RETHINK NUCLEAR

WHAT A WASTE

How fast-fission power can provide clean energy from nuclear waste

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REPLANET

EXECUTIVE SUMMARY

This report outlines how existing nuclear materials stockpiles currently considered 'waste' can instead be repurposed to provide energy to support wind and solar in achieving a net zero economy in Europe.

In particular, it quantifies how much energy is embedded in nuclear materials and how long these might provide carbon-free electricity if repurposed as fuel in closed-cycle fast reactors.

We find, using a calculation based mainly on current inventories of uranium, that there is sufficient energy in nuclear 'waste' to run Europe at current electrical power consumption for up to a thousand years.

If unconventional uranium and thorium resources are considered in the global picture, nuclear fuel is essentially limitless: sufficient to supply a growing human civilisation with carbon-free energy for tens of thousands of years, and likely far longer.

Using this fuel in a new generation of fast-neutron reactors would eliminate it as a 'waste' concern via a carbon-free waste-to-energy process. Most of **the remaining leftover fission products would return to a level of radioactivity comparable to the original uranium ore within 200–300 years.** This means that current deep geological disposal strategies can be simplified and scaled back.

- RePlanet is therefore proposing a repurposing of nuclear materials with a view to fast-tracking an urgent programme of fast reactor build-outs. These must be deployed in such a way as to reduce grid congestion and increase security of supply to enable the deployment of wind, solar and nuclear for the majority of electrical power generation and heat supply in a net zero Europe[2].

While the economics of fast reactors are currently unproven, if resources currently intended for deep geological disposal of spent fuel were diverted instead into a fast reactor programme that would enable the re-use of that fuel, this would turn a burden into a useful part of a legitimate circular economic activity.

INTRODUCTION

All current nuclear power reactors used in Europe – with the exception of the gas-cooled reactors In the UK and the heavy water reactors in Romania– are light-water reactors using enriched uranium as their fuel. While these have a long history of safe use, and have provided prodigious quantities of clean electricity for decades, **they utilise less than 1% of the actual energy potential in the natural uranium** used to make their fuel. Irradiated fuel assemblies removed from reactors are thus considered 'nuclear waste', as are depleted uranium 'tails' left over from the enrichment process (see below).

While this nuclear 'waste' is not a serious environmental or health threat – it occupies trivial volumes compared to waste produced by other industries, and does not harm anyone if properly shielded and safeguarded – it does provide a political challenge, and is among the most oft-cited reasons for continued opposition to carbon-free nuclear power. Deep geological disposal strategies – while entirely feasible technically and economically – add to the sense that nuclear power is somehow inherently unsafe and will leave a toxic legacy for unborn generations many millennia into the future.

popular depictions of nuclear power and waste bear no resemblance to reality

It does not have to be this way. **Repurposing and reducing this legacy using a waste-to-energy approach would have wide political appeal and be environmentally beneficial as a fully efficient way to use uranium,** without the need for additional uranium mining, to support the ongoing increase of nuclear needed to tackle the climate emergency.

A more tangible issue in the short term is the need for uranium mining. While nuclear energy needs less material extraction than fossil fuels or solar energy, mining of any kind has a local environmental impact. Increasing the energy use of nuclear fuels would reduce or even eliminate the need for mining of fresh uranium.

Climate and environmental groups should therefore support fast reactors with the design potential not just to produce carbon-free power, but to eliminate existing stockpiles of long-lived nuclear waste by employing modular, passively safe and meltdown-proof designs.


