Question: Should we stop oil production now? Discuss both sides of the argument.

Title: Our Fatal Alliance with Oil Production

1. Introduction

Wars, Death and Destruction. Security, Development and Habitat. All are things we have oil production to thank for. The 21st century is the era of oil; everything we do, have and see has oil behind it. Are the consequences of oil significant enough to stop production? And do we have the resources to do this right now? In this essay, I will discuss the consequences of oil production, the state of available alternatives and the economic importance of oil.

2. Offshore Oil

Offshore oil platforms are essential in meeting the world's growing oil demands. In Asia-Pacific, countries like India, China, and Indonesia turn to offshore projects due to limited land resources and abundant coastlines. The rapid population growth in these regions drives the demand for electricity and petroleum products, with the projected 2.1 trillion cubic feet increase in gas consumption in Japan, Australia and New Zealand between 2001 and 2025. (Glenn, 2005) Interestingly, these platforms can act as artificial reefs and habitats that support marine life. In fact, around 30% of reef habitats in the Gulf of Mexico are formed by these structures. When decommissioned, the steel structures are left in place to continue benefiting marine creatures, reducing costs through a practice known as reefing (Chapman, 2022). Additionally, oil platforms serve as

Figure 1: Source: Wired (Nast, 2021). Example of a thriving ecosystem on oil platform pillars.

practical platforms for scientific research and monitoring in areas where traditional vessels are insufficient.

Despite this, offshore oil poses significant dangers, with explosions a prominent one. The Piper Alpha Disaster in 1988 stands as the "deadliest offshore oil rig accident in history" (Praveen, 2019), claiming the lives of 167 people in Aberdeen, Scotland. The catastrophe was triggered by the removal of a pressure safety valve without proper communication between crews, resulting in a gas leak and subsequent explosion. A small oversight led to devastating consequences and a three-week-long fire. Occidental, the responsible company, was found to have inadequate safety measures, leading to revisions to regulations in place (Praveen, 2019). Explosions and leaks still occur, albeit with lower severity. A recent incident on July 7th, 2023, at the Pemex Oil Platform in Mexico resulted in the death of two workers, one missing, and six injuries due to an explosion (Reuters, 2023). The narrow margin for error on oil platforms means even the most minute mistakes can trigger highly destructive explosions, indicating how oil companies are continuously cutting costs by disregarding safety regulations.

Figure 2: Source: Offshore Technology (Praveen, 2019). Large fires consumed the platform as the 3-week-long extinguishing project goes on.

Offshore oil has another devastating consequence: oil spillage. The Deepwater Horizon Oil Spill, induced by a surge of natural gas igniting the platform, holds the record for the largest accidental oil spill, claiming the lives of 11 workers and injuring 17. This tragic event took place in the Gulf of Mexico on April 20, 2010, when a staggering 134 million gallons of oil were unleashed, impacting five U.S. states and over 2,100 km^2 of ocean area (Britannica, n.d). This led to the following consequences:

2.1. Health Damage

Multiple studies related to this oil spill have delved into the effects of oil exposure on respiratory health due to the release of sulfur, nitric and aromatic hydrocarbon gases.

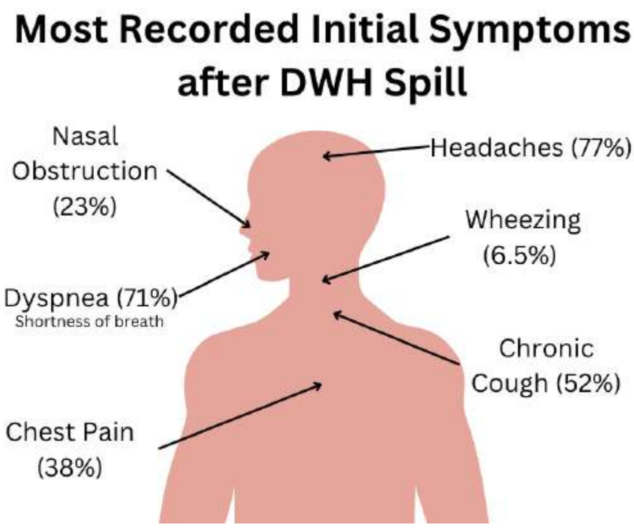

Figure 3: Common symptoms observed in 2,530 exposed subjects after the spill (D'Andrea & Reddy, 2013). A correlation between the frequency of oil inhalation and the development of these symptoms was found. (Alexander et al., 2018)

A follow-up seven years later showed that most respiratory symptoms seen in Fig. 3 persisted, with a striking "91% developing chronic rhinosinusitis," featuring fevers, facial pain, and excess mucus (D'Andrea & Reddy, 2018). Treatment involves surgical and medicinal approaches, which are costly and complicated (Vernick, 2023). These respiratory issues can harm pulmonary function, as seen in a 9% rise in severe pulmonary problems post-oil exposure (D'Andrea & Reddy, 2018).

