

FUSION PRODUCES ENERGY GAIN

A big step forward towards clean, limitless energy



Dr Quamrul Haider is a professor of physics at Fordham University in New York, US. He is also one of the authors of the book "Nuclear Fusion - One Noble Goal and a Variety of Scientific and Technological Challenges" (Intech Open, London, UK, 2019).

QUAMRUL HAIDER

The declining reserves of fossil fuels and their detrimental effects on the environment have thrust nuclear power into the limelight. However, the 1986 Chernobyl and 2011 Fukushima accidents involving fission-based nuclear reactors that are in use now have heightened our doubts about nuclear technology's ability to provide a safe way of generating clean power.

Within the context of climate change, nuclear fusion is an attractive alternative because it does not produce greenhouse gases (GHG). Besides, unlike fission, fusion has a low burden of long-lasting dangerous radioactive waste. Fusion's by-product is helium, which is a non-toxic, non-radioactive gas used to inflate children's balloons.

So what is nuclear fusion? It is a process in which two lighter nuclei, typically isotopes of hydrogen such as deuterium and tritium, combine together under extreme conditions to form a heavier nucleus, releasing inexhaustible amounts of energy. A "fusion reactor" buried deep in the Sun's interior produces, in one heartbeat, the energy equivalent of 100 billion nuclear bombs.

Major challenges

The quest to make fusion a viable power generation option has turned out to be extraordinarily difficult.

Yet, since the 1950s, scientists have been working tirelessly to develop a fusion reactor with the following goals in mind: 1) achieve the required temperature of more than 100 million degrees Celsius to ignite a self-sustaining fusion reaction, 2) contain and control the staggering levels of heat generated in the plasma, which is an ultra-hot soup of gases in which the electrons are completely detached

from the atomic nucleus, 3) keep the plasma together at this temperature long enough to get useful amounts of energy out of the reaction, and 4) obtain more energy from the reaction than is used to heat the plasma to the ignition temperature.

The breakthroughs

In August 2021, researchers at the National Ignition Facility (NIF) at the Lawrence Livermore National Lab in California were able to ignite a fusion reaction that lasted for a fraction of a second by pumping laser beams into a tiny chamber containing deuterium and tritium. A year later, researchers in South Korea were able to keep the reaction going for 30 seconds at temperatures beyond 100 million degrees Celsius.

The energy yield of both the experiments was modest and less than the energy needed to ignite the reaction.

Physicists have also devised two competing techniques to control the hot plasma and keep it away from the walls of the container. They are magnetic confinement and inertial confinement. The one that is preferred by fusion researchers is a magnetic confinement device called "tokamak." This workhorse of fusion is a doughnut-shaped chamber in which magnetic fields keep the plasma in perpetually looping paths without touching the walls.

The energy gain breakthrough

On December 13, 2022, the US Department of Energy announced that scientists at the NIF had managed for the first time ever to achieve a "net energy gain" - producing more energy in a fusion reactor than was required to drive the process. In particular,



The 35-nation International Thermonuclear Experimental Reactor (ITER) under construction in Cadarache, France is the world's largest tokamak fusion reactor. Pictured here is the facade of the Tokamak Complex in October 2022.

PHOTO: ITER

it produced three million joules of energy, with about two million joules going into the reaction. (To put the unit of energy into perspective, the kinetic energy of a one tonne car moving at 100 mph is one million joules.) In the past, the energy input far exceeded the energy output from a fusion reaction.

So what does this mean for the possibility of creating effectively unlimited amounts of clean energy? Fusion researchers denote the ratio of output energy to input energy with the letter Q. Although in this experiment Q=1.5, fusion reactors will have to reach a threshold of Q=10 before energy generation can be considered practical for commercial use.

While the amount of energy

released in the experiment at the NIF is barely enough to boil water for a few cups of coffee, in some ways, it is a scientific milestone in the sense that scientists and engineers, after "more than 60 years of research, development, engineering and experimentation," achieved a Q value of greater than one.

Moreover, once vetted by outside experts, this landmark achievement will be a big step forward towards clean, limitless energy - at least four million times more energy than is produced by burning coal or oil, according to the UN's International Atomic Energy Agency. More importantly, it promises to stimulate interest in fusion-related research, and possibly leverage funds for building fusion reactors.