nuclear waste in reality

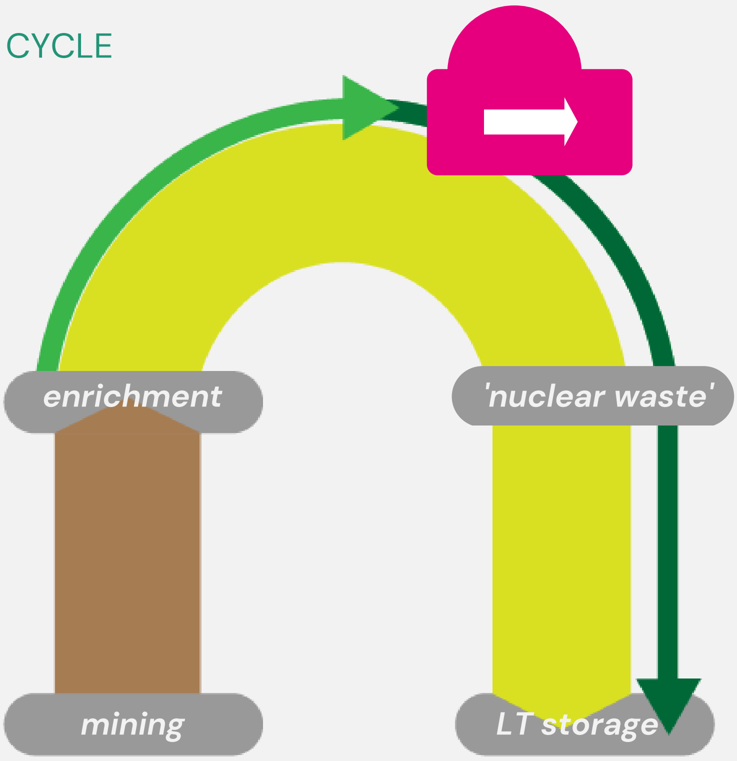
THE PHYSICS OF FAST REACTORS

It has been understood since the 1950s that fast reactors would be able to 'breed' more fuel than they consume, and that this could provide an energy source that is essentially limitless over human timescales. Most obviously, this reduces the urgency for the development of incredibly physically challenging nuclear fusion, which is usually justified on the basis of concerns about waste and long-term fuel supply with fission. Both these issues are definitively solved using fast reactor technology, while fusion – despite recent much-hyped breakthroughs – remains decades from any prospect of commercialisation.

Many countries in the past have run fast reactor prototypes, such as EBRII in the United States, Phénix in France, Monju in Japan and the Russian BN fast reactor programme. The Western programmes were closed down prematurely for a combination of political and technical reasons, with only the Russian effort currently continuing. Economically, conventional pressurised water reactors using fission in the thermal neutron spectrum[3] have been cheap enough to run, because using once-through enriched fuel and then disposing of it is only a small part of the overall cost of building and running a reactor. With fresh uranium fuel extremely cheap in a historically oversupplied market, there has been little incentive to use fissionable materials more efficiently in fast reactors.

STANDARD REACTOR "ONCE THROUGH" FUEL CYCLE

The open nuclear fuel cycle as it is today: uranium is mined, 1% of it is split in a reactor to generate electricity, and the other 99% becomes various forms of "nuclear waste" to be disposed of. (Arrow width indicates relative mass flow size)



- **less than 1%** of mined uranium is fissioned
- fissile material is consumed and not replenished
- spent fuel is not reprocessed and needs long duration storage
- **16 tons of natural uranium** needed for every **1 TWh of electricity** generated

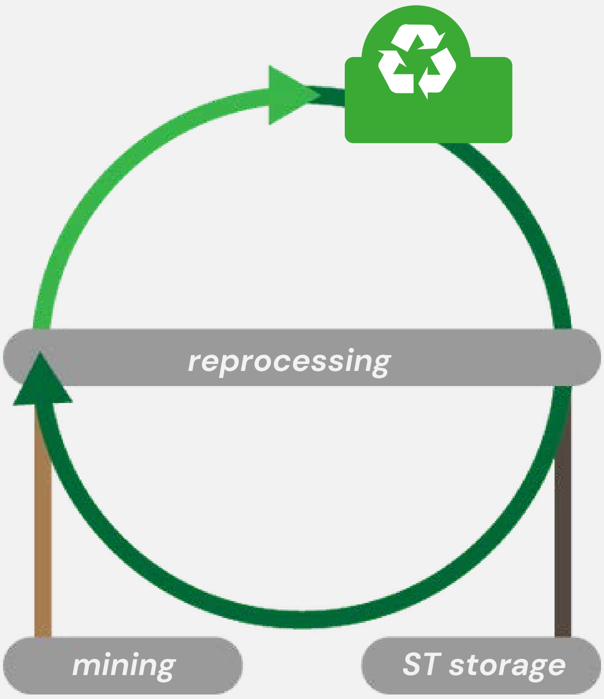
Light-water reactors use fissile isotopes, primarily uranium-235, which must be 'enriched' from natural uranium through complicated fabrication processes such as cascades of centrifuges. This is because U-235 comprises only 0.7% of natural uranium, with the remainder being uranium-238, which is not fissile. Enrichment was originally designed to isolate sufficient U-235 to produce atomic bombs, which need very high proportions of fissile isotopes (over 90%) in order to enable chain reactions swift enough to yield explosive power.

Uranium enriched to lower levels, around 5%, is sufficient to run light-water reactors to generate electricity. However, this means that most of the remaining uranium in their fuel, primarily U-238 plus un-fissioned U-235, is left over at the end in highly radioactive fuel assemblies and in the 'depleted uranium' from which most of the U-235 has been separated[4]. The used fuel assemblies contain a mix of mostly short-lived 'fission products' such as caesium-137 and strontium-90, along with long-lived 'actinides' such as plutonium, curium, americium and neptunium, as well as the leftover uranium, and remain significantly radioactive for millennia (though at increasingly weak levels) unless the long-lived materials can be removed and refashioned into fuel.