Conversely, Gam et al. found no link between "Total Hydrocarbon Exposure" and lung function (Forced Vital Capacity) in 6,288 workers "1-3 years after the spill" (Gam et al., 2018), implying some conditions like dyspnoea and reduced lung capacity are temporary. However, all mentioned studies mostly relied on self-reported data, introducing recall bias that affects reliability.

Cancer, neurological, and reproductive worries arise due to high polycyclic aromatic hydrocarbon (PAH) levels during spills. Harville et al. (2018) examined 1,524 women aged 18-45, finding no strong spill-exposure ties to miscarriage or infertility, but found that 5.1% of women delayed pregnancy due to the spill.

2.2. <u>Endangerment of Animals and the Environment</u>

Exposure to spilt oil caused significant damage to the health and population sizes of bottlenose dolphins in Bataria Bay through direct contact, inhalation and ingestion of contaminated prey.

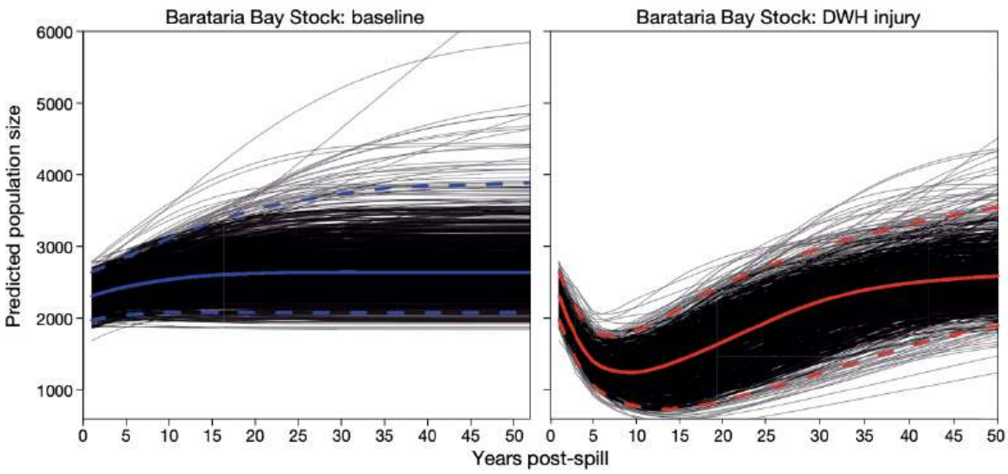

Figure 4: Simulated population trajectories for Bataria Bay bottlenose dolphin stock (Schwake, 2017) under baseline conditions (left) and DWH injury (right). Solid Blue and Red lines represent the median.

According to figure 4, the DWH injury dolphin population has shown a decline in populations for a median of 7.5 years after the spill due to several reasons. Bataria Bay dolphins were "5 times more likely to have moderate to severe lung disease" due to the toxicity and deficiencies in hormone production leading to infertility and hypoadrenocorticism (Schwake, 2017), meaning the adrenal gland produces insufficient hormones resulting in symptoms including diarrhoea, lethargy and vomiting (Van Lanen & Sande, 2014). On a positive note, 4 out of 6 experts agreed that a full recovery from most of these conditions would be made after 10-12 years (Schwake, 2017).

Figure 5 : Dead Bottlenose Dolphin Calf stranded in Louisiana. This area saw an increase in beached dolphins due to the spill. Photo courtesy of NOAA Fisheries (2021).

Marked as endangered by the NWF (2019), 20% of juvenile Kemp's Ridley Turtles present during the spill died from exposure. "Decreased mobility, exhaustion and dehydration" (Stacy et al. 2017) were some of the many symptoms experienced, reducing their ability to evade predators.

Figure 6: An oiled Kemp's Ridley Turtle being cleaned by Dr. Brian Stacey at the NOAA (2021).

Additionally, light exposure to oil was associated with hemolytic anaemia for birds, and avian mortality events are common following large-scale oil spills (Fallon et al., 2017).

