

## COMBATING CLIMATE CHANGE

## Fusion: A safer nuclear option

QUAMRUL HAIDER

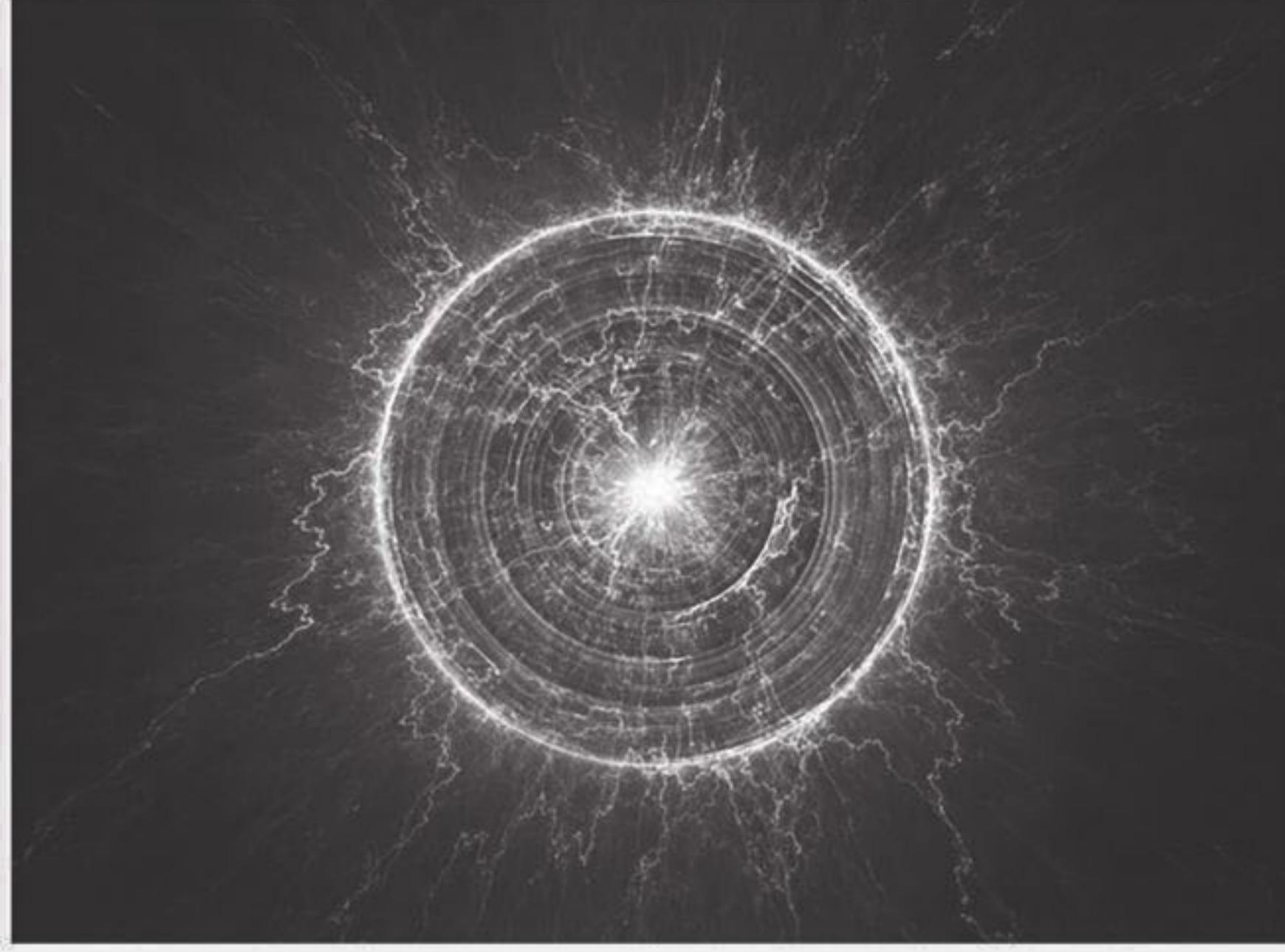
It is obvious that global efforts to combat climate change—that were agreed upon at the 21st Conference of Parties in Paris—have already gone off the rails. Subsequent conferences produced nothing but a long laundry list of unenforceable rules to cope with the rapidly changing climate that is forcing millions of people to lead cramped lives with other climate refugees in the slums of sweltering, shrinking continents.

Arguably, renewable energy is one of the most effective tools we have in the fight against climate change, and there is every reason to believe it will succeed, albeit partially only if we stop, or at least, cap fossil fuel emissions. Otherwise, we cannot simply bet on renewables to combat global warming.

Notwithstanding the remarkable growth due to technological advancements and huge cost improvements over the past decade, renewables, such as solar, wind, geothermal and tides, to name a few, are not available 24/7, year-round, everywhere. The sun does not shine at night or on cloudy or rainy days, and some days may be calm or less windy than others. Geothermal power plants cannot be built in places that do not have the right geological characteristics, while the energy carried by tidal surges can be utilised in coastal regions only, for a limited number of hours per day, though.