Unlike thermal reactors, which exploit the fact that U-235 is far more likely to fission when hit with slowed down 'thermal' neutrons, fast reactors do not use a 'moderator' to slow down neutrons in the fission chain reaction. Fast reactors are designed to run using fresh, fast neutrons directly, as soon as they are released by a fission event. Fast neutrons are far less likely to cause fission – making it harder to achieve a chain reaction – but they are more likely to cause fission events that yield greater numbers of neutrons, which are then available to transmute 'fertile' materials like U-238 into fissionable fuels like plutonium. This is known as 'breeding' fissile fuels from fertile materials.

FAST BREEDER REACTOR
CIRCULAR FUEL CYCLE

The closed nuclear fuel cycle as it was envisioned by the inventors of nuclear power nearly a century ago: all the mined uranium (or thorium) is used up to generate electricity in a closed cycle of irradiation, splitting, breeding, and reprocessing of nuclear materials, leaving nothing to waste. (Arrow width indicates relative mass flow size)

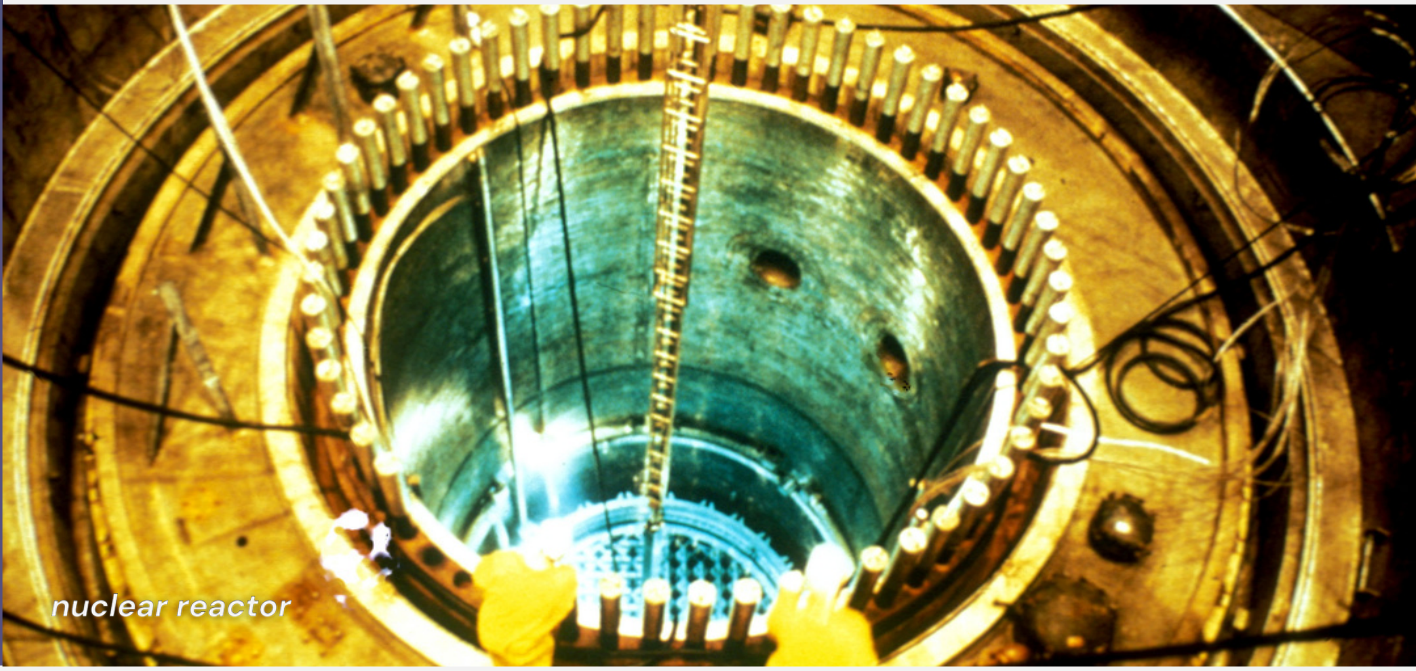


- more than **99% of mined uranium is fissioned**
- fissile material is created as much as is consumed
- only useless fission products are sent to disposal
- **0.1 tons of natural uranium** needed for every **1 TWh of electricity** generated

Plutonium is a key fuel for fast reactors because it tends to yield more neutrons when fissioning than uranium. Plutonium-239 is a fissile isotope that does not occur naturally on Earth, and which was originally generated by transmutation of U-238 in military nuclear reactors optimised for plutonium production, and isolated in order to be used in nuclear bombs. Light-water reactors also get about a third of their heat from the generating and fissioning of Pu-239, but fast reactors – albeit through multiple recycling and refabrication cycles of fuel – are much more efficient fuel 'breeders' and are thus able to utilize essentially all their uranium this way.

