Nuclear application

Potential role of nuclear cogeneration: heat applications

Cogeneration of heat and power

The main function of today's operating nuclear power plants is electricity production. However, many countries are also interested in applying nuclear energy to help meet 'difficult to decarbonise' industrial, commercial, and residential energy demands. Combining the heat and power operation of a nuclear power plant can help optimize energy flows and minimize energy losses, thus improving a country's energy efficiency and energy security without the output of carbon emissions.

Apart from traditional biomass burning, most heat that is used in industry or the commercial sector is currently generated by burning fossil fuels. A switch to a carbon-free source of heat like nuclear energy is required to address concerns about current levels of carbon emissions.

The cogeneration of heat and electricity generated by nuclear power plants, depending on the reactor type, has the potential to power district heating for residential and commercial buildings, industrial process heat supply, desalination of seawater, and hydrogen production.

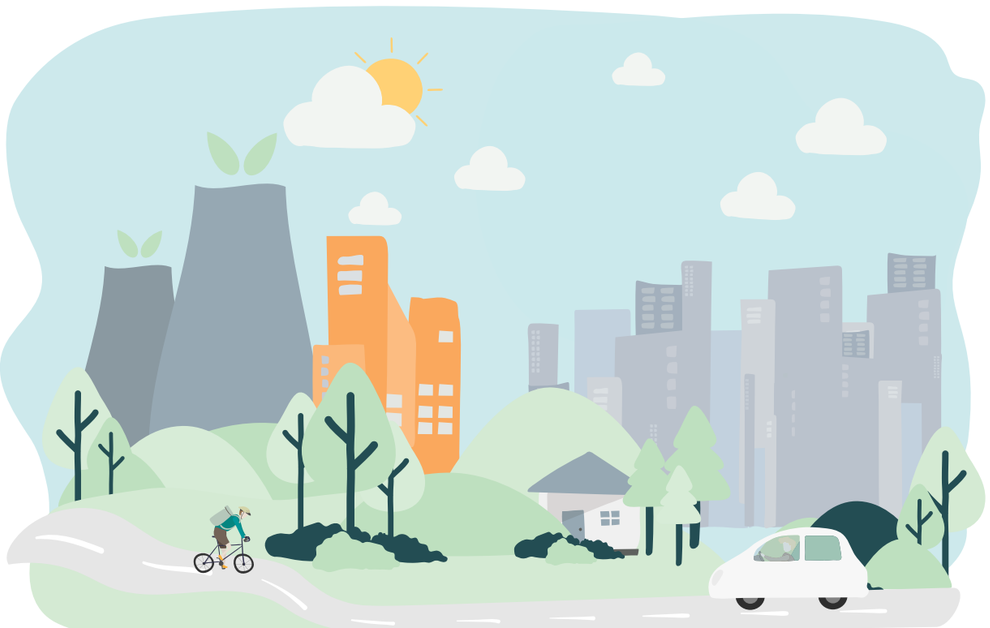
Small modular reactors represent a particularly suitable option for nuclear cogeneration applications, and would enable the use of heat available in areas where the size or other attributes of conventional nuclear power plants are not as well suited.

Nuclear energy for heat applications

In order to mitigate the effects of climate change, countries will need to reduce their carbon emissions and use energy more efficiently. For power plants, this means learning how to make use of excess heat typically wasted when producing electricity. Advanced nuclear energy can solve this problem by supplying carbon-free electricity and heat that can be used for residential, industrial, and other purposes.

The ability to heat homes more efficiently can help reduce carbon emissions. With district heating, power plants are able to provide buildings with the thermal energy produced in their plant to heat buildings and provide warm water. The benefit is that district heating improves energy efficiency, reduces emissions, and simplifies operation and maintenance costs.

Advanced reactors also have the potential to decarbonize other economic activities. Due to advances in materials engineering, advanced reactors will be able to operate at higher temperatures than conventional reactors. Sodium cooled reactors and liquid metal cooled reactors will be able to produce temperatures up to about 600°C, which is optimal for certain applications like co-production of hydrogen. Other technologies, like very high temperature reactors, will have the ability to produce heat at a temperature high enough for cement making or steel manufacturing, two of the most carbon-intensive processes in the world.



YES TO NUCLEAR PERSPECTIVES I INDUSTRY PERSPECTIVE

Using nuclear heat in district heating and industrial processes

District heating involves the production and distribution of steam or hot water from a central, underground plant. The hot water or steam is transmitted through a thermal piping network and distributed to multiple residential or commercial buildings to meet heating needs. This process is cost efficient as consumers avoid having to install their own expensive boilers.

District heating is regarded as more sustainable since the centralization of heat generation results in an overall reduction in energy inputs necessary to produce sufficient heating for all compared to more distributed heating methods.

Nuclear power is a good fit for district heating as the economies of scale for such applications prefer multiple 10's to 100's MWth decarbonized energy sources which both large-scale as small modular reactors can provide. There are already cases of nuclear power plants enabling district heating as far back as the1960's (e.g., the Ågesta reactor in Sweden), as well as in Russia and Ukraine. Additionally, various advanced reactor designs, such as high-temperature reactors, are currently being developed for district heating and other specific industrial heat applications.

Viewpoint

Bohunice NPP heating network

The Bohunice Nuclear Power Plant is unique in Europe — as a low-carbon source it supplies electricity as well as heat for district heating in its vicinity. Heat supplied from a nuclear source is ecological — it is produced by high-performance combined heat and power generation without greenhouse gas emissions; and the cheapest — more than 30% cheaper than the average price of heat on the Slovak market. Over two thirds of the heat supplied is used for household heating, the rest for industry.

Specific heat supplies in hot water are reliably provided by the heating system for end customers — family houses in Jaslovske Bohunice municipality, homeowner communities, schools, offices, institutions, sports grounds, recreational facilities, railways, industrial companies in surrounding towns. Three hot water pipelines run from the Bohunice NPP since 1988 or 1997 resp.: 21 km pipeline to Trnava; 16 km pipeline to Hlohovec and Leopoldov; and one for industrial use on the NPP site, incl. JAVYS company. The annual heat supply from Bohunice NPP is about 1.6-1.8 mil. GJ.

The heat supply system consists of a heat exchanger station and pipes with diameter of up to 700 mm, which gradually branch into smaller connections to customer transfer stations.

Water temperature in the heat feeder is outside-temperature-controlled and ranges from 90 to 140°C. The returning water is about 40°C colder. The heat pipeline water is heated in the power plant exchanger station by steam taken directly from turbines and is fed to transfer stations of customers, where it heats the secondary heating water or tap water.

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