ECONOMIC ASPECTS OF NUCLEAR ENERGY IN INDIA

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Abstract

One of the main requisites for development by any developing economy is to have continuous and efficient sources of energy. India being no exception needs to fuel its growth however, since the sources of energy are limited and headed to a serious level of depletion, the need of the hour is to identify and develop new sources of energy which can sustain the development. As a result, India is poised to embark upon a comprehensive nuclear power program with an emphasis on a new series of nuclear power plants, including some of higher capacities.

This paper highlights the reasons for increasing utilization of energy in India and also points out as to why nuclear power needs to be given more attention over the traditional resources of energy.

The increased attention to the alternative sources of energy has also raised apprehensions about the costs involved in the generation and the usage of the nuclear energy. By using the secondary data gathered from various recent reports published nationally and internationally, this paper tries to analyze and compare the costs involved in setting up and running of nuclear power plants and other energy resources, to find answer to the question as to whether nuclear sources are feasible in terms of the costs they generate.

The use of nuclear energy is not without any probable negative consequences. The steps which can be taken to avoid possible negative off-shoots are also dealt with briefly in this paper. Finally, this paper tries to project the overall importance and potential of nuclear power for playing a major role in India's quest for more power.

THE CURRENT INDIAN ENERGY SPECTRUM

India, home to fifteen percent of the world population and on track to replace China as the most populous country on Earth, ranks sixth in the world in terms of energy production. However, the mounting energy demand to meet the growth requirement makes it imperative for India to explore new options which can satisfy the demand as well as be economically and environmentally viable. To meet this critical challenge, the base of the country's energy supply system has been expanded to include more of renewable sources. This challenge is intensified by the limited availability of conventional sources. All these factors make energy independence India's first and highest priority.

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The current energy base of India includes options like thermal, hydro, bio, wind, solar, oil and natural gas. Coal has traditionally been the primary energy source in India, accounting for 55 percent of India's energy production. The reserves of which within India are estimated to be around 247.85 billion tonnes (as of 2005). These reserves can last for approximately 80 years at the current level of consumption. However, if domestic coal production continues to grow at the current rate of 5 percent per year, they will run out in 40 years.

Oil resources constitute over 35 percent of the primary energy consumption in India although only half a percent of global reserves are within India. Moreover even though India's per capita consumption of oil and gas is one-third the global average, the reserves of crude oil (about 739 MMT), can sustain the current level of production for 22 years.

Natural gas constitutes about 9 percent of India's energy production, as compared to about 25 percent in the world. India already imports 20 per cent of its natural gas and this is predicted to go up to about 75 per cent by 2020.

India has a total installed capacity of 870 megawatts based on biomass combustion, gasification and biomass cogeneration. The government is promoting the use of ethanol made from sugar cane and bio-diesel extracted from trees that are common in many parts of India, such as Jatropha, Karanja and Mahua. India's Ministry of Non-Conventional Energy Sources has put forward a goal for the nation to produce 60 million tons per year of bio-fuel. The government is already promoting biomass based technologies in selected villages for meeting energy requirements, such as cooking, motive power and electricity generation under various schemes.

India is endowed with enormous economically exploitable hydro potential, assessed at about 84 Giga-watts. To-date only around 18 percent of India's hydro-electric potential has been harnessed. Opposition to large hydro infrastructure projects has been intensified because of the Indian government's poor track record of resettlement and rehabilitation of the people displaced by these projects. This opposition puts unwanted obstacles in the path of future projects.

However, these resources are not sufficient enough for a large developing country like India so, nuclear power is expected to play an important role for sustainable supply of energy. Nuclear power is the fourth-largest source of electricity in India after thermal, hydro and renewable sources of electricity. As of September 2011, India has 20 nuclear power plants in operation generating 4,780 MW while 5 other are under construction and are expected to generate an additional 3,900 MW. India's nuclear power industry is undergoing rapid expansion with plans to increase nuclear power output to 63,000 MW by 2032.

As a result the question which emerges is that whether nuclear energy is the right answer to our energy problems or are we moving in the wrong direction?