Fast reactors will also be able to use all the actinides left over in spent nuclear fuel. These actinides are what make spent fuel radioactive for very long periods of time because they have long half-lives, even though they are primarily alpha emitters and are thus not a significant concern in terms of any likely effects on future people. However, if they are removed from fuel and burned in fast reactors, the radioactivity of the remaining waste – which will then be composed mostly of fission products with short half-lives – will decline to the original uranium ore levels within as little as 200–300 years, making surface storage feasible and reducing and simplifying, if not removing altogether, the need for deep geological disposal with complex design considerations taking into account million-year timescales. Shortening the time frames of radioactive waste storage and disposal processes could make it easier to demonstrate their safety and communicate this to the general public.

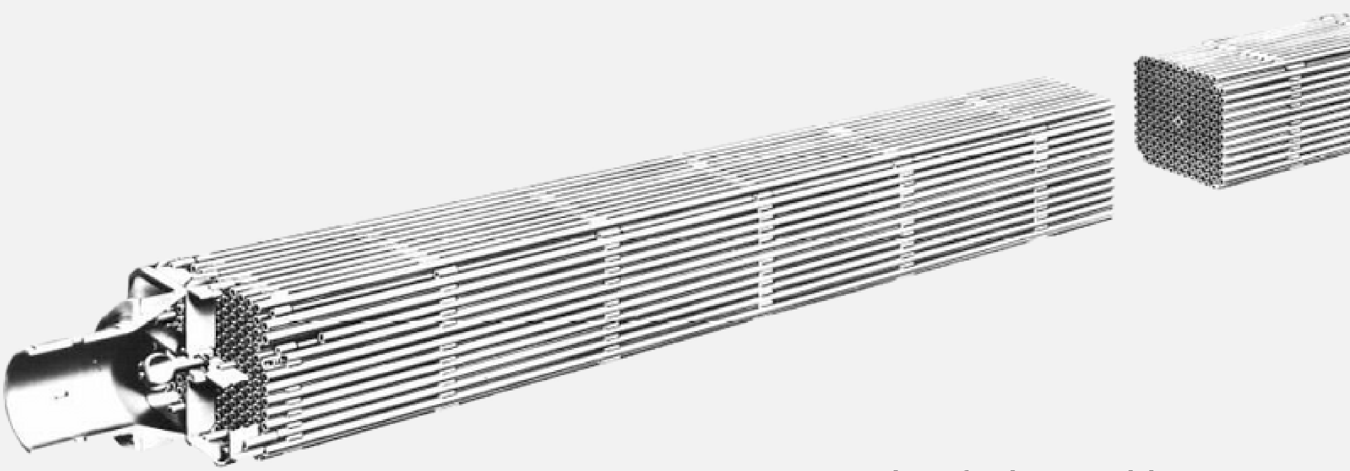
These inherent advantages raise the question of why fast reactors have not so far been deployed at scale in our nuclear power fleets. **The main reason – apart from the political choices made to discontinue Western research programmes – is that uranium has been cheap enough that there has not been a need to utilise it more efficiently**. Additionally, designing and licensing a new type of reactor and new type of fuel is an enormous R&D investment, something which commercial operators have not been very interested in so far, especially as just licensing and maintaining conventional nuclear has been difficult enough.


nuclear reactor

In other words, more uranium could simply be enriched and fabricated from mining sources, and spent fuel stored indefinitely, while the issue of deep geological disposal could be endlessly pushed down the line. This is known as the 'once-through' uranium fuel cycle. And there has been no economic need to close the fuel cycle, because nuclear fuel is a very small component of the overall cost of running a reactor, even if only 1% of mined uranium is used productively. This is different to fossil fuels, where the cost of the fuel is the main consideration with running power-generating plants, and is more akin to renewables, where the fuel – solar or wind – is essentially free once the capital cost of the generating plant has been covered.

However, this is now changing. **With the ongoing reconsideration of nuclear power, driven by the acknowledgement by most experts that net zero targets will not be achievable without it, uranium reserves are a consideration for the long term.** Modular fast reactor designs have now been produced by reputable companies in numerous countries – varying from startups to older engineering companies – several of which are already close to prototype or first-of-a-kind deployment. (Due to the war in Ukraine, we do not discuss the Russian fast reactor programme further in this report.) Fast reactor designs promise full passive safety, meaning there is no risk of meltdown and the associated release of radiation such as happened at Fukushima in Japan following the tsunami disaster in March 2011.

