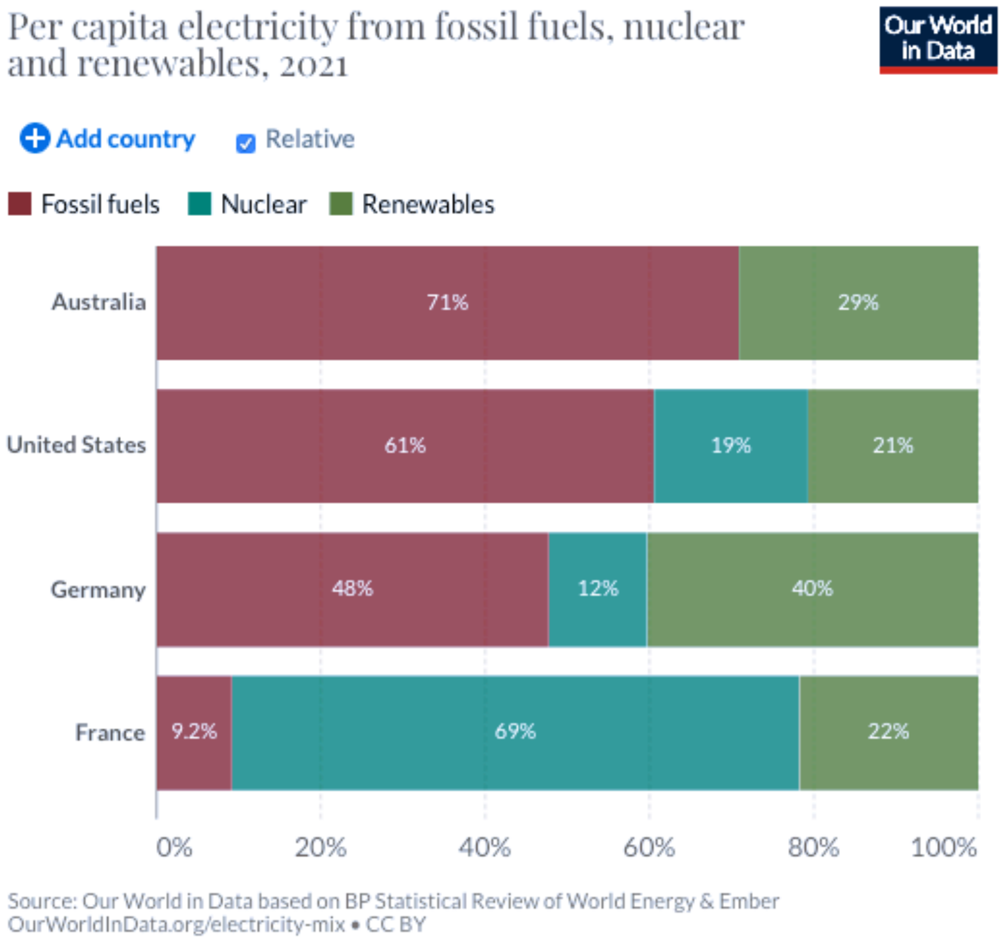
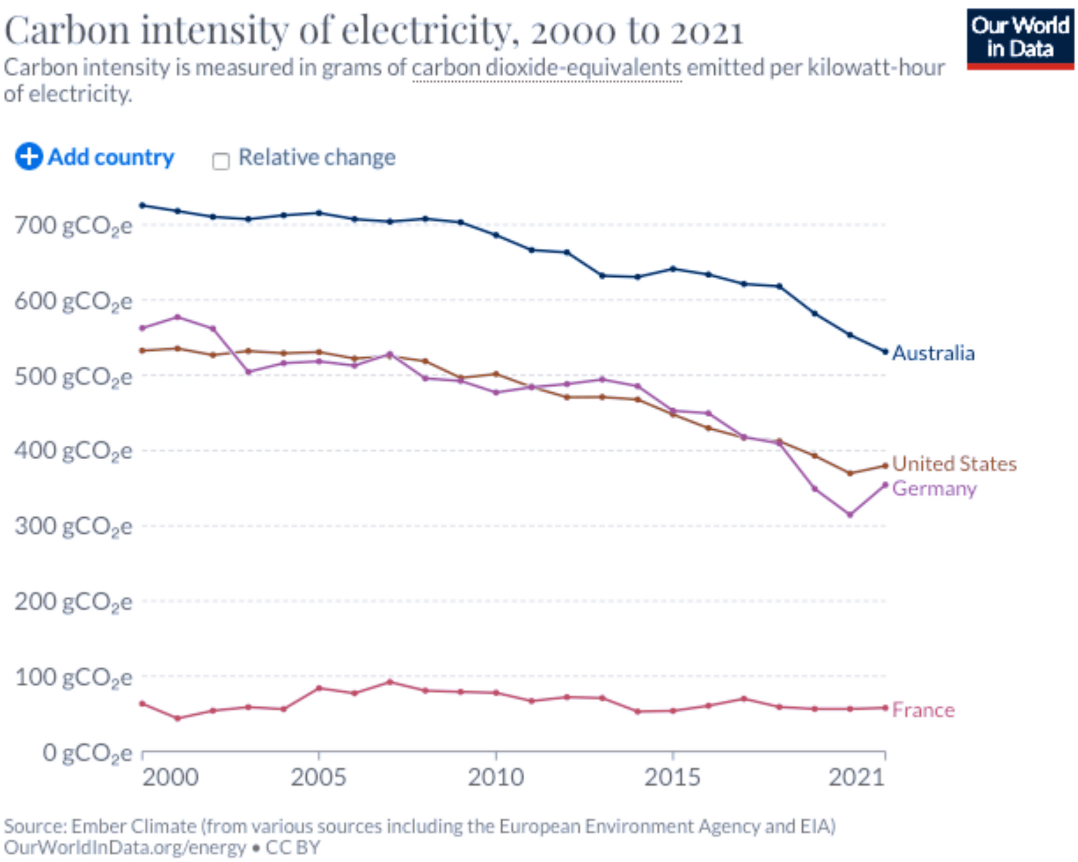
Submission to the Inquiry into the *Environment and Other Legislation Amendment (Removing Nuclear Energy Prohibitions) Bill 2022*

> *Here we demonstrate the potential for a large-scale expansion of global nuclear power to replace fossil-fuel electricity production, based on empirical data from the Swedish and French light water reactor programs of the 1960s to 1990s.* ***Analysis of these historical deployments show that if the world built nuclear power at no more than the per capita rate of these exemplar nations during their national expansion, then coal- and gas-fired electricity could be replaced worldwide in less than a decade****.* ***Under more conservative projections*** *that take into account probable constraints and uncertainties such as differing relative economic output across regions, current and past unit construction time and costs, future electricity demand growth forecasts and the retiring of existing aging nuclear plants,* ***our modelling estimates that the global share of fossil-fuel-derived electricity could be replaced within 25–34 years****. This would allow the world to meet the most stringent greenhouse-gas mitigation targets.*
>
> (Qvist & Brook, 2015)

The removal of prohibitions on nuclear energy is an essential step to shifting Australia to an energy system that is simultaneously low-carbon, cheap and matches supply and demand.
To oppose nuclear power while claiming to be concerned about climate change requires a large dose of cognitive dissonance. The mental gymnastics get even greater for those who claim to be 'progressive' and to care about the less fortunate, as they oppose a source of carbon-free energy that will also be reliable and able to sustain a high standard of living,

Let's compare four countries: Australia, the United States, Germany and France. None have such resources that they can power themselves based on massive amounts of hydroelectricity. Three of these have substantial heavy industry, while Australia's has been allowed to wither and die.

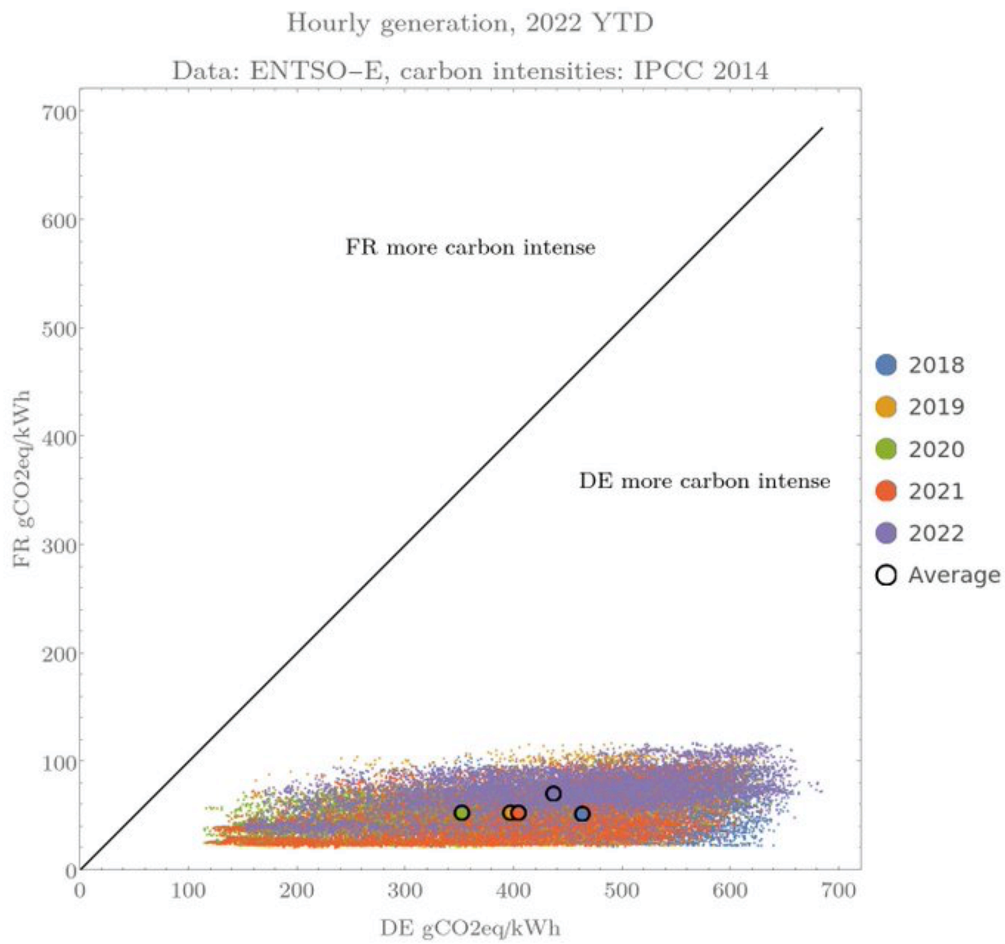




One can see that France, with 69% nuclear and 22% renewables achieved in 2021 a CO2 intensity of 58 gCO2-equivalent per kWh, while Germany (40% renewables) and the US (20% renewables) were virtually identical on 354 and 380 gCO2-equivalent per kWh respectively. France's electricity, with the same renewable proportion as the US and half that of Germany has a carbon intensity of one-sixth that of the latter two countries. What is the difference? The high proportion of nuclear.

