way [24]. There is even evidence that traffic pollution may increase the risk of Rheumatoid Arthritis [25].

The lockdown has reduced the amount of traffic on UK roads considerably resulting in less traffic pollution. Table 2 shows the reduction in pollutants NO_2 and $PM_{2.5}$ due to lockdown. If the reduction of these pollutants was permanent, then perhaps this would lead to a positive health outcome. This could be achieved by moving to electric cars and away from petrol and diesel cars.

Month	**Mean NO_2 ug/m^3**	**Mean $PM_{2.5}$ ug/m^3**
January	25.73	12.48
February	14.79	10.16
March	15.83	8.69
April	14.05	14.09
May	8.93	9.70
June	8.46	6.68

Table 2: NO_2 and $PM_{2.5}$ pollution levels from traffic in 2020

Electricity generation has seen a gradual move from burning coal and oil, the largest generators of CO_2, to using alternative sources of energy. Similarly, the amount of electricity generated from nuclear power has also reduced, most likely due to the fear of radioactive pollution and the very high cost of making this technology safe. To balance this the use of biofuels, wind and solar have all significantly increased, see Table 3.

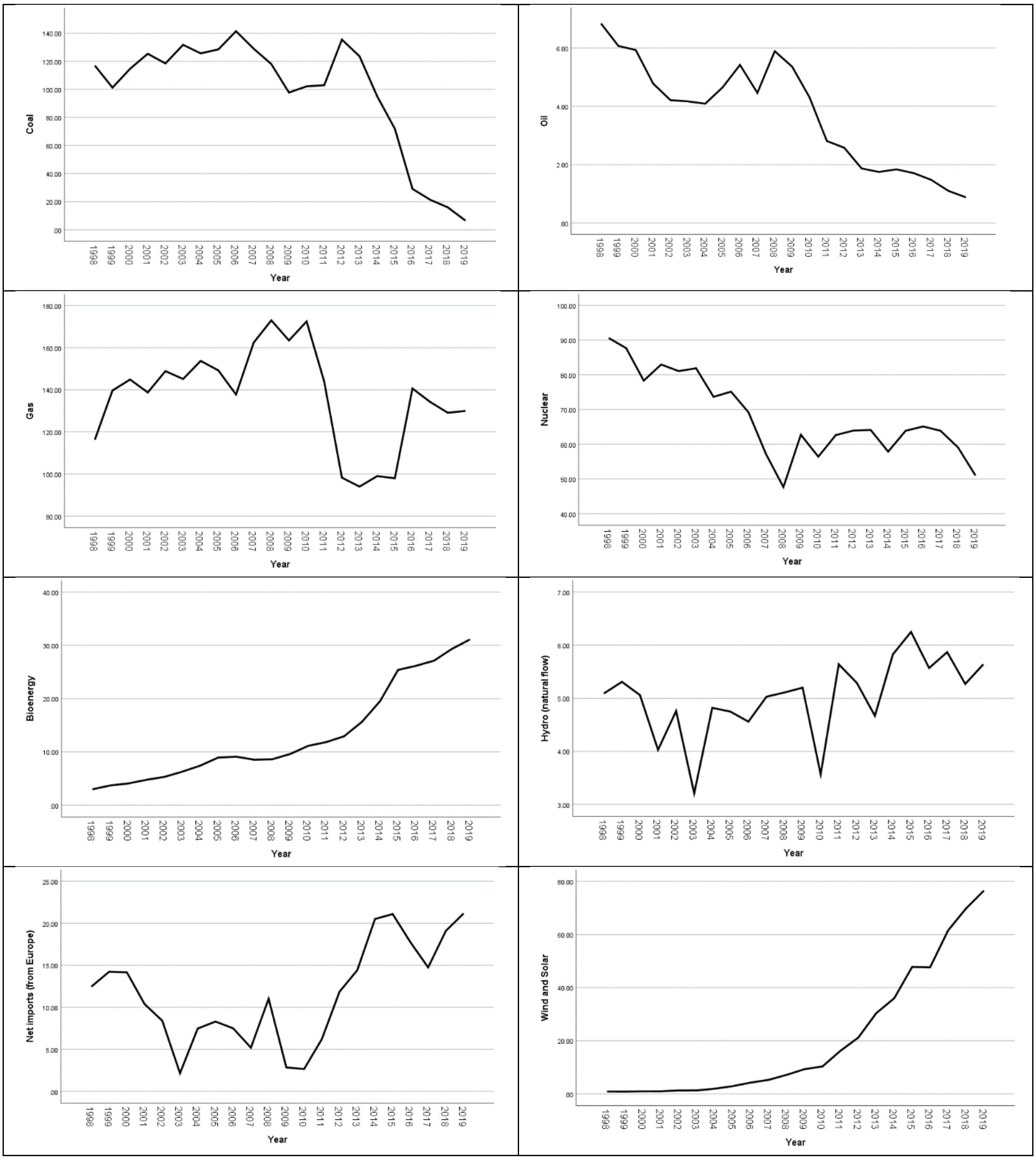


Table 3: Energy sources used in Electricity generation; Coal, Oil, Gas, Nuclear, Bioenergy, Hydro, Imports from Europe and Wind and Solar by year (source: Ofgem)

4 Conclusions

To drastically reduce the UKs CO_2 emission a bold new plan is required.

1. The UK could increase the amount of biofuel that is burnt to create electricity, but this would require the putting aside of vast tracts of land to grow such biofuels.
2. The UK could increase the amount of electricity generated from nuclear reactors, but this is both expensive and runs the risk of radioactive pollution.

3. The UK could increase the amount of electricity generated from hydro, but it doesn't have enough large rivers.
4. This leaves solar and wind as possible clean ways to generate electricity, but both suffer from the same problem, they can't guarantee to produce electricity when it is needed.