Many of the new fast reactor designs also include a load-following component, such as via thermal storage in molten salts, w**hich will allow the generating plant to rapidly respond to changing grid needs in order to balance intermittent power delivered by wind and solar,** and provide peaking power in place of traditional natural gas plants. Thus, while the majority of electrical power for most of the year could be met with renewables, these new reactors can solve the intermittency problem that will otherwise make 100% clean grids difficult to achieve, due to the lack of cost-effective large-scale electricity storage options. Batteries are far too resource-intensive and costly for use as seasonal storage of electricity, and hydrogen is not much better due to its inherent difficulties of production, transport and storage.



Nuclear fuel assembly

HOW MUCH FUEL IS THERE?

Answering this question involves a quantification of all the stockpiles of nuclear material currently held in Europe. These statistics are not easy to access and have been compiled here from a number of sources, some more up to date than others. There are also assumptions in this calculation, which are described below. Ideally, the outputs should be considered as answering an order-of-magnitude question rather than viewed as exact numbers. We see them as most useful as a strategic guide to energy system decisions currently being taken to achieve climate goals.

Country	Fuel type	Amount (tonnes/tHM[5])
France[6]	Mined natural uranium Uranium in spent fuel (incl. MOX) Depleted uranium (DU)	29,900 tHM 46,700 tHM 310,000 tHM
United Kingdom[7]	Plutonium Uranium (DU/low enriched/natural) Spent fuel	112 tHM 99,000 tHM 6,100 tHM
Netherlands[8]	Depleted uranium	48,000 tonnes
Germany[9]	Depleted uranium	13,000 tonnes
Finland	Spent fuel	2,500 tonnes
Spain[10]	Spent fuel	5,710 tonnes
Sweden[11]	Spent fuel	6,756 tonnes
	Total nuclear heavy metals in Europe	567,778 tonnes or tHM

In the table above we present the approximate inventory data, considering heavy metals which are either fertile or fissile as interchangeable. Thus, depleted uranium (DU), uranium in spent fuel and plutonium can all be considered in a single tonnage total, since all can be used as fuel in fast reactors. (In reality, fissile plutonium-239 and U-235 will be needed separately to start up fast reactors and begin the breeding process of creating more fissile materials from U-238.)

We find that Europe (meaning the UK and the EU combined) has a total inventory of nearly 580,000 tonnes of potential nuclear fuel for fast reactors. This compares with about 470,000[11] tonnes of uranium in depleted uranium (mostly stored as 700,000 metric tonnes of UF6, or uranium hexafluoride) in the United States, and a worldwide stock of about 1.6 million[12] tonnes of DU only (not including spent fuel), according to the World Nuclear Association. This global stock of DU increases by about 50,000 tonnes per year due to new uranium enrichment and fuel fabrication.

There are significant uncertainties in exactly how much more efficiently fast reactors using a closed fuel cycle can use uranium as compared to current-generation light-water reactors. Estimates generally vary from a factor of 60[13] to a factor of 100[14], where the differences in these estimates largely concern assumptions about the retrieval efficiency of the repeating cycle of using, reprocessing and refabricating fuels. This efficiency depends on the reactor and reprocessing technologies employed, with the factor of 100 assuming fully efficient retrieval and return of all fissionable and fertile materials from spent fuels to the fuel cycle.

Calculating how much energy could be released by using the entire stock of fissionable and fertile materials consists of summing the fission energy yields of all the components of that stock. Fortunately, this procedure can be simplified by recognising that the specific fission energy yield of all nuclear fuels, including thorium, uranium, plutonium and other actinides, is around 22,000 gigawatt-hours (GWh) per tonne[15]. Thus, the 580,000-tonne stock of heavy metals in Europe could yield around 580,000 x 22,000 = over 12 billion GWh of heat energy. This heat can be converted to electricity with an efficiency of at least 33%, resulting in a total potential of at least 4 billion GWh of electricity yield locked inside the stock.

How much is 4 billion GWh of electricity? **The EU and the UK currently consume about 3 million GWh of electricity annually, so Europe's stock of nuclear heavy metal 'waste' could therefore be used to power all of Europe at current rates of consumption for over 1,000 years under a high-end estimate of perfectly effective fuel recycling.** At the low end, assuming more realistic partially effective recycling, the stock would last over 600 years.

OUR FINDING

Thus, today's inventories of nuclear materials held in Europe contain enough energy, if used up in fast reactors, to power the continent's electricity grids at current rates entirely on nuclear energy for about 600 years in our low estimate, and 1,000 years in our high estimate, with no additional uranium mining.

