

Report&Poster CC

by Ellis Christie

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Contemporary Challenges: Making a Difference

Nuclear Power as a Segue to Clean Energy

Ellis Christie

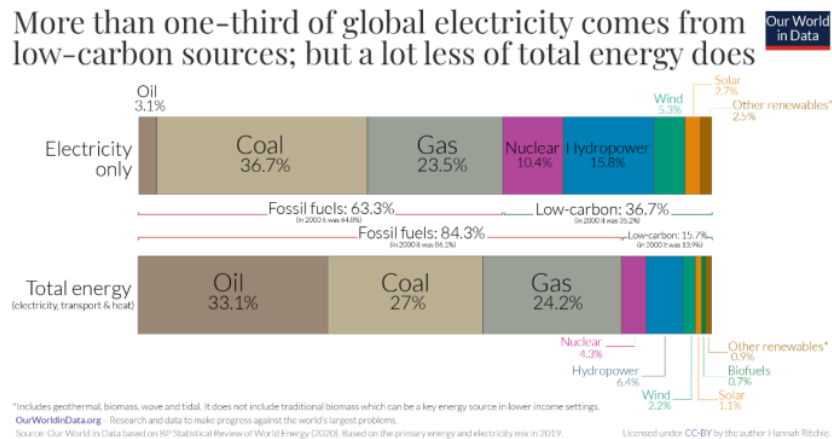
What is this about?

This report is discussing current global energy production, the problems that come from it in relation to climate change, and how nuclear energy can be used as a way to reduce the impact as we transition to renewable energy sources going forwards.

Energy and Electrification

As this topic is such a large and complex subject with many contributing factors at play, this report going forwards will be focusing on specifically electricity production, but I will make note here that energy consumption outside of electricity (e.g. transportation) is even more reliant on fossil fuels.

More than one-third of global electricity comes from low-carbon sources; but a lot less of total energy does

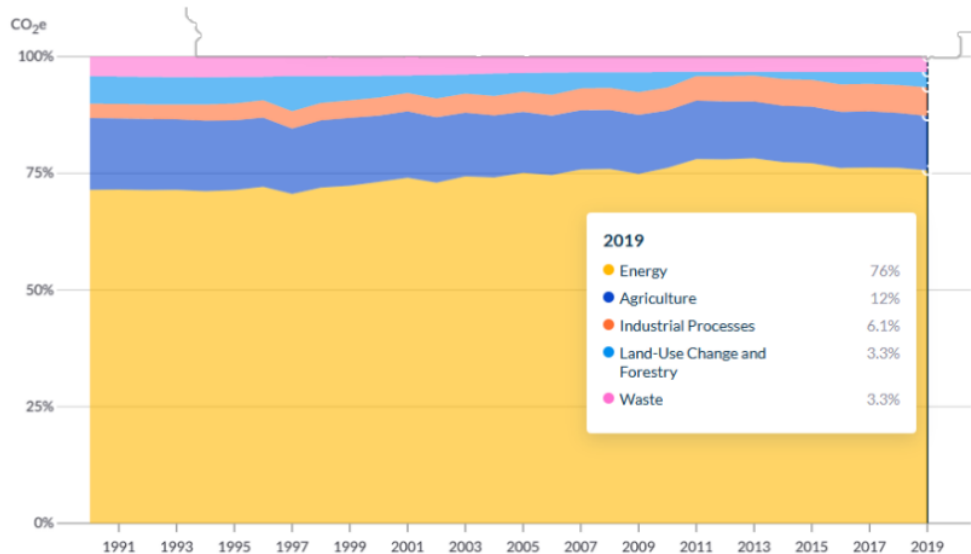


[1]

The impact this has on moving to clean power, even in relation to the production of electricity alone is significant enough to warrant brief discussion even if not the primary topic. A key way we are moving away from the use of fossil fuels in these sectors is through electrification, which is replacing technology powered by fossil fuels with technology powered by electricity.^[2] We see this happening within transportation especially right now, and it will likely continue to increase over time. This makes the sustainable production of

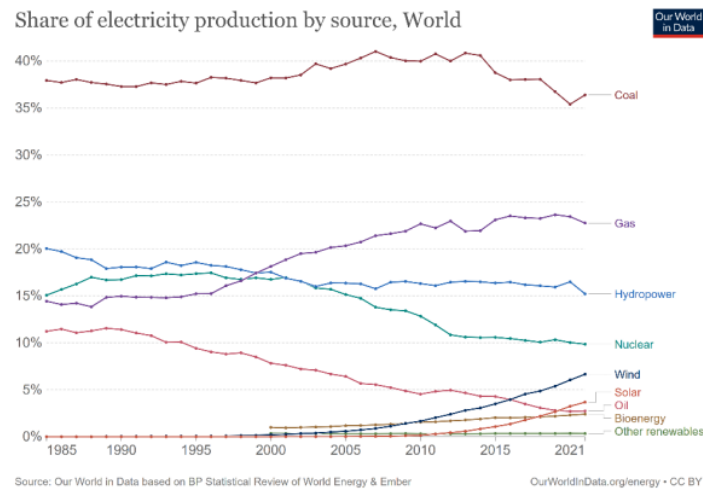
clean electricity even more important going forwards, as the demand will increase over the following years.