The solution often proposed for using more solar and wind power is to store electricity in batteries when the sun shines and the wind blows making this stored energy available when needed. This may be a feasible solution, but another is to **store the excess energy as hydrogen (H_2)**. Using excess energy to break down water (H_2O) into hydrogen (H_2) and oxygen (O_2) leads to interesting possibilities. It would allow the UK to move away from an electricity generation model that always tries to balance supply with demand to a model where the UK generates as much electricity as possible and then converts the excess into hydrogen (H_2), the oxygen (O_2) being discarded as it is too dangerous to store in large quantities. In this case hydrogen becomes a cheap waste product and such a useful cheap waste product will find a use much as the waste product from lamp oil production, petrol, was found a use. An example may be to add the hydrogen (H_2) to the natural gas (CH_4) used in millions of homes reducing the CO_2 emissions from cooking and central heating. Initially this would require no adjustment to the gas appliances in UK homes but as the amount of hydrogen (H_2) in the mix increased adjustments would have to take place. Such an adjustment has already taken place in the UK in the past when the UKs gas supply was changed from town gas (CO/H_2) to natural gas (CH_4). Another use might be to replace petrol and diesel to power cars. Another is to generate the heat required in the making of cement. Another use could be to generate electricity when both sunshine and wind are low. And yet another possibility could be to make space flight cheap kicking off another industrial revolution. However, this all requires a very cheap source of renewable energy… which is where this report comes to.

It may be possible to create cheap renewable energy by **mass producing floating wind turbines**. The UK has a large coastline and wind turbines could be sat out to sea, but away from shipping, out of sight. Floating turbines would not be affected by sea level rising. To make production cheap make the floating platforms out of concrete. To make the concrete float fill it with large bubbles of air. Create these large bubbles of air from big hollow spheres made of plastic, the rubbish plastic that can't be recycled. This removes unwanted plastics from the environment as well as helping generate renewable energy. The important thing is to scale up mass production of these floating turbines to make them as cheap as possible. Solar panels could also be placed on the floating structure and as the UK is fond of sailing add mooring posts so people can sail out to them and have a picnic on them.

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