CAVEATS

Of course, current electricity levels will not be maintained – economic growth and the electrification of the economy as we transition to net zero will substantially increase electricity generation needs. Even so, if electricity generation triples over the next few decades, we will still have well over two centuries-worth of generation available from fast reactors from current heavy metal inventories.

We are not, however, proposing 100% of generation from fast reactors. If we instead assume, for illustrative purposes, that renewables (plus whatever is the size of the light-water reactor fleet at the time) make up 80% of generation on an annualised basis[16], this means fast reactors need only to generate 20% of power, allowing us to multiply the available energy in current fuel stockpiles by a factor of five. **Fast reactors could therefore make up the difference for a fully carbon-free electricity grid for over a thousand years, even at tripled rates of electricity use in our high estimate, if they work in support of renewables.**

From a global perspective, current inventories of 1.6 million tonnes of fertile and fissile heavy metal would, using the above calculation and the lower estimate, add up to over 11 million terawatt-hours (TWh) of electrical energy. Current world electricity consumption is about 23,000 TWh, so we already have enough fuel for 500 years of global clean electricity at current rates of use with 100% nuclear power, and much more with a more realistic energy generation mix.

If we include uranium still in the ground in economically proven reserves, this gives another 6.2 million tonnes, enough for about 2,000 years of clean power globally at our lower estimate. There are even larger amounts of uranium in unconventional resources, such as dissolved in seawater or as trace amounts in common rock[17].

And uranium is not the only potential nuclear fuel. We can also use the thorium fuel cycle, as pioneered in India and proposed for a new generation of thorium reactors. Thorium-232 breeds into fissile uranium-233 by neutron capture, making this another fuel source. Thorium is three to four times more abundant than uranium on Earth[18], making it a source of power which could support human civilisation for tens of thousands of years, merely using conventional reserves.

The up to 100-fold greater fuel efficiency of breeder reactors means that even very poor sources of nuclear fuel, such as seawater or common rock, are rendered economically viable. Remarkably, even the discarded ashes from coal power plants contain uranium and thorium traces, with an energy content ten times that of the original coal before it was burned. This illustrates the power of fast breeder reactor technology: we could even utilise coal ash for future clean nuclear power. Unconventional sources of uranium and thorium contain not millions, but billions of tonnes of uranium and thorium, multiplying by a further factor of one thousand the already long time periods above.

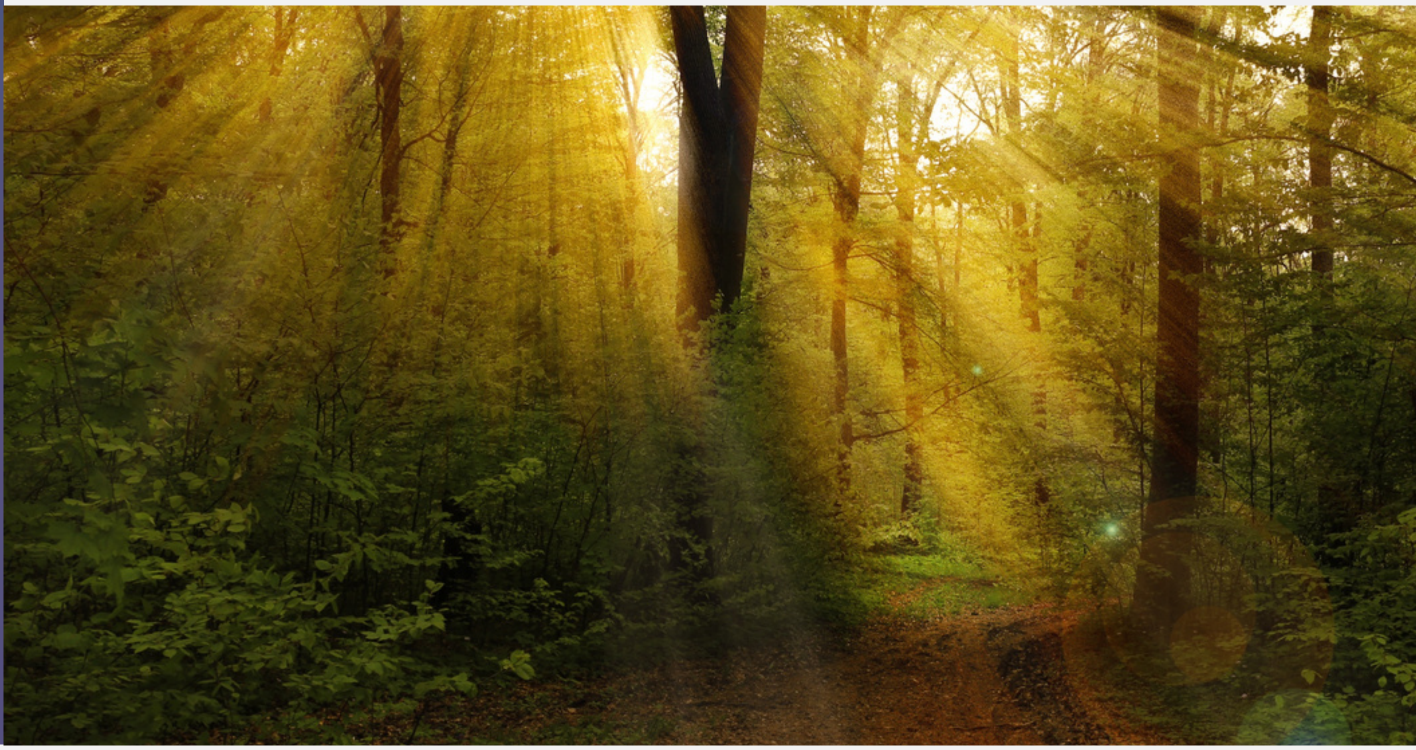
In other words, **if uranium or thorium are used in breeder reactors with a closed fuel cycle, the supply of nuclear fuel for fission is essentially limitless on any timescale meaningful to human civilisation.**