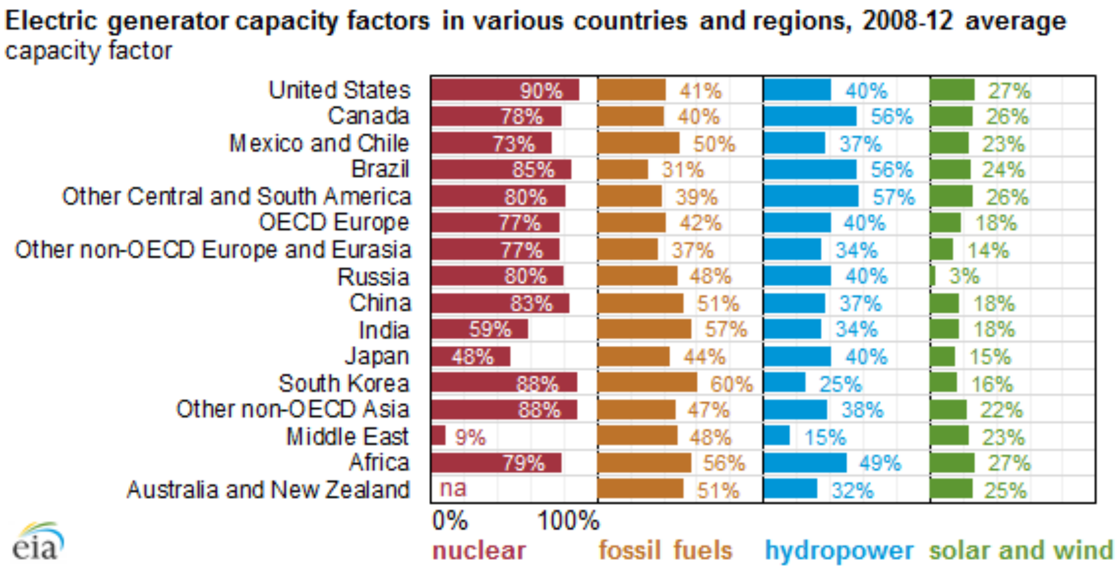
Australian electricity produced 151 million tons of CO2 in 2020-21 according to the Clean Energy Regulator (CER, 2022). According to *Our World in Data*, Australia's emissions output in 2020 was 400 million tons, so electricity comprised about 37% of the total. The CO2 intensity of our electricity was 531 gCO2-equivalent per kWh, 9.2 times that of France.
If Australia's electricity mix was the same as France's, our electricity sector would have produced 0.11 times the CO2 it did, lowering electricity emissions from 151 million to 16.6 million tons of CO2. This would have reduced our total emissions to about 257 million tons, a decease on the actual figure of 35.8%.
To put it in the context of the government's goal to reduce emissions by 43% of our 2005 level by 2030 (i.e., from 386.15 million tons to 220 million tons), we would have had to reduce emissions by only 37 million tons compared to 2020 if we had the same electricity mix as France. If we had embraced nuclear power to the extent that France did, our 2030 emissions goals would have been mostly achieved before they were even set.

Again, to return to France and Germany, below is a plot of hourly data for the last five years from the European Network of Transmission System Operators for Electricity and IPCC:



One can see that at no point did the CO2 intensity of Germany's electricity even come close to equalling France's, let alone improving on it. This demonstrates that the French route, taken before climate change became an overriding concern, was much more effective than Germany's conscious attempts at reducing CO2 emissions.

Nuclear also has a very high capacity factor compared to other forms of energy (EIA, 2015):



The above chart shows that in most cases, nuclear power's capacity factor exceeds that of fossil fuels and is far in excess of renewables'.

This should also be the case in Australia. According the Australian Energy Council (Tran, 2017), about South Australia's wind farms:

> *For a total of 206 days (56.4 per cent of the total number of days throughout the 2016-17 financial year) wind output was below 30 per cent capacity, while for 297 days (81.4 per cent) wind output for the state was below 50 per cent of total capacity. Actual output from wind farms in South Australia during 2015-16 and 2016-17 on average are 33.4 and 30.9 per cent respectively.*

In the 2021, US nuclear power plants:

> *operated at full capacity more than 92% of the time in 2021—making it the most reliable energy source in America. That's about 1.5 to 2 times more reliable as natural gas (54%) and coal (49%) plants, and roughly 2.5 to 3.5 times more reliable than wind (34%) and solar (25%) plants.*

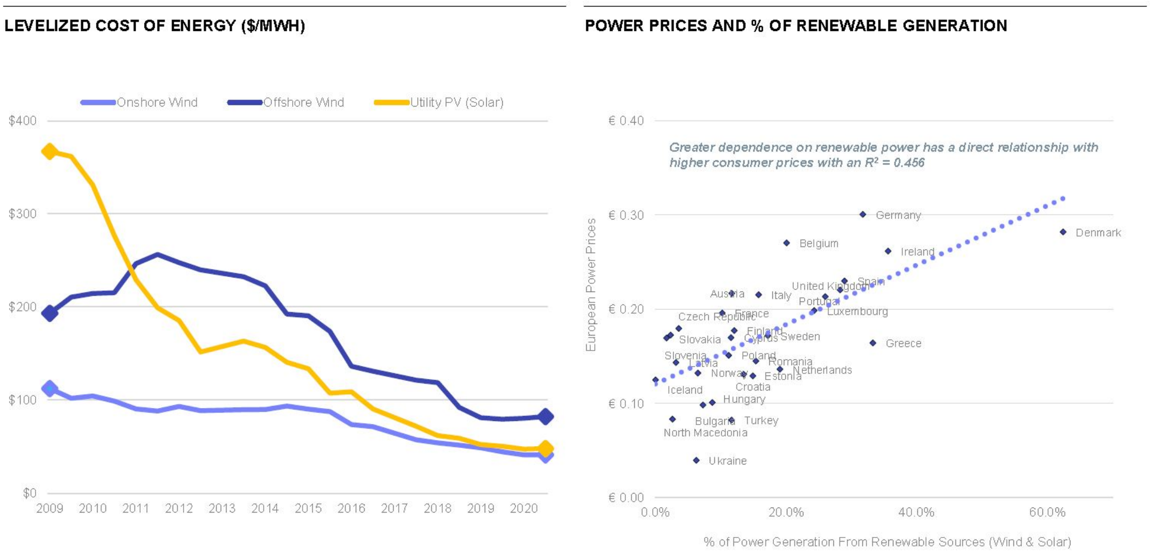
When it comes to economics, the correct way of approaching the question should be thus:

> ***If we were to have spent the same amount of money on nuclear power as renewables, given it the same market preference the renewable energy target does, subsidised the development and installation to the same cost, had a 'nuclear energy target' rather than a renewable energy target, a nuclear energy finance corporation, and so forth, would we have a nuclear power industry? And if so, how much generation capacity?***

It is doubtful Dave Sweeney, for example, has approached the issue like that. Saying that nuclear energy is expensive is misleading for several reasons. First, crude comparisons based on levelised costs do not account for the actual supply, distribution and use of electricity that the consumer has to pay. As the below graph shows, it might be cheap to run, but wind and solar make for expensive electricity to purchase from the grid (Denmark's case is especially instructive):

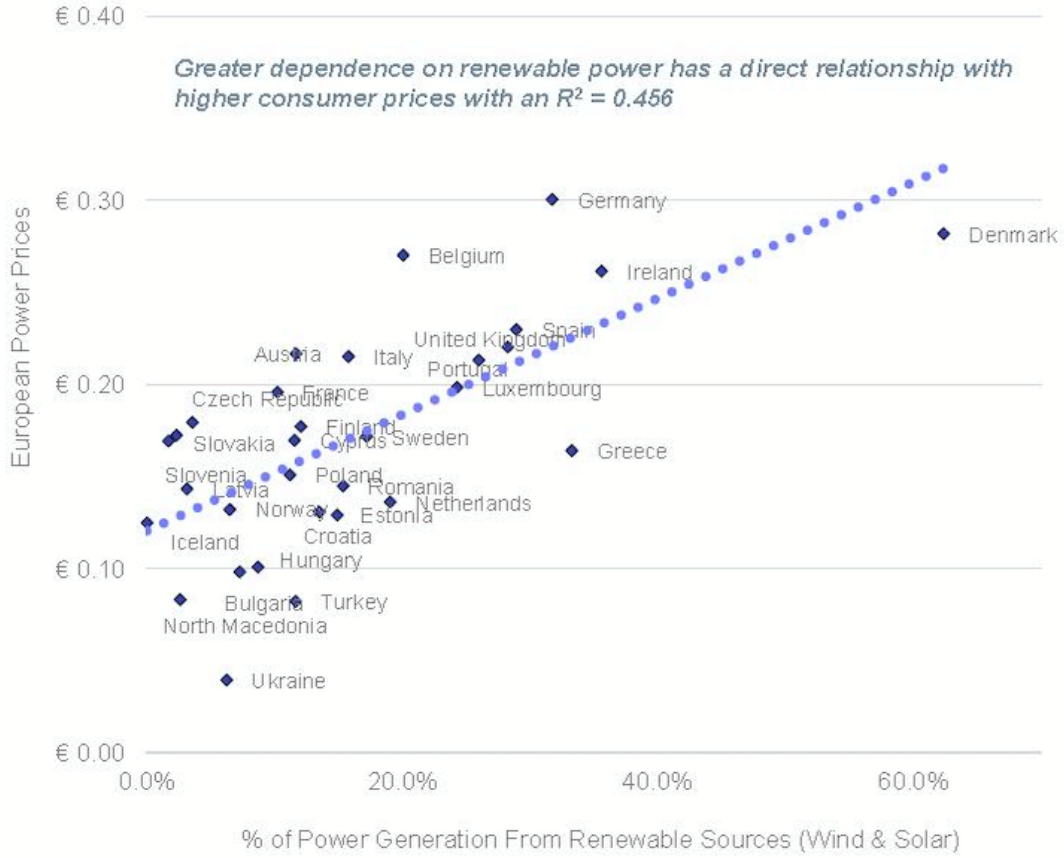
Associated Costs Are Still High For Renewables

