The future of energy

Why should it be nuclear-based?

Energy is essential for human life and technology, powering homes, industries, transportation, and communication. It drives innovation, improves living standards, and fosters economic growth. Moreover, energy sustains essential services like healthcare and agriculture. Ensuring humanity's survival hinges upon securing safe and dependable energy sources. Our quest for new energy must be guided by a balanced and scientifically informed approach, steering clear of the pitfalls of fear, self-deception, and disinformation.

In a changing climate, the search for sustainable energy sources is vital for human wellbeing, the economy, and the environment. Renowned British physicist Wade Allison, emeritus professor of physics and Fellow of Keble College at Oxford University in the UK has dedicated years of research into a largely untapped and misunderstood source of energy. His findings give us hope for a better future; however, enlightening the public and dispelling their apprehension, he maintains, is the need of the hour!

- Nuclear energy is the energy released during nuclear reactions, such as controlled nuclear fission or fusion.
- It provides an efficient and virtually unlimited source of power for electricity generation and industrial applications.
- For a long time, however, nuclear energy has been seen by the wide public as a high-risk technology.
- Professor Wade Allison from the University of Oxford in the UK presents evidence for a different viewpoint. By assessing its actual strengths and dangers, he shows that nuclear energy can provide a viable, safe, and environmental replacement for fossil fuels and renewables.

Energy and the physical world

In accordance with the laws of physics, energy is conserved and can only change forms. For example, in internal combustion engines, fuel combustion produces heat energy, which is then converted into mechanical work. Additionally, energy tends to disperse leading to increased disorder – or entropy – as seen in the way that heat flows only from hot to cold. These principles of energy conservation and entropy apply throughout the universe to all energy processes and technologies.

Energy sources

There are only a small number of classes of energy sources on Earth. The most obvious are the renewables – wind, water, and sunshine. Depending on the weather, these are replenished intermittently. Because they are weak, structures to harvest them are large, vulnerable, and environmentally intrusive. Modern technology is not likely to change that.

More intensive are sources of chemical energy – in particular, the combustion of fossil fuels. During the Industrial Revolution, their increased reliability and the advent of engines enabled a vast increase in living standards, so much so that the use of renewables declined.

Beyond fossil fuels

Owing to greenhouse gas emission, the use of fossil fuels throughout the world is becoming a serious concern, because of its contribution to climate change. The escalating local pollution levels in cities, recurrent safety lapses and tensions caused by the unequal geographical fossil fuel distribution pose significant dangers to both the environment and human wellbeing.

The United Nations Climate Change Conference or Conference of the Parties of the UNFCCC (COP 28) in Dubai in 2023 closed with an agreement signalling the 'beginning of the end' of the fossil fuel era and the need to transition away from fossil fuels.