Exposure to oil poses dangers not only to humans but to animals and their habitats as well. These creatures experience life-changing illnesses, deaths and many other terrible symptoms through no fault of their own, so it is imperative that oil production is stopped or made safer to mitigate these consequences.

2.3. <u>Financial Damage</u>

The Deepwater Horizon (DWH) disaster was an economic catastrophe on top of its environmental impact. The spill wreaked havoc on the thriving fishing industry in the Gulf of Mexico. It prompted a massive 225,290 km^2 fishing ban by the National Oceanic and Atmospheric Administration of the U.S. (NOAA Fisheries, 2021). This ban dealt a devastating blow, costing the industry a staggering US$2.5 billion (Walsh, 2010) as much of the seafood became contaminated or perished. Furthermore, the spill wreaked havoc on tourism, with the renowned Gulf beaches becoming undesirable tourist attractions (Reed & Travis, 2010). Over a three-year period, the spill had the potential to cause a whopping $23 billion in losses (Walsh, 2010), prompting British Petroleum to pay millions to promote unaffected beaches and compensate affected states. BP's financial woes were substantial, with more than $65 billion spent on cleanup, charges, and penalties (Bousso, 2018). Their stock price plummeted by 51%, resulting in the net worth of the company dropping by 55% as well. However, pity is hard to feel for BP due to their quick recovery to 87% of pre-spill net worth, as seen in Figure 7 below.

Figure 7: (Macrotrends, n.d.) shows the fluctuations of BP's market value over time. The market value of the company plummeted from 187.5 billion to 84.6 billion due to the spill. However, it quickly recovered back to 162.9 billion by 2014 and remains around this price. Drops in 2016 and 2020 occurred due to the 2016 financial crisis and COVID-19, respectively.

On the other hand, fishing communities struggled to recover. Even ten years later, oil contamination is present in fish in the Gulf, which will continue to affect the health of the people. Furthermore, reproduction rates have been found to be low even now, so fishing industries have not made a full recovery yet (ABC Action News, 2021).

It becomes clear that the local community ends up paying the price for the spill, facing potentially irrecoverable effects compared to the prospering oil companies. It is imperative that this oil production method is stopped as soon as possible to prevent these financial nightmares and, at the very least, stricter regulations to remove power from the oil companies.

3. The Fossilisation of Fossil Fuels

Fossil Fuels have dominated the transportation industry for centuries, especially through the rise of the steam engine during the Industrial Revolution. Since the 20th century, Oil has been crucial in providing energy security due to its energy density, versatility and widespread availability. It currently serves as a primary source of transportation fuels, as in 2019, 40% of all oil demand was consumed by road transport (BloombergNEF, 2020). However, in recent years, governments, companies, and scientists have come together to begin the battle of phasing out oil.

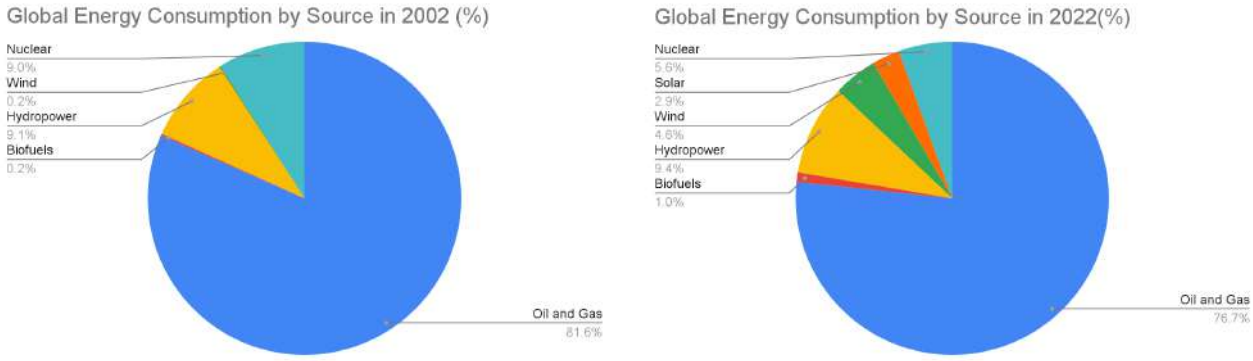

Figure 8: A reduced proportion of Oil and Gas, and more development in different sustainable energy sources is seen in the past 20 years. data from EIA (n.d.)