In our view, levelized cost of energy (LCOE), a common measure of renewables cost, is an incomplete metric as it does not account for high associated costs of transmission and back-up generation



Sources: Goldman Sachs Asset Management, BP Statistical Review, Eurostat, and BloombergNEF. Latest year-end data available as of March 31, 2022. **Past performance does not guarantee future results, which may vary.**

Goldman Sachs Asset Management 40



One can see that intermittent renewables clearly make power more expensive. In Australia, this cost is disguised because the Renewable Energy Target mandates the purchase of certain amounts of renewable power, and this is frequently purchased at a fixed cost leaving everyone else to pick up the slack. In Germany, Denmark and California, prices have risen substantially concurrent with installation of wind and solar (Shellenberger, 2018a). The fact that wind turbines and solar panels cost less than they used to to make and run does not matter, because that has nothing to do with their ability to actually supply electricity. Reliance on levelised cost only to compare the cost of systems verges on misinformation.

The second reason this is misleading is that renewable energy has absorbed large amounts of government subsidies in order to become established, and continues to do so through such organisations as the Clean Energy Finance Corporation. All over the world, tax breaks, installation subsidies, direct funding and so forth have been given to renewables. Germany's *Energiewende* **cost a mere €160 billion over five years to 2019**, according to its Federal Court of Audit, **all to achieve the same CO2 intensity as the United States at a much greater cost and with higher electricity prices** (Smil, 2020). Therefore, why should nuclear not be subject to the same support? Environmentalist arguments about cost of nuclear tend to ignore that of their own preferred solutions.

The government should give the same support to nuclear it did and continues to do for renewables. Furthermore, the regulatory environment around nuclear should be such as to not handicap it compared to other forms of generation, especially the fossil fuel powerplants it should be replacing. By giving nuclear a level playing field rather than an over-regulated, over-managed one, prices will probably be economic enough, especially if the it is not under-privileged compared to renewables.

The fact is the claims that nuclear power is uneconomic tend to work on levelised costs and are unlikely to afford the same support to nuclear power as to renewables. Hence, they are adjacent to misinformation. **If nuclear power were included under an expanded 'low-carbon energy target' to replace the RET, it would be more competitive**.

Any economic evaluation of nuclear power should include the following:

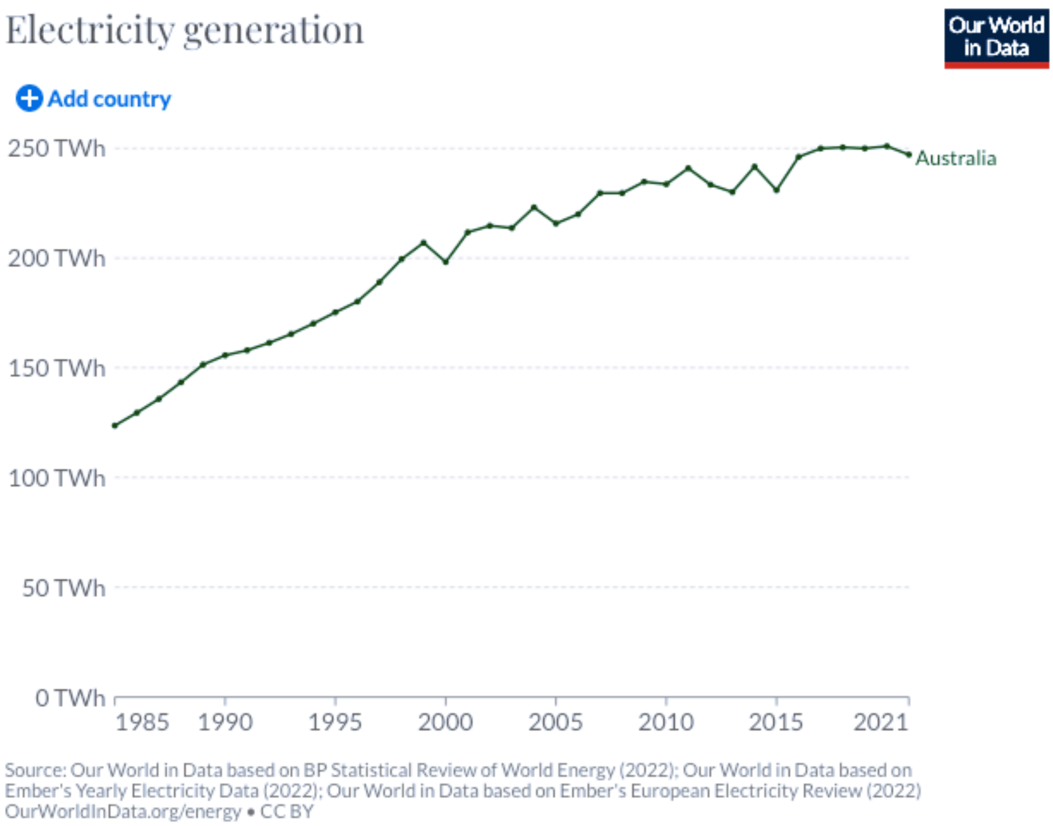
- **Pricing incorporating supply/demand, transmission costs and capacity factors.**
- **A comparison with the amount of money spent on renewable power accounting for capacity factors, and including all subsidies to R&D, support given to manufacturing and generation corporations of RE generators, the cost of feed-in tariffs and the difference between fixed-price contracts and the spot prices of electricity at times of high demand. In short, if nuclear power needs the same amount of money as all renewable energy initiatives have over the past three decades, then is misinformation to call it 'uneconomic', because the same could have been applied to renewables twenty-five years ago.**

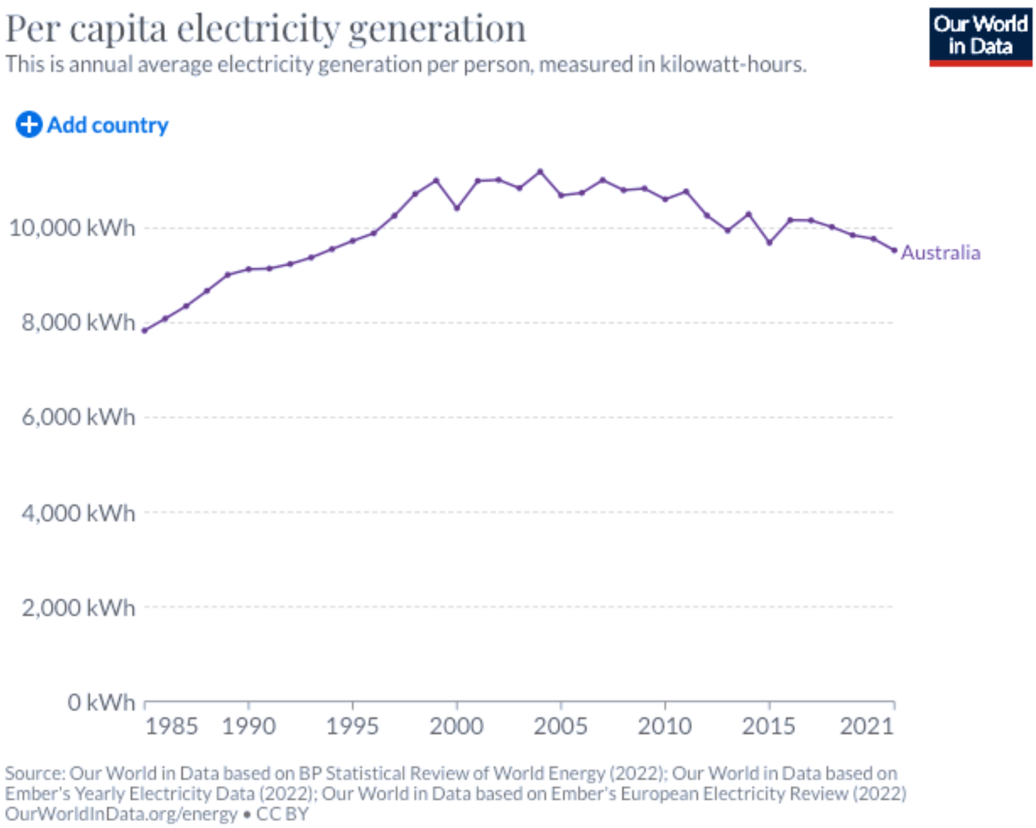
Finally, a lot of anti-nuclear arguments come down to time: it will take so long. Anyone paying attention to UK politics may have seen the video of then deputy PM Nick Clegg saying in 2010 that nuclear power would not be worthwhile because, amongst other things, they wouldn't open 'until 2021 or 22'. If such obstructionism had not existed, perhaps the UK would have less in the way of energy shortages. Furthermore, we in Australia should be able to do better than the UK's typically inefficient processes.

