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# Asia's Nuclear Ambitions

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What is the status of nuclear energy in Asia today?

Nuclear energy generates about 14% of all electricity worldwide, but only about 1% in Asia. Yet, Asia's economies, and therefore its energy demands, are the fastest-growing in the world. So far, only Japan, China, Korea, India and Pakistan have nuclear-generated power.

What affect will the development of nuclear energy have on fossil fuels?

Coal is abundant throughout Asia, principally sourced from China, Indonesia, Australia, Vietnam and Russia. Natural gas prices have fallen during the past year, but long-term availability and pricing of all natural resources remains a concern and a matter of national economic security throughout the region. Coal will likely remain the leading fuel supply for the foreseeable future. The role of nuclear energy is not to supplant coal - at least not in the medium term - but to play a larger role in the broader mix of energy solutions.

What are the environmental considerations in nuclear versus coal?

There are more than 50,000 fossil-fuelled plants in the world today, including coal, oil and natural gas. Each year, these plants generate nearly 30 billion tonnes of carbon dioxide - the principal greenhouse gas. By 2030, non-OECD countries alone will account for almost 60% of global energy consumption and emit about the same quantity of CO2 as today's global total. Today, coal generates about 41% of the world's electricity. By 2030, that will be 44% - a larger proportion of worldwide generation that itself will increase by 77%. Nuclear power creates heat through fission, rather than combustion, and emits no carbon dioxide, nitrogen oxide or sulphur dioxide (which forms acid rain). The 400 nuclear power plants in the world effectively reduce carbon emissions by 2.5 billion tonnes every year.

How does nuclear compare to other clean energy alternatives?

In most developing countries, the objective is to achieve a baseload power generation that can feed major industrial and commercial centres and provide at least minimum supply to rural areas. Wind, solar, geothermal and biomass fuels are neither economically or operationally effective to meet baseload electricity demand. The price of natural gas - also a fossil fuel - is high and volatile. Hydropower is efficient and effective, but already nearly fully developed. Nuclear is the only remaining alternative. As a result, 11 countries in Asia now have nuclear energy programmes or plans.

Who are the major players in the nuclear energy sector?

Traditionally, western players like Westinghouse of the US, Areva of France and Toshiba, Mitsubishi and Hitachi in Japan dominated the market. Together, American, French and Japanese companies have built more than 70% of the world's nuclear reactors. More recently, however, Atomenergomash, the nuclear machinery arm of Russia's Rosatom, as well as Korea's Doosan Heavy Industries and Korea Hydro & Nuclear Power, are aggressively pursuing a wide range of projects across Asia. And, inevitably, China is now offering globally competitive reactor technology, project management and financing in an effort to become a market leader.

What are the biggest challenges in financing nuclear plants?

The biggest challenge in financing nuclear power is the upfront capital costs. In nuclear energy projects, the term "overnight capital costs" is used to capture the engineering, equipment and materials procurement and construction (EPC) costs and the owner's costs in land, infrastructure, site work, interconnection, licensing, project management and administration, plus contingency, but excludes interest charges during construction.

The overnight capital cost of a new nuclear plant ranges from $1,500 to $5,800 per kilowatt (kW) with an OECD world median of $4,100/kW. OECD costs for a black coal plant range from $897 to $2,700/kW. Overnight capital costs vary widely from country to country, largely on the basis of EPC costs, project management and experience in the country. Phase 1 of the Sanmen nuclear plant in Zhejian, China will comprise two 1,250 megawatt (MW) units that will generate 17.5 billion kWh of electricity for a total project cost reportedly of $5.3 billion. Phase 1 of the Ninh Thuan nuclear plant in central Vietnam will generate 2,000MW and cost about $8 billion.

Another factor is the longer construction time required for nuclear plants. Today, the construction period for a nuclear plant is about five to eight years, compared to two years for a gas or coal plant. The longer construction time and higher capital costs means nuclear projects require more total investment and a longer period during which that capital is at risk. These risk factors contribute to investors' determination of required returns on their equity and debt.

What are the other variables in assessing these deals?

Other variables include discount rates, the mix of equity and debt in the project, interest rates, construction periods, plant life, taxes, inflation, depreciation rules and overnight capital costs, as well as the allowance for contingencies. And contingencies are no small risk either. Delays and cost overruns at the Olkiluoto nuclear project in Finland have ballooned project costs from €3 billion ($4 billion) to €5.7 billion and extended the construction time from four to eight years.

You mention all these costs. Where are they incurred?

The engineering, equipment procurement and construction (EPC) costs comprise about 85% of the project's total overnight capital costs. These are comprised of direct and indirect costs. The direct costs are about 70% of the total, and include the costs of equipment, labour and the materials required to assemble and install the equipment.

In most of the Asian countries targeted for nuclear development, much of the equipment would be imported, so shipping and insurance costs and project management become important. About 50% of the EPC costs are attributable to the nuclear reactor and turbine equipment – the most significant of the imported equipment.

The indirect costs are about 30% of the total EPC costs, and include engineering, supporting labour and supervisory costs.

At the back-end, the decommissioning costs of a nuclear plant are also significant, and the owner or operator has to establish reserves for them. Decommissioning a nuclear plant involves a range of special procedures because of the possible presence of radioactive or fissile materials in the equipment, premises or site.

Where does nuclear catch up with alternative fuel supplies?

Operating costs are where nuclear catches up to its coal and gas counterparts. Of course, nuclear plants have to account for higher costs needed for waste disposal and reserves for decommissioning. But fuel costs and other operating costs are significantly lower for nuclear than for coal or gas.

For nuclear, uranium has to be processed, enriched and fabricated into fuel elements. About half these costs are attributable to the enrichment and fabrication processes. Spent fuel also has to be reprocessed, separated and disposed.

According to the OECD, however, the operating costs of a coal-fired plant are about three times as high as nuclear, and a gas combined-cycle plant is about four to five times higher, even after taking into account the higher fuel and waste management costs of a nuclear plant.

What is the typical lifespan of a nuclear project?

Plant life expectancy is the other factor where nuclear catches up to fossil fuel plants on the economics. Nuclear plants today are expected to operate for 60 years or more as compared to 30 to 40 years for a coal or gas plant.

And this is where Asia holds a considerable advantage. The centralised determination of policy-making and the co-ordination of the entire supply chain and financing enable some of these countries to accommodate larger capital costs by defraying them over a longer-term than might be tolerable in the West. The closer ties between government policy-makers, project sponsors, off-takers and lenders also enables them to work more effectively towards longer-term goals of energy security, cost-efficiency in baseload power generation and minimising environmental impact. During that life span, the full economic benefits of a nuclear plan far outweigh the benefits from coal or gas, even before taking into account the savings and social benefits offered by nuclear in terms of impact on the environment and public health.

But, in the West - particularly in the US or UK where much of the power generation sector has been privatised - it is more difficult for investors to make investment/return decisions over such a long time span. Merchant and public generators and their lenders have greater pressures for shorter-term returns, and the government role is merely supportive through tax incentives, loan guarantees and public financing. It works, but it's more complicated and less efficient.