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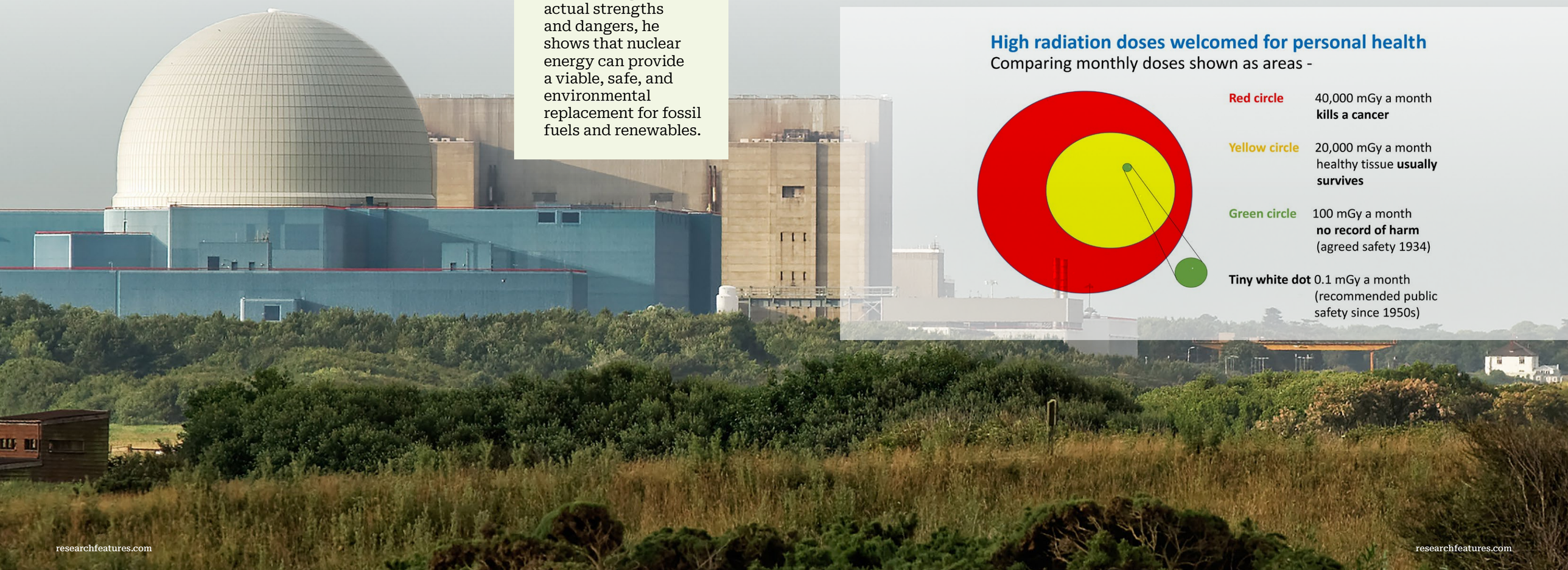
An option is to revert to renewables. However, this would require huge batteries for their intermittent availability, massive interconnectors, and grid upgrades to reach users. The availability of enough minerals is also a problem. It is unlikely that they could support today's economy – they were inadequate even before 1800.

Nuclear energy

The potential of chemical energy was not fully understood until the advent of wave mechanics. All matter is composed of atoms which contain electrons and nuclei. Electrons, despite being material particles, also behave as waves. These resonate as in a musical instrument, as first shown by Nobel Prize winner Louis de Broglie in 1924. The shorter their wavelength, the higher the pitch and the higher the energy they carry. It is this electron energy that explains why molecules are stable and why, in chemical processes including those occurring in living organisms, they can be converted into one another, exchanging energy with the environment.



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Nobel Prize winner Louis de Broglie suggested that electrons also behave as waves, resonating as in a musical instrument.

The predictions of wave mechanics about electrons must also apply to the constituents of atomic nuclei, which are, however, 100,000 times smaller. The energy stored in the interaction between protons and neutrons within a nucleus must therefore be over a million times larger than typical chemical energies. This is the nuclear energy that has been studied for 100 years, with density ten orders of magnitude greater than typical renewable energy sources. Furthermore, the fuel supplies required for nuclear fission – uranium and thorium – are plentiful.

The dangers of nuclear energy: truth or myth?

The technology required to harness and control nuclear energy has been available since the 1950s. However, the attitude of political leaders and the public towards its extensive utilisation has been one of extreme caution. Over-simplified descriptions of a future worldwide nuclear war, illustrated with images of Hiroshima and Nagasaki in 1945, have led to an unjustified demonisation of nuclear energy, even in its peaceful applications.

In particular, the supposed dangers of radioactivity and the radiation it emits have been used to justify an international regime of general safety regulations and bureaucratic restrictions impacting the design and construction of nuclear power plants. Allison shows with extensive evidence that the extra costs and delays are unjustified and ineffective, even as a means of public reassurance.

Educating future generations

Nuclear energy, Allison points out, is not man-made: it is part of the natural world, just as much as chemical energy. Today, biology explains why life can thrive in a radioactive world, and why, in fact, radiation can be a powerful gift, for instance, in the treatment of cancer. 'We know', Allison says, 'that nuclear energy is far more controllable than fire, and that life has evolved successfully in the presence of radiation. We would not be here if we were not naturally protected against radiation.'