THE WEIGHING OF NON-ECONOMIC PROS AND CONS

FAVORABLE FACTORS

- Fossil fuels have limited quantity and are depleting at a very fast rate considering which nuclear fuel provides a very good option for energy as it has large untapped resources.
- Nuclear power plants need little fuel, as compared to other resources. Also, since India has large reserves of thorium, it will not be too dependent on other countries for running the reactors.
- Mining of the fuel required to operate a nuclear plant for one year is expected to avert a few hundred deaths, while the ashes from a coal-burning plant cause 30 deaths.
- The technologies which make the production of nuclear fuel safer, have improved significantly over last few decades.
- Nuclear programs like those of Sweden and France have been very safe and delivered a lower carbon footprint than countries like Australia which have burnt coal for most of their electricity.

UNFAVORABLE FACTORS

- It is difficult to forecast the future scenario as the geopolitical issues that are associated with nuclear fuel are quite complex and sensitive. An endless supply of uranium and thorium is not there as result when we run out of the fuels, breeder reactors will cease to be useful.
- Although there are many methods used to actually prevent accidents but even a tiny error can lead to disastrous effects. Three Mile Island and Chernobyl are examples of the serious problems that meltdowns can create.
- According to United States Environmental Protection Agency standards, the byproducts of nuclear fuel remain radioactive for thousands of years, requiring safe disposal away from society until they lose their significant radiation values. Although, underground sites have been constructed but they can be filled within months, frequently creating the problem of disposing the waste. This will limit the amount of nuclear fuel that can be used per year. Also, transporting the waste is risky, as many unknown variables may affect the containment vessels. If even one of these vessels were compromised, the results may be deadly. This problem is bound to get bigger as there are a large number of power plants that are about to come up.
- Yet another issue is whether the waste buried in the ground will or will not cause damage to the earth itself.
- Indirect risk from terrorism is also there. Accumulations of spent fuel in surface storage may be more attractive targets for proliferation, dirty-bomb or terrorist efforts than deeply buried accumulations.

- Nuclear waste has half lives that last 10,000s of years. No civilization has ever lasted that long. The ethical nature of these options is questionable as it is leads to the creation of a form of waste that will require careful storage for a timeframe longer than any civilization has lasted.
- The mining of nuclear fuel is facing its own challenges as there has been quite an unrest in areas in Meghalaya where mining is proposed which seems quite justified if conditions of Jaduguda mines in Andhra Pradesh are considered an example.

EXPLORATION OF THE ECONOMIC FACETS

For new construction, the economic competitiveness of nuclear power depends on:

- On the alternatives available. Countries may be rich in some sources and not so sufficient in others. Also some may be cheap and attractive at some point of time and later on expensive due to shortage over a period of time.
- Second, it depends on the overall electricity demand in a country and how fast it is growing.
- Third, it depends on the market structure and investment environment. Other things being equal, nuclear powers sector is less attractive to a private investor because of huge cost, strict regulatory terms and absence of rapid profit flows along with internalization of costs like GHG emissions, pollution and security issues.
- Also important are regulatory risks. Different countries have different approval processes, and political support varies. Some processes are less predictable than others and create greater investment risks.
- Finally, it depends on national preferences and priorities as expressed in national policies. The extent to which a country considers trade off among environmental quality, jobs, occupational hazards, energy security and energy costs will determine its economic competitiveness and desirability.

Some of the benefits which have emerged with respect to the nuclear energy are-

- Storage technology has a proven record with 50 years of experience and success. Extended storage for another 100 or 200 years can be done without obstacles. This will give each country to opportunity to work out its preference for final disposal. Also it allows the cheapest adjustment to changing circumstances in case the economics of recycling plutonium change or new technologies are developed.
- Electricity from nuclear energy is considered to be economical and very cost effective, in particular compared to electricity from renewable energy sources like wind, water, sun, biomass or geothermal energy.

- Research and development for nuclear applications has been financed by the governments, therefore these costs don't get transferred to the cost of electricity produced from nuclear power. However the cost of R&D for renewable energy sources is mostly financed privately and therefore added to the production cost. It is therefore included in the cost of renewable electricity.
- Nuclear power plants are underinsured for legal liability. The risk for nuclear catastrophes is not carried by the owner of the nuclear power plant; it is carried by the whole nation. Electricity from nuclear power would cost at least twice as much than today if operator companies of nuclear power plants were to insure the plants for the real risks.