What is the problem?



[3]

The energy sector is by far the biggest contributor to carbon emissions globally. The exact amount of this to come from the production of electricity varies from country to country, but it accounts for over 40% of all carbon emissions within the energy sector.^[4] It has also been seen that globally that emissions from electricity production increasing as of 2021, not decreasing. This is due to the fact that demand for electricity is increasing, especially throughout Asia, and renewable sources have been unable to keep up with this demand. As such, fossil fuels are rising along with other sources, especially coal, with 59% of the demand increase being met by it.^[5]

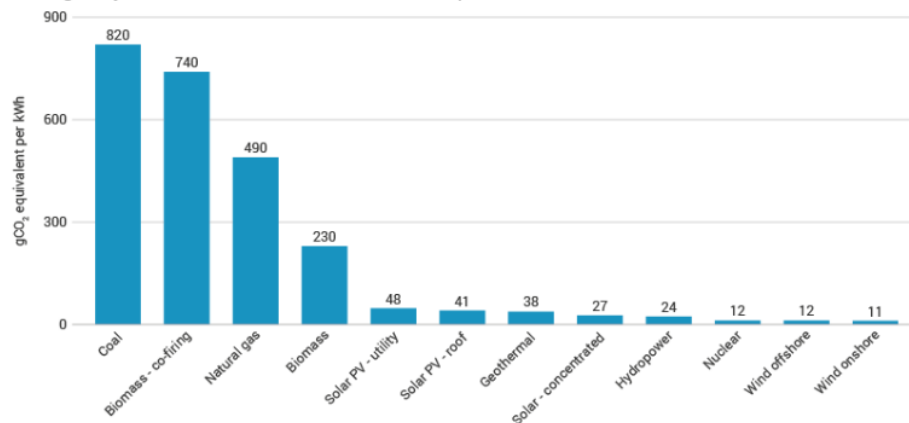


[1]

Coal and gas continue to be by far the largest source of electricity produced, and while renewable sources such as wind and solar power have been increasing steadily over the years, the impact of progress made here is lessened by the fact that, inversely, nuclear energy has been decreasing almost as fast.

Why is this a problem?

In short; Climate change. While that isn't the only problem with the overuse of fossil fuels, it's certainly one of the most prevalent. We're all aware that climate change is bad and needs to be combatted, and while the consequences of climate change will be touched on, the more interesting exploration is in looking at just how much 'dirtier' of a power source fossil fuels can be.

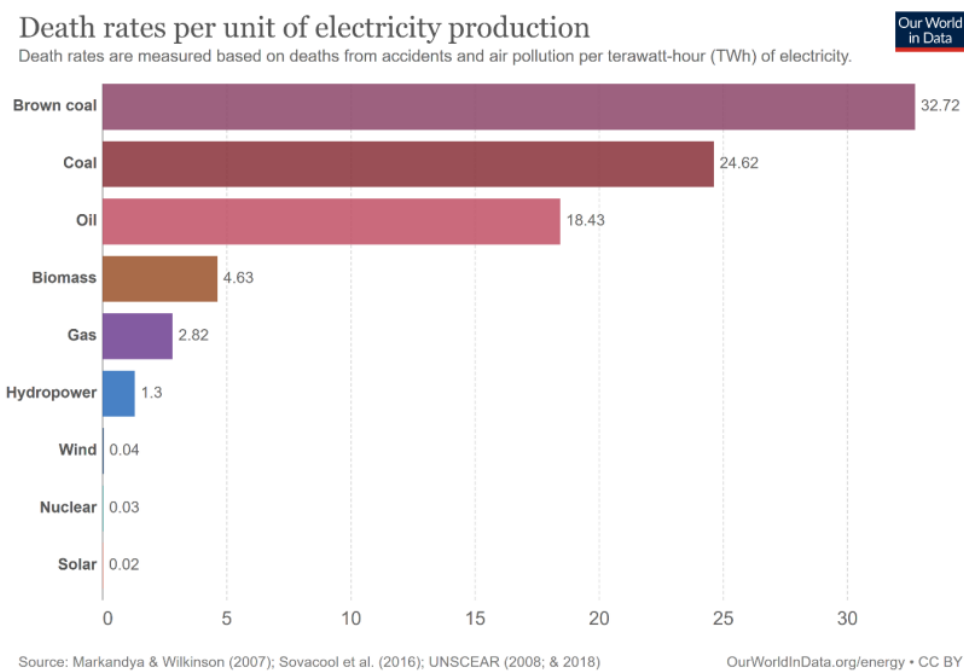


[4]

The graph shown above displays the CO2 equivalent (a measurement used to factor in all greenhouse gases based on their impact on global warming by converting other gases to the amount of CO2 that would cause the same effect^[6]) of different sources of electricity over the course of their lifespan. This factors in construction, maintenance, and what is released during the production of electricity itself.