Hennesson (2019) estimated, in fact, that *household energy costs in Europe are very high compared to the highest estimates of the 'social cost of carbon'*. Again, there is a disconnection between the rhetoric of 'cheap renewables', usually based on levelised costs and misleading quotations of South Australia's electricity spot prices in the middle of the day when the sun is out, wind is blowing and demand is lower than the peak. Therefore, price cannot be used as an argument against nuclear as it also applies to renewables.

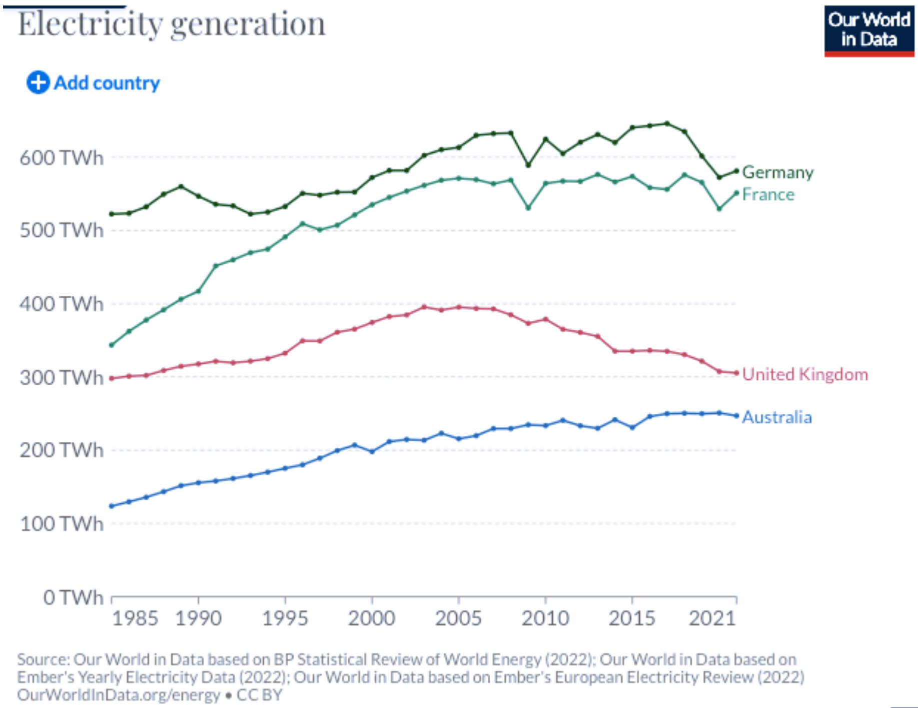
Perhaps the starkest illustration comes courtesy of group Environmental Progress in 2018. They calculated that using particular quoted prices, **if Germany and California had spent as much on nuclear as they have on renewables, they could have completely eliminated fossil-fuelled generation. <u>In Germany's case, they could also have installed enough capacity to replace all light vehicles with electric ones</u>**. The fact is that by choosing the renewables route and relying on Russian gas to fill any shortfalls, Germany emits more carbon dioxide and is having to increase its use of coal, as anyone reading the news recently should know.

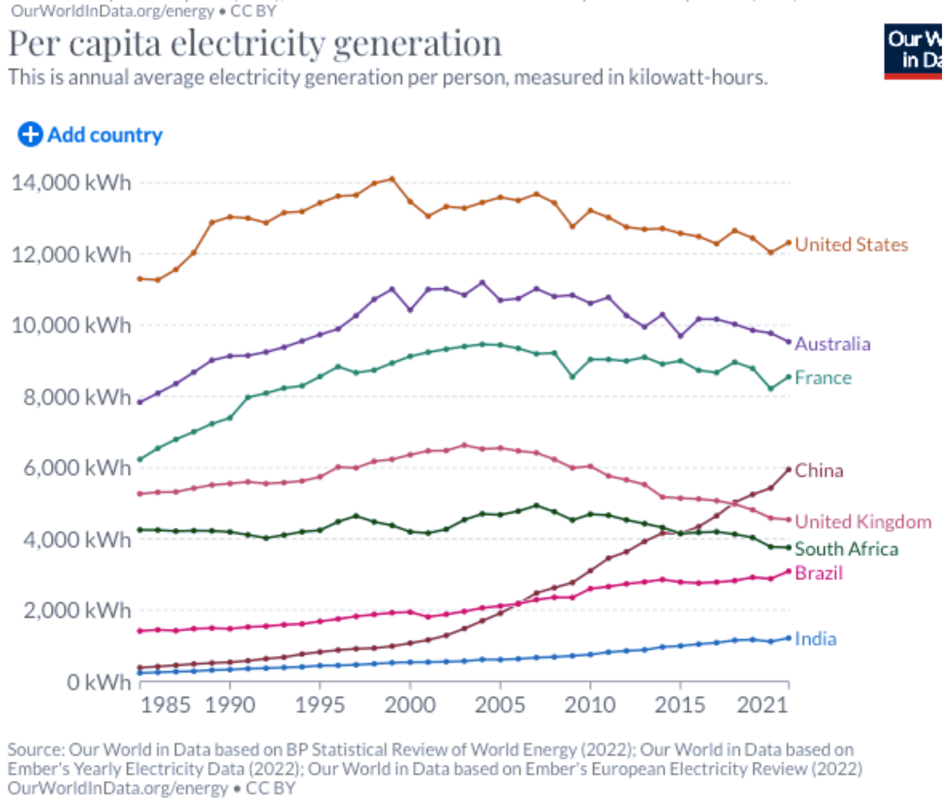
There is also a case to be made from looking at electrical production. The following graphs are Australia's, total and per capita:





Is it not interesting what these graphs show? Australian electricity generation is plateauing, and worse, it has been falling in per capita terms for the last seventeen years. The same trends have been occurring in other countries:



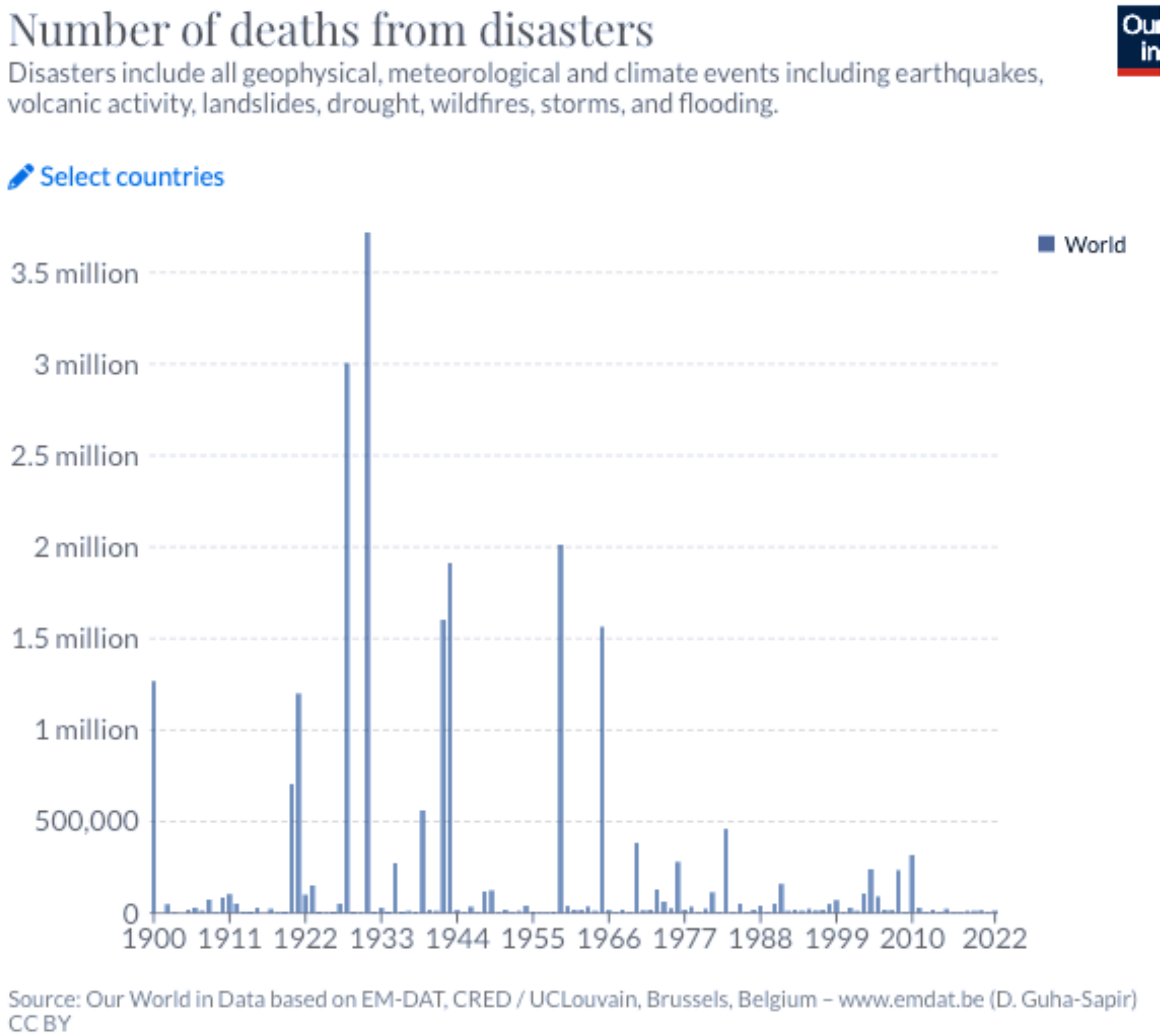


This stagnation and even fall in the actual generation of electricity in advanced economies has come at a time when massive efforts have been made to install renewable energy capacity. Somehow, this has failed to translate to maintaining growth in electrical generation, especially enough to keep pace with population growth.