OTHER ENVIRONMENTAL CONSIDERATIONS

Note that the calculations above concern physics not economics. **This is a back-of-the-envelope exercise simply to understand the energy resource implied by known nuclear fuels.** We do not yet know what forms of reactor design will perform best economically, or to what extent nuclear will be able to out-compete alternative sources of clean energy.

However, nuclear does have inherent physical advantages. In the fast reactor system described above, there will be no need for uranium mining for centuries to come. The existing stockpile of 'waste' will be repurposed as fuel, and the remnant will be so short-lived that deep geological disposal will be very much simplified, if not unnecessary altogether.

Nuclear is also very power dense, so uses land much more efficiently than any competing power source. For RePlanet, as an environmental group concerned about land use, this is a major consideration. Nuclear is at least 50 times more land-efficient than solar PV and uses 800 times less land than onshore wind[19]. **If we wish to see a large-scale restoration of natural ecosystems over more than 50% of the Earth's surface, alongside a flourishing high-energy human civilisation, nuclear will therefore be an essential component.** Nuclear also has a similar or better materials use intensity compared to current renewables – another important environmental consideration – and materials use intensity decreases further with a closed fuel cycle[20]. Furthermore, nuclear power has one of the lowest environmental impacts of any energy source, in terms of other life-cycle indicators such as eutrophication, ecotoxicity and human health[21,22].



WHAT REPLANET WANTS

- **All stockpiles** of nuclear material – including plutonium, depleted uranium, actinides and spent fuel – **should be reconsidered as potential fuel for the future**.

- **Modular fast reactors**, including the supply chain, licensing and validation of their fuel cycle, **should be accelerated** to rapid mass deployment to support wind and solar in the achievement of a net zero economy.

- Resources should be allocated urgently to regulators to more **rapidly assess reactor designs using a fully closed fuel cycle** which leave mostly short-lived fission products as waste, simplifying and reducing the scale of deep geological disposal systems.

- All fast reactors must employ engineering characteristics that prioritise **passive safety and reliability, competitive economics, proliferation resistance and fuel cycle sustainability**, as per Gen IV International Forum goals[23].

- **Regulators** must increase their capacity and **fast-track new designs** for build-outs beginning **within five years,** and regulatory approval should apply regionally or even internationally with safeguards.

- **Priority** should also be given to **high-temperature reactors which produce hydrogen** most of the time but can switch to multi-gigawatt support of electricity grids during low wind and solar periods.

- **Governments must take a systems approach**, considering steel-making, transport, electricity and social issues in siting and permitting reactors.

- Special consideration should also be given to **gigafactories located in industrial areas** and shipbuilding ports, supporting steel and chemicals, and **repowering coal plants** with fission clean power.

- As currently, **the International Atomic Energy Agency (IAEA) must take full responsibility for oversight of the fuel cycle**, to avoid any proliferation concerns with the production of fissile materials.

- Reactors and fuel assemblies must also be given design consideration, to enable the using up of existing nuclear warheads **as we reduce stockpiles and achieve a nuclear weapons-free world**.