A brief acknowledgement- while biomass (the burning of organic matter such as wood) does have higher emissions than other renewable energy sources, when the number of plants grown in place of the ones harvested for fuel are equal, the CO2 released is also equal to how much is absorbed over the course of the plant's life. As such, the only concerns come from emissions during cultivation and transportation of the fuel, which can be reduced through local sourcing.^[7]

The long-term impact of emissions isn't the only issue, however. Accidents and premature deaths from air pollution are too, much higher in fossil fuels than low carbon sources.



[8]

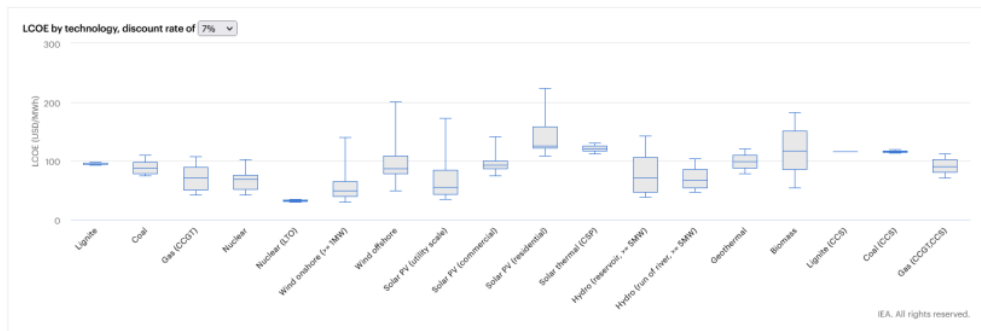
The estimates for fossil fuel related deaths seen here are also based on European power plants, where they are located further from urban areas with stricter regulations on pollution, and so in other parts of the world these figures could be even higher. What we can gather from this though, is that low carbon fuel sources are also safer overall, so in moving away from fossil fuels the number of deaths from electricity production in the short-term will also decrease substantially as well as climate change related deaths.

Climate change has been mentioned throughout, but a brief explanation will be given as to how electricity production is impacting this. Most of the data presented on emissions has been looking at CO₂, which is the main source of emissions for electricity production. In short, CO₂ is a gas that contributes to the greenhouse effect, an effect that sustains the Earth's atmospheric temperature through absorbing and trapping heat from the sun. The greenhouse effect is necessary for the planet's habitability, as the surface temperature would be significantly lower without, but the mass release of so called 'greenhouse gases' intensifies this effect. This is causing the surface temperature to rise (i.e. global warming, the cause of rapid climate change).^[9]

Why Nuclear?

One of the biggest issues in replacing fossil fuels for electricity production is that building alternatives is a lengthy and expensive process; however both of these are limited resources, and few are willing to invest enough in these alternatives enough to make the progress required. If meeting energy demands with newer renewable technologies isn't currently viable to replace fossil fuels in time to reduce greater damage, instead there may be more potential in looking to what we already have available to give more time.

Long term operation (LTO) of nuclear power plants is a way of keeping up with energy demands at a low cost for years to come. The majority of operating nuclear power plants today were intended to have a lifespan of 30-40 years, but through LTO they are able to remain functional for considerably longer, potentially to 80 years or longer. Continuing to develop new nuclear power stations and other renewable sources are still necessary, but in refurbishing and maintaining existing power stations, it gives that crucial time needed for such developments to take place.^[10]



[11]

Of the current technologies available to us, nuclear is among the cheapest, easily keeping up with fossil fuel costs. LTO nuclear power stations especially, being the cheapest option in most markets at this time.

As touched upon earlier though, the use of nuclear power in electricity production has been decreasing despite the financial and environmental benefits. One of the biggest and most difficult to overcome reasons for this is from public perceptions, and subsequent political action, causing nuclear reactors to be retired much earlier than they potentially could operate for. For example, in Japan there were 54 operational reactors before the 2011 disaster at Fukushima Daiichi. By 2012, none were in operation and since then only 10 have resumed operations while 21 have been decommissioned entirely as a result of the mistrust in nuclear power following the disaster, despite many being approved under regulatory standards.^[12]

Final Note (an informed opinion)

Nuclear is known for its disasters, but as mentioned earlier, it remains one of the safest and cheapest forms of electricity production, with technology constantly being improved upon. It will potentially be the most important tool in moving away from fossil fuels for good, bridging the gap between where we are now and reaching sustainability.