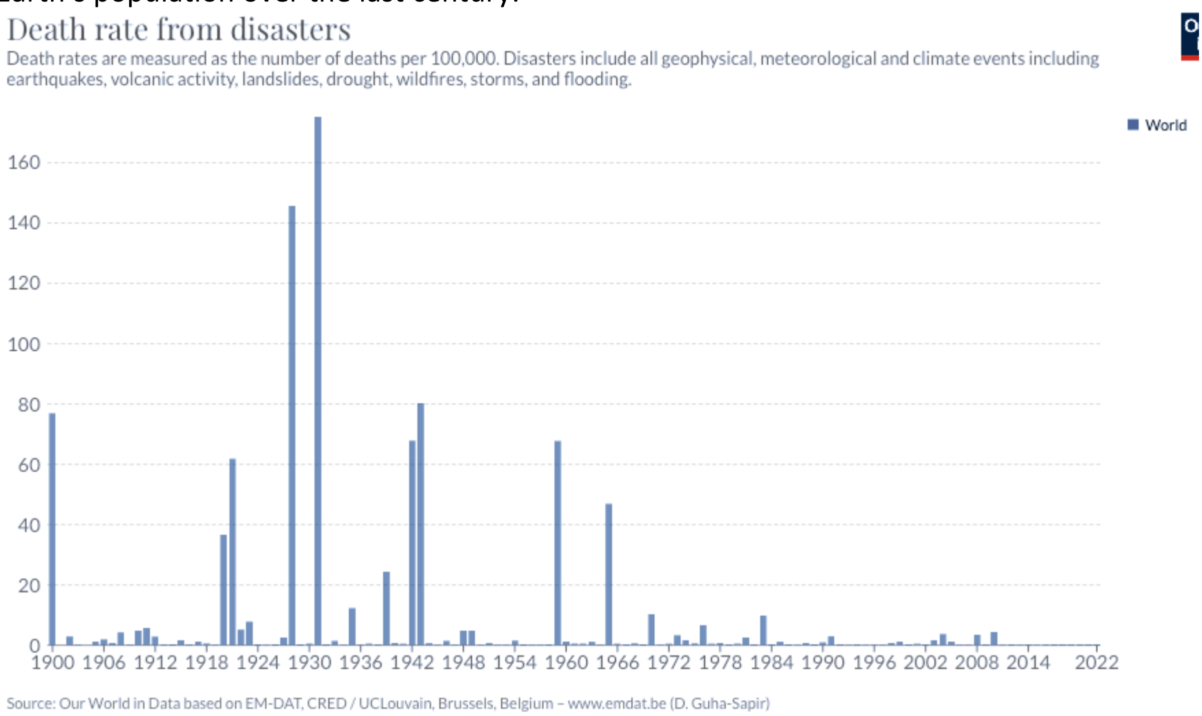
Much opposition to nuclear energy comes from alarmist misinformation and misunderstandings of incidents in countries with generally proper safeguards such as Three Mile Island or Fukushima (and in the latter case, it was reasonably foreseeable that positioning backup generators on the shore of a country that gave the world the word 'tsunami' was not sensible), and ignorance of the context of a true disaster (Chernobyl) that occurred in a country with no environmental safeguards, in a facility of flawed design not generally used elsewhere and which lacked the containment structures used in other facilities of similar age in countries that tended to take safety a bit more seriously than the Soviet Union. Returning to Fukushima, there has already been misleading reporting around the possibility of disposing of tritium-contaminated water in the oceans (Conca, 2019): the risks are actually very small given its widespread natural presence in the atmosphere and oceans. And there tends to be a very studied ignorance of the fact that there were no deaths as a result of radiation, and the risk of future health consequences for workers is such that it would be difficult to distinguish from background rates (WHO, 2016). Again, if you don't take a Soviet approach to engineering, accidents can be mitigated much more easily. **Fact is that the release at Fukushima was able to be absorbed with little harm**. **Also, background radiation needs to be taken into account before setting regulations for harm. It is misguided to require that releases never ever ever happen, because releases are unlikely to create a noticeable difference in radiation from background levels**.

Lurking at the back of environmentalist concerns is an opposition to anything that might tend to ease humanity's lot. If you start with the idea humanity is a cancer on the planet, as many environmentalists do to greater or lesser extent, then you will begin to oppose many solutions that would address climate change because they also provide energy reliably, and therefore maintain or increase the scope of human activity.
Such selectiveness is typical of environmentalists, who invariably ignore the benefits of the technologies they take issue with. The use of fossil fuels meant that forests no longer had to be cleared for wood for fires. Petroleum fuels reduce use of much more polluting coal (and wood), while other petroleum products superseded those derived from agriculture, freeing up land for food or to be returned to nature. Motor-cars removed horses from the road, horses which left manure everywhere and might themselves die in the street and attracted disease as their corpses rotted. Intensive agriculture has resulted in the amount of farmland in advanced economies falling, as more can be got from less, and marginal land can be abandoned. Indeed, the reason we can protect and conserve land so well compared to a century ago is because much of it is no longer needed. This was achievable thanks to the adoption of ever denser forms of fuel. Let's not send ourselves backwards. Warnings of a 're-materialisation' of society have already been made (Capellán-Pérez et al., 2019; IEA 2022).

One of the most striking improvements has been disaster casualties. Today's climate is not 'safe', nor will tomorrow's be. But nor was yesterday's. However, with housing that can insulate us from the elements; large and dependable supplies of food and water; railway, highway and aviation networks that allow rapid evacuation and response; even air conditioners and heaters to protect against the vicissitudes and caprice of the weather; all these have allowed us to protect ourselves against natural disasters as shown below:



The number of people killed by natural disasters has decreased despite the massive growth in the Earth's population over the last century:

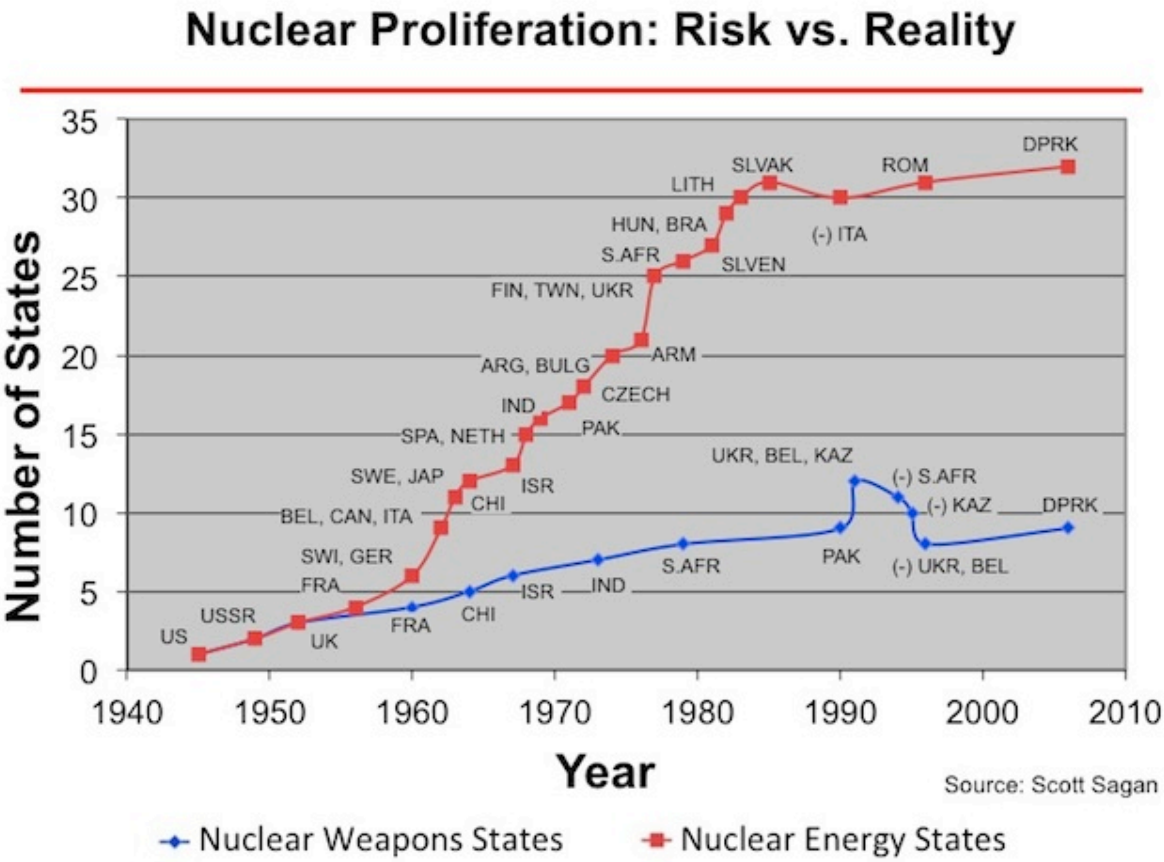


Therefore, it is paramount that we do not allow these hard-won advantages to slip away. 'De-growth' and deindustrialisation will leave *more* exposed to the harms of climate change. Embracing the fullest human innovation has to offer will protect us, and we need energy for this.