Future outlook

Considered to be the holy grail of energy, nuclear fusion has the magic wand that will most certainly solve our lingering energy problem.

Having said that, significant challenges still remain. Researchers are now actively working on improving laser technology and reactor design at several laboratories in the US and around the world. But 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) under construction in Cadarache, France is the world's largest tokamak fusion reactor. Since its inception in 2006, ITER

has progressed in fits and starts. It is beset with technical delays, a labyrinthine decision-making process, and cost estimates that have soared from EUR 5 billion to around EUR 20 billion.

Regardless, ITER will move the world a step closer to creating energy that is inherently safe and clean, using controlled thermonuclear fusion.

Ultimately, though, the achievement of fusion energy production with Q greater than one does not necessarily mean a green energy revolution is imminent. It will probably be years, likely a decade or so, before fusion power bears fruit. And it is also not clear if fusion will ever be cheap enough to radically transform our power grid.

Devaluing women's care work is costing us all

Gitanjali Singh is country representative for UN Women Bangladesh.
Tuomo Poutiainen is country director of the International Labour Organization (ILO) Bangladesh.

GITANJALI SINGH and TUOMO POUTIAINEN

Lokkhi Rani from Satkhira spends her days taking care of her two daughters and carrying out household chores, with no time to find paid work. In addition to the unpaid care work, her chances of economic opportunities are further constrained by her limited education and the conservative social norms that constrain her choices. Lokkhi's life is shaped by decisions made by her husband and in-laws.

Care work constitutes the foundation on which our very existence depends. It includes activities people perform daily, including cooking, cleaning, and other household chores. It also includes direct face-to-face personal care activities such as nurturing the sick, feeding a baby, or teaching young children. Care work can be both paid and unpaid and performed in private households as well as in hospitals, nursing homes, schools, and other care establishments.

In general, many care activities are often unpaid and unrecognised, overwhelmingly done by women, leaving them with little time to pursue income opportunities.

The first-ever time-use survey, conducted by the Bangladesh Bureau of Statistics (BBS) in 2021, with support from UN Women, put a spotlight on the care economy of Bangladesh. The survey quantified how individuals spent or allocated their time in urban and rural areas across the country.

On average, women in Bangladesh spend about 25 percent of their time daily on unpaid care work while men spend 3.3 percent of their time on the same. This means that women carry out seven times more care work than men. Women's unpaid care work steadily increases with age, peaking at 6.2 hours for women aged 25-59 years, after which it reduces to 2.7 hours.

Comparatively, men's unpaid care work only marginally increases from 0.5 hours

for the 15-24 years age group to 0.8 hours for the 25-59 years age bracket. Unpaid care work rates remain similar for women living in urban and rural areas, as well as for women with and without formal education. With marriage, women's load of unpaid care work increases by more than 151 percent, whereas men increase their employment-related activities by more than 78 percent after marriage.

The unequal distribution of unpaid care work was further exacerbated during the Covid-19 pandemic. According to the "Rapid Analysis of Care Work during COVID Pandemic in Bangladesh," women spent 28 percent more time on domestic duties than they did before the pandemic, with the burden increasing by about 40 percent for married women and adolescent girls, due to lockdowns and movement restrictions. Considering the data, it is no surprise that women's labour force participation is a low 36 percent compared to 80 percent for men.

Women's lack of time to participate in paid work constitutes a significant barrier to their access to income, which limits their autonomy and leadership. Women who are engaged in the formal labour force often end up working a "double shift" of paid and unpaid work. This has serious consequences for their health and well-being.

The disproportionate division of unpaid care work is not isolated to Bangladesh, though. The ILO's 2019 report, "Unpaid Care Work and the Labour Market," which analyses time-use surveys from across the world, highlighted that, without exception, women carry out 75 percent of unpaid care work (88 percent in Bangladesh). Moreover, ILO estimates that unpaid care work accounts for around nine percent of global GDP, approximately USD 11 trillion.

The gendered division of care and domestic responsibilities has cost implications for individuals, society,

and the economy. In addition, given the common perception of "care" related work as primarily "women's work," there persists a strong cultural notion for an undervaluation of the work, which is also reflected in the wages and benefits offered to workers in the sector, especially to domestic workers.

