Review

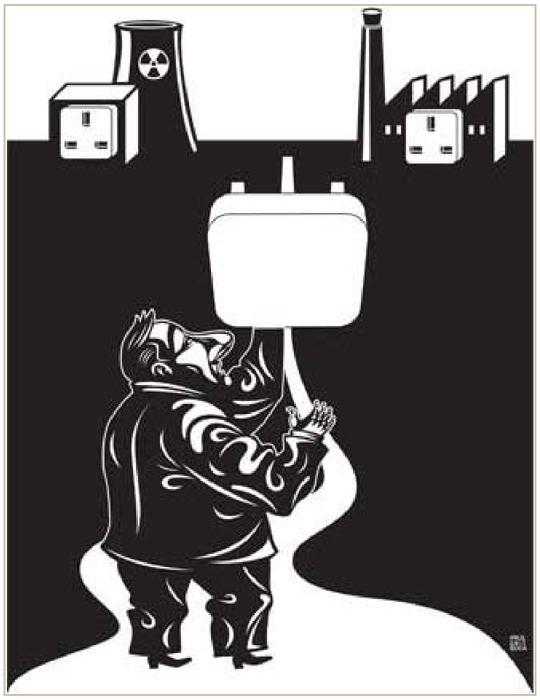
May 17, 2011

Next »

More than mere hot-air issues

By Elspeth Thomson, Melissa Low & Dickson Yeo, For The Straits Times

In the interests of energy security, the best solution is probably not one or the other, but both in combination with as much harnessing of renewable forms of energy as possible.



ALONG with the rest of the world, Chinese and Indian citizens watched with horror the Japanese technicians at the Fukushima nuclear power plant frantically trying to cool down the rods and stop the radiation leakage following the earthquake and subsequent tsunami more than two months ago.

We now know that the suffering in Japan - 14,998 people dead, 9,761 missing, 5,282 injured and over 135,000 displaced in the immediate area, and major disruptions in power and transport throughout the country - was the result of two fundamental factors: the insufficiently high sea wall that allowed sea water to flood the nuclear plant, and the subsequent loss of onsite and offsite power needed to cool the reactors. The plants themselves withstood the 9.0 temblor even though they were designed to handle one that measured at most 8.5 on the Richter scale.

China has been generating nuclear power since 1991 and India since 1969. China has 13 nuclear reactors in operation, more than 25 under construction and dozens more on the drawing boards. India has 20 reactors in operation, five under construction and also dozens under consideration.

Review

Others

More than mere hot-air issues

From value to values

Harvesting the benefits of a rice futures market

Whither EU? Angry Birds soar as Nokia goes sour

Editorial

Indonesian haze: Seeing through smoke

Following Fukushima, the Chinese government suspended the approval process for new nuclear power stations in order that safety standards could be reexamined and revisions be made to the country's Atomic Energy Act. For its part, the Indian government promised to undertake a safety review of all its plants. In short, both countries' ambitious nuclear power targets are still in place.

Both countries have no choice but to rely on coal to generate the bulk of their electricity for some decades yet. However, in order to slow the formidable growth of their carbon dioxide emissions, both had been hoping to try to raise the share of nuclear power by as much as possible over the next two decades.

Of all anthropogenic CO2 emissions, coal-fed thermal power plants contribute by far the most CO2. In 1990, China and India together accounted for 13 per cent of world carbon dioxide emissions; by 2007 their combined share had risen to 26 per cent, mostly because of their strong economic growth and increasing use of coal to provide energy for that growth.

In 2008, the share of coal in China's total electricity generation was 79 per cent, and 69 per cent in the case of India. By 2035, largely due to their plans to increase coal-fed electricity generation, both countries could account for 37 per cent of the world's total CO2 emissions, with China alone responsible for 31 per cent.

For many years, both governments have been intensely studying the relative economic and socio-political costs of nuclear power plants versus carbon capture and storage (CCS) attached to coal-fired power plants. China already has several projects in operation or in planning stages, and will likely become a leader in CCS research in the near future.

In July 2009, China's Huaneng Group started building the country's first commercial-scale integrated gasification combined cycle demonstration plant. This 250MW plant in Tianjin is planned in three phases, with hydrogen production and CCS by around 2015. The Shenhua Group, China's biggest coal producer, is planning to launch the country's first commercial-scale CCS facility. It will be built at the coal-to-liquids plant at Ordos in Inner Mongolia. New Delhi is keenly watching the results of these and other such projects around the world in order to assess their feasibility in India.