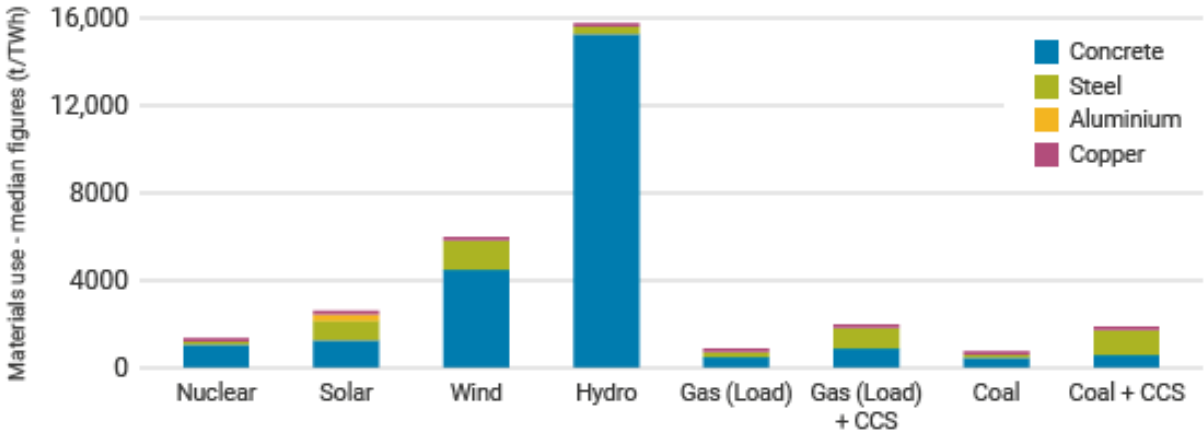
To quote the highlights of Formetta and Feyen (2019):

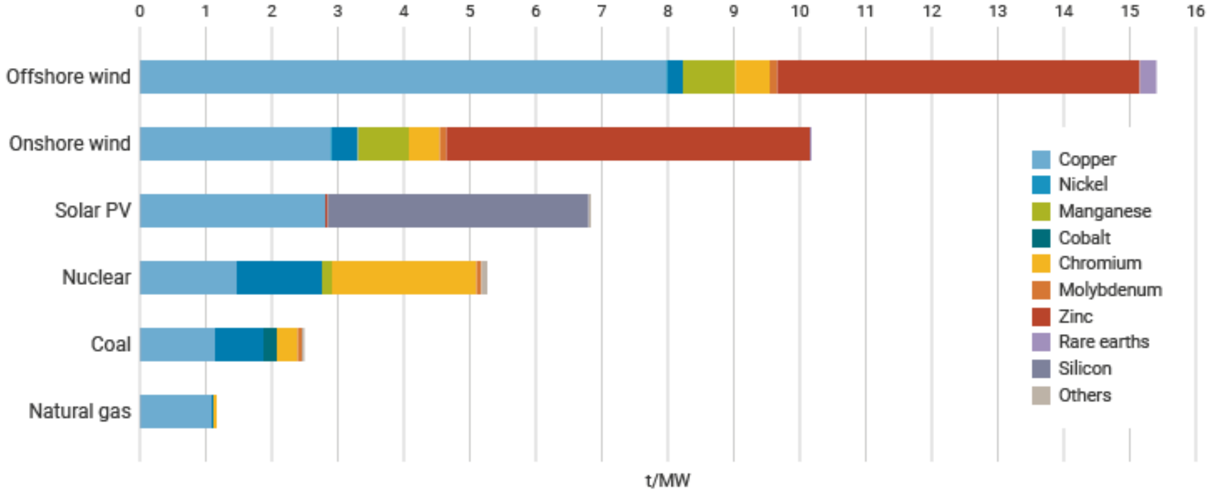
> *Using a global, spatially explicit framework that integrates population and economic dynamics with one of the most complete natural disaster loss databases we quantified mortality and loss rates across income levels and analyzed their relationship with wealth. Results show a clear decreasing trend in both human and economic vulnerability, with global average mortality and economic loss rates that have dropped by 6.5 and nearly 5 times, respectively, from 1980–1989 to 2007–2016.* ***We further show a clear negative relation between vulnerability and wealth, which is strongest at the lowest income levels****. This has led to a convergence in vulnerability between higher and lower income countries. Yet, there is still a considerable climate hazard vulnerability gap between poorer and richer countries.*

Of course, some people (recently, Mark Diesendorf in the *Guardian*) try to make a link to nuclear weapons whenever nuclear energy comes up (in his case, it was about nuclear *fusion*, a still unproved technology, thereby demonstrating a mind closed to anything other than a narrowly approved range of solutions). This is a red herring, for military applications for many technologies can be found: indeed, they frequently come first. The fact that people resort to this misinformation shows that they are unable to counter the fact that nuclear power will provide carbon-free energy. If nuclear weapon proliferation was such a concern as a result of the installation of reactors for energy, why is it the number of countries with nuclear power is far greater than that with nuclear weapons?



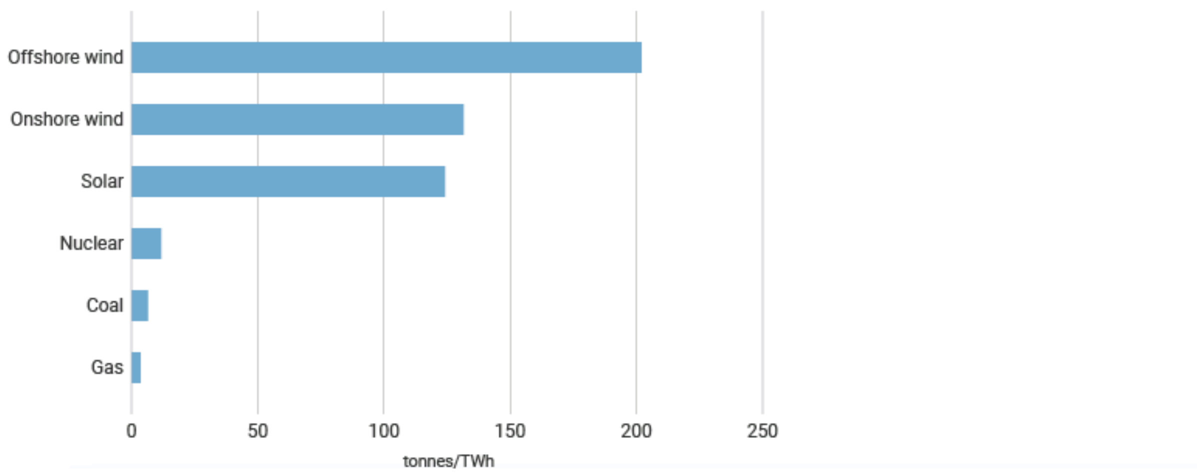
The same has also produced studies claiming that nuclear is not a low-carbon energy source due to the effort needed to mine and refine uranium. This does not, it seems, account for the possibility that with sufficient amounts of power, the charging of electric vehicles or power of fuel/materials synthesis is possible, and so the use of fossil fuels need not occur. It is easy and convenient to forget that the resources to go into renewable power plants also need mining and refining. Not only do renewables tend to fall short on providing enough electricity enough of the time, but the amount of materials needed to produce the same amount of power is much greater:

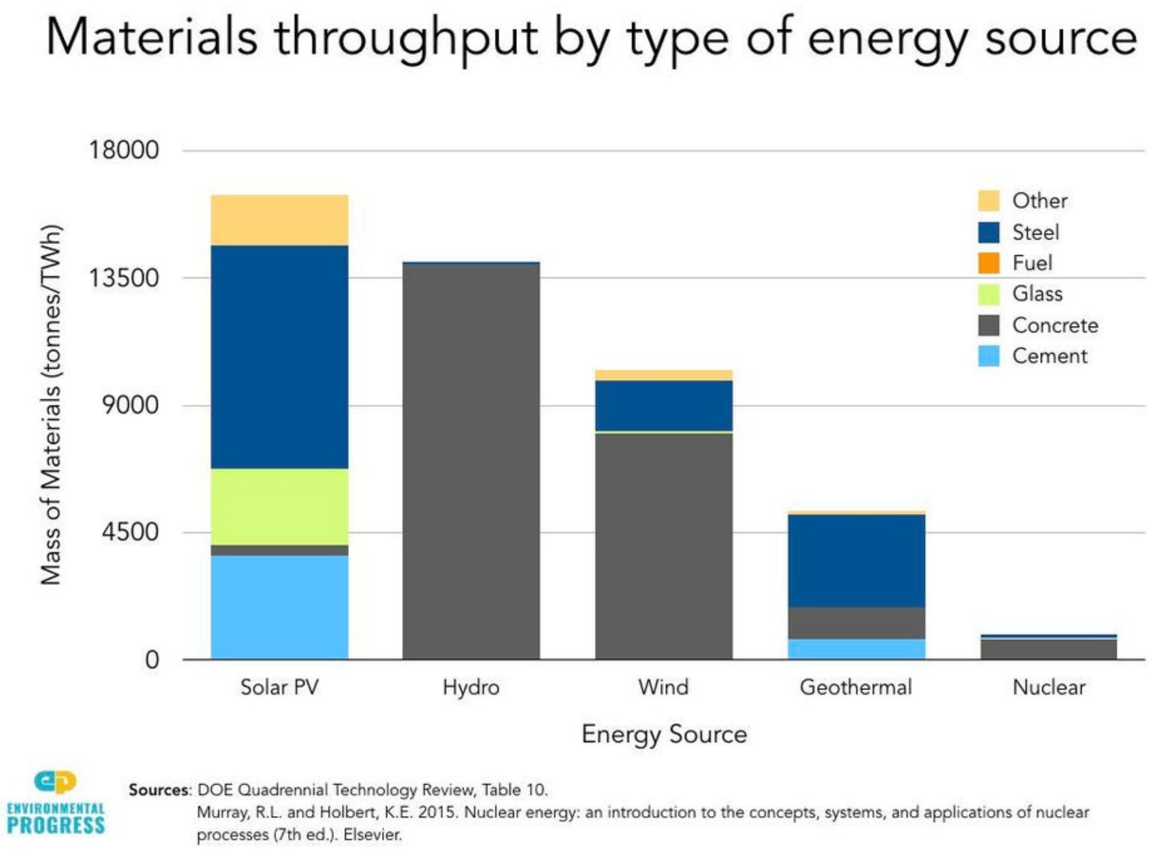




And once one accounts for capacity factors, the difference between the sources of energy grows even greater:

