

The impact of technological advancements on global warming

By Roshan Joseph

Author Biography

Roshan Joseph is currently a high school student at Bateen world academy, Abu Dhabi. He enjoys both maths and physics and hopes to be able to research both in further education. He enjoys swimming and is a part of the swim squad in school.

Abstract

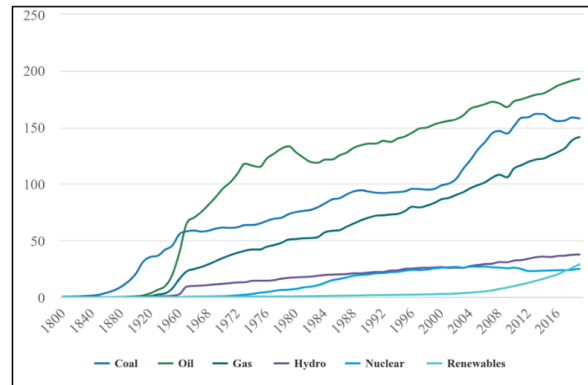
Global warming, or climate change, refers to long term shifts in temperature and weather patterns. These shifts may be natural, however, from 1870, which is the start of the technical or second industrial revolution, there has been abnormally large amount of carbon dioxide (CO₂) and other greenhouse gases such as methane and nitrous oxide getting trapped in the atmosphere, resulting in an enhanced greenhouse effect causing global temperatures to increase. This study seeks to assess and analyse the impact technology, its advancements and how it has impacted the global temperatures. By examining the correlation between technological development and CO₂ emissions from machinery, this study will provide a comprehensive analysis of the relationship between the two.

Introduction

Climate change, often referred to as global warming, is driven by significant emissions of greenhouse gases leading to a high retention of solar heat within the earth's atmosphere. The process begins when solar radiation passes through the atmosphere and heats the earth's surface. As the surface warms up (known as the greenhouse effect), it emits infrared radiation. Greenhouse gases then absorb some of this infrared radiation preventing some of it from escaping into space. This normally happens naturally over large geological time periods, resulting in fluctuations of very warm, cold and moderate temperatures. A good example of this is the early eocene period where the earth was extremely warm where the global average temperature was over 8 degrees celsius (Venditti 2). Earth should be in an interglacial period where there are moderate temperatures.

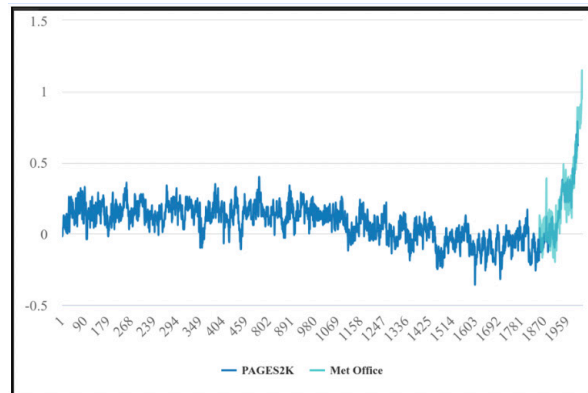
However, since 1890 global temperatures have been abnormally high, 15 degrees above what would be considered normal. This can be attributed to anthropogenic activities and the advancement of technology using fossil fuels. As these fuels are used and burned, large amounts of carbon dioxide are released, more heat is being absorbed into the atmosphere, in addition to that other greenhouse gases like methane, nitrous oxide and industrial gases such as hydrofluorocarbons and sulphur hexafluoride all get released into the atmosphere from factories, locomotives, cars and ships, further exacerbating global warming. However, the evolution of technology holds promise for the future, as newer technologies are being developed in order to transition to achieve net zero emissions. The changes to technology have also allowed millions around the world to gain insightful knowledge into the state of the environment underscoring their importance

Figure 1
Relationship between energy usage and time



Source: Zeidan, Adam. "Industrial Revolution." Encyclopedia Britannica, 21 July 2021.

Figure 2
Global average temperature anomaly of the last 2000 years relative to the 1800-1960b average



Source: Zeidan, Adam. "Industrial Revolution." Encyclopedia Britannica, 21 July 2021.

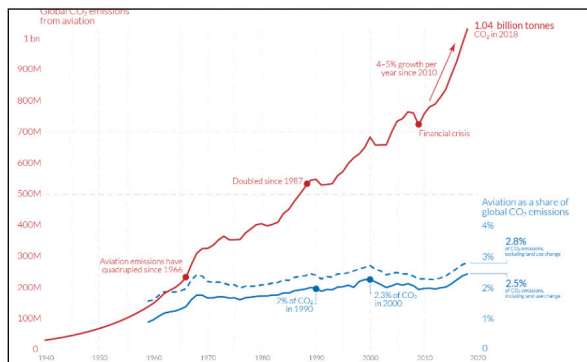
Historical context

During the early 1700's, Thomas Newcomen invented the steam engine. This was later improved by James Watt and finally used practically in the late 1800's, in locomotives and ships (Encyclopedia Britannica 1-3), and these locomotives worked by the force produced by the steam

to push pistons back and forth resulting in the wheels moving as they are connected to the driving wheels. The steam that is produced comes from burning coal to heat water, ultimately resulting in CO₂ being released in the atmosphere. As seen in Figure 1, there is a spike in the amount of coal used as an energy source from 1850, where around 25 exajoules of energy was consumed (Zeidan 1).