The disadvantages which come to light are:

- A comparison among the costs of generating electricity at the Kaiga Atomic Power Station and the Raichur Thermal Power Station (RTPS) VII (both plants of similar size and vintage) and the coal for RTPS VII priced for a transportation distance of 1,400 km, Kaiga proved competitive only for low discount rates. These low discount rates on the other hand are not logical because of the multiple demands on capital for infrastructural projects, including the demand for electricity generation.
- There is a long history of making extravagant projections, involving extravagant budgets. As the Comptroller and Auditor General of India noted in its 1999 report, "Against the targeted additional power generation of 940 MW by 1995-96, gradually increasing to 7880 MW by 2001 AD, the actual additional generation of power under the profile as of March 1998 was nil in spite of having incurred an expenditure of 52.91 billion rupees." The trend has continued, as per the prediction by 2000, there would be 43,500 MW. Reality, however, was quite different and the actual installed capacity 2,720 MW. The DAE projected that nuclear power would constitute 275 GW by 2052; 20 percent of India's total projected electricity generation capacity. The latter has been increased to 470 GW following the US-India nuclear deal. In light of the appalling history of the DAE's abilities to meet targets, such claims should be considered implausible.
- Managing the waste is expensive. There are expensive ways to dispose of long-lived radioactive waste. Sweden after spending billions to manage its radioactive waste is now decommissioning its reactors.
- Renewables are less expensive than Nuclear Power. On the 17th of June 2003 the Economist magazine , wrote that Nuclear energy does not merit any more investment because it is too expensive compared to alternatives including wind and solar energy sources. RMI's Small is Profitable publication demonstrates that once all the 207 benefits of distributed energy generation are taken into account, distributed renewable energy is more profitable than nuclear power. Historically, nuclear power plants have been not only

expensive, they're also financially extremely risky because of their long lead times, cost overruns, and open-ended liabilities. If the same money were invested in efficiency or renewables it would have a greater impact on the emissions of the greenhouse gases.

- If the residual waste is stored, it is like leaving your garbage for someone else to deal with, i.e. it raises issues of intergenerational equity. Also if any proper use of the waste is not made over the years it makes the storage of the spent fuel worthless and the entire cost incurred in the process cannot be recovered.
- Some experts might be of the opinion that nuclear power age will end before we run out of uranium or space for waste dumps and that Governments should be encouraged to continue research for both nuclear power and renewable power, as well as for carbon capture and storage, nanotechnology, genetic engineering and all the rest. This leads to a logical question that if huge resources are to be spent in finding methods to replace nuclear fuel would it not be more prudent to not divert such huge funds for the use of nuclear energy in the first place?
- On one hand the atomic industry does not get tired in emphasizing that the risks involved with the operation of nuclear power plants were extremely low. On the other hand the cost to insure these "extremely low" risks cannot be added to the product costs because otherwise nuclear power would not be competitive any more, making nuclear power economically much less attractive compared to electricity from renewable sources. The committee for energy from the National Council of Switzerland concluded „...increasing the legal liability to 300 billions Euro (400 billions USD) ... would basically make it impossible to implement new nuclear power plants."
- In case of nuclear energy, the nation carries the risks for the operators of the power plants while operators of other technologies have to carry the risks themselves. The cost for electricity from non-nuclear sources does of course include the respective costs for the liability insurance. This is not the case for nuclear power, which makes nuclear power competitive only if the costs of the risks involved are paid by someone else.
- The research and development of nuclear power is financed by the government, the cost of which is not included in the price to make it affordable.
- As the option for nuclear energy is very expensive, the Indian government has restored faith in the DAE by allocating huge investment. These same sums of money can be invested extensively into the research and development of less dangerous, less expensive, more reliable sources of energy.
- Nuclear power plants are called to be extremely safe. However, if these "extremely safe" plants had to be insured for liability by an insurance company, the costs would be so high that nuclear power loses its financial competitiveness.

- Many countries have pursued breeder programs but almost all of them have given up on breeder reactors as unsafe and uneconomical. In the words of Admiral Hyman Rickover, the founder of the U.S. naval nuclear submarine program, his experiments with breeder reactors showed that they were "expensive to build, complex to operate, susceptible to prolong shutdown as a result of even minor malfunctions, and difficult and time-consuming to repair." This puts India in a rickety position as construction of hundreds of fast breeder reactors is an important part of the much touted three stage Indian nuclear program.

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