	Plant t/MW	Indicative CF	TWh/yr	Operational lifetime (yrs)	Lifetime TWh	Plant t/TWh
Coal	2.5	85%	7.5	50	375	7
Nuclear	5.3	85%	7.5	60	450	12
Gas	1.2	60%	5.2	30	156	8
Solar	6.8	25%	2.2	25	55	124
Onshore wind	10.1	35%	3.1	25	78	130
Offshore wind	15.5	35%	3.1	25	78	200

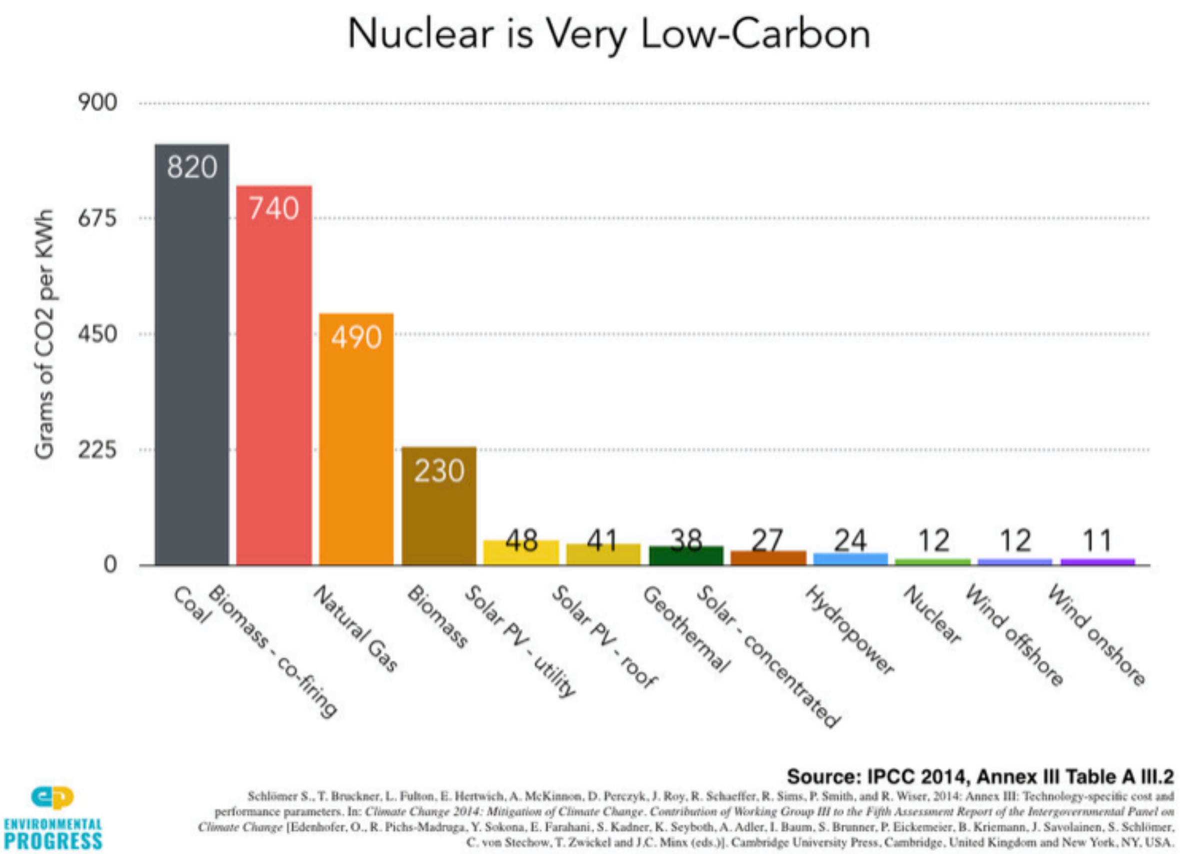




Why not account for this too? It would probably begin to impute a large amount of emissions to favoured technologies, thereby defeating that argument. Someone associated, say, with the Australian Conservation Foundation, Greenpeace Australia Pacific, WWF Australia, and the Australasian Wind Energy Association might also be a little inclined towards a certain set of *a priori* assumptions and preferences as to what is considered 'sustainable' rather than an unbiased endeavour to find what methods might reduce CO2 emissions.
This is a particularly example of the sort of bias that environmentalists show. It is not a deliberate bias, but rather a shaping of one's response to facts due to one's world-view. It is an insidious bias, calling into question the way we think and the very meaning of expertise itself: studies show that most people, even 'experts', persistently make decisions in line with their political/ideological beliefs. It is easier to use a person's politics to predict their position on something than their nominal expertise. The only solution is to harness a more diverse range of voices. The Sweeneys and Diesendorfs of the world have ideologies that motivate their reasoning and research, even if they do not realise it, and the effect of this motivated reasoning should not be underestimated.

The fact is that when energy density, capacity factors and reliability of supply are taken into account, nuclear can power its own production; renewables are unlikely to do so.

Furthermore, the IPCC also agrees the nuclear *is* a low-carbon energy source:



And one again needs to consider capacity and materials considerations of renewables. 'Burden of proof: A comprehensive review of the feasibility of 100% renewable-electricity systems', by Heard et al. (2017) examines the assumptions behind claims that 100% RE can be achieved and finds them wanting. It is worth quoting parts of this paper at length:

> *While many modelled scenarios have been published claiming to show that a 100% renewable electricity system is achievable, there is no empirical or historical evidence that demonstrates that such systems are in fact feasible. We critically review these studies using four novel feasibility criteria for reliable electricity systems needed to meet electricity demand this century. These criteria are: (1) consistency with mainstream energy-demand forecasts; (2) simulating supply to meet demand reliably at hourly, half-hourly, and five-minute timescales, with resilience to extreme climate events; (3) identifying necessary transmission and distribution requirements; and (4) maintaining the provision of essential ancillary services. Evaluated against these objective criteria, none of the 24 studies provides convincing evidence that these basic feasibility criteria can be met.* ***Of a maximum possible unweighted feasibility score of seven, the highest score for any one study was four. Eight of 24 scenarios (33%) provided no form of system simulation. Twelve (50%) relied on unrealistic forecasts of energy demand. While four studies (17%; all regional) articulated transmission requirements, only two scenarios—drawn from the same study—addressed ancillary-service requirements****.*
>
> *…*
>
> *Much academic, governmental and non-governmental effort has focused on developing energy scenarios devoted exclusively to energy technologies classed as 'renewable' (mainly hydroelectricity, biomass, wind, solar, wave and geothermal), often with the explicit exclusion of nuclear power and fossil fuels with carbon capture and storage.* ***These imposed choices automatically foreclose potentially essential technologies. In this paper, we argue that the burden of proof for such a consequential decision is high and lies with the proponents of such***

> ***plans. If certain pathways are excluded a priori, then such exclusions should be fully justified and the alternatives proven. This is rarely the case****.*
>
> *The increasing penetration of variable, climate-dependent sources of generation that are largely uncorrelated with demand, such as wind and solar generation, provides additional challenges for managing system reliability [75], [76], [77], [78], [79]. Such generators can have high reliability in terms of being in working order, yet they have low and intermittent availability of the resource itself [72].* ***Furthermore, system-wide reliability cannot be determined based on 'typical' weather conditions*** *[36],* ***but must instead account for present and predicted variability in the resource over foreseeable time scales, from <1 minute to decadal. Atypical conditions that are extreme, yet credible (e.g., based on historical precedent or realistic future projections), must be identified, both for each generation type in isolation and in combination (e.g., severely drought-impacted hydro-electric output in winter combined with coincident low solar and wind output)****.*
>
> *In September 2016, the loss of transmission lines in South Australia during a major storm caused disturbances triggering the departure of 445 MW of wind generation. Without adequate synchronous generation, the rate of change of frequency exceeded prescribed limits, resulting in total power loss to all 1.7 million residents, all business and all industry in the state [92]. The estimated economic impact of this event was AU$367 million [93].*
>
> ***Not accounting for the full range of variability of renewable energy resources is another area of vulnerability****. The year-to-year variability of inflows that ultimately determine hydro-electric output is well-known — the minimum annual US output over 1990–2010 was 23% lower than mean output for the same period [129]. The range of capacity factors for Hydro Portugal varied from 11.8% to 43.2% over 13 years to 2009 [20]. Recent drought has reduced California's hydro-electric output by more than half [130]. Record-low dam levels in Tasmania coincided with the failure of network interconnection and triggered an energy crisis for that state in 2015–2016 [131]. Extreme droughts are also projected to impact hydroelectric output negatively in the Zambezi River Basin [132].* ***Yet there has been limited or no effort, with the exception of studies by Mason et al.*** *[9], [104]* ***and Fthenakis et al.*** *[133],* ***to identify and resolve renewable-energy conditions that are not 'typical', but are ultimately inevitable in a system that is relied on every year****. Ensuring stable supply and reliability against all plausible outcomes in renewable energy availability, not only for hydro-electricity, but also for wind, solar and commercial biomass, will raise costs and complexity through the need for additional capacity that will be redundant in most years. Such costs are obscured unless the impacts of worst-case conditions are expressly identified and quantified.*

Essentially, published studies modelling a 100% RE system tend to have unrealistically low assumptions of future energy demand and do not account for variability in weather or in the actual generation rates. Good news is AEMO's studies, though still flawed, were among the best.