NUCLEAR vs COAL

Cost 



1mw/h (⚡ 2000🏠 For 1h)

\$32

\$88



• Long-term operation power plants

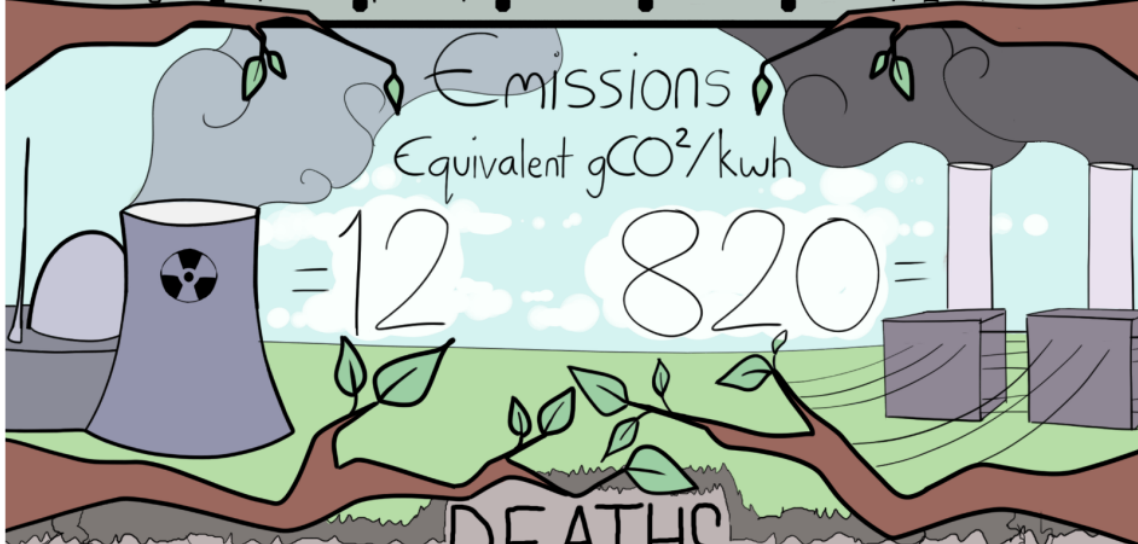
• standard non-ccs power plants •

Emissions

Equivalent gCO_2/kwh

=12

=820



DEATHS

1 year in a town of 150,000...

0.3

or 1 every 33 years

(With deaths from Chernobyl & Fukushima factored into calculations)



25

Sources

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Updated 24-Mar-2022

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- [12] "Japan's nuclear power plants in 2022," *nippon.com*, 30-Jun-2022. [Online]. Available: <https://www.nippon.com/en/japan-data/h01365/>. [Accessed: Feb-2023].

FINAL GRADE

75 / 100

GENERAL COMMENTS

Instructor

1. Engagement With Literature Skills (68%)

A very good amount of research has been evidenced in a Bibliography and referenced throughout the written report. This extends to information being presented as well as using quotes/references. You can separate your research into a References (items you've quoted/referenced) section and a Bibliography (Everything you looked at, whether you used it or not) but this is more advice for future assessments. The research has been presented in IEEE format – this is good.

2. Knowledge & Understanding Skills (72%)

Comparison for electrifying power sources has been made with the push for cleaner transportation – this is good as it could help make a persuasive argument in favour or nuclear power.

Appreciation that wicked problems and the factors contained within them aren't a simple binary issue, for example the greenhouse effect is not simply 'bad' as it is necessary to sustain life and climates – it is a lack of balance that is the cause of the problems faced.

3.Cognitive & Intellectual Skills (76%)

Use of research sources and statistics in the report shows an ability to present and analyse information. This also helps communicate ideas such as the problems faced and potential solutions.

Acknowledgement of limited data is evidenced in the work, e.g. air pollution and subsequent deaths in Europe are affected by stricter regulations than elsewhere, meaning that the numbers are likely to be much higher than the research suggests. This displays an awareness of the bigger picture/wider problems of the topic.

A very good comparison of fossil fuels versus nuclear energy is presented visually on the poster.

4. Practical Application Skills (82%)

The report is structured well and focuses on key points in a coherent manner.

The poster is informative and visually interesting, with key facts driving the visual design elements without being overbearing. The 'hand-drawn' approach to text makes the design more friendly. This is a very good piece of work and compliments the report well.

5. Transferrable Skills for Life and Professional Practice (71%)

The work is presented well and is clear and accessible to read. All components required by the assessment brief have been submitted by the deadline. This is a well constructed, analytical and academically strong submission – Well done Ellis.

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