That brings nuclear power, which generates huge amounts of electricity with zero emission of greenhouse gases, into the climate change equation. Yet, it is seen by many, and with good reason, as the misbegotten stepchild of nuclear weapon programmes.

What has given rise to our fears about nuclear power more than



SOURCE: EANDT.THEIET.ORG

anything else are the accidents at Chernobyl in 1986 and Fukushima in 2011. The Fukushima disaster in particular has shattered the zero-risk myth of power reactors and heightened our concern about the invisibility of the added lethal component, nuclear radiation. These reactors entail substantial safety and security risks, waste disposal challenges and water requirements, too.

Nevertheless, scientists are reevaluating nuclear power as a possible solution to combat global warming. But they are not considering fission-based nuclear reactors that are used in power plants today. In fission reactions, a heavy nucleus, such as uranium, breaks up into two lighter fragments and two or three neutrons. The process is accompanied by the release of a large amount of energy.

Instead, scientists are actively engaged in developing safer nuclear power systems as one among several technologies that would not use the atmosphere as a waste basket. Specifically, they are focusing attention on nuclear fusion that would rekindle our trust in nuclear energy.

Nuclear fusion is a reaction in which two lighter nuclei, typically isotopes of hydrogen, combine together under conditions of extreme pressure and temperature to form a heavier nucleus, releasing energy in the process. Fusion has been powering the sun and stars since their formation. The energy released during fusion in the sun makes all life on earth possible.

The simplest way to replicate the primordial source of power on earth is via the fusion of deuterium and tritium. Deuterium is found aplenty in ocean

water, enough to last for billions of years. Naturally occurring tritium is extremely rare, but it can be produced inside a reactor by neutron activation of lithium, found in brines, minerals and clays.

The appeal of fusion energy is enduring for several reasons. For equal mass, calculations indicate that fusing two nuclei in a controlled way would release nearly four million times more energy than burning fossil fuels and four times as much as nuclear fission reactions. Moreover, to run a 1,000 MW power plant with a fusion reactor, it is estimated that about 150kg of deuterium and three tonnes of lithium would be required per year, while the current fission reactors consume 25 to 30 tonnes of enriched uranium. A similar coal-fired power plant uses about three million tonnes of fuel. Clearly, gram for gram, fusion reactor wins the energy race hands down.

Unlike fission, fusion will have a low burden of radioactive waste. Fusion's by-product is helium, which is an inert, non-toxic, non-radioactive gas used to inflate balloons. In addition, a fusion power plant would not require transporting hazardous radioactive materials. Furthermore, because there is no "critical mass" required for fusion, the possibility of a "runaway" reaction that could result in a core meltdown—the most serious calamity possible in a fusion reactor—is not an issue with fusion reactors.

Considerable amount of research on the development of reactors that would harness fusion energy is currently underway at several laboratories in the United States and around the world. However, the high cost of research and very expensive hardware limit most of the work to multinational consortia.

The 35-nation International Thermonuclear Experimental Reactor

(ITER) project under construction at Cadarache in France is the world's largest fusion reactor. Launched in 2006, ITER has been beset with technical delays, labyrinthine decision-making and costs that have soared from an initial estimate of five billion euros to around 20 billion euros.

Despite the slow pace, construction of the project reached the halfway point last year. It is an important milestone for the multi-billion-euro facility, whose goal is to begin generating power on an experimental basis by 2025, although the technology to produce electricity commercially is likely many decades away.

Once fusion reactors become a reality, they would be an absolute game-changer in the sense that there will be a paradigm-shifting development in the global energy mix, thereby laying the groundwork for a clean energy revolution. As a source of non-hazardous, carbon-free energy, producing no long-lived radioactive waste, fusion will eventually make fossil-fuel-fired power plants and uranium-based nuclear facilities obsolete. More importantly, if we want to keep the lights on and the wheels of industries running while hardly producing greenhouse gases, nuclear fusion would provide sustainable energy on a nearly unlimited scale.

Finally, according to researchers at Columbia University in New York, in order to avoid disastrous effects of climate change, we have to reduce greenhouse gas emissions by at least six percent annually. They argue that "it's hard to see how we could conceivably accomplish this without nuclear."

Quamrul Haider is a Professor of Physics at Fordham University, New York. He is one of the authors of the book *Nuclear Fusion – One Noble Goal and a Variety of Scientific and Technological Challenges* (IntechOpen, 2019, UK).

## Game of Thrones: An allegory or an escape?



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THE word "Dracarys" has the power to burn entire cities to the ground with scathing dragon fire in HBO's epic fantasy saga *Game of Thrones*. Even off-screen, the Valyrian term

has had an impact on millions of fans around the globe. Regardless of their nationalities, cultural upbringing and religious sentiments, countless people have participated in this mega frenzy. The grand spectacle of fire-breathing dragons, prophecies, sly political crafts, incestuous profanity and a supernatural threat that was beyond the realms of men, scampered to a brusque end on May 19. Around 20 million viewers watched the series finale last week. And many heaved a sigh of disillusionment.