Nuclear energy offers a tremendous opportunity to replace fossil fuels, while satisfying the current and future energy demands in an environmentally and economically sustainable way. It is now up to everyone – the media, educators, and the wide public – to appreciate the real strengths and safety of nuclear energy. They and their children should look forward to the transition toward a new age of safe and plentiful energy production.

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	Pre-industrial era ('renewables')	Industrial Revolution (carbon)	Next Revolution (nuclear fission)
Fuel	Slaves, animals, water, wind, bio/wood, sun	Fossil fuels	Uranium, thorium
Energy density kWh per kg	0.0003	1 to 7	20 million
Lifetime fuel per person	10 million tonnes	1,000 tonnes	1 kg
Points in favour	Accepted	24/7, anywhere	24/7, anywhere, compact, resilient, safe
Points against	Intermittent, weak, huge footprint	Emissions, poor safety	Fear, poor education
Energy renewal	Daily sunshine with seasons	Ancient fossilised sunshine	Pre-solar supernovae

Personal response

What has prompted you to reassess from a general perspective the strengths and actual dangers of nuclear energy for human society?

At Oxford, for some years, I conducted a course for the physics students on radiation and medical physics. Once, when I gave a popular lecture to alumni on the subject, I found that they were quite ignorant, very apprehensive but easily reassured. I realised that everybody has been scared for 75 years and I should work to correct this.

What are the main advantages of nuclear energy over fossil fuels and renewables?

The huge energy content means only one kg of nuclear fuel is all that one person needs for life – leaving only one kg of waste that is easily stored and becomes harmless in 600 years. Nuclear energy is available whenever and wherever needed, regardless of the weather. There is plenty of uranium and thorium fuel widely distributed on Earth. The land and mineral requirements are minimal. It should not be expensive.

What are the most important sources of evidence concerning the safety of controlled nuclear fission in energy production?

- Except at the centre of the Sun (where it occurs only once every billion years), the nuclei of atoms are celibate – they never meet and thus, do not react.
- Fresh nuclear energy is only released inside a working reactor through the agency of neutrons, but these are unstable and easily absorbed.
- Unstable nuclei decay (fall apart) uncontrolled.
- The accident record of 70 years of nuclear reactors worldwide has proved their safety.
- Nuclear radioactivity and its radiation are not contagious and do not multiply and spread like fire, viral infection, or the popular fear and panic that engages media excitement.

What are your suggestions concerning potential approaches to educate future leaders and the wide public about the potential and safety of nuclear energy?

- Understanding and education are slow processes. Therefore, it will take time to establish trust and confidence.
- Shock, horror, and pictures of people in protective suits may sell advertising for the media, but are counterproductive.
- Children are most receptive to teaching, and parents would much prefer listening to their children than politicians.
- Communities should establish a sense of pride, security, and ownership of their local nuclear plant. They should welcome school visits and vacation jobs for young people, charity involvement, etc.
- People in the medical field should be more open and honest about radiation safety (while also learning more themselves).

What is your outlook on the wide adoption of nuclear energy during the current and next generation?

Its adoption will become accepted as:

- renewables fail to deliver when required, resulting in blackouts;
- climate change worsens and more people understand the need for change;
- extreme weather events disable vulnerable renewables;
- foreign agents/terrorists threaten vulnerable renewables and connectors;
- the skilled jobs that nuclear power provides are welcomed locally;
- young people tell fossil fuel and renewable business recruiters that they prefer to work for nuclear; and
- it is realised that nuclear plants last for 60–100 years whereas renewables last only 15–20 years.

Fuel for nuclear fission was created in supernova explosions, like the Crab Nebula, seen in broad daylight in 1054 AD and its remnant photographed today.

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Bio

Wade Allison is Professor Emeritus and Fellow of Keble College at Oxford. His studies stretch from mathematics to medical physics on which he has lectured worldwide and published four books: *Fundamental Physics for Probing and Imaging, Radiation and Reason, Nuclear is for Life,* and *The Flight of a Relativistic Charge in Matter.*

Competing interest statement

Wade Allison declares, 'No competing interests except those of my six grandchildren, as I tried to explain to sceptical audiences when asked, for instance, in Japan and Korea. They and their contemporaries should study in preparation for life in a world facilitated by nuclear energy.'

Further reading

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