CCS involves capturing CO2 from industrial activities that emit large amounts of carbon dioxide - such as fossil fuel or biomass-fed power plants, cement plants, etc. - transporting it by pipeline and then injecting it into subsurface geological formations such as depleted oil and gas reservoirs, unmineable coal seams and deep saline aquifers. Sometimes the injected CO2 can be used to enhance oil recovery from declining fields.

Two of the world's industrial-scale CCS projects in operation are in Norway, and a third is in Algeria. Canada has a large-scale CO2-enhanced oil recovery project and four commercial-scale CCS projects due to be on-line by 2015. Other pilot or planned projects are in Australia, Britain, China, Germany, Italy, Norway, Poland and the US.

On the plus side, the building and operating of coal mines and coal-fed thermal plants do not require large numbers of highly specialised workers, the costs of building them are far lower than those for nuclear power plants and the construction timelines are much shorter. As long as geological site studies of where the CO2 is to stored are carried out properly, there is little likelihood of leakage. Due to the uncertainties of the impact that large scale injection of CO2 into deep ocean storage might have, most proponents of CCS no longer deem this a viable option.

On the minus side, the use of CCS increases the fuel needs of the plants. The capture and compression of CO2 are very expensive compared to the transport and storage of the carbon.

The main advantages of nuclear power are their very low CO2 emissions, low operating costs and their ability to generate large and sustained amounts of energy for at least 30 years. The main disadvantages are the long planning periods, high construction costs, finding and keeping sufficient numbers of highly trained labour, the disposal of nuclear wastes and the link with nuclear weapons proliferation.

Geoscientists can determine fairly accurately where large earthquakes could occur in and near China and India but have no way of knowing when. Both countries have a history of major earthquakes. The amount of damage these earthquakes cause depend, of course, on their proximity to densely populated areas. Going forward, the placement of new plants with respect to fault lines and potential tsunamis will be studied ever more carefully. Older-generation plants that require external sources of electricity for cooling may be phased out sooner than originally planned in favour of Generation III and IV plants that rely instead on gravity forces to cool the reactors.

However, even if almost completely earthquake- and tsunami-proof sites are found, the questions of insufficient skilled labour, high costs, waste storage and disposal and the link with nuclear weaponry remain.

This puts coal-fired power plants coupled with CCS in a good light. Besides being much cheaper, quicker and easier, in the event of an earthquake, coal mine operations could be restarted quite easily depending on whether it is a surface mine (most of the mines in India are surface) or underground (most in China are underground). When waiting for the mines to be rebuilt or new ones to open, coal could also be imported. A fungible commodity, coal can be procured from many different sources around the world, though the continual growth in demand for it will increase costs for countries having to import the resource in the future.

A CCS storage site is unlikely to be affected by an earthquake. Deliberately located away from fault lines, and situated over a kilometre underground, some CO_2 might migrate slowly to the surface through old wells or fissures that could be easily cemented.

As for the costs, several studies are in the works proving that the cost of CCS is becoming more competitive with that of nuclear power. It is expected that over the next 10 to 20 years, the cost of CCS will be relatively lower than it is now due to technological innovation.

Without doubt, determining the relative costs of nuclear power and CCS attached to coal-fed plants will remain near the top of the energy research agenda in both China and India. Therefore, we can expect a large number of studies in the coming months and years on the merits and risks of nuclear power versus those of CCS. All countries that rely heavily on coal to generate electricity as well as those that rely mainly on gas are also extremely keen to get firm answers to these questions.

Of course, besides the relative economic costs of nuclear power and CCS and the monitoring aspects, there is also a host of other factors such as public tolerance towards living near a nuclear power plant (NIMBY, or not in my back yard) or CCS site (NUMBY, or not under my back yard), the ideal ratio of government and private investment funding for such projects, the need to develop appropriate institutional and regulatory mechanisms, whether or not stored CO_2 would be eligible for carbon credits, and so on.

In the interests of energy security, the best solution is probably not one or the other, but both in combination with as much harnessing of renewable forms of energy as possible.

Elspeth Thomson is a senior fellow at the Energy Studies Institute, NUS. Melissa Low and Dickson Yeo are energy analysts at the institute.