George RR Martin's adaptation of *A Song of Ice and Fire* successfully gave rise to a passionate fandom for fantasy but beyond that, it led to a grand scale of viewership and riveted the interest of critics due its medieval elements, which were borrowed from historical events in our own turbulent world. It also drew heavily from concepts and realities of our own societies such as feminism, corruption in politics, religious radicalism, moral ambiguity and the classic dichotomy between love and duty. This is ironic because fans of such escapist fantasy shows—under which *Game of Thrones* is supposedly categorised by definition—use them as an imaginary gateway to an exotic world. But despite the presence of supernatural elements such as sword-and-sorcery and ice zombies, the show places its political plots—that often mirror the real world—at the forefront. This theory that explains why *Game of*



Sansa Stark evolved into a calm and fierce character despite having been subjected to countless acts of brutality.

*Thrones* has attracted so many viewers posits a broader question for fans of the fantasy genre: Do people really want an escape from reality or do they just desire the flavours of current affairs in exotic settings?

A show that began with what many would call a misogynistic standpoint, coupled with barbarism and gratuitous nudity, saw strong female characters rise to power. This correlates to the rising feminist movements today that seek gender equality. Female characters like Sansa Stark, Arya Stark, Cersei Lannister, Daenerys Targaryen, Brienne of Tarth and even Lyanna Mormont challenged patriarchal foundations either through the wielding of swords

or manoeuvring political tactics for revenge. From being victims of brutality to becoming the rulers and warriors of Westeros, the female characters in *Game of Thrones* shone light on the profoundly feminist strands of the show.

Khaleesi, the mother of Dragons, rose to power ambitiously, wanting the Iron Throne all for herself—not to fulfil a male agenda. Even Sansa Stark, who faced challenges from various adversaries owing to her petulant and timid nature, later rose to power with her calm determination and sharp wit. This only made it apparent that feminism does not revolve around a virile idea of masculine strength

that manifests itself through wielding weapons or waging violence but rather the development of a strong, level-headed matriarch. The show portrayed a realistic dimension of feminine strength by empowering women who, despite being at the receiving end of misogyny, emerge as strong-willed survivors.

Martin said, "The true horrors of human history derive not from orcs and Dark Lords, but from ourselves." It is evident that he based the storyline on this belief. The ruling and competing forces in Westeros often misuse power to reach the Iron Throne. What the show does differently from other shows of the same theme is concentrate less on supernatural blood magic and more on the unpredictable, vicious ploys of masterminds. It parallels the real world where the political superpowers blatantly engage in corrupt schemes, and where we are witnessing a rise in neo-feudalism. The thematic atmosphere of the show has also been influenced by "realpolitik"—a German term for a set of principles that are pragmatic and pay little or no regard to the welfare of the general masses. When Samwell Tarly suggests the notion of democracy in order to elect a next king, the other lords of Westeros could not help but laugh at his proposition—much like the real world where we have ended up making a mockery of the very concept of democracy and have no regard for the welfare of the people. As rightly said by the character Jorah Mormont, "the common people pray for rain, health, and a summer that never ends. They don't care what games the high lords play."

Even the impending apocalypse caused by the white walkers and the initial disregard for it by the lords and ladies of Westeros can be compared to the emerging threat of global warming.

As in the show, powerful leaders in

the real world are busy squabbling over their share of domination, with some leaders entirely dismissing the idea of climate change as a myth. Charli Carpenter, a professor of political science at the University of Massachusetts, implied in an article that the concept of the Northern Wall in *Game of Thrones* is a caricature of our belief that modern civilisation can protect us from the devastating effects of climate change.

But what the plot of the show has depicted immaculately is the coexistence of moral duality and the juxtaposition of good and evil when it comes to power and ambition. The narrative does not try to promote a utopian point of view. Martin triumphed in adapting an Aristotelian view of the leaders of Westeros, successfully highlighting their inner demons. A seismic shift can also be seen in the show with the emergence of the younger characters who want to "break the wheel" or status quo of noble families withholding political power. This shift parallels the real world where new progressive leaders strive to promote equality and challenge the status quo.

With *Game of Thrones* embodying all these aspects of the real world, should we perceive it as a means to escape from the chaos or as an allegory of the modern civilisation itself? Despite its underwhelming finale, the widespread fascination towards the show will last for quite some time because in it, we witnessed how the coexistence of moral extremities played out in such a way that the fictional world in *Game of Thrones* ultimately became less chaotic—something that one can only hope will materialise in the real world.

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## ON THIS DAY IN HISTORY



May 26, 1896

The Dow Jones Industrial Average is first published

The Dow Jones is one of the world's most important stock market indices. Today it comprises data from 30 major US companies.

## CROSSWORD BY THOMAS JOSEPH

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- 25 Lawn material
- 26 Painter Ernst
- 27 Like xenon
- 30 Toddler's cry
- 32 Passover feast
- 33 Had dinner
- 34 Game with tiles
- 38 Eastern temple
- 41 Sneaker problem
- 42 Late hour
- 43 Headey of "Game of Thrones"
- 44 Irrigates
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## YESTERDAY'S ANSWERS

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## BEETLE BAILEY



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by Mort Walker

## BABY BLUES



by Kirkman &amp; Scott

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