The graphs in Figure 8 are ample evidence that the world has already made a decision – oil is on its way out – now it's just a matter of replacing that 76.7% of Oil and Gas (EIA, n.d.) to achieve an oil-free future. All it requires is replacing using a substance that's ruining the planet versus using the resources we have in abundance to turn a turbine. Renewable energy sources are transformative in two transportation solutions: electric vehicles and hydrogen-powered vehicles.

3.1. Battery Electric Vehicles

The introduction of BEVs (Battery Electric Vehicles) has been the perfect companion to renewable energy implementation since these low-emission sources can charge the lithium batteries in the cars to power them to drive. With brands like Tesla and BYD dominating car markets, BEVs' prominence has increased to the point that 14% of new cars sold in 2022 were electric (WWF, 2016).

On the positive, BEVs have no combustion elements (unless hybrid), meaning emission of CO_2 (global warming), NO (Smog) and SO_2 (Acid Rain) will be low or non-existent, as even in the worst-case scenario, BEVs still produce 37% less CO_2 than traditional vehicles (Gimbert, 2020). These vehicles will also pose lower running costs since electricity (Helmers & Marx, 2012), especially that produced by renewable energy, will cost less than oil, and the increased energy efficiency of lithium batteries (Kim et al., 2019) helps the car drive for longer while using the same amount of space as a fuel tank.

However, this technology does pose some challenges. The most fundamental issue posed is the infrastructure changes required, as reaching total BEV usage will require replacement of old gas stations and the creation of charging stations at sufficient distances. Rural areas are disadvantaged over cities, as charging stations may be few and far between due to slower development. Traditional cars will be left obsolete in scrapyards, and many families cannot afford to switch to electric vehicles, though these issues can be solved with recycling and government subsidies, respectively. The battery technology used also requires significant development due to short-battery lives (Kim et al., 2019), ethical concerns involving child labour used in lithium farming (McKie, 2021) and the high costs of production. Currently, battery units account for ⅓ of BEV costs of production (WWF, 2016), so development in this aspect will also reduce the costs of these cars to make them more accessible.

The exponential growth of BEV usage is pertinent to prepare the world for an oil-free future as it replaces gas-based vehicles on the road. However, BEVs are only as clean as their power supply; China, having contributed to 33% of global GHG emissions in 2021 (IEA, 2022), has been a global frontrunner in this market (WWF 2016) due to the oil and gas resources used to power BEVs.

3.2. Hydrogen-Powered Vehicles

Green hydrogen, a game-changer in energy planning, boasts remarkable characteristics that make it desirable for many applications.

- **Clean and Environmentally Friendly**: With only water as its waste product The Economist (2021), hydrogen fuel offers high energy output without greenhouse gas emissions, resulting in a smaller impact on global warming and a cleaner environment.

- **Abundant and Renewable**: Locked away in compounds, hydrogen was difficult to obtain regardless of its abundance, but now, it can be derived from scrap aluminium and water (Stauffer, 2021). This innovative process allows for the resulting waste to create more hydrogen.

- **Energy Density**: With higher energy capacity than many fossil fuels (See Fig. 9 below), hydrogen's compactness surpasses batteries and oil tanks. Notably, ships benefit from hydrogen's density, supporting longer voyages with more available capacity. Ammonia, derived from hydrogen and nitrogen, boasts even greater energy density (12.7 MJ/L vs. 8.5 MJ/L for hydrogen) despite its handling challenges (Tullo, 2021).

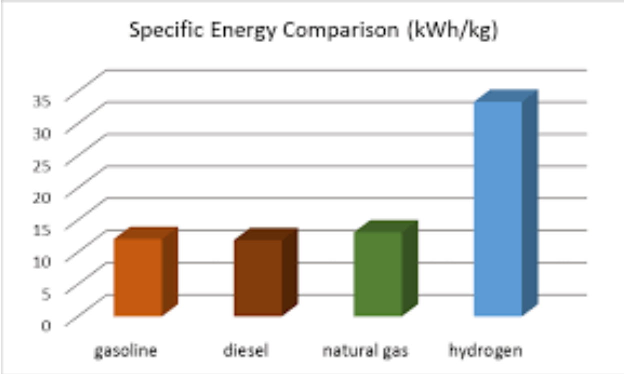

Figure 9 shows that Hydrogen has a significantly higher energy capacity than fossil fuels. (Department of Energy, 2018), meaning there is a higher energy density.

