Fusion power could transform how we get our energy—and worsen problems it's intended to solve

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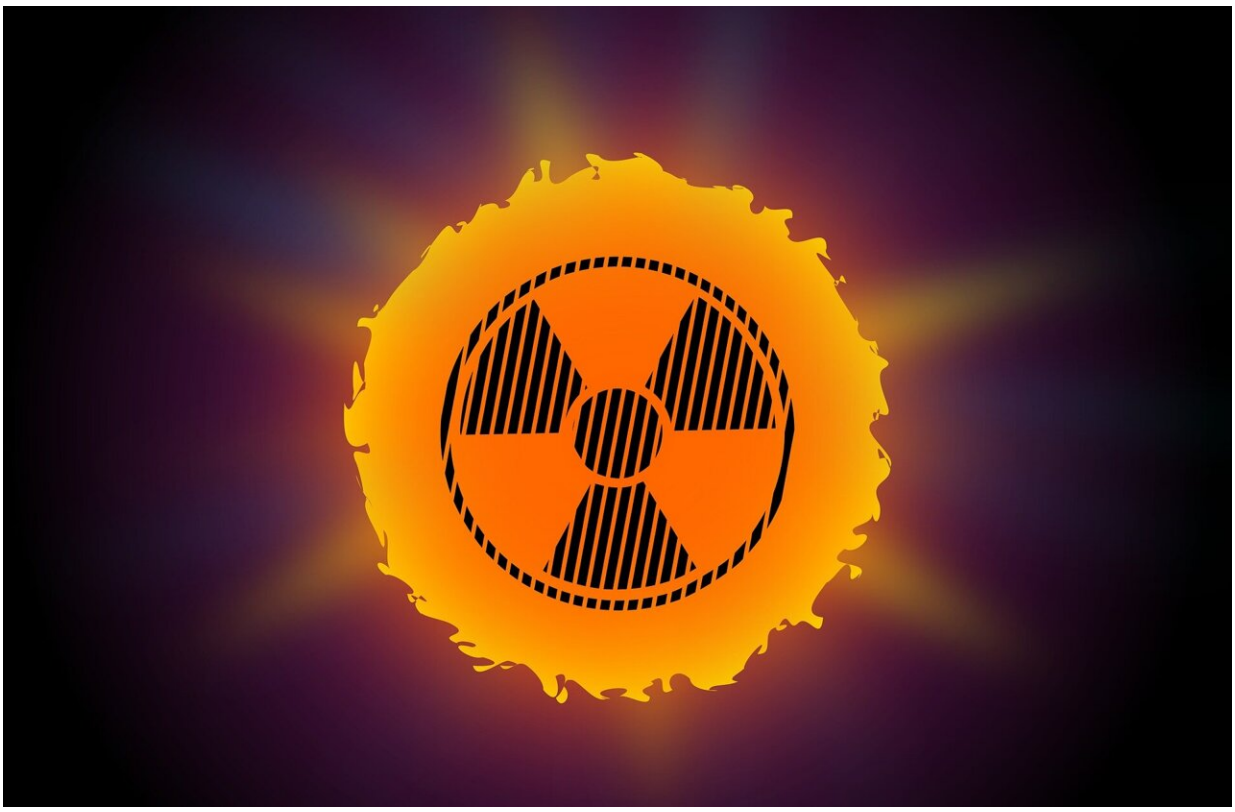

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Harnessing energy from nuclear fusion—the combining of nuclei, which lie within atoms—could be instrumental in the shift towards a

decarbonized global energy system. As issues of climate change and energy security are becoming increasingly salient, the promise of an apparently "clean," "abundant" and "safe" energy source, such as fusion, is ever more appealing.

In response, the fusion industry is growing rapidly and the trope that fusion is "30 years away and always will be" is beginning to lose credibility as the technology moves beyond its experimental stage.

But it's too easy to generate hype around a seemingly ideal solution to societal challenges—and I would argue that the realization of fusion energy may come into tension with the issues it proposes to solve.

Contextualizing this hype and exploring areas where these tensions may arise is critical to ensuring the technology develops in an ethically sound way and can provide net societal benefit if it proves viable.

The appeal of a zero-carbon, low-waste, reliable and relatively safe energy source, such as fusion, is self-evident. It is set against the background of growing global energy demand and in the context of climate change. This all necessitates a transition to a clean energy system.

It's widely thought that fusion energy would be able to plug the gaps of existing energy sources. For example, it would circumvent the intermittency of renewables, given that the supply from solar and wind power is unpredictable, reliant as it is on weather. Fusion also avoids the long-lived radioactive waste, safety issues and public concerns around conventional nuclear fission power. It would help mitigate the carbon cost and greenhouse gas emissions from fossil fuels.

Fusion energy may also placate energy security concerns because some of its key resources are abundant. For example, the deuterium fuel used

in some fusion processes can be readily derived from seawater. This would reduce reliance on imports and insulate nations against global market shocks.

But these benefits may mask deeper ethical questions around the development of the technology and some potentially detrimental impacts. Perhaps one of the clearest instances of such a tension arises over environmental sustainability. This applies particularly to the association with climate change mitigation and the reduction of greenhouse gas emissions.

Climate change is an issue that lends itself to the "techno-fix" approach—in other words, it can be tempting to avoid making important changes to our behavior because we think we can depend on technology to fix everything. This is known as the "mitigation obstruction" argument .

Squaring greenhouse gas emissions with energy demand also raises questions of justice and equity. Energy demand is growing in certain regions, primarily the global south, that have contributed the least to the current climate crisis. Yet fusion programs are overwhelmingly based in the global north. So if fusion proves viable, those with access to such a transformative technology are not necessarily those who will need it most.

Climate change is a global challenge, so any proposed solution must account for global impact. Efforts must be made to recognize the context of development and incorporate considerations of global inequity in the deployment of fusion if we are to meet the climate challenge.

Similar concerns can be found in the materials used for fusion energy. These include critical minerals, including lithium, tungsten and cobalt. Extraction and processing of these minerals emits greenhouse gases. In

some cases, extraction operations are located on or near the lands of indigenous peoples. And the supply chains for these materials are embedded in geopolitical tensions, with alliances, collaboration, competition and the potential for monopolies forming.

Mercury, for example, is used in the processing of lithium for fusion reactors. Not only is the element environmentally damaging and toxic but depends largely on Chinese production.

The accelerating pace of fusion energy increases the risk of overlooking these potential hazards along the way. However, I would say this is not a case where we need to apply moral brakes, but rather shift gear. Approaching these potential ethical tensions requires systematic thought throughout the development process, from thinking about the implications of design decisions and materials choices, through to equitable deployment strategies and knowledge sharing.

Energy access underpins human well-being and development and the energy system as a whole has deep societal impacts. Failure to openly engage with the social and ethical challenges of new and emerging technologies in this space would be irresponsible at best, and harmful at worst. This is particularly so when impacts of fusion technology may compound the precise challenges it aims to solve.

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