Nuclear and Heavy Industry Decarbonisation

Energy-intensive industries

Large industry and manufacturing such as cement, steel, aluminium, paper, chemical and mining are often reliant on sizable quantities of energy to sustain production.

Electricity is one of the main energy forms used, but there is often a requirement for high-temperature heat such as that used in cement and steel production. This heat is generated through the burning of fossil fuels.

New technologies, such as some crypto-currency platforms, also have huge energy requirements due to the high electrical demands of computer processing.

These industries collectively contribute large volumes of air pollution including harmful gases and small particulate matter that are causing serious threats to public health and damage to our environment.

Industrial activities emit carbon dioxide, nitrous oxide, methane, and fluorinated gas, all of which are potent greenhouse gases (GHG). This is all adding to the well documented and proven climate emergency.

Unchecked, these emissions will have a catastrophic effect on our planet. This crisis is further fuelled as developing countries seek prosperity through industrialisation.

Renewables such as solar and wind generation cannot alone meet the growing demands for energy. Therefore, to sustain the increasing levels of industrialisation, while also ensuring that global targets for GHG reduction are reached, the world's leaders must embrace nuclear technology.

Decarbonisation of heavy industry

Heavy industry accounts for 22% of global carbon emissions. Steel, cement, oil refining and chemical industries all require large quantities of high temperature heat. Most of this heat is currently produced using fossil fuels, even though advanced nuclear reactors could reliably deliver high temperature (>400°C) steam to power these sectors.

In fact, about half of all energy produced globally is used for heat. Add in the transport industry and these sectors alone could emit more than 500 Gt of CO_2 between now and 2050. That is 100 Gt more than the maximum which can safely be emitted if the rise in average global surface temperature is to stay below 1.5°C.

The shipping industry, a big emitter that has largely escaped regulation, relies on cheap fuel oil. Nuclear is a proven, reliable transport power source only held back by its historically high cost. Now that the EU carbon pricing is high enough to drive investment in low carbon alternatives, the advantages of nuclear energy as a climate solution are becoming clear.

Heavy industry will face growing pressure, not least from investors, to cut its fossil fuel consumption. Broader implementation of climate policy including carbon pricing, coupled with border tax adjustments to prevent carbon leakage, could accelerate decarbonisation without penalising individual first mover companies who are willing to act now to reduce their carbon footprint.

This would help deliver the emissions cuts that heavy industry must make. It would also make nuclear energy much more attractive for many industrial processes.

New nuclear technologies

Decarbonising the industrial sector, which accounts for about a fifth of global CO_2 emissions, is a key part of an economy-wide decarbonisation effort. The nuclear sector is developing advanced reactor designs that meet tomorrow's changing energy needs as well as provide additional advantages for a more holistic, sustainable nuclear energy system.

Advanced nuclear technologies are designed to provide not only electricity, but also energy to various non-electric services such as process heat for industrial applications, electrolysis-based and heat-process based hydrogen generation, water desalination and district heat. Current advanced generation technologies including light-water reactors and next-generation advanced reactors could significantly help in decarbonising the heat necessary in both the industrial and domestic sectors, and ultimately mitigate the carbon footprint of heavy industry.

Some of these advanced nuclear technologies are expected to generate temperatures above 600°C, which are required by some of the industrial processes hardest to decarbonise, such as chemical and steel production.

In the EU, a quarter of industrial processes depend on high-temperature heat (above 400°C), which could be generated by next generation advanced reactors. Additionally, lower temperature nuclear heat could be used to heat homes through district heating systems.

YES TO NUCLEAR PERSPECTIVES I INDUSTRY PERSPECTIVE

Role of SMRs in eliminating heavy industrial emissions

Reducing emissions from fossil fuel-intensive industrial processes is an essential step to achieving international and national decarbonization goals. Many different advanced reactor designs have an advantage over conventional reactors as they can not only generate carbon-free electricity, but also provide process heat for district heating, desalinization, hydrogen production, and other energy-intensive manufacturing and refining processes.

Many advanced reactor concepts are currently in development to help accomplish this. A key player among them will be small modular reactors (SMRs) that use the same, or similar, water-cooled technology as most conventional reactors operating today. Water-cooled SMRs bridge the gap between conventional and non-water cooled advanced reactors because they incorporate many elements of this familiar technology, while also improving safety, efficiency, and flexibility.

Water-cooled nuclear technology is mature; it is well tested, has years of operating experience, and is well-understood by regulators. Thus, these water-cooled SMRs will likely have the fastest path to market, kicking off power- and industrial-sector decarbonization, with other advanced technologies following in subsequent years.

An example is NuScale Power's water-cooled SMR concept called the NuScale Power Module (NPM) that generates a gross output of 77 MWe. NuScale's larger plant configurations are comprised of several of these modules. One NPM is useful for supplying energy to distributed centers of industrial activity. NuScale states that the NPM can be sited in many places, including on retired coal power plant footprints, "to supply energy for electrical generation, district heating, desalinization, and other process heat applications."

Viewpoint

Decarbonizing Heavy Industry with Clean, Advanced Nuclear Technology

Decarbonizing the global economy represents a significant undertaking. Industry contributes 21% of greenhouse gas emissions globally, according to the U.S. Environmental Protection Agency. However, it remains one of the most difficult sectors to transition to carbon-free technologies. Fortunately, advances in nuclear energy technologies prove they have an important role in achieving the world's decarbonization goals and addressing climate change.

Industrial processes, like producing hydrogen, petrochemicals and steel, require high-temperature heat and traditionally rely on fossil fuels burned on-site for energy. Many clean energy technologies available today do not operate at high enough temperatures to decarbonize these processes. That's where advanced nuclear technologies come in. These technologies operate at the temperatures needed to generate the heat to power these processes without creating emissions.

Advanced reactor technologies, like the NatriumTM technology and Molten Chloride Fast Reactor (MCFR) design, will provide the clean, reliable and efficient energy needed to decarbonize heavy industry. The Natrium reactor is a sodium-cooled fast reactor and the MCFR design is a type of molten salt reactor. Both technologies will operate at higher temperatures than conventional reactors, thus offering applications to decarbonize industrial processes.

To advance next-generation reactor technologies, the U.S. Department of Energy (DOE) launched its Advanced Reactor Demonstration Program (ARDP), which seeks to demonstrate advanced reactors this decade through cost-shared partnerships with U.S. industry. In October 2020, TerraPower received $80 million in initial funding to demonstrate the Natrium technology. Relevant to TerraPower's MCFR design, DOE also selected the Molten Chloride Reactor Experiment proposal, with Southern Company as the prime, to receive funding as part of the ARDP's risk-reduction pathway.

The ARDP continues the momentum for the years of research, design and testing behind advanced reactor technologies that will power our clean energy future and help to decarbonize everything from electricity generation to energy-intensive industrial processes.

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