At the global level, several initiatives are advancing the care agenda forward. As part of the 25-year review of the Beijing Platform for Action, the multigenerational campaign "Generation Equality" was launched, which demands equal pay and equal sharing of unpaid care work. Additionally, in response to the Covid-19

The gendered division of care and domestic responsibilities has cost implications for individuals, society, and the economy. In addition, given the common perception of "care" related work as primarily "women's work," there persists a strong cultural notion for an undervaluation of the work, which is also reflected in the wages and benefits offered to workers in the sector, especially to domestic workers.

pandemic, ILO and UN Women launched a joint programme to support governments, women's organisations, development, and social partners globally in implementing gender-sensitive policy responses to the Covid-19 crisis and ensuring a job-rich and inclusive recovery.

In Bangladesh, the government's 8th Five-Year Plan commits to a comprehensive Gender Equality Strategy. The Plan aims to address the Sustainable Development Goal Indicator 5.4.1. (proportion of time spent on unpaid care and domestic work,

by sex) and reduce the proportion of total time that women spend on unpaid domestic and care work from 25 percent to 20 percent, and increase the time that men spend from 3.3 percent to 10 percent by 2025. This will be achieved by investing in safety net programmes and conducive work environments, including strengthening the provision of medical and childcare support. Furthermore, the Women Development Policy (2011) emphasised the need to reflect women's household labour in the national accounts. In 2021, PM Sheikh Hasina pledged to raise women's participation in the workforce to 50 percent by 2041 in her address at the UNGA.

UN Women and ILO are committed to working with the Government of Bangladesh to accelerate women's economic empowerment via initiatives that address discriminatory social norms that perpetuate the unequal care work burden and create political consensus for the adoption of macro-level economic policies in pursuit of gender equitable growth.

This includes recognising, reducing, and redistributing unpaid care work, and rewarding and representing paid care by a) promoting decent work for care workers, including through job creation for women, and promotion of sectoral and industrial policies that tackle occupational and sectoral segregation, b) supporting health protection for pregnant and nursing women to protect their right to a safe and healthy working environment, c) supporting parental leave provisions as a universal human and labour right, for both men and women, d) advancing care workers' representation by promoting social dialogue and collective bargaining, and e) promoting the right to childcare and long-term care services and ensuring that investments in care service provisions are costed, financed, and implemented through policy advice, capacity development, and technical support.

As reiterated by the UN Secretary General, António Guterres, we must invest in quality jobs in the care economy that will promote greater equality and ensure everyone receives the dignified care they deserve.

CROSSWORD BY THOMAS JOSEPH

- ACROSS**
- 1 Nuisance
- 5 Jelly buys
- 9 Juliet's love
- 10 Concerning
- 12 Love affair
- 13 Perhaps
- 14 Wealthy travelers
- 16 Cart puller
- 17 Pub brews
- 18 Eggy dish
- 21 Brick carrier
- 22 Crooner
- 23 Uses the phone
- 24 Better half
- 26 Jazz style
- 29 Rob
- 30 Cause of ruin
- 31 Count start
- 32 China collection
- 34 Fall flower
- 37 Stage comment
- 38 Fashionably dated
- 39 Croons
- 40 Beginner
- 41 Otherwise
- DOWN**
- 1 Citrus fruit
- 2 Hammed it up
- 3 Grinch's creator
- 4 Ripped
- 5 Jelly's kin
- 6 Lawyers' org.
- 7 "Casino —"
- 8 Group within a group
- 9 Prince of India
- 11 Exam
- 15 Handyman's collection
- 19 Cart puller
- 20 Overhead trains
- 22 Ancient France
- 23 Machinery part
- 24 Western sight
- 25 Comely
- 26 Washroom fixtures
- 27 Nervous
- 28 "For — sake!"
- 29 Sow's mate
- 30 Pesto herb
- 33 Simplicity
- 35 Screw up
- 36 Aussie hopper

WRITE FOR US. SEND US YOUR OPINION PIECES TO dsopinon@gmail.com.



YESTERDAY'S ANSWERS