While hydrogen fuel may seem new, it traces its roots back to the 1800s as brown hydrogen from coal (Graham Dallas, personal communication, August 2023). However, mainstream adoption of the fuel of the future has been slow. Let's explore the reasons behind this delay.

- **Energy-Intensive Production and High Costs**: While contributing just 10% of global energy consumption in 2019 (Planete Energies, n.d.), The European Union projects spending 470 billion euros on green hydrogen by 2050 (Fickling, 2020). In 2022, 70% of hydrogen production was done using natural gas, and only 1% used low-emission methods (IEA, n.d.). Utilising surplus renewable energy can make production energy-positive and cost-free, offering storage and transport solutions (Graham Dallas, personal communication, August 2023). Still, with the current state of renewable energy, this seems very far in the future. Ammonia fuel, on the other hand, benefits from existing agricultural infrastructure (Tullo, 2021).

- **Politics and Lobbying by Oil Companies**: The trillion-dollar oil and gas industry has fiercely protected its interests, spending millions on lobbying efforts (Sayki &

Cloutier, 2023), which has influenced the prioritisation of hydrogen on legislative agendas. In contrast, countries like China, with less industry influence over the government, have taken the lead in global hydrogen supply.

- **Hydrogen Safety**: Safety concerns arise due to hydrogen's volatile and flammable nature. Pipelines can experience degradation and leaks, posing risks to human safety through asphyxiation or injuries from explosions and the environment (Najjar, 2013). Further advancements are needed in storage and pipeline construction to ensure safe handling. Still, solutions can be found, as we have dealt with volatile substances before, such as crude oil itself.

In conclusion, many of the obstacles facing hydrogen can be overcome through continued innovation. Industry professionals believe that hydrogen's versatility positions it as a pivotal solution in the transition away from oil. While it may not end oil production immediately, hydrogen will play a significant role in the future energy landscape.

3.3. Biofuel-Powered Vehicles:

For centuries, humans have used biofuels like cow dung and food scraps. Today, biodiesel from vegetable oils and animal fats is gaining popularity due to its environmental benefits and compatibility with diesel engines and the fact that it's cheaper and renewable (Doble & Kruthiventi, 2006). While its combustion emits greenhouse gases, plant-derived biodiesel's CO_2 intake during growth makes it carbon neutral, reducing global warming. It's sulfur-free, cutting acid rain and engine wear by 30%. However, 15% more nitrous oxides are released by biodiesel, and limited availability and land competition with food crops persist (Agarwal, 2005).

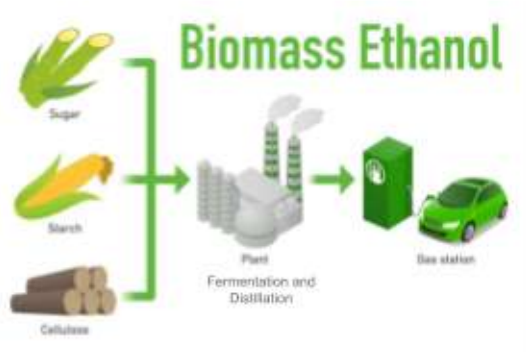

Fig 10: Infographic to show the stages in Bio-Ethanol Production. (Futuribles, n.d.)

Ethanol, another biofuel, burns cleanly with less CO, SO_2, and NO emissions, ideal for spark-ignition engines. However, ethanol production is slow, requiring specialist equipment and labour and hardware adjustments are needed in vehicles (Morganti et al., 2018).

Biofuels aid oil-poor countries like Pakistan, which is estimated to save US $200-400 million annually by 2030 through ethanol (Harijan et al., 2008). They also benefit food-rich nations like the USA and Brazil, using corn and sugarcane, respectively. However, challenges remain in production methods and food industry impact, and many more advancements are required for this to act as a reliable fuel for vehicles.

In conclusion, like the energy sector has renewable and nuclear energy developments to replace oil, the transport sector has BEVs, Hydrogen and Biofuels for different use cases. Richer nations choose to utilise BEVs, whilst lower-developed nations choose to use biofuels. Support for these technologies is strong, with Hydrogen and BEVs receiving high amounts of government funding, along with oil companies, such as Ørsted, initiating renewable energy programs themselves (Sophie Bevan-Thompson, personal communication, August 2023). However, all three of these fuels require significant advancements in order for oil-free, widespread use. There are also many critical applications for crude oil where adequate replacements have not been found, such as pharmaceuticals, fertilisers and aviation fuels, which all require deep exploration.