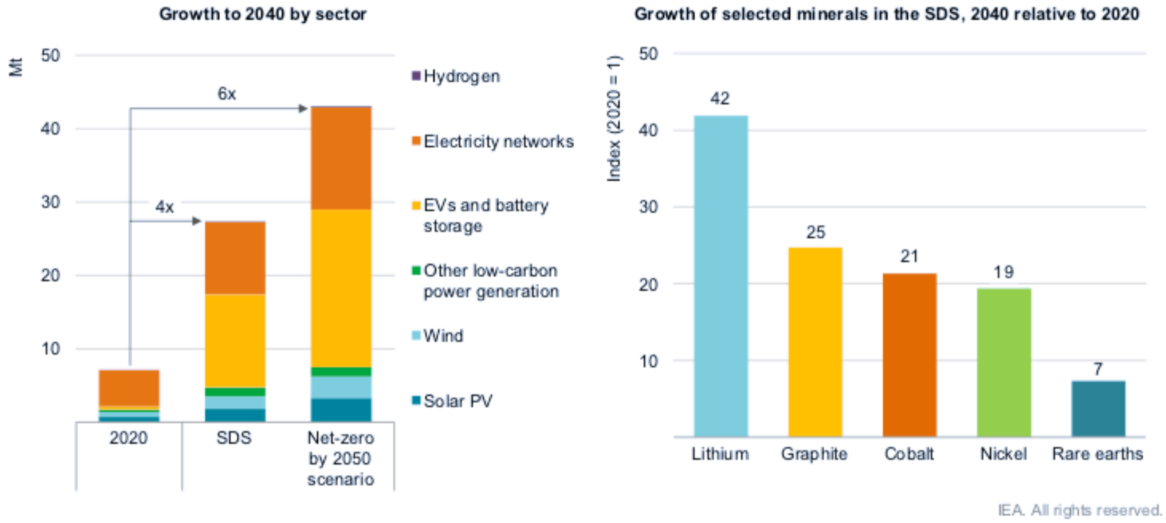
Similarly, according to Capellán-Pérez et al., 2019:

> *The obtained results indicate that a fast transition achieving a 100% renewable electric system globally by 2060 consistent with the Green Growth narrative could decrease the [Energy Returned on Energy Invested] of the energy system from current ~12:1 to ~3:1 by the mid-century, stabilizing thereafter at ~5:1.* ***These EROI levels are well below the thresholds identified in the literature required to sustain industrial complex societies****.* ***Moreover, this transition could drive a substantial re-materialization of the economy,***

> ***exacerbating risk availability in the future for some minerals****. Hence, the results obtained put into question the consistence and viability of the Green Growth narrative.*

Furthermore, a reliance on battery storage is flawed. Apart from decreasing grid efficiency as storage will never allow all energy used in charging to be re-extracted, it will add further to the massive expansion of resource extraction required to convert to electric cars. The IEA's report *The Role of Critical Minerals in Clean Energy Transitions*, which should be compulsory reading for all policymakers, shows that to achieve its sustainable development scenario, an expansion in Lithium production of a mere 42 times will be needed.

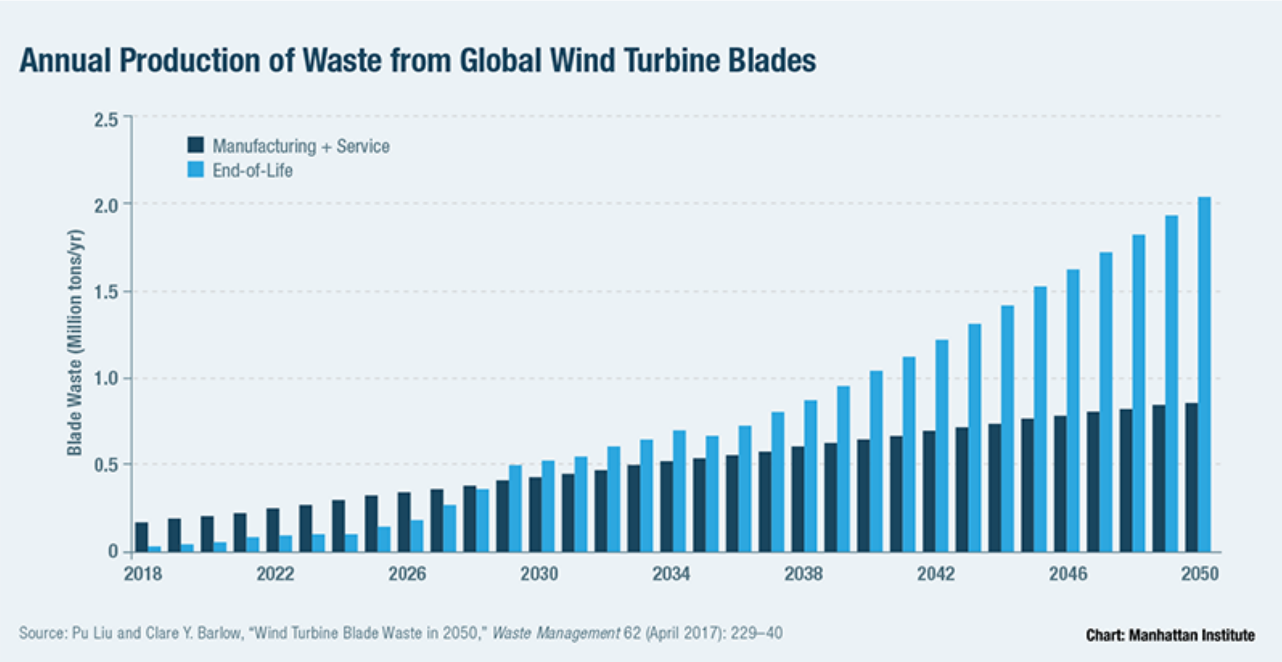
Mineral demand for clean energy technologies by scenario



Notes: Mt = million tonnes. Includes all minerals in the scope of this report, but does not include steel and aluminium. See Annex for a full list of minerals.

Therefore, it would be best to avoid straining the resources of this mineral by adopting a form of electrical generation that does not require it in order to produce a reliable flow of electricity. Unless of course, one supports 'degrowth', in which case rising prices and increasing poverty are acceptable prices to pay. Some people even say they care about social justice while supporting degrowth-oriented policies, a tremendous example of cognitive dissonance given that fact that degrowth will hit the poor hardest.

Lastly, waste. It is true that nuclear waste poses unique problems, but as ever, it is also prone to misinformation from those who should know better.
First, the amounts of waste produced are very small on a per-person basis and only 3% of this is highly radioactive (ONE, 2021; WNA, 2022).
Second, transport accidents are rare (ONE, 2017). Again, severity of possible hypothetical accidents must be balanced against the small amounts involved.
Third, recycling of spent fuel is possible thereby reducing the amount of new material that must be extracted (WNA, 2021). Reprocessing decrease the amount of high-level waste by 85% and also leaves it less radioactive than non-reprocessed fuel once finally disposed of (WNA, 2022).
Fourth, anyone concerned about the waste from nuclear power should also be concerned about that from other forms of generation. Waste from renewables is very high for the amount of electricity they will produce, both due to the low energy density of those technologies and short lifespans (typically, 25-30 years). For example, the following graph shows a prediction of wind turbine waste, from the blades only:



This also applies to solar: a 2016 estimate was for 78 million tonnes of waste by 2050, assuming that panels were used for most of their specified lifetime (IREA, 2016). However, solar-installation subsidies may promote the early replacement of panels, exacerbating the waste problem (IER, 2021).

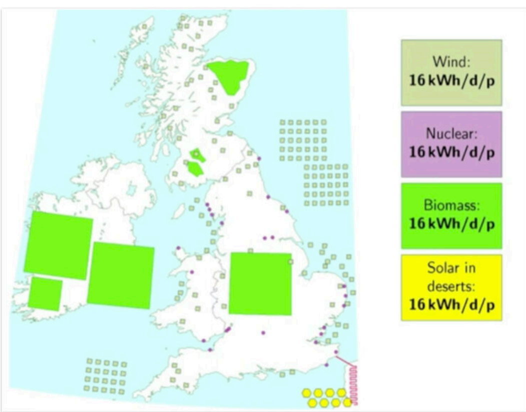
Furthermore, recycling in these technologies may not be as economical as some think as the concentrations of many minerals incorporated in a manufactured generator is often lower than that find in freshly-mined ore.

Nuclear power plants also take up much less land. There is little reason for nuclear power plants to take up much more room than the coal power plants they should have replaced, however the same does not apply for renewables (van den Ven et al., 2021):

> … The potential solar land requirements and related land use change emissions are computed for the EU, India, Japan and South Korea. […] **At 25–80% penetration in the electricity mix of those regions by 2050, we find that solar energy may occupy 0.5–5% of total land. The resulting land cover changes, including indirect effects, will likely cause a net release of carbon ranging from 0 to 50 gCO2/kWh**, depending on the region, scale of expansion, solar technology efficiency and land management practices in solar parks.

Perhaps a graphical format can best convey this:

To power 16 lightbulbs per person in the UK, you would need either..



- 160 wind farms, each 100 square km's in size
- 24 nuclear plants that each have 2 GW's of capacity
- A land area of about 3.5 Wale's worth for biomass production (72,726.5 square km)
- 8 Solar plants totaling an area of two greater London's worth of someone else's Sahara

*for solar you would also need power lines stretching across Spain and France to bring the power from the Sahara to Surrey

Therefore, someone concerned about the environment might take the time to consider the volumes of materials and waste their proposed solutions will produce (and note that mass figures mislead, as uranium is very dense, and composite wind-turbine blades are not). A small amount of radioactive waste for which handling solutions exist is better than filling our landfills. **And again, obstructionism is a bigger problem in finding waste disposal site than practicability** (EP, no date).

A dispassionate examination of the facts should show that nuclear is a low-carbon source that can produce electricity more reliably and with less materials. Those who argue otherwise are in the grip of an ideology.
Nuclear power is a form of electrical generation that can maintain advanced technological societies with minimal use of fossil fuels for electrical generation, and which should be able to expanded to include enough generation to eliminate fossil fuels from land transport. The obstacles and expense of nuclear energy are not inherent to the technology itself, which is mature, **but rather to the determination of politicians to make it as difficult and over-regulated to install and run as possible**.

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