- The rapid deployment of today's modern, commercially available 'once-through' nuclear reactor technology should not be abandoned, even as we push for fast reactors to become available. **Fast breeder reactors are able to work together with existing reactor designs**, since breeders produce enough fuel to resupply not just themselves but also an additional conventional reactor of the same power. **All forms of nuclear can thus also work together, in partnership with renewables.**

AUTHORS

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Mark Lynas is the author of numerous books on the environment. His latest is Our Final Warning: Six Degrees of Climate Emergency. A co-founder of RePlanet, he also advises former Maldives president Mohamed Nasheed on climate, and works with the 55-member Climate Vulnerable Forum.

ABOUT

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REFERENCES

1. Assessment of the Anticipated Environmental Footprint of Future Nuclear Energy Systems. Evidence of the Beneficial Effect of Extensive Recycling, Energies 2017
2. 'We find that flexible nuclear operation lowers power system operating costs, increases reactor owner revenues, and substantially reduces curtailment of renewables.' See: J. Jenkins et al, The benefits of nuclear flexibility in power system operations with renewable energy, Volume 222, Applied Energy, 2018.
3. For a description see https://en.wikipedia.org/wiki/Thermal-neutron_reactor
4. Depleted uranium is considered useless except in dubious military application as raw material for the manufacture of high density armour-penetrating projectiles.
5. tHM = tonnes of heavy metal. Hence, the mass is entirely uranium/plutonium etc, not considering other aspects of the fuel such as oxides. We consider tonnes and tHM to be interchangeable but use them separately as per the original sources.
6. France gives the most precise figures for its nuclear materials. See p.34 of https://international.andra.fr/sites/international/files/2019-03/Andra-Synthese-2018_EN_relu_HD.pdf, dating to 2019.
7. The UK also gives precise and updated figures for its nuclear materials inventory. These are from https://ukinventory.nda.gov.uk/wp-content/uploads/2020/01/2019-Materials-Report-Final.pdf
8. Data provided by COVRA, Dutch nuclear storage facility, adjunct director Ewoud Verhoef..
9. Totals are not given by Urenco or the German national authorities. However, according to Current Issues - Waste Management of Depleted Uranium: Storage, 13,000 tonnes of DU were stored at Urenco's Gronau plant in 2014. This may not be the current inventory, as unspecified amounts were exported to Russia and stored by Rosatom up until when Russia's attack on Ukraine led to the suspension of this agreement.
10. See https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019SC0435&rid=7
11. Undated. See https://web.evs.anl.gov/uranium/mgmtuses/storage/index.cfm
12. Updated in 2020 according to WNA. https://world-nuclear.org/information-library/nuclear-fuel-cycle/uranium-resources/uranium-and-depleted-uranium.aspx
13. WNA says: 'The FNR [fast-neutron reactor] was originally conceived to burn uranium more efficiently and thus extend the world's uranium resources – it could do this by a factor of about 60.' https://world-nuclear.org/information-library/current-and-future-generation/fast-neutron-reactors.aspx
14. See https://www.iaea.org/newscenter/news/fast-reactors-provide-sustainable-nuclear-power-thousands-years or https://www.iop.org/sites/default/files/2019-06/generation-iv-reactors.pdf (slide 24). Also slide 30 in this presentation by Yoon Chang, one of the pioneers of fast reactor design in the US: https://gsdm.u-tokyo.ac.jp/file/140528gps_chang.pdf. Chang discusses 'essentially complete uranium utilization as compared to <1% in today's reactors.'
15. https://www.whatisnuclear.com/energy-density.html for MJ/kg. This is then converted to GWh per tonne.
16. Note this is not necessarily our idealised energy pathway, discussion of which lies outside the scope of this report.
17. https://www.researchgate.net/publication/241148150_Nuclear_Fission_Fuel_is_Inexhaustible
18. https://www-pub.iaea.org/MTCD/publications/PDF/TE_1450_web.pdf
19. https://ourworldindata.org/land-use-per-energy-source
20. https://www.sciencedirect.com/science/article/pii/S095965262202131X
21. https://iopscience.iop.org/article/10.1088/1748-9326/aa6047/
22. https://unece.org/sites/default/files/2022-04/LCA_3_FINAL%20March%202022.pdf
23. https://www.gen-4.org/gif/jcms/c_9502/generation-iv-goals

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ABOUT US

RePlanet is a network of grassroots charitable organisations driven by science-based solutions to climate change, biodiversity collapse and the need to eliminate poverty.

As a young global environmental organization, the start-up of our activities has been made possible by membership fees and donations, as well as very welcome contributions from the Rodel Foundation, Quadrature Climate Foundation, The Dreamery Foundation and the Anthropocene Institute. Our funding has come exclusively from charitable sources. As part of our commitment to transparency all donors of over €5,000 are listed here. We have not received any funding from industry or party political sources.

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