4. The Economic Importance of Oil

Every nation on Earth will feel the impact of oil's departure. Over the next four years, Middle Eastern energy exporters are projected to gain US$1.3 trillion (Ebrahim, 2022), in a region renowned for its oil dominance since the early 1900s. The Gulf Cooperation Council countries, including Kuwait, Bahrain, Oman, Qatar, UAE, and Saudi Arabia, experienced exponential growth during oil booms (Saif, 2002), transforming barren landscapes into towering skyscrapers and even Olympic stadiums. While economists fear the dreaded "Dutch Disease," where a booming oil industry stifles other sectors, the Middle East seems immune to this problem. Take Saudi Arabia, for instance, which shifted from a diverse economy to heavily relying on oil production, leading to the blossom of manufacturing and agriculture (Bajwa et al., 2019). All GCC countries actively invest in various industries, from tourism to real estate, to decrease their oil dependence while highlighting that the "Dutch Disease" is not a prevalent issue.

The global oil industry employs millions worldwide, with China alone contributing 86 million jobs (Statista, n. d.). In the UK, the industry supported around 375,000 jobs in 2014, accounting for 1 in 80 jobs at the time (Soubry and Leadsom, 2016)). Transitioning to an oil-free future poses challenges, as current oil workers face a skills mismatch. From my interview with Sophie Bevan-Thompson (personal communication, August 2023), I learnt that Scotland's Oil & Gas Transition Training Fund is helping affected workers find new opportunities in sectors like railway engineering, welding, and wind turbine engineering. However, renewable energy employment is growing four times faster than the overall UK job market (Lawson, 2022), so redirecting oil workers into the booming renewable energy sector is crucial for a smooth transition to an oil-free future.

Oil is politically important as well. Before the war on Ukraine, Russia exported 8 million barrels of oil daily (Adolfsen, 2023), which stopped due to sanctions.

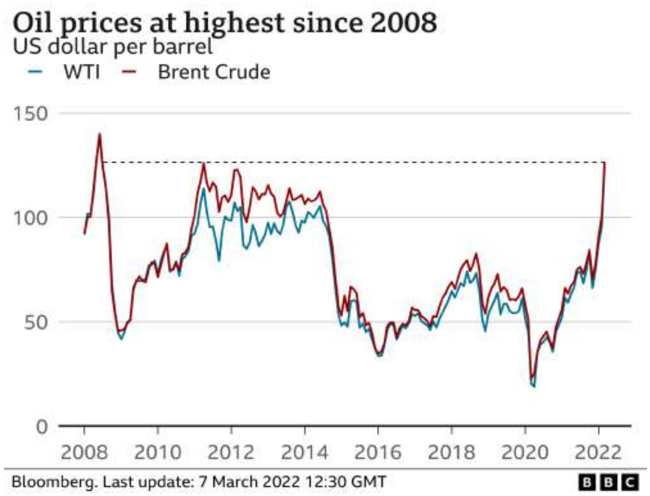

Figure 11: Oil prices surged to the highest they have been since 2008 due to Russian Oil Sanctions. (BBC News, n.d.)

Due to increased oil prices, EU nations reliant on Russian oil, faced energy rationing, limiting heating during bitter winters, while rising costs triggered inflation, further deteriorating quality of life. These situations prompt nations to rethink their oil dependence and seek alternative energy sources like nuclear and renewables. Russian oil exports are now "back to pre-war levels"(Cooban, 2023), highlighting the privilege that comes with being oil-rich. On the other hand, the Persian Gulf War's devastating effects on oil-rich Iraq (Grossman, 1996) highlight the vulnerability of oil-abundant states. Having oil gives a country power but also makes it a target.

5. **Conclusion:**

Oil production is a detriment to our society, but it cannot stop now. Offshore oil destroys communities, health and ecosystems, but without it, our society would crumble as our oil-free alternatives are insufficient to support us. Renewable energy makes up for less than a quarter of energy consumption, while transport alternatives we currently have are costly, dangerous and require significant advancements over the next few years. On the other hand, countries largely reliant on oil, like GCC countries, are starting to branch out to other industries. Also, retraining schemes are starting all over the world to transfer oil skills into renewable energy skills, signalling that the world is moving towards an oil-free direction. Currently, we need oil for everything we do, but with the world's trajectory, an oil-free future does not seem impossible. Oil production must be stopped, and the consequences would be devastating if we didn't. With time, our fatal reliance on oil can be reduced, but right now isn't the right time for it.

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