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Is Nuclear Energy a Viable Option for All?

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The prospect of nuclear energy as an alternative to traditional fossil fuels has increased sharply due to soaring oil prices. This has been further boosted by the challenge of global climate change. Do these factors mean that nations should adopt nuclear energy as a strategy for energy security?

THERE HAVE been much debate about nuclear energy for civilian use. Proponents argue that it is a viable source of alternative energy to traditional fossil fuels, and is also environmentally friendly given its lower carbon emissions. With the prospect of a booming Southeast Asia consuming more energy for economic development, ASEAN countries have seriously considered nuclear energy as an option to diversify its energy mix and rely less on oil, coal and natural gas. Indonesia, Vietnam and Thailand have all planned to have their reactors running in the next decade. Other nations in the region could possibly join in the quest for nuclear technology for the same reason.

Why Nuclear Energy

The rapid depletion of fossil minerals, exacerbated by the growing demands from industrialised nations, has led to the scarcity of conventional hydrocarbon fuels. The close relationship between energy consumption and economic growth has contributed to the securitisation of energy resources. Rising prices of oil and natural gas has provided the impetus to search for alternative sources of energy. Nuclear energy emerged as the viable option as it is able to replace the large-scale energy demands traditionally used by fossil fuels. Solar and wind energy need to be stored sufficiently and are therefore not ready for large-scale deployment, hence making this option economically unviable.

There is an intricate link between energy consumption and climate change. With about 80% of energy derived mainly from fossil fuels, much effort is now needed for finding alternative fuel sources that will help manage the problems of climate change. Coal, though abundant, is certainly one of the most polluting sources of energy. On the other hand, nuclear energy is known to be environmentally friendly as it emits zero carbon dioxide into the atmosphere. France, which derives more than 70% of its electricity from nuclear power, has the lowest carbon-dioxide intensity per unit GDP.

Although nuclear energy is the answer for a carbon-free source that can be deployed on a large-scale basis, it is not without any concern. Analysts are wary that the growth potential of nuclear energy could lead to a similar impact that oil and natural gas has had.

Addressing Nuclear Concerns

Currently, uranium serves as the fuel for nuclear reactors. Studies have estimated that the available uranium resources for current generation of light-water reactors could last for a few decades. However, with better exploration techniques in extracting uranium from seawater, the source of uranium for nuclear energy would grow. Thorium, which is more abundant than uranium, can also be used as a fuel for nuclear reactors.

Furthermore, spent fuel from the nuclear reactors can be reprocessed via methods such as pyrometallurgical processing, which would render nuclear energy 'renewable'. With the advent of the new generation of fast-breeder reactors, continuous recycling of the spent fuel is even possible. The plutonium and actinides can be fed back and mixed to be used with the new fuel for the reactors. Reprocessing of the spent fuel not only addresses the major concern of nuclear waste-disposal but also provides the solution of sustainability in the issue of energy security.

Another concern regarding nuclear energy is the safety of nuclear reactors. Both the Chernobyl and Three Mile Island accidents served as prominent lessons of nuclear meltdowns. The newer generation of nuclear reactors are designed with passive safety systems that can automatically shut down its fission process without human or electrical intervention. In earthquake-prone regions such as Japan and Indonesia, the more advanced reactors can respond to the ground peak acceleration of the earth's movements, thereby shutting down its operations in the event of a serious tremor. Obviously, it is not possible to predict the exact magnitude of an earthquake. Nevertheless, it is within the discretion of the authorities to establish a level of safety for the nuclear reactors. The existence of safety mechanisms in modern nuclear reactors will enhance the safety of nuclear plants and allow reactors to operate in less benign geographical terrains. However, Indonesian observers have emphasised the country's lack of a safety culture and highlighted the risks arising from the operation of civilian nuclear reactors.

Scientific developments can also contribute to limiting the proliferation of nuclear weapons. But the more significant regulation lies in the political domain to prevent the risks of developing Weapons of Mass Destruction (WMD), which could arise during the enrichment and reprocessing stages of the nuclear fuel cycle. Global frameworks such as Global Nuclear Energy Partnerships (GNEP) could serve to promote international nuclear energy cooperation to address proliferation issues associated with nuclear materials.

Nuclear option viable for all nations?

It has to be noted that the heavy costs associated with nuclear energy have been a major deterrence for many nations to invest in nuclear technology. Certainly, the newer generation of nuclear reactors would not come cheap, and the operational cost of the entire nuclear fuel cycle, right from the mining process to the reprocessing stages, remains questionable. In addition, the enhanced security required for the infrastructure of nuclear plants would add to the operating cost. The nuclear option may be a good option as a platform to replace energy sources on a large-scale basis, but what if nations only intend to make nuclear energy less than 10% of its energy mix? Having such large investments into nuclear technology in order to churn out a small output of its total demand would not make economic sense. In such a case, the better investment would be on safer renewables such as wind, solar or biomass, which typically account for a minor proportion of a nation's energy mix. Developing nations that are rich in energy resources, such as Indonesia, therefore need to realise that nuclear energy is not the only option for economic development.

While the nuclear plant is carbon-free, the entire nuclear fuel cycle is not. The mining and enrichment processes of nuclear fuels would require the use of fossil fuels, which leads to significant carbon emissions into the atmosphere. Yet, if the utilisation of nuclear energy is a small proportion of its total

energy mix, it remains a question as to how much environmental impact and savings can be derived from a nation whose gross energy consumption is relatively small.

Nuclear energy would be an attractive option for large consumers like the United States or China, even if it is a small percentage of its energy mix, to create significant environmental impact. But for a relatively small consumer, there is a need to weigh the investments and economic viability carefully before jumping onto the wagon.

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