This is further cemented by Figure 2 (Zeidan 3), where the global average temperature never went beyond 0.5 degrees above the temperature that is considered safe. After 1860, when there was an exponential increase in temperatures going above 1 degree. A key factor for this is the improvements that were done on the steam engine and its widespread use across the world. Furthermore, the steam engine allowed for more mechanisation in factories. By the second half of the 20th century, the old factory system of workers carrying parts to the assembly point to build it was completely replaced, becoming fully autonomous. As a result of this autonomy, more machinery was used, which of course led to more oil and gas being used, as parts had to be built and shipped, all resulting in more greenhouse gases being released into the atmosphere.

Figure 3
Global CO₂ emissions from aviation



Source: Ritchie, Hannah. "What Share of Global CO₂ Emissions Come from Aviation?" Our World in Data, 8 Apr. 2024

Factories, trains and ships have all made huge contributions to CO₂ emissions whether direct or indirect, but planes have a similar effect. First invented in 1903 by the Wright brothers and commercialised in 1914, planes also used burned fuels such as kerosene to function. This then leads to pollutants such as carbon dioxide, nitrogen dioxide and sulphur dioxide being released into the atmosphere. As shown in Figure 3, approximately almost 500 million tonnes of CO₂ emissions were released in 1990 (Ritchie 2-4), which only increased over the years as population has grown as well as more flights being available to the public due to more people being able to afford flights.

Other inventions such as smartphones have also had an impact on the global climate situation, where one smartphone generates approximately 63 kg of carbon dioxide emissions and 1.5 billion new phones are made every year (Cooper 2-3) and though smartphones don't have as high an impact as other factors, it is still the technology that is contributing to climate change. Furthermore, future technology such as quantum computers could also generate enlarged amounts of carbon dioxide. However, this is only speculation, and there is no evidence or statistics to support such claims as of 2024.

Conclusion

The climate change problem is caused by multiple factors in society such as population growth, economic growth of countries, globalisation and development of technology. Though all of these factors are interlinked to a degree, the usage and evolution of technology has undoubtedly had an effect on global warming and is a huge contributor to the problem. Other pieces of technology, such as the machinery used to dig landfills, and nature both produce CO₂ emissions once again, contributing to the ever increasing global temperature.

References

Cooper, Laura. "The Hidden Environmental Impact of Our Smartphones." Tier1, 28 Feb. 2024, <https://www.tier1.com/the-hidden-environmental-impact-of-our-smartphones/#:~:text=Back%20in%202020%2C%20researcher%20and,1%25%20of%20all%20worldwide%20emissions.>

"Energy and Climate Change: A Story in 11 Charts." Morgan Stanley, <https://www.morganstanley.com/ideas/energy-economies-climate-change-infographic>

Duffy, Paula. "Environmental Technology | Impact of Technology on Environment." Edinburgh Sensors, 13 Nov. 2021, <https://edinburghsensors.com/news-and-events/environmental-technology-the-impact-of-technology-on-the-environment-and-environmental-technology/>

Dwivedi, Yogesh K. et al. "Climate Change and COP26: Are Digital Technologies and Information Management Part of the Problem or the Solution? An Editorial Reflection and Call to Action." *International Journal of Information Management*, vol. 63, no. 63, 1 Apr. 2022, p. 102456. Sciencedirect, <https://www.sciencedirect.com/science/article/pii/S0268401221001493>

Global Climate Media. "Climate Change and Flying: What Share of Global CO2 Emissions Come from Aviation?", April 2021 <https://www.globalclimatemedia.com/staging/8209/climate-change-and-flying-what-share-of-global-co2-emissions-come-from-aviation/>

"Globalwarmingindex.org -- Tracking Progress to a Safe Climate.", Jan 8, 2013 <https://www.globalwarmingindex.org/>

Lunt, Dan. "Climate Change in the Geological Record." *GEOSCIENTIST*, 1 Sept. 2021, <https://geoscientist.online/sections/unearthed/climate-change-in-the-geological-record/>

Riebeek, Holli. "Global Warming." Nasa, NASA Earth Observatory, 3 June 2010, earthobservatory.nasa.gov/features/GlobalWarming.

Ritchie, Hannah. "What Share of Global CO2 Emissions Come from Aviation?" Our World in Data, 8 Apr. 2024, <https://ourworldindata.org/global-aviation-emissions>

"Technology's Impact on Climate Change." Arcadia, 1 Nov. 2021, <https://www.arcadia.com/blog/technologys-impact-on-climate-change>

Venditti, Bruno . "Here's How CO2 Emissions Have Changed since 1900." World Economic Forum, 22 Nov. 2022, <https://www.weforum.org/agenda/2022/11/visualizing-changes-carbon-dioxide-emissions-since-1900/>

Zeidan, Adam. "Industrial Revolution." *Encyclopedia Britannica*, Britannica, 21 July 2021, <https://www.britannica.com/event